Biology of Tea Garden Weeds in Darjeeling District of West Bengal (India)

Thesis submitted for the degree of Doctor of Philosophy (Science) of the University of North Bengal
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November 09, 2006

TO WHOM IT MAY CONCERN

It is my pleasure to certify that **Ms. Chandrâ Ghosh**, M.Sc. has carried out a piece of research work under the joint supervision of me and Dr. S.E. Kabir, former Course-Coordinator, Department of Tea Management, University of North Bengal. Her thesis, entitled "***Biology of Tea Garden Weeds in Darjeeling District of West Bengal (India)***", is a bona fide work and is based on her original research work. The thesis is being submitted for the award of **Doctor of Philosophy** (Science) degree in Botany in accordance with the rules and regulations of the University of North Bengal.

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Dedicated

to

My beloved father

Late (Mr.) Mani Ghosh

Who

Was the guide of my every steps of life!

And

It is my homage to him!!

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9th November, 2006

[Chandrâ Ghosh] 9/11/2006

CHAPTER **1**

General Introduction

The part of the Indian state of West Bengal, located on the north of the river **Ganga** is generally referred as **Uttar Banga** or **North Bengal** that constitutes of six civil districts, namely **Maldah, Dakshin Dinajpur, Uttar Dinajpur, Darjiling, Jalpaiguri** and **Cooch Behar**. The diversities in landscape, soil, population structure, economic resources, vegetation structure, biological resources etc all are widely recognisable.

1.1. Three 'T's of North Bengal

Three 'T's – "**Tea, Timber & Tourism**" formed the economic backbone for the people of this northernmost part of West Bengal. Darjiling Tea is famous world-wide for its aroma and, at the same time, dense forests of this region are the sources of huge amount of excellent quality timber produced by a large number of local species. Plantations of some species over wide areas also increased this potentiality. - - On the other hand, the scenic beauty of Darjiling in the background of the snow peaks of Mt Kanchanjangha and the thick vegetation covered altitudinal gradients and hill slopes made it a much attracted tourist place inviting innumerable tourists from each and every corner of this planet every year.

1.2 Richness of Biodiversity

For the Scientists, this northernmost part of the state is also important with a different reason that is for its rich biodiversity. Hills of Darjiling are forming a part of the Singalila Range of Eastern Himalaya, which is widely known for its extremely rich biodiversity before the world in general and botanists, horticulturists, floriculturists etc. in particular. Eminent plant explorers, including Sir J.D. Hooker studied the flora of this region. Numerous organisations even from far away countries tried to explore the flora of this region which include Tokyo University [*Flora of Eastern Himalaya*] (Hara 1966, 1971; Ohashi 1975), British Museum of Natural History [*Enumeration of the Flowering Plants of Nepal*] (Hara *et al* 1978, 1979; Hara & Williams 1982), Royal Botanic Garden, Edinburgh [*Flora of Bhutan*] (Grierson & Long 1983, 1984, 1987, 1991, 1999, 2001; Noltie 1994, 2000; Pearce & Cribb 2002) etc.

Darjiling is situated almost at the central part of Eastern Himalaya and is equally rich in biodiversity with its western and eastern fringes [Das 1986, 1995, 2002, 2004; Das & Chanda 1987; Bhujel & Das 2002; Bhujel *et al* (in press)]. Das (2005) has estimated that, apart from algae, fungi and other microbes, there are at least 3662 species (Table 1.1) (Bryophytes 200; Pteridophytes 250; Gymnosperms 12; Dicots 2200 and Monocots 700) growing in this district. Now it is also known that over 30% species of higher plants (i.e. Angiosperms) of this region are endemic (Grierson & Long 1983; Das 1995, 2004; Bhujel & Das 2002). This type of rich vegetation is not restricted to the hill regions only. Different types of vegetation in Terai and Duars are also equally rich. A fairly good number of endemic and/or threatened plants also inhabit in the grassland and herbland vegetation in Terai (Das 1996; Bhujel *et al* (in press); Das *et al* 2003).

Table 1.1: Numerical estimation for the flora of Darjiling (Das 2005).

TAXA	Algae	Fungi	Lichen	Bacteria & Virus	Bryo.	Pterodo.	Gymnos.	Dicots.	Monocots.	**TOTAL**
No. of Species	*No proper record*	*No proper record*	*No proper record*	*No proper record*	200	250	12	2200	700	**3662**

1.3 Darjiling is a Part of Himalayan Hotspot

In 1990 McNeely *et al* estimated that 70% of the world's flowering plants grow in 12 countries. They then referred these as '**Mega-diversity Countries**' and each of those countries are forming a **Mega-diversity Centre**. India was unique in the list at that time for the recognition of two Mega-diversity Centres [namely '***Indo-Burma Hotspot***' and '***Western Ghats – Sri Lanka Hotspot***'] within its territory. Table 1.1 presented the list of those 12 countries.

India was recognised as the 11th Mega-diversity country (Table 1.2) in the said list with its estimated 17,500 species of higher plants. The country is occupying only 2.4% of the global land area but it harbours about 11% of the world's biota. According to a rough estimate Indian flora has more than 45,000 plant species including bacteria, fungi, algae, lichens, bryophytes, pteridophytes etc. (Singh & Chowdhery 2002).

Darjiling area was included in the **Indo-Burma Hotspot** at the beginning and until 2004 it was enjoying that status. But, the latest reallocation of world Hotspots has now changed the situation. IUCN in recent years has significantly modified the concept and included a precondition that the hotspots must hold at least 1500 endemic plant species and have lost 70 percent of its original habitat extent. The updated analysis (February 2005) of **Conservation International** reveals the existence of 34 biodiversity hotspots (Fig 1.1). These hotspots are estimated to have lost 86 percent of the habitat and the intact remnant of the hotspot now only covers 2.3 percent of the earth's land surface (CI, 2005). These hotspots hold astounding level of species endemism with an estimated 150,000 endemic plant species that accounts to 50 percent of the world's total. Such high level of endemism represents evolutionary potential, ecological diversity and the range of options for future human use.

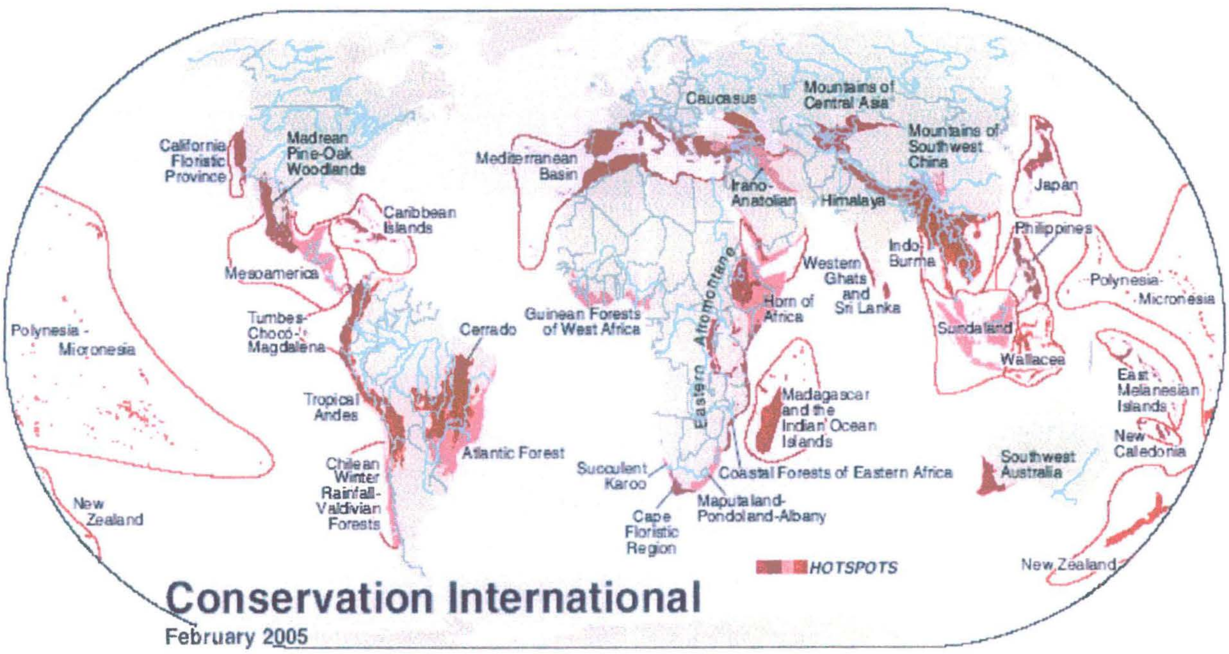


Figure 1.1: Distribution of IUCN recognized 34 Hotspots in the world [*Courtesy*: Conservation International].

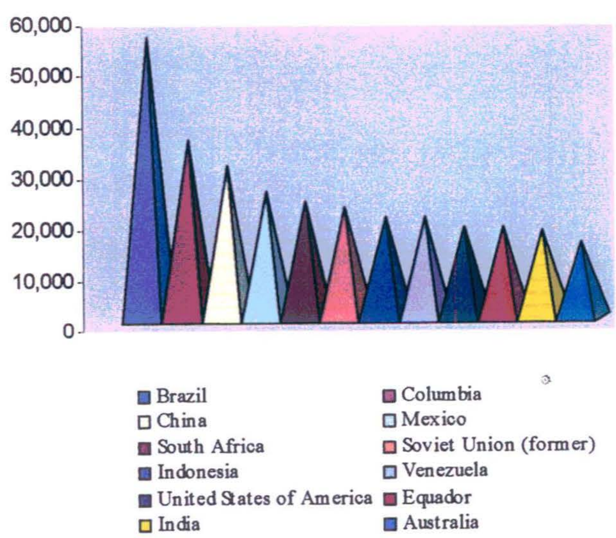
Table 1.2: Flowering Plant mega-diversity countries of World (Groombridge, 1992).

Sl. No.	Countries	Number of Flowering Plant species
1	Brazil	55,000
2	Columbia	35,000
3	China	30,000
4	Mexico	25,000
5	South Africa	23,000
6	Soviet Union (former)	22,000
7	Indonesia	20,000
8	Venezuela	20,000
9	United States of America	18,000
10	Equador	18,000
11	India	17,500

12	Australia	15,000

Figure 1.2: Map of the Himalayan Hotspot [*Courtesy*: Conservation International]

Fig. 1.3: Flowering plant mega-diversity countries of world



In this revised classification of Conservation International, updated in February 2005, a new Hotspot, **Himalayan Hotspot** (Fig 1.2), have been created in this region that covers the entire Himalayan region including the Eastern Himalaya, which were part of the previous Indo-

Burma hotspot; and that has been included amongst the top eight most important hotspots. So, Darjiling Hills region is now included in the Himalayan Hotspot.

[http://www.biodiversityhotspots.org/xp/Hotspots/hotspotsScience/hotspots_revisited.xml].

1.4 Early History of the Land

Darjyu Lyang, or *'the land of God'* or *'heaven earth'* is believed to have given 'Darjeeling' (**Darjiling**, after the 1981 census), the northern most district of the Indian state of West Bengal, its name. It is also believed that the name is a corrupted form of ***Dorjee ling*** of the Lamaist religion, *'Dorjee'* the Celestial sceptre of double-headed thunderbolt and *'ling'* or the land, and thus, literally means *'the land of the thunderbolt'* after the famous Buddhist monastery, which stands atop the observatory hill and was known by the same name. In the 18th century and in the early part of 19th century, when Darjiling area was repeatedly getting transferred from one country to the other (Bhujel 1996; Das 2004), at that time there was no such township or any tea garden in the area covering the undulating hilltops (Das, 2001). Everything has developed after the Chogyal (the king) of Sikkim presented Darjiling to British Government on 1st February 1835 as a token of friendship (Table 1.3). Again, the history of the Kalimpong part of Darjiling hills is different, which was a part of Bhutan for a long time. The boundary of Nepal, Bhutan, Sikkim, Darjiling etc. were not so clearly demarcated earlier and the entire area was covered with very deep forest. So, there was every possibility that a specimen marked as Nepal might have actually collected from Sikkim or Darjiling's territory. Naturally, the history of floristic studies in Darjiling is intimately related to the same for Nepal and Sikkim, at least.

Table 1.3: The history of Darjiling Hill areas [Bhujel 1996; Das 2004].

Darjiling part: Prior to 1789: [called *Goondri Bazar* till 1886]	In the Sovereign state of Sikkim
1789 – 1817 (part west to Tista)	Gorkha army conquered it for Nepal
10th February 1817	British restored it for Sikkim
1827	Capt. Lloyd & Mr. Grant visited Darjiling
1st February 1835	Chogyal of Sikkim donated the place to British: token of friendship
1840	First motorable road to Darjiling
Till 1706	Kalimpong area was conquered by Bhutan from Sikkim

10th November 1865	Kalimpong ceded to British
1866	Kalimpong was transferred to Darjiling
1850	Darjiling was annexed to Rajsahi
1905	Darjiling was placed under Bhagalpur
1912	Again transferred to Rajsahi (now in Bangladesh)
1947 [at the time of India's independence]	Automatically included in West Bengal

The district is now divided into four subdivisions, three of which are now on hills namely Darjeeling, Kalimpong and Kurseong and the remaining Siliguri subdision is situated in the plains adjacent to the hills. The three hilly subdivisions of the district are now under the administrative purview of the 'Darjeeling Gorkha Hill Council' that came into effect on 22nd August 1988. The district head quarter as well as that of DGHC, both are located in Darjeeling, a thickly populated hill-town.

1.5 Initiation of Modification

Now, the British ruler of India discovered there a favourable climate for (i) establishing a sanatorium at Darjiling for the ailing Britons working in British-India and also for (ii) Tea cultivation. With this the history of Darjiling took a new turn. Forest cover started declining along with the inward migration of the amenities of modern civilisation into the area. British Government established one giant sawmill at Siliguri, on the bank of the river Mahananda, mainly to shape the giant Sal trees into railway-sleepers and for that they had slaughtered lakhs of trees, which, in turn, resulted into the clearing of forested areas.

In the first decade of the 20th century, British Government's forest department initiated plantation forest in Darjiling Hills [a clear-felled patch was planted with *Cryptomeria japonica*] (Das & Lahiri 1997). And, the first Tea garden at Lebong (±1900 m) was established in 1835, and its cultivation spread to Terai in 1862 and to Duars in 1874 (Ghosh *et al* 2004). Since then, in regular intervals, new tea gardens are coming up, sometimes in denuded forestland or by clearing the Herbland and/or Grassland vegetation. As the Herbland/ Grassland vegetation does not produce timber, apparently, those were thought to be useless. Today, in Darjiling district wide areas are under tea cultivation, and there are at least 85 large Tea Gardens (total area 17463

Ha) on hills and 65 large Tea Gardens (total area 16358 Ha) in Terai and, in addition, there are at least 5573 small gardens (total area 6500 Ha) in Terai (*Source*: Tea Board of India) situated in Darjiling district only covering an area of 38465 hectares and producing about 45 m kg of processed tea.

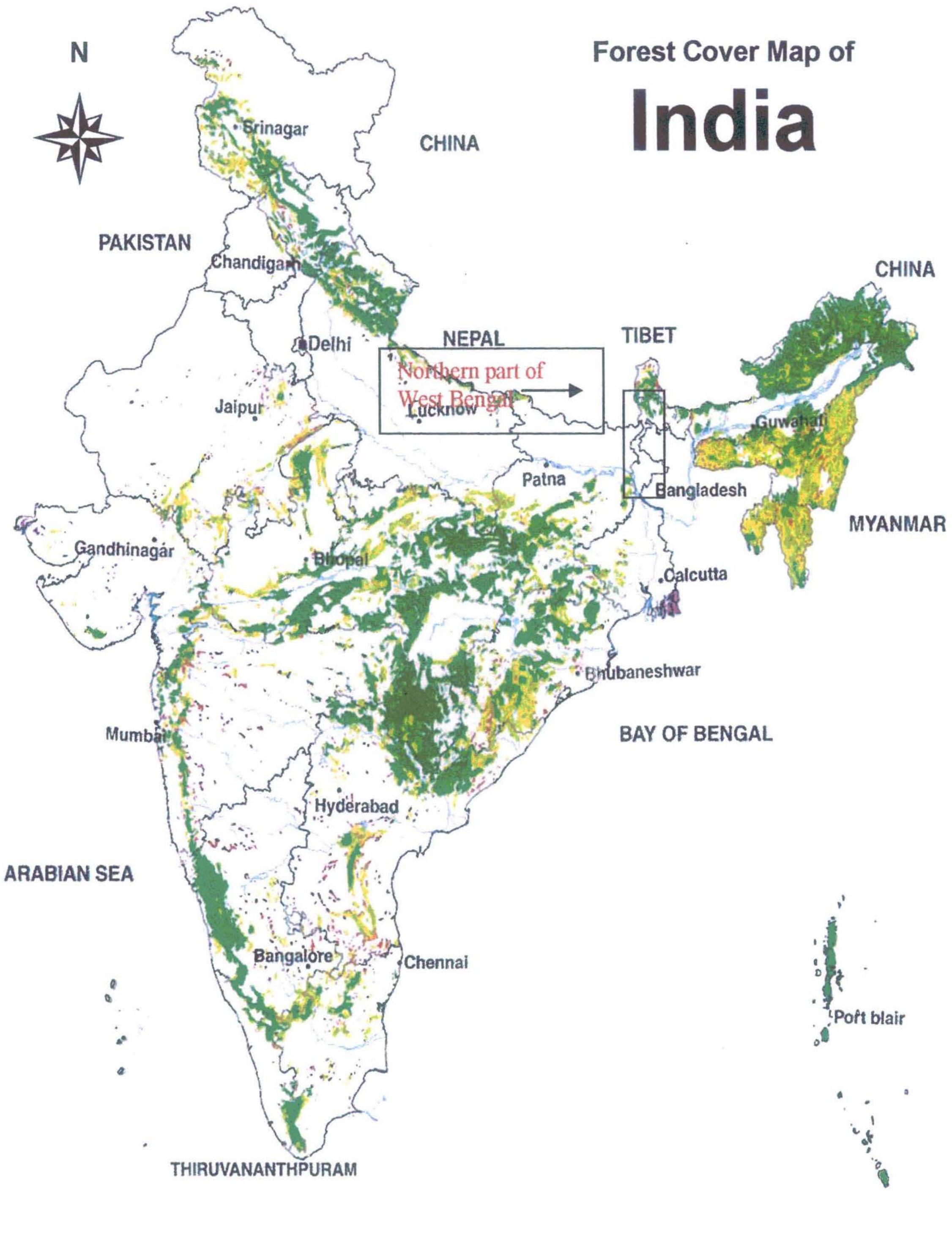


Figure 1.3: Map of India [*Courtesy*: Forest Survey of India]

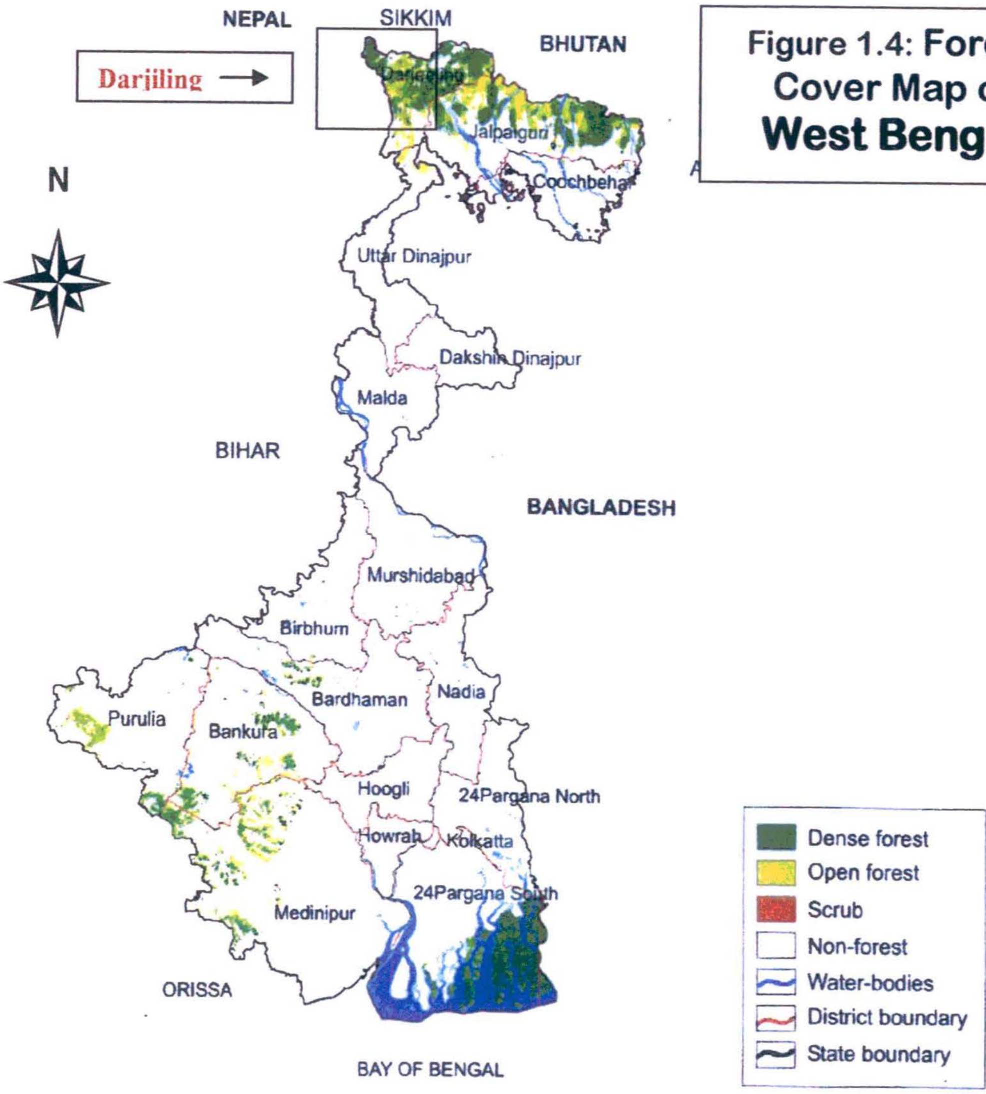


Figure 1.4: Forest Cover Map of West Bengal

1.6 Location and Boundary

Hills, Terai and Duars of Darjiling are located within 26° 31′ 05″ and 27° 13′ 10″N latitude and between 87° 59′ 30″ and 88° 53′ E longitude and is covering an altitudinal range of c. 132 m (at Siliguri) to 3660 m (at Phalut). Of all the frontier districts of India, Darjiling has the most complicated boundaries. It shares its boundaries with international frontiers, with Nepal in the west and Bhutan towards the east; the River Tista forms its northern border with the state of Sikkim with its southern border being with the districts of Jalpaiguri of West Bengal and Purnea of the state of Bihar. The plains part of the district, situated at the feet of the hills, is divisible into two parts. The area west of Tista is referred as **Terai** and the area east of the river is **Duars**.

1.7 Topography and General Features

1.7.1. Topography

The Darjiling part of the Eastern Himalaya is essentially mountainous with the increase of elevation in the northern direction. Two transverse ranges running north south enclose it. They are the Singalila in the west and Dongkya in the east. In this part the great Himalayan range runs from Kanchenjunga (8598 m) in the west to Chomolhari (7324 m) in the east, which lies near the northern border of Sikkim with the Chumbi valley, which forms a part of Tibet. The hills of Darjiling are actually the spurs of the Singalila range that enters India from Mt. Ghosla (3800 m) at Sikkim and enters the district near Phalut. The highest points Sandakphu and Tonglu of the district after Phalut (3660 m) are the continuation of the Ghosla-Phalut ridge. The Rechila (ca. 3100 m) and Thusum peaks of the Kalimpong subdivision of the district lie on the eastern ridge and spreading from Lava. The Ghosla-Phalut ridge enters the Tiger Hill node from where four major ridges radiate out along the four directions (Banerjee 1980; Das 1986; Bhujel 1996). *viz.* Darjiling ridge in the North which extends to Lebong through Jalapahar, BirchHill and descends to the River Rangeet at Badamtam; the Takdah spur to the east spreads down to the Tista Bazar; the Dow Hill ridge which is long and forms numerous spurs rolls down to the plains of Darjiling and Jalpaiguri districts.

1.7.2. Rivers and Drainage

The rivers of the tract drain ultimately to the south but the west to east ridges cross the tract and cause a series of rivers and streams to flow northwards or eastwards before joining the main river system. The two most important rivers of Darjiling are the river Tista and the river Great Rangeet. Both of these glacier fed rivers originated from Sikkim. While the Tista originates from the Zemu glacier located in north Sikkim the Rangeet arises from the Rothong glacier in West Sikkim.

The Tista is a broad mountainous river with numerous shallows and rapids. It traverses a large part of the state of Sikkim and enters the district of Darjiling at the point it meets with the Great Rangeet. The major tributaries in Sikkim include the Lachung chhu, the Zemu chhu, the Dhakung chhu, in the North district the Talung chhu and Tangpo chhu in the West district and Sethikhola Rangpo khola, Jolly khola in the East district while the Reyang, originating from Mahaldiram Reserve Forest (2438m), Peshok and Gail khola constitutes its main tributaries on the right bank after its entry into the District of Darjiling.

The main tributary of Tista is the Great Rangeet, which arises from the Pathong glacier and confluences with Tista at Tista Bazar. It enters the district of Darjiling at the point on the northern boundary where it receives the Ramam River arising from Singalila and Rangu arising from Senchal in Darjiling on its right bank. Below the confluence the Tista flows eastwards where it receives the Little Rangit from Darjeeling from where it enters the plains of North Bengal and finally joins the river Brahmaputra in Bangladesh.

The other important rivers of Darjiling includes the Balason arising from the Ghoom saddle running south till it reaches the plains at an altitude of 304.8 m, then turns south east and divides into two channels the New Balason and the Old Balason and subsequently joins the Mahananda further south. It receives tributaries like Pulungdung khola, Rangbang Khola, the Marma khola, Dudhia khola on the right bank and Rinchingtong khola, Rakti khola, Rohini khola, Jor khola etc on the left. The Mahananda has its source near the Mahaldiram east of Kurseong and flows south-east receiving a few sizable right side tributaries, the Siva khola being the most important one. Its left bank tributaries include the Jholi khola, the Jogi khola, Gulma khola, Babu khola and Ghoramara khola. The Tista and Jaldhakha form the western and eastern boundaries of the sub Division of Kalimpong. A number of rivers and tributaries originate in this sub-division the principal ones include the Lish which originates at the ridge of Pabringtar village and flows downwards receiving the Amal khola on the western side and Turung khola on the east further southwards it is joined by the Phang khola and Chun khola near the Bagrakote Colliery and eventually joins the Tista at the Kalagaiti Tea estate. The river Gish is formed by the joining of two small rivulets, one originating below Lava and the other below the Chumang reserve forest. Ramthi and Lethi form the major tributaries for the river. The river Neora originates from the Rechila Chawk, just below the Rechila danda and joins the Thosum chu at the boundary of Thosum and Rechila. It then flows southwards and eventually joins the Tista. The Relli originates in Khempong reserve forest below Lava-Algarah and runs along the southern boundary of Saihur reserve forest after which it is joined by the Pala and Lolley khola and moving southwards it joins the Rani khola. Murti originates in the Mo block south of Thosum hills flowing through the reserve forest and emerging in the Samsing area and eventually joining the Jaldhaka River.

Along with these, numerous small springs occur which meet to form small rivulets at the bottom of valleys (Chopra 1985).

1.8 Geology and Soil

1.8.1. Geology

Nature has a way of writing her own history in her rocks. Indeed, the geological history of any region is a record of all the ancient changes or events geographical, climatic and pertaining to its life that it has undergone or witnessed. Geographically, the Darjiling part of the Himalayas is wedged between Central (Nepal) Himalaya to the west and the Bhutan Himalaya in the east.

Hooker (1854) in his famous *'Himalayan Journals'* reported regional gneissic domes, the overlying bedded sedimentary rocks and crinoidal limestones at the Tso Lhamo Lake during his extensive travels in many parts of Sikkim. An excellent account of the geology of the Darjiling district and its foothills has been made by Mallet (1875). von Loczy published a geological section from Darjiling to Kanchendzonga, which he observed as far back as 1878 (Gansser 1964). Other notable works on the geology of the region were made by workers like Dyhrenfurth (1931), Wager (1934, 1939), Auden (1935), Wadra (1957), Roy (1945), Acharya (1968), Powde & Saha (1982).

The Himalayan region is believed to be an old geosyncline that was once occupied by a long arm of the sea called Tethys. A series of upheavals led to the considerable increase of elevation of the floor of Tethys. The upheaval of the mountains is not a continuous process; it took place in four successive stages separated from each other by long intervals of time. The first upheaval took place in the Upper Eocene period, resulting in the breaking up of the continuity of the sea basin into smaller areas of sedimentation. The second upheaval of the Middle Miocene led to longitudinal depressions on the southern side where the succeeding Siwalik sediments were laid down. The third phase of Himalayan orogeny, during the Upper Pliocene period, gave rise to the present day Siwalik hills and the fourth that commenced in the Pleistocene led to the alluvial deposits being pushed up to their existing heights. This phase continues and the mountains are still believed to be getting higher as a result.

The geological formations of Darjiling part of the Himalayas consist of unaltered sedimentary rocks. Morphologically the area is well defined. The sub-Himalayas are made up of Siwalik deposits of the Tertiary age. North of the Siwaliks is coal bearing lower Gondwana formations comparable to the Damudas of Peninsular India. The Darjiling gneiss succeeds the Pre Cambrian Dalings that lie further north.

1.8.2 Geological Formations in Darjiling

Two distinct conditions can be recognized as follows:

1. Darjiling Sub-Himalaya

The Terai and the plains at the foothills (given in their present form) that arose after the final upheaval of the mountain system consist of almost horizontal layers of unconsolidated sand, silt, pebbles and gravel. The Sikkim Himalayas are noteworthy for the abundance of sub-recent and recent alluvial terraces, which clearly display the last tectonic displacement. The raised terraces of the Pleistocene are made up of similar but well cemented and more compact alluvium detritus and sands, clay, gravel, pebbles, boulders etc. representing older flood plain deposits.

The Sub-Himalayas are made up of the Siwalik deposits of Tertiary that extend from Nepal, to as far as 20 km east of the Tista River. Further east, they disappear for about 10 km, and appear once again and finally disappear in Western Bhutan at the Jaldhaka River valley (Mallet, 1875; Pilgrim, 1906). Good Siwalik exposures are met along the River Tista. The deepest outcrops, forming the southern margins of the Siwaliks, consist of bluish grey nodular marls and clays with micaceous fine-grained sandstones. There is great discrepancy in boulder sizes in the recent alluvial deposits as compared to the small pebbles embedded in the Upper Siwaliks, which supports the concept of very pronounced young morphogenic uplift of the Himalayas.

2. Darjiling Lower Himalaya

Along the foothills of Darjiling, the Siwaliks are steeply over-thrust by formations belonging to the Damudas (Lower Gondwanas). The thrust zone which is poorly exposed appear to dip at 60 - 70° towards the North. This thrust fault coincides with the well-known Main boundary faults, which extends for the whole length-distance along the Himalayas. The Damudas are characteristic coal-bearing detritus rocks, containing fossil flora indicating a Lower Gondwana age. The predominant rocks are feldspathic, partly micaceous brownish sandstones, and shaly micaceous sandstones often with plant impressions, carbonaceous shales and coal seams. It appears that the Damudas are a tectonized relic where the presence of boulder beds suggests Lower Damudas or Barakar formation, while the flora and lithology of the coal bearing layers points to the Upper Damudas or Raniganj formation.

Northwards, the Damudas is succeeded by the very uniform and characteristic Dalings. These border the Damudas with a very sharp thrust contact, dipping steeply towards the north. The Dalings consists typically of greenish greasy-feeling clay slates to more or less green quartzite schist. Slaty and quartizitic layers often alternate, but the argillaceous type dominates. The Dalings are remarkable for their constant and monotonous lithology over a great thickness, characteristically representing the late Precambrain and early Cambrain sequence. The Dalings are well developed along the lower and middle course of the Tista and form the over 50 km long core of the large north-south directed domal uplift dominating the Sikkim area.

In the higher reaches of the hills the coarse grained quartzo-feldspathic Darjiling gneiss occupies a greater part of the region. The gneiss is highly micaceous and is composed of colourless or grey quartz, white opaque feldspar, muscovite and biotite. It often varies from fine grained to moderately-grained coarse rock, lenticular layers of minerals of different degrees of coarseness are commonly interbanded with bands and lenses of pegmatite and aplite.

1.8.3. Soil

The Darjiling part of the Himalayas enjoys a wide range of physiography, geology and vegetation that influence the formation of different kings of soils (Planning Commission 1981). In accordance with the physiographic sequence and terrain features soil of Darjiling Himalaya is represented with 5 orders. The lower reaches comprise of the ultisols of the palehumultus group and comprises of red, brown and yellow soil with coarse texture. Further north the ultisols give way to the alfisols of the hapludalfs or submontane type. The alfisols are followed by the mollisols comprising or three suborders udolls, argiudolls and hapludolls occupies the steeper slopes under the temperate forests. The entisols with four sub orders arents, psamments, flubents and orthents occur further to the north and the inceptols with two sub-orders orchrepts and umbrepts make up the northern most part of the region. The depth of the soil vary from 0 -100 cm in different regions, with texture varying from fine sandy, loamy to sandy. The pH of the soil of the region is acidic due to heavy rainfall the region experiences lead to the leaching of bases from the soil surfaces to low horizons .The pH ranges from being slightly acidic between 5.6 and 6.5 in some parts with the major portion showing highly acidic soil with pH below 5.5. Almost everywhere the soils are derived from weathering of underlying rocks. The impervious clay is found mixed with the grains of quartz, feldspar and flakes of mica. This has a bearing to the massive landslips in the hilly regions.

One of the major environmental problems of the region relates to its soil degradation. According to Dent (1984), the Himalayas is the most severely degraded region of the world. The weak and unstable geology along with monsoonal type of per humid climate and undulating terrain with diversified landforms are some of the natural processes helping soil degradation in Sikkim and other North Eastern States (Patiram & Bhaduria 1995). This has been aggravated due to the pressure of the increasing population on land.

1.9 Climate

The great Himalayan range forms a complex system that separates the northern part of the Asian continent from the southern Indian subcontinent. The physical features of the Indian subcontinent are of great importance as they have profound influence on the wind systems, which ultimately affect the distribution of temperature, humidity and rainfall over the subcontinent and its neighborhood. The Darjiling part of the Himalayas has its own climatic peculiarities due to its geographical location, relief and a wide range of altitudinal variations ranging from 135 m to 3669 m above mean sea level. It exhibits a typical monsoon climate, with wet summer and dry winter. The condition is brought about by the direct exposure to the moisture laden southwest monsoon air flowing upwards during May to October from the Bay of Bengal. The great variation in altitude and the configuration of the neighboring mountain ranges greatly affect air movement, rainfall and temperature and leads to a greater range of variation in local climatic conditions. It is quite interesting to note that even in adjacent or in opposite slopes with little aerial distance there exists quite contrasting climatic characters. Although the latitudinal location of the region is in the sub-tropical climatic regime its mountainous configuration has led to varied climates ranging from the subtropical to the temperate to subalpine types. This major climatic variation in Darjiling is based mainly upon the elevation the region and that shows four distinct climatic zones, viz. Tropical, Subtropical, Temperate, and Sub-alpine. The distance from southern plains outside the hills and on the other side from the permanent snow covered regions also affect the local climate. This variation is also responsible for the creation of wide range of vegetation structure, which supports the survival of great biological diversity.

1.9.1 Seasons of the Year

Four climatic seasons can be recognized within the region (a) Monsoon or Rainy Season, (b) Autumn, (C) Winter, and (d) Summer (spring). However, it is difficult to differentiate Spring and Summer in this part of the hills (Das 1986; Bhujel 1996; Lama 2004). Choudhury (1998) classified the climate of the Darjiling-Sikkim region into six types based one of the most important single factor which is the altitude. Of these five types are recognizable in Darjiling Hills as follows:

(i) Tropical Humid type: The lower ridges of this region lying up to 800 m experience high humidity and temperature. The rainfall remains high with very hot summers and warmer winters.

(ii) Sub-tropical Humid type: Areas lay between 800 – 1600 m experiences a humid sub-tropical type of climate. The summers are hot and winters cool. The humid period is long extending from April to September with heavy rainfall during the monsoon.

(iii) Semi-temperate type: In between 1600 – 2400 m the summers are moderate and the winters generally dry and temperature falling below the freezing point only very occasionally for very few days. The annual precipitation is quite high, about 3500 mm with the rainfall being heaviest during the monsoons i.e. usually between June to August.

(iv) Temperate type: Slopes laying between 2400 – 3200 m shows this type of climate where the summers are never hot with the temperature rarely exceeding 18° C. The annual temperature in the valleys of Bikhay Bhanjyang experience an annual temperature which never reaches beyond 17° C. Rainfall is much lesser than the semi temperate type rarely exceeding 1700 mm annually. The winters are very cold with high snowfall and frosting being common at nights for most parts of the year.

(v) Alpine Snow forest type: This type of climate is experienced in places situated above 3200 m. The temperature remains low for more than five months of the year with extremely cold winters. Rainfall begins from the end of May and usually continues till September. Precipitation in the form of snow and slit is common in winter. Major part of this region is uninhabited due to harsh climate and includes places between Sandakphu and Phalut.

1.9.2. Rainfall/ Precipitation

The whole region consists of a tangled series of interlacing ridges, rising range above range to the foot of the Wallich of high peaks and passes which marks the 'abode of snow' and its off-shoot (Risley 1894). This tangled assemblage of ridges and peaks coupled with altitude, aspect and exposure brings about sharp changes in the rainfall in any particular location of the region. In general the south facing ridges receive the highest rainfall in comparison with the north facing ridges.

The Darjiling (and Sikkim) region is viewed as a stupendous stairway leading from the western border of Tibetan plateau down to plains of West Bengal. It is highly humid because of its proximity to the Bay of Bengal and direct exposure to the effects of moisture laden southwest monsoon. Rainfall variation occurs along the entire stretch of the Tista valley. Another more striking feature of the region is the peculiar V-shaped valleys with steep and often precipitous slopes. This peculiar configuration of the mountainous region brings sharp changes in the rainfall. The rainfall recorded from different locations are provided below in Tables: 1.4(a) - 1.4(d).

Table 1.4(a): Rainfall data for the Darjiling sub-division during 1995 – 2000. Rainfall in mm (altitude: Darjiling Met. Stn., 2150 m)

Years ▸ Months ▾	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**Average**
January	29.4	52.3	26.7	-	9.2	-	*19.6*
February	14.5	5.4	15.9	5.5	0	22.6	*10.65*
March	25	41.8	15.9	125	3.6	15	*37.72*
April	33.2	81.9	146.4	220.6	31.9	139.6	*108.93*
May	130.8	74.9	116.1	110.3	253.2	319.4	*167.45*
June	597.4	464.1	462.6	352.1	863	474.4	*535.60*
July	846.3	585.7	571.1	1071.7	731.9	507.8	*719.08*
August	499.9	671.2	689.7	807.4	895.6	608.1	*695.32*
September	413.1	337	468.7	449.4	393.4	499.7	*426.88*
October	26.6	92	5.5	87.8	243.2	14.5	*78.27*
November	279	-	1.3	7.5	1.7	8.2	*49.62*
December	20.5	-	89	-	7.5	-	*19.50*
TOTAL	**2915.7**	**2406.3**	**2608.9**	**3237.3**	**3434.2**	**2609.3**	***2868.617***

(Source: Office of the Principal Agricultural Officer, DARJILING: 2150 m.)

Table 1.4(b): Rainfall data for the Kalimpong sub-division during 1995 – 2000. Rainfall in mm (altitude: Kalimpong Met. Stn., 975 m)

Years ▸ Months ▾	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**Average**
January	40.07	15.86	19.21	0	12.49	5.55	***15.53***
February	9.91	2.23	18.22	4.21	0	18.64	***8.87***
March	0	68.14	58.92	63.89	8.63	5.67	***34.21***
April	24.02	69.52	22.32	92.51	32.71	58.91	***50.00***
May	63.63	80.64	249.82	105.82	87.32	69.83	***109.51***
June	376.12	282.84	698.53	578.53	355.38	763.82	***509.20***
July	641.21	590.03	394.27	812.54	698.67	471.67	***601.40***
August	325.02	493.71	294.87	526.43	439.32	359.19	***406.42***
September	363.24	159.02	248.73	206.3	273.81	228.27	***246.56***
October	1.01	64.71	23.51	91.71	131.76	44.51	***59.54***
November	96.53	0	0	5.34	31.23	3.58	***22.78***
December	16.56	0	47.54	0	2.98	0	***11.18***
TOTAL	**1957.32**	**1826.7**	**2075.94**	**2487.28**	**2074.3**	**2029.64**	***2075.20***

(Source: Regional Sericulture Research station, 7th Mile Kalimpong 975m.)

Table 1.4(c): Rainfall data for the Kurseong sub-division during 1995 – 2000. Rainfall in mm (altitude: Kurseong Met. Stn., 1480m)

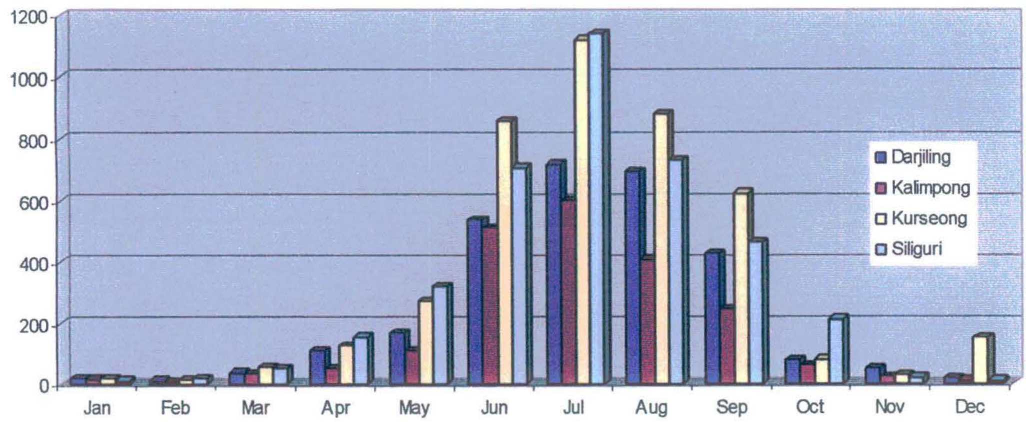
Years ▸ Months ▾	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**Average**
January	26.71	46.42	22.81	0.54	13.21	7.47	***19.53***
February	28.92	7.84	15.42	18.31	0	17.62	***14.69***
March	36.8	20.43	80.31	136.12	57.44	8.12	***56.54***
April	38.12	75.16	78.74	145.27	29.78	374.12	***123.53***
May	335.12	109.27	180.37	213.91	408.21	385.63	***272.09***
June	947.53	1044.29	671.21	694.42	867.42	921.97	***857.81***
July	1093.52	923.84	1064.76	1432.31	1084.31	1120.39	***1119.86***
August	749.24	1003.31	964.71	847.82	1119.91	598.72	***880.62***
September	747.26	725.97	493.5	658.18	596.42	517.43	***623.13***
October	70.31	108.98	8.63	84.12	192.37	17.88	***80.38***
November	92.23	23.67	5.13	17.52	22.34	14.23	***29.19***
December	233.61	2.21	655.51	4.89	4.67	0	***150.15***
TOTAL	**4399.37**	**4091.39**	**4241.1**	**4253.41**	**4396.08**	**3983.58**	*4227.49*

(Source: Office of the Mont Eviot Tea garden, Kurseong 1480m.)

Table 1.4(d): Rainfall data at Sukna during 1997 – 2005. Rainfall in mm (altitude: Sukna Environmental Research Stn., 140m)

Years ▸ Months ▾	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**Mean**
Jan	9.8	0.8	0	1.4	2.2	27.8	18.8	26.8	14.6	***11.36***
Feb	20.6	3.6	0	20.2	23.2	0	104.7	0.0	6.8	***19.9***
Mar	35.5	198.2	10	1.9	16	42.1	37	18.5	102.6	***51.31***
Apr	157.9	232.1	49.5	299.6	104.5	143.5	180.8	128.8	91.8	***154.28***
May	134.7	275.3	448.5	614.6	535	267.6	201.2	313.8	103.2	***321.54***
Jun	680.9	821.1	661.3	809.2	909.9	671.5	873.4	522.9	426.1	***708.48***
July	940.1	1423	995.4	983.5	783.8	1402.3	1446.1	1443.3	830.7	***1138.69***
Aug	560.4	1150.6	1090.1	869.9	514.1	554.3	768.3	456.4	620.4	***731.61***
Spt	619.6	491.8	444.7	470	697.4	359.2	539.6	445.4	92.6	***462.26***
Oct	30.5	339.9	231.8	40.6	481.4	47.6	352.4	197.7	181.6	***211.5***
Nov	8.9	27.4	0.4	16.7	108.7	23	2.7	4.1	1.7	***21.51***
Dec	43.7	1.2	13.9	0	5.2	8.6	16	5.2	0.0	***10.42***
TOTAL	***3242.6***	***4965***	***3945.6***	***4127.6***	***4181.4***	***3547.5***	***4541***	***3562.9***	***2472.1***	**3842.86**

Fig. 1.6: Average Rainfall in Four sub-divisions of Darjiling District



For the district of Darjiling the highest rainfall occurs at Kurseong, the south facing township, with an annual rainfall of over 4000 mm followed by Darjiling and Kalimpong. The district experiences the highest rainfall during the months between June to September brought about by the south-west monsoons and the lowest between Novembers to February with occasional moderate showers during March to May.

Not only the total rainfall of an area influence the structure and composition of local flora, its annual distribution is also very important. Very high downpour within a very short period can damage the vegetation and can remove the top soil. This also means that there will be a prolonged dry period, which certainly have important role in the selection of the type and number of species. On the other hand, similar amount but widely distributed rainfall will select a different set of larger number of species as the water relation of the vegetation will remain favourable for a longer period. - - Out of the three hill subdivisions Kurseong not only receive very high rainfall [annual average of 422.75 cm] it is also distributed over a much larger average number of 210.2 days [Table 1.5] per annum. Hills of Kurseong area are forming the outermost peaks of the Darjiling part of the Himalayas and south facing. So, the moisture-laden monsoon air coming from the Bay of Bengal, hitting the hills for the first time, cooling down rapidly and causing heavy rain. The location and altitude of Kalimpong, on the other hand, is not suitable to receive the monsoon air directly and that is why the area receives very less precipitation and that distributed over 116.6 days (average) only. - - Again, the hills of Darjiling subdivision are much taller than Kurseong hills. Monsoon-air after releasing a considerable load of water at Kurseong goes up and enters inside the Darjiling Hills. Get cooled. And, release a major part of the carrying water in this region. However, the rain is well distributed and spreading over 154.6 days (average) in Darjiling area.

Table 1.5: Average number of rainy days in different subdivisions of Darjiling District [after Das 2004].

Subdivisions	No. of rainy days/ annum
Darjiling	154.6
Kalimpong	116.6
Kurseong	210.2
Siliguri (Sukna)	148.56

1.9.3. Tmperature

Being a hilly terrain and part of a great mountain system, the temperature in different localities of the Darjiling district shows a great degree of variation with the altitude of the place. In the upper hilly regions the temperature (day and night) remains higher during rainy season than in the summer and spring while the range of fluctuation of temperature between the day and night is higher in the plains of Siliguri and Terai region. The temperature usually start increasing from the month of May and the days remain warm till the withdrawal of southwest monsoon (i.e. from the month of November) and then the temperature falls rapidly throughout the region. Normally January is the coldest month and the daily temperature at Darjiling, Sonada, Labha and Rechila often go down below 0°C. Table 1.6(a) – 1.6(c) shows the detailed month-wise temperature records for Darjiling (2150m), Kurseong (1480m) and Kalimpong (972m) subdivisions of the district, respectively.

However, the areas located above 3000 m, specially from Tonglu to Sandakphu to Phalut remain very cold for most of the time. Many places around Sandakphu and Phalut remain snow covered for 1 – 5 months of the year.

Table 1.6(a): Month-wise average temperature data in °C for Darjiling sub-division during 1995 - 2000. (*Altitude*: Darjiling Met. Stn. 2150 m)

Years ▸ Months ▾	1995		1996		1997		1998		1999		2000		AVERAGE	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
January	10.0	2.7	8.9	1.5	9.8	2.7	11.3	2.7	14.0	2.7	12.3	2.1	*11.0*	*2.4*
February	11.5	5.2	13.2	4.9	8.6	2.4	13.8	5.6	16.8	6.3	9.6	2.1	*12.2*	*4.41*
March	15.6	8.0	16.9	8.2	15.7	9.3	13.9	6.5	18.0	8.4	15.3	5.2	*15.9*	*7.6*
April	20.4	11.9	20.5	10.1	16.4	9.2	19.4	10.7	21.7	12.0	18.0	7.5	*19.4*	*10.2*
May	22.0	13.7	20.8	11.4	20.1	12.1	20.2	12.8	18.7	11.2	19.7	9.8	*20.2*	*11.8*
June	20.2	15.3	20.2	13.7	20.4	13.5	20.7	15.2	20.4	13.2	20.3	12.1	*20.3*	*13.8*
July	19.9	15.9	19.9	15.4	20.2	15.4	18.8	15.0	19.3	14.3	19.2	12.5	*19.5*	*14.7*
August	20.6	15.7	20.5	15.2	20.2	15.6	18.5	14.9	19.1	14.6	20.2	13.5	*19.8*	*14.9*

September	19.0	14.7	19.9	14.8	18.9	14.0	19.7	15.0	19.4	14.2	19.5	12.9	***19.4***	***14.2***
October	19.8	11.3	19.1	11.8	18.1	10.0	18.9	12.9	19.1	11.9	20.0	11.1	***19.1***	***11.5***
November	17.4	8.1	16.7	7.7	16.3	7.1	18.7	8.5	18.7	8.4	17.1	7.5	***17.4***	***7.8***
December	10.7	3.2	14.5	5.3	12.8	3.9	17.1	5.4	15.7	4.6	15.8	4.8	***14.4***	***4.5***

(Source: Office of the Principal Agricultural Officer, DARJILING: 2150 m.)

Table 1.6(b): Month-wise average temperature data in °C for Kalimpong sub-division during 1995 - 2000. (*Altitude*: Kalimpong Met. Stn. 975 m)

Years ▸ **Months** ▾	1995		1996		1997		1998		1999		2000		AVERAGE	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
January	15.9	7.9	16.1	8.5	17.8	8.4	20.0	9.0	20.8	8.4	17.6	8.8	***18.0***	***8.5***
February	18.8	9.7	20.5	11.1	15.8	10.7	21.3	11.2	24.5	13.8	17.3	9.0	***19.7***	***10.9***
March	23.3	13.6	22.9	14.4	24.1	13.3	22.8	12.0	26.3	14.7	22.7	12.6	***23.6***	***13.4***
April	27.6	16.3	26.5	16.2	23.5	14.9	26.9	16.5	28.9	18.8	25.7	16.7	***26.5***	***16.6***
May	28.8	20.8	26.9	18.9	27.4	18.1	29.3	19.6	28.0	20.2	26.6	19.8	***27.8***	***19.6***
June	26.7	21.4	27.0	21.0	26.9	20.5	28.0	21.3	29.4	20.2	27.2	21.2	***27.5***	***20.9***
July	26.9	21.3	26.6	21.5	27.4	21.6	25.9	21.3	26.8	21.2	26.6	21.8	***26.7***	***21.5***
August	28.1	21.1	27.1	20.9	27.3	21.1	27.1	20.3	26.7	20.6	26.5	21.6	***27.1***	***20.9***
September	27.5	20.3	27.3	20.4	26.7	19.8	27.5	18.0	27.4	19.8	25.7	19.8	***27.0***	***19.7***
October	32.0	17.4	25.9	21.4	25.9	15.8	27.0	18.9	26.0	17.5	25.7	17.6	***27.0***	***18.1***
November	25.8	14.2	24.1	16.5	23.9	12.9	24.0	15.8	22.7	14.7	21.6	14.4	***23.6***	***14.8***
December	17.9	10.4	21.1	10.6	21.8	9.9	21.1	11.5	20.0	9.5	19.6	10.2	***20.2***	***10.4***

(Source: Regional Sericulture Research station, 7th Mile Kalimpong 975m.)

Table 1.6(c): Month-wise average temperature data in °C for Kurseong sub-division during 1995 – 2000. (*Altitude*: Kurseong Met. Stn. 1480 m)

Years ▸ **Months** ▾	1995		1996		1997		1998		1999		2000		AVERAGE	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
January	11.3	5.7	13.4	5.4	11.6	2.1	12.2	2.0	15.0	3.6	13.7	2.7	***12.9***	***3.6***
February	15.1	8.1	17.8	8.2	12.0	2.4	15.8	4.8	18.7	7.8	12.1	2.9	***15.3***	***5.7***
March	21.1	11.2	21.6	12.4	18.6	7.5	16.2	6.5	20.4	9.5	18.4	6.9	***19.4***	***9.0***
April	24.9	15.3	25.7	15.5	17.9	8.9	20.6	10.6	23.4	12.9	21.9	10.6	***22.4***	***12.3***
May	25.8	19.7	25.3	17.7	22.6	12.4	23.2	13.8	21.0	13.4	22.3	13.6	***23.4***	***15.1***
June	25.0	19.4	23.8	18.2	22.1	14.0	23.1	15.8	24.2	15.0	22.1	14.6	***23.4***	***16.2***
July	23.6	18.9	22.7	18.9	21.5	15.4	20.6	15.6	21.0	14.7	21.5	14.9	***21.8***	***16.4***
August	24.9	19.0	24.0	18.8	22.8	15.9	21.4	15.4	20.1	14.9	21.0	15.3	***22.4***	***16.6***

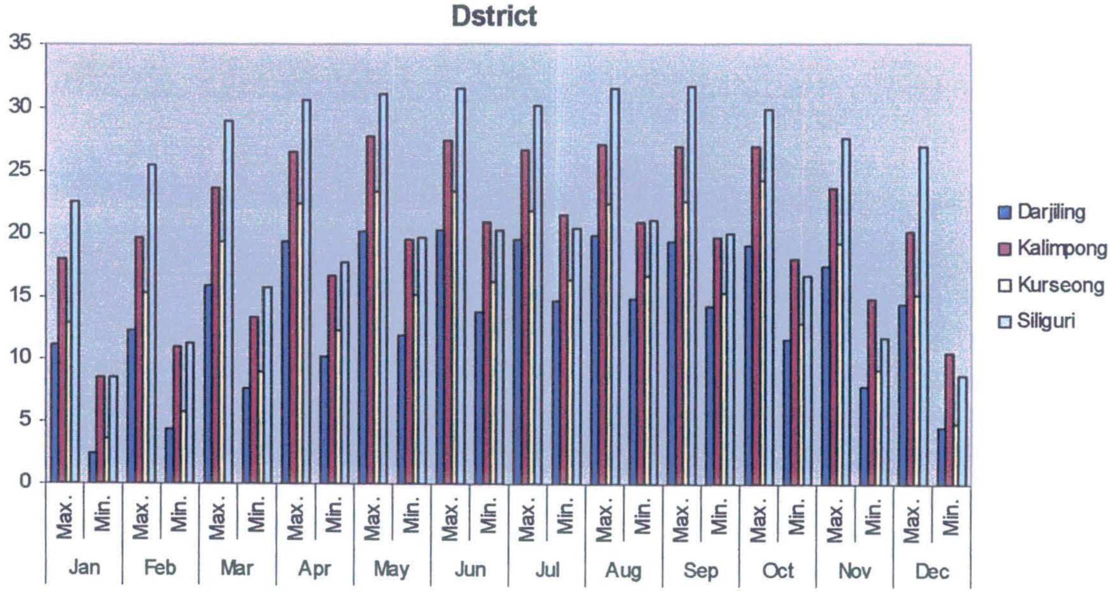
September	24.0	17.9	24.7	18.0	21.2	14.1	23.9	14.8	20.5	13.5	21.0	13.2	*22.6*	*15.3*
October	24.5	15.7	25.4	14.9	28.5	9.8	24.4	13.4	21.0	12.2	21.4	11.3	*24.2*	*12.9*
November	19.0	12.0	22.4	11.2	17.6	7.2	20.5	9.5	18.3	7.5	17.6	7.1	*19.2*	*9.1*
December	13.3	7.4	16.3	4.3	14.2	3.7	16.2	5.4	15.7	4.8	14.9	3.6	*15.1*	*4.9*

(Source: Office of the Monteviot Tea garden, Kurseong 1480m.)

Table 1.6 (d): Month-wise average temperature data in °C for Sukna during 1995 – 2000. (*Altitude*: Environmental Research Stn., Sukna 140 m)

Years ▸ Months ▾	**2004**		**2005**		**AVERAGE**	
	Max.	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**
January	21.6	10.4	23.6	6.5	***22.6***	***8.45***
February	24.5	13	26.5	9.5	***25.5***	***11.25***
March	28.5	17.6	29.4	13.9	***28.95***	***15.75***
April	30.1	19.7	31	15.9	***30.55***	***17.8***
May	31.4	22	30.8	17.4	***31.1***	***19.7***
June	30.7	21.4	32.3	19.2	***31.5***	***20.3***
July	29.7	21.3	30.7	19.5	***30.2***	***20.4***
August	31.07	20.61	31.9	21.6	***31.49***	***21.11***
September	29.9	18.86	33.4	21	***31.65***	***19.93***
October	29.9	15.64	29.7	17.8	***29.8***	***16.72***
November	26.9	10.59	28.4	12.6	***27.65***	***11.6***
December	26.9	8.14	27.1	9.1	***27***	***8.62***

Fig. 1.7: Average Temperature in Four sub-divisions of Darjling Dstrict



1.9.4. Relative Humidity

Uniformly, the entire Darjiling-Sikkim Himalayas experiences a high relative humidity round the year. This factor according to Sahni (1981) is conducive for tree growth. Generally the north facing slopes are colder and remain humid throughout the whole year. The relative humidity is higher towards the higher altitudes (above 2000 m) ranging between 85 – 99% during monsoons, and it generally decreases towards the lower elevations. March and April are drier months and the relative humidity is maintained between 45 – 60%.

The Relative humidity recorded for a period of six years for three locations in the three hill sub divisions of Darjiling are given below in Tables 1.7(a) – 1.7(c).

Table 1.7(a): Month-wise Average Relative humidity data in % for Darjiling sub-division during 1995 – 2000. (Altitude: Mungpoo Met. Stn., 1200 m)

Years ▸ Months ▾	1995		1996		1997		1998		1999		2000		AVERAGE	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
January	73	51	69	57	73	61	74	59	75	52	75	65	73.17	***57.50***
February	73	51	73	62	69	56	76	65	72	49	78	59	73.50	***57.00***
March	75	43	76	60	67	54	73	61	70	45	85	67	74.33	***55.00***
April	64	51	49	30	56	40	66	62	57	40	61	45	58.83	***44.67***
May	41	57	25	51	65	56	72	61	60	42	63	56	54.33	***53.83***
June	55	59	66	58	66	58	63	54	64	56	69	62	63.83	***57.83***
July	72	70	73	59	75	64	75	59	67	61	76	67	73.00	***63.33***
August	74	66	77	67	76	69	76	68	72	68	76	72	75.17	***68.33***
September	72	51	72	62	75	63	76	68	77	65	76	77	74.67	***64.33***
October	72	66	72	60	76	70	72	64	71	67	75	70	73.00	***66.17***
November	65	63	68	58	73	62	71	60	72	62	69	60	69.67	***60.83***
December	73	53	69	52	77	68	74	58	77	65	75	66	74.17	***60.33***

(Source: Research Laboratory, Directorate of Cinchona and other Medicinal plants, Mungpoo, 1200m.)

Table 1.7(b): Month-wise Average Relative humidity data in % for Kalimpong sub-division during 1995 – 2000. (Altitude: 7[TH] MILE, Kalimpong 975m)

Years ▸ Months ▾	1995		1996		1997		1998		1999		2000		AVERAGE	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
January	77	78	84	83	80	65	76	65	77	56	83	69	***79.5***	***69.33***
February	76	77	85	84	82	65	77	58	71	49	81	62	***78.67***	***65.83***
March	80	81	83	87	83	62	70	53	75	54	78	76	***78.17***	***68.83***
April	77	78	78	83	72	57	71	63	63	43	67	56	***71.33***	***63.33***
May	69	76	75	67	78	68	73	60	81	60	74	66	***75.00***	***66.17***
June	76	74	83	64	75	67	80	75	87	78	87	77	***81.33***	***72.50***
July	90	85	83	86	86	76	86	85	88	76	92	86	***87.50***	***82.33***
August	90	86	90	89	88	83	93	89	92	87	95	88	***91.33***	***87.00***
September	84	87	90	91	88	81	93	90	93	89	95	90	***90.50***	***88.00***
October	90	90	90	89	89	80	88	80	93	83	92	82	***90.33***	***84.00***
November	88	86	87	84	82	72	88	79	85	73	80	73	***85.00***	***77.83***

December	79	80	84	84	80	67	78	69	81	66	84	73	***81.00***	***73.17***

[Source: Regional Sericulture Research Station, 7th Mile, Kalimpong, 975m]

Table 1.7(c): Month-wise Average Relative humidity data in % for Kurseong sub-division during 1995 – 2000. (Altitude: Kurseong Met. Stn., 1480 m)

Years ▸ Months ▾	1995		1996		1997		1998		1999		2000		AVERAGE	
	Mor.	Eve.	Mor.	Eve.	Mor.	Eve.	Mor.	Eve.	Mor.	Eve.	Mor.	Eve.	Mor.	Eve.
January	93	85	92	88	92	82	85	90	92	93	94	91	***91.33***	***88.17***
February	95	92	94	89	92	87	89	91	94	90	92	93	***92.67***	***90.33***
March	92	88	91	88	91	85	85	93	95	91	92	92	***91***	***89.5***
April	93	86	87	82	86	80	88	91	86	93	93	87	***88.83***	***86.5***
May	95	92	94	92	94	90	92	94	90	96	96	96	***93.5***	***93.33***
June	96	96	96	94	94	96	96	96	95	96	95	96	***95.33***	***95.67***
July	96	95	96	95	95	96	95	96	96	96	97	95	***95.83***	***95.5***
August	96	95	96	95	95	93	96	95	97	96	97	96	***96.17***	***95***
September	94	93	95	94	93	91	96	96	96	96	96	94	***95***	***94***
October	92	85	90	87	91	88	94	88	89	93	93	89	***91.5***	***88.33***
November	88	89	82	79	93	93	93	80	93	93	94	93	***90.5***	***87.83***
December	92	93	69	77	93	90	93	93	93	90	91	87	***88.5***	***88.33***

[Source: Experimental Watershed Area, Sonada]

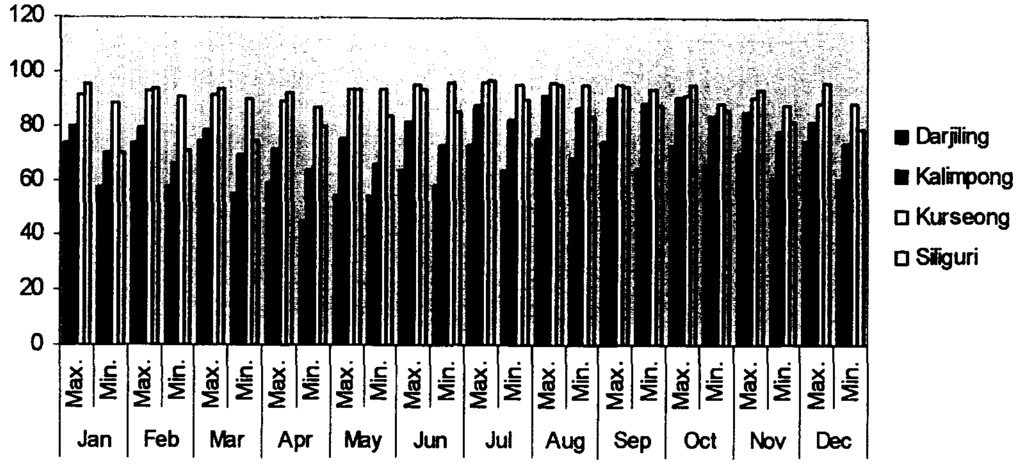
Table 1.7(d): Month-wise Average Relative humidity data in % for Sukna during 2004 – 2005. (Altitude: Environmental Research Stn., Sukna 140 m)

Years ▸ Months ▾	**Morning**				**Evening**			
	2004	**2005**	**Total**	**Mean**	**2004**	**2005**	**Total**	**Mean**
Jan	95	96	191	***95.5***	60	79	139	***69.5***
Feb	92	95	187	***93.5***	69	72	141	***70.5***
Mar	92	95	187	***93.5***	76	73	149	***74.5***
Apr	89	95	184	***92***	85	74	159	***79.5***
May	93	95	188	***94***	86	82	168	***84***
Jun	93	95	188	***94***	87	83	170	***85***
July	95	98	193	***96.5***	91	89	180	***90***
Aug	94	97	191	***95.5***	77	90	167	***83.5***
Spt	95	94	189	***94.5***	93	82	175	***87.5***
Oct	94	96	190	***95***	83	89	172	***86***
Nov	90	97	187	***93.5***	77	85	162	***81***
Dec	95	97	192	***96***	73	85	158	***79***
Mean	***93.08***	***95.83***	***188.91***	***94.46***	*79.75*	***81.92***	***161.67***	**80.84**

1.10. General Vegetation Type

The vegetation of Darjiling, phytogeographically, is contiguous with the vegetation of Sikkim and is a part of the Eastern Himalayan Province that in turn is one of the thirteen provinces of the Eastern Asiatic Regional Centre of Endemism (Takhtajan 1986). Lying between 83°00' to 92°00' E and 27° 30' to 29° 30' N, the Eastern Himalayan Province is located almost wholly within the Indian subcontinent. It includes Nepal east of Kali River (83°00') and extends to southeastern Tibet (the Tsangpo valley east of 92°00' E). It includes all the mountainous country east of the Kali River and north of the Ganga-Bramhamaputra flood plains.

Fig. 1.8: Average Relative Humidity in Four sub-divisions of Darjiling District



Floristically, the Eastern Himalaya is one of the richest regions in the world that is literally considered as a *botanist's paradise* and has thus, attracted a large number of plant hunters and botanists at least during the last three centuries (Don 1821; Das 1995, 2004). Phytogeographically, it forms a meeting ground of the Indo-Chinese and Indo-Malaysian tropical lowland flora, the Sino Himalayan east Asiatic flora and the Western Himalayan flora comprising about 9000 spp. with a high percentage of endemic plants (Chatterjee 1940; Puri *et al* 1983; Myers 1988; Wilson 1992; Das 1995, 2004; Bhujel 1996; Bhujel & Das 2002). This province along with Khasi Hills, Arunachal Pradesh and Manipur has the richest flora of the Indian subcontinent with the exception of Myanmar (Rao & Murti 1990). A comprehensive travelogue through the dense and magnificent forest and vegetation of this region is rather difficult to conceive due to the nature of Himalayan terrain and intricacy of the plant cover comparable to almost that of the tropical rainforest in some of the river valleys (Bhattacharya 1997).

Although, the Darjiling-Sikkim Himalayas forms a very small part of this province covering an area of only 9020 sq km of a total area of 1,22,802 sq km (Negi 1990) it shows a remarkable richness and variety in its flora. None other than Sir Joseph Dalton Hooker appreciated the beauty and the floristic richness of this region and preached it to the outside world for the first time. The occurrences of very large variation in physiographic, climatic and edaphic conditions often aided by biotic factors are responsible for such richness and diversity.

The configuration of the hills, pattern of rainfall distribution over the lower, middle and upper elevation ranges and high humidity have a great role in the determination of the type of vegetation of the area. The highly humid tree-producing climate and as such the timber line or the upper vegetation in this sector goes up to 4750 m above m.s.l. (Sahni 1981).

The altitude of the various hill ranges varies markedly and usually there is a distinct correlation between the altitude and vegetation. Thus, altitude is one major factor that determines the range of distribution of different plant species and the associations that they form at different elevation ranges.

Many workers have tried to classify the vegetation of this region and they includes workers like Gamble (1875), Hooker (1906), Cowan (1929), Champion (1936), Kanai (1967), Rao (1974), Sahni (1982), Jain (1982) and Bhujel (1996). These authors have essentially classified the 'flora and vegetation' according to altitudinal ranges, although they differ considerably in detail. Six major types of vegetation which are further subdivided to sub types can be recognised (Table 1.8):

Table 1.8: Altitudinal distribution of major vegetation types in Darjiling-Sikkim part of Eastern Himalaya

Nos.	**Vegetation Types**	**Altitudinal Ranges**
1.	Tropical and plains	Plains to 800 m
2.	Subtropical	800 - 1600 m
3.	Temperate	1600 - 2400 m
4.	Cold temperate	2400 - 3200 m
5.	Sub alpine	3200 - 4000 m
6.	Alpine	4000 m and above

The tropical and subtropical types represent the vegetation of the plains in part, but the remaining four are forming the true hill forests. However, in Darjiling part any form of Alpine vegetation is absent as the highest altitude achieved by any peak of this area is 3660 m, i.e. remaining below 4000m.

1. The Tropical and plains vegetation [plains to 800 m]

High temperature and heavy rainfall characterize this zone leading to the development of dense vegetation. The Tropical vegetation is characterized by the presence of deciduous forests with *Shorea robusta* as a dominant species. Bhujel (1996) further divided it into four sub types:

a. Riverine forest
b. Sal forest
c. Dry mixed forest
d. Wet mixed forest

a. The Riverine forests: These can be observed in small patches in the elevated riverbeds and/or in the land raised after shifting of rivers like Tista, Rangit, Balasan, Mahananda, Sukuna, Relli, Chel, Lesh, Gish, Jaldhaka, Sevoke and Mechi. The forests remain dominated by perennial plants mostly shrubs and climbers. The common species of trees found in this region include *Bombax ceiba* L., *Meliosma pinnata* (Roxburgh) Maximowicz, *Albizia procera* (Roxburgh) Bentham, *Albizia lebbeck* (L.) Bentham, *Acacia lenticularis* Bentham, *Alstonia scholaris* (L.) R.Br., *Lagerostroemia parviflora* Roxburgh with *Acacia catechu* (L.f.) Willdenow and *Dalbergia sissoo* DC. occurring as distinct patches in these forests. *Saccharum spontaneum* L., *Mikania micrantha* Kunth, *Clerodendrum japonicum* (Thunburgh) Sweet, *C. viscosum* Ventenat, *Buddleja asiatica* Loureiro, *Oroxylum indicum* L., *Globba macroclada* Gagnepain, etc are covering the forest floor.

b. Sal *(Shorea robusta)* forest: These are mostly tropical forests. *Shorea robusta* Gaertner f. is the conspicuous species growing in Lower Siwalik 'Dry' Terai and Bhabar sal belt, ridges, spurs and well-drained loamy plains. The main associates of sal in this region include *Terminalia alata* Roth, *Aglaia lawii* (Wight) Ramamoorthy, *Duabanga grandiflora (*Roxburgh ex DC.) Walpers, *Eugenia kurzii* Duthie, *Dillenia pentagyna* Roxburgh, *Chukrasia tabularis* A. Jussieu, *Meliosma pinnata* (Roxburgh) Maximowicz, *Lagerstroemia parviflora* Roxburgh, *Tetrameles nudiflora* R.Br., *Stereospermum chelonoides* (L.f.) DC. *Anthocephalus chinensis* (Lamarck) A. Rich ex Walpers along with *Pavetta indica* L., *Clerodendrum japonicum* (Thunburgh) Sweet, *Clerodendrum viscosum* Ventanat, *Phlogacanthus thyrsiflorus* (Roxburgh) Nees, *Barleria cristata* L. etc.

Pinus roxburghii Sarg., a normal inhabitant of the temperate to subtropical region can also be seen associated with species like *Shorea robusta* Gaertner f., *Ficus oligodon* Miquel, *Phoenix humilis* Royle ex Becc. & Hook.f. in some drier valleys like at Badamtam, below Ging. Remnants of once the magnificent sal forests which has given way to the need of the expansion of civilization can be seen along the banks of the River Rungeet.

c. The Dry Mixed Forest: Though the annual precipitation is high and with prevalent high atmospheric humidity for most of the period, the dominance of deciduous species of trees is quite prominent in foothill and Terai-Duars forests. This type of vegetation is characterized by the presence of *Gmelina arborea* Roxburgh, *Tetrameles nudiflora* R.Br., *Beilschmiedia dalzellii* (Meisner) Kostermans, *Erythrina stricta* Roxburgh, *Bombax ceiba* L., *Alstonia nerifolia* D. Don, *Merremia emarginata* (Burm.f.) Hallier f., *M. hederacea* (Burm.f.) Hallier f., *Artocarpus* *lacucha* Buch-Ham, *Eugenia kurzii* Duthie etc. It is common in the lower Tista Valley and on low altitude hills and in Terai & Duars.

d. The Wet Mixed Forests: Just reverse to the Dry-Mixed Forests, this type of vegetation is dominated by evergreen and semi-evergreen trees along with a very large number of shrubs, climbers and herbs. These are mainly evergreen forests mixed with taller deciduous trees in very low frequency, which Champion & Seth (1968) designated as 'Sub-Himalayan Secondary Wet Mixed Forest' [2B/2S_3]. Though in small patches but is met with in Terai and Duars of Darjiling. This zone is rich in epiphytes and stem-parasites and giving it a distinct characteristic structure. The major tree species of this sub zone include *Syzygium formosum* (Wallich) Masamune, *Syzygium cumini* (L.) Skeels, *Litsea glutinosa* (Loureiro) Roxburgh, *Litsea salicifolia* (Nees) Hook.f., *Mesua ferrea* L., *Knema erratica* (Hook.f. & Thomson) Sinclair, *Knema tenuinervia* de Wilde *Terminalia myriocarpa* Heurck & Mueller, *Michelia champaca* L., *Cinnamomum glaucescens* (Nees) Handle-Mazzetti, *Beilschmiedia roxburghiana* Nees, *Pterospermum acerifolium* (L.) Willdenow. There are a good number of climbers, some of those are liana, dominating the vegetation like *Beaumontia grandiflora* (Roxburgh) Wallich, *Bauhinia vahlii* Wight & Arnott, *Entada pursaetha* DC. ssp. *sinohimalensis* Grierson & Long, *Cryptolepis buchananii* Roem. & Schult., *Mikania micrantha* Kunth, *Ipomoea quamoclit* L., *Boerhavia diffusa* L., *Argyreia roxburghii* Choisy, etc. The ground cover vegetation is also very rich, which include annuals, perennial herbs, suffrutescent plants, root parasites, saprophytes etc. like *Ageratum conyzoides* L., *Blumea balsamifera* DC., *Sonchus asper* Hill., *Sauropus pubescens* Hook.f. etc.

2. Sub-Tropical forests [800 - 1600 m]

The vegetation of this region is contiguous with the vegetation of Terai and Duars and is effected by a seasonal climate of dry winter and a wet monsoon and thus consists largely of tropical genera and species (Grierson & Long, 1983). The mixed forest is mostly deciduous. Several species tend to remain in this zone from the tropical and plains zone. *Castanopsis indica* (Roxb.) A.DC, *Schima wallichii* (DC.) Korthals, *Gmelia arborea* Roxb., *Adina cordifolia* (Roxb.) Hook.f. ex Brandis, *Duabanga grandiflora* (DC.) Walp., *Gynocardia odorata* R.Br., *Bischofia javanica* Bl., *Callicarpa arborea* Roxb., *Alangium chinensis* (Lour.) Harms, *Terminalia alata* Roth., *T. bellirica* (Gaertn.) Roxb., *Sygzygium ramosissmum* (Bl.) Balakrishnan, constitute the dominant trees in this region. In addition *Castanopsis tribuloides* (Smith) A. DC., *Cinnamomum bejolghota* (Ham.) Sweet, *Magnifera sylvatica* Roxb., *Phoebe lanceolata* (Nees) Nees, *Litsea cubeba* (Lour.) Pers., *Fraxinus floribunda* Wallich., *Helicia nilagirica* Beddl., *Phyllanthus* *emblica* L., *Mallotus philippensis* (Lamk.) Muel. *Engelhardtia spicata* Bl. can be seen in some places. The undergrowths include *Mussaenda roxburghii* Hook.f., *Dendrocalamus hamiltonii* Nees et Arn. ex Munro, *Osbeckia nepalensis* Hook., *Osbeckia stellata* D. Don, *Pandanus furcatus* Roxburgh, *Pandanus anguifer* Hook.f., *Buddleja asiatica* Lour., *Embelia floribunda* Wallich., *Croton caudatus* Geisel, *Thysanolena maxima* (Roxb.) O. Kuntze, *Imperata cylindrica* (L.) P. Beauv., *Holmskioldia sanguinea* Retz., *Woodfordia fruticosa* (L.) Kurz, *Boehmeria glomerulifera* Miq. This type of forest is characterised by the presence of a good number of climbers such as *Bauhinia vahlii* Wight et Arnott., *Tinospora cordifolia* Meirs, *Cissampelos pareira* L., *Mucuna pruriens* DC., *Thunbergia fragrans* Roxb., *Vitex negundo* L. The common herbs are *Commelina benghalensis* L., *Cynodon dactylon* (L.) Pers., *Pilea hookeriana* Weddell, *P. smilacifolia* Weddell, *Elatostema lineolatum* Wight, *Ageratum conyzoides* L., *Oxalis corniculala* L., *Urena lobata* L. and *Triumfetta rhomboidea* Jacq.

Exotic weeds like *Chromolaena odorata* L. and *Mikania micrantha* Kunth. grow profusely in disturbed forests, while thickets of the tree fern *Alsophila spinulosa* (Wallich *ex* Hooker) Tryon is found in moist shady places.

3. Temperate Vegetation [1600 - 2400m]

The temperate vegetation comprise of dense forest that includes areas extending from Kurseong, Toong, Sonada, Darjeiling, Mirik, Sukhia Pokhri, Maneybhangyang, Rimbick, Lodhama, Kalimpong, Lava, etc. in the Darjiling Himalaya and areas above Gyalshing in West Sikkim, Namchi in South, Chungthang in North and Gangtok and Pangthang in East Sikkim. The temperate forest occupies most of the region of the Darjiling-Sikkim Himalayas. The richness of the vegetation is displayed by the presence of the largest number of species and the widest diversity occurring in this region. J.D. Hooker (1907) remarked that the temperate vegetation of this region 'is roughly divisible into lower non-coniferous and upper coniferous and *Rhododendron* belt, but the line of demarcation between these varies so greatly with the exposure and humidity of the locality that they cannot be dealt apart'. Kanai (1966) and Grierson & Long (1983) classified the temperate forest of the region into three subtypes.

a. Temperate Deciduous forest: It is characterized by the presence of trees like *Betula alnoides* D. Don, *Exbucklandia populnea* (Griff.) R.W. Brown, *Eleocarpus lanceifolius Roxb.*, *Eleocarpus sikkimensis* Masters, *Acer campbellii* Hiern., *A. sikkimensis* Miq., *Engelhardtia spicata* (R.Br.ex Griff.) R.W.Brown, *Lindera neesiana* (Nees) Kurz. *L. pulcherrima* (Nees) Benth.ex Hook.f, *Prunus napaulensis* (Ser.) Steu., *Alnus nepalensis* D. Don, *Rhododendron* *grande* Wight, *Rhododendron arboreum* Hook.f., *Eurya acuminata* DC. etc.

b. Evergreen Oak forest: This type comprises of trees like *Quercus lamellose* Smith, *Q. lineata* Bl., *Q. oxydon* Miq., *Lithocarpus pachyphylla* (Kurz.) Rehder., *Acer hookeri* Miq. *Lithocarpus elegans* (Bl.) Hatus ex Soep., *Cinnamomum impressinervium* Meisner, *Eriobotrya petiolata* Hook.f., *Eurya acuminata* DC., *Pentapanax fragrans* (D. Don) Hara, *Litsea elongata* (Nees) Hook.f., *Litsea sericea* (Nees) Hook.f., *Juglans regia* L., *Leucosceptrum canum* Smith, *Lithocarpus pachyphyllus* (Kurz) Rehder, *Poplus ciliata* Royle. Shrubs like *Dichroa fabrifuga* Lour, *Viburnum erubescence* Wallich, *Jasminum dispermum* Wallich., *Nellia thyrsiflora* D .Don, *Yushania maling* (Gamble) R.B. Majumdar, *Hypericum hookeriana* Wtght et Arnott, *Norysca urala* (Hamilt.) K. Koch, *Notochaete haemosa Benth.* with climbers like *Dicentra scandens* (D. Don) Walp., *Edgaria darjeelingensis* Clarke, *Holboellia latifolia* Wallich., *Sechium edule* (Jacq.) Swartz, *Smilax ferox* Wallich., *Codonopsis affinis* Hook.f. & Thomson., *Streptolirion voluble* Edgew., *Rubia manjith* Roxb. ex Flem. etc. and herbs like *Achyranthes bidentata* Bl., *Anaphalis contorta* (D. Don) Hook.f., *A. triplinervis* (Sims.) C.B.Cl., *Artemesia japonica* Thunb, *Bidens pilosa* L., *Potentila fulgens* Wallich, *Plantago erosa* Wallich., *Rumex nepalensis* Spreng., *Clinopodium umbrosa* (M. Bieb) C. Koch., *Gallium asperifolium* Wallich., *Swertia chirayita* (Roxb.) Darsten, *S. bimaculata* (Sieb. & Zucc.) Hook.f. & Thomson. ex C.B.Clarke *Impatiens arguta* Hook.f. & Thomson. *Lysimachia alternifolia* Wallich. *Poulzolzia hirta* Hassk., *Hypoestes triflora* Roem. & Sch., *Hemiphragma heterophylla* Wallich., *Erigeron karwinskianus* DC., *Fragaria nubicola* Lindl. to name a few, forming the ground cover.

3. Cold Temperate Vegetation [2400 – 3200 m]

Regions lying above 2400 m usually receive snowfall and remain covered from a few days to few months (usually 3 - 4 months) during the year. As such there is a decrease in the diversity of the arboreal flora. However, the region is inhabited by numerous herbs, many of which are endemic to the region (Hara 1966; Bhujel 1996). The vegetation of this zone can be broadly classified as being of two types:

a. Mixed temperate forest of the upper hill region: The mixed temperate forest of the upper hill region extends to about 2800 m and comprises of trees like *Brassaiopsis mitis* Clarke, *Quercus lamellosa* Smith, *Magnolia campbellii* Hook.f. & Thomson., *Lithocarpus pachyphylla* (Kurz) Rehder, *Sorbus rhamnoides* (Decaisne) Rehder, *Ilex fragilis* Hook.f., *Prunus undulata* D. Don with climbers *Dicentra paucinerva* K.R. Stern, *Clematis buchaniana* DC, *Actinidia strigosa* Hook.f. & Thomson. ex Benth, *Smilax glaucophylla* Klotzch, *Schisandra grandiflora*

(Wallich) Hook.f. & Thomson. like and shrubs like *Piptanthus nepalensis* (Hook.) D. Don, *Elsholtzia fructioca* D. Don, *Daphne involucrata* Wallich, *Bistorta amplexicauli* (D. Don) Greene *Berberis insignis* Hook.f. & Thomson., *Aconogonum campanulatum* (Hook.f.) Hara, *Arisaema speciosum* (Wallich.) Martius *Rosa serecia* Lindley with herbs like *Fragaria nubicola* Lindley, *Ranunculus diffisus* DC., *Viola sikkimensis* W. Backer, *Ajuga lobata* D. Don, *Paris polyphylla* Sims., *Gentiana speciosa* (Wallich) Miq., *Geranium donianum* Sweet , *Pilea anisophylla* Wedd., etc. *Arundinaria maling* Gamble is found to invade large open areas in the region.

b. Rhododendron – Hemlock forest: The uppermost tier of the temperate forest is clearly dominated by different species of *Rhododendron* with few patches of other trees. The commonly occurring trees of this sub-region include *Rhododendron arboreum* subsp. *roseum* Lindley, *R. falconeri* Hook.f., *R. hodgsonii* Hook.f., *R. decipiens* Lacaita, *Betula utilis* D. Don, *Abies densa* Griff., *Tsuga dumosa* (D. Don) Eichl, *Taxus baccata* L., *Acer pectinatum* Nichol., *A. stachyophyllum* Hiern., *Daphnephyllum himalense* (Benth.) Muller, *Ilex insignis* Hook.f., *Larix griffithiana* Carr, *Picea spinulosa* (Griff.) Henry. The ground cover include *Rosa sericia* Lindl., *Virburnum erubescence* Wallich., *Viburnum nervosum* D. Don, *Ribes* spp. *Mecanopsis napaulensis* DC., *Nellia rubiflora* D. Don, *Potentilla fruticosa* L., *Berberis insignis* Hook.f. et Thomson., *B. umbellata* Wallich., *Daphne bholua* Ham. ex D. Don Climbers include *Actinidia strigosa* Hook.f. & Thomson. ex Benth., *Holboellia latifolia* Wallich., *Aristolochia griffithii* Hook.f. & Thomson., *Leptocodon gracilis* Hook.f. & Thomson. With herbs like *Aconitum spicatum* Stapf, *Aconitum bisma* (Hamilt.) Rapaics, *Fritillaria cirrhosa* D.Don, *Hemiphragma heterophyllum* Wallich., *Panax pseudoginseng* Wallich., *Valeriana wallichii* DC., *Primula capitata* Hook., *Pdenticulata* Smith, *Gentiana capitata* Hamil. ex Don, *G. bryoides* Burk., *G. glabriuscula* H. Smith, *Swertia dilatata* C.B. Clarke, *S. macrocsperma* (Clarke) C.B. Clarke etc.

5. Sub-alpine vegetation [3200 - 4000 m]

Ranging between 3200 m upto around 4000 m lays the sub alpine region. This region has been categorized by some as alpine region (Biswas 1959; Mitra 1951); while as temperate region by others (Gamble 1875; Kanai 1966). A sharp reduction in the temperature to subzero level during winter with precipitation in form of snow and hail that melts during the summer characterizes the climate of this zone. The common plant species observed in this zone include *Acer acuminatum* Wallich, *Acer caudatum* Wallich, *Abies spectabilis* (D. Don) Eichler, *Cotoneaster frigidus* Lindley, *Salix sikkimensis* Anderson, *Salix flabellus* Anderson, *Sorbus microphylla* Wenzig., *Viburnum nervosum* D. Don, *Rhododendron cinnabarium* Hook.f., *Rhododendron* *campylocarpum* Hook.f., *Rhododendron campanulatum* D. Don, *Juniperus squamata* Hamilt. ex Lambert, *J. communis* L., *J. wallichiana* Hook.f. & Thomson etc. The herbs in the forests and meadows include *Rubus fragarioides* Bertoloni, *Potentilla microphylla* D. Don, *P. monanthes* Lindley, *Primula glabra* Klatt., *P. oblique* W.W. Smith, *Ranunculus adoxifolius* Hand.-Mzt., *R. brotherusi* Freyn., *Anemone demissa* Hook.f & Thomson, *Tithymalus sikkimensis* (Boiss.) Hurusawa & Ya. Tanaka, *T. stracheyi* (Boiss.) Durusawa et Ya. Tanaka, *Saxifraga hispidual* D. Don, *S. latifolia* Hook.f. & Thomson. *Viola biflora* L., *V. cameleo* Boiss., *Pedicularis mollis* Wallich *ex* Bentham, *P. clarkei* Hook.f., *Neopicrorhiza scrophulariiflora* (Pennell) Hong, *Rheum acuminatum* Hook.f. & Thomson.

1.11. Floristic Works in Darjiling Hills

The floristic richness of Darjiling, Sikkim and Nepal parts of the Himalayas has attracted naturalists, plant explorers, botanists and plant science researchers since the 18th century (Don 1821; Das 1995, 2004). The Indian flora was scientifically and systematically explored since the 1840's. Sir J. D. Hooker in 1848 took up the third botanical expedition to the Eastern Himalaya and became the first ever-botanical explorer of the Eastern Himalaya while writing the *Flora of British India* as a whole (Burkill 1965). In most of the previous works Darjiling and Sikkim have been considered together as Darjiling was then a part of Sikkim.

Explorers from different far and wide areas have explored the region in different times and a number of floras included their records and findings and thereby adding to the knowledge on the vegetation and flora of the region. Some such major overseas contributions include J. D. Hooker (1849 - 1851, 1854, 1855, 1872 – 1897, 1907); T. Anderson (1832 – 1870); C. B. Clarke (1876,1885); H. J. Elwes (1877); George Watt (1881); G. A. Gammie (1893); R. Pantling with Sir George King (1989); Sir George King (1840 – 1909): Sir W. W. Smith (1911, 1913); C. C. Laccaita (1916); W. J. Buchanan (1916); Bruhl (1926); Burkill (1907,1965); Ducan (1935); Hara (1963, 1966, 1971); Hara *et al* (1978, 1979, 1982); Mizushima (1963); Nakao (1964); Ohashi (1975); Grierson & Long (1978, 1979, 1982, 1983, 1984, 1987, 1991); Noltie (1994, 2000) and Pearce & Cribb (2002).

On the other hand, workers like J. S. Gamble (1875, 1986), A.M. Cowan & J. M. Cowan (1929) have published floras for the Darjiling part of the Himalayas taking the foresters' point of view. A large number of publications on the flora of the region have been made by these botanists from time to time. They include M.J. Berkeley (1850), P. Bruhl (1926), Percy Brown (1936), H.P.V. Townend (1936); P.C. Duncan (1935), G.A. Gammie (1893 – 1894), F.

Kingdonward (1913, 1942) and M. Tamina (1964).

In addition, a large number of Indian workers have also contributed towards the Floristic knowledge of Darjiling-Sikkim Himalaya and include D. Chatterjee (1940); S. K. Mukherjee (1940, 1945, 1958); K. P. Biswas (1940, 1967); H. L. Chakraborty (1959); R. S. Rao (1964a, 1964b); P.N. Mehra & S.S. Bir (1964); B. D. Sharma & Ghosh (1971); G. S. Yonzone (1976); Mathew (1981); Sahni (1981); Tamang & Yonzone (1982); B. Mathew (1983); Bennet (1983); Mukherjee (1983); Das & Bhujel (1983); N. C. Muzumdar, B. Krishna & M.C. Biswas (1984); U. C. Pradhan & B. M. Rai (1983-85); Das & Chanda (1986, 1986a, 1987, 1990); Bhujel (1984, 1992, 1996); P. C. Lama (1989); Bhujel *et al* (1994, 1996); T. Rai & L. Rai (1994) Das (1995, 1995a, 2004); Samanta & Das (1995, 1996); A.S. Chauhan (1998) are some such important references.

Although the region apparently appears to be well-explored, closer scrutiny of literature, which include travel itineraries and specimens reveal that large tracts of vegetation mainly forested, are yet to be surveyed. The rapidly increasing human population in the region is demanding more and more areas for habitations and other civilisation related activities causing rapid and steady dwindling of forest cover. Naturalization of numerous exotics, excessive increase of pollution, grazing etc. are exerting tremendous pressure on the natural vegetation and thereby the flora of this area (Das 1995, 1998, 2002, 2004) resulting in the loss or extinction of many species and leading many others to different levels of endangered status.

This entire discussion it can be understood that the flora as well as the vegetation of Darjiling Hills and its nearby Terai and Duars are extremely rich and diverse. Any sort of interference and/or modification in such vegetation will cause irreparable loss to the region's biodiversity.

1.12. Present Status of Vegetation

Before the establishment of human settlements in Darjiling Hills, almost the entire area was covered with dense forested vegetation. Rivers and fresh land-slips areas were the only blank areas. When first Lepchas entered this area they created very small hamlets thatched cottages. Their requirement for survival was nominal and the effects of their interference with the local vegetation were not alarming. But, with the visit of Capt. Lloyd and Mr. Grant to Gundari Bazar (present Darjiling) in 1827, the history of the land took a sharp turn and that was true for the local vegetation too. Very soon, the British Indian Government established a sanatorium and constructed road and rail links to Darjiling initiated disturbances in the vegetation.

1.12.1. Introduction of Three Trees: Discovery of a favourable climate for the cultivation of Tea [*Camellia sinensis*] in Darjiling Hills was probably the second dangerous incident in this respect. Now the wide plantations of this species in Terai, Duars and hills upto 2100 m have eliminated so much of important and dense local vegetations. Introduction of Dhupi (*Cryptomeria japonica*) in Darjiling to collect timber for Tea-boxes was another mistake as the species is now proved to be a great enemy for the local species of plants and as the timber produced from this species at Darjiling is not suitable for making Tea-boxes. Widespread plantation of *Cinchona* spp. in Mongpoo – Latpanchor area has also replaced much of local vegetation.

1.12.2. Migration of Work-force: The local population, comprising mostly Lepchas and some Nepali communities, was not enough to maintain different developmental activities in Darjiling. So, it becomes essential to introduce workers from outside. While numerous tribal people from Santhal Paragas, now in Jharkhand State of India, Western part of Bengal were brought to Terai and Duars areas, people from Nepal and Bhutan, in general migrated to the hilly regions of Darjiling (Ghosh & Das 2004).

Arrival of these people caused some changes and those are mainly related to their survival. New settlements were developed in this region to accommodate these people. More natural vegetations were cleared for the cultivation of different crops of their liking. Again, the requirement of firewood as cooking fuel and for running the driers in Tea Factories and for room heating started affecting local forests. Forests started depleting and the rate started accelerating with the increase of population.

1.12.3. Rapid Extension of Civilization: With the establishment of road, rail and air links with Darjiling and nearby areas different facilities of modern civilization continuously pouring into the different corners of this area. And to keep cope with the demand, people utilised more and more natural forest resources with the pass of time.

1.12.4. Fragmentation of Vegetation: The result of the explosion of population, extension of civilization including Tea Gardens, factories, roads, villages, townships, crop-fields etc. has made the Darjiling vegetation highly fragmented. It is now extremely difficult to find out a patch of vegetation that is free from anthropogenic interferences. Forests from wide areas are now completely missing or are highly degraded. And, all these have resulted into the very high fragmentation of forests or other type of natural vegetation. However, still today, there are some good patches of vegetation particularly in protected areas. But, all these patches are quite isolated and any type of migration or exchange of the inhabitants of these protected appears to be either impossible or difficult. Das *et al* (2005) projected some corridors to connect the four major protected areas located within this district, but none of these are either free from human settlements or is provided with a continuous patch of forested vegetation.

1.12.5. Loss of Habitat: The loss of forest cover in a locality where the prevailing environment is suitable for the development of dense forested vegetation is certainly affecting the local biodiversity. It is the common experience, evidenced from the previous literature, that numerous species of plants in this area are known to have extremely restricted distribution. Sometimes a species is known to grow only on a particular hill slope. So, clearing and/or modifying the vegetation on that slope will certainly affect the survival of that species (Das 1986, 1995, 2004). *Liparis tigerhillensis* AP Das & Chanda was collected from the northern slope of Tiger Hill in Darjiling is no more available and probably became extinct. So, the wide scale loss of habitat in Terai, Duars and Darjiling Hills is certainly exerting tremendous pressure on the survival of numerous weak/ new/ restricted distribution species.

1.12.6. Loss of Biodiversity: Survey of old literature on the flora and vegetation of the concerned area (Gamble 1896; Hooker 1872 - 1897; Cowan & Cowan 1929) shows that a good proportion of endemic species which were recorded growing in this area are not recorded during recent explorations. Samanta (1998) and Das (2004) presented a list of such angiospermic climbers and they also believe that proper search among the plants of other habit groups will also produce similar such lists. This is a dangerous situation as the habitat loss and fragmentation of habitat is increasing every day. Very soon, conservationists are afraid of even the protected areas will also loose their capability to conserve most of the species growing there today.

1.12.7. Attempts for Conservation: Realising the importance of the biodiversity in the Himalayas, IUCN has declared the Himalaya Hotspot and considered it one of the hotspots in danger (CI 2005). Even before that the hills of Darjiling part of the Himalayas was forming a part of the Indo-Burma Hotspot. So, there is a general realisation that the biodiversity in the region is under stress and something is to be done to protect it.

The realisation, specially after the Rio de Janeiro Earth Summit in 1992, has fermented into the idea of protecting existing less affected vegetations. This has led to the creation of four major protected areas within the boundary of Darjiling District itself. Two of these are National Parks and two are Wildlife Sanctuaries (Table 1.19).

Table 1.19: Protected areas in Darjiling [Bhujel 1996; Rai 2001].

Types of Protected Area	Protected Areas	Area in sq km	Altitude in m
National Parks	Neora Valley National Park	88	500 – 3150
	Singalila National Park	78.6	2624 – 3660
Wildlife Sanctuaries	Mahananda Wildlife Sanctuary	38.6	200 – 1000
	Senchal Wildlife Sanctuary	127.22	1800 - 2400

Apart from these, there are some Reserve Forests maintained by Forest Department, Government of West Bengal. But, considering the extent of diversity among the life forms, their endemicity and the threats they are facing, the present status of conservation in Darjiling is not yet satisfactory.

All the threatened species can not be saved when they are spotted in an *in situ* conservatory. Sometimes, *ex situ* conservatories are also required for saving a species and for increasing its population.

CHAPTER 2

Tea in India & World

2.1. Early History of Tea

Emperor Shen Nung is said to have introduce Tea to the world in 2737 BC. Ancient Chinese and Japanese legends refer to the beverage made from an infusion of dried tea leaves (Anonymous 1979). Lu Yu, writing in above AD 780 said that there were "a thousand and ten thousand teas". According to Tokeo (1992), the tea plant was brought from China to Japan by a Buddhist monk in the 12th Century and this led to the production of a steamed brick tea that was used only as a medicine or in upper class society affairs. By the 16th Century, Senno-Rikyuu had developed the art of tea ceremony. Tea got the status of pleasant drink only after it was introduced in Japan in the 17th Century. Reporting on the drink to the Venetian Geographer Ramusio in 1550, Haji Mohammed, the Arab traveller referred to the Chinese belief that "one or two cups of the decoction taken on an empty stomach remove fever, headache, stomach-ache, pain in the side or joints". According to Ukers (1935), the first authentic reference to tea is found in an ancient Chinese dictionary which was revised around the year AD 350 by KuoP'O, a celebrated Chinese scholar. Use of tea as beverage had began towards the close of the 6th Century. The first book exclusive on tea 'Cha' Ching or 'Tea Classic' was published around AD 780 by Lu Yu. The word tea comes from a Chinese ideogram pronounced "tay" in the Amoy dialect or 't'e' of the Chinese Fukien dialect. In Cantonese, tea is known as 'Ch'a'. In this form the name reached Japan, India, Russia, Iran and Middle East (Barua 1989). From 1689 onwards the England East India Company started importing tea from China (Weatherstone, 1992).

In Assam, tea was first discovered growing near Rangpur, now Sibsagar, by Major Robert Bruce and his brother C A Bruce around 1823. It was not until 1834 that Lord William Bentink the then Governor General of India, appointed the tea committee that affirmed the growing of bushes wild in the hills of Assam. It took 7 more years to dispatch the first invoice of Indian tea to London (Barbora 1994).

2.2. Cultivation of Tea

The tea cultivation started in China and even today, the largest area [1262310 ha] covered by this crop is in China. India followed China, though not very closely, with its 521403 ha of tea plantations. At least 33 countries covering almost all the continents are in the World Tea Map and the total area under Tea production is 2774797 hectares in 2004.

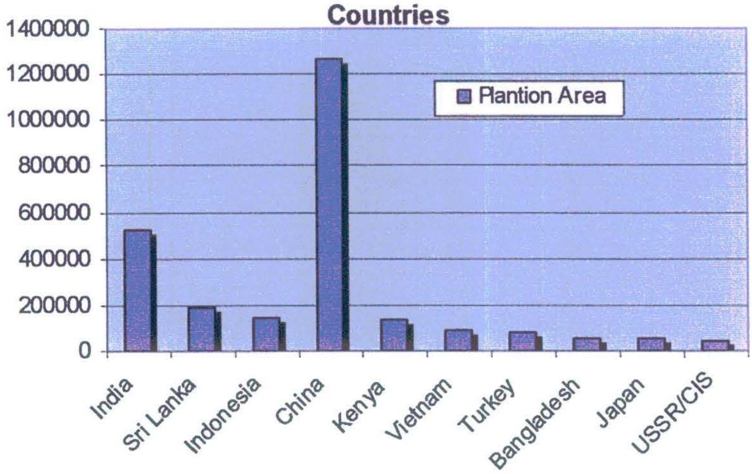
Table 2.1: Presented the land area used for planting Tea in different countries. [Area in Hectares]

Name of the Countries	1992	1993	1994	2001	2002	2003	2004*
India	420289	418363	425966	509806	515832	519598	521403
Sri Lanka	221836	221836	187310	188971	187971	188199	188720
Indonesia	138736	129231	128503	150938	150723	143620	142782
Bangladesh	47781	47888	47847	49313	49500	50000	50400
China	1084200	1170800	1134600	1140700	1134200	1207300	1262310
Taiwan	22177	23087	21218	18938	18329	18500	18600
Japan	56700	55700	54500	50100	49700	50000	50000
Vietnam	68000	70000	72000	82000	85000	87000	90000
Papua & New Guinea	4000	4000	4000	3800	3700	3700	3700
USSR/CIS	1600	1600	1600	40600	40500	41300	41800
Iran	31874	34650	34650	34664	34500	34500	34000
Turkey	89345	89330	76971	76653	76600	76639	77000
Kenya	101845	104864	110222	131581	139976	131419	131418
Uganda	20500	20500	20500	20870	21170	21570	21720
Tanzania	19415	19415	19881	21371	21316	21984	22287
Malawi	18587	18705	18801	18761	18800	18694	18663
Mozambique	2000	2000	2000	3200	3200	3200	3250
Zaire	9000	9000	9000	6000	6200	6200	6250
Mauritius	3133	3151	3028	659	680	681	674
Rwanda	12566	12566		12825	12862	12862	12849
Burundi	8363	8750	9065	8709	8625	8800	8900
Cameroon	1512	1531	1547	1500	1500	1550	1600
Argentina	41406	41406	40000	36000	36000	36000	36300
Brazil	6000	6000	6000	5000	5000	5000	5200
Peru	2000	2000	2000	2700	2700	2800	2800
Equador	890	930	920	950	950	950	960
Zimbabwe	6421	6455	6445	6800	6850	6850	6800
Myanmar	59	59	61	75	80	85	90

Malaysia	3039	3005	3091	3100	3100	3300	3500
South Africa	6164	6164	6130	7335	6597	6435	6401
Australia	784	706	634	800	800	850	850
Ethiopia				2350	2400	2400	2400
Nepal				1100	1100	1150	1170
GRAND TOTAL	**2450222**	**2533692**	**2448490**	**2638169**	**2646461**	**2713136**	**2774797**

- Provisional and subject to revision

Fig. 2.1: Plantion Area (in H) in different Countries



Though having largest area under plantation, in total Tea production, China is coming behind India with 870000 Thousand kg of Tea production in 2005. In the same year India has produced 927984 thousand kg of tea. And, the world Tea production in 2005 was 3376013 thousand kg of made Tea.

Table 2.2: Total Production of made Tea in different countries. [Quantity in Th .Kg]

Countries	**1992**	**1993**	**1994**	**2001**	**2002**	**2003**	**2004**	**2005 (E)**
India	732322	760826	752895	853923	838474	878129	892965	927984
Sri Lanka	178870	233276	243563	296301	310604	303254	308089	314778
Indonesia	144834	136587	128289	166868	162194	169819	164817	164191
Bangladesh	48935	50507	51655	56820	53624	58298	55627	58618
China	559827	599941	588468	701699	745374	768140	835231	870000
Taiwan	20685	20412	21886	19837	20345	21000	21000	21200
Japan	92103	92103	86303	90371	83677	91930	100262	100000

Vietnam	36200	37700	40000	80000	88000	93000	95000	109000
Papua & New Guinea	5950	6000	6500	6100	6200	6400	6500	6600
USSR/CIS	55000	30000	18000	15000	14300	14500	15650	16300
Iran	48000	50000	57768	59000	49500	58051	55000	45000
Turkey	156269	127715	134350	142900	142000	155000	165000	135000
Kenya	188072	211168	209422	294631	287102	293670	324609	328584
Uganda	9129	12289	13461	33255	33831	36475	35706	37734
Tanzania	18365	23249	23764	24745	27511	29482	30688	30362
Malawi	28136	39497	35140	36770	39185	41693	50090	37978
Mozambique	1500	2000	2000	3000	3000	3200	3100	3200
Zaire	3000	3000	3000	2600	2700	2800	3000	3000
Mauritius	5844	5930	5089	612	1382	1436	1482	1500
Rwanda	13643	9500	4136	17809	14948	15484	14191	14500
Burundi	5921	5523	6864	9011	6605	7380	7500	7000
Cameroon	3417	3903	3568	4200	4200	4300	4500	4600
Argentina	44000	46000	42000	59000	58000	60000	63000	73000
Brazil	9000	10000	8000	4427	4561	4800	4900	5000
Peru	3000	3000	2700	2600	2700	2700	2750	2800
Equador	1574	1489	1768	1600	1700	1800	1850	1900
Zimbabwe	7797	14091	13437	22382	22544	21973	18734	14884
Myanmar	50	54	52	65	70	75	80	18000
Malaysia	6499	5886	6091	5413	5060	4040	4500	2900
South Africa	9737	10805	11705	10734	11650	10932	5694	5500
Australia	525	789	1340	1300	1400	1500	1550	1600
Ethiopia				4600	4700	4800	4700	4900
Nepal				7700	7900	8000	8200	8400
GRAND TOTAL	**2438204**	**2553240**	**2523214**	**3035273**	**3055041**	**3174061**	**3305965**	**3376013**

* Provisional and subject to revision (E) Estimated & subject to revision

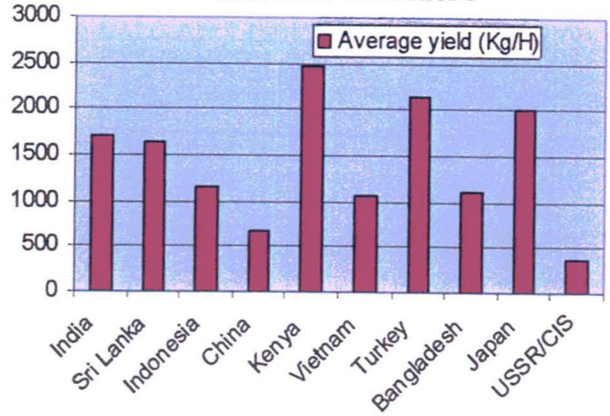
The efficiency of Tea bushes can not be same in all the countries or in all types of habitat where this species can be grown. This even varies greatly in different seasons and in different years. Table 2.3 presented the average yield [kg/ Hecare] of made tea in different countries. In 2004 the highest average yield was in Nepal [7009 kg/ Hectare] and the lowest yield was recorded in USSR/CIS [374 kg/ Hectare], followed by Zair [480 kg/ Hectare]. However, in higher yield, no other country is nearing Nepal. India has produced only 1713 kg made Tea per Hectare in 2004. In that year high tea yielding countries includes Cameroon [2813 kg/ Hectare], Zimbabwe [2755 kg/ Hectare], Malawi [2684 kg/ Hectare], Kenya [2470 kg/ Hectare], etc.

Table 2.3: Average Yield of Tea in different countries during last two decades [Yield in kg / Hectare].

Name of the Countries	1992	1993	1994	2001	2002	2003	2004*
India	1742	1819	1768	1675	1625	1690	1713
Sri Lanka	806	1052	1300	1568	1652	1611	1633
Indonesia	1044	1057	998	1106	1076	1182	1154
Bangladesh	1024	1055	1080	1152	1083	1166	1104
China	516	512	519	615	657	636	662
Taiwan	933	884	1031	1047	1110	1135	1129
Japan	1624	1654	1584	1804	1684	1839	2005
Vietnam	532	539	556	976	1035	1069	1056
Papua & New Guinea	1488	1500	1625	1605	1676	1730	1757
USSR/CIS	34375	18750	11250	369	353	351	374
Iran	1506	1443	1667	1702	1435	1683	1618
Turkey	1749	1430	1745	1864	1854	2022	2143
Kenya	1847	2014	1900	2239	2051	2235	2470
Uganda	445	599	657	1593	1598	1691	1644
Tanzania	946	1197	1195	1158	1291	1341	1377
Malawi	1514	2112	1869	1960	2084	2230	2684
Mozambique	750	1000	1000	938	938	1000	954
Zaire	333	333	333	433	435	452	480
Mauritius	1865	1882	1681	929	2032	2109	2199
Rwanda	1086	756	- -	1389	1162	1204	1104
Burundi	708	631	757	1035	766	839	843
Cameroon	2260	2549	2306	2800	2800	2774	2813
Argentina	1063	1111	1050	1639	1611	1667	1736
Brazil	1500	1667	1333	885	912	960	942
Peru	1500	1500	1350	963	1000	964	982
Equador	1769	1601	1922	1684	1789	1895	1927
Zimbabwe	1214	2183	2085	3291	3291	3208	2755
Myanmar	847	915	852	867	875	882	889
Malaysia	2139	1959	1971	1746	1632	1224	1286
South Africa	1580	1753	1909	1463	1766	1699	890
Australia	670	1118	2114	1625	1750	1765	1824
Ethiopia				1957	1958	2000	1958
Nepal				7000	7182	6957	7009
Other countries	995	1008	1031	1151	1154	1170	1191

* Provisional and subject to revision

Fig. 2.2: Average yield (Kg/H) in different Countries



May be, India is the highest Tea producing country, but in recent years they are loosing their grip from the world Tea-market. In 2005 the small African country Kenya exported highest amount of 3,49,738 thousand kilogram made tea. It is followed by 2,86,341 thousand kilogram by China, 2,28,766 thousand kilogram by Sri Lanka and 1,91,850 thousand kilogram by India [Table 2.4].

Fig. 2.3: Production and Export of made Tea in different Countries

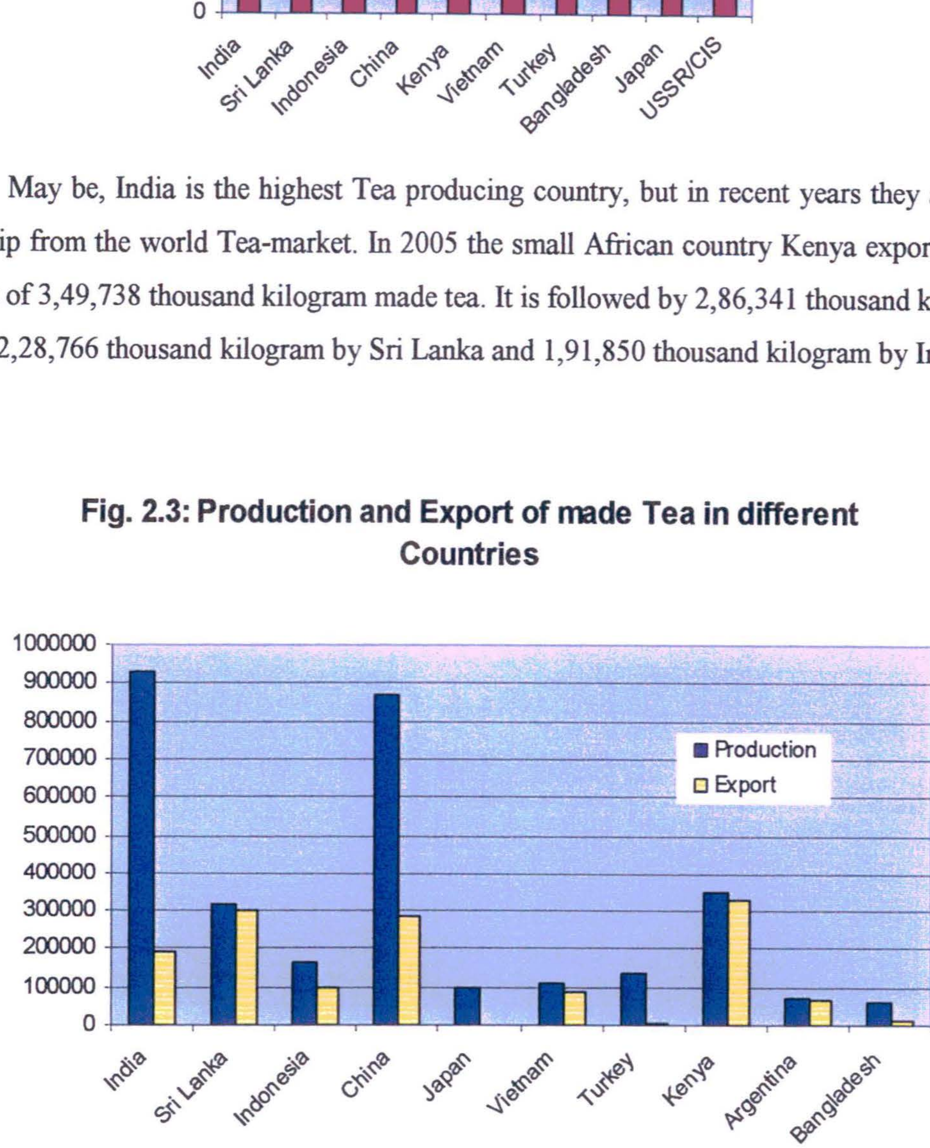


Table 2.4: Export of made Tea by different Tea-producing countries [in Th. kg].

Countries	1992	1993	1994	2001	2002	2003	2004*	2005(E)
India	174962	175318	150691	182588	201002	173684	197668	191850
Sri Lanka	177801	209942	224235	287503	285985	290567	290604	298766
Indonesia	121243	123926	84916	99721	100185	88175	98572	101000

Bangladesh	27160	31914	23640	12925	13653	12173	13435	9000
China	175526	201435	179679	249678	252273	259980	280193	286341
Taiwan	5296	5142	4373	2451	2592	2713	2388	2500
Japan	290	328	345	760	806	845	923	1096
Malaysia	286	272	378	400	440	450	500	300
Vietnam	12967	18000	20000	68217	74812	59900	70000	88000
Nepal ^	22	25	30	70	2090	2800	3100	3300
Iran	1000	1700	1038	4000	8457	7014	8000	6500
Turkey	5048	39611	5199	4809	5160	7042	5904	7000
Kenya	166518	188390	183147	258118	272459	269268	333802	349738
Uganda	7817	10251	10971	30427	31073	34069	29686	30062
Tanzania	17835	19387	18570	22060	22563	20416	24170	23253
Malawi	35363	35270	38672	38261	39386	42015	46599	42978
Mozambique	800	300	500	700	750	800	900	900
Congo/ Zaire	1500	2353	1501	2000	2100	2200	2200	2250
Ethiopia			0	1000	1100	1200	1200	1300
Mauritius	5461	4398	4036	41	39	41	42	40
Rwanda	13034	7200	4500	11000	11200	11500	13000	13500
Burundi	5651	5760	6009	8709	6510	6926	7000	6500
Zimbabwe	6089	8065	9688	17154	17634	17056	14912	8451
South Africa				6632	7400	7168	3500	3300
Georgia / CIS				8000	7000	7000	7300	7400
Argentina	36529	43549	43230	56645	57107	58191	66374	66389
Brazil	8211	8335	8377	4082	3979	4209	3593	3700
Peru	248	388	205	100	100	100	100	100
Ecuador	1458	1512	1470	1300	1185	1094	1036	1050
Cameroon	2479	5780	3176	4200	4300	4400	4500	4600
Papua & New Guinea	5648	6441	6300	6100	5500	5600	6500	6000
Other countries	800	1000	1500	2000	2000	2200	2300	2300
GRAND TOTAL	**1017042**	**1155992**	**1036376**	**1391651**	**1440840**	**1400796**	**1540001**	**1569464**

* Provisional and subject to revision (E) Estimated & subject to revision

Source: Apart from India figures from "Annual Bulletin of Statistics 2005, ITC London"

2.3. History of Indian Tea

Early 19th century saw the discovery of Tea in India and hence the birth of the tea industry in Indian subcontinent.

The Singpo tribal people in Assam prepare a drink from a wild bush that was later recognized as Tea plant. Tea in those days was brewed by the Burmese method that involved pickling of leaves. Robert Bruce, a Scot who was commissioned in the Rangpur district of Assam by the British army came across this popular drink. Events took a turn when the Burmese war broke out and Robert Bruce died suddenly. His brother Charles Bruce managed to get some seeds of these Tea plants from the Singpo chief. He sowed them at his home garden in Sadiya. Samples of this Tea plant were sent to the Botanical Garden at Kolkata that was then identified as a member of the same family as the tea plants of China. By that time, Chinese tea was a popular beverage in Europe. Since long experiments were on in India with seeds from Chinese tea plants and they were not successful in Assam or other parts of North East India. So, this newly discovered Assam plant was used for Tea cultivation in entire North East India. These seeds were subsequently grown successfully in Darjiling area too.

In 1834, a committee was appointed by Lord Bentinck, the then Governor General of India with an intention to introduce tea culture in India. Based on the reports of this committee, the British government sent a scientific commission to Assam to study more on indigenous tea plant and also to find out the most suitable place for growing it.

Organised research in Tea commenced with the appointment of M Kelway Bamber, Chemist, by a Joint Committee of the ITA and the Agriculture and Horticultural Society of Bengal in 1891. In 1893, Dr George Watt, an Entomologist with the Govt. of India took over the investigation. Dr Harold H Mann was appointed as the scientific Officer in 1900. Under his supervision, a tea research centre was established in 1904 at Heeleakah Tea Estate, 20 km away from Jorhat , Assam. Tocklai Experimental Station was established in 1911. Tea Research Association, constituted in 1964, took over the management of Tocklai and its outstations.

The first sample of manufactured tea in Assam was ready in 1837. The next year, the first shipment of 8 chests of Indian tea was sent to England. When Sibsagar and Lakhimpur districts came under the British administration in 1839, it paved way for private entrepreneurs to get into the tea business. They approached the British government both in London and Kolkata for transfer of plantation to them. In fact, the first attempt to compete with the British was made by Maniram Dewan. The world's first tea company was formed in 1839 with Dwarakanath Tagore, grandfather of Nobel Laureate Rabindranath Tagore as one of its directors.

Companies formed in Kolkata and London in 1839 were brought under a common umbrella called the Assam Company. The Jorhat tea company was incorporated in June 29, 1859, which had its garden in Assam. In the early 1860, Rameswar Barua started 6 gardens in Sibsagar district of Assam, which he subsequently sold off to the British during the economic recession in 1866.

By 1856, tea plantations had started in Darjiling and Cachar, along with gardens in Terai in 1862 and in the Dooars in 1874. However before 1857, cultivation of tea was also started at the foot of Western Himalayas in Dehra Dun and Kangra.

Tea plant was also reported growing in Nilgiri Hills in South India. This plant was found similar to the ones growing in Assam. However, tea was made to grow on a commercial scale only in 1854. The tea plant was found in Wynard and Travancore areas too. Statistics have shown that in 1893 the area under tea was estimated around 1200 hectares in Nilgiris, 100 hectares in Wynaad, 130 hecatres in high range Kerala and 2000 hectares in the rest of Travancore.

Today, India has 39,700 tea estates (32,000 in the south and 6,700 in north) and a tea-producing workforce of more than a million people. Little did the Singpo tribals know that the plant that was wildly growing in Assam would play a major role in the economy of India today with India being the largest producer of tea globally.

Table 2.5: Estimation of Made Tea production in India during and upto December 2005 [in Thousand kg)

Districts / States	During December		Up to December		Increase (+) or Decrease (-) in 2005 over 2004	
	2005	2004	2005	2004	During December	Up to December
Assam Valley	9,237	9,815	424,607	392,260	(-) 578	32347
Cachhar	6,208	5,753	49,530	43,389	455	6141
Total Assam	15,445	15,568	474,137	435,649	(-) 123	38488
Darjiling	230	251	11,366	10,065	(-) 21	1301
Dooars	10,525	10,613	133,054	135,237	(-) 88	(-) 2183
Terai	4,888	5,067	70,240	69,239	(-) 179	1001
Total: West Bengal	15,643	15,931	214,660	214,541	(-) 288	119
Others	594	602	12,178	11,994	(-) 8	184
Total North	31,682	32,101	700,975	662,184	(-) 419	38,791

India						
Tamil Nadu	11,734	14,502	154,598	163,015	(-) 2768	(-) 8417
Kerala	4,969	5,201	67,033	62,146	(-) 232	4887
Karnataka	349	370	5,378	5,620	(-) 21	(-) 242
Total South India	17,052	20,073	227,009	230,781	(-) 3021	(-) 3772
ALL INDIA	**48,734**	**52,174**	**927,984**	**892,965**	**(-) 3440**	**35,019**

Fig. 2.4: Made Tea Production in India

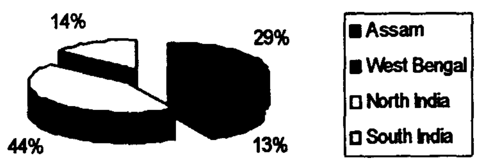
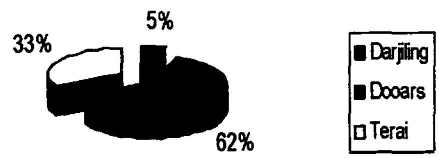


Fig. 2.5: Made Tea Production in West Bengal



2.4. Tea in Darjiling

It has been mentioned in the Imperial Gazetteer of India (1908, P172) that the introduction of Tea "*into Darjiling is due to Captain James, who persuaded Government to obtain seed from China, which he distributed among residents of the district to experiment with*". A very important event was the posting of Dr. A. Campbell as Superintendent of Darjiling in 1838 who was pleading with the Government all along for the establishment of Tea plantation either directly by the Government or by the native residents in Darjiling region. Tea seeds were first sowed in 1835 in an experimental nursery at Lebong. Dr. Campbell pioneered the experimental Tea Garden in the hills in early 1839 around his bungalow which is now known as Beechwood, 2134 meters above mean sea level. The first experimental trial at Darjiling was made in 1841 with a few seeds grown in the Kumaon plantations from China stock and it was quite successful. When W. B. Jackson came on tour to Darjiling in 1854 noticed one Tea plantation but in 1876 Hunter reported the existence of two or three gardens in 1853 in Darjiling. But he had not mentioned their names and location. However, the real date of commencement of the tea industry may be taken at 1856 – 57. The Tea gardens viz. Alubari, Pandam and Steinthal opened in 1856 in Darjiling district (Imperial Gazetter, 1908, P172). Mr. Stolke planted at Steinthal while Barnes brothers planted at Mineral Springs, Bannockburn, and Soom. Captain Samler was the first planter of Darjiling who in 1856 started the Alubari tea garden under the management of Kurseong and Darjiling Tea Company. The largest tea concerned in the district was Darjiling Company Limited which owned four gardens viz. Ambootia, Ging, Tukda and Phoobshering established between 1860 and 1864. The head office of the said company was in London. Its local management was vested in the hands of the Superintendent with five European assistants. In spite of monthly wage as high as Rs. 5 for men, 3 for women and Rs 2 for children were paid there was a shortage of workers. These people were encouraged to settle down in the company's garden permanently by assigning on them small plots of land for cultivation of cereal crops such as maize, millet etc. The entire labour force in the gardens was 'Gorkhas'. Dr. Brougham started Dootoriah garden in 1859. Lebong Tea Company opened Tukvar and Badamtam tea gardens before 1864. Singell and Makaibari tea estates were also opened in this period. Singell tea estate was planted by Mr. James White who later turned his attention to the plains and started first garden at Chamta near Sukna in 1862. The tea industry in Darjiling district during the four years following 1870 continued to develop at an even greater pace than before, and by 1874, the number of tea gardens had increased from 56 to 113. In 1874, there were 129 Europeans employed as managers or assistant managers of tea gardens in Darjiling, and there were 1373 natives in posts of trust or authority employed under the Europeans. In 1891, there were 177 tea gardens but thereafter the number decreased. The reason may be the Tea Estates after 1891 were more organized under big limited concerns so that total area under tea although increased, the number of gardens decreased. However, the growth was by no means a smooth sailing. There were many difficulties like communication bottlenecks, administrative problems, shortage of provisions and manpower. After independence, the British planters who owned about 90 % of the estates in Darjiling hills started selling their holdings to local entrepreneurs and by the mid - 1950 a large number of estates had changed hands. There are around seventy Tea Estates functioning at present in Darjiling hills on a total area of 19,000 hectares. The total production ranges from 10 to 11 million kg annually. The tea industry in Darjiling employs over 52 thousand people permanently while a further 15,000 persons are engaged mainly during the plucking season which lasts from March to November. In the work force, more than 60 percent are women and the employment is mostly done on a family basis. Apart from tourism, tea is the biggest industrial activity offering the largest employment in the hills.

The history of tea cultivation in Terai is originally associated with the plantation of tea in Darjeeling District by Dr Campbell in 1839. From Darjeeling hills, tea cultivation spread to Terai in 1862 (Anonymous, 1982). In 1874 the first garden in Dooars came up.

CHAPTER 3

Weeds of Cultivation

'Weed' is a very common and popular word in the English language, generally meant for unwanted plants on a crop-field, but is used with a much variable cases to indicate 'unwanted', 'weak', 'unrelated disturbing element' etc. In linguistics even man in some profession are sometimes referred to as weeds. However, in plant science, particularly in its applied branch Agriculture, the word refers to a large array of unwanted plants growing in the fields of cultivation.

3.1 What is a Weed?

Weeds are unwanted and unappreciated plants growing within the cultivation of a particular crop plant. Even if a paddy plant grows in the wheat field – that will be regarded as a weed. So, any other plant, if not grown purposefully, interfering with the growth and yield of a cultivated crop-plant, whether useful or useless, are treated as weeds. And, for the improvement of the cultivation of any crop it is essential to remove weedy plants from the land under cultivation.

They grow in the fields where they generate formidable competition with the cultivated plants for nutrients, space, air, light, moisture particularly during drought and thus reduce crop yields. Weeds harbour insects and diseases for which they serve as alternate hosts. These apart they restrict the normal development of crop plants due to growth of creepers and thorny weeds.

However, the word 'weed' is also referred to numerous other plants, growing any where and is disturbing our normal activities, including our health. *Parthenium hysterophorus*, an exotic but widely naturalised herb, growing abundantly almost everywhere, is much hazardous to our health and is one of the commonest 'exotic weeds' in the warmer parts of this country.

Ill effects of weeds are greatest in agriculture as they form an important factor in the management of land and water resources for crop production. The losses caused by weeds exceed the total loss from any other type of agricultural pests like insects, nematodes, diseases, rodents etc. (Subramanian *et al* 2005). Of the total annual loss of agricultural produce from various pests in India, weeds account for 45%, insects 30%, diseases 20% and other pests 5%. In hybrid maize, in the early stages of crop growth the weeds remove nine times more of Nitrogen, ten times more of Phosphorus and seven times more of Potassium (Rajan & Sankaran 1974).

3.2. Sources of Weeds

Weeds are neither strangers nor a special group of plants, which grow only in cultivated fields. In fact, most of these plants are coming from the local vegetation growing naturally around the agricultural land (Ghosh *et al* 2004; Subramanian *et al* 2005). The environment in a crop field is not at all hospitable for the growth of other plants. But, weedy plants can survive there due to their wide adaptive features and broad ecological amplitude. Their efficiency for very high rate reproduction, tolerance to extreme disturbances, quick dispersal methods, variable periods of dormancy in seeds, etc. made them successful in competing with the cultivated plant in the field. Climate in major parts of India encourage the growth of therophytic plants. And, most of the weeds are therophytes and early reproducers.

3.3. Concern for Weeds

Weeds cause loss of crop production. As early as in 1938, Luthra calculated the loss upto the 30% of expectation in Punjab. But, sometimes it increased to the extent of nearly 90% of expectation (Tiwari 1953-'54; Thakur 1954). These plants create or modify the habitat in such a manner which does not favour the proper growth of crop plants by utilising space and nutrients for their own growth. Like all other crop fields, Tea Gardens are also greatly affected by weeds and causing qualitative and quantitative loss of crop (Mustafee 1981, 1998; Ghosh *et al* 2004).

From this type of observation different workers realised the importance of studying ecology of weeds [Pammel & King 1910; King 1966; Datta & Banerjee 1976; Datta & Chakraborty 1983]. Ghosh *et al* (2004) listed the harmful effects of weeds in the following manner:

1. In young tea, weeds remove as high as 270 kg Nitrogen per ha.
2. Some species of weeds serve as hosts for pests (Red spider, Tea mosquito bug, Root knot nematode, etc.)
3. Eden (1961) reported 9 % crop loss due to soft weed competition in tea in Sri Lanka
4. Cramer (1967) estimated (14-15 %) crop loss in tea world wide due to weeds

5. 6 – 12 % crop loss due to competition by weeds in South India [Venkatramouni 1964]
7. Weeds compete with crop not only for nutrients but also for moisture and light
8. Some weeds grow on tea bushes absorb nutrients and fuse with the tissue of tea plants
9. Epiphytic ferns and orchids also affect tea plants due to their luxuriant growth
10. Some weeds, specially climbers, grow over the tea bushes and reduce the speed of plucking
11. The foetid smell of some weeds can also reduce the quality of tea; etc.

Realising the problem numerous workers, round the globe, given much thought over the effective control of weeds in different crops (Takur 1954). Weed control in tea is also studied by many workers including Sharma (1977), Sharma & Satyanarayana (1978), Rahaman (1975), Mustafee (1988, 1994, 1998) and others.

3.4. Need for Surveying Weed Flora

Realising the problem many authors, in different times, tried to explore the weed flora in different crops [Salisbury 1942; Chakraborty 1957; Datta & Maity 1964; Tripathy 1964; Mahapatra *et al* 1965; Baker 1972; Sharma 1978, 1981, 1983; Neogy & Rao 1980; Datta & Chakraborty 1983; Hore *et al* 1985; Acharyya *et al* 1997; Bandopadhay 1972]. Tea gardens are also much infested in weeds specially in Northeast India (Mustafee 1972, 1988). Late Prof. A.C. Datta (of Cotton College, Gowhati) established one rich and beautiful 'Tea-Weed Herbarium' at the Tocklai Tea Research Centre at Jorhat, Assam. (Dutta 1983)

Not only in this Eastern and Northeastern part of the country, similar works have been done also in the Nilgiries. In all these areas existences of a rich flora inside the plantations (Harikrishnan 1978; Ramachandran 1978; Haridas & Sharma 1972; Haridas & Venkataramani 1972; Rahman 1975) have been recoded.

There is much difference between the floras of Assam or other states of Northeast India and Darjiling (including Terai) and, it is expected that the weed flora also will be quite different as weedy plants come mostly from the local floras and enters the crop field through different channels. So, it should be the first duty to explore the weed flora of these tea gardens to prepare a proper management plan.

Weeds are neither strangers nor a special group of plants, which grow only in cultivated fields. In fact, most of these plants are coming from the local vegetation. But, they can survive in the tea gardens due to their adaptive features and broad ecological amplitude. Most of the weeds are suppose to be high reproducers i.e. with high reproductive potential.

A sound knowledge in the weed flora for different crops in a region is extremely important basically for weed management. The strategies for weed management should be crop friendly in one hand but should be effective against weeds. And, not only is the flora, proper knowledge on the phenology, methods of dispersal, mechanism of pollination for different weed species also extremely important for this purpose.

3.5. Usefulness of Weeds

Weeds of agriculture are no doubt harmful. But, many of these are also having some beneficial effects or aspects [Fukai 1940; Fox 1942; Ghosh *et al* 2004]:

1. Weeds minimise the force of falling raindrops
2. Check soil erosion on sloping land mainly in hilly terrains
3. Many weeds have medicinal importance
4. Some of the weeds used as food and fodder
5. Weeds add good amount of humus into the soil
6. Weeds retain the actual soil structure or even improve the situation
7. Some weeds fix atmospheric nitrogen in soil
8. Weeds help to maintain a balanced structure of ecosystem
9. Some weeds provide food and shelter for numerous local animals; etc.

So, weeds are not useless plants. They are useful not only for the proper maintenance of ecosystem but also for the human society.

CHAPTER 4

The Study Area

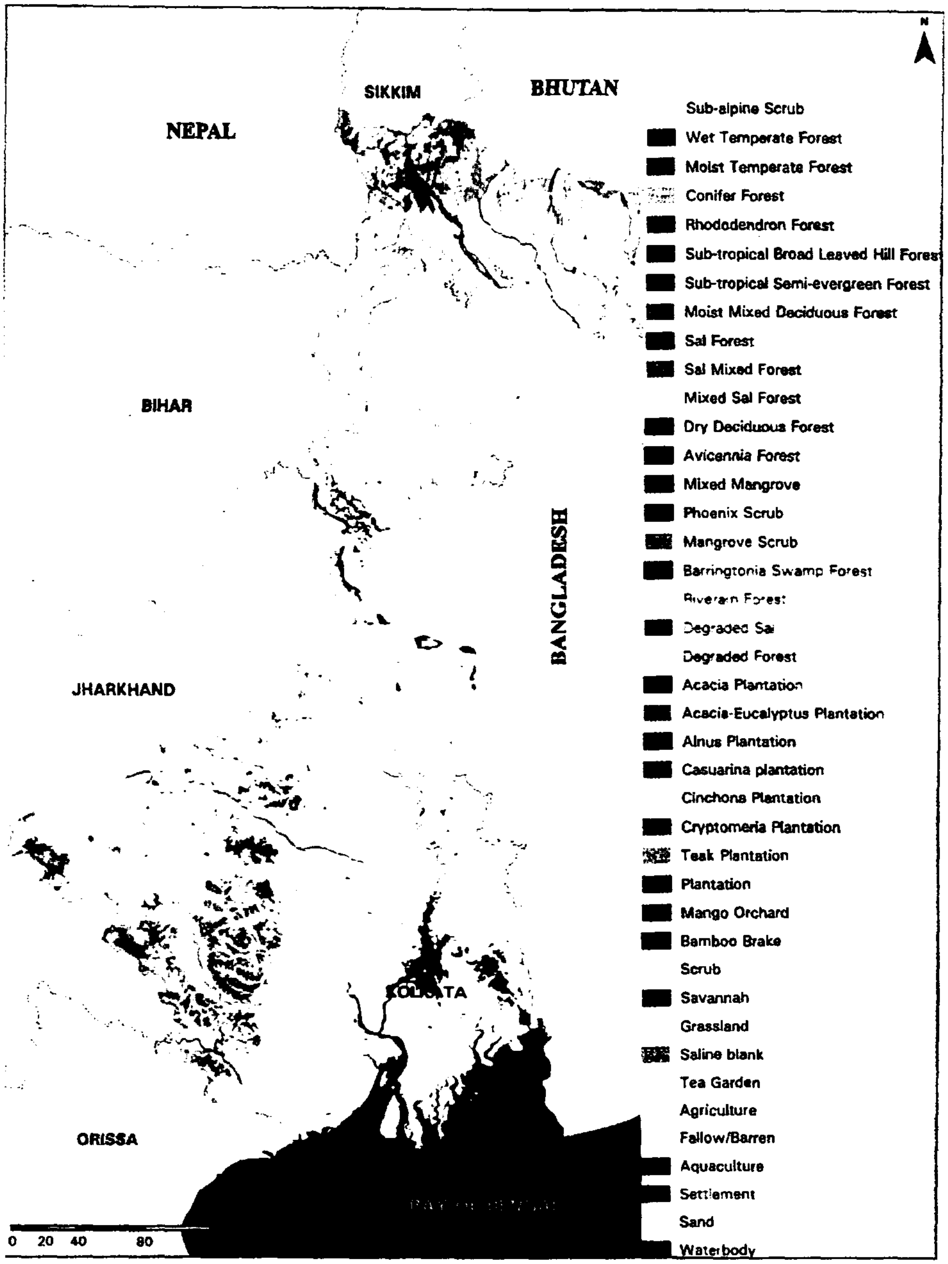
4.1 Introduction

The present dissertation is based on the studies on weeds of Tea Gardens in Terai and on the Hills of Darjiling. This entire region is located within 26° 31′ 05″ and 27° 13′ 10″N latitude and between 87° 59′ 30″ and 88° 53′ E longitude and is covering an altitudinal range of c. 132 m (at Siliguri) to 3660 m (at Phalut). Before the establishment of Tea Gardens, the entire area was covered with forests (Bhujel 1996). So, today's Tea Gardens have replaced the region's basic floristically rich vegetation (Fig. 4.1). In fact, entire Terai, Duars and upto 2100 m altitude of Darjiling Hills are supporting a very large number of Tea Gardens. While the gardens on hills generally cultivate China variety plants [*Camellia sinensis* var. *sinensis*], the gardens in Terai and Duars grow Assam variety [*Camellia sinensis* var. *assamica*] plants.

Chinese variety plants prefer cooler climate and produce best quality of tea. These plants are comparatively smaller and generally form lower and smaller bushes. On the other hand, Assam variety plants are stouter, stronger and fast growing and produce much higher amount of tea.

The structures of plantations of these two varieties of plants are visually different. That is mainly due to the landscape structure. However, for a trained eye the difference is quite widely recognizable. Chinese variety plants are grown in close space and are generally not in strait lines. There is no need of a well defined drainage system inside the plantations as the excess water will easily move downward following the hill slopes.

4.1. Map of West Bengal showing vegetation types.



Vegetation/Land Cover in West Bengal

On the other hand, Assam variety plants are grown in the plains. Here, saplings are planted more spaced and in definite rows. At the same time, development of proper drainage system within the plantations is a must.

4.2 Selection of Area

Basically, the work was designed to do within the boundary of the District of Darjiling. Tea Gardens of Duars are rarely located within this district [Fig. 4.2]. So, during the selection of

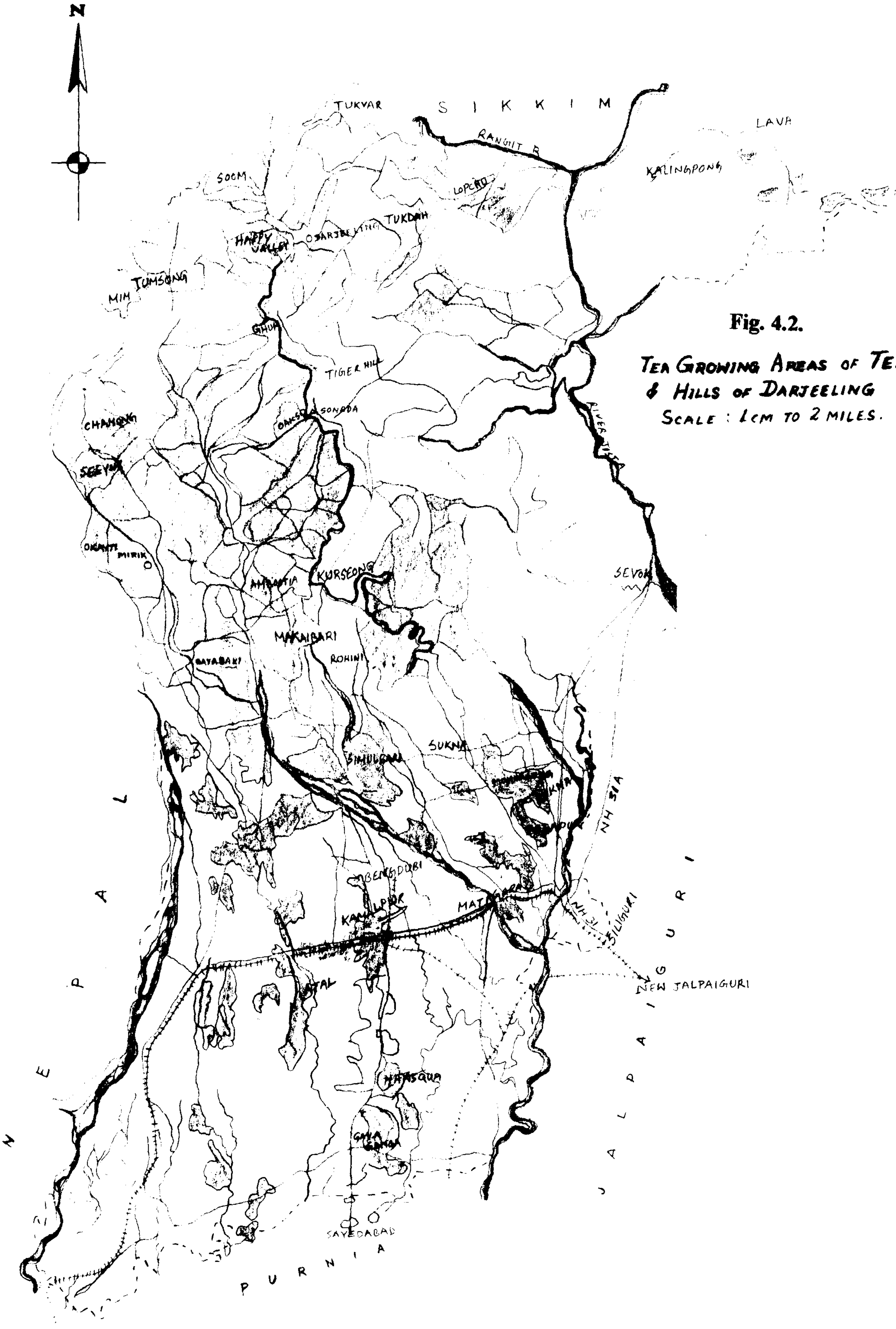


Fig. 4.2.

Tea Growing Areas of Terai & Hills of Darjeeling

Scale : 1cm to 2 miles.

Gardens Tea Gardens from Duars were not considered. Accordingly, all the selected Tea Gardens are located within the District of Darjiling and are either in Terai or on the hills. And, we know, there are at least 102 Tea Estates located within this district. This entire range, plains of Terai to the highest altitude where Tea is under cultivation in Darjiling, the habitat is suitable for the growth of weeds and, in fact, the back ground natural vegetation in the entire area is floristically very rich. The difference is that, due to the prevalence of tropical climate in Terai, the weeds species are supposed to be warm-weather plants and in hills the may be subtropical and/or temperate weather loving plants. And, in the transition zone, the weed flora is expected to change gradually, along with the increase of altitude, from a purely tropical to a purely temperate type.

4.3 Gardens from Terai

From Terai FOUR Tea Gardens has been selected for the study. Those are:

1. **Mohurgong & Gulma Tea Estate:** The average altitude of the Tea Estate is ±154 m amsl and the central location of the garden is 26° 47.203' N Latitude & 88° 22.866' E Longitude. The place is very near to Sukna where from the outermost hills of the Darjiling Himalaya starts rising and the topography of the garden is quite undulating. The area of the garden is 1120.08 Ha. [Fig. . 4.3].
2. **Hansqua Tea Estate:** The average altitude of the Tea Estate is ±125 m amsl and the central location of the garden is 26° 37.784' N Latitude & 88° 19.068' E Longitude. Out of the four selected gardens this is located furthest from the Hills and the topography is nearly flat and gradually sloping towards the south. The area of the garden is 604.92 Ha. [Fig. 4.4].

3. **Kamalpur Tea Estate:** The average altitude of the Tea Estate is ±154 m amsl and the central location of the garden is 26° 42.341' N Latitude & 88° 18.428' E Longitude. This garden is also located completely on the plains and is slowly sloping towards the south. The area of the garden is 92 Ha. [Fig. 4.5].

4. **Matigara Tea Estate:** The average altitude of the Tea Estate is ±130 m amsl and the central location of the garden is 26° 42' 500" N Latitude & 88° 22' 142" E Longitude. This garden is only about 10 km away from the foot of the hills and is located completely on the plains and is slowly sloping towards the south. This is the nearest Tea

Garden of the University and, in fact, a part of the garden is situated within the University campus. The area of the garden is 215.16 Ha. [Fig. 4.6].

The environment, topography and soil structure of these gardens are nearly similar. And all four of these gardens are planted with Assam variety of Tea. But, the **Mohurgong & Gulma Tea Estate** is expected to have good influence of hills on its weed-vegetation.

4.4 Gardens from Hills

From the hill part of Darjiling THREE Tea Gardens has been selected for the study. Those are:

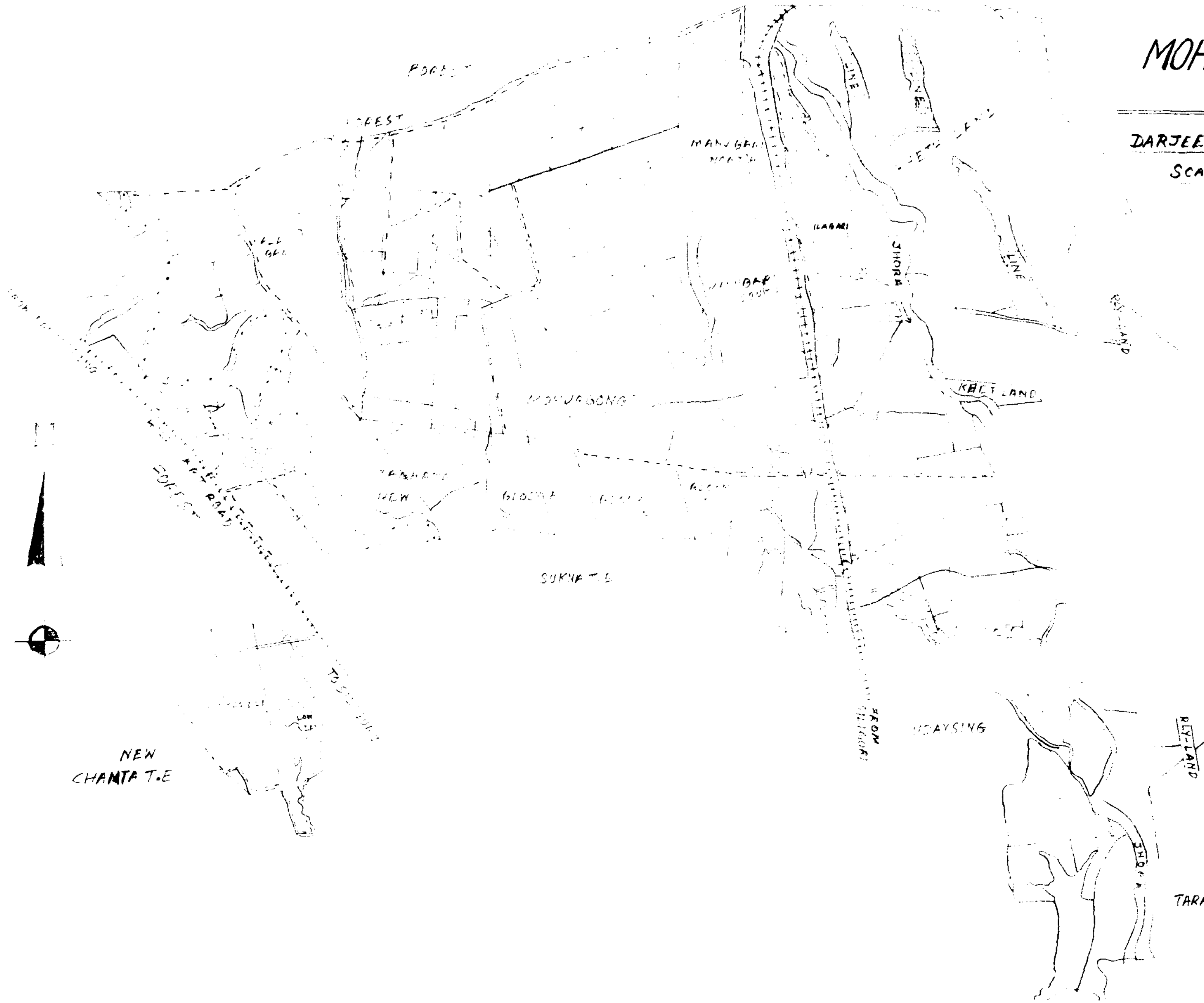
1. **Makaibari Tea Estate:** The average altitude of the Tea Estate is ± 1100 m amsl and the central location of the garden is 26° 62' 59" N Latitude & 88° 16' 43" E Longitude. The place is little below the township of Kurseong, and on the Kurseong – Pankhabari Road. The hills are quite stiff at most of the places and face the plain-land of the country. The entire garden is situated on hills and the prevailing climate is of subtemperate type. The area of the garden is 570.21 Ha. [Fig. 4.7].

2. **Soom Tea Estate:** The average altitude of the Tea Estate is ±1200 m amsl and the central location of the garden is 27^{0} 04·590$'$ N Latitude & 88^{0} 13·723$'$ E Longitude. The place is well inside the hill-system on the southern bank of the river Rangit. The region is much cool and the prevailing climate is ranging between subtropical and temperate. The hills are moderately stiff and at places the slope is quite gentle. The area of the garden is 507 Ha. [Fig. 4.8].

3. **Tamsong Tea Estate:** The average altitude of the Tea Estate is ±1300 m amsl and the central location of the garden is 27^{0}02.318$'$ N Latitude & 088^{0}09.992$'$ E Longitude. The place is well inside the temperate hills and the lowest altitude is around 1000 m. The upper reaches of the garden little above 1500 m. The prevailing environment is temperate with a chilling winter. The slope is generally moderate. The area of the garden is 280 Ha.[Fig. 4.9].

4.5 Climate of Study Area

Though many Tea Gardens regularly collect and maintain the records of climatic data but all the selected gardens are not doing so. It is also true that, specially in the hills, the climatic condition



MOHURGONG & GULMA T.E.

DARJEELING, WEST BENGAL.

SCALE 4" INCHES TO 1 MILE

Fig. 4.3.

HANSQUA TEA GARDEN

P.O. Bagdogra, Dist. Darjeeling

Scale:- 4" = 1 Mile

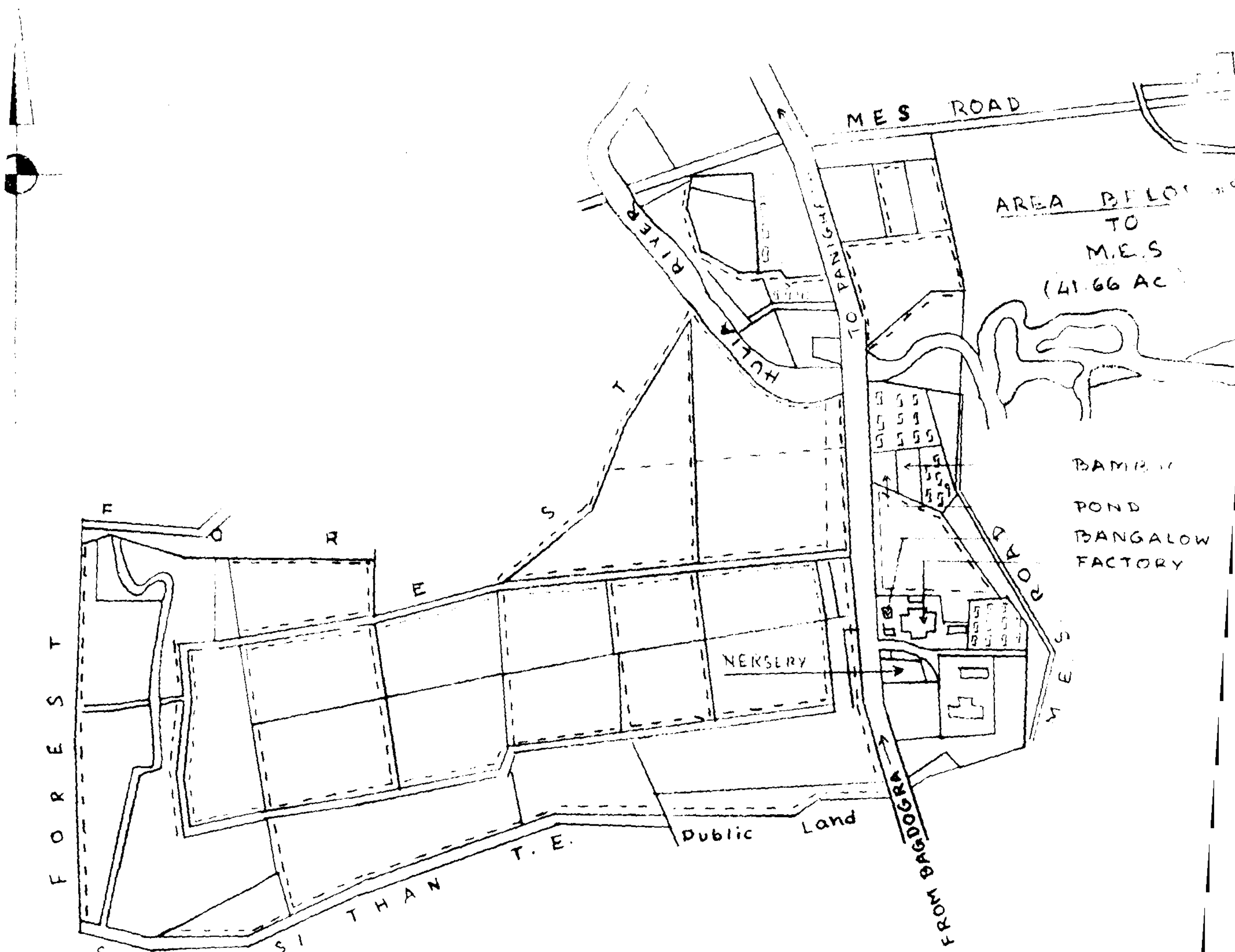
Fig. 4.4.

KAMALPUR TEA ESTATE

P.O Baydogra, Dist Darjeeling

(Scale:-8"= 1 Mile)

Fig. 4.5.



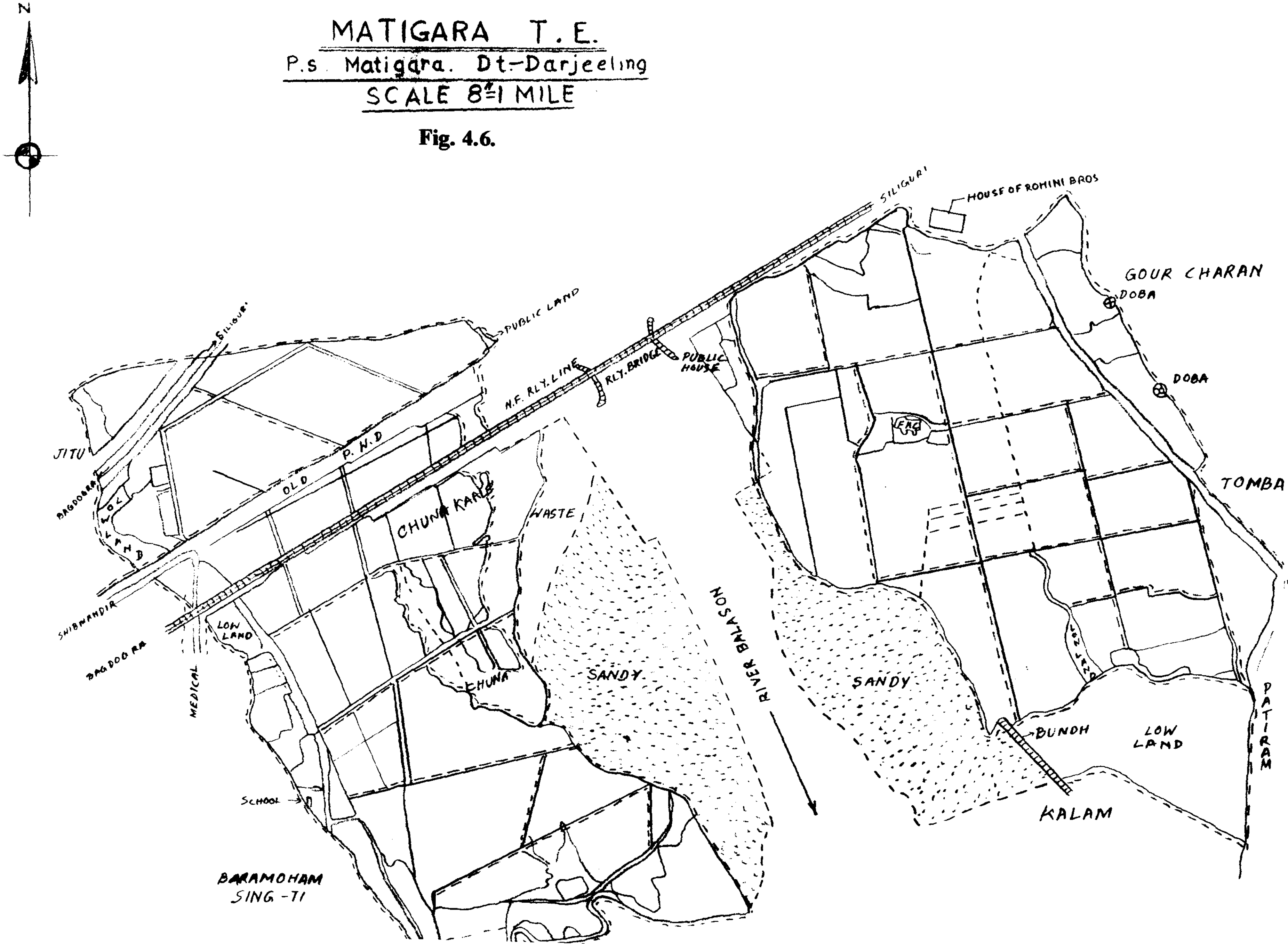

N
MATIGARA T. E.
P.s Matigara. Dt-Darjeeling
SCALE 8"=1 MILE
SILIGURI
HOUSE OF ROMINI BROS
GOUR CHARAN
DOBA
DOBA
TOMBA
PUBLIC LAND
SILIGURI
N.F. RLY. LINE
RLY. BRIDGE
PUBLIC HOUSE
FAC
JITU
BAGDOGRA
OLD P.W.D
CHUNA KARL
WASTE
SHIBMANDIR
BAGDOGRA
LOW LAND
MEDICAL
SANDY
RIVER BALASON
SANDY
CHUNA
BUNDH
LOW LAND
PATIRAM
SCHOOL
KALAM
BARAMOHAM
SING -TI

Fig. 4.6.

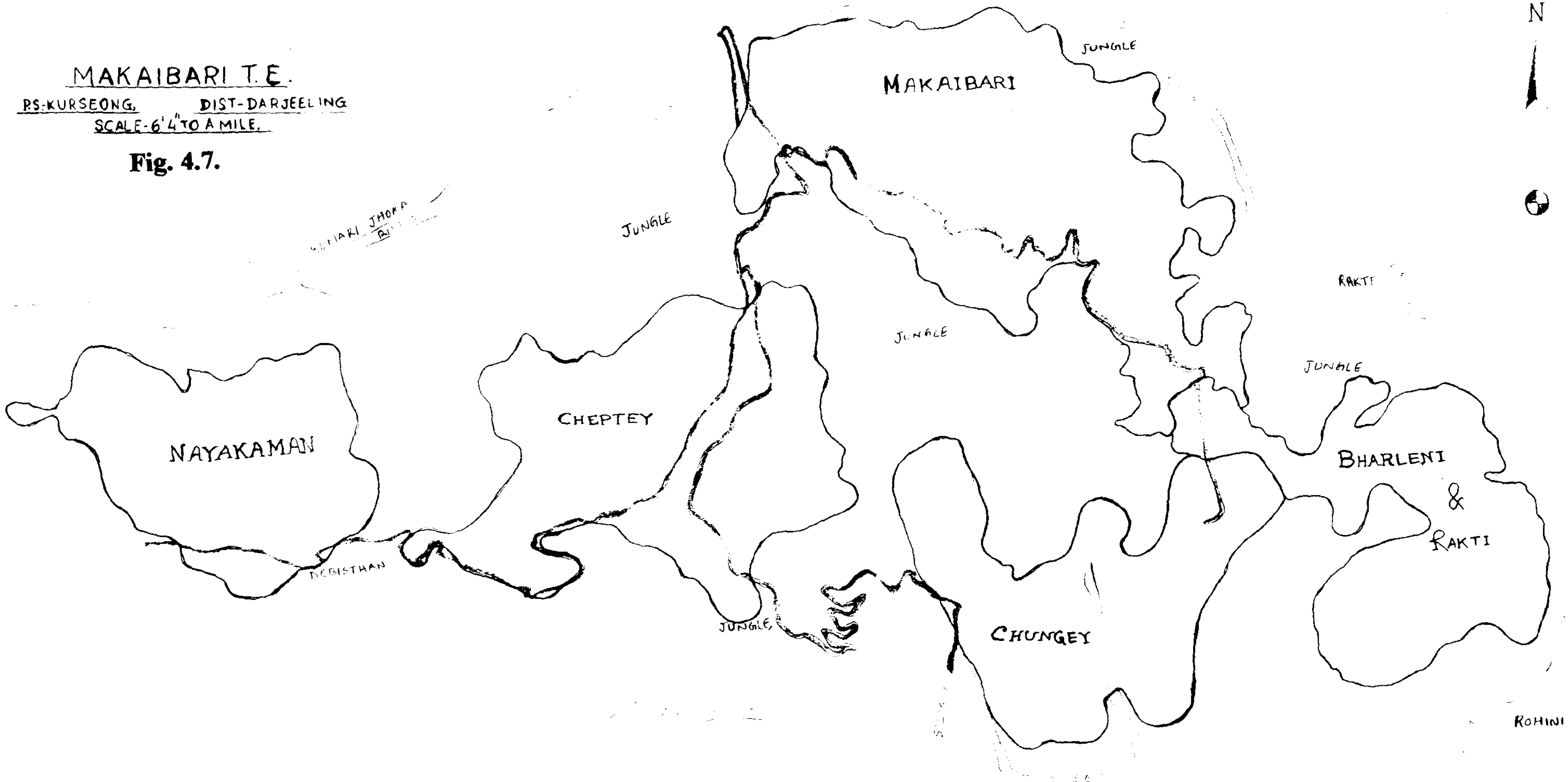

MAKAIBARI T.E.
P.S-KURSEONG, DIST-DARJEELING
SCALE-6'4" TO A MILE.
N
MAKAIBARI
JUNGLE
JUNGLE
RAKTI
JUNGLE
JUNGLE
NAYAKAMAN
CHEPTEY
BHARLENI
&
RAKTI
JUNGLE
CHUNGEY
ROHINI

Fig. 4.7.

SOOM TEA ESTATE

P.S. DARJEELING DT. DARJEELING

SCALE-8"=1 MILE

Fig. 4.8.

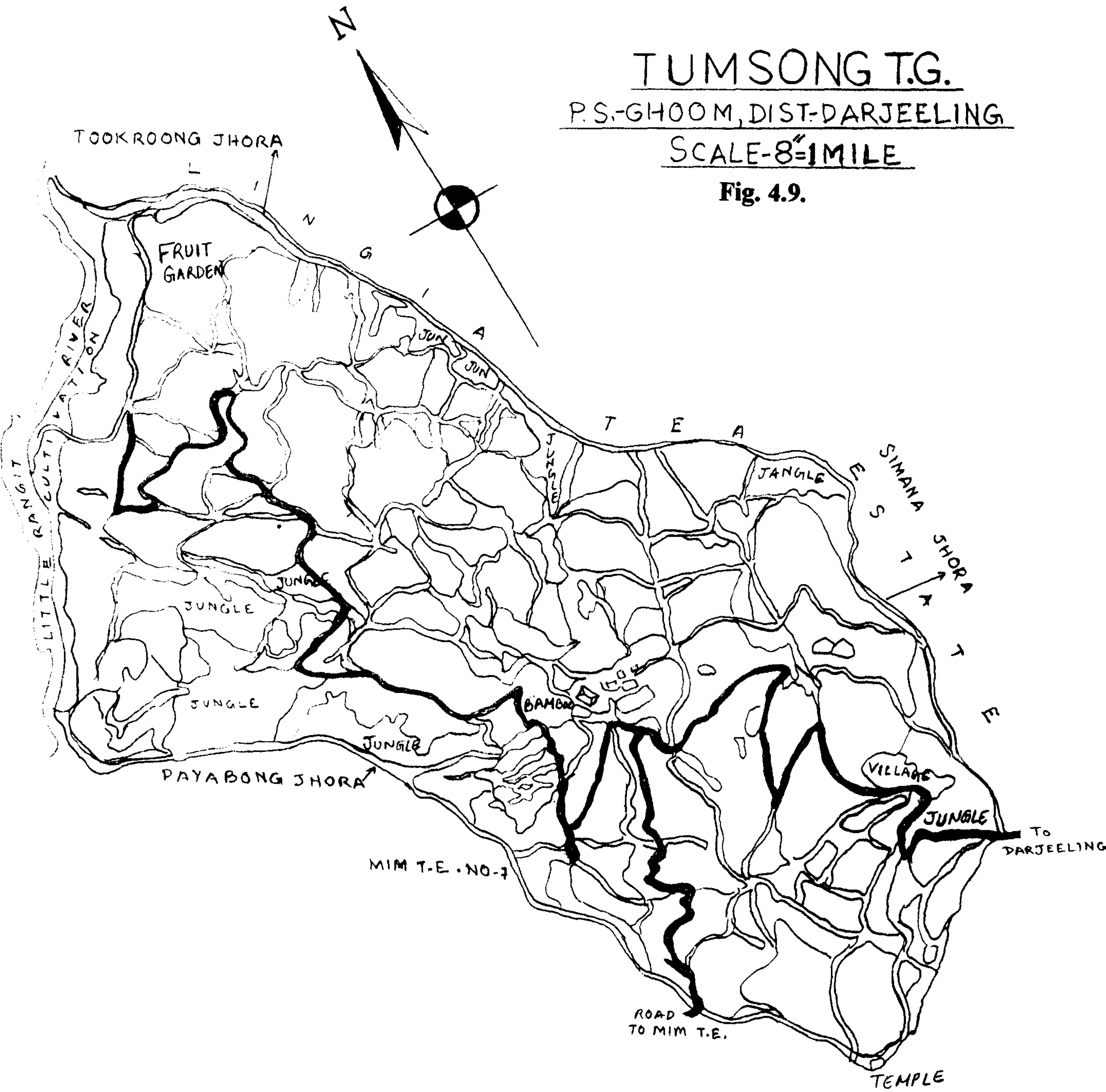
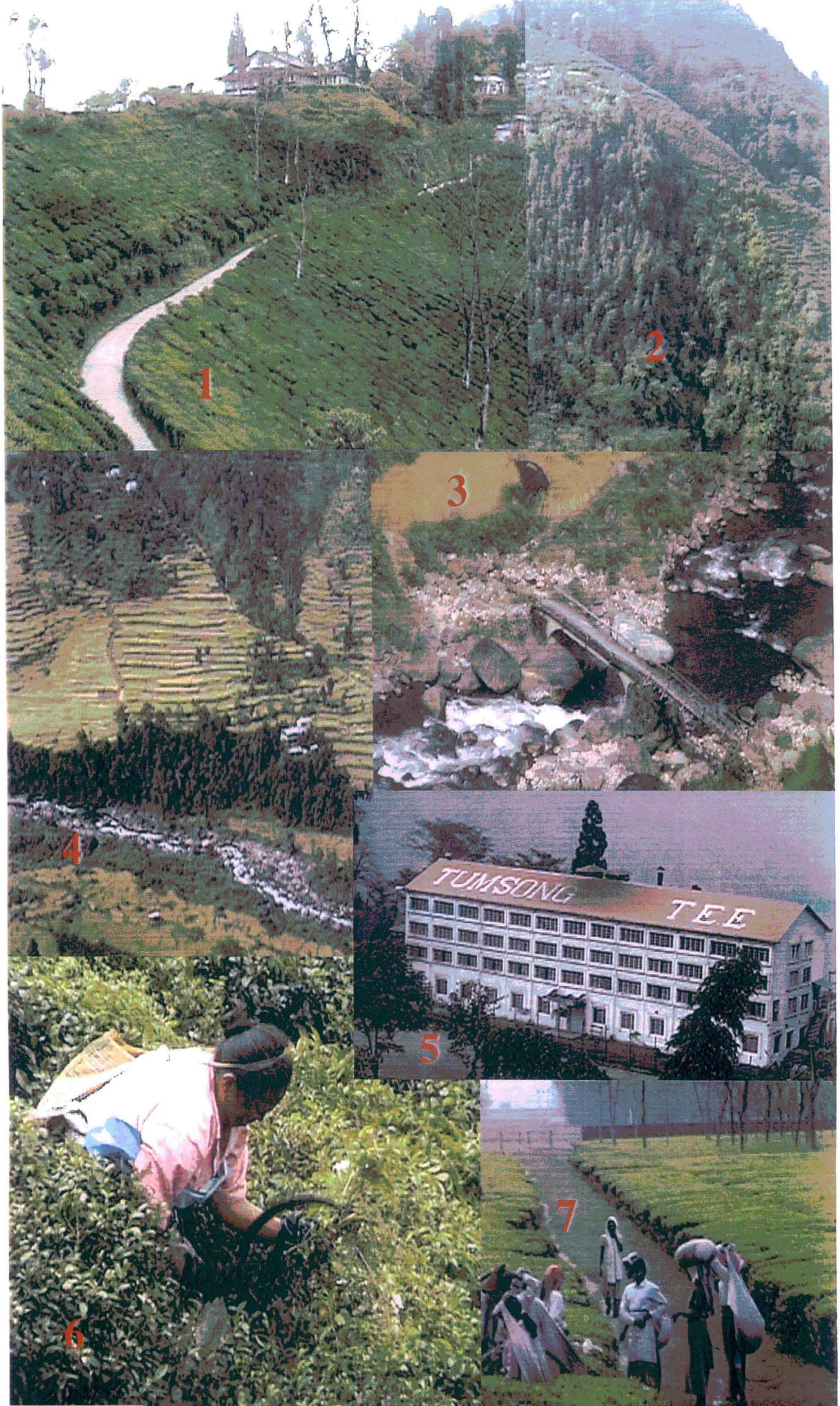

TUMSONG T.G.
P.S.-GHOOM, DIST-DARJEELING
SCALE-8"=1MILE
N
TOOKROONG JHORA
L I N G I A T E A E S T A T E
FRUIT GARDEN
LITTLE RANGIT RIVER
CULTIVATION
JUN
JUN
JUNGLE
JANGLE
SIMANA JHORA
JUNGLE
JUNGLE
JUNGLE
JUNGLE
BAMBOO
PAYABONG JHORA
VILLAGE
JUNGLE
TO DARJEELING
MIM T.E. NO-7
ROAD TO MIM T.E.
TEMPLE

Fig. 4.9.


1
2
3
4
TUMSONG
TEE
5
6
7

in different localities in this area varies too much. Even the adjacent slopes do not receive same amount of precipitation. Availability of sunlight will vary greatly due to the differences in angle of exposure. Accordingly, ambient temperature and its diurnal variation and also the atmospheric humidity will be different.

Considering all these factors, climatic data for different locations in Terai and in Darjiling Hills has been provided under *General Introduction* [Chapter 1, Section 1.9]

CHAPTER 5

Materials and Methods

The present work has been designed to cover many aspects of weedy plants growing in Tea Gardens of Terai, Duars and Darjiling Hills. Accordingly, a wide array of methodology has been followed to carry out different types of such works and those has detailed below with proper references.

5.1. Selection of Tea Gardens

A careful study of available literature on Tea Gardens or Tea Estates (T. E.) of the region, accompanied with preliminary visits to numerous gardens in different corners of Terai Duars and Darjiling Hills and also considering the topography of the entire region, nine gardens has been selected for the present dissertation. These are namely (i) Kamalpur Tea Estate, (ii) Hansqua Tea Estate, (iii) Matigara Tea Estate, (iv) Mohurgong & Gulma Tea Estate, (v) Makaibari Tea Estate, (vi) Tamsong Tea Estate and (vii) Soom Tea Estate. These gardens are representing three tiers of elevation of the region. Terai gardens are located between 127 and 141m amsl, Middle Hill gardens are between 1300 and 1600m amsl and Upper Hill Gardens are between 1900 – 2200m amsl. A GPS (GARMIN 12CX) was used to determine the altitude and location of these gardens.

5.2. The Floristic Survey

The weed flora of these Tea Gardens has been prepared through random sampling in three different seasons during three consecutive years, starting from 2002 to 2004. The three different seasons selected for survey were (i) winter, (ii) Pre-monsoon and (iii) Post-monsoon. This has been done to get a holistic picture of the weed flora including all types of perennial and seasonal elements present in these gardens. Gardens were visited regularly for the collection of all relevant field data including the time of flowering, fruiting, leaf flash, uses etc.

5.2.1. Collection and Preservation of Materials

During the field trips, different species of plants growing inside and just on the margins of the tea gardens were traced visually and were collected at random. The specimens, mainly healthy leafy twigs with flowers and/or fruits or the entire plants were collected in triplicates. In case, flowering and/or fruiting plants were not available, specimens with healthy and mature leaves were collected. The specimens were tagged and recorded in the *Field Note Book* and temporarily pressed in a portable herbarium press between blotting papers or old newsprints during the trip. In case of tubers, rhizomes, large fruits etc. were collected and sometimes split apart or made into thick longitudinal or transverse section and dried in separate blotting papers or cotton pads to maintain shape. In case of some succulents, hot air oven was used for quick drying. On return to the laboratory specimens were cleaned, trimmed and transferred to a heavy wooden plant press for drying. Sometimes, drops of formalin were added at nodes and other soft joints to save the specimens from shattering. After proper drying specimens were poisoned by soaking with saturated solution of Mercuric Chloride in rectified alcohol and then dried again under pressure using blotters like newsprints. After proper drying and poisoning, specimens were mounted on standard herbarium sheets, labelled and temporarily stored in the Herbarium cabinet in the *Taxonomy & Environmental Biology Laboratory* in the Department of Botany of the University of North Bengal. After completion of the work, main set of the herbarium specimens will be deposited at 'NBU-Herbarium' and the duplicates will be deposited in the Central National Herbarium, Howrah (CAL).

5.2.2. Field Note Book

The records in the Field Note Book covers specific locations, altitude, dates of collections, availability, habit, habitat, flower colour and such other characters of plants which are not available with dry and mounted herbarium specimens. The field notes were transferred to herbarium labels for ready reference. After finishing of work, the Note Book will be submitted at the 'NBU- Herbarium'. However, for the entire field and herbarium techniques Jain & Rao (1977) has been followed in general.

5.2.3. Identification

Identification of all the collected specimens were primarily done in the Taxonomy & Environmental Biology Laboratory of the Department of Botany, North Bengal University using available literature and matching with the available predetermined specimens at the NBU-

Herbarium, and were finally matched at the Central National Herbarium, Howrah (CAL), and at the herbarium of Sikkim-Himalayan Circle of Botanical Survey of India (BSHC).

5.2.4. Enumeration and Description

Different species, species under genera and genera under each family were enumerated in an alphabetic manner for easy handling. However, a basic classification of specimens into **Pteridophyta, Pinophyta** and **Magnoliophyta** has been made. At the second step, the Magnoliophyta has been divided into **Magnoliopsida** and **Liliopsida**. For each species the correct name is followed by basionym, if present, and other available synonyms. Proper author citation, protologue references and references to the record in other floras addressing this and/or nearby regions also have been provided. A key to the acronyms and abbreviations used to denote various journals and books cited as references in the enumeration has been provided at the beginning of the enumeration. The reference part of enumeration of a species is followed by the name(s) available with the local language of the name being indicated. Total ranges have been provided for those species, which are growing over a wide altitudinal range and tends to show variation in flowering time.

To cite the voucher specimen, the place of collection with altitude, date, collector's names and field numbers have been provided with the specimens from different places of collections being provided separately.

Local distribution provided in the enumeration are based both on collected specimens and observation made during the field trips and is not based upon any literature. Besides, the general distribution of a species have been determined from its record in published literature and from the deposited specimen in different herbaria visited.

At the end of the enumeration a 'NOTE' has been provided which shows the local uses of plants if any or any other observations of interest made during the fieldwork.

5.3. Vegetation Analysis

Analysis of the structure of vegetation was carried out with a primary aim to determine the status of availability, horizontal and altitudinal distribution and to know the natural association of different species leading to the determination of Relative Density (RD), Relative Frequency (RF), Relative abundance (RA) and finally the Important Value Index (IVI). For Phytosociological analysis methodology followed by Misra (1968), Shimwell (1971), Tripathi &

Misra (1971), Phillips (1959), Malhotra (1973), Das & Lahiri (1997) and Kadir (2001) have been followed.

5.3.1. Methods of Vegetation Sampling

To understand the phytosociological behavior of different species of weeds growing in Tea Gardens, some randomly selected fields of selected tea gardens were sampled through quadrat method. As most of the weeds are small and herbaceous, a standard quadrate size of 1 x 1m was used for the purpose. However, Misra (1968) was followed for the determination of size and number of quadrats. The study was conducted during 2002 to 2004 in three distinct seasons, which covers whole year, namely Pre-monsoon (March - May), Post-monsoon (September - November) and Winter (December - February). A minimum of 50 quadrats were laid down randomly in each tea garden in each season during the survey period (i.e. a total of 150 quadrats or more, were sampled in the whole year from each garden). List-count data for all the available species in quadrats were recorded in the *Field Note Book* which also included the habit and habitat, abundance, life form, flowering and fruiting period, flower colour, odour and such characters of plants, which are not available with dry herbarium specimens.

5.3.2. Collection and Preservation of Materials

All the specimens with leaves, flowers and /or Fruits (if available) were collected from quadrats, which were tagged and kept temporarily in polythene bags. All the collected specimens were treated in the same manner as it was done with specimens collected for the preparation of flora and mounted and labelled Herbarium Sheets were temporarily stored in a cabinet pending identification.

5.3.3. Identification

All the specimens collected during phytosociological studies were also identified in the same manner as it was done with the same for the floristic studies.

5.2.4. DATA ANALYSIS: Using list, count and basal cover data of quadrats following phytosociological parameters were calculated. All these parameters were determined as suggested by Misra (1968) and Phillips (1959):

$$\textbf{Abundance (A)} = \frac{\text{Total number of plants of a species in all the quadrats}}{\text{Number of quadrats in which the species occurred}}$$

$$\textbf{Density (D)} = \frac{\text{Total number of individuals of a species in all the quadrats}}{\text{Number of quadrats examined}}$$

$$\textbf{Frequency (F \%)} = \frac{\text{Number of quadrats in which the species occurred}}{\text{Total number of quadrats examined}} \times 100$$

$$\textbf{Relative Abundance (RA)} = \frac{\text{Abundance of a species}}{\text{Sum of the Abundances of all species}} \times 100$$

$$\textbf{Relative Density (RD)} = \frac{\text{Density of a species}}{\text{Sum of the Densities of all species}} \times 100$$

$$\textbf{Relative Frequency (RF)} = \frac{\text{Frequency of a species}}{\text{Sum of the Frequencies of all species}} \times 100$$

Important Value Index (IVI): The relative values of density, frequency and abundance were summed-up to represent the Importance Value Index of all the recorded individual species i.e.

$$IVI = RD + RF + RA$$

5.3.5 Diversity Indices

Various diversity indices were studied to understand the diversity of these Tea Garden landscape communities in space and time. For quantification of diversity and comparison of species diversity between different ecosystems in various climatic conditions, it is useful to calculate an index of diversity and dominance. Out of the numerous indices formulated by different workers from time to time for diversity study, only following two diversity indices have been chosen.

5.3.5.1 Species Diversity [Shannon-Weiner Index]

Species diversity is the expression of community structure and indicates the complexity of a habitat. Shannon-Weiner Index (1963), which incorporates both species richness and evenness components, is one of the most widely used indexes for measuring species diversity in an ecosystem (ref). This index emphasizes on the common species rather than in rarity in a given habitat. This index has also been used to describe the landscape diversity by many landscape ecologists. Higher diversity is encountered when the number of species and the evenness component are large i.e. low dominance.

Shannon-Weiner Index (1949)

$H' = -\sum[(ni/N)\ \ln(ni/N)]$

Where; 'H' is the index value

'ni' is the number of individuals of a species.

'N' is the total number of species in the habitat type.

5.3.5.2 Species richness [Menhinick Index]

Species richness is another mode of expressing the diversity and is described by the number of species present in a sample or habitat per unit area. The simplest species richness index is based on the total number of species and the total number of individuals in a sample or habitat. This unlike Shannon-Wieners index and Simpson's index gives more weightage to the rare species:

Menhinick Index (1964)

$D = S/\sqrt{N}$

Where; 'D' is the index value

'S' is the total number of species

'N' is the total number of individuals of all species.

5.3.5.2 Similarity Index

Similarity index help to compare different habitat types and their suitability for migration and evolution of species. Of the many mathematical formulations, Sorensen's (1968) has been adopted in the present study.

$$S = \frac{2C}{A + b}$$

Where; S: index value

C: number of species common to both sites

a: number os species in site 'a'

b: number of species in site 'b'

5.4. Weed Phenology

The phenological observations on dominant and troublesome weeds were made through direct observation of different species of plants in their native habitat for three different parallel altitudinal tiers of gardens and also in *in vitro* condition. These include both dicotyledonous and monocotyledonous plants. Repeated visit to different tea gardens in different months were made to record the stages of life cycle of different species of plants in the vegetation and a comprehensive phenological calendar were prepared, covering the period from 2002 to 2004.

Different parameters or phenophases used for this study are: ***germination, seedling appearance, vegetative stage, flowering, fruit-set, seed dispersal,*** and ***death or perennation***. Special emphasis was given on seedling morphology, as it is the most essential feature to know the weeds of tea gardens at their early stages. The phenological observations were made following Salisbury (1942); Thakur (1954); Hakinsson (1982); Neogi & Rao (1980); Das & Chanda (1987), Lawrence (1955), Oper *et al* (1980) and Ralhan *et al* (1985, 1991).

A species was considered in a particular phenophase when it actually entered in that stage for instance, when just one or few individuals starts flowering, the species then enters in that phase / stage of flowering or, the other way, a particular phenophase was considered to have started when about 10% (Semalty & Sharma 1996) individuals were observed in the phase and the phase was considered completed when only less than 10 % of the individuals remained in that particular phase. For life-form classification, Raunkiaer (1934) has been followed:

Phanerophytes (P): Perennating buds well above (more than 30 cm) the ground.

Chamaephytes (Ch): Herbaceous perennials or suffrutescent plants bearing perennating buds just above the ground level to 30 cm high.

Hemicryptophytes (H): Perennating buds half hidden at the ground level.

Cryptophytes (C): Perennating organs remain below the ground surface.

Therophytes (T): Annuals that propagate through seeds or spores and complete their life cycle within a short period.

5.5. Reproductive Potential

Success of a weed greatly depends on its reproductive potentiality. During this work different aspects like ***Seed Size Index and Shape Index, Seed Weight, Viable percentage, Non-viable percentage, Germination percentage, Seed output*** and ***Reproductive capacity*** of weeds have been covered. However, plants for this work were procured from low altitude Terai gardens only and the experiments were conducted during November – July of 2003 - 2005. Mature dominant weeds with higher IVI values were collected from the selected Tea Gardens and were brought to the laboratory. Methods largely followed by Acharyya (1998); Baker (1975); Steven (1932, 1957); Datta & Banerjee (1976); Datta *et al* (1980); Paria & Sahoo (1981); Hakinsson (1982); Gross (1984); Stebbins (1971) and Zimmerman & Weis (1983) were used for this work.

5.5.1. Seed Characters

For the determination of fruit and seed characters, fruits from 5 plants were collected separately at random and counted separately. In general a plant of average size and growing under little competition, were chosen for the collection of fruits and seeds. After harvesting the fruits were cleaned and air dried for three weeks and then seeds were separated, air dried and stored in desiccators under normal room temperature in brown paper bags. For plants in which ripening extends over a considerable period and seeds are set free as soon as mature, only a part of the total number can be procured at a single collection. In these cases daily collection was made for three months because fruit formation and seed maturity are successive to each other. For plants in which fruit formation and seed maturity are simultaneous to each other, collection were made every day for a month and were bulked to calculate the total seed number. In most cases well-developed seeds for a single plant were recorded. The morphology of seed shape and size, the seed length and breadth and weight of 1000 dry seeds was determined. In some plants where seeds cannot be separated from fruits, the seed weight depicts the weight of complete fruit. An electronic digital weighing machine [SARTORIUS, Model No.BP-110] has been used for this purpose.

5.5.2. Seed Viability Percentage

Tests for seed viability were followed immediately after harvest i.e. before storage some seeds were kept for germination for the first time. Then, after every four months some seeds were taken out of the desiccators and were tested for germination. For this work 25 seeds were placed in a sterile glass Petridis containing a single layer of filter paper (Whatman no.-1) soaked with distilled water. Two replicates were taken each time for viability testing. In most of the cases germination tests were conducted on a table in diffuse light near the window of the laboratory.

However, some seeds were germinated only when petridises were incubated in the dark environment.

5.5.3. Seed Germination

For this investigation, only the healthy seeds were chosen from stored seeds. Seeds were taken out periodically from the desiccators and tested for germination at room temperature. Radicle emergence was considered as the criterion for seed germination. The germination tests of mature seeds were made in duplicates, taking 25 healthy seeds for each species with sufficient sterile distilled water, in sterile 15 cm petriplates lined with a single layer of Whatman No.-1 filter paper. The Number of seeds germinated was recorded on alternate days upto the 10^{th} day. This experiment was conducted under diffused light condition in the laboratory.

5.5.4. Reproductive Capacity and Seed Output

Reproductive capacity was determined by calculating the average seed output per plant and average percentage of seed germination.

For the determination of seed output, fruits produced by five mature plants of each species were taken and the numbers mature seeds containing in fruits were counted from each plant. Further, five fruits were selected from the pool and the averages of seeds per fruit were calculated. Remarks are made following Stevens (1957) concerning abortive and immature seeds as well as number of stalks and fruits borne by the concerned plants. Abortive seeds indicate those which do not develop at all, where as immature seeds are those that do not attain the same colour, size and shape as those of the mature ones. In runners, where it was difficult to detach the stalks, a square area was used as the unit of measure and the numbers of rooted nodes producing branches were counted. Average seed output of a particular species was calculated using simple mathematics.

5.5.5. Data Analysis

The results of different investigations were statistically analyzed at the replication and treatment levels as mean. Using the data from different investigations following parameters was calculated:

1. ***Seed Size Index and Seed Shape Index***: Seed Size Index and Shape Index were calculated following the method of Hill *et al.* (1968):
   Seed Size Index = Length of seed x Breadth of seed

$$\text{Seed Shape Index} = \frac{\textbf{Length of seed}}{\textbf{Breadth of Seed}}$$

2. *Viability of Seeds*: Viability of seeds are expressed in percentage and was calculated using the following formula:

$$\text{Viable \%} = \frac{\textbf{Total number of viable seeds}}{\textbf{Total number of seeds sown}} \times 100$$

3. *Non-Viability of Seeds*: Non-viable percentage of seeds was calculated using the following formula:

$$\text{Non-viable \%} = \frac{\textbf{Total number of non-viable seeds}}{\textbf{Total number of seeds sown}} \times 100$$

4. *Rate of Germination*: The rate of germination of seeds has been expressed in percentage and was calculated using the following formula:

$$\text{Germination \%} = \frac{\textbf{Total number of seeds germinated}}{\textbf{Total number of seeds sown}} \times 100$$

5. *Reproductive Capacity and Seed Output*: Reproductive capacity and seed output were determined by standard method of Salisbury (1942):

$$\text{a. Reproductive Capacity} = \frac{\textbf{Average seed output of a plant}}{\textbf{100}} \times \text{\% of germinated seeds}$$

b. Average seed output =

Average number of fruits / plant x Average number of seeds / fruit

5.6. Effects of Herbicides:

The experiment was conducted on 5 years old bushes in North Bengal University campus Tea Garden that has been leased out to Hurdeodass & Co. Ltd. (Owner of Matigara Tea Estate) [26°42'50.0" N latitude & 88°22'14.2" E longitude; 130 metres above MSL]

The trial was laid out in Randomized Block Design, R.B.D.). There were five replications and 20 plots. Average plot size was 10 m^2 consisting of average 130 plants in each plot. Spacing of tea plants were 105 x 60 cm planted in staggered single hedge style. Weed population per plot (species wise) on quadrates (1 x 1m size) was counted after 7 days, 14 days and 21 days from the date of spray of herbicides from randomly selected points in pre monsoon and post monsoon seasons in 2004. Dry weight of collected weeds was recorded (species wise) in two different seasons. Yield of green leaf (tea) was recorded at weekly interval in pre monsoon and post monsoon seasons (three rounds after each spray).

5.7. Allelopathic Effects

To determine the allelopathic effects on tea [*Camellia sinensis* (L.) O. Kuntze], six common weeds with higher ***IVI*** values were selected as test plants. Among these six dicotyledonous test plants, three are very common herbaceous plants [*viz. Drymaria villosa, Galinsoga parviflora, Persicaria runcinata*] were chosen from Hill tea gardens and other three common herbaceous plants [*viz. Ageratum conyzoides, Borreria alata, Mikania micrantha*] were selected from Terai tea gardens. Entire aerial parts i.e. branches with leaves, inflorescence etc. of the different species were collected from the fields in polythene bags and were brought to the laboratory. Work was confined only to the effect of leachetes and/or extracts on the germination of seeds and on the growth of root and shoot of young seedlings of tea. For the present set of experiments seeds of TS $_{520}$ cultivar of tea were used. Mature tea seeds were collected from the *seed-bari* [demarcated good seed producing part of a Tea Garden] of Terai tea gardens and stored at 4° C in brown paper envelopes. The experiment was conducted during December and January of 2003 – 2004. Observation was made for one month. The procedures described by Putnam and Duke (1978); Kadir (2001); Datta & Ghosh (1987) were followed for this work.

5.7.1. Preparation of Extract and Leachete Solutions

After thoroughly washing the aerial parts or whole plant body of collected test plant materials in distilled water to remove any adhering particles, the leachetes were obtained by soaking 100 g of fresh materials in distilled water for 72 hrs. The leachetes were then filtered through Whatman (No.1) filter paper and the volume of the filtrate was made to 250 ml by adding distilled water. This becomes the stock solution of leachates and was expressed by the ratio 1:2.5. The stock solution of the leaf extract 1:2.5 was prepared by taking thoroughly washed fresh plant materials but the extraction was carried out after grinding it into the paste in a Bajaj Mixture Machine. The desired concentration of 1:5, 1:10, 1:20 of both the leachetes and extracts were prepared consequently from the stock by subsequent dilution with distilled water. Distilled water was also used for control. For each treatment there were two replicates and one set control.

5.7.2. Germination Tests

Seeds of test plant i.e. *Camellia sinensis* or Tea were surface sterilized with 0.1% Mercuric Chloride solution for three minutes and transferred to 1% silver nitrate solution to remove the

$HgCl_2$ and were washed several times in sterile distilled water. 10 healthy seeds were placed in a pair of sterile plastic bowls [Diameter 12.2 cm, Depth 4 cm] lined with a layer of absorbent cotton. The cotton was moistened sufficiently by adding 25 ml of the test solutions. Replicas for each test solution were made along with a control with 25 ml of sterile distilled water. The sterile plastic bowls lined inside and mouth with aluminium foil and kept under 20^0c temperature. The germinated seeds were counted daily and the linear length of roots; shoots and seedlings were made after 15 days of sowing. Emergence of radicle was considered as a criterion for seed germination. Root hairs, lateral roots and leaf initiation were also observed, counted and recorded.

5.7.3. Data Analysis

The data thus obtained for the different parameters of seed germination and seedling growth were statistically analyzed and presented in tabular forms. The different parameters of seed germination and growth analysis are given below:

1. ***Germination Percentage***: The germination percentage was calculated with the formula:

$$\text{Germination Percentage} = \frac{\text{Total number of germinated seeds}}{\text{Total number of seeds sown}} \times 100$$

2. **Germination Inhibition or Stimulation:** The formula of Saxena *et al,* (1995) was used for the calculation of the percentage of inhibition or stimulation in Germination:

$$\text{Percentage inhibition or stimulation} = \frac{\text{Germination \% in desired solution} - \text{Germination \% in control}}{\text{Germination \% in control}} \times 100$$

3. **Percentage of Viability:** Percentage of viability was calculated by using the following formula:

$$\text{Percentage viability} = \frac{\text{Total number of viable seeds}}{\text{Total number of seeds sown}} \times 100$$

4. **Percentage of Non-Viability**: Percentage of nonviable seed was calculated by using the following formula:

$$\text{Percentage Non-viability} = \frac{\text{Total number of non-viable seeds}}{\text{Total number of seeds sown}} \times 100$$

5. **Percentile of Viability:** Percentile of viability was calculated by using the following formula:

$$\text{Percentile of viability} = \frac{\text{Percentage of viability at observed dilution}}{\text{Maximum percentage of viability}} \times 100$$

6. Percentage inhibition or stimulation of shoot Length: Percentage of inhibition or stimulation of shoot length was calculated using the formula:

$$\%\text{ inhibition or stimulation of shoot length} = \frac{\text{Shoot length in desired solution} - \text{Shoot length in Control}}{\text{Shoot length in the Control}} \times 100$$

7. Percentage inhibition or stimulation of root Length: Percentage of inhibition or stimulation of root length was calculated using the formula:

$$\%\text{ inhibition or stimulation of root length} = \frac{\text{Root length in desired solution} - \text{Root length in Control}}{\text{Root length in the Control}} \times 100$$

8. Percentage inhibition or stimulation of seedling Length: Percentage of inhibition or stimulation of seedling length was calculated using the formula:

$$\%\text{ Inhibition/Stimulation of seedling length} = \frac{\text{Seedling length in desired solution} - \text{Seedling length in Control}}{\text{Seedling length in the Control}} \text{ X } 100$$

9. Shoot Vigour Index: Shoot Vigour Index was calculated following the formula described by Thind & Malick (1988):

Shoot Vigour Index = Germination % X Shoot Length

10. Root Vigour Index: Root Vigour Index was calculated by using the following formula:

Root Vigour Index = Germination % X Root Length

11. Seedling Vigour Index: For the calculation of the Seedling Vigour Index the following formula was adopted:

Seedling Vigour Index = Germination % X Seedling Length

12. Shoot : Root Ratio: The formula of Bajpai *et al* (1995) was used for the calculation of the shoot: root ratio:

$$\text{Shoot : Root Ratio} = \frac{\text{Length of the Shoot}}{\text{Length of the Root}}$$

5.8. Uses of Weeds

Plants growing inside tea gardens as weeds are also expected to have some uses. The abundance of medicinal plants in the flora of this part of the country is well known (Biswas & Chopra 1956; Rai *et al* 1998; Rai & Bhujel 1999, 2002; Das & Mandal 2003). In addition, there are numerous wild-edibles, fodders, ornamentals, etc. which are not only used by tribal people but are also marketed regularly for the mass. So all the information related to ethnobotany of the Tea Garden workers and nearby people, collected besides floristic work during the period of 2002 – 2004 has been included here.

This was observed from two different angles:

5.8.1. Useful and Poisonous Weeds

All the plants growing as weeds are not useless plants. Many of these plants having useful properties and at the same time, some other plants are poisonous or allergenic to man or cattle or to other animals. All these plants were recognized through survey among the local people and recognition of all those plants by the users. Information on the floristic distribution and the usefulness or poisonous effects of different tea weeds with their ethnic relations were recognized from already existing literatures and have been presented in the form of a utilitarian classification. Categories were recognized as *edible, medicinal, fodder, ornamental, fish poison, cattle poison, human poison,* etc. Literature like Kirtikar & Basu (1935); CSIR (1948 - 1976); Chopra *et al* (1956, 1969); Asolkar *et al* (1992); Biswas & Chopra (1940); Hajra & Chakraborty (1981); Das & Chanda (1990); Jain (1991); Bhujel *et al* (1984 a,b,c); Shah & Das (2002) and many others were used for scanning such information.

5.8.2. Ethnobotany of Tea Garden Workers

Tea Garden workers are generally superstitious poverty stricken people, live in the workers colony inside or on the periphery of the gardens and supposed to be much dependent on the local resources for their survival. As part of their daily needs they use numerous local plants, majority of which are weedy and, in general, are not directly useful in the civilised society.

During the present survey, wide range of ethnobotanical information was recorded from the resourceful persons with the help of local field guides and/or contact persons in workers colonies and also from nearby villages. In general, after being briefed about the importance of ethnobotanical documentation, our aims and objectives of field visit etc, the field guides or contact persons were motivated and helped us in approaching more resourceful persons of their localities. Discussions were held in the visited areas with field guide, local herbal practitioners, vendors, priests, spiritual healers known as *Jhankri* (in general) and experienced senior rural folks of different ethnic communities. While most of the common people provided information on various types of uses of local plants like edible, fodder-producing, dye yielding, thatching, etc. herbal practices, on the other hand shared their knowledge on herbal drugs. Many of these tribal people are the lineage of different primitive traits in the culture of this Himalayan region and most of the people in rural and far flung areas have sound knowledge on the remedies of common or ordinary ailments. Also the local people of different age group, sex and profession were interviewed following a prepared questionnaire. They were requested to spot the plants in the vegetation about which they are talking so that a voucher specimen can be procured and the plants can be recognized scientifically.

The survey works were done mostly at their residence when they were usually free from their domestic duties. Special emphasis has been given on the plants of medicinal value, their indigenous formulation and methods of preparation by the herbal practitioners and experienced village folks of different ethnic communities. In case of ethnomedicinal plants the uses of single plant followed by the uses in combination with other plants were recorded including the types of ailments, source of medicines, parts of administration and also its side effects. Discussions were held on the doubtful specimens and materials and also in case of local names that varied from place to place but these were rectified afterwards in the laboratory and herbaria. The methods of preparation of different articles and /or compounds were also observed in different communities.

During the collection of specimens, field observations like habit, availability, local distribution and preservation and identification were done same as before. However, Jain (1981, 1987, 1991); Rai *et al* (1998); Rai & Bhujel (1999), Rai (2002) among others, were followed for overall methodology.

CHAPTER 6

Floristic Studies

6.1 Introduction

Darjiling area is a part of the IUCN recognised Himalayan Hotspot. The richness of the flora of this region is well known and that has been discussed under the General Introduction (Chapter 1). Tea is a plantation crop and the natural habit of *Camellia sinensis* is arboreal i.e. tree of about 10 m tall. However, in the plantation the height of plants is manually maintained at around 1m only. Their branches produce a crown like structure and the crowns of tens of thousands of such plants in plantations forms almost a continuous cover over the soil. This actually creates the problem by cutting the sunlight from reaching to the soil surface.

Tea Gardens were established after clearing very large tracts of vegetation those were floristically extremely rich. After the establishment of Tea saplings, weeds start growing there, either from the pre-existing seeds in the soil or from the freshly arrived seeds and/or propagules from the nearby natural vegetations.

It is also expected that seeds or propagules from all types of plants will enter the plantations. But the environment inside a plantation is different from that of the outer natural vegetation. Regular cleaning of weedy plants is the main problem for the survival of majority of the plants. Then the non-availability of direct sunlight is another major problem. So, only a limited number of species of plants are expected to grow there. Again, whatever may be the density of Tea plants there are always some open spaces available in such plantations. Roadsides, gaps created by the death of some plants, very steep surface where plantations could not be made, exposed rocky areas etc. where many native wild species can grow successfully.

The locally prevalent favourable or conducive environment is much suitable for the successful occurrence of many species in apparently difficult-looking habitats.

6.2. Selected Gardens

For the preparation of weed-flora of the Tea Gardens of Darjiling area four gardens from Terai and three gardens from Hills were selected as it has been done for other works in the present dissertation. Gardens from Terai are (1) Kamalpur Tea Estate, (2) Hansqua Tea Estate, (3) Matigara Tea Estate and (4) Mohurgong & Gulma Tea Estate. And, the three gardens from Hills are (v) Makaibari Tea Estate, (vi) Tamsong Tea Estate and (vii) Soom Tea Estate.

6.3. Methods of Survey

The weed flora of these Tea Gardens has been prepared through random sampling in three different seasons for three consecutive years, starting from 2002 to 2004. The three different seasons selected for survey were (i) winter, (ii) Pre-monsoon and (iii) Post-monsoon. This has been done to get a holistic picture of the weed flora including all types of perennial and seasonal elements present in these gardens. Gardens were visited regularly for the collection of all relevant field data including the time of flowering, fruiting, leaf flash, uses etc. Further details about the methodology have been discussed in ***Materials and Methods*** (Chapter 4).

6.4. Enumeration of the Flora

The readers and/or users of this weed flora are mostly non-taxonomists and for this reason, except for the three higher taxa, namely Divisions, Classes and Subclasses, all other taxa starting from Families, then to Genera, Species and Varieties present in this flora are arranged alphabetically. Different steps in the Enumeration are as follows:

I. *Names:* As far as possible, up-to-date correct nomenclature has been adopted for the plants. A corrects name is followed by a Basionym if any and the common Synonym(s).

II. ***Author Citation:*** Proper Author Citation has been provided to all taxa, family to variety of Forma as per the effective ICBN. As far as possible, full name of most of the authors has been cited.

III. ***Reference Citation:*** No reference has been provided for Family and Genus names. But, for binomials the prtologue reference has been provided in all cases. This is then followed by the references to the record of the plant in floras covering this region. In most of the cases, prologues have been provided with standard and conventionally used abbreviated form. But, for the local flora much concise abbreviations has been used.

IV. ***Local Names:*** The local languages in the study area are mainly Bengali and Nepali. In addition, there is a sizeable population of Hindi speaking people. Names provided here are all collected from the local people during field works. In the enumeration the language for a name has been provided in parenthesis.

V. ***Description:*** A very brief description using mostly habit and macromorphological characters has been provided for each plant. Detailed descriptions of all these plants are available in local floras.

VI. ***Voucher Specimens:*** Only one or few specimens have been cited for each and every species/ variety/ forma recorded in this weed-flora. All these field numbers are from the Field Note Book of '***AP Das & Chandrâ***'. Along with the number the garden from which the specimen has been collected, the date of collection and the altitude of the place has been provided.

VII. ***Flowering & Fruiting Period:*** A broad flowering and/or fruiting season for most of the plants have been provided on month to month basis.

VIII. ***Local Distribution:*** Here it is nothing but the presence of a plant in one or more of the selected seven Tea Gardens.

IX. ***General Distribution:*** It is collected from available literature and, as far as available, the total range of distribution of each taxon has been provided.

X. ***Note:*** At the end of enumeration of a species/ variety/ forma if some more relevant information are available then a 'Note' has been appended.

6.5. *Abbreviations Used:*

FEH = Flora of Eastern Himalaya; **EFPN** = Enumeration of the Flowering Plants of Nepal; **FBI** = Flora of British India; **FI** = Flora of India; **FB** = Flora of Bhutan; **FWB** = Flora of West Bengal; **PPB** = Perspectives of Plant Biodiversity; **TBRI** = Transactions Bose Research Institute; **Beng** = Bengali; **Eng** = English; **Nep** = Nepali.

Other abbreviations used are standard ones and as been presented/ recorded by Stafleu & Cowan (1976 – 1988).

6.6 Systematic Position of the Recorded Flora

No recent classification has covered the entire Kingdom Plantae. So, three different classification have followed for three major groups of taxa, namely Pteridophyta, Pinophyta and Magnoliophyta.

6.6.1 Pteridophyta

There are serious disagreements between eminent Pteridologists about the Phylogenetic schemes of classification of this important taxa. Schemes presented by eminent pteridologists particulary by Holttum (1947) and Pichi-Sermolli (1958, 1977, 1981) are now in a 'flaux' (Panigrahi 2003). Under such circumstances it has been decided to present the recorded 26 families in an alphabetical sequence following the leads from Kramer et al (1990) and Singh & Panigrahi (2005) but with a basic recognition of two groups (i) Fern-Allies & (ii) Ferns:

I. Fern-Allies:

i. Equisetaceae

ii. Lycopodiaceae

iii. Selaginellaceae

II. Ferns

i. Adiantaceae

ii. Aspleniaceae

iii. Athyriaceae

iv. Blechnaceae

v. Dennstaedtiaceae

vi. Dryopteridaceae

vii. Gleicheniaceae

viii. Hemionitidaceae

ix. Hypolepidaceae

x. Lindsaeaceae

xi. Lygodiaceae

xii. Marattiaceae

xiii. Marsileaceae

xiv. Monachosoraceae

xv. Nephrolepidaceae

xvi. Parkeriaceae

xvii. Polypodiaceae

xviii. Pteridaceae

xix. Pteridiaceae

xx. Taenitidaceae

xxi. Tectariaceae

xxii. Thelypteridaceae

xxiii. Vittariaceae

6.6.2 Pinophyta [Gymnosperms]

Only three species from three genera covering two families have been recorded in the present work. For this taxon the classification made by Cronquist, Takhtajan & Zimmermann (1966) has been followed:

Subdivision **A. Cycadicea** (no record)

Subdivision **B. Pinicae**

Class 2: Pinatae

Subclass ii: Pinidae

Family: Pinaceae

Taxodiaceae

Subdivision **C. Gneticae** (no record)

6.6.3 Magnoliophyta [Angiosperms]

For Angiosperms classification of Arthur Cronquist (1981) has been followed and the position of the recorded families has been presented below.

***Division*:** **MAGNOLIOPHYTA**

***Class*:** **MAGNOLIOPSIDA**

Subclass **: MAGNOLIIDAE**

Order: MAGNOLIALES
Family: Annonaceae
Family: Magnoliaceae

Order: LAURALES
Family: Lauraceae

Order: PIPERALES
Family: Saururaceae
Family: Piperaceae

Order: RANUNCULALES
Family: Ranunculaceae
Family: Menispermaceae

Order: PAPAVERALES
Family: Papaveraceae
Family: Fumariaceae

***Subclass* II. HAMAMELIDAE**

Order: HAMAMELIDALES
Family: Hamamelidaceae

Order: URTICALES
Family: Ulmaceae
Family: Cannabaceae
Family: Moraceae
Family: Urticaceae

Order: JUGLANDALES
Family: Juglandaceae

Order: FAGALES
Family: Fagaceae
Family: Betulaceae

***Subclass* III. CARYOPHYLLIDAE**

Order: CARYOPHYLLALES
Family: Nyctaginaceae
Family: Aizoaceae
Family: Chenopodiaceae
Family: Amaranthaceae
Family: Portulacaceae
Family: Basellaceae
Family: Molluginaceae
Family: Caryophyllaceae

Order: POLYGONALES
Family: Polygonaceae

***Subclass* IV. DILLENIIDAE**

Order: THEALES
Family: Theaceae
Family: Actinidiaceae

Family: Hypericaceae

Order: MALVALES
Family: Elaeocarpaceae
Family: Tiliaceae
Family: Sterculiaceae
Family: Malvaceae

Order: VIOLALES
Family: Flacourtiaceae
Family: Violaceae
Family: Passifloraceae
Family: Cucurbitaceae
Family: Begoniaceae

Order: CAPPARALES
Family: Capparaceae
Family: Cleomaceae
Family: Brassicaceae

Order: ERICALES
Family: Ericaceae

Order: PRIMULALES
Family: Myrsinaceae
Family: Primulaceae

***Subclass* V. ROSIDAE**
Order: ROSALES
Family: Crassulaceae
Family: Saxifragaceae
Family: Rosaceae

Order: FABALES
Family: Mimosaceae
Family: Caesalpiniaceae
Family: Fabaceae

Order: PROTEALES
Family: Proteaceae

Order: MYRTALES
Family: Sonneratiaceae
Family: Lythraceae
Family: Thymeleaceae
Family: Myrtaceae
Family: Onagraceae
Family: Melastomataceae
Family: Combretaceae

Order: CORNALES

Family: Alangiaceae

Order: SANTALALES
Family: Santalaceae

Order: CELASTRALES
Family: Celastraceae
Family: Icacinaceae

Order: EUPHORBIALES
Family: Euphorbiaceae

Order: RHAMNALES
Family: Vitaceae

Order: LINALES
Family: Linaceae

Order: POLYGALALES
Family: Polygalaceae

Order: SAPINDALES
Family: Aceraceae
Family: Anacardiaceae
Family: Meliaceae
Family: Rutaceae

Order: GERANIALES
Family: Oxalidaceae
Family: Balsaminaceae

Order: APIALES
Family: Araliaceae
Family: Apiaceae

***Subclass* VI. ASTERIDAE**
Order: GENTIANALES
Family: Apocynaceae
Family: Asclepiadaceae

Order: SOLANALES
Family: Solanaceae
Family: Convolvulaceae
Family: Cuscutaceae

Order: LAMIALES
Family: Boraginaceae
Family: Ehretiaceae
Family: Verbenaceae
Family: Lamiaceae

Order: PLANTAGINALES
Family: Plantaginaceae

Order: SCROPHULARIALES
Family: Oleaceae
Family: Scrophulariaceae
Family: Gesneriaceae
Family: Acanthaceae
Family: Bignoniaceae

Order: CAMPANULALES
Family: Campanulaceae
Family: Lobeliaceae

Order: RUBIALES
Family: Rubiaceae

Order: DIPSACALES
Family: Caprifoliaceae
Family: Carlemanniaceae
Family: Sambucaceae
Family: Valerianaceae

Order: ASTERALES
Family: Asteraceae

***Class* LILIOPSIDA**
***Subclass* II. ARECIDAE**

Order: ARECALES
Family: Arecaceae

Order: ARALES
Family: Araceae

***Subclass* III. COMMELINIDAE**

Order: COMMELINALES
Family: Commelinaceae

Order: JUNCALES
Family: Juncaceae

Order: CYPERALES
Family: Cyperaceae
Family: Poaceae

***Subclass* IV. ZINGIBERIDAE**

Order: ZINGIBERALES
Family: Zingiberaceae

Family: Costaceae
Family: Marantaceae

***Subclass* V. LILIIDAE**

Order: LILIALES
Family: Pontederiaceae
Family: Amaryllidaceae
Family: Convallariaceae
Family: Hemerocallidaceae
Family: Hypoxidaceae
Family: Smilacaceae
Family: Dioscoreaceae

Order: ORCHIDALES
Family: Orchidaceae

6.7 THE ENUMERATION OF THE FLORA

PTERIDOPHYTES

ADIANTACEAE Newman

ADIANTUM L.

Adiantum capillus-veneris L., Sp pl. 2: 1096. 1753; Trans. Linn. Soc. London ser. II. Bot. 1: 453. 1880; Handb. Ferns Brit. Ind. 84. 1883; Fern & Fern-allies Arun. Prad. I. 84. 2005.

Rhizome creeping, ca 2 mm across; fronds10-25 x 4-7 cm, bipinnate, ovate-lanceolate, stipes 4-12 cm long, thin, dark brown/ blackish. Lamina 7-13 cm; pinnae 3-5 pairs, alternate. Sori marginal, single or double at apex of pennule-lobes; indusium thin, entire veins 3-6.

Specimen Cited: Makaibari TE, AP Das & Chandrâ 1966, dated 30.06. 2003
Status: Abundant
Local Distribution: All three hill gardens
General Distribution: India, Pan-tropical and -temperate region including Europe and Surinam.
Note: The fern is used as pectoral demulcent, expectorant and tonic. It is boiled in wine that is given in cases of hard tumours of the spleen, liver and other viscera. Contains essential oil.

Adiantum edgeworthii Hooker, Sp. Fil. 2: 14. t. 81 B. 1851; Handb. Ferns Brit. India 1: t. 17. 1865; Ferns Fern-All. Arun. Prad. 1: 86. 2005.
Adiantum caudatum L. var. *rhizophorum* C.B.Clarke in Trans. Linn. Soc. London ser. II. Bot. 1: 453. 1880, *in synon.*

Rhizomes erect, short, paleaceous; roots thin, brown; Fronds 15-20 x 3 cm, tufted, pinnate, deltoid-lanceolate, acute. Stipes 8-10 cm, blackish-brown, glabrous. Pinnae 17 x 8 mm, lower largest, entire, glabrous. Sori marginal, interrupted, subentire, dark brown.

Specimen Cited: Soom TE, ***AP Das & Chandrâ*** 2593, dated 27.12. 2003.
Status: Common
Local Distribution: Found only in Soom & Tamsong gardens
General Distribution: India, Nepal, Myanmar, Malaya, Taiwan, Philippines, China, Japan.

Adiantum philippense L., Sp. Pl. 2: 1094. 1753; Ferns Fern-All. Arun. Prad. 1: 86. 2005.
Adiantum lunulatum N. Burman, Fil. Ind. : 235. 1768.

Rhizomes erect, short; paleae dark brown. Fronds 10-40 cm, tufted, pinnate, oblong-lanceolate, obtuse. Stipes 5-20 cm, glabrous, base paleaceous. Pinnae alternate, 5-15 pairs, glabrous. Sori marginal, elongated, interrupted, false indusium thick, entire.

Specimen Cited: Tamsong TE, AP Das & Chandrâ 2398, dated 05.11. 2003
Status: Common
Local Distribution: Found only in Soom & Tamsong gardens
General Distribution: India, Tropical and sub tropical areas of the old world.
Note: Used in blood diseases, in epileptic fits and in rabies, rhizomes prescribed for strangery and in fever due to elephantiasis. Fronds are burnt in oil and applied to itch.

ASPLENIACEAE (C. Presl) Mettenius *ex* A.B. Frank

ASPLENIUM L.

Asplenium ensiforme Wallich *ex* Hooker & Grev., Ic. Fil.: t. 71. 1829; Handb. Ferns Brit. Ind. 141. t. 71.1883; Fern & Fern-allies Arun. Prad. I. 97. 2005.
Asplenium ensiforme Wallich, Num. List. No. 200. 1829, *nom. nud.*

Rhizome erect, short. Fronds 20- 40 x 1.0- 2.5cm, simple, repand. Lamina base decurrent, veins forked 1-2 times, free. Sori oblique, blackish brown, 8- 12 mm long.

Specimen Cited: Makaibari TE, AP Das & Chandrâ 2509, dated 11.11. 2003.
Status: Less Common
Local Distribution: Found only in Makaibari garden
General Distribution: India, Sri Lanka, Nepal, Bhutan, Myanmar, Thailand, Vietnam, Taiwan, Hong Kong, Japan.

Asplenium filix-femina var. ***parasnathensis*** Bernham, Schrad. Neu. J. i. pt. ii. 26, t.2.; Ferns N. India, I: 491. 1973 (Indian Reprint).

Fronds 60-120 cm long, lanceolate, both ends narrowed, membranous, bipinnate; rachis appears triangular when dry. Primary pinnae linear-oblong, base broadest. Secondary pinnae oblong, sessile, acute, very persistant. Sori globose, median, blackish-brown.

Specimen Cited: Tamsong TE, AP Das & Chandrâ 2431, dated 05.11. 2003.
Status: Less Common
Local Distribution: Found only in Soom & Tamsong gardens
General Distribution: Endemic to India
Note: Anthelmintic, Diuretic, Poultice, Women's complaints; relieving labour pains; internal ailments such as cancer of the womb; general body pains to stop breast pains caused by childbirth and to induce milk flow in caked breasts; externally to heal sores; liquid root extract is an effective anthelmintic.

ATHYRIACEAE A.H.G. Alston

ATHYRIUM A. W. Roth

Athyrium drepanopterum (Kuntze) A. Br. *ex* Milde, Fl. Eur.: 49. 1867; Fern & Fern-allies Arun. Prad. I. 128. 2005.
Polypodium drepanopterum Kunze in Linnaea 23: 278, 318. 1850.
Athyrium oxyphyllum Moore., Ind. XLIX. 1857; Handb. Ferns Brit. Ind. 170. 1883.

Rhizome erect, ascending. Paleae basifixed, ovate-lanceolate, gradually long, acuminate, entire. Fronds 50- 70 x 11-15 cm, bi- or tripinnatifid. Lamina 30-50 cm, deltoid lanceolate; basal or 2nd pair pinnae largest. Sori median, elongated – hooked or rounded.

Specimen Cited: Soom TE, ***AP Das & Chandrâ 2608***, dated 27.12. 2003.
Status: Common.
Local Distribution: In Terai and low altitude areas
General Distribution: India, Bhutan, China, Myanmar, Philippines.

Athyrium puncticaule (Blume) T. Moore, Ind. Fil. 186.1860; FEH 3: 183. 1975.
Aspidium puncticaule Blume, Enum. Pl. Jav. 159. 1828.

Rhizome erect, paleaceous. Fronds oblong, 20- 30 x 5-7 cm, tufted, tripinnatifid, lanceolate. Lamina 25 - 35 cm long; bipinnatifid at basal region only, rachis paleaceous only at stipe base. Sori medium, dorsal, indusium athyrioid or reniform, thin.

Specimen Cited: Tamsong TE, AP Das & Chandrâ 3011, dated 10.04. 2004
Status: Less Common
Local Distribution: Found only in Soom & Tamsong gardens
General Distribution: India, Sri Lanka, Java.

Athyrium solenopteris (Kuntze) T. Moore, Ind. Fil.: 43, 187. 1857; Handb. Ferns Brit. Ind. 166. 1883, *p.p. excl. syn.*; Fern & Fern-allies Arun. Prad. I.132.2005.
Allantodia solenopteris Kunze in Linnaea 24: 266. 1851.

Rhizome erect, fronds ca 60 x 23 cm, tufted. Lamina 30-40 x 22 cm, oblong, gradually acuminate; pinnae 14-20 pairs, 2^{nd} or 3^{rd} pair largest, basal slightly reduced. Pinnules ovate-oblong, 2.0 x 1.0 cm, oblique, acute, pinnule-lobes oblong-rectangular, crenate to serrate. Sori basal, athyrioid to asplenioid, indusium whitish pale, thin, persistent.

Specimen Cited: Tamsong TE, AP Das & Chandrâ 2346, dated 05.11. 2003; Makaibari TE, AP Das & Chandrâ 1851, dated 10.06. 2003.
Status: Less Common
Local Distribution: All three hill gardens
General Distribution: India, Nilgiris, Sikkim, Meghalaya, West Bengal, Arunachal Pradesh, Sri Lanka.

CORNOPTERIS T. Nakai

Cornopteris opaca (D. Don) Tagawa in Acta Phytotax. Geobot. 8: 92. 1939; Fern & Fern-allies Arun. Prad. I. 134. 2005.
Hemionitis opaca D.Don, Prod. Fl. Nepal.: 13. 1825.
Leptogramma opaca (D. Don) Beddome, Handb. Ferns Brit. India: 379. f.217. 1883.

Rhizomes erect, apex densely paleaceous; Fronds 100-115 x 30-40 cm, ovate-lanceolate; stipes 50-65 cm long, glabrous. Pinnae 1^{st} to 3^{rd} pair the largest, lamina elliptic oblong, bipinnatifid. Pinnules alternate, pinnatifid, acuminate. Sori up to 2 mm long, rounded to oblong, dorsal superficial, exindusiate.

Specimen Cited: Soom TE, ***AP Das & Chandrâ 3384***, dated 12. 10. 2004.
Status: Common
Local Distribution: Found only in Soom & Tamsong gardens
General Distribution: India, Java, China, Japan.

DIPLAZIUM Swartz

Diplazium axillare Ching in Lingnan Sci. J. 15(2): 277. 1936, *p.p.* Fern & Fern-allies Arun. Prad. I. 145. 2005.
Diplazium polypodioides sensu C. Christensen in Contrib. U. S. Nation. Herb. 26 (6): 304. 1931, *p.p. incl. spec.* Yunnan, *non* Blume (1828).

Rhizome erect, paleae basifixed, ovate lanceolate, hairy, brown. Fronds 150-180 x 80-100 cm, tripinnatisect, caudate-acuminate; stipes 60-120 cm, grooved dorsally. Largest pinnae towards middle, alternate, acuminate; pinnules largest towards base, alternate, papillose. Sori 1.5-2 mm long, basal.

Specimen Cited: Tamsong TE, AP Das & Chandrâ 3024, dated 10.04. 2004.
Status: Less Common
Local Distribution: Found only in Soom & Tamsong gardens
General Distribution: India, Arunachal Pradesh, Myanmar.
Note: A new record for West Bengal.

Diplazium esculentum (Koenig *ex* Retzius) Swartz in Schrad. J. Bot. 1801: 312. 1803; Handb. Ferns Brit. Ind. 192. 1883; Ferns Fern-All. Arun. Prad. I. 161.2005.
Hemionitis esculenta Koenig ex Retz., in Obs. Bot. 6: 38. 1791.

Terrestrial fern; rhizome erect, dark brown. Fronds large; lamina 2 pinnate; pinnae petiolate; pinnules many, sessile or shortly stalked, acuminate, broadly cuneate at the base, margin lobed. Sori linear, continuous along almost whole length on both sides of the veins, brown; sporangia shortly stalked.

Specimen Cited: Mohurgong & Gulma TE, AP Das & Chandrâ 0009, dated 27.01.2002; Makaibari TE, AP Das & Chandrâ 1861, dated 10.06. 2003.
Status: Abundant.
Local Distribution: In Terai and low altitude areas
General Distribution: India, Sri Lanka, Myanmar, Malaya, Malaysia, Taiwan, Philippines, New Guinea, Samoa.
Note: Young unopened fronds eaten in salad or as cooked vegetable.

Diplazium sikkimense (C.B. Clarke) C. Christensen in Contrib. U.S. Nation. Herb. 26: 304. 1931; Fern & Fern-allies Arun. Prad. I.183. 2005.
Asplenium sikkimense C.B. Clarke in Trans. Linn. Soc. London ser. II. Bot. 1: 500. pl. 65. f. 1. 1880.

Rhizome erect, roots thick; paleae entire, ovate-lanceolate. Fronds 175-250 x 80-120 cm, tufted, lanceolate, tripinnatisect, acuminate; stipes 75-120 cm, base black, dirty brown, grooved. Lamina 100-150 cm, pinnae over 8 pairs, alternate, pinnules opposite. Sori few diplazioid, small, basal.

Specimen Cited: Soom TE, ***AP Das & Chandrâ 3455***, dated 12. 10. 2004.
Status: Rare
Local Distribution: Found only in Soom garden
General Distribution: Sikkim, Arunachal Pradesh, West Bengal; endemic.
Note: New record for West Bengal.

Diplazium stoliokae Beddome, Ferns Br. Ind. Suppl. 13, pl. 361.1876; FEH 3:186. 1975.

Rhizome erect; paleae basifixed, ovate lanceolate, acuminate, hairy, brown. Fronds 150 x 80 cm, tripinnatisect, caudate, acuminate; stipes 60-80 cm, grooved. Largest pinnae towards middle, alternate, acuminate, pinnules the largest towards base, alternate. Sori 1.5-2 mm long, basal.

Specimen Cited: Makaibari TE, AP Das & Chandrâ 1725, dated 17.05.2003.
Status: Rare
Local Distribution: Found only in Makaibari garden
General Distribution: India; endemic.

BLECHNACEAE (C. Presl) Copel

BLECHNUM L.

Blechnum orientale L., Sp. Pl. ed. 1, 2: 1077. 1753; Handb. Ferns Brit. Ind. 132. t. 66.1883; Fern & Fern-allies Arun. Prad. I.206-207.2005.
Asplenium orientale (L.) Bernhardi, Schrad. J. 1801 (1): 17. 1802.

Rhizome erect; densely paleaceous at apex. Fronds up to 150 x 25-45 cm, tufted, pinnate, caudate acuminate. Stipes upto 40 cm, base paleaceous, thick, small auricles several pairs, lamina 120 cm long, pinnae alternate, spreading, entire. Sori costal, elongated, indusium long, narrow, brown.

Specimen Cited: Kamalpur TE, AP Das & Chandrâ 1183, dated 18.10.2002.
Status: Common
Local Distribution: All Terai gardens
General Distribution: India, Sri Lanka, Nepal, Bhutan, Bangladesh, China, Myanmar, Thailand, Indonesia, Malaysia, and Australia.
Note: Rhizome edible and also used in urinary disorders and as an anthelmintic, poultice applied to boils.

DENNSTAEDTIACEAE Ching *ex* Pichi Sermolli

MICROLEPIA C. Presl

Microlepia pilosiuscula (J.E.Smith) Morton in Contrib. U.S. Nation. Herb. 38(7): 313. 1974; Fern & Fern-allies Arun. Prad. I. 255. 2005.
Davallia pilosiuscula J.E. Smith in Ress, Cycloped. 11: 10. 1808.

Rhizomes creeping, thick. Fronds upto 150-80 cm, lanceolate, caudate acuminate, tripinnate. Stipes 60 cm, grooved, pubescent, green. Pinnae 14 pairs, 50 x 17 cm, alternate. Pinnules 20-25 pairs, long, acuminate, acumination crenate, hairy on both side. Sori half cup-shaped, terminal.

Specimen Cited: Makaibari TE, AP Das & Chandrâ 2570, dated 11.11. 2003.
Status: Less Common
Local Distribution: Found only in Makaibari garden
General Distribution: India, Sri Lanka, Nepal, Myanmar, Thailand, Malaya, Indonesia, Vietnam, China, Philippines.

Microlepia rhomboidea (Wallich *ex* Kuntze) Prantl in Arb. Bot. Gart. Breslau 1:31.1892; Ferns Fern-All. Arun. Prad. I. 259. 2005.
Davallia rhomboidea Wallich *ex* Kuntze in Bot. Zeit. 8: 158. 1850.

Rhizomes creeping, thick, tips hairy; roots profuse. Fronds 120-170 x 55-70 cm, closely originated, ovate-lanceolate, tripinnate to quadripinnatified, caudate acuminate; stipes long, dirty brown, grooved. Lamina 90-125 cm; pinnae widest at base, basal pair shorter. Sori half cup shaped, terminal, towards margin below or above sinus.

Specimen Cited: Soom TE, ***AP Das & Chandrâ 2633***, dated 27.12. 2003.
Status: Common
Local Distribution: Found only in Soom & Tamsong gardens
General Distribution: India, Nepal, Bhutan, Myanmar, Malaysia.

Microlepia speluncae (L.) T. Moore, Ind. Fil. XCII. 1857; Handb. Ferns Brit. India: 67. 1883; Fern & Fern-allies Arun. Prad. I. 268. 2005.
Polypodium speluncae L., Sp. Pl. 2: 1093. 1753.

Rhizomes short, creeping. Fronds 120-175 x 50-80 cm, ovate-lanceolate, caudate, acuminate, quadripinnate. Stipes ca 70 cm long, grooved dorsally. Pinnae basal pair largest, alternate. Pinnules alternate, sessile, oblong-lanceolate, bipinnate. Sori near to margin, davallioid, terminal.

Specimen Cited: Makaibari TE, AP Das & Chandrâ 2762, dated 25.03. 2004.
Status: Less Common
Local Distribution: Found only in Makaibari garden
General Distribution: India, Tropical Asia.

Microlepia speluncae (L.) T. Moore var. ***pubera*** (C.B. Clarke) Sledge in Kew Bull. 11: 525. 1956; Fern & Fern-allies Arun. Prad.I. 264. 2005.
Davallia flaccida var. *pubera* C.B. Clarke in Trans. Linn. Soc. London ser. II. Bot. 1: 449. 1880.

Rhizomes creeping. Fronds tripinnate to quadripinnatifid, caudate acute; rachis grooved dorsally, hairy throughout. Pinnae ca 20 x 9 cm, alternate; pinnules 15 pairs, alternate, deltoid-lanceolate, base oblique, acuminate. Sori near to margin, davallioid, terminal.

Specimen Cited: Makaibari TE, AP Das & Chandrâ 2804, dated 25.03. 2004.
Status: Less Common
Local Distribution: Found only in Makaibari garden
General Distribution: India, Nepal; endemic to Himalayas.

DRYOPTERIDACEAE Herter

DRYOPTERIS Adanson

Dryopteris filix-mas (L.) Schott, Gen. Fil. ad. *pl.* 9. 1834.

Polypodium filix-mas L., Sp. pl. 1090. 1753.

Rhizome erect, paleaceous. Fronds 55 x 15cm, tufted, lanceolate, bipinnate towards base, bipinnatisect upwards, acuminate. Stipes 25 cm, paleaceous, grooved. Lamina 30 cm long, pinnae upto 9 x 2.5 cm, subopposite; pinnules 8-12 x 5-7 mm, pinnatifid, veins pinnate. Sori round, median, indusium, entire, brown.

Specimen Cited: Hansqua TE, AP Das & Chandrâ 1153, dated 14.06.2002.
Status: Abundant.
Local Distribution: In Terai and low altitude areas
General Distribution: India, China.
Note: Young fronds - cooked and eaten. Roots anodyne, antibacterial, anti-inflammatory, antiviral, astringent, febrifuge, vermifuge, worm-expellant, internal haemorrhage, uterine bleeding, mumps and feverish illnesses. Pregnant women and people with heart complaints should not consume this plant.

Dryopteris sparsa (Hamilton *ex* D. Don) O. Kuntze, Rev. Gen. Pl. 2: 813. 1891; Fern & Fern-allies Arun. Prad. I. 286. 2005; FEH 3:188. 1975.
Nephrodium sparsum D. Don, Prodr. Fl. Nepal.:6. 1825;

Rhizome erect, paleaceous. Fronds 50-70 x 15-25 cm, tufted, oblong-lanceolate, caudate acuminate. Stipes 20-30 cm, grooved. Lamina 30-45 cm, pinnae 7-11 pairs, widest at base, pinnules subsessile, oblique deltoid, acute, pinnatifid, lobes entire. Sori globose, receptacles elevated, dorsal, indusium reniform.

Specimen Cited: Tamsong TE, AP Das & Chandrâ 2027, dated 30.04. 2003.
Status: Less Common
Local Distribution: Found only in Soom & Tamsong gardens
General Distribution: India, Sri Lanka, Nepal, Myanmar, Tibet, China, Malaysia, Philippines, Japan, Taiwan.

POLYSTICHUM A. W. Roth

Polystichum lentum (D. Don) T. Moore, Ind. Fil. : 86, 95. 1858; Fern & Fern-allies Arun. Prad. I. 299. 2005.
Aspidium lentum D. Don, Prod. Fl. Nepal.:4. 1825.

Rhizomes erect, short, paleaceous, curved, teeth dark brown. Stipes dense, 8-11x 3-5 mm, ascending, margin irregularly toothed. Lamina 20-35 cm; pinnae 20-40 pairs, basal pair strongly reflexed, slightly reduced, sessile, subopposite. Sori on basal acroscopic vein, entire, peltate, deciduous.

Specimen Cited: Tamsong TE, AP Das & Chandrâ 3047, dated 10.04. 2004
Status: Common
Local Distribution: Found only in Soom & Tamsong gardens
General Distribution: India: Sikkim, West Bengal, Meghalaya, Arunachal Pradesh, Nagaland,; Nepal, Bhutan; endemic to Eastern Himalaya.

Polystichum sublentum S. Singh & Panigrahi, Fern & Fern-allies Arun. Prad. I. 307. 2005.

Rhizome erect, medium sized, paleaceous; roots profuse; paleae polymorphous. Fronds 70-90 x 8-10 cm, tufted, narrow lanceolate, pinnate, acuminate; stipes ca 30 cm long, grooved. Lamina 45-55 cm long; pinnae 35-50 pairs, subopposite to alternate, pinnatifid, acuminate. Sori mostly terminal, a few dorsal.

Specimen Cited: Makaibari TE, AP Das & Chandrâ 2791, dated 25.03. 2004.
Status: Rare
Local Distribution: Found only in Makaibari garden
General Distribution: India: Arunachal Pradesh, West Bengal; endemic
Note: New record for West Bengal.

Polystichum subapiciflorum Hayata, Ic. Pl. Formosanum 5: 335-337. 1913; Fern & Fern-allies Arun. Prad. I. 305. 2005.
Polystichum longipinnulum Nair in Amer. Fern J. 64: 15. f. 11-12. 1974.

Rhizomes erect, paleaceous. Fronds 80-110 x 20-25 cm, lanceolate, caudate acuminate, bipinnate. Stipes 35-45 cm, base densely paleaceous, grooved. Lamina 40-70 cm; pinnae 20 pairs, ascending, oblong-lanceolate, acuminate. Pinnules 13-17 pairs, subsessile, overlapping, oblique. Sori rounded, receptacles globose, sunk, terminal.

Specimen Cited: Makaibari TE, AP Das & Chandrâ 2845, dated 25.03. 2004; Tamsong TE, AP Das & Chandrâ 2054, dated 30.04. 2003.
Status: Less Common
Local Distribution: Found only in Makaibari & Tamsong gardens.

General Distribution: India, Nepal, Myanmar, Thailand, N. Vietnam, China, Philippines.

EQUISETACEAE Rich. *ex* DC.

EQUISETUM L.

Equisetum diffusum D. Don, Prod. Fl. Nepal.: 19.1825; Fern & Fern-All. Arun. Prad. 1: 78.2005

Terrestrial to sub aquatic; stem erect and diffused; aerial shoots jointed with hollow internodes. Leaves very small, whorled. Internodes ca 2- 4 cm long, sheaths loose, ridged, linear-lanceolate. Sporangia homosporus, paired; sporophylls on terminal stalked, oblong cylindrical strobilus.

Specimen Cited: Tamsong TE, AP Das & Chandrâ 2229, dated 05.09. 2003; Soom TE, ***AP Das & Chandrâ 3294***, dated 26.06. 2004.
Status: Abundant.
Local Distribution: All three hill gardens
General Distribution: West Bengal, Assam, Arunachal Pradesh, Meghalaya, Bhutan, China, Myanmar, Nepal, S. E. China.

Equisetum ramosissimum Desf. Subsp. ***debile*** (Roxburgh *ex* DC.) Hauke in Amer. Fern J. 52: 33. 1962; Fern & Fern-allies Arun. Prad. I.80.2005.
Equisetum debile Roxburgh *ex* Vaucher in Mem. Soc. Phys. Hist. Nat. Geneve 1: 387, 1822; FEH. 2: 197. 1971.

Stem creeping, subterranean, ridged and grooved, hollow, internodes 7 – 8 cm. Leaves (sheath) rudimentary, 5-6 cm long, fused laterally, toothed. Cones sessile to subsessile, terminal on branch, solitary. Sporangiophore many, whorled, very dens and compact.

Specimen Cited: Mohurgong & Gulma TE, AP Das & Chandrâ 0033, dated 27.01.2002; Tamsong TE, AP Das & Chandrâ 1944, dated 30.04. 2003.
Status: Common
Local Distribution: All Terai gardens
General Distribution: India: Himalayas, North-East region; Nepal, China, Myanmar, Thailand, Vietnam, Malaysia.
Note: Used as refrigerant and given in gonorrhea.

GLEICHENIACEAE (R. Brown) C. Presl.

DICRANOPTERIS Bernhardi

Dicranopteris linearis (N. Burman) Underw. in Bull. Torrey Bot. Cl. 34: 249. 1907; Fern & Fern-allies Arun. Prad. I. 313-314. 2005.
Polypodium lineare N.Burm., Fl. Indica: 235. t. 67. f. 2. 1768.

Rhizomes creeping. Fronds large, forming thickets; stipes stout, brown, 10-12 x 3-4 cm lanceolate, deeply lobed; ultimate-pinnae c.30 x 7 cm, lanceolate, gradually acuminate, base unequal. Ultimate-lobes oblong, 4-5 mm wide, entire, incurved. Sori round, dorsal, exindusiate, sub-basal.

Specimen Cited: Tamsong TE, AP Das & Chandrâ 2299, dated 05.09. 2003.
Status: Very common

Local Distribution: All three hill gardens

General Distribution: India, Tropical and sub Tropical Asia, Malaysia, Australia.

Note: Rhizomes anthelmintic; fronds used for asthma; rachis used for making mats, chairs, seats, pouches, caps, fishing traps, baskets, belts etc. Fronds used as one of the ingredients for making local beverages.

Dicranopteris linearis (N. Burman) Underw. var. ***montana*** Holttum in Reinwardtia 4: 276. 1957; Fern & Fern-allies Arun. Prad.I. 314. 2005.
Polypodium lineare N.Burman, Fl. Indica: 235. t. 67. f. 2. 1768.

Rhizomes long creeping. Fronds very large, dichotomously branched; stipes short to quite long, ultimate-branches 20-35 x 5-7 cm. Ultimate-pinnae falcate, deeply lobed, acuminate, brown, septate. Ultimate-lobes 5-7 mm wide, 7-15 mm apart, entire to repand. Sori round, exindusiate.

Specimen Cited: Soom TE, ***AP Das & Chandrâ*** *3732*, dated 26.06. 2004.
Status: Less Common
Local Distribution: Found only in Soom garden.
General Distribution: India, Sri Lanka, Malaysia, Moluccas.

DIPLOPTERYGIUM (Diels) Nakai

Diplopterygium blotianum (C. Christensen) Nakai in Bull. Nat. Sci. Mus. 29: 49.1950; Ferns Fern-All. Arun. Prad. I. 317. 2005.
Gleichenia blotiana C. Christensen in Bull. Mus. Hist. Nat. Paris 2 ser. 6(1): 103.1934; Bull. Bot. Surv. India 10(3-4): 339.f.15-27.1969 (1968).

Common Name: *Welcome fern*

Rhizomes long creeping; Paleae peltate, ovate-lanceolate to variously shaped, toothed, light brown on rachis, costae and costules. Fronds up to 3 m with long stipes, rachis dichotomously branched, dormant apex with small pinnatifid leaflet. Lamina oblong-lanceolate, deeply pinnatisect. Sori sterile.

Specimen Cited: Soom TE, ***AP Das & Chandrâ*** *2657*, dated 27.12. 2003.
Status: Less Common
Local Distribution: Found only in Soom garden.
General Distribution: India: Eastern Himalaya, North East India; Vietnam, S. China, Malay Peninsula.

HEMIONITIDACEAE Pichi Sermolli

PITYROGRAMMA Link

Pityrogramma calomelanos (L.) Link, Handb. d. Gewachse 3: 20.1883; Fern & Fern-allies Arun. Prad. I. 326. 2005.
Acrostichum calomelanos L., Sp. Pl. 2: 1072. 1753.

Common Name: *Silver Fern*

Rhizomes erect, short. Paleae entire, acuminate, brown. Fronds 50-90 x 7-15 cm, tufted, lanceolate. Stipes 20-40 cm, blackish brown, grooved, glabrous. Lamina 15-40 cm long, pinnae long, acuminate, pinnate to bipinnatifid, 2^{nd}- 3^{rd} pair largest. Pinnules sessile. Sori scattered on lower surface on veins along midvein, exindusiate.

Specimen Cited: Soom TE, ***AP Das & Chandrâ 3100***, dated 03.05. 2004
Status: Very common
Local Distribution: All three hill gardens
General Distribution: India, Temperate Europe and Surinam (S. America).
Note: Constituent of a decoction used in kidney troubles. Rhizomes used as an anthelmintic and leaf smoked for colds in head and chest.

HYPOLEPIDACEAE Ching *ex* Pichi Sermolli

HYPOLEPIS Bernhardi

Hypolepis punctata (Thunberg) *Mettenius ex* Kuhn, Fil. Africanae: 120. 1868; Handb. Ferns Brit. Ind. Suppl.: 19. 1892; Fern & Fern-allies Arun. Prad. I. 355. 2005.
Polypodium punctatum Thunberg, Fl. Jap.: 337. 1784.

Rhizome creeping, fronds 30-40 x 15-20 cm, acute. Stipes 10-15 cm long, grooved dorsally, hairy throughout. Lamina 20-30 cm long, Pinnae basal or next pair the largest, hairs brown, articulated, pointed, curved. Pinnules basal pair the largest, sessile. Sori antimarginal, dorsal on single vein, indusium false.

Specimen Cited: Makaibari TE, AP Das & Chandrâ 2850, dated 25.03. 2004.
Status: Common
Local Distribution: Found only in Makaibari garden
General Distribution: India: throughout the mountain region; Sri Lanka, Vietnam, Malaya Peninsula, S. China, S. Korea, Japan.
Note: Fronds used for poultice boils.

LINDSAEACEAE Ching *ex* Pichi Sermollii

ODONTOSORIA Fee

Odontosoria chinensis (L.) J. Smith in Seem. Bot. Voy. Herald: 430. 1857; Fern & Fern-allies Arun. Prad. I. 365. 2005.
Trichomanes chinense L., Sp.Pl. 2: 1099. 1753.

Rhizome short, erect, paleaceous at apex. Fronds 15-55 x 5-15 cm, tufted, tri or quadripinnate, acuminate; stipes 5-25 cm long, paleaceous at base. Lamina 10-40 cm, pinnae largest in lower half of lamina, 3-11 x 1-5 cm, alternate, acuminate, pinnules up to 3 x 1.5 cm, winged. Sori marginal, terminal on 1or 2 veins.

Specimen Cited: Soom TE, ***AP Das & Chandrâ 3596***, dated 12. 10. 2004.
Status: Less Common
Local Distribution: Found only in Soom garden
General Distribution: India: Sikkim, Assam, Meghalaya, Arunachal Pradesh; Nepal, Bhutan, Myanmar, Thailand, Vietnam, China, Malaysian Islands, Japan, Taiwan, Madagascar.
Note: New record for West Bengal. Prescribed in chronic enteritis.

LYCOPODIACEAE P. Beauv *ex* Mirb.

LYCOPODIELLA Holub

Lycopodiella cernua (L.) Pichi-Sermolli, Ollgaard in Kramer & Green, Fam. Gen. Vasc. Pl. 1:38. 1990.; Fern & Fern-allies Arun. Prad.I.: 48.2005
Lycopodium cernuum L., Sp. Pl. 2: 1103. 1753; Baker, Handb. Fern Allies : 23. 1887

Terrestrial; rhizome subterranean, simple in basal part, copiously branched above. Leaves crowded, small linear, subulate. Strobili oblong, sessile at the ends of branch lets. Sporophylls broadly ovate, cuspidate, ciliate at margins.

Specimen Cited: Tamsong TE, AP Das & Chandrâ 3014, dated 10.04. 2004; Soom TE, ***AP Das & Chandrâ 3459***, dated 12. 10. 2004; Mohurgong & Gulma TE, AP Das & Chandrâ 1525, dated 22.10. 2002.
Status: Common
Local Distribution: In Terai and low altitude areas
General Distribution: India, Tropics and subtropics of all the continents.
Note: Decoctions used in lotions in beriberi, cough and uneasiness in the chest. Embrocation of ashes in vinegar recommended for skin eruption. Plants used for stuffing pillows after drying. Ceruine and small quantities of nicotine have been isolated from the plants.

LYCOPODIUM L.

Lycopodium pseudoclavatum Ching in Acta Bot. Yunnanica 4 (3): 222. 1982; Fern & Fern-allies Arun. Prad. I.: 52.2005.
Lycopodium clavatum auct., non L. (1753); C. B. Clarke in Trans. Linn. Soc. London ser. II. Bot. 1:592. 1880, *p.p. excl. syn.*;

Terrestrial. Leaves spirally arranged, ca 0.1- 0.2 cm long, linear-lanceolate. Sporangia in strobili. Strobili erect ca 25- 30 cm long, long stalked. Sporophylls deltoid, margins irregularly ciliate. Spores oval, dark.

Specimen Cited: Soom TE, ***AP Das & Chandrâ 3392***, dated 12. 10. 2004; Tamsong TE, AP Das & Chandrâ 1956, dated 30.04. 2003.
Status: Common
Local Distribution: All three hill gardens
General Distribution: India: northern mountain region; Nepal, Bhutan, N. Myanmar, Thailand, China.
Note: Spores used as dusting powder, for sound experiments in physics, absorbent in excoriation of the skin, base for medicated snuff, covering pills to prevent adhesion, for dyspepsia, in constipation with flatulence, hepatic congestion and pustular skin eruption. In homeopathy, it is used against disorders of chest, urinary passage, rheumatism, cramps and varices. Powder employed in fireworks; flash light on the stage, as dusting powder for sand- moulds for fine casting. It contains fatty oil. The alkaloids lycopodine, clavatine and clavotoxine have been isolated.

Lycopodium serratum Thunberg, Fl. Jap. 341. t. 38. 1784; Icon. Fil. T. 37. 1827; Trans. Linn. Soc. II. Bot. 1: 591. 1880; Ferns of N. India, 591, 1973 (Ind. Reprint).

Terrestrial. Stems rigid, 15-25 cm; leaves spiral, 0.5 - 1.5 cm, spathulate, oblong, subpetiolate, serrate; Strobili distinct 1-1.5 cm, cylindrical, sporophylls spirally arranged, dense, peltate, acuminate, serrate.

Specimen Cited: Tamsong TE, AP Das & Chandrâ 3068, dated 10.04. 2004.
Status: Rare
Local Distribution: Found only in Tamsong garden
General Distribution: India, Nepal, Bhutan, Malaysia, Japan.

LYGODIACEAE C. Presl

LYGODIUM Swartz

Lygodium japonicum (Thunberg) Swartz in J. Bot. (Schrader) 1800(2): 106. 1801; Handb. Ferns Brit. Ind.: 457. 1883; Fern & Fern-allies Arun. Prad. I. 389. 2005.
Ophioglossum japonicum Thunberg, Fl. Jap.: 328. 1784.

Rhizome long creeping. Fronds 200-300 x 20-60 cm; rachis ca 2mm across, pinnae in sterile fronds tripinnate, ovate-deltoid; lamina pubescent, blackish brown when dried. Sorophores up to 7 mm long, 4-7 solitary sporangia.

Specimen Cited: Tamsong TE, AP Das & Chandrâ 2885, dated 10.04. 2004; Hansqua TE, AP Das & Chandrâ 1381, dated 20.10.2002.
Status: Less Common
Local Distribution: In Terai and low altitude areas
General Distribution: India: S. india, Assam, Meghalaya, Arunachal Pradesh, Nagaland, Manipur, Mizoram; Sri Lanka, Thailand, Vietnam, China, Malaysia, Japan, Korea, Malaya peninsula, Malesian Islands, Philippines, Australia.
Note: New record for West Bengal. Used as expectorant, decoction of fertile fronds as diuretic and cathartic.

Lygodium microphyllum (Cavan) R.Brown, Prod. Nov. Hollandiae: 162. 1810; Handb. Ferns India: 455. t. 282. 1883; Fern & Fern-allies Arun. Prad. I: 391, 2005.
Ugena microphyllum Cavan, Ic. Descr. Pl. 6(2): 76. t. 595. f. 2. 1801.

Rhizomes long-creeping. Fronds 5-7 m x 15-45 cm, tripinnate; pinnae 12-20 x 4-8 cm, ovate-oblong. Primary rachis-branches 3-5 mm long, brown; secondary rachis- branches glabrous; ultimate pinnules ovate-oblong, obtuse, smooth, veins forked, prominent. Sorophores up to 3 mm long, 4-5 sporangia on each side.

Specimen Cited: Mohurgong & Gulma TE, AP Das & Chandrâ 0975, dated 04.05. 2002; Hansqua TE, AP Das & Chandrâ 0254, dated 09.02.2002.
Status: Abundant.
Local Distribution: All Terai gardens
General Distribution: India, Sri Lanka, Africa, Melanesia, Malaysia, Hongkong, Australia.
Note: Young leaves eaten, as poultice in skin disease, swellings, their decoction used in dysentery; old rachis for basket making and plaiting.

Lygodium salicifolium C. Presl, Suppl. Tent. Pterid.: 102. 1845, *p.p. excl. pl. Wallich p.p.* and *syn. L. semibipinnatum* Wallich; Proc. Indian Acad. Sci. (Pl. Sci.) 93 (2) : 131. f. 20-22.1984; Fern & Fern-allies Arun. Prad. I: 394, 2005.
Lygodium flexuosum sensu Beddome, Handb. Ferns Brit. India : 457.1883, *p.p. incl. L. longifolium* Wallich *nom. nud. tantum pro syn.*, non (L.) Swartz

Twining fern; rhizome creeping, glabrous. Leaflets pinnate, basal leaflets large, separate or lobed; fertile leaflets narrower than sterile ones. Sori protruding from the margin; sporangia large, shortly stalked, arranged in 2 rows.

Specimen Cited: Mohurgong & Gulma TE, AP Das & Chandrâ 0014, dated 27.01.2002; Hansqua TE, AP Das & Chandrâ 0172, dated 03.02.2002; Tamsong TE, AP Das & Chandrâ 2134, dated 30.04. 2003.
Status: Abundant.
Local Distribution: In all gardens
General Distribution: India, China, Malaysia, Sri Lanka, Philippines, Australia, Africa.
Note: Used as expectorant, fresh roots used in external application for rheumatism, sprain, scabies, eczema, wounds and particularly useful for carbuncles.

MARATTIACEAE Bercht. & J.S. Presl.

ANGIOPTERIS Hoffmann

Angiopteris crassipes Wallich *ex* C. Presl, Tent. Pterid. Suppl.: 23.1845. Fern & Fern-allies Arun. Prad. 1: 397. 2005.
Angiopteris evecta sensu auct. multi.; Beddome, Handb. Ferns Brit. Ind. 460. t. 285. 1883; Holttum, Rev. Fl. Malaya 2:44.t.3 A-D.1955, *non* (G. Forst.) Hoffmann

Terrestrial, rhizome erect, broad. Stipe long, swollen at base. Fronds ca 100-200 cm long, 2 pinnate; pinnae ca 80 cm long, pinnules shortly stalked, acuminate. Sori dark-brown, arranged in two close rows.

Specimen Cited: Makaibari TE, AP Das & Chandrâ 2821, dated 23.02. 2004.
Status: Rare
Local Distribution: Found only in Makaibari garden
General Distribution: Hilly regions of India, Nepal, Bhutan, Myanmar, Australia, China, Japan, Madagascar, Malaysia.
Note: Aromatic oil is used to perfume coconut oil in Pacific (May, 1978), massive short stem, full of starch, is edible in India and form the basis of an intoxicating drink. Leaves used as head dresses and temporary beds; stipules have been eaten by man in times of extreme food scarcity and frequently eaten by wild pigs; an alcoholic drink has been brewed from stipules. Stem is reported to be very effective in curing white patches on skin in Central India.

MARSILEACEAE R. Brown

MARSILEA L.

Marsilea quadrifolia L. Sp.Pl. 1099. 1753; Prodr. Fl. Nepal. 19.1825.
Marsilea crenata Presl, Rel. Haenck. 1: 84 (1825); FEH 2: 221. 1971.

Amphibious; rhizome long, creeping; rooting at nodes. Stipes with four leaflets, Pinnae entire, forked. Sporocarps oval, 2-4 in a group.

Specimen Cited: Kamalpur TE, AP Das & Chandrâ 0457, dated 17.04.2002.
Status: Common
Local Distribution: All Terai gardens

General Distribution: India: Himalaya,South India; Nepal, Bhutan, Bangladesh, Japan, Philippines, Malaya Islands, Malaya peninsula, Europe, North America, Russia.

MONACHOSORACEAE (Crabbe, Jermy & Mickel) Ching

MONACHOSORUM Kuntze

Monachosorum henryi Christ in Bull. Herb. Boiss. 6: 869. 1898; FEH 1: 463. 1966; Ferns Fern-All. Arun. Prad. I. 402. 2005.
Phegopteris subdigitata sensu Beddome, Handb. Ferns Brit. India: 295. 1883, *p.p.*

Rhizomes wide creeping. Fronds ca 100 x 50 cm, quadripinnate; rachis pubescent; hairs brown. Pinnae 20-30 x 10-20 cm, alternate, elliptic-lanceolate, acuminate; pinnules the largest in middle of pinnae, gradually acuminate, upper surface glabrous; Sori rounded, median, subterminal, exindusiate.

Specimen Cited: Mohurgong & Gulma TE, AP Das & Chandrâ 0068, dated 27.01. 2002.
Status: Less Common
Local Distribution: Found only in Mohurgong & Gulma garden
General Distribution: India, Nepal, Bhutan, Vietnam, S. China.

NEPHROLEPIDACEAE Ponce de Leon *ex* Pichi Sermolli

NEPHROLEPIS Schott

Nephrolepis auriculata (L.) Trimen in J. Linn. Soc. London Bot. 24: 152. 1887; Bot. J. Linn. Soc. 84: 7, 20. 1982; Fern & Fern-allies Arun. Prad. I. 405. 2005.
Polypodium auriculatum L., Sp.Pl. 2: 1088. 1753.
Nephrolepis cordifolia sensu auct. pl., non (L.) Presl (1836); Trans. Linn. Soc. London ser. II. Bot. 1: 541. 1880, *p.p.*

Rhizome short, erect, paleaceous at apex; roots thick, bearing fleshy tubers; Fronds 35-50 x 4.5-5.0 cm, tufted, linear-elliptic, acuminate, pinnate; stipes 4-6 cm long, pale brownish, paleaceous; pinnae largest in the middle of the fronds, 20-25 x 7-8 mm, sessile, alternate, drying pale green. Sori median, terminal, indusium reniform.

Specimen Cited: Makaibari TE, AP Das & Chandrâ 2473, dated 11.11. 2003; Tamsong TE, AP Das & Chandrâ 2233, dated 05.09. 2003.
Status: Abundant.
Local Distribution: In all gardens
General Distribution: India, Tropical Asia.
Note: Tubers are edible and decoction of the fresh fronds given in cough and highly ornamental.

PARKERIACEAE Hooker

CERATOPTERIS Ad. Brongniart

Ceratopteris thalictroides (L.) Brongniart in Bull. Sci. Soc. Philom. Paris 1821: 186. cum *tabula*, 1822; Handb. Ferns Brit. Ind.: 123. 1883; Fern & Fern-allies Arun. Prad. II. 430. 2005.
Acrostichum thalictroides L., Sp. Pl. 2: 1070. 1753.

Rhizome short, erect, roots fibrous, annual in marshes or on moist soil. Fronds dimorphic, herbaceous; sterile fronds 5-40 x 3-25 cm, ovate-lanceolate, lobed. Stipes wrinkled on drying.

Fertile fronds 3-100 x 3-40 cm, lanceolate, acute to acuminate. Stipes similar to sterile fronds; lamina 3-60 x 3-40 cm, acute to acuminate. Sporangia dorsal, solitary, indusium absent.

Specimen Cited: Hansqua TE, AP Das & Chandrâ 1664, dated 13.11. 2002.
Status: Abundant.
Local Distribution: All Terai gardens
General Distribution: India; Pantropics and Subtropics.
Note: Mabberley (1987) states that "much cultivated in flooded rice fields etc. as a spring vegetable (esp. Japan)"; also used as poultice in skin complaints and as tonic in styptic. Vegetative fronds are edible both as green salad and after cooking as potherb.

POLYPODIACEAE Bercht. & J.S. Presl

ARTHROMERIS (T. Moore) J. Smith

Arthromeris himalayansis (Hooker) Ching, Contrib. Inst. Bot. Nat. Acad. Peiping 2: 99 1933; FEH 489.1966; Candollea 27:279.1972; FEH 3: 195.1975.
Polypodium himalayense Hooker, Sp. Fil. 5: 91 (1863).

Rhizomes creeping, thick, long acuminate, paleaceous; Fronds up to 50-60 x 15-18 cm, distant, imparipinnate. Stipes ca 12 cm long, articulated, glabrous, slender. Lamina up to 40 cm long; pinnae up to 15 x 6 cm, subsessile, ovate-lanceolate, serrulate, acute to acuminate. Sori globose, paraphyses absent.

Specimen Cited: Makaibari TE, AP Das & Chandrâ 2809, dated 25.03. 2004.
Status: Rare
Local Distribution: Found only in Makaibari garden
General Distribution: Eastern Himalaya, Western China and North Burma.

Arthromeris lehmanni (Mettenius) Ching in Contrib. Inst. Bot. Nat. Acad. Peiping 2: 96. 1933; Fern & Fern-allies Arun. Prad. II. 442. 2005.
Polypodium lehmanni Mettenius, Abh. Senck. Naturf. Ges. 2(1): 109. Oct. 1857 (Farngatt. 1: 117. t. 3. f. 35. 1857).

Rhizomes wide creeping, thick, paleaceous; paleae peltate, brown. Fronds up to 50 x 15 cm, distant, paripinnate. Stipes ca 13 cm, articulated, glabrous, slender. Lamina up to 30 cm long; pinnae up to 15 x 1.8 cm, sessile, lanceolate, entire, acuminate. Sori globose in 2-rows in between 2-lateral veins.

Specimen Cited: Soom TE, ***AP Das & Chandrâ 3266***, dated 26.06. 2004.
Status: Common
Local Distribution: Found only in Soom & Tamsong gardens
General Distribution: India, Myanmar, Vietnam, China.

Arthromeris wallichiana (Sprengel) Ching , Contr. Inst. Bot. Nat. Acad. Peiping 2: 92 (1933); FEH 490 .1966; FEH 3: 196.1975.
Polypodium wallichianum Sprengel, Syst. Veg. 4: 53 (1827), based on *P. juglandifolium* D Don.

Rhizomes wide creeping, thick, paleaceous; Fronds up to 40 x 12 cm, distant, imparipinnate Stipes ca 13 cm, articulated, glabrous, slender. Lamina up to 30 cm long, leathery; pinnae up t(12 x1.5 cm, sessile, lanceolate, entire, acuminate. Sori globose in 2-rows, between 2-latera veins.

Specimen Cited: Makaibari TE, AP Das & Chandrâ 3341, dated 26.09. 2004.
Status: Rare
Local Distribution: Found only in Makaibari garden
General Distribution: India, Nepal.

COLYSIS C. Presl

Colysis decurrens (Blume) Panigrahi, Abstr. and Souv. Nation. Symp. Curr. Trends Pterid. 1991: 13. 1991; Ferns Fern-All. Arun. Prad. II. 447. 2005.
Leptochilus decurrens Blume, Enum. Pl. Javae: 206. 1828.

Rhizomes wide creeping, paleaceous; Fronds simple, strongly dimorphic. Sterile 40-50 x 6- 7.5 cm, grooved, paleaceous at the base; lamina elliptic-lanceolate, entire, repand, subacuminate. Fertile 30-50 x 0.8- 1 mm, stipes 30-50 cm, grooved, lamina linear, entire. Sori acrostichoid covering entire lower surface of the lamina.

Specimen Cited: Tamsong TE, AP Das & Chandrâ 3081, dated 10.04. 2004.
Status: Rare
Local Distribution: Found only in Soom & Tamsong gardens
General Distribution: India, Myanmar, Malaya, Vietnam, China, Taiwan, Malesia to Polynesia.

DRYNARIA (Bory) J. Smith

Drynaria propinqua (Wallich ex Mettenius) J. Smith [in J. Bot. 4: 61. 1841] *ex* Beddome, Ferns Brit. Ind.: t. 160. 1866, & Handb. Ferns Brit. Ind.: 339. t. 189. 1883; Ferns Fern-All. Arun. Prad. II. 456. 2005.
Polypodium propinquum Wallich ex Mettenius In Abh. Senck. Naturf. Ges. (Farngatt.) 2: 120. t. 3. f. 50. 1857.

Rhizome long, creeping, thick, paleaceous; paleae peltate, ovate-lanceolate, long acuminate, brown with darker brown at sinus. Fronds dimorphic; sterile 16-22 x 15-18 cm, sessile, broadly ovate, pinnatifid, entire, acute, brown; fertile 25-50 x 16-25 cm long, paleaceous at base, lamina pinnatisect, ovate, caudate acute. Sori round, basal large, in two rows along the costae.

Specimen Cited: Makaibari TE, AP Das & Chandrâ 2520, dated 11.11. 2003.
Status: Rare
Local Distribution: Found only in Makaibari garden
General Distribution: India, Nepal, Bhutan, Myanmar.

Drynaria quercifolia (L.) Small in J. Bot. 3: 398. 1841; Handb. Ferns Brit. Ind. 341. t. 191. 1883.
Polypodium quercifolium L., Sp. Pl. 1541. 1753.

Epiphytic herb; rhizome scales linear, cordate, dark brown. Fronds dimorphic; sterile fronds overlapping the base of fertile fronds; fertile fronds ovate to oblanceolate, ca 30-70 cm long, pinnatisect, stipitate. Sori small, copious, biseriate lamina in between lateral veins.

Specimen Cited: Makaibari TE, AP Das & Chandrâ 1877, dated 10.06. 2003..
Status: Abundant.
Local Distribution: In all gardens
General Distribution: India, China, Malaya, Tropical Australia.

GONIOPHLEBIUM (Blume) C. Presl

Goniophlebium argutum (Wallich *ex* Hooker) Beddome, Ferns Br. Ind. pl. 6 (1865), (1883) 323, f. 174; Ferns Fern-All. Arun. Prad.II. 459. 2005.
Polypodium argutum Wallich *ex* Hooker Sp. Fil. 5:32.1863 ;FEH 497 .1966; FEH 3: 202.1975.

Rhizome wide-creeping, paleaceous, thick. Paleae peltate, ovate-lanceolate, entire, acuminate, brown. Fronds with long glabrous stipes. Lamina long with lobes subulate-lanceolate, base dilated, subentire to distantly minutely crenate, acuminate, costate, blackish, sparsely paleaceous below. Sori rounded, median, terminal, sunk, brown.

Specimen Cited: Soom TE, ***AP Das & Chandrâ 3571***, dated 12. 10. 2004.
Status: Less Common
Local Distribution: Found only in Soom garden
General Distribution: India, Thailand, Indo-China, China, Philippines.

MICROSORUM Link

Microsorum dilatatum (Beddome) Sledge in Bull. Br. Mus. Nat. Hist. (Bot.) 2: 143.1960; Ferns Fern-All. Arun. Prad.II. 474. 2005.
Pleopeltis dilatata Beddome, Ferns Brit. India: t.122.1866.

Rhizomes creeping, thick, paleaceous; roots many; paleae pseudopeltate, lanceolate, acuminate, brown; Fronds 40-100 x 20-50 cm, distant; stipes winged. Lamina up to 90 cm, elliptic broad, caudate acute, pinnatifid; lobes subulate-lanceolate to elliptic or oblong, acuminate, entire. Sori rounded to slightly elongated, interrupted, superficial, dorsal, scattered irregularly beneath.

Specimen Cited: Tamsong TE, AP Das & Chandrâ 2094, dated 30.06. 2003.
Status: Less Common
Local Distribution: Found only in Tamsong garden
General Distribution: India, Sri Lanka, Nepal, Myanmar, Malaya, China, Taiwan, S. Japan.

Microsorum membranaceum (D. Don) Ching, Bull. Fan Mem. Inst. Biol. 4: 309 (1933); FEH 495 .1966; 3: 201.1975.
Polypodium membranaceum D. Don, Prodr. Fl. Nepal.: 2. 1825. Ferns of N. India, 560, 1973.

Rhizomes stout, shortly creeping, with ovate lanceolate scales; fronds large, lanceolate, thin, membranous, green, gradually narrowed at the base to a short stipe; Sori many, rarely coalescent, on the anastomosing veinlets included in the areola between the secondary veins.

Specimen Cited: Soom TE, ***AP Das & Chandrâ 3198***, dated 26.06. 2004.
Status: Rare
Local Distribution: Found only in Soom garden
General Distribution: India, Sri Lanka.

Microsorum pteropus (Blume) Copel. in Uni. Calif. Publ. Bot. 16: 112. 1929; Ferns Fern-All. Arun. Prad. II. 479. 2005.
Polypodium pteropus Blume, Enum. Pl. Javae addenda: 3. 1828, & Fl. Jav. Fil. : 168. t. 76. 1829.

Rhizomes wide creeping, paleaceous, brown with dense hairs; paleae ovate-lanceolate, entire, acute. Fronds 15-35 x 10-17 cm; stipes 15 cm, densely paleaceous. Lamina up to 20 cm long, deltoid to rhomboid, trilobed, elliptic-lanceolate, entire, acuminate, drying dark green. Sori rounded to oblong.

Specimen Cited: Tamsong TE, AP Das & Chandrâ 3036, dated 10.04. 2004.
Status: Less Common
Local Distribution: Found only in Soom & Tamsong gardens
General Distribution: India, Sri Lanka, Nepal, Bhutan, Myanmar, Malaya, China, Vietnam, Philippines.

NEOCHEIROPTERIS Christ

Neocheiropteris normalis (D. Don) Tagawa in J. Jap. Bot. 27: 217.1952. Ferns Fern-All. Arun. Prad. II. 487. 2005.
Polypodium normale D. Don, Prod. Fl. Nepal. 1: 1825.

Rhizomes wide creeping, stout, paleaceous. Roots sparse, long, stout. Paleae peltate, ovate to circulate, toothed, dark brown, long pale hairs at sinus. Fronds simple, narrow, elliptic-lanceolate, sessile to stipes, repand, acuminate. Rachis raised on lower surface and sparsely paleaceous. Sori round, large, superficial, nearer to rachis in one row on each side.

Specimen Cited: Soom TE, ***AP Das & Chandrâ*** 2647, dated 27.12. 2003.
Status: Rare
Local Distribution: Found only in Soom garden
General Distribution: India, Nepal, Bhutan, N. Myanmar, S. China, Thailand, Malaya, Indonesia.

PHYMATOSORUS Pichi-Sermolli

Phymatosorus cuspidatus (D.Don) Pichi-Sermolli in Webbia 31:249.1977; Ferns Fern-All. Arun. Prad. II. 496. 2005.
Polypodium cuspidatum D. Don, Prod. Fl. Nepal.: 2. 1825.

Rhizomes wide, creeping, paleaceous; paleae circular, peltate, entire. Fronds 80-120 x 20-45 cm, caudate-acuminate, pinnate. Stipes 30-50 cm, grooved, smooth. Lamina 50-70 cm; pinnae 9-11 pairs, 15-25 x 1.5-3 cm, lanceolate, entire, acuminate. Sori round in two rows, dorsal on veins, sunken, papillae on dorsal side.

Specimen Cited: Makaibari TE, AP Das & Chandrâ 2799, dated 25.03. 2004.
Status: Rare
Local Distribution: Found only in Makaibari garden
General Distribution: India, Nepal, Vietnam, China, Vietnam, Laos.

PLEOPELTIS Humboldt & Bonpland *ex* Willdenow

Pleopeltis bicolor (Takeda) Sledge in Bull. Br. Mus. Nat. Hist. 2(5): 138. 1960; Ferns Fern-All. Arun. Prad. II. 503. 2005.
Polypodium excavatum var. *bicolor* Takeda in Notes R. Bot. Gard. Edinburgh 8: 280. 1915.

Rhizomes creeping, short, paleaceous; paleae 6 x 2.5 mm, peltate, lanceolate, toothed, acute, bicolorous. Fronds 35-45 x 2.5-2.7 cm; stipes 0.5- 1 cm long, paleaceous; lamina elliptic lanceolate, long acuminate, reticulate. Sori round, median, large, sunk, paraphyses long stalked, peltate.

Specimen Cited: Mohurgong & Gulma TE, AP Das & Chandrâ 0054, dated 27.01.2002.

Status: Abundant
Local Distribution: In all gardens.
General Distribution: India, Nepal, Bhutan, Myanmar, China.

Pleopeltis contorta (Christ) Alston & Bonner in Candollea 15: 209. 1956; Ferns Fern-All. Arun. Prad. II. 503. 2005.
Polypodium lineare var. *contortum* Christ in Nuovo Giorn. Bot. Soc. Ital. n.4: 98. pl. 1. f.3. 1897.

Rhizome wide creeping, paleaceous; paleae peltate, lanceolate, brown. Fronds 15-25 x 0.5-1 cm; stipes 0.5-1.5 cm long, paleaceous at the base; lamina narrow linear to elliptic-lanceolate, entire in sterile portions to repund in fertile portion, long acuminate; Sori rounded to oblong, median, paraphyses brown, shortly stalked, dentate.

Specimen Cited: Tamsong TE, AP Das & Chandrâ 2283, dated 05.09. 2003.
Status: Less Common
Local Distribution: Found only in Soom & Tamsong gardens
General Distribution: India, China, Tibet.

Pleopeltis leiopteris (Kuntze) S. Singh & Panigrahi in J. Hill Res. 3: 18. 1990; Ferns Fern-All. Arun. Prad. II. 506. 2005.
Polypodium leiopteris Kuntze in Linnaea 23: 279, 319. 1850.

Rhizomes wide creeping, densely paleaceous; roots thin, short; paleae peltate, lanceolate, dull brown, persistent on rhizomes and rachis. Fronds 30-37 x 1.6 cm; stipes to 1 cm, paleaceous at base, glabrous. Lamina narrow linear-elliptic, acuminate; Sori round, large, near midvein in two rows, slightly sunk.

Specimen Cited: Tamsong TE, AP Das & Chandrâ 2096, dated 30.04. 2003.
Status: Less Common
Local Distribution: Found only in Soom & Tamsong gardens
General Distribution: India, China, Thailand.

Pleopeltis macrosphaera (Baker) Panigrahi & Patnaik in Proc. Nat. Acad. Sci. India, B, 34: 481. 1964; Ferns Fern-All. Arun. Prad. II. 511. 2005.
Polypodium macrosphaerum Baker in Kew Bull.: 55. 1895.

Rhizomes short creeping, paleaceous; paleae peltate, ovate-elliptic, entire, obtuse, brown, bicolorous, deciduous. Fronds 20-40 x 1.5-1.8 cm, close; stipes 3-4 cm, glabrous; lamina linear-elliptic, entire or repand, acuminate, reticulate. Sori round, on vein plexus, submarginal, paraphyses brown, long stalked, subentire.

Specimen Cited: Tamsong TE, AP Das & Chandrâ 3089, dated 10.04. 2004.
Status: Rare
Local Distribution: Found only in Tamsong garden
General Distribution: India, China.
Note: New record for West Bengal.

Pleopeltis nuda Hook., Exot. Fl. 1: t. 63. 1823; Ferns Fern-All. Arun. Prad.II. 513. 2005.
Pleopeltis wightiana (Hook.) Beddome, Ferns S. India: 60. t. 180. 1864.

Rhizomes widely creeping, drying blackish brown, paleaceous; roots long, less branched, subglabrous. Paleae peltate, lanceolate, subentire, acute, thin, brown. Fronds 15-26 x 1.8-2.3 cm.

Stipes 1.5-3.5 cm, glabrous; lamina elliptic lanceolate, entire, gradually acuminate. Sori round, sunk papillate dorsally on vein-plexus.

Specimen Cited: Soom TE, ***AP Das & Chandrâ 3223***, dated 26.06. 2004.
Status: Rare
Local Distribution: Found only in Soom garden
General Distribution: India, Sri Lanka, Nepal, Thailand, China.

PYRROSIA Mirbel

Pyrrosia lanceolata (L.) Farwell in Amer. Midland. Nat. 12: 245. 1931; Ferns Fern-All. Arun. Prad. II. 537. 2005.
Acrostichum lanceolatum L., Sp. Pl. 2: 1067. 1753.

Rhizomes wide-creeping, paleaceous. Paleae up to 6 x 0.5 mm, peltate, lanceolate, long toothed to hairy, acuminate, brown. Fronds up to 11 x 0.5 cm, sessile. stipes ca 1 cm, elliptic to lanceolate, entire, acute. Sori globose, close, sunk, stellate-hairs with lanceolate arms.

Specimen Cited: Makaibari TE, AP Das & Chandrâ 2818, dated 25.03. 2004.
Status: Common
Local Distribution: Found only in Makaibari garden
General Distribution: India, Sri Lanka, China, Polynesia.
Note: New record for West Bengal.

PTERIDACEAE Reichb.

ALEURITOPTERIS Fee

Aleuritopteris albo-marginata (C.B.Clarke) Ching in Hong Kong Nat. 10: 199. 1941; Ferns Fern-All. Arun. Prad. II. 560. 2005.
Cheilanthes albo-marginata C. B.Clarke in Trans. Linn. Soc. London. Ser. II. Bot. 1: 456. f. 52. 1880; Handb. Ferns Brit. India: 94. 1883.

Rhizomes short, paleaceous; roots thick; Fronds 30 x 8 cm, deltoid or ovate-lanceolate, bipinnatifid; stipes up to 12 cm, blackish brown, paleaceous. Lamina up to 18 cm; pinnae 4 x 3.5 cm, basal pair largest, sessile, oblique deltoid, acute, margin irregular; Sori marginal, terminal, indusium false, broad reniform; sporangium very few.

Specimen Cited: Soom TE, ***AP Das & Chandrâ 3421***, dated 12. 10. 2004.
Status: Abundant.
Local Distribution: In all gardens
General Distribution: India, Nepal, Bhutan, China.

PTERIS L.

Pteris aspericaulis Wallich *ex* J. Agardh, Rec. Spec. Gen. Pterid.: 22. 1839; Ferns Fern-All. Arun. Prad. II.: 565.2005
Pteris quadriaurita Retz. var. *aspericaulis* (Wallich *ex* J. Agardh) Bedd., Handb. Ferns Brit. India: 111. 1883.
Pteris aspericaulis Wallich, Num. List No. 107. 1829, *nom. nud.*

Rhizomes erect, medium sized, paleaceous at apex. Roots firm, brown. Fronds 80-100 x 30-40 cm, tufted, ovate to ovate-lanceolate, caudate acuminate, bipinnatisect. Lamina 30-40 cm long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with 3-7 pairs pinnae, basal most or 2 nd pair the largest. Sori marginal, elongated, reaching sinusand almost to tip with dark brown spores.

Specimen Cited: Hansqua TE, AP Das & Chandrâ 1065, dated 09.05.2002.
Status: Common
Local Distribution: All Terai gardens
General Distribution: India, Nepal, Myanmar, Thailand, China.

Pteris biaurita L, Sp. Pl. 2: 1076. 1753; Ferns S. India : t. 44. 1863; Fern & Fern-allies Meghalaya 110. 1982; Ferns Fern-All. Arun. Prad. II.: 569.2005

Terrestrial fern; rhizome short with many crowded roots. Scales linear-lanceolate, dark brown. Lamina deeply two pinnatifid, glabrous; pinnae 5-9 pairs with a single apical pinna. Fertile pinnae narrower and shorter than sterile ones. Sori confluent along the margin of the sinus but not reaching the apex of lobes.

Specimen Cited: Mohurgong & Gulma TE, AP Das & Chandrâ 0923, dated 04.05. 2002; Makaibari TE, AP Das & Chandrâ 2571, dated 11.11. 2003; Soom TE, ***AP Das & Chandrâ 2659***, dated 27.12. 2003; Tamsong TE, AP Das & Chandrâ 2033, dated 30.06. 2003.
Status: Abundant.
Local Distribution: All Terai gardens
General Distribution: India, China, Malaysia, Sri Lanka, Philippines, Australia, Africa.

Pteris ensiformis N. Burm., Fl. Ind.: 230 1768; Handb. Ferns Brit. Ind. 107.t.58. 1883; Fern & Fern-allies Arun. Prad. II. 576. 2005.

Rhizomes creeping, short, paleaceous. Fronds dimorphic. Pinnae subsessile, deltoid lanceolate, serrate, acute. Sori marginal, elongated, uninterrupted.

Specimen Cited: Makaibari TE, AP Das & Chandrâ 2560, dated 11.11. 2003.
Status: Less Common
Local Distribution: Found only in Makaibari garden
General Distribution: India: throughout, Sri Lanka, Nepal, Bhutan, Bangladesh, Myanmar, China, Japan, Taiwan, Philippines, Malaya Islands, Tropical Australia, Polynesia, Micronesia.

Pteris semipinnata L., Sp.Pl. 2: 1076. 1753; Handb. Ferns Brit. Ind.: 109. t. 58. 1883; Ferns Fern-All. Arun. Prad. II. 591. 2005.
Pteris dimidiata Willd., Sp.Pl. 5: 381. 1810.

Rhizome erect, short, paleaceous, hard. Fronds 50–65 x 15-25 cm, pinnate, caudate acuminate. Stipes 20-30 cm, brown lustrous, grooved, smooth. Lamina 30-40 cm; pinnae 12-18 x 5-8 cm, sessile, long acuminate, sterile serrate, fertile entire, costae brown. Sori marginal, elongated, interrupted at sinus and apex of lobes.

Specimen Cited: Makaibari TE, AP Das & Chandrâ 1900, dated 10.06. 2003.
Status: Common
Local Distribution: All Terai gardens
General Distribution: India, Nepal, Bhutan, Myanmar, S. E. China, Malaya peninsula, Japan, Taiwan, Philippines, Borneo.

Pteris vittata L., Sp. Pl. 2: 1074. 1753; Ferns Fern-All. Arun. Prad. II: 605, 2005.

Pteris longifolia auct, quoad pl. Asia; sensu Beddome, Handb. Fern Brit. India: 106 t. 55. 1883, *p.p.*

Rhizomes erect, short, paleaceous; paleae up to 4 x 0.5 mm, basifixed, entire, acuminate,pale, thin. Fronds 50-75 x 18-22 cm, oblanceolate, caudate-acute, pinnate; stipes 10-15 cm, grooved, pale brown. Lamina 40-60 cm; pinnae up to 12 x 0.7 cm, sessile, linear to subulate-lanceolate. Sori marginal, elongated, indusium entire, thick, pale brown.

Specimen Cited: Kamalpur TE, AP Das & Chandrâ 0576, dated 20.04.2002.
Status: Abundant.
Local Distribution: In all gardens
General Distribution: India, Cosmopolitan.

PTERIDIACEAE Ching

PTERIDIUM Gleditsch *ex* Scopoli

Pteridium aquilinum (L.) Kuhn subsp. ***aquilinum*** var. ***wightianum*** (J.Agardh) Tryon in Rhodora 43: 22. pl. 650. f. 1, pl. 651. f. 3. 1941; Ferns Fern-All. Arun. Prad. II: 610, 2005.

Rhizomes wide creeping, thick, hairy. Fronds up to 150 x 100 cm, 4-7 m tall, ovate, tripinnatifid; stipes 60 cm, grooved. Lamina up to 100 cm; pinnae 40-45 x 15-35 cm, opposite, bipinnatifid, oblong-lanceolate/ ovate-acuminate, densely hairy. Pinnules up to 20 x 3 cm, alternate to opposite, sessile, oblong-lanceolate, deeply pinnatifid, smooth. Sori marginal, elongated, indusium double, paraphyses absent.

Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0317,*** dated 16.02. 2002; Tamsong TE, AP Das & Chandrâ 2255, dated 05.09. 2003.
Status: Very common
Local Distribution: In all gardens
General Distribution: India, Sri Lanka, Nepal, Bhutan, Myanmar, Thailand, Vietnam, Taiwan, Java, Indonesia, Philippines, North and South America.
Note: Boiled rhizomes eaten during scarcity, or grounded into flour for making bread. Rhizomes used for brewing local beer; contains bitter saponin toxic to fish and non-toxic to rabbits. Young fronds used as vegetables, as soup, fodder and dried fronds as packing material. Rhizome astringent and anthelmintic; proves fatal when consumed more and solely. Used formerly as a source of potash for making glass and soap, for thatch, swine food, bedding material for animals and man. Young leaves contain a nerve poison and are carcinogenic. In Japan, the young leaves are consumed and cause stomach cancer.

SELAGINELLACEAE Palisot de Beauvois

SELAGINELLA Palisot de Beauvois

Selaginella bisulcata Spring, Mém. Acad. Sci. Belg. 24: 259 (1850); FEH 2:200 .1971; 3: 167.1975.

Common Name: *Spike Moss*

Rhizomatous, bushy, creeping, erect bases bearing soft branches arched outward, successively branching and lacily cut to narrow skeleton segments. Stems long, rooting at prostrate base only.

Stem leaves distant, almost uniform, adpressed, oblique-ovate, entire. Strobili 5-6 mm long. A laminar flap present on the adaxial surface of larger sporophylls.

Specimen Cited: Soom TE, ***AP Das & Chandrâ 2640***, dated 27.12. 2003.
Status: Very common
Local Distribution: In all gardens
General Distribution: N. India, Yunnan, Burma, and N. Thailand.
Note: Highly ornamental, much cultivated in gardens as potted plants or trained in trellis as climbers, as potted plants they decorate indoors due to their attractive feathery foliage. Sold in Indian markets as resurrection plant. It is reputed as '*Sanjeevany*' and is sold during summer as cooling agent.

Selaginella monospora Spring in Mem. Acad. Roy. Sci. Belg. 24: 135. 1850; Ferns Fern-All. Arun. Prad.I. 62. 2005.

Plants 15-50 cm long, prostrate-ascending; stems thin at base, glabrous, rooting in lower ½ to 2/3 of stem. Stem-leaves dimorphic, dorsal leaves adpressed, broad ovate, toothed, ventral leaves overlapping, oblique-ovate, obtuse. Branch axillary-leaves broad ovate, acute. Strobili terminal, simple; sporophylls uniform, spiral, broad ovate, acuminate, green.

Specimen Cited: Tamsong TE, AP Das & Chandrâ 2447, dated 05.11. 2003.
Status: Very common
Local Distribution: All three hill gardens
General Distribution: India, Nepal, Bhutan, Myanmar, Thailand, China, Vietnam.

Selaginella semicordata (Wallich *ex* Hooker & Grev.) Spring in Mart. Fl. Bas. 1(2): 122. 1840; Ferns Fern-All. Arun. Prad. I. 69. 2005.
Lycopodium semicordatum Wallich *ex* Hooker & Grev. in Hook. Bot. Misc. 2: 396. 1831.

Plants prostrate-ascending, 10-20 cm long, glabrous, pinnately branched, rooting in basal 2/3rd; rhizophores long, axillary; stem leaves dimorphic; dorsal leaves antrorse, ovate-oblong, entire, acute; lateral leaves broad ovate, entire, acute. Branch axillary-leaves ovate, entire, acute. Strobili 5-8 mm long, simple, terminal; sporophylls uniform, ovate lanceolate, entire, acuminate, keeled.

Specimen Cited: Kamalpur TE, AP Das & Chandrâ 0420, dated 27.02.2002; Makaibari TE, AP Das & Chandrâ 2789, dated 25.03. 2004.
Status: Less Common
Local Distribution: All Terai gardens
General Distribution: India, Nepal, Bangladesh, Myanmar, Malaya Peninsula.

Selaginella tenuifolia Spring in Mem. Acad. Roy. Sci. Belg. 24:253.1850; Ferns Fern-All. Arun. Prad. I. 71. 2005.

Plants 4-7 cm long, rooting at base, rhizophores small in basal 2-3 nodes. Stems glabrous, c.1 mm across, drying stramineous, pinnately branched. Branches further pinnately branched, glabrous, slender. Stem leaves dimorphic. Strobili 5-7 x 3-3.1 mm with dimorphic sporophylls. Spores yellow, tuberculated on dorsal side.

Specimen Cited: Soom TE, ***AP Das & Chandrâ 3586***, dated 12. 10. 2004.
Status: Common

Local Distribution: Found only in Soom & Tamsong gardens
General Distribution: India, Myanmar, Thailand, Laos.

TAENITIDACEAE (C. Presl) Pichi Sermolli

ONYCHIUM Kaulfuss

Onychium siliculosum (Desvaux) C. Christensen, Ind. Fil.: 469. 1906; Ferns Fern-All. Arun. Prad. II. 619. 2005.
Pteris siliculosa Desv., Naturforsch. Freund. Berl. Mag. 5: 324. 1811.

Common Name: *Golden Fern*

Rhizomes erect, short, brown, paleaceous. Fronds 25-80 x 8- 25 cm, deltoid to lanceolate, tripinnate to quadripinnate, sterile fronds more dessected; fertile fronds ovate-lanceolate; stipes 13-40 cm, paleaceous at base, grooved. Lamina 13-30 cm long; pinnae lowest pair the largest. Sori marginal elongated to almost entire, indusium entire, thin, waxy powder yellow, opening at maturity.

Specimen Cited: Mohurgong & Gulma TE, AP Das & Chandrâ 1604, dated 22.10. 2002.
Status: Very common
Local Distribution: In all gardens
General Distribution: India, Nepal, Bhutan, Myanmar, Vietnam, W. China, Malaysian Islands, Taiwan, Philippines
Note: Decoction of the fronds used in dysentery.

TECTARIACEAE (Holttum *ex* Nayar) Panigrahi

TECTARIA Cavanilles

Tectaria coadunata (J. Smith) C. Christensen in Contrib. U. S. Nation. Herb. 26: 331. 1931; Ferns Fern-All. Arun. Prad. II. 633. 2005.
Sagenia coadunata J. Bot. 4: 184. 1841; Ferns S. India: 28. t. 81. 1863.

Pinnae ca 50 x 30 cm wide, tripinnatifid, oblong, caudate acute; coastae grooved. Pinnules ca 13 x 10-13 cm, suopposite, oblong, acuminate. Lobes broad ovate, obtuse, shallowly lobed to entire. Sori round, terminal on included veinlets in 2-rows along midvein in areoles, slightly sunk; indusium large, persistent reniform, thin, subentire.

Specimen Cited: Soom TE, ***AP Das & Chandrâ 3204***, dated 26.06. 2004; Tamsong TE, AP Das & Chandrâ 2167, dated 30.06. 2003.
Status: Very common
Local Distribution: In all gardens
General Distribution: India, Sri Lanka, Myanmar, S. W. China, North Malaysia, Taiwan, Thailand.
Note: Used as medicine in acute cases of diarrhoea in children and other stomach troubles and eaten as salad.

Tectaria dubia (C.B.Clarke & Baker) Ching in Sinensia 2(2): 23. pl. 5. 1931; Ferns Fern-All. Arun. Prad. II. 637. 2005.

Nephrodium cicutarium var. *dubia* C.B.Clarke & Baker in J. Linn. Soc. London 24: 417. 1888.

Rhizomes erect. Fronds bipinnatifid; rachis densely pubescent, brown; pinnae alternate, acuminate; pinnae lobes up to 3.5 x 7-9 mm, gradually acuminate, repand, margin distantly hairy; hairy below, sparsely hairy above. Sori round, terminal, indusium large, sporangiophore long.

Specimen Cited: Makaibari TE, AP Das & Chandrâ 2543, dated 11.11. 2003.
Status: Common
Local Distribution: In Terai and low altitude areas
General Distribution: India: West Bengal, Assam, Arunachal Pradesh; endemic.
Note: New record for West Bengal.

Tectaria fuscipes (Wallich *ex* Beddome) C.Christensen in Contrib. U.S. Nation. Herb. 26: 290. 1931; Ferns Fern-All. Arun. Prad. II. 637. 2005.
Aspidium fuscipes Wallich *ex* Beddome Ferns Brit. India Suppl.: 15. t. 366. 1876.

Rhizomes erect, paleaceous at tip; fronds tufted, subdimorphic, bipinnatifid; fertile narrow and long than sterile, 26-40 x 6-11 cm; stipes grooved dorsally, 12-23 cm; lamina deltoid, caudate acute; pinnae 3-4 pairs below deeply pinnatifid apex, opposite, repand, obtuse. Sori round, terminal, indusium reniform, brown, thin, persistent.

Specimen Cited: Mohurgong & Gulma TE, AP Das & Chandrâ 0042, dated 27.01.2002.
Status: Rare
Local Distribution: Found only in Mohurgong & Gulma garden
General Distribution: India: West Bengal, Assam, Arunachal Pradesh; Myanmar, China.
Note: New record for West Bengal.

THELYPTERIDACEAE Ching *ex* Pichi Sermolli

CYCLOSORUS Link

Cyclosorus jaculosus (Christensen) H. Ito in Bot . Mag. Tokyo 51: 725. f. 4. 1937, *non sensu* Panigrahi & Monton (1958); Ferns Fern-All. Arun. Prad. II. 685. 2005.

Rhizomes erect, thick, apex paleaceous; roots many; Fronds 125-200 x 18-30 cm, elliptic, caudate acuminate, bipinnaitfid; stipes 10-20 cm, paleaceous at base, groove. Lamina 110-160 cm long, pinnae largest of lamina, sessile, oblong-lanceolate, gradually acuminate, entire. Sori round, median, indusium large, persistent, reniform.

Specimen Cited: Mohurgong & Gulma TE, AP Das & Chandrâ 1610, dated 22.10. 2002.
Status:Common
Local Distribution: Found only in Mohurgong & Gulma garden
General Distribution: India: West Bengal, Meghalaya, Arunachal Pradesh; Thailand, China, Japan.
Notes: New record for West Bengal.

Cyclosorus namburensis (Beddome) Ching in Bull. Fan Mem. Inst. Biol. Bot. 8: 216. 1938; Ferns Fern-All. Arun. Prad. II. 692. 2005.
Nephrodium namburense Beddome, Handb. Ferns Brit. India Suppl.: 69. 1892.

Rhizomes long, creeping, paleaceous. Fronds 75-120 x 24-28 cm, ovate, caudate acuminate, bipinnatifid. Stipes 35-45 cm, curved, base paleaceous. Lamina 50-90 cm; pinnae large, 12-17 x 2-2.5 cm, 9-10 pairs, oblong, gradually acuminate, entire, glandular hairy. Sori round, divergent in basal lobes, close to excurrent vein, supramedial; indusium reniform, persistent, thick, entire.

Specimen Cited: Mohurgong & Gulma TE, AP Das & Chandrâ 1632, dated 22.10. 2002.
Status: Less Common
Local Distribution: All Terai gardens
General Distribution: India: West Bengal, Assam, Arunachal Pradesh; Thailand.
Note: New record for West Bengal.

Cyclosorus siamensis (Tagawa & Iwats.) Panigrahi in Research J. Pl. Environ. (Bhambie Comm. Vol.) 9: 67. 1993. Ferns Fern-All. Arun. Prad. II. 702. 2005.
Thelypteris siamensis Tagawa & K. Iwats. in Acta Phytotax. Geobot. 22: 101. f. 5. 1967.

Rhizomes erect, short, apex paleaceous; fronds 95 x 15-17 cm, elliptic lanceolate, caudate acuminate, bipinnatifid. Stipes 40 cm, grooved dorsally and laterally, paleaceous; lamina 55 cm; pinnae 16 pairs, sessile, oblong lanceolate, acumination long, entire, margin hairy. Sori round, median to nearer to midvein; indusium reniform, persistent, densely hairy on surface.

Specimen Cited: Mohurgong & Gulma TE, AP Das & Chandrâ 1648, dated 24.10. 2002.
Status: Very common
Local Distribution: In Terai and low altitude areas
General Distribution: N.E. India, Thailand, China, Taiwan.
Note: New record for West Bengal.

PRONEPHRIUM C. Presl

Pronephrium clarkei S. Singh & Panigrahi, Fern & Fern-allies of Arunachal Pradesh II. 726. 2005.

Rhizomes creeping, stout, paleaceous. Roots many, firm. Fronds very small in fully-grown and fertile plants, widely spaced, rhomboid or lanceolate-ovate, pinnate. Lamina 12-18 cm, glabrous, surface pustular, drying whitish pale, coriaceous. Sori round, median; spores plenty brown.

Specimen Cited: Makaibari TE, AP Das & Chandrâ 2519, dated 11.11. 2003.
Status: Common
Local Distribution: Found only in Makaibari garden
General Distribution: India: Arunachal Pradesh; endemic.
Note: New record for West Bengal.

Pronephrium nudatum (Roxburgh) *Chandrâ* in Bull. Bot. Surv. India 13: 274. 1971; Ferns Fern-All. Arun. Prad. II. 732. 2005.
Polypodium nudatum Roxburgh in Griffith, Calcutta J. Nat. Hist. 4: 491. 1844.

Rhizome creeping, paleaceous; paleae basifixed, lanceolate, entire, acuminate, pale brown. Fronds 90- 150 x 50 cm, pinnate, caudate acuminate. Stipes 60-90 cm, base paleaceous, grooved, hairy. Pinnae up to 30 x 5 cm, subopposite to alternate, sessile, about 10 pairs, densely hairy. Sori round, median, indusium small.

Specimen Cited: Soom TE, ***AP Das & Chandrâ 3309***, dated 26.06. 2004.
Status: Less Common
Local Distribution: Found only in Soom & Tamsong gardens
General Distribution: India, Nepal, Bhutan, Bangladesh, Myanmar, Malaysia.

TRIGONOSPORA Holttum

Trigonospora caudipinna (Ching) Sledge in Bull. Br. Mus. Nat. Hist. (Bot.) 8: 15. 1981; Ferns Fern-All. Arun. Prad. II. 767. 2005.
Thelypteris caudipinna Ching in Bull. Fan Mem. Inst. Biol. 6: 288. 1936.

Rhizomes erect, apex blackish-brown paleaceous; fronds 100-110 x 20-25 cm, tufted, deltoid, caudate-acuminate, bipinnatifid. Stipes 50-70 cm, base paleaceous, grooved. Lamina 35-40 cm; pinnae 10-13 x 1.5-2.2 cm, sessile, pinnatifid, acuminate, oblique, entire. Sori round, nearer to midvein, indusium reniform, entire, thick.

Specimen Cited: Soom TE, ***AP Das & Chandrâ 2622***, dated 27.12. 2003.
Status: Rare
Local Distribution: Found only in Soom garden
General Distribution: India, Sri Lanka, Nepal, Bhutan, China.

VITTARIACEAE (C. Presl) Ching

VITTARIA J. E. Smith

Vittaria elongata Swartz, Syn. Fil.: 109, 302.1806; Handb. Ferns Brit. India: 404.f.238.1883; Ferns Fern-All. Arun. Prad. II. 791. 2005.

Rhizomes creeping, paleaceous throughout; Fronds 15-35 x 4.5 mm, subsessile to stipes up to 1.5 cm, base paleaceous. Lamina linear-lanceolate, long acuminate; rachis invisible. Sori long elongate, marginal, sunk; sporangium with thick stalk, glandular, paraphyses branched.

Specimen Cited: Hansqua TE, AP Das & Chandrâ 1150, dated 14.06. 2002.
Status: Abundant.
Local Distribution: In Terai and low altitude areas
General Distribution: India: West Bengal, Sikkim, Arunachal Pradesh, Meghalaya; Africa, Sri Lanka, Bangladesh, Myanmar, Vietnam, Laos, Malaysia, Taiwan, Philippines, S. China, Australia.
Note: New record for West Bengal.

PINOPHYTA
[GYMNOSPERMS]

Only three species of Gymnospermic plants has been recorded from the seven Tea Gardens of Darjiling District under study. However, all of these are planted and only very few individuals found scattered in hill Tea Gardens.

PINACEAE Lindley

PINUS L.

Pinus roxburghii Sargent, Silva N. Amer. 11:9. 1897; FEH 1:40. 1966; 2:12. 1971; EFPN 1:26. 1978; FB 1 (1):46. 1983.
P. longofolia Roxb. *ex* Lambert, Descr. Gen. Pinus 1:29, 21. 1803.

Local Name: *Dhup* (Nep); *Pine* (Beng)

Evergreen trees upto 28m. Leaves upto 29cm long, drooping, fimbriate scales at base. Male cones in large clusters. Female cones sessile, 8-19 x 7-9.5cm, ovoid; scales upto 2.2 cm broad, woody, reflexed, curved upward; seeds 0.7-0.8 x 0.5cm; wings upto 1.5cm.

Specimen Cited: Tamsong TE, AP Das & Chandrâ 3089, dated 10.04. 2004.
Status: Frequently planted.
Local Distribution: All hill gardens.
General Distribution: Afghanistan, Himalayas (Kashmir-Bhutan).
Note: Timber useful, tapped resin produce turpentine.

TSUGA Carriere

Tsuga dumosa (D. Don) Eichler in Engl., Pfl. - fam. II, 1: 30, 1889; FEH 1: 41. 1966; FB 1(1): 50. 1983.
Pinus dumosa D. Don, Prodr. Fl. Nep. 55. 1825

Local Name: *Tengre Salla* (Nep).

Evergreen trees, 15-40m tall; branches puberulous. Leaves spiral, linear, margins inrolled downward, shiny white beneath, green above. Male cones almost globose; Female cones terminal, pendulous, ovoid; ovuliferous scales rounded, leathery; seeds ovoid, compressed, winged.

Specimen Cited: Tamsong TE, AP Das & Chandrâ 3067, dated 10.04. 2004.
Status: Rarely planted.
Local Distribution: Found only in Tamsong garden.
General Distribution: Nepal, India (Kumaon, Sikkim, Darjeeling), Bhutan, N. Myanmar.
Note: Timber sometimes used in house construction.

TAXODIACEAE Warming

CRYPTOMERIA D. Don

Cryptomeria japonica (L.f.) D. Don. in Trans. Lin. Soc. 18: 167, t. 13, f. 1. 1841; FEH 1: 41. 1966; FB 1(1): 51. 1983.
Cupressus japonica L. f., Suppl. Pl. 421. 1781.

Local Name: *Dhupi* (Nep).

Tall tree to 35m or more with drooping branches. Leaves 0.65-1.1 cm, 4-angled, curved inwardly, acuminate, base decurrent. Male cones smaller, 0.65 - 0.95 x 0.28 - 0.35 cm. Female cones 1.2-1.4 cm, scales 3-6 toothed at apex; bracts adnate to scale, exerted. Seeds narrow elliptic.

Specimen Cited: Soom TE, ***AP Das & Chandrâ 3264***, dated 26.06. 2004.
Status: Frequently Planted.
Local Distribution: In all hill gardens.
General Distribution: Japan, China, introduced in India.
Note: Cultivated as a fast-growing timber tree.

MAGNOLIOPHYTA
[ANGIOSPERMS]

MAGNOLIOPSIDA
[DICOTYLEDONS]

ACANTHACEAE A. Jussieu

ASYSTASIA Blume

Asystasia macrocarpa Nees in Wallich, Pl. As. Rar. 3: 89. 1832; FBI 4: 495. 1885; FEH 1: 300. 1966.
Ascending undershrub to 2 m. Lamina lanceolate, acuminate at both ends, glabrous below, sparsely pilose above, dark green. Recemes short solitary, terminal of 2-6 cm with pale purple flowers in opposite pairs with linear bracts. Capsule 28-36 mm, glandular-pubescent.

Flowers & Fruits: June - December
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1917,*** dated 10.06.2003.
Status: Less common
Local Distribution: Found only in Makaibari garden.
General Distribution: Subtropical Himalayas

BARLERIA L.

Barleria cristata L., Sp. Pl. 636.1753; FBI 4:488.1884; FB 2(3): 1281.2001

Pilose undershrub; branches, many, wiry. Leaves elliptic-oblong, both ends acute, pilose, spines absent. Flowers pinkish-purple in dense axillary clusters; bracts spinescent. Capsules oblong, glabrous, 4-seeded.

Flowers & Fruits: September – February
Specimen Cited: Makaibari TE, **AP Das & Chandrâ 2546,** dated 11.11. 2003
Status: Rare
Local Distribution: Found only in Makaibari garden.
General Distribution: India, Myanmar, Malaysia and China.

Barleria strigosa Willdenow, Sp. Pl. 3: 379. 1800; FB 2(3): 1281.2001

Strigose undershrub to 50cm. Lamina ovate or broadly elliptic, acute, attenuate at base and decurrent on petiole, strigose especially on margin and veins below. Petiole winged. Flowers blue – purple, 5-6.5cm, glandular-pubescent, subsessile in dense, shortly pedunculate, 1 sided, axillary cymes.

Flowers & Fruits: January - April
Specimen Cited: **Mohurgong & Gulma TE, *AP Das & Chandrâ 0006*,** dated 27.01. 2006.
Status: Rare
Local Distribution: Found only in Mohurgong & Gulma garden.
General Distribution: Tropical Himalayas, Myanmar, Indo –China

DICLIPTERA A. Jussieu

Dicliptera bupleuroides Nees in Wallich, Pl. As. Rar. 3: 111. 1832; FEH 1: 301. 1966; EFPN 3:139.1982.
Dicliptera roxburghiana Nees var. *bupleuroides* (Nees) C.B.Clarke in FBI 4: 554. 1885.

Perennial undershrubs, branches long, scrambling, ascending to 2m; lamina elliptic, entire or obscurely sinuate, shortly acuminate at both ends, dark green, glabrous or thinly pubescent. Flowers pink with white tube, lobes longer than tube in sessile or shortly pedunculate axillary and terminal clusters. Capsule clavate, pubescent, 7-8 mm.

Flowers & Fruits: October – June.
Specimen Cited: Makaibari TE, **AP Das & Chandrâ 2500,** dated 11.11. 2003; Kamalpur TE, AP **Das & Chandrâ 0517,** dated 17.04.2002
Status: Less Common
Local Distribution: All Terai gardens and in lower areas of hill gardens.
General Distribution: India, Nepal, Bhutan, China, Indo –China, Afghanistan

Dicliptera roxburghiana Nees in Wallich, Pl. As. Rar. 3:111. 1832.
Dicliptera roxburghiana non Nees: Clarke in Hook.f., FBI 4: 553. 1885.

Like *D. bupleuroides* but leaves more ovate; inflorescence more dense; corolla smaller.

Flowers & Fruits: October – June.
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1040,*** dated 09.05.2002 ; Makaibari TE, ***AP Das & Chandrâ 2528,*** dated 11.11. 2003; Soom TE, ***AP Das & Chandrâ*** 3573, dated 12.10. 2004.
Status: Very common
Local Distribution: In all gardens.
General Distribution: India, Nepal, Bhutan, Myanmar, Thailand

HYPOESTES R.Brown

Hypoestes triflora (Forsskal) Roemer & Schultes, Syst. Veg. 1: 141. 1817; FBI 4:557. 1884; FEH 2:123. 1971; EFPN 3:141. 1982; FB 2(3): 1293.2001
Justica triflora Forsskal, Fl. Aegypt.- Arab. 4.1775.

Small ramous semi-erect herbs, ±30cm tall; stem ribbed, pubescent; lamina ovate, crenate, acute, rounded at base, pubescent; cymes capitellate, 1-5 flowered; bracts and bracteoles opposite; corolla pinkish to white, red-spotted within, deeply bilipped; capsules ellipsoid, 4 seeded.

Flowers & Fruits: September – March
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2763***, dated 25.03. 2004; Soom TE, ***AP Das & Chandrâ 2669***, dated 04.01.2004.
Status: Very common
Local Distribution: All three hill gardens.
General Distribution: W. Asia, Himalayas (Nepal-Bhutan), W. China.

Hypoestes sanguinolenta Hooker in Bot. Mag. 91: t. 5511. 1865.

Local Name: *Swapnabati* (Nep).

Erect, much branches undershrubs, braches slender. Lamina ovate, entire, shortly acuminate, green to brownish, white streaked. Flowers pink in terminal slender terete spikes.

Flowers & Fruits: September – June.
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3411,*** dated 12.10.2004; Makaibari TE, **AP Das & Chandrâ 1778**, dated 17.05.2003; Tamsong TE, **AP Das & Chandrâ 2149**, dated 30.06.2003.
Status: Less Common
Local Distribution: All three hill gardens.
General Distribution: Nicely naturalized in subtropical hills.
Note: First record of naturalization in India.

JUSTICIA L.

Justicia adhatoda L., Sp. Pl. 1: 15. 1753; FB 2(3): 1287.2001
Adhatoda zeylanica Medicus in Hist. Comm. Acad. Theod. Palat 6 Phys. 393. 1790.
A. vasica Nees in Pl. As. Rar., 3: 103 1832; FBI 4: 540. 1885.

Local Name: *Asuro, Kalo vashak* (Nep), *Basak* (Beng)

Gregarious shrubs, 1-2 m tall. Lamina 8-18 cm, entire or undulate, acuminate or acute, base cuneate to attenuate, subcoriaceous, pubescent. Spikes peduncled, bracteate; corolla white, palate spotted; Capsules clavate; seeds suborbicular.

Flowers & Fruits: January – June
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0430*** , dated 05.04.2002; Hansqua TE, ***AP Das & Chandrâ 0976,*** dated 09.05.2002; Kamalpur TE, ***AP Das & Chandrâ 0643,*** dated 20.04.2002.
Status: Very common.
Local Distribution: All Terai gardens.
General Distribution: Subtropical Himalayas, India, and Malaysia.
Note: Leaves and roots used to cure cough, cold and asthma; flowering shoots insecticidal.

Justicia diffusa Willdenow, Sp. Pl. 1: 87. 1797; FBI 4: 538. 1885; FB 2(3): 1288.2001
Justicia procumbens L., Sp. Pl. 15. 1753, *p.p.*

Much branched, diffuse perennial hairy herb. Lamina ovate-lanceolate, entire, acute, nerves 6 – 7 pairs. Flowers in erect terete dense spikes; bracts linear lanceolate, scarious margined; corolla pink, brown spotted near throat. Capsule oblong, glabrous.

Flowers & Fruits: October – May.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 1282***, dated 18.10.2002.
Status: Common.
Local Distribution: Found only in Kamalpur garden.
General Distribution: India, Nepal, Bhutan, Sri Lanka, Myanmar, Thailand

Justicia gendarussa Burman f., Fl. Ind. 10. 1768; FBI 4: 532. 1885; FB 2(3): 1287.2001
Gendarussa vulgaris Nees in Wallich, Pl. As. Rar. 3: 104. 1832.

Shrubs 1-1.5 m, stem dark brownh, glabrous; lamina lanceolate or narrowly elliptic, tapering to obtuse apex, attenuate, glabrous, purplish. Spikes terminal and axillary, 2-11cm; corolla white with purple streaks, glabrous; flowers in clusters along rachis with leafy bracts.

Flowers & Fruits: October – May.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0496***, dated 17.04. 2004
Status: Less Common
Local Distribution: All Terai gardens.
General Distribution: India, Nepal, Bhutan, Myanmar, Thailand

Justicia simplex D.Don, Prodr. 118. 1825; FBI 4: 539. 1885; FB 2(3): 1288. 2001.
Justicia japonica Thunb., Fl.Jap. 20.1784.

Wiry annual herbs; stems decumbent, rooting at nodes, thinly bifariously pubescent. Lamina ovate-elliptic, acute, attenuate at base, thinly pilose. Spikes simple, terminal, hairy, sometimes interrupted below; corolla pink, glabrous; bracts slender. Capsule cylindric, hairy at tip.

Flowers & Fruits: August - November
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0913***, dated 04.05.2002.
Status: Less Common
Local Distribution: All Terai gardens.
General Distribution: India, Nepal, Bhutan, Sri Lanka, Myanmar, Thailand, Malaya

LEPIDAGATHIS Willdenow

Lepidagathis incurva Buch.-Ham.ex D. Don, Prodr. Fl. Nep. 119. 1825; FEH 1: 303. 1966; EFPN 3:142.1982; FB 2(3): 1286.2001.
Lepidagathis hyalina Nees in Wall., Pl. As. Rar. 3: 95. 1832; FBI 4: 521. 1885.

suffrutescent herbs, glabrescent, branches ascending to 50 cm. Lamina of lower leaves ovate, upper elliptic, acuminate, base rounded, glabrous or shortly glandular-pubescent. Flowers white, streaked with purple c1 cm, glabrous in dense, 1 sided, subsessile heads, in terminal clusters.

Flowers & Fruits: November – June
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2556***, dated 11.11. 2004
Status: Very common
Local Distribution: All three hill gardens. Rarely in Terai during winter
General Distribution: Subtropical Himalayas, China, Malaysia.

NELSONIA R. Brown

Nelsonia canescens (Lamarck) Sprengel in L., Syst. Veg. ed. 16.1:42.1824. 1884; FB 2(3): 1250.2001.
Justicia canescens Lamarck, Tab. Encycl. Method Bot. 1:40. 1791.
Nelsonia campestris R. Brown, Prodr. Fl. Nov. Holl. 1:481. 1810; FBI 4:394.

Perennial, prostrate, diffuse herbs; branches radiating from taproot, softly pilose. Leaves dimorphic, shortly petiolate, elliptic-oblong, entire, obtuse, pubescent. Flowers in dense, terminal, pilose bracteate spikes, lips purplish. Capsules narrow conical; seeds glabrous, brown, ellipsoid.

Flowers & Fruits: February – April
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0076,*** dated 27.01.2002; Hansqua TE, ***AP Das & Chandrâ 1501***, dated 20.10.2002; Kamalpur TE, ***AP Das & Chandrâ 0416***, dated 27.02.2002.
Status: Common.
Local Distribution: All Terai gardens.
General Distribution: Pantropic weed.

PERISTROPHE C.G.D.Nees

Peristrophe paniculata (Forsskal) Brummitt in Kew Bull. 38: 451. 1983.
Dianthera paniculata Forsskal, Fl. Aeg. -Arab. 7. 1775
Peristrophe bicalyculata (Retzius) Nees in Wallich, Pl. As. Rar. 3: 113. 1832; FBI 4: 554. 1885.

Erect, much branched herbs upto 70 cm high with hairy 6 angled stems. Lower lamina larger, upper lamina smaller, all ovate, entire, acute, base decurrent, surfaces hairy. Flowers pink in copiously branched lax panicles with bracts and bracteoles. Capsules pointed, narrowed to a stalk.

Flowers & Fruits: October – June.
Specimen Cited: Matigara TE, ***AP Das & Chandrâ 3611***, dated 20.10.2004.
Status: Common
Local Distribution: All Terai gardens.
General Distribution: Subtropical Himalayas, Indo –China, Malaya.

Peristrophe speciosa (Roxburgh) Nees in Wallich, Pl. As. Rar. 3: 3. 1882; FB 2(3): 12. 2001.
Justicia speciosa Roxburgh, Fl.Ind. 1: 123. 1820.

Perennial undershrubs; branches leggy, ascending, glabrescent, 1-2 m long. Lamina ovate-elliptic, acute, cuneate at base, dark green above, thinly pubescent or glabrescent. Flowers pink in small, shortly pedunculate axillary and terminal clusters. Capsules clavate, pubescent 15 – 18 mm.

Flowers & Fruits: June - December.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2533,*** dated 11.11.2003; Tamsong TE, ***AP Das & Chandrâ 2046***, dated 30.04.2003.
Status: Rare
Local Distribution: Found only in Makaibari & Tamsong gardens
General Distribution: Himalayas.

PHAULOPSIS Willdenow, *emend.* K.P.J.Sprengel, *nom. cons.*

Phaulopsis imbricata (Forsskal) Sweet, Hort. Brit. ed. 1. 327. 1827. FB 2(3): 1275.2001.
Ruellia imbricata Forsskal, Fl. Aegypt-Arab. 113.1775.
Phaulopsis parviflora Willdenow, Sp.Pl. 3:342. 1801; FBI 4:417. 1884.

Prostrate or decumbent, suffrutescent, much branched, herbs. Leaves ovate or elliptic, acute, base oblique. Flowers in terminal and axillary secund spikes, bracteate; Capsules clavate, glabrous, tips pointed; seeds 4, brown, supported by jaculators.

Flowers & Fruits: December – April
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0012,*** dated 27.01.2002; Hansqua TE, ***AP Das & Chandrâ 1081***, dated 09.05.2002; Kamalpur TE, ***AP Das & Chandrâ 0558***, dated 17.04.2002; Makaibari TE, ***AP Das & Chandrâ 2830***, dated 25.03.2004; Tamsong TE, ***AP Das & Chandrâ 2990***, dated 10.04.2004.
Status: Abundant.
Local Distribution: All Terai gardens and in lower areas of hill gardens.
General Distribution: India, Sri Lanka, Malagasy and tropical Africa.

PHLOGACANTHUS Nees

Phlogacanthus thyrsiflorus (Roxburgh) Nees in Wallich, Pl. As. Rar. 3: 99. 1832; FBI 4: 512. 1884; FEH 1: 303. 1966; EFPN 3:143.1982; FB 2(3): 1284.2001.
Justicia thyrsiflora Roxburgh, Fl. Ind. 1: 116. 1820.

Local Name: *Chua* (Nep)

Shrubs to 3 m tall; stems erect, glabrous and leaves often crowded near branch tips, elliptic-obovata, both ends shortly acuminate, glabrous. Flowers orange-brown dense, uninterrupted terminal thyrse, usually solitary, rarely 2-3 with linear bracts. Capsules narrowly clavate.

Flowers & Fruits: January – March.
Specimen Cited: Soom TE, ***AP Das & Chandrâ*** *2722*, dated 27.01.2004.
Status: Less Common
Local Distribution: Found only in Soom garden.
General Distribution: India, Nepal, Bhutan.

PTERACANTHUS (Nees) Bremek

Pteracanthus alatus (Wallich *ex* Nees) Bremekamp in Verh. Nederl. Akad. Wet. 41. 199. 1944; FB 2(3): 1271.2001.
Ruellia alata Wallich, Pl. As. Rar.1: 26,t. 31. 1830.
Strobilanthes wallichii Nees in Wallich, Pl. As. Rar. 3: 87. 1832, FBI 4: 471. 1884; FEH 1: 305. 1966.

Perennial herbs, 0.3-0.5-1m, glabrous, erect from creeping woody rootstock. Leaves equal or slightly unequal, ovate or elliptic, serrate to coarsely crenate, acute, base rounded to attenuate, shortly decurrent, glabrous, sessile above. Flowers blue in opposite pairs in axils of leaf like bracts forming small axillary secund spikes.

Flowers & Fruits: September – December.
Specimen Cited: Soom TE, ***AP Das & Chandrâ*** *3383*, dated 12.10.2004.
Status: Very common
Local Distribution: Found only in Soom & Tamsong gardens
General Distribution: India, Nepal, Bhutan.

Pteracanthus urophyllus (Nees) Bremekamp: FB 2(3): 1271.2001.
Strobilanthes urophyllus Nees in DC. Prodr. 11. 192. 1947.
Strobilanthes urophylla (Nees) Nees

Small branched undershrubs, glabrous; leaves slightly unequal, narrowly ovate-elliptic, serrate, shortly acuminate, base cuneate, paler beneath, veins prominent, glabrous. Flowers blue, fragrant in opposite pairs, 1-1.5 cm apart in axils of leaf like bracts on short axillary branchlets

Flowers & Fruits: September – December.
Specimen Cited: Soom TE, ***AP Das & Chandrâ 2597***, dated 27.12.2003.
Status: Less Common
Local Distribution: Found only in Soom garden.
General Distribution: India, Nepal, Bhutan.

RUNGIA Nees

Rungia himalayensis C. B. Clarke in FBI 4: 548. 1885; FEH 1: 303. 1966; EFPN 3:144.1982; FB 2(3): 1291.2001.

Wiry decumbent perennial herb, rooting at nodes, thinly puberulent. Lamina ovate or elliptic, often suffused with red, acute, shortly cuneate onto petiole, minutely scabrid. Flowers white, lower lip pink. Spikes axillary and terminal secund. Capsules oblong, mucronate, pubescent.

Flowers & Fruits: November – January.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2535***, dated 11.11. 2003
Status: Rare
Local Distribution: Found only in Makaibari garden.
General Distribution: India, Nepal, Bhutan.

Rungia pectinata (L.) Nees in DC., Prodr. 11:469. 1847. FB 2(3): 1291.2001.
Justicia pectinata L. in Torner, Cent. II Pl. 3. 1756.
Rungia parviflora (Retzius) Nees var. *pectinata* (L.) Clarke in Hook.f., FBI 4:550. 1985.

Prostrate or diffuse annual much branched herbs, minutely pubescent. Lamina narrowly lanceolate to elliptic, tapering at ends. Spikes sessile, secud, axillary & terminal; bracts hyaline margined, dimorphic; corolla blue. Capsules ovoid, compressed; seeds 2-4, orbicular.

Flowers & Fruits: September – May
Specimen Cited: Matigara TE, ***AP Das & Chandrâ 3632,*** dated 20.10.2004; Makaibari TE, ***AP Das & Chandrâ 2819***, dated 25.03. 2004; Soom TE, ***AP Das & Chandrâ 2754***, dated 12.02.2004; Tamsong TE, ***AP Das & Chandrâ 2339***, dated 05.11.2003.
Status: Abundant.
Local Distribution: In all gardens.
General Distribution: India, Sri Lanka, Bangladesh, Myanmar, Nepal, and Malaysia.

STROBILANTHES Reichb.

Strobilanthes capitatus T. Anders.in J. Linn. Soc. 9: 475. 1867; FB 2(3): 1263.2001

Local Name: *Kibu* (Nep)

Much-branched undershrub, often leafless when in flower. Stems decumbent or ascending. leaves unequal, lanceolate- broadly elliptic-ovate, serrate, both ends shortly acuminate, base oblique, whitish beneath. Flowers blue in dense, pedunculate axillary heads, borne in 3s on small axillary branchlets with reduced leaves.

Flowers & Fruits: September – December.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2848***, dated 25.03. 2004; Soom TE, ***AP Das & Chandrâ 2680***, dated 09.01. 2004
Status: Common
Local Distribution: All three hill gardens.
General Distribution: India, Nepal, Bhutan.

Strobilanthes divaricatus (Nees) T. Anders. In J. Linn. Soc. 9: 478. 1867; FBI 4: 468. 1884; FEH 1: 305. 1966; FB 2(3): 1273.2001
Goldfussia divaricata Nees in Wallich, Pl. As. Rar. 3: 89. 1832.

Undershrubs; branches 10-50 cm, glabrous, zigzag above, erect from a creeping root-stock; leaves unequal; smaller ones ovate, obscurely serrulate, glabrous, acute, rounded at base, sessile, often deciduous, larger broadly lanceolate-elliptic, acuminate. Flowers deep purple in opposite pairs on small axillary branchlets forming a lax spicate inflorescence.

Flowers & Fruits: September – January.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2531***, dated 11.11. 2003.
Status: Less Common
Local Distribution: Found only in Makaibari garden.
General Distribution: Himalayas.

Strobilanthes extensus Nees, Prodr. 11: 195. 1847; FB 2(3): 1270. 2001

Much branched shrubs, branches 0.5-2m, erect, pilose. Leaves slightly unequal, ovate above, serrate, elliptic below, shortly acuminate, base cuneate, pilosa, whitish beneath, sessile, lower leaves decurrent onto pseudo-petiole. Spikes lax; flowers blue in opposite pairs.

Flowers & Fruits: September – November.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2301***, dated 05.09.2003.
Status: Less Common
Local Distribution: Found only in Tamsong garden.
General Distribution: NE India, Myanmar.

Strobilanthes oligocephalus T. Anders. ex. C.B.Clarke in FBI 4: 461. 1884; FB 2(3): 1265.2001

Much branched undershrubs, branches 30-50cm, decumbent, rooting below, eventually erect. Leaves unequal, elliptic or narrowly obovate, falcate, serrate, abruptly acuminate, base attenuate, whitish beneath, glabrous, sessile above. Flowers blue or white in pedunculate, shortly elongate terminal heads.

Flowers & Fruits: October – December.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2569***, dated 11.11. 2003
Status: Rare
Local Distribution: Found only in Makaibari garden.

General Distribution: Himalayas.

Strobilanthes thomsonii T. Anders. In J. Linn. Soc. 9: 478. 1867; FBI 4: 467. 1884; FEH 2: 123. 1971; EFPN 3:144.1982; FB 2(3): 1268.2001

Much branched erect undershrubs, appearance untidy, 0.6 –2 m; leaves unequal, ovate or elliptic, serrate, acuminate, base cuneate or attenuate, glabrous or thinly pilose, sessile above. Flowers blue in opposite pairs in lax, axillary spikes, becoming branched & compound, developing into large leafless panicles in older plants.

Flowers & Fruits: September – December.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2238***, dated 05.09. 2003.
Status: Common
Local Distribution: Found only in Tamsong garden.
General Distribution: Himalayas.

THUNBERGIA L.f.

Thunbergia fragrans Roxburgh, Pl. Corom. 1:47, t. 67. 1795; FBI 4:390. 1884; Trs. N. Beng. 97. 1929; FEH 1:305. 1966; EFPN 3:145. 1982; FB 2(3): 1247.2001

Local Name: *Kaneshi Lahara* (Nep).

Slender twining herbs, roughly pilose. Lamina ovate-lanceolate or triangular cordate, acute to acuminate, base cordate, pubescent above. Flowers white, fragrant, thinly pilose, solitary or paired from leaf axils. Fruits glabrous, beaked, 4 seeded.

Flowers & Fruits: July – February
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0453,*** dated 05.04.2002; Kamalpur TE, ***AP Das & Chandrâ 0526***, dated 17.04.2002.
Status: Less Common
Local Distribution: All Terai gardens.
General Distribution: Himalayas, Tropical and Sub-tropical Asia, Australia, W. China

Thunbergia grandiflora Roxburgh [H. Beng. 45. 1814, *nom.nud.*] Lodd., B. Cab. 4: t. 324. 1819. [nom. nud.] in B. Reg. 6: t. 495. 1820; EFPN 3:145.1982; FB 2(3): 1248.2001
Flemingia grandiflora Roxb. ex Rottl. in Ges. Naturf. Fr. Neuc. Schr. 4: 202. 1803.

Local Name: *Kanesi Lahara* (Nep).

Vigorous liana; branches long, glabrous to tomentose. Lamina ovate-triangular, rarely suborbicular, sinuate with few large teeth, acute or shortly acuminate, hastate or coradte. Flowers white or bluish, glabrous, 6-9 cm borne on solitary pedicels from lea f axils on mature stems.

Flowers & Fruits: August – April.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0545***, dated 17.05. 2002.
Status: Rare
Local Distribution: Found only in Kamalpur garden.
General Distribution: Himalayas, China, Indo –China, Myanmar.

ACERACEAE A. Jussieu

ACER L.

Acer campbellii Hk.f. *et* Thoms. *ex* Hieren in FBI 1: 696. 1875; Trs. N. Beng. 42. 1929; FEH 1:191. 1966; EFPN 2: 98. 1979; FPK 23. 1981; TBRI 50(4): 104. 1987; FB 2(1): 64. 1991; FWB 1:465. 1997; FI 5: 396. 2000.

Local Name: Kapasi (Nep.)

Large deciduous trees. Stem greenish. Leaves exstipulate, palmately 5-7 lobed, lanceolate or ovate-caudate, serrate-biserrate, teeth fine acute, caudate acuminate, sub-cordate, and glabrous both sides, dark green above, yellowish when dry. Peduncles narrow, elongated, many flowered. Fruits (mericarps) numerous in each cluster.

Flowers: April – May; *Fruits:* June – August
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2895***, dated 10.04.2004.
Status: Common.

Local Distribution: All three hill gardens.
General Distribution: E. Himalaya (Nepal-Arunachal Pradesh), W. China.
Note: Woods used as firewood.

Acer hookeri Miq. in Arch. Neerl. Sci. Nat. 2: 471. 1852; FBI 1:694 1875; Trs. N. Beng. 41. 1929; FEH 1:191. 1966; EFPN 2: 98. 1979; TBRI 50(4):104. 1987; FB 2 (1):64. 1991; FWB 1:467. 1997; FI 5: 400. 2000.

Local Name: *Lal Kapasi* (Nep)

Medium tree. Young branchlets reddish. Leaves ovate sharply serrate to biserrate, caudate-acuminate, shallowly cordate, glabrous and green both sides or sparsely hairy on veins of old leaves beneath. Racemes simple, pendulous with actinomorphic, monoecious, greenish white flowers, appear along with new leaves. Fruits shortly winged.

Flowers: April - June *Fruits:* June - November
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2898***, dated 10.04.2004
Status: Rare
Local Distribution: Found only in Tamsong garden.
General Distribution: *General Distribution*: E. Himalaya (Nepal-Arunachal Pradesh).

Acer thomsonii Miquel in Arch. Ne'erl. Sci. Nat. 2:470. 1867; FEH 1: 193. 1966; 2: 73. 1971; EFPN 2: 98. 1979; Fasc. Fl. Ind. 9: 18. 1982; TBRI 50(4): 104. 1987; FB 2(1): 65. 1991; FI 5: 410. 2000.
A. villosum Wallich var. *thomsonii* (Miquel) Hiern in FBI 1: 695. 1875.

Local Name: *Melo Kapasi* (Nep).

Trees, 15-28 m tall. Lamina coriaceous, trilobed, mid-lobe ovate to triangular, entire or obscurely serrate, acuminate. Inflorescence spicate racemose, 8-21 cm long. Sepals upto 0.3 cm, oblong, pubescent within. Petals equal to sepals or slightly longer, yellowish. Samara reddish brown, wings 5-6cm, straight-parallel.

Flowers: October – December; *Fruits:* January – July
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2950***, dated 10.04.2004
Status: Less common
Local Distribution: Found only in Makaibari & Tamsong gardens.
General Distribution: Himalayas (Simla-Arunachal Pradesh), Manipur, MyanMarch

ACTINIDIACEAE Van Tiegh.
[SAURAUJACEAE J.G. Agardh.]

SAURAUJA Willd.

Saurauja napaulensis DC., Mem. Ternstr. 29. 1822; Pl. As. Rar. 40, 77 t. 178. 1813; FBI 1: 286. 1874; Trs. N. Beng. 20. 1929; FEH 1: 207. 1966; FB 1(2): 359. 1984; FI 3: 201. 1993.

Local Name: *Gagun* (Nep).

Soft wooded small deciduous tree to 7 m; young twigs brown tomentose, scaly; leaves simple, alternate, elliptic-lanceolate, finely serrulate, acuminate, base rounded, glabrous or thinly brown tomentose beneath, dark green above, whitish-green beneath. Flowers pinkish in axillary panicles, shorter than leaves; Fruit globose, sweet.

Flowers: May - August *Fruits:* September - December
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3369***, dated 12. 10. 2004; Tamsong TE, **AP Das & Chandrâ 3070**, dated 10.04.2004.
Status: Common.
Local Distribution: All three hill gardens.
General Distribution: Himalayas (Garhwal-Bhutan), Khasia, Mishmi Hills, N. Myanmar, Indo-China and W. China.
Note: Fruits edible. Good fodder for cattle.

AIZOACEAE Rudolphi

GLINUS L.

Glinus lotoides L., Sp. Pl. 463. 1753.
Mollugo lotoides (L.) O. Ktze., Rev. Gen. Pl. 264. 1891; FBI 2:662.1879.

Prostrate, spreading annual; stems tomentose, with stellate and simple hairs. Leaves fascicled, obovata, entire, apiculate, densely tomentose, shortly petiolate. Flowers axillary, solitary or cluster of 6, white. Capsules oblong with several black seeds.

Flowers & Fruits: January – May
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 0265,*** dated 09.02.2002; Mohurgong & Gulma TE, ***AP Das & Chandrâ 0972,*** dated 04.05.2002; Kamalpur TE, ***AP Das & Chandrâ 0656***, dated 20.04.2002.
Status: Very common.
Local Distribution: All Terai garden.
General Distribution: Pantropical.

Glinus oppositifolius (L.) A. DC., Bull. Herb. Boiss. 2, 1:552. 1901.
Mollugo oppositifolia L., Sp. Pl. 89. 1753.
M. *spergula* L., Syst. ed. 10:881.1759; FBI 2: 662. 1879.

Local name: *Gimasak* (Beng)

Prostrate or ascending herbs with slender, glabrescent stems. Leaves fascicled, petiolate elliptic-obovate or oblanceolate, entire, acute, apiculate, glabrous or sparsely hairy beneath. Flowers in axillary fascicles of 2-7, pedicellate, white. Capsules oblong with reddish seeds, ± reniform.

Flowers & Fruits: January – June.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0973***, dated 04.05.2002; Matigara TE, ***AP Das & Chandrâ 3132,*** dated 10.05.2004.
Status: Abundant
Local Distribution: All Terai garden.
General Distribution: Pantropical.
Note: The plant is taken as vegetable.

ALANGIACEAE DC.

ALANGIUM Lamarck

Alangium alpinum (C.B. Clarke) W.W. Smith & Cave in Rec. Bot. Surv. 6: 96. 1914; FEH 1: 219. 1966; EFPN 2: 194. 1979; FB 2(1): 332. 1991

Small soft wooded trees; lamina broadly ovate, shallowly lobed, acuminate; flowers in axillary few-flowered corymbs, white; fruits oblong.

Flowers & Fruits: June – September.
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3468***, dated 12. 10. 2004.
Status: Common.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: India, Nepal, Bhutan, Myanmar.

Alangium chinense (Loureiro) Harms in Ber. Deuts. Bot. Ges. 15: 24. 1897; FB 2(1): 332. 1991.
Stylidium chinense Loureiro, Fl. Cochinch. 1: 221. 1790.
Marlea begoniaefolia Roxburgh, Cor. Pl. 3: 80 t. 203. 1819; FBI 2: 743. 1879.

Local Name: *Akhane* (Nep).

Small tree with spreading, zigzag branches. Leaves alternate; pubescent, shape very variable, ovate to suborbicular or broadly subquadrate, margin entire to angular lobed, tip long acuminate, base usually oblique, truncate or deeply cordate, glabrous above, pubescent beneath with tufts of hair. Inflorescence axillary with white flowers; Fruits ovoid, dark purple when ripe, glabrous, succulent.

Flowers: March – May; *Fruits:* July - October
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0488***, dated 17.04.2002.
Status: Very common

Local Distribution: All Terai gardens.
General Distribution: Tropical Africa, Himalayas (Nepal-Bhutan), Myanmar east to China, Malaysia.

AMARANTHACEAE A. Jussieu

ACHYRANTHES L.

Achyranthes aspera L., Sp. Pl. 204. 1753; FBI 4: 730. 1885; FEH 1: 76. 1966; EFPN 3:168.1982; FB 1(2): 227.1984.

Local Name: *Apang* (Beng)

Erect or sprawling herb with long branches 25-100cm. with leaves ovate-elliptic, acute, base cuneate, sparsely to densely appressed pubescent. Flowers at first erect-spreading, congested, becoming strongly deflexed, distant in long slender spikes up to 35cm with rigid, greenish perianth.

Flowers & Fruits: June - August
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0620***, dated 20.04.2002; Mohurgong & Gulma TE, ***AP Das & Chandrâ 0277***, dated 16.02.2002.
Status: Very common.
Local Distribution: All Terai gardens.
General Distribution: Throughout India; Tropical Africa.
Note. – Roots, leaves and seeds used medicinally.

Achyranthes bidentata Blume, Bijdr. 545. 1825; FBI 4:730. 1885; FEH 1:76 & 635, f. 57. 1966; 2:25. 1971; EFPN 3:168. 1982; TBRI 50(4):104. 1987. FB 1(2): 227.1984.

Local Name: *Ankhlay Jhar* (Nep). FB 1(2): .1984.

Erect biennial herb; branches long, slender, striate, pubescent. Leaves petiolate opposite, ovate-elliptic, acute, repund, pubescent. Flowers bisexual on 10 – 20 cm long spikes. Tepals ovate-lanceolate, greenish, rigid, persistent. Capsules oblong, 1-seeded.

Flowers: August – November; *Fruits:* October – February
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 1207***, dated 18.10.2002; Tamsong TE, ***AP Das & Chandrâ 2384***, dated 04.11.2003; Soom TE, ***AP Das & Chandrâ 3435***, dated 12.10. 2004; Makaibari TE, ***AP Das & Chandrâ***, dated 17.05.2003.
Status: December – July.
Local Distribution: In all gardens.
General Distribution: Tropical Africa, Himalayas (Kashmir-Sikkim), India, Sri Lanka, China, Malaysia and New Guinea.

ALTERNANTHERA Forsskal

Alternanthera paronychioides St. Hill, Voy. Bres. 2: 439. 1833.

Prostrate, creeping herbs with profusely branched stems, rooting at nodes. Leaves opposite, oblanceolate – elliptic to spathulate, entire, acute, base narrowed, hairy. Flower heads axillary, many with white tepals, pilose on back, 3-nerved.

Flowers & Fruits: January – December
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0498***, dated 17.04.2002.
Status: Rare
Local Distribution: All Terai gardens.
General Distribution: A native of tropical America; naturalized in tropics.

Alternanthera sessilis (L.) R. Brown *ex* DC. in Cat. Hort. Monsp. 77. 1813; FBI 4: 731.1885; FB 1(2): 228. 1984.
Gomphrena sessilis L., Sp. Pl. 225. 1753.

Prostrate or decumbent herbs, often perennial, stem hairy in 2 lines, nodes rooting. Leaves opposite; lamina oblanceolate or elliptic, acute, glabrous. Flower heads sessile, globose; tepals 5, membranous. Capsules rounded, compressed, emarginated; seeds with broad wings.

Flowers & Fruits: March – September
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 0142***, dated 03.02.2002; Kamalpur TE, ***AP Das & Chandrâ 0458***, dated 17.04.2002; Mohurgong & Gulma TE, ***AP Das & Chandrâ 0846***, dated 04.05.2002.
Status: Common
Local Distribution: Very common.
General Distribution: India, Sri Lanka, and probably pantropic.

AMARANTHUS L.

Amaranthus lividus L., Sp. Pl. 1: 990. 1753; FB 1(2): 224. 1984.
Amaranthus blitum L., Sp. Pl. 1: 990. 1753; FBI 4: 721. 1885.

Erect or prostrate annuals, 10 –50 cm. Lamina broadly ovate, subacute or obtuse; spikes slender; flowers mostly female, males few above; tepals 3; stamens 3; stigmas 2 –3, minute. Capsules distinctly exceeding perianth. Seeds strongly glossy, faintly striate without scurfy warts.

Flowers & Fruits: Jun. - Dec.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0586***, dated 20.04.2002; Hansqua TE, ***AP Das & Chandrâ 1053***, dated 09.05.2002.
Status: Very common.
Local Distribution: All Terai gardens.
General Distribution: Widely distributed in tropical to temperate regions.

Amaranthus spinosus L., Sp. Pl. 991.1753; FBI 4:718.1885; FB 1(2): 225.1984.

Local name: *Kanta note* (Beng)
Erect much-branched armed herbs; spines axillary, straight, yellowish. Leaves alternate, ovate-lanceolate, entire, obtuse or mucronata, base cuneate, glabrous. Flowers unisexual, in compact axillary and terminal branched spikes. Utricles ovoid, rugose; seed 1, shining, black.

Flowers & Fruits: May – December

Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0898***, dated 04.05.2002; Hansqua TE, ***AP Das & Chandrâ 1420***, dated 20.10.2002; Kamalpur TE, ***AP Das & Chandrâ 0607***, dated 20.04.2002.
Status: Abundant
Local Distribution: All Terai gardens.
General Distribution: Pantropical.
Note: Young shoots taken as vegetable.

Amaranthus viridis L., Sp. Pl. 2: 1405. 176; FBI 4: 720. 1885; FB 1(2): 224.1984.

Erect annual unarmed herbs. Leaves alternate; lamina broadly ovate, subacute or obtuse, base attenuate, glabrous. Flowers mainly female, males few, usually on the upper part of slender spikes; Capsules equal or slightly exceeding perianth; seeds glossy, scurfy warty.

Flowers & Fruits: April – July
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0916***, dated 04.05.2002; Hansqua TE, ***AP Das & Chandrâ 1476***, dated 20.10.2002; Kamalpur TE, ***AP Das & Chandrâ 1182***, dated 18.10.2002; Makaibari TE, ***AP Das & Chandrâ 1807***, dated 17.05.2003.
Status: Abundant
Local Distribution: In all gardens.
General Distribution: Pantropic weed.
Note: Commonly taken as vegetable.

CELOSIA L.

Celosia argentea L., Sp. Pl. 205.1753; FBI 4:714.1885; FB 1(2): 221.1984.

Erect annual; branches grooved. Leaves alternate, variable, shortly petiolate, linear-lanceolate, acute, base tapering, glabrous. Flowers bisexual, white or tinged pink in dense, terminal, lanceolate spikes. Capsules ellipsoid; seeds 4-8, sub-reniform, black, shining.

Flowers & Fruits: March – August
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0446***, dated 05.04.2002.
Status: Rare
Local Distribution: Found only in Gulma garden.
General Distribution: Tropical regions of Asia, Africa and America.

DEERINGIA Brown

Deeringia amaranthoides (Lamarck) Merrill, Interpr. Rumph. Herb. Amboin. 211. 1917; FEH 1: 78. 1966; EFPN 3:169.1982; FB 1(2): 221.1984.
Achyranthes amaranthoides Lamarck, Encycl. Meth. B. 1: 548. 1785.

Stems up to 6m. with leaves ovate, acute or acuminate, base rounded or truncate, often reddish-tinged, puberulous beneath. Spikes with crimson perianth. Berry subglobose, red.

Flowers & Fruits: August – February
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1422***, dated 20.10.2002.
Status: Very common.
Local Distribution: All Terai gardens.

General Distribution: Throughout India; China, Australia.

GOMPHRENA L.

Gomphrena celosioides Martius in Beitr. Amar. 93. 1825; FB 1(2): 229. 1984; FS 312, 2004.

Prostrate or decumbent perennial, up to 40 cm. Leaves elliptic-oblanceolate, subacute, attenuate, appressed pilose beneath. Flower heads oblong, closely subtended by uppermost leaves. Bracts ovate. Outer 3 tepals almost flat, inner 2 with green midrib. Capsules ovoid, compressed.

Flowers & Fruits: June - December
Specimen Cited: Matigara TE, ***AP Das & Chandrâ 3630***, dated 20.10.2004.
Status: Rare
Local Distribution: Found only in Matigara garden.
General Distribution: Native of tropical America; now widely distributed in tropics.

PUPALIA Adanson *mut.* A. Jussieu

Pupalia lappacea (L.) A. Jussieu in Ann. Mus. Hist. Nat. Paris 2:132.1803; FBI 4:724.1885.
Achyranthes lappacea L., Sp. Pl. 204.1753.
Pupalia atropurpurea (Lam.) Moq. in DC., Prodr. 13(2): 331.1849;

Straggling tomentose suffrutescent plant. Leaves opposite, short petioled, ovate, entire. Flowers green, fascicled in simple spikes with hooked bristles of perianth. Utricles ovoid, membranous, hooks stalked enclosed by perianth; seeds ellipsoid, shining, black.

Flowers & Fruits: September – January
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2106,*** dated 30.06. 2003.
Status: Abundant
Local Distribution: In all gardens.
General Distribution: Tropical parts of India, Nepal, Sri Lanka, Singapore, Java, Madagascar, S. Africa and Philippines.

ANACARDIACEAE Lindley

CHOEROSPONDIAS Burtt & Hill

Choerospondias axillaris (Roxburgh) Burtt. & Hill in Ann. Bot. n. s. 1:254. 1937; FEH 1: 180. 1966; FEH 3:76. 1975; EFPN 2:100. 1979; FB 2 (1): 60. 1991; FWB 1:479. 1997; FI 5: 448. 2000.
Spondias axillaris Roxburgh, Fl. Ind. 2: 453. 1832; FBI 2: 42. 1876.

Local Name: *Lapsi* (Nep).

Evergreen tree, 10 m high or more. Leaves alternate, leaflets 2-6 pairs, ovate, acuminate, base rounded, entire, glabrous. Dioecious. Panicles with purple flowers. Drupes oblong or ovoid; stone with 5 oval depressions at apex.

Flowers & Fruits: April – June

Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2161,*** dated 30.06. 2003

Status: Less common

Local Distribution: All three hill gardens.

General Distribution: E. Himalaya (Nepal-Bhutan), Assam, Thailand, C. and S. China, Japan.

Note: Fruits delicious.

DRIMYCARPUS Hook.f.

Drimycarpus racemosus (Roxbur)gh Hook.f., FBI 2: 36. 1876; FB 2(1): 59. 1991; FI 5: 454. 2000.
Holigarna racemosa Roxb., Fl. Ind. 2: 82. 1832.

Local Name: *Khak Balaiyo* (Nep)

Tree to 30m. with leaves elliptic or oblanceolate, acuminate, entire, margin fluted or crispate and with a marginal vein, glabrous, base cuneate. Racemes up to 6cm, in axillary clusters. Fruit subglobose, oblique, 1-seeded.

Flowers & Fruits: March – April
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1772,*** dated 17.05.2003.
Status: Rare.
Local Distribution: Found only in Makaibari garden.
General Distribution: India, Nepal, Bhutan, Thailand.

MANGIFERA L.

Mangifera indica L., Sp. Pl. 1: 200. 1753; FBI 2: 13. 1876; FB 2(1): 59. 1991; FI 5: 466. 2000.

Local Name: *Aam* (Beng, Nep)

Tree 10-30m. with leaves elliptic or lanceolate, acuminate, base cuneate, glabrous. Panicles usually terminal, pubescent. Drupe variable in shape, ovoid-oblong, weakly compressed, yellowish or reddish when ripe.

Flowers & Fruits: February – June
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2115,*** dated 30.06. 2003.
Status: Common in Terai; sometimes grown in hills.
Local Distribution: In all gardens
General Distribution: India: Sub Himalayan Tract, Hilly areas of Central, Eastern and South India; Nepal, Bangladesh, Myanmar and Malaysia.

RHUS L.

Rhus chinensis Miller, Gard. Dict.ed. 8. sub. n. 7. 1768; FB 2(1): 55. 1991; FI 5: 486. 2000.
Rhus semialata Murray in Comm. Soc. Goett. 5: 27.t. 3. 1784; FBI 2: 10. 1876.

Local Name: *Bhakimlo* (Nep).

Shrub to small tree, upto 12 m high. Branches lax, spreading. Leaves alternate, leaflets 3-6 pairs, variable in form, oblong-ovate or elliptic, margin crenate-dentate, acute, base rounded or sometimes truncate, thinly pubescent above, densely brown tomentose beneath. Panicles pyramidal, terminal with flowers yellow or greenish-white; Drupe subglobose, reddish when ripe and densely hairy.

Flowers & Fruits: August – January
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1884,*** dated 10.06.2003.
Status: Less common
Local Distribution: Found only in Makaibari & Tamsong gardens.
General Distribution: Himalayas, Assam, Myanmar, Thailand, China, Formosa, Korea, Japan.
Note: Local vinegar is prepared from its fruits and often consumed as medicine.

Rhus succedanea L., Mant. Pl. 2: 221. 1771; FBI 2: 12. 1876; Trs. N. Beng. 45. 1929; Faun. & Fl. Nep. Him. 173. 1955; FEH 1:186. 1966; 3: 76. 1975; TBRI 50(4):125. 1987; FWB 1:483. 1997; FI 5: 494. 2000. var. ***acuminata*** (DC.) Hk. f. in FBI 2: 12. 1876; FB 2(1): 65. 1991.
R. acuminata DC., Prodr. 68. 1815.

Local Name: *Rani Bhalayo* (Nep).

Shrub to small trees, upto 10.5 m. Stem gray-brown, glabrous, sap acrid, irritating and causing blisters on human skin. Leaves imparipinnate, leaflets 2-6 pairs, ovate or oblong, entire, caudate-acuminate, base varible, cuneate, some rounded or even oblique, glabrous both sides, green and glossy above, silvery white below. Panicles axillary, slender with unisexual, small, yellowish green flowers.

Flowers : April - June *Fruits:* June - August
Specimen Cited: Tamsong TE, **AP Das & Chandrâ 2986**, dated 10.04.2004.
Status: Less common
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Himalaya, Myanmar, Thailand, Indo-China, Japan.
Note: Sap causes irritating and itching blisters on skin.

ANNONACEAE A. Jussieu

ANNONA L.

Annona reticulata L., Sp. Pl. 1: 573. 1753; FBI 1: 78. 1872; FB 1(2): 244. 1984; FI 1: 207.1993.

Local Name: *Nona Ata* (Beng)

Tree 6-12m. with leaves oblong-lanceolate, acuminate, base rounded, minutely pubescent at first, later glabrous. Cymes 2-9 flowered extra-axillary or terminal. Fruit ovoid-globose, 5-10cm diameter, reddish green or brownish.

Flowers & Fruits: July – January.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1202***, dated 18.10.2002.
Status: Common

Local Distribution: All Terai gardens.
General Distribution: Native of Central America cultivated for its edible fruit; naturalized in India.

MILIUSA Lesch.

Miliusa globosa (DC.) Panigrahi *et* S.C. Mishra in Taxon 33:713. 1984; FI 1:215. 1993; FWB 1(2):149. 1997.
Guatteria globosa DC. In Mem. Soc. Physt. Geneve. 5: 41. 1831.
Miliusa roxburghiana (Wallich) Hk. f. *et* Thoms., Fl. Ind. 150. 1855; FBI 1:87. 1872;

A small deciduous shrub to small tree, 3.5-5 m, young shoots pubescent. Branches spreading. Leaves subsessile, oblong - elliptic, acuminate, base rounded, somewhat aromatic. Flowers dioecious or polygamous either, crimson red. Ripe carpels subglobose or oblong, glabrous, borne long stalks.

Flowers & Fruits: March – December.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2846***, dated 25.03. 2004.
Status: Rare.
Local Distribution: Found only in Makaibari area.
General Distribution: Himalayas (Nepal-Sikkim), Assam, Myanmar

APIACEAE Lindley, *nom. alt.* [UMBELLIFERAE A. Jussieu, *nom. cons.*]

CENTELLA L.

Centella asiatica (L.) Urban in Martius, Fl. Brasil 11:287, t. 78, f.1.1879; FEH 1:229. 1966; EFPN 2:188. 1979; FB2(2): 446.1999.
Hydrocotyle asiatica L., Sp. Pl. ed. 1(1): 234. 1753; FBI 2:669. 1979.

Local Name: *Ghor Topray* (Nep), *Thankuni* (Beng).

Small annual/perennial herbs; runners rooting at nodes. Lamina 1.5–5 cm across, reniform, crenate, deeply cordate. Bracts ovate, partially subtending flowering umbels of 3-6 pinkish, sessile flowers. Fruits reticulate-rugose with elevated ridges.

Flowers & Fruits: April – August
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0446***, dated 05.04.2002; Hansqua TE, ***AP Das & Chandrâ 0264***, dated 09.02.2002; Kamalpur TE, ***AP Das & Chandrâ 1180***, dated 18.10.2002; Makaibari TE, ***AP Das & Chandrâ 1822***, dated 10.06. 2003; Soom TE, ***AP Das & Chandrâ 3313***, dated 26.06. 2004; Tamsong TE, ***AP Das & Chandrâ 2430***, dated05.11.2003.
Status: Abundant.
Local Distribution: All gardens.
General Distribution: Tropical and sub-tropical parts of the world.
Note: Important medicinal plant; leaf-decoction taken locally to cure dysentery.

HYDROCOTYLE L.

Hydrocotyle himalaica P.K. Mukherjee in For. 95: 470. t. 1. 1969; EFPN 2: 186. 1979; TBRI 50(4): 116.1987.
H. javanica Thunb. *sensu* Hara, SFSH f. 174. 1963.
H. podantha auct. non Molkenb; FEH 1: 230. 1966.

Local Name: *Golpatta, Dallo patta, Ataney Jhar* (Nep).

Prostrate perennial, runners rooting at nodes. Stem pubescent. Lamina 0.8-3.2 x 1.1-3.7 cm, reniform, crenate, deeply cordate, glossy, 7-9 nerved. Umbels solitary, 0.6-0.9 cm across, flowers many. Peduncles longer than petioles, leaf-opposed; pedicels upto 0.3 cm. glabrous. Petals white.

Flowers: June - October *Fruits:* July - December
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1690,*** dated 17.05.2003; Tamsong TE, ***AP Das & Chandrâ 2886,*** dated 10.04. 2004; Soom TE, ***AP Das & Chandrâ 3488***, dated 12. 10. 2004.
Status: Abundant.
Local Distribution: In all hill gardens.
General Distribution: E. Himalaya (Nepal-Bhutan), Meghalaya.
Note: Leaf extracts used medicinally in dysentery and stomach disorders.

Hydrocotyle nepalensis Hook., Exot. Fl. 1: t. 30. 1823; FEH 1: 229 & 643. 1966; EFPN 2: 186. 1979; TBRI 50(4): 116. 1987.
H. javanica auct. Non Thunb.: Clarke in FBI 2: 667. 1879, P.P.

Similar to *H. himalaica* but comparatively larger. Leaves 1.5-4 x 1.8-6.2 cm; petioles 1.3-8 cm long, light red when young; lamina palmately 6-7 lobed, serrate, broadly cordate, hairy above. Umbels aggregated; peduncles 1.8-2.5 cm long,. Petals light-green; stamens upto 0.7 cm long.

Flower & Fruit: May - December
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2954***, dated 10.04. 2004; Soom TE, ***AP Das & Chandrâ 3553***, dated 12. 10. 2004.
Status: Less common.
Local Distribution: In Soom & Tamsong gardens.
General Distribution: Himalayas (Kashmir-Bhutan), Meghalaya, Tibet, Myanmar.
Note: Leaf extract used to treat diptheria, throat-pain and pneumonia.

Hydrocotyle sibthorpioides Lamarck, Encycl. Meith. 3:153. 1789; FEH 1:230.1966: EFPN 2:187. 1979; FB 2(2): 444.1999.
H. rotundifolia Roxb. *ex* DC., Prodr. 4:64. 1830; FBI 2:668. 1879.

Prostrate herbs; branches filiform, forming mess, rooting at nodes. Lamina 0.55-1cm across, orbicular, cordate, shallowly lobulate, lobes crenate, glabrous, glossy. Flowers sessile, greenish-white in simple umbels. Ripe fruits broadly orbicular, smooth, 3-ribbed, yellow / dark-brown.

Flower & Fruit: April – August

Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0059***, dated 27.01.2002; Hansqua TE, ***AP Das & Chandrâ 1009***, dated 09.05.2002; Kamalpur TE, ***AP Das & Chandrâ 0397***, dated 27.01.2002; Matigara TE, ***AP Das & Chandrâ 3128***, dated 10.05. 2004; Makaibari TE, ***AP Das & Chandrâ 2861***, dated 25.03. 2004; Tamsong TE, ***AP Das & Chandrâ 2957***, dated 10.04. 2004.
Status: Abundant.
Local Distribution: All gardens.
General Distribution: S.E. Asia, Australia.

OENANTHE L.

Oenanthe thomsonii Cl. In FBI 2: 697. 1879; FB 2(2): 486. 1999.
Oenanthe javanica (Blume) DC., Prodr. 4: 138. 1830.
Sium javanicum Blume, Bijdr. 15: 881. 1826.

A weak diffuse herb, 20 –80 cm. Leaves 3 –15cm long, finely 3 –4 x pinnately divaricately divided, ultimate segments linear. Umbels, 3 –9 rayed; peduncle 1 –7cm; rays 1 –2.5cm; bracteoles 2 –3mm. Calyx teeth 0.5 –1mm. Petals white, 1 –1.5mm long. Fruits ovoid.

Flowers & Fruits: Jun. - Dec.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2760***, dated 25.03. 2004; Tamsong TE, ***AP Das & Chandrâ 2271***, dated 05.09. 2003.
Status: Less common.
Local Distribution: All three hill gardens
General Distribution: Eastern Himalaya, Khasia Hill, Indochin, China.

SANICULA L.

Sanicula elata Hamilton ex D.Don, Prodr. 183. 1825; FB 2(2): 446. 1999.

Erect perennial herbs to 100 cm. Leaves twice deeply divided to base, segments acute or acuminate, serrations spinulose, glabrous; upper leaves smaller. Bracts linear lanceolate to ovate; flowers almost sessile. Corolla greenish –white, purple tinged. Fruits subterete, bristles hooked.

Flowers & Fruits: **May – September.**
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3244***, dated 26.06. 2004
Status: Rare
Local Distribution: Found only in Soom & Tamsong gardens
General Distribution: Kashmir – Bhutan, Khasia Hills, Myanmar, Sri Lanka, Indochin, China.

APOCYNACEAE A. Jussieu

ALSTONIA R.Brown, *nom.cons.*

Alstonia scholaris (L.) R.Br., Mem. Wern. Soc. 1:76.1811; FBI 3:642.1882; FB 2(2): 672.1999.
Echites scholaris L., Mant. 1:53.1767.

Local Name: *Chhatiwan* (Nep), *Chhatim* (Beng).

Medium, evergreen trees with a dense, spreading crown. Leaves in whorls of 5-7, rarely more, oblong-lanceolate or obovate, bright green, glossy, thick, crowded at the ends of branches. Flowers greenish-yellow in compact, umbellate cymes. Follicles 2, terete, pendulous.

Flowers & Fruits: November – May
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0831***, dated 04.05. 2002; Hansqua TE, ***AP Das & Chandrâ 1033***, dated 09.05.2002; Kamalpur TE, ***AP Das & Chandrâ 1184***, dated 18.10.2002; Makaibari TE, ***AP Das & Chandrâ 1735***, dated 17.05.2003.
Status: Abundant
Local Distribution: All Terai gardens.
General Distribution: India, Sri Lanka, Singapore, Malay Archipelago, tropical Australia and Africa.
Use: Bark used as medicine and a pig fodder.

BEAUMONTIA Wallich

Beaumontia grandiflora Wallich, Tent. Fl. Nep. 15.t. 7. 1824; FB 2(2): 677. 1999.

Local Name: *Gautali phul, Gathale phul* (Nep); *Chomrik* (Lep)

Liana, rusty–brown tomentose. Lamina obovate to elliptic oblong, acuminate, cuneate, glabrous above. Corolla white, pale green below, fragrant, lobes triangular-ovate. Calyx lobes obovate to oblanceolate, tomentose. Fruits narrowly ellipsoid, obtuse. Seeds 2 x 1 cm, coma 4 cm long.

Flowers & Fruits: April – November

Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2481***, dated 11.11. 2003.
Status: Rare
Local Distribution: Found only in Makaibari garden.
General Distribution: NE India.

CATHARANTHUS G. Don

Catharanthus roseus (L.) G.Don, Gen. Hist. 4: 95. 1837; FB 2(2): 670. 1999.
Vinca rosea L., Syst. Ed. 10: 944. 1759; FBI 3: 640. 1882.

Local Name: *Nayantara* (Beng)

Erect to decumbent undershrub; stems yellowish green. Lamina glabrous, elliptic-obovate, obtuse-mucronate, cuneate. Corolla lobes white with a purple, red, pink, pale yellow or white eye or purple, obovate, hairy ring bellow anthers. Sepals teeth lanceolate. Fruits striate; seeds oblong.

Flowers & Fruits: January – December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 1537***, dated 22.10. 2002; Makaibari TE, ***AP Das & Chandrâ 2470***, dated 11.11. 2003.
Status: Rare
Local Distribution: In Terai and low altitude areas.
General Distribution: A native of South America, fairly naturalized in the tropics.

ICHNOCARPUS R. Brown, *nom.cons.*

Ichnocarpus frutescens (L.) Aiton in Ait.f., Hort. Kew. ed. 2, 2:69.1811; FBI 3:669.1882; FB 2(2): 686.1999.
Apocynum frutescens L., Sp. Pl. 213.1753.

Local Name: *Dudhe Lahara* (Nep)

Woody climbers, young branches red-brown tomentose, latex milky. Lamina lanceolate to elliptic-oblong, acute-acuminate, base acute, glabrous. Flowers small, fragrant, white, tinged with green or purple. Follicles 2, very slender, curved, divergent with linear, black seeds.

Flowers & Fruits: June – December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0043***, dated 27.01.2002; Hansqua TE, ***AP Das & Chandrâ 1028,*** dated 09.05.2002; Kamalpur TE, ***AP Das & Chandrâ 1236***, dated 18.10.2001; Makaibari TE, ***AP Das & Chandrâ 1879***, dated 10.06. 2003; Tamsong TE, ***AP Das & Chandrâ 2116***, dated 03.07.
Status: Very common.
Local Distribution: In all gardens.
General Distribution: India, Sri Lanka, Bangladesh, Nepal, Myanmar, Java and Australia.

TABERNAMONTANA L.

Tabernamontana divaricata (L.) R. Br. in R & S. Syst. 4: 427. 1819; FEH 1: 259. 1966, Fl. Jow. 2: 311. 1983, Fl. Meg. 2: 607. 1987.
Nerium divaricatum L., Sp.Pl. 209. 1753.
Tabernaemontana coronaria (Jacq.) Willd., Enum. Hort. Bertol 275. 1809; FBI 3: 646. 1882.

Shrub bark; gray, minutely fissured; dichotomously branched. Lamina 4-13 x 1.2-4 cm, ovate-lanceolate, oblong-lanceolate, acuminate, base cuneate, greenish, glossy. Cymes upto 10 cm long. Flowers 4.5 cm diam., fragrant. Follicles 2-4.5cm long, divaricate, yellowish, seeds red-arillate.

Flowers & Fruits: April – November
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1104***, dated 09.05.2002; Soom TE, ***AP Das & Chandrâ 3538***, dated 12. 10. 2004.
Status: Common
Local Distribution: In Terai and low altitude areas.
General Distribution: Native of Tropical Asia, widely naturalised.

VALLARIS Burmann f.

Vallaris solanacea (Roth) O. Kuntze, Rev. Gen. 417. 1891; FB 2(2): 678. 1999.
Peltanthera solanacea Roth, Nov. Sp. 132. 1821.

Local Name: *Dudhe Lahara, Harmali* (Nep)

Extensive woody twinner; branches pale grey. Leaves opposite, membranous, elliptic-lanceolate, acuminate, minutely dotted. Corolla salver shaped, fragrant, white to creamy, tinged with green, in axillary or terminal cymes. Follicle fibrous, green to light brown; seeds with long coma.

Flowers & Fruits: March – June
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0289***, dated 16.02.2002; Hansqua TE, ***AP Das & Chandrâ 1151***, dated 14.06. 2004.
Status: Less common
Local Distribution: All Terai gardens.
General Distribution: Tropical and Subtropical regions of Himalayas; Myanmar, Indo -China and South China.

VINCA L.

Vinca minor L., Sp. Pl. 209. 1753.

Small under shrub, branches procumbent. Leaves petiolate, ovate –lanceolate, entire, acute. Flowers axillary, corolla tube narrow, limb broad, bluish –violate. Fruit a pair of follicle.

Flowers & Fruits: June – November.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 3066***, dated 10.04 2004.
Status: Rarely naturalized; commonly grown ornamental
Local Distribution: All three hill gardens.
General Distribution: India, Europe and many temperate regions

WRIGHTIA R.Brown

Wrightia arborea (Dennst.) Mabberley in Taxon 26(5/6): 533.1977. FB 2(2): 676.1999.
Periploca arborea Dennst. in Schluessel Hort. Malab. 13, 23 & 25.1818
Wrightia tomentosa Roem. *et* Schult. in L., Syst. Veg. 4/414. 1819; FBI 3:653.1882;

Local Name: *Khirra, Dudhi* (Nep)

Small crooked tree; branches lenticellate. Leaves ovate-elliptic, caudate-acuminate, base cuneate, puberulent to tomentose. Flowers fragrant in peduncled cymes; corolla greenish white or yellow; coronal scales orange, pubescent. Follicles connate throughout; seeds with long white coma.

Flowers & Fruits: April – July
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0774***, dated 04.05.2002
Status: Rare
Local Distribution: All Terai gardens.
General Distribution: India, Pakistan, Sri Lanka, Bangladesh, Myanmar, Thailand and China.

ARALIACEAE A. Jussieu

BRASSAIOPSIS Decaisne et Planch

Brassaiopsis hainla (Hamilton) Seemann in J. Bot:2: 291. 1864; FBI 2: 735. 1879; FEH 1:226. 1966; FB 2(1): 343. 1991.
Hedera hainla Hamilt. *ex* D. Don, Prodr. Fl. Nep. 187. 1825.

Local Name: Chu*l*etro (Nep).

Small armed trees to 3-10m. Stems and branches spiny. Leaves palmately lobed, ovate or suborbicular, shallowly 3-7 lobed, acuminate, base cordate, serrate, glabrous, rarely stellate-pubescent beneath. Flowers in umbels borne in panicles, stellate-pubescent, greenish. Fruits globose with 2 seeds obscurely compressed.

Flowers & Fruits: February - April
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2564***, dated 11.11. 2003; Tamsong TE, ***AP Das & Chandrâ 2891***, dated 10.04. 2004; Soom TE, ***AP Das & Chandrâ 3422***, dated 12. 10. 2004.
Status: Common
Local Distribution: All three hill gardens.
General Distribution: E. Himalaya (Nepal-Bhutan), Meghalaya, S. W. China.

TREVESIA Vis.

Trevesia palmata Vis. in Mem. Acc. Torin. Ser. 2: 4. 262. 1842; FB 2 (1): 350. 1991.

Local Name: *Phutta* (Nep)

Trees to 6m, bark strongly prickly. Lamina palmately 7 –9 lobed from base; lobes ovate –elliptic, acuminate, coarsely serrate, sparsely stellate –pubescent; petioles sparsely prickly or unarmed. Umbels up to 30 flowered, 5 –10 cm in diameter. Corolla yellowish, narrowly ovate. Fruits 10 –16mm diameter.

Flowers & Fruits: April – November

Specimen Cited: Makaibari TE, ***AP Das & Chandrâ1787***, dated 17.05.2003.
Status: Few plants only; probably planted.
Local Distribution: Found only in Makaibari garden.
General Distribution: Eastern Himalaya (Nepal – Assam), W. China, Malaysia.

ASCLEPIADACEAE R. Brown

CALOTROPIS R. Brown

Calotropis gigantea (L.) Dryand. in Aiton, h. Kew. ed. 2, 2: 78. 1811; FBI 4: 17. 1883; FEH 1: 260. 1966; EFPN 3:85.1982; FB 2(2): 701.1999.
Asclepias gigantea L., Sp. Pl. 214. 1753.

Local Name: *Aakanda* (Beng); *Aak* (Nep)

Large shrub to small tree, 1.5-3m tall with stout hollow trunk. Leaves dense at ends of branches, obovate to oblong, apex acute, base strongly cordate, sub-sessile, glabrous above, white tomentosa below. Inflorescence 4-many-flowered with campanulate, spreading, white with purple corolla.

Flowers & Fruits: February –November
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0739***, dated04.05. 2002; Soom TE, ***AP Das & Chandrâ 3482***, dated 12. 10. 2004.

Status: Very common.
Local Distribution: All Terai gardens.
General Distribution: India, Tropical Asia.

HOYA R. Brown

Hoya parasitica Wallich in Wight, Contrib. Bot. Ind. 37. 1837; FBI 4: 57. 1883; FB 2(2): 719.1999.

Epiphytic succulent glabrous, twiner. leaves flat, ovate, thickly fleshy-coriaceous, long petioled. Flowers white and broad on long persistent peduncles. Follicles long, slender, glabrous, thin skinned; seeds oblong with coma.

Flowers & Fruits: July - November
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 1636***, dated 24.10. 2002; Kamalpur TE, ***AP Das & Chandrâ 1173***, dated 18.10.2002.
Status: Common
Local Distribution: All Terai gardens.
General Distribution: India: Andaman Island, North East India; Bangladesh, Malacca, Singapore.

MARSDENIA R. Brown

Marsdenia tinctoria R. Brown in Mem. Wern. Nat. Hist. S. 1: 30. 1811; FBI 4: 34. 1883; FEH 1: 262. 1966; EFPN 3:87.1982; FB 2(2): 709.1999.

High climbing glabrous under shrub to 7m. or more. Stem beneath bark, leaves, calyx etc., suffused with purple-blue dye. Leaves ovate to elliptic, apex acuminate or caudate, base rounded to truncate to shallowly cordate, membranous, sparsely hairy. Flowers white, very small in distinctive crowded spike like cymose.

Flowers & Fruits: August – October
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1056***, dated 09.05.2002; Soom TE, ***AP Das & Chandrâ 2716***, dated 28.01. 2004
Status: Less Common.
Local Distribution: In Terai and low altitude areas.
General Distribution: Subtropical Himalaya (Nepal – Bhutan), Assam, China, Taiwan, Malaysia.

TYLOPHORA R. Brown

Tylophora belostemma (Wallich) Bentham ex Bentham & Hooker f., Gen. Pl. 2: 771. 1876; FBI 4: 43. 1883; EFPN 3:88.1982; FB 2(2): 727.1999.
Belostemma hirsutum Wallich ex Wight, Conrt. B.Ind. 52. 1834.

Slender climbing shrub with long, twining branches, densely softly-hirsute. Leaves ovate to lanceolate, apex acuminate, base cordate to rounded, membranous. Flowers dull purple, small in few-flowered almost sessile umbels.

Flowers & Fruits: June- July


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Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1383***, dated 20.10.2002; Makaibari TE, ***AP Das & Chandrâ 2800***, dated 25.03. 2004.
Status: Less Common.
Local Distribution: All Terai gardens.
General Distribution: NE India.

WATTAKAKA Hasskarl

Wattakaka volubilis (L.f.) Stapf in Curtis, Bot. Mag. Sub. t. 8976. 1923; FB 2(2): 723.1999.
Dregea volubilis (L.f.) Bentham *ex* Hook.f. in Hook.f., FBI 4:46. 1883.
Asclepias volubilis L.f., Suppl. Pl. 170. 1781.

Extensive liana, glabrous, sometimes parts puberulent. Lamina large, ovate to suborbicular, acuminate, cordate to truncate or rounded; petioles long and slender. Umbels axillary, many flowered; flowers yellow-green. Follicles thick, hard; seeds with coma.

Flowers & Fruits: May – January
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 0092***, dated 03.02.2002; Mohurgong & Gulma TE, ***AP Das & Chandrâ 1524***, dated 22.10.2002.
Status: Less common
Local Distribution: All Terai gardens.
General Distribution: India, east to W. & S. China, Taiwan, Sri Lanka, Java, Malaysia.

ASTERACEAE **Dum., nom. alt.**
[COMPOSITAE **Giseke, *nom. cons.***]

ACMELLA Richard

Acmella calva (DC.) Jansen : FB 2(3): 1605. 2001.
Spillanthes calva DC. in Wight, Contr. Bot. Ind. 19. 1834; FEH 2:141. 1971; EFPN 3:45. 1982; TBRI 50 (4):127. 1987; FI 12:409. 1995.
S. acmella var. *calva* (DC.) Clarke, Comp. Ind. 138. 1876; FBI 3:307. 1881.

Local Name: *Kalijhar* (Nep).

15-35cm tall diffuse annual. Leaves opposite; lamina ovate, acute, serrate, 3-nerved. Capitula 0.7-0.82cm in diam., either in solitary paniculate peduncles, yellow. Involucral bracts 2-seriate, ovoid. Heads ovoid. Receptacle conical. Rays uniseriate, yellowish. Discs tubular. Pappus absent.

Flowers & Fruits: July – November.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 1374,*** dated 18.10.2002.
Status: Abundant in low altitude.
Local Distribution: All Terai gardens
General Distribution: E. Himalaya (Darjeeling, Sikkim, Assam), Nepal, Sri Lanka, China, Myanmar, Indonesia, Malaysia.

Acmella paniculata : FB 2(3): 1605. 2001.
Spilanthes paniculata Wallich ex DC., Prodr. 5: 625. 1836; FI 12: 410. 1995.
Spilanthes acmella var. *paniculata* (DC.) C.B.Clarke, Comp. Ind. 139. 1876; FBI 3: 307. 1881.

Similar to *Acmella uliginosa* but capitula discoid, 7-9mm diameter, rather many in terminal, corymbose panicles. Achenes strongly ciliate; weak pappus bristles present.

Flowers & Fruits: November – February
Specimen Cited: Soom TE, ***AP Das & Chandrâ*** 2653, dated 27.12.2003
Status: Less Common.
Local Distribution: Found only in Soom garden.
General Distribution: India, Nepal, Sri Lanka, Myanmar, Thailand, Indonesia, Philippines, Vietnam, South America, New Guinea.

Acmella uliginosa Sw., Nov. Gen. Pl. Seu Prodr. Descr. Veg. Ind. Occ. 110. 1788; FI 12: 412. 1995; FB 2(3): 1406. 2001.

Local Name: *Gorakba, Pirazh* (Nep)

Plant erect or decumbent, 5-30cm with stems ± glabrous or sparsely pilose at nodes and leaves acute or subobtuse, attenuate at base, subentire or serrate, subglabrous or sparsely pubescent on both surfaces. Capitula 3-5mm diameter, radiate, yellow.

Flowers & Fruits: February – August
Specimen Cited: Soom TE, ***AP Das & Chandrâ 1577***, dated 22.10. 2002.
Status: Common
Local Distribution: In Terai and low altitude areas.
General Distribution: India: West Bengal, Tamil Nadu; Nepal, Sri Lanka, Myanmar, Indonesia, Philippines, South America, New Guinea.

AGERATINA Spach

Ageratina adenophora (Sprengel) King & Robinson in Blumea 1:502. 1935; FEH 1:339. 1966; FEH 2:137. 1971; EFPN 3: 27. 1982; FI 12:350. 1995; FB 2(3): 1624.2001.
Eupatorium adenophorum Spreng, Syst. Veg. 3: 420. 1826.
E. glandulosum Humboldt, Bonpland & Kunth, Nov. Gen. & Sp. 4: 122. 1820; *non* Michaux (1803).

Local Name: *Kalo Banmara* (Nep).

Undershrubs, about 1m tall. Stem reddish, glandular hairy. Leaves opposite; lamina rhomboid-elliptic or almost triangular, crenate-serrate, acute, base cuneate, dark green, almost glabrous above, glandular-hairy beneath. Heads discoid in corymbs; florets white, longer than involucre.

Flowers: June – September; *Fruits:* July – October
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2780***, dated 25.03. 2004; Soom TE, ***AP Das & Chandrâ 3277***, dated 26.06. 2004; Tamsong TE, ***AP Das & Chandrâ 2182***, dated 30.06.2003.
Status: Less common
Local Distribution: Makaibari, Soom & Tamsong gardens.

General Distribution: Pantropical weed; native of Mexico.
Note: Medicinal and dried leaves used extensively as potent manure.

AGERATUM L.

Ageratum conyzoides L., Sp. Pl. 839. 1753, FBI 3: 243. 1881; FEH 1:330. 1966; TBRI 50 (4):105. 1987; FI 12:348. 1995; FB 2(3): 1627. 2001

Local Name: *Elami-paat* (Nep).

Erect annuals to 95 cm high, pilose. Lamina ovate, ovate-rhomboid, crenate-serrate, obtuse/ acute, subtruncate, 3-nerved. Capitula discoid, all discs, white. Involucral bracts, lanceolate. Achenes black-brown; pappus scales 5, flattened at base.

Flowers & Fruits.: January – December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0788***, dated 04.05. 2002; Hansqua TE, ***AP Das & Chandrâ 1001***, dated 09.05.2002; Kamalpur TE, ***AP Das & Chandrâ 1316***, dated 18.10.2002; Makaibari TE, ***AP Das & Chandrâ 1732***, dated 17.05.2003; Soom TE, ***AP Das & Chandrâ 2001***, dated 27.12.2003; Tamsong TE, ***AP Das & Chandrâ 2261***, dated 05.09. 2003.
Status: Abundant.
Local Distribution: All Gardens
General Distribution: Native of Tropical America. Now a pantropic weed.
Note: Young leaf extract applied on cuts and injuries as haemostatic.

Ageratum houstonianum Mill., Gard. Dict. Ed. 8. 1768; FI 12: 349. 1995; FB 2(3): 1627. 2001

Local Name: *Elami-paat* (Nep).

Annual, erect. To 1 m tall; leaves usually truncate to cordate, gradually acuminate; stipitate-glandular. Capitula larger, bluish, all discs; Styles much exerted, 2-3 mm; pappus not exceeding corolla, awn-tipped.

Flowers & Fruits: Major part of the year.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0297,*** dated 16.02.2002; Hansqua TE, ***AP Das & Chandrâ 0099***, dated 03.02. 2002; Kamalpur TE, ***AP Das & Chandrâ 0371***, dated 27.02.2002; Makaibari TE, ***AP Das & Chandrâ 1790***, dated 17.05.2003; Soom TE, ***AP Das & Chandrâ*** 2604, dated 27.12.2003; Tamsong TE, ***AP Das & Chandrâ 2201***, dated 30.06. 2003.
Status: Abandant
Local Distribution: All Gardens
General Distribution: Native of Tropical America. Naturalized in India, Nepal, Indonesia, Mexico, W. Indies, Peru, Colombia and British Honduras.

ANAPHALIS DC.

Anaphalis busua (D.Don) DC., Prodr. 6: 275. 1838; FEH 1: 331.1966; 2:132. 1971; 3: 110.1975; EFPN 3: 10.1982; TBRI 50(4):105. 1987; FI 13:57. 1995; FB 2(3): 1517. 2001
Gnaphalium busua D. Don., Prodr. 173.1825.

Local Name: *Bukki Phool* (Nep).

Erect 30-70cm tall softly hairy branched herb. Leaves numerous, decurrent, 3-6 cm, narrow lanceolate to oblanceolate, margins recurved, entire, acute, green, puberulous above, white wooly beneath. Involucral bracts elliptic. Capitula in branched corymbs, subglobose; florets white.

Flowers: Jul. - Nov. *Fruits:* Sep.- Jan.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2089,*** dated 30.06. 2003.
Status: Common.
Local Distribution: Found only in Soom & Tamsong gardens
General Distribution: Himalayas, Meghalaya, Myanmar, Thailand, Philippines, China.

Anaphalis contorta (D. Don) Hook. f., FBI 3: 284. 1881; FEH 1: 331. 1966; 2: 132. 1971; 3: 110. 1975; EFPN 3: 10.1982; TBRI 50(4): 105. 1987; FI 13:59. 1995; FB 2(3): 1518. 2001
Antennaria contorta D. Don in Bot. Reg. t. 605.1821.

Local Name: *Bukki Phool* (Nep).

Perennial tufted herbs; branches slender, wooly. Leaves sessile, densely clustered, overlapping, upper linear, basal obovate, margins inrolled, nerve-one, thick. Capitula 0.35 cm in diam. in terminal compact corymbose clusters. Involucral bracts 0.1-0.2 cm. Discs whitish-yellow.

Flowers & Fruits: August – March
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2402,*** dated 05.11.2003; Soom TE, ***AP Das & Chandrâ 3451,*** dated 12.10.2004.
Status: Common.
Local Distribution: Soom & Tamsong gardens.
General Distribution: Temperate regions of Afganistan, Himalayas, Meghalaya, Assam, China.

Anaphalis margaritacea (L.) Bentham & Hook.f., Gen. Pl. 2: 303.1873; FEH 1: 331.1966; 2: 132.1971; EFPN 3: 10.1982; TBRI 50(4): 105.1987; FI 13:68. 1995; FB 2(3): 1517. 2001
Gnaphalium margaritaceum L., Sp. Pl. 850. 1753.
Anaphalis cinnamomea C.B. Clarke, Comp. Ind. 103. 1876; FBI 3: 281. 1881.

Erect, usually unbranched, leafy, wooly, 30 – 55 cm tall herbs. Leaves sessile; lamina 3-9 x 0.5-1 cm, lanceolate, entire, acute, glabrous to thinly hairy, bright green above, 3-4 nerved. Involucral bracts small, elliptic-ovate. Capitula 0.7 cm across, subglobose, grouped in dense domed clusters.

Flowers: Aug. - Nov. *Fruits.:* Sep. - Dec.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2221,*** dated 05.09. 2003.
Status: Common
Local Distribution: Soom & Tamsong gardens.
General Distribution: Kashmir-Bhutan, Meghalaya, Thailand, China, Japan, N. America.

ARTEMISIA L.

Artemisia dubia Wallich *ex* Besser in Nouv. Memb. S. Imp. Nat. Mos. 3:39. 1834; FEH 1:332. 1966; EFPN 3:12. 1982; TBRI 50(4):106. 1987; FI 12:19. 1995; FB 2(3): 1565 . 2001.

Local Name: *Titepaati* (Nep).

Aromatic tomentose suffrutescent plant, paniculately branched. Lamina to 8.2 cm, sessile, pinnatisect, irregularly serrate, acute, pale underside. Capitula 0.25-0.35cm across, nodding on racemes, reddish brown. Involucral bracts scarious. Outer florets female; corolla yellowish green.

Flowers: Aug. - Oct. *Fruits.:* Oct. - Jan.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2289***, dated 05.09. 2003; Soom TE, ***AP Das & Chandrâ3470***, dated 12. 10. 2004.
Status: Common.
Local Distribution: All three hill gardens
General Distribution: Himalayas, Nepal, Bhutan, Tibet and China.

Artemisia indica Willdenow, Sp. Pl. 3:1846. 1803; FEH 1: 332. 1966; 2: 133. 1971; EFPN 3: 12. 1982; TBRI 50(4):106. 1987; FI 12: 27. 1995; FB 2(3): 1559. 2001.
A. vulgaris auct. non. L., FBI 3: 325. 1881. p.p.; KB 42 (2): 447. 1987.

Local Name: *Titepaati* (Nep); *Nak-nisinda* (Beng).

Bushy shrubs to 2m high. Stem whitish hairy, rarely glabrescent. Leaves alternate, sessile, highly aromatic, 2.4-7 x 1.25-3.7 cm, ovate, lobed or deeply pinnatisect, cottony white beneath; terminal leaves smaller, entire or 3-lobed. Heads 0.25-0.35cm diam., ovoid, in long pyramidal panicles.

Flowers: Aug. - Dec. *Fruits.:* Oct. - Feb.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1720,*** dated 17.05. 2003; Soom TE, ***AP Das & Chandrâ 3521***, dated 12. 10. 2004; Tamsong TE, ***AP Das & Chandrâ 2588***, dated 27.12.2003.
Status: Abundant.
Local Distribution: All three hill gardens
General Distribution: Subtropical-temperate regions of India, Myanmar, Thailand, China and Japan.
Note: An important plant in local folk medicine of Hill people and religious ceremonies of Hindu community. Also used as insect repellant.

BIDENS L.

Bidens pilosa L., Sp. Pl. ed. 1. 832. 1753; FBI 3:309. 1881; FEH 1: 333. 1966; EFPN 3: 15. 1982; TBRI 50 (4): 107. 1987; FI 12:372. 1995; FB 2(3): 1619. 2001

Local Name: *Kuro* (Nep)

Erect glabrous annual to 60 cm. Leaves opposite; lamina 3-lobed, 1-2 pinnatisect or undivided; leaflets 2-5x 1-2.5cm, ovate, toothed, acute. Peduncles stout. Involucral bracts scarious margined. Capitula c.1 cm across; rays white. Achenes 1-1.5cm, linear, black; pappus bristles barbed.

Flowers & Fruits: June – March.

Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0789***, dated 04.05. 2002; Hansqua TE, ***AP Das & Chandrâ 1503***, dated 20.10.2002; Kamalpur TE, ***AP Das & Chandrâ 1185***, dated 18.10.2002; Makaibari TE, ***AP Das & Chandrâ 1748***, dated 17.05.2003.; Soom TE, ***AP Das & Chandrâ 2625,*** dated 27.12. 2003; Tamsong TE, ***AP Das & Chandrâ 2464,*** dated 05.11.2003.
Status: Common
Local Distribution: All gardens.
General Distribution: Pantropic, also extending to temperate regions.

BLUMEA DC. *nom. cons.*

Blumea axillaris DC., Prodr. 5: 434. 1836; FB 2(3): 1504. 2001
Blumea mollis (D.Don) Merrill in Philip. J. Sci. (Bot.) 5: 395. 1910; FI 13: 135. 1995.
Erigeron molle D.Don, Prodr. Fl. Nepal. 192. 1825.

Strong smelling, annual or biennial; stems 5-100 cm. Leaves ovate oblong to obovate, obtuse. Capitula few; involucres 4-seriet; phyllaries linear lanceolate. Corolla purplish.

Flowers & Fruits: January to November.
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1144,*** dated 09.05. 2002.
Status: Less common
Local Distribution: Found only in Hansqua garden
General Distribution: India, Pakistan, Nepal, Bhutan, Bangladesh, Myanmar, China, Sri Lanka, S.E.Asia, Africa and Australia.
Note:

Blumea hieraciifolia (D. Don) DC. in Wight, Contr. 15. 1834; FBI 3:263. 1881; FEH 1:333. 1966; 2:134. 1971; EFPN 3:16. 1982; TBRI 50(4):107. 1987; FI 13:125. 1995; FB 2(3): 1502. 2001
Erigeron hieraciifolium D. Don, Prodr. Fl. Nep. 172. 1825.
A. sericans Hook.f., FBI 3:262. 1881.

Erect harbs, 25-70cm tall, densely villous; usually unbranched or few branches at tip. Radical lamina pubescent, elliptic-oblong, acute, srrate-dentate, silky; cauline sessile. Capitula globose, fascicled. Involucral bracts lanceolate to oblanceolate. Outer florets female. Achenes oblong, hairy, brown. Pappus white.

Flowers & Fruits: April - September.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2196,*** dated 30.06. 2003; Soom TE, ***AP Das & Chandrâ 3260,*** dated 26.06.2004.
Status: Common.
Local Distribution: All three hill gardens
General Distribution: Subtropical-temperate regions of Nepal, Myanmar, Bangladesh, China, S.E. Asia, Philippines, New Guinea and Australia.

Blumea lacera (Burman f.) DC. in Wight, Contrib. Bot. Ind. 14. 1834; FBI 3: 263. 1881; FI 13: 128. 1995; FB 2(3): 1504. 2001
Conyza lacera Burm.f., Fl. Ind. 180.t. 59.f. 1.1768.

Local Name: *Kuksima* (Beng)

Annual rosette herbs, to 100 cm. Lamina lyrate pinnatisect, terminal lobe obovate or oblanceolate, acute. Involucres 5-seriate; phyllaries all linear. Receptacle hair less; corolla yellow. Pappus dirty-white.

Flowers & Fruits: March to June.
Specimen Cited: Mohurgong & Gulma TE, AP Das & Chandrâ 0444, dated 05.04. 2002; Hansqua TE, ***AP Das & Chandrâ 0085,*** dated 03.02. 2002; Kamalpur TE, AP Das & Chandrâ 0539, dated 17.04.2002.
Status: Very common
Local Distribution: All Terai gardens
General Distribution: India, Nepal, Bhutan, China, Sri Lanka, Australia, Tropical Africa.
Note: Medicinally used as diuretic, anthelmintic, stimulant and febrifuge. It yields an essential oil.

BLUMEOPSIS Gagnepien

Blumeopsis flava (DC.) Gagnepien in Bull. Mus. Hist. Nat. Paris 26: 76. 1920; FI 13: 145. 1995; FB 2(3): 1507. 2001
Blumea flava DC., Prodr. 6: 439. 1836.

Plants 25-100 cm; stems simple. Leaves mostly in basal rosette, toothed; lowest ones obovate, acute, truncate at base. Capitula golden yellow. Phyllaries glabrous, ovate-lanceolate; corolla lobes hairy. Achenes glabrous; pappus white.

Flowers & Fruits: January – May.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ0784,*** dated 04.05.2002
Status: Less common
Local Distribution: Found only in Mohurgong & Gulma garden
General Distribution: India, Bangladesh, Myanmar, Malaya, Sumatra and Hainan.

CHROMOLAENA DC.

Chromolaena odoratum (L.) King & Robinson in Phytologia 20:204.1970; FB 2(3): 1628. 2001
Euaptorium odoratum L., Syst. Nat. ed.10:1205. 1759; FBI 3:244. 1881; FI 12:354. 1995.

Local Name: *Banmara* (Nep).

Suffrutescent undershrub to 1.5 m high, much branched, green. Lamina 1.2-6 x 0.35-1.5 cm, oblanceolate-spathulate, serrate-incised, acute, base cuneate, adpressed hairy. Capitula 1.1-1.4 cm in diam.. Involucral bracts lanceolate-elliptic. Florets bluish; pappus whitish.

Flowers & Fruits: June - December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0349***, dated 16.02.2002; Hansqua TE, ***AP Das & Chandrâ 0260***, dated 09.02. 2002; Kamalpur TE, ***AP Das & Chandrâ 1353***, dated 18.10.2001; Makaibari TE, ***AP Das & Chandrâ 1744***, dated 17.05.2003; Tamsong TE, ***AP Das & Chandrâ 2040,*** dated 30.06.2003.
Status: Abundant

Local Distribution: In all gardens.
General Distribution: Native of America; naturalised in Tropical Asia.

CONYZA L.

Conyza canadensis (L.) Cronqist in Bull. Torrey Bot. Club 79: 632. 1943; FI 12: 105. 1995; FB 2(3): 1546. 2001
Erigeron canadensis L., Sp.Pl. 863. 1753; FBI 3: 254. 1881.

Erect annuals, stems 30-100 cm. Upper stem much branched, densely hairy, leaves and inflorescence yellowish-green. Lamina narrowly oblong, distantly serrate. Capitulum cylindric, all discs. Pappus dirty white.

Flowers & Fruits: June to August.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0361***, dated 16.02. 2002; Hansqua TE, ***AP Das & Chandrâ 0152,*** dated 03.02. 2002; Kamalpur TE, ***AP Das & Chandrâ 0556***, dated 17.04.2002; Makaibari TE, ***AP Das & Chandrâ 1751***, dated 17.05.2003; Soom TE, ***AP Das & Chandrâ 3225***, dated 26.06. 2004; Tamsong TE, ***AP Das & Chandrâ 3041,*** dated 10.04. 2004
Status: Abundant
Local Distribution: In all gardens.
General Distribution: India, Nepal, Pakistan.

Conyza stricta Willdenow, Sp. Pl. 3:1922. 1803; FBI 3:258. 1881; FEH 1:337. 1966; 3:114. 1975; EFPN 3:21. 1982; TBRI 50(4):110. 1987; FI 12:108. 1995. var. ***stricta*.: FB** 2(3): 1544. 2001.

Small annual erect, pubescent herb, 15-28cm tall. Stem leafy, corymbosely branched. Leaves sessile, linear-spathulate or spathulate-obovate, acute. Capitula numerous and borne in peduncled corymbose branches. Inner florets yellowish-white. Cypsela pubescent.

Flowers & Fruits: April – October

Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2918,*** dated 10.04. 2004; Soom TE, ***AP Das & Chandrâ 3574,*** dated 12.10.2004.
Status: Less common.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: India (Darjeeling, Jammu and Kashmir, Himachal Pradesh, Utter Pradesh), Africa, W. Asia and MyanMarch

COTULA L.

Cotula australis (Sieb. ex Spreng.) Hook.f., Bot. Antarch. Voy. 2(1): 128. 1825; FI 12: 54. 1995; FB 2(3): 1569. 2001.
Anacyclus australis Sieb. ex Spreng. In Linnaeus Syst. Veg. (ed. 16) 3: 497. 1826.

Much branched annual to 10cm, most part sub-glabrous. Lower leaves 1-2-pinnatisect, ± obovate in outline, very sparsely villous beneath. Upper leaves smaller, usually 1 pinnatisect. Capitula at anthesis 2-5mm diameter, often sub-sessile, peduncles longer 2-6cm in fruit, appressed pubescent.

Flowers & Fruits: July – October.
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3424,*** dated 12.10. 2004.
Status: Very common.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Native of Australia and New Zealand; naturalized in India.

Cotula hemispherica (Roxburgh) Wallich *ex* Clarke, Comp. Ind. 150. 1876; FBI 3:316. 1881; EFPN 3:21. 1982; TBRI 50(4):110. 1987; FI 12:54. 1995.
Artemisia hemispherica Roxburgh, Fl. Ind. ed. 2 (3):422. 1832.

Small diffuse annual herb to 24cm tall. Lamina pinnatisect, linear, segments many, mucronate. Capitula solitary subglobose, yellowish white, usually drooping in fruit. Ray-florets in 2 series; Cypsela very minute, flat and angled.

Flowers & Fruits: October – July
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 1636,*** dated 24.10.2002
Status: Rare
Local Distribution: All Terai gardens.
General Distribution: India (Sikkim, West Bengal, Assam, Manipur, Meghalaya), China and Japan.

CRASSOCEPHALUM Moench.

Crassocephalum crepidioides (Bentham) S. Moore in J. Bot. 1912: 211. 1912; FEH 1: 337.1966; 2: 136.1971; EFPN 3: 22.1982; TBRI 50(4):110.1987; FI 13:201. 1995; FB 2(3): 1597. 2001
Gynura crepidioides Bentham in Hook., Niger Fl. 468. 1849.

Local Name: *Nowlay Jhar, Pani Jhar* (Nep).

Erect herb to 30cm tall; branche few, hairy. Leaves alternate; lamina 5.5-10.5 x 2-6.5 cm, ovate, irregularly serrate, dentate, acute, greenish above, coarse beneath. Involucral bracts linear, glabrous. Capitula 1-1.4cm long, oblong, in drooping clusters. Florets orange-red. Pappus white.

Flowers & Fruits: January - December.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0285***, dated 16.02. 2002; Hansqua TE, ***AP Das & Chandrâ 0083***, dated 03.02. 2002; Kamalpur TE, ***AP Das & Chandrâ 0369***, dated 27.02.2002; Makaibari TE, ***AP Das & Chandrâ 1792,*** dated 17.05.2003; Soom TE, ***AP Das & Chandrâ 2603,*** dated 27.12.2003; Tamsong TE, ***AP Das & Chandrâ 2154***, dated 30.06. 2003.
Status: Abundant.
Local Distribution: In all gardens.
General Distribution: Native of Tropical Africa; naturalised throughout the tropics.

DICHROCEPHALA L' Herit ex DC.

Dichrocephala integrifolia (L.f..) O. Kuntze, Rev. Gen. Pl. 333. 1891. FEH 1: 338. 1966; 2: 136. 1971; 3: 115. 1975; FI 12:114. 1995. FB 2(3): 1526.2001.
Hippia integrifolia L.f.., Suppl. Pl. 389. 1781.

Erect herbs, 10-15 cm; branched upward, pubescent. Leaves alternate; lamina lyrate or pinnatifid, terminal lobe ovate, acute toothed, thinly hairy. Capitula 0.25 – 0.4 cm in diam., on slender and divaricate peduncle, globose, all-disc, whitish. Pappus absent or 2, minute, bristly.

Flowers: June – September; *Fruits:* August – December
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1863,*** dated 10.06. 2003; Tamsong TE, ***AP Das & Chandrâ 1996,*** dated 30.06. 2003; Soom TE, ***AP Das & Chandrâ 2621***, dated 27.12. 2003
Status: Common
Local Distribution: All three hill gardens.
General Distribution: Subtropical-temperate Asia and Africa.

DUHALDEA DC.

Duhaldea cappa (D. Don) Anderberg in FBI 3:295. 1881; FEH 1:340. 1966; 2:138. 1971; EFPN 3:30. 1982; FI 13:13. 1995; FB 2(3): 1495.2001.
Inula cappa (D. Don) DC., Prodr. 5:469. 1836;
Conyza cappa Buch.-Ham. *ex* D. Don, Prodr. Fl. Nep. 176. 1875.

Local Name: *Taimakhu* (Nep)

Erect tomentose shrubs, stem branched. Leaves subsessile or shortly petiolate, oblong-lanceolate, irregularly toothed, acute, amplexicauled, tomentose beneath. Heads ca 0.8cm across, in terminal corymbs, densely silky with yellow rays and disc florets. Cypsela silky. Pappus whitish yellow.

Flowers: October – March; *Fruit:* December – April
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1883,*** dated 10.06. 2003; Tamsong TE, ***AP Das & Chandrâ 2292***, dated 05.09. 2003.
Status: Less common.
Local Distribution: All three hill gardens.
General Distribution: India (Himalayas and N.E. region), Bhutan, Myanmar, China, Thailand and Indonesia.

ECLIPTA L. *nom. cons.*

Eclipta prostrata (L.) L., Mant. Pl. 2: 286. 1771; FI 12: 381. 1995; FB 2(3): 1623. 2001
Verbesina prostrata L., Sp. Pl. 902. 1753.
Eclipta alba (L.) Hasskarl, Pl. Jav. Rar. 528. 1848; FBI 3: 304. 1881.

Local Name: *Keshut* (Beng.)

Prostrate to decumbent herbs; stems up to 50 cm. Leaves elliptic lanceolate, acute or acuminate, 3-veined at base. Capitula 3-5 mm diameter; phyllaries ovate, acuminate. Rays white in 2-3 series. Cypsela dark brown; Pappus obsolete.

Flowers & Fruits: Throughout the year.

Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0802***, dated 04.05. 2002; Hansqua TE, ***AP Das & Chandrâ 1654***, dated 13.11. 2002; Kamalpur TE, ***AP Das & Chandrâ 0491***, dated 17.04.2002.
Status: Very common.
Local Distribution: All Terai gardens.
General Distribution: India.

ELEPHANTOPUS L.

Elephantopus scaber L., Sp. Pl. 814. 1753; FBI 3: 242. 1881; FI 13: 333. 1995; FB 2(3): 1489. 2001.

Rhizomatous with stems 10-60cm, appressed stiffly white pubescent. Basal leaves obtuse or subacute, base attenuate, sparsely hirsute above, pubescent and glandular beneath, margin crenate-serrate; cauline leaves shorter, ovate or oblong, semi-amplexicaul at base. Flowers lilac or white.

Flowers & Fruits: November - January.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 1523***, dated 22. 10. 2002; Kamalpur TE, ***AP Das & Chandrâ 0484***, dated 17.04. 2002
Status: Less common
Local Distribution: All Terai gardens.
General Distribution: Tropical Asia, Australia, Africa.

EMILIA Cassini

Emilia sonchifolia (L.) DC. in Wight, Contrib. Bot. Ind. 24. 1834; FI 13: 212. 1995; FB 2(3): 1598. 2001
Cacalia sonchifolia L., Sp. Pl. 1835. 1753; FBI 3: 336. 1881.

Local Name: *Sadhimodi* (Beng); *Hirankhuri* (Hindi).

Annual soft herbs. Leaves weakly dentate; basal lamina lyrate, sessile; upper lamina ovate, long petiolate. Capitula oblong, drooping; phylliaris narrowly oblong-lanceolate. Corolla deep pink. Pappus soft, white.

Flowers & Fruits: June to October.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0061***, dated 27.01.2002; Hansqua TE, ***AP Das & Chandrâ 0116***, dated 03.02. 2002; Kamalpur TE, ***AP Das & Chandrâ 0540***, dated 20.04.2002; Tamsong TE, ***AP Das & Chandrâ 1979***, dated 27.12.2003; Soom TE, ***AP Das & Chandrâ 2642***, dated 30.06. 2003.
Status: Abundant
Local Distribution: In all gardens.
General Distribution: India, China, Asia, Africa.
Note: Cauline leaves are taken as vegetable; also used as salad. Decoction of the herb used as a febrifuge and also in bowel complaints. Juice of leaves used for sore of eyes and night blindness.

ERIGEREON L.

Erigeron karvinskianus DC., Prodr. 5:85. 1836; EFPN 3:27. 1982; TBRI 50 (4): 113. 1987; FI 12:122. 1995; FB 2(3): 1540. 2001
Vittadenia triloba auct. DC: FEH 1:347. 1966.

Diffuse tufted perennial herbs; branching from base. Leaves sessile, alternate; lamina 0.8-1.9 x 0.2-0.5 cm, lanceolate, often lobed/ subentire, acute, hairy. Peduncles to 8.5cm, thinly hairy. Heads to 2 cm across. Ray-florets 2 seriate, longer than discs, white, turns pink. Pappus white.

Flowers & Fruits: March – December
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1920***, dated 10.06. 2003; Soom TE, ***AP Das & Chandrâ 3288***, dated 26.06. 2004; Tamsong TĖ, ***AP Das & Chandrâ 2949***, dated 10.04. 2004.
Status: Abundant.
Local Distribution: All three hill gardens.
General Distribution: Native of New Zealand; naturalised in Subtropical-Temperate Central Asia.

GALINSOGA Ruiz & Pavon

Galinsoga parviflora Cav., Ic. Descr. Pl. 3: 41. t. 281. 1795; FBI 3: 311. 1881; FI 12: 388. 1995; FB 2(3): 1610. 2001.

Plant 10-60cm, stems pubescent above. Leaves ovate-lanceolate, acute or acuminate, rounded or alternate at base, shallowly serrate – crenate, ciliate and sparsely pilose on both surfaces with petiole upto 1cm or upper ones sub-sessile. Capitula white.

Flowers & Fruits: March – December
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1921,*** dated 10.06. 2003; Soom TE, ***AP Das & Chandrâ 2626***, dated 27.12. 2003; Tamsong TE, ***AP Das & Chandrâ 2015,*** dated 30.06.2003
Status: Very common
Local Distribution: All three hill gardens.
General Distribution: Cosmopolitan weed; native of Tropical America.

GNAPHALIUM L.

Gnaphalium luteo-album L., Sp. Pl. 851. 1753; FBI 3:288. 1881. subsp. ***affine*** (D. Don) Koster in Blumea 4 (3):484. 1941; FI 13:87. 1995.
Gnaphalium affine D. Don., Prodr. Fl. Nep.173. 1825; FBI 7:288. 1881; FEH 1:339. 1966; 3:116. 1975; EFPN 3:29. 1982; TBRI 50(4):115. 1987.

Annual erect, 14-25 cm tall. Stem unbranched, white hairy. Leaves sessile, half-clasping, oblong spathulate, entire, acute to rounded white wooly-haired. Flower-heads globular, clustered, bright shining yellow. Rays absent. Discs tubular, outer female, inner ones bisexual.

Flower & Fruits: February - October
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0287***, dated 16.02. 2002; Hansqua TE, ***AP Das & Chandrâ 0205,*** dated 19.02. 2002; Kamalpur TE, ***AP Das &***

Chandrâ 0626, dated 20.04.2002; Makaibari TE, ***AP Das & Chandrâ 2876***, dated 25.03. 2004; Soom TE, ***AP Das & Chandrâ 2591***, dated 27.12. 2003; Tamsong TE, ***AP Das & Chandrâ 1977***, dated 30.06. 2003.

Status: Abundant.

Local Distribution: In all gardens.

General Distribution: Himalayas, Myanmar, Thailand, Indo-Chin, Java, China and Japan.

Gnaphalium purpureum L., Sp. Pl. 854. 1753; FBI 3:289. 1881; FI 13:92. 1995; TBRI 50 (4):115. 1987.

Local Name: *Urua Jhar* (Nep).

Erect annual to 48cm, tomentose. Basal branches procumbent. Lamina sessile spathulate, base narrowed, entire, shortly mucronate/ broadly rounded, pubescent. Heads in spicate globose clusters. Involucral bracts many-seriate, brownish. Ligules female; discs bisexual. Pappus white.

Flower & Fruits: August - June

Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0974,*** dated 04.05. 2002; Hansqua TE, ***AP Das & Chandrâ 0999,*** dated 19.05. 2002; Kamalpur TE, ***AP Das & Chandrâ 0619***, dated 20.04.2002; Makaibari TE, ***AP Das & Chandrâ 1923***, dated 10.06. 2003; Soom TE, ***AP Das & Chandrâ 2611***, dated 27.12. 2003; Tamsong TE, ***AP Das & Chandrâ 2021***, dated 30.06. 2003.

Status: Abundant

Local Distribution: In all gardens..

General Distribution: Himalayas, W. Ghats (Nilgiris, Jammu and Kashmir, West Bengal, Tamil Nadu, Maharastra), Pakistan, N. and S. America.

GRANGEA Adamson

Grangea maderaspatana (L.) Poiret in Lamarck, Encycl. Suppl. 2: 825. 1811; FBI 3: 247.1881; FB 2(3): 1529. 2001.

Artemisia maderaspatana L., Sp. Pl. 849. 1753.

Annual rosette herbs, branches long, prostrate. Leaves lyrate, subauriculate; upper lobe ovate, acute. Capitula 6 mm in diameter, all discs. Phyllaries oblong. Corolla yellow.

Flowers & Fruits: February - May

Specimen Cited: Hansqua TE, AP Das & Chandrâ 1388, dated 20.10. 2002; Kamalpur TE, ***AP Das & Chandrâ 0649,*** dated 20.04. 2002.

Status: Less common.

Local Distribution: All Terai gardens.

General Distribution: India, Africa, Si Lanka, China, Malaysia.

GYNURA Cassini

Gynura cusimbua (D. Don) S. Moore in Journ. Bot. 1:212. 1912; FEH 1:340. 1966; EFPN 3:29. 1982; TBRI 50(4):115. 1987; FB 2(3): 1600. 2001.

Cacalia cusimbua D.Don., Prodr. 179. 1825.

Gynura angulosa DC. Prodr. 6:298. 1837; FBI 3:334. 1881.

Erect herb, 50-150 cm tall. Leaves alternate, sessile, oblong or oblanceolate, margin irregularly toothed, acuminate, base attached to stem (base of upper leaves often lobed), glabrous to sparsely hairy. Corymbs both terminal and axillary. Heads many, discoid. Pappus hairs whitish.

Flowers & Fruits: October – March
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2278,*** dated 05.09. 2003.
Status: Rare
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Nilgiri, Himalayas, Myanmar, Thailand and China.

Gynura nepalensis DC., Prodr. 6: 300. 1838; FBI 3: 333. 1881; FB 2(3): 1600. 2001

Local Name: *Tong kribi* (Nep).

Large bushy or subshrub. Leaves ovate elliptic; pubescent at both surface. Capitula few, born in loose panicles or corymbs, pendulous. Phyllaries narrowly oblong, acuminate. Corolla yellow.

Flowers & Fruits: March to May.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0301,*** dated 16.02. 2002; Kamalpur TE, ***AP Das & Chandrâ 0375***, dated 27.02.2002; Makaibari TE, ***AP Das & Chandrâ 2806***, dated 25.03. 2004; Tamsong TE, ***AP Das & Chandrâ 2234,*** dated 05.09. 2003.
Status: Common
Local Distribution: In all gardens.
General Distribution: India, Nepal, China, Myanmar and Thailand.

IXERIS Cassini

Ixeris polycephala Cassini in Dict. Sci. Nat. 24: 50. 1822; FI 12: 279. 1995; FB 2(3): 1467. 2001
Lactuca polycephala (Cassini) Bentham & Hook.f., Gen. Pl. 2: 526. 1873; FBI 3: 410. 1881.

Small rosette herbs, scapes to 45 cm. Basal leaves oblong lanceolate. Cauline leaves lanceolate to linear, acuminate, sessile; radicals sagittate-auriculate. Capitula urn-shaped; Outer phyllaries 5-6, ovate. Inner phyllaries 7-8, linear-lanceolate. Ligules yellow. Pappus yellowish, simple.

Flowers & Fruits: November to May.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0034,*** dated 27.01.2002; Hansqua TE, ***AP Das & Chandrâ 0136***, dated 03.02. 2002; Kamalpur TE, ***AP Das & Chandrâ 0406***, dated 27.02. 2002.
Status: Less common
Local Distribution: All Terai gardens.
General Distribution: India, China, Japan.

MIKANIA Willdenow

Mikania micrantha Kunth in Humboldt, Bonpland & Kunth, Nov. Gen. Sp. 4: 134. 1820; FI 12: 357. 1995; FB 2(3): 1625. 2001.
Mikania scandens auct.; C.B. Clarke, Comp. India 34. 1876, non Willd.

Extensive climbers, branches hairy. Lamina triangular-ovate, acute or acuminate, cordate, pubescent. Capitula numerous in dense compound corymbs. Phyllaries oblong, acute or shortly acuminate; corolla greenish white. Cypsela ribbed, glandular; pappus longer than achenes.

Flowers & Fruits: June to December.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0008,*** dated 27.01.2002; Hansqua TE, ***AP Das & Chandrâ 1075***, dated 09.05.2002; Kamalpur TE, ***AP Das & Chandrâ 0615***, dated 20.04. 2002; Matigara TE, ***AP Das & Chandrâ 3159***, **dated** 10.05.2004; Makaibari TE, ***AP Das & Chandrâ 1798***, dated 17.05.2003; Soom TE, ***AP Das & Chandrâ*** 3394, dated 12. 10. 2004; Tamsong TE, ***AP Das & Chandrâ 2113***, dated 30.06. 2003.
Status: Abundant
Local Distribution: In all gardens.
General Distribution: Native of Tropical America. Now naturalized in India, Nepal, Myanmar, Malay Archipelago, Cochinchina, Anaam, Philippines, Taiwan and Tropical Africa.
Note: Natives use the leaves to cure wounds.

MONTANOA La Llave et Lexarza

Montanoa bipinnatifida C. Koch in Wochenschr. Vereins Beford. Gartenbauces Konigl Preuss. Staaten 7: 406. 1864; FI 12: 399. 1995; FB 2(3): 1623. 2001.

Stems up to 10m. Leaves with 3-5 broad, often lobed segments on each side, acute or acuminate, shallowly serrate, scabrid on both surfaces. Flowers white.

Flowers & Fruits: September – January.
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3527***, dated 12.10. 2004.
Status: Rare; also grown as ornamental
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Mexico to Columbia. Naturalized in India.

MYRIACTIS Lessing

Myriactis nepalansis Lessing in Linnaea 6: 128.t. 2. 1831; FBI 3: 247. 1881; FI 12: 134. 1995; FB 2(3): 1529. 2001

Annuals, erect, glabrous. Leaves ovate or lanceolate, sessile. Heads globose, sub paniculate. Involucral bracts acute, reflexed. Rays 10-seriate; discs few. Cypsela mucronate.

Flowers & Fruits: June to August.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 3021,*** dated 10.04. 2004; Soom TE, ***AP Das & Chandrâ 3404,*** dated 12.10.2004
Status: Common
Local Distribution: All three hill gardens.
General Distribution: India, Nepal, Bhutan, China, Java, Afghanistan and Iran.

PARTHENIUM L.

Parthenium hysterophorus L., Sp. Pl. 988. 1753; FI 12: 403. 1995; FB 2(3): 1622. 2001.

Plant to 80cm; stems stiffly appressed white puberulous; leaves white pubescent, often pilose on veins. Basal leaves ovate, long petiolate; cauline leaves more finely cut, short petiolate; upper leaves smaller narrower, sub-sessile. Capitula 3mm with white corollas.

Flowers & Fruits: January – December.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0858***, dated 04.05. 2002; Kamalpur TE, ***AP Das & Chandrâ 0705***, dated 20.04. 2002.
Status: Less common
Local Distribution: All Terai gardens.
General Distribution: Native of America; widely naturalized in India.
Note: Pollen, whole plant can cause intense allergic reaction.

SASSAUREA DC.

Saussurea deltoidea (DC.) Sch.–Bip. in Linnaea 19: 331. 1846; FEH 1: 342.1966; 2:140.1971; TBRI 50(4):126.1987; FI 12: 197. 1995; FB 2(3): 1442. 2001.
Aplotaxis deltoidea DC., Prodr. 6: 541. 1838.
Cnicus deltoideus Wallich, Cat. 100, n. 2994. 1831; FBI 3: 374. 1881.

An erect perennial herbs. Stem branched above, white hairy. Leaves petioled, very variable, upper deltoid or triangular ovate, lower lyrate-pinnatifid, sinuate-toothed, acute, base narrow, above glabrous and greenish, beneath white-tomentose, nerves prominent below. Flower heads peduncled, scattered or nodding panicled. Pappus single.

Flowers & Fruits: January – February.
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 0110***, dated 03.02. 2002
Status: Rare
Local Distribution: This temperate plant has been recorded from tropical Hansqua TE in winter.
General Distribution: Nepal, Bhutan, Myanmar, China, Taiwan, Thailand.

SONCHUS L.

Sonchus asper (L.) Hill. Herb. Brit. 1: 47. 1769; FBI 3: 414. 1881; FI 12: 318. 1995; FB 2(3): 1479. 2001.
Sonchus oleraceus var. *asper* L., Sp. Pl. 794. 1753.

Annual, 15-75 (-120)cm, glabrous or stems above and peduncles glandular-hairy. Leaves simple or pinnatifid, segments ± triangular, sharply dentate or denticulate with rounded auricules at base. Achenes strongly compressed, winged.

Flowers & Fruits: February – September.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0743***, dated 04.05. 2002; Kamalpur TE, ***AP Das & Chandrâ 0506***, dated 17.04. 2002; Makaibari TE, ***AP Das & Chandrâ 1926***, dated 10.06. 2003.
Status: Less common
Local Distribution: Common in low altitude areas.
General Distribution: Europe, S.W. Asia, Africa.

Sonchus oleraceus L., Sp. Pl. ed. 1:174. 1753; FBI 3:414. 1881; FEH 1:345. 1966; 2:141. 1971; EFPN 3:43. 1982; TBRI 50(4):127. 1987; FI 12:321. 1995; FB 2(3): 1479. 2001; FB 2(3): 1480. 2001..

Annual, glandular hispid, subumbellately branched, 30 – 120cm tall. Radical leaves semiamplexicauled; lamina lanceolate, spinulose-toothed, glabrous; auricle entire or pinnatifid. Capitula cylindric, all rayed, laxly subcorymbose. Involucral bracts multiseriate, connate at base. Florets yellowish. Cypsela elliptic, brownish. Pappus to white, copious.

Flowers & Fruits: April – October.
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 0243***, dated 09.02. 2002.
Status: Common.
Local Distribution: All Terai gardens.
General Distribution: India (throughout subtropical and temperate regions), Nepal, Bhutan, Afganistan, Pakistan, China, Iraq, Iran, Europe, Australia, N. and S. America.

Sonchus wightianus DC., Prodr. 7:187. 1838; EFPN 3:43. 1982; TBRI 50 (4):127. 1987; FI 12:321. 1995; FB 2(3): 1480. 2001.
S. arvensis auct non L., Clarke in Comp. Ind. 27. 1876, p.p.; FBI 3:414. 1881, p.p.; FEH 1:345. 1966; 2:140. 1971; 3:118. 1975.

Perennial herbs, 20-40cm, root-stock creeping. Stem erect, leafy, subumbellately branched above. Leaves runcinate-pinnatifid, spinous-toothed; caulines semiamplexicauled, auricles rounded. Capitula ±1.5cm long, in lax corymbs, glandular. Rays yellowish. Cypsela narrow, compressed, ribbed. Pappus white.

Flowers & Fruits: April – December.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0824,*** dated ; Kamalpur TE, ***AP Das & Chandrâ 0571***, dated 17.04. 2002; Soom TE, ***AP Das & Chandrâ 3242,*** dated 26.05.2004; Tamsong TE, ***AP Das & Chandrâ 2147***, dated 30.06. 2003.
Status: Common
Local Distribution: In all gardens.
General Distribution: Throughout India, Nepal, Bhutan, Myanmar, China, Pakistan, Afganistan, Indonesia and Philippines.

SYNEDRELLA *Gaertn.*

Synedrella nodiflora (L.) Gaertn., Fruct. et. Sem. 2:456. T. 171.f. 7. 1791; FBI 3:308. 1881; FEH 1: 345. 1966; FI 12: 413-415. 1995; FB 2(3): 1607. 2001.
Gnaphalium luteo-album L., Sp. Pl. 851. 1753; FBI 3: 288. 1881.
Verberina nodiflora L., Cent. Pl. 1: 28. 1755.

Erect, annual, upto 1.3m tall, whitish pilose. Lamina ovate-elliptic, sub-entire to serrate, acute, cuneate or rounded, trinerved, appressed hairy. Heads 0.4-0.6cm across, clustered in radiate groups. Involucral bracts foliaceous, greenish. Receptacle convex. Rays yellowish; discs narrow yellowish; ray achenes narrowly winged. Disc achenes pubescent and black.

Flower & Fruits: Throughout the year.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0455***, dated 05.04. 2002; Soom TE, ***AP Das & Chandrâ 3593,*** dated 12.10.2004
Status: Common.

Local Distribution: Common in low altitude areas.
General Distribution: India (Marshy places of West Bengal, Madhya Pradesh, Assam, Tamil Nadu, Kerala and Andaman and Nicobar Islands), Sri Lanka, China, Malaya, tropical America and West Indies.

TARAXACUM F.H. Wiggers

Taraxacum officinale Weber in Wiggers, Prim. Fl. Holset 56. 1780; FBI 3:401. 1881; EFPN 3:46. 1982; TBRI 50 (4):128. 1987; FI 12:252. 1995; FB 2(3): 1463. 2001.

Small rosette perennial, scapes 20-30cm high. Root-stock deep seated. rLadical leaves oblanceolate-linear, runcinate-pinnatifid below. Capitula to 1cm in diam., solitary, homogamous. Involucral bracts multiseriate. Florets all rayed, yellowish; Cypsela 4-5 angled, obovoid, ribbed. Pappus unequal.

Flowers & Fruits: May – January.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2938,*** dated 10.04. 2004.
Status: Common in open places.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Himalayas.

TITHONIA Desf.

Tithonia diversifolia (Hemsl.) A Gray in Proc. Amer. Acad. Arts 19: 5. 1883; FEH 1:346. 1966; EFPN 3:47. 1882; TBRI 50 (4):129. 1987; FI 12: 416. 1995; FB 2(3): 1607. 2001.
Mirasolia diversifolia Hemsl., Biol Centr. Amer. Bot. 2: 168.t. 47. 1881.

Local Name: *Titeni, Gham Phul* (Nep).

Shrubby forming thickets to 1.5-3m high, young parts tomentose. Root-stock woody. Leaves alternate, pinnatifid with serrate lobes, white hairy beneath, base narrowed into the petioles. Capitula solitary, borne on axillary and terminal peduncles. Ray florets uniseriate, oblong to spathulate, bright yellow. Disc florets tubular, yellowish. Cypsela tapering towards base.

Flowers & Fruits: October - March
Specimen Cited: Makaibari TE, AP Das & Chandrâ 1723, dated 17.05.2003; Tamsong TE, ***AP Das & Chandrâ 2122,*** dated 30.06. 2003.
Status: Rare
Local Distribution: All three hill gardens.
General Distribution: Native of South America; naturalized in India.

TRIDAX L.

Tridax procumbens L., Sp. Pl. ed. 1:900. 1753; FBI 3:311. 1881; FEH 1:346. 1966; 2:141. 1971; 3:118. 1975; EFPN 3:47. 1982; TBRI 50 (4):129. 1987; FI 12:418. 1995; FB 2(3): 1611. 2001.

Perennial herbs. Stem rooting, procumbent. Leaves opposite; lamina elliptic-ovate to lanceolate, acute, irregularly serrate, cuneate. Heads radiate, solitary, heterogamous. Peduncles straight.

Involucral bracts 2-3 seriate, ovate-lanceolate Rays white, bifid/ trifid. Discs numerous, yellowish. Achenes oblong, silky.

Flowers & Fruits: June – December.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0882***, dated 04.05.2002; Hansqua TE, ***AP Das & Chandrâ 1432***, dated 20.10. 2002; Kamalpur TE, ***AP Das & Chandrâ 1345***, dated 18.10.2002.
Status: Common
Local Distribution: All Terai gardens.
General Distribution: Pantropic weed of S. American origin.

VERNONIA Schreb. *(nom. cons.)*

Vernonia cinerea (L.) Less in Linnaea 4:291. 1829; FBI 3:233. 1881; FEH 1:346. 1966; EFPN 3:56. 1982; FI 13:367. 1995.
Conyza cinerea L., Sp. Pl. 862. 1753.

Erect annual or perennial herbs to 75cm tall. Stems terete, pubescent, ribbed, glandular. Leaves subsessile variable, acute or obtuse, undulate or entire, usually glabrous. Heads in loose corymbose panicles. Involucral bracts many seriate, lanceolate. Achenes, terete, silky. Pappus whitish.

Flower & Fruits: Throughout the year.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0819,*** dated 04.05. 2002; Makaibari TE, ***AP Das & Chandrâ 1738,*** dated 17.05. 2003; Soom TE, ***AP Das & Chandrâ 2607,*** dated 27.12. 2003.
Status: Common.
Local Distribution: In all gardens.
General Distribution: Africa, Asia, Australia.

YOUNGIA *Cass.*

Youngia japonica (L.) DC., Prodr. 7:194. 1838; FEH 1:347. 1966; 2:142. 1971; EFPN 3:49. 1979; TBRI 50 (4):130. 1987; FI 12:329. 1995: FB 2(3): 1457. 2001.
Prenanthes japonica L., Mant. Pl. 107. 1767.
Crepis japonica Benth., Fl. Hongk. 194. 1861; FBI 3:395. 1881.

Puberulous annual, 20-70cm tall. Leaves rosulate, radical lyrate-runcinate, obovate or oblanceolate, sinuate-toothed; cauline leaves smaller, linear to lanceolate. Heads in cymose corymbs. Peduncles dichotomously branched. Involucral bracts ovate. Florets all ray, yellowish.

Flowers & Fruits: March - August.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0010,*** dated 27.01.2002; Hansqua TE, ***AP Das & Chandrâ 0106***, dated 03.02.2002; Kamalpur TE, ***AP Das & Chandrâ 0376***, dated 27.02.2002; Makaibari TE, ***AP Das & Chandrâ 1761***, dated 17.05.2003; Soom TE, ***AP Das & Chandrâ 2490***, dated 27.12. 2003; Tamsong TE, ***AP Das & Chandrâ 2007***, dated 30.06. 2003
Status: Abundant in open and semiopen places.
Local Distribution: In all gardens.

General Distribution: W. Pakistan, Himalayas (Kashmir-Bhutan), India, east to China, Japan, Malaysia.

BALSAMINACEAE A. Rich.

IMPATIENS L.

Impatiens arguta Hooker f. & Thomson in J. Linn. Soc., Bot. 4: 137. 1860; FBI 1: 470. 1875; FEH 1: 194. 1966; EFPN 2: 78. 1979; FB 2(1): 92.1991; FI 4: 120. 1997.

Perennial herb to 80 cm with leaves elliptic to ovate – elliptic or lanceolate , glabrous. Flowers ependunculate, solitary or in clusters of 2-3 (-5), rose-purple to violet. Capsule clavate, glabrous.

Flowers & Fruits: May – October

Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2541,*** dated 11.11. 2003
Status: Very common.
Local Distribution: All three hill gardens.
General Distribution: India, Nepal, Bhutan, China, Tibet, Myanmar

Impatiens balsamina L., Sp.Pl. 938. 1753; FBI 1: 453. 1874; FB 2(1): 103.1991; FI 4: 123. 1997.

Annual herb to 60 cm tall. Stem simple, more rarely branched. Leaves elliptic to narrow – obovate, usually glabrous. Flowers epedunculate, solitary or in axillary fasciles of 2-3, pink , mauve or white.

Flowers & Fruits: November- June
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0779***, dated 04.05. 2002
Status: Very common.
Local Distribution: All Terai gardens.
General Distribution: Native of India and Burma but widely naturalized and cultivated in Himalayan foothills.

Impatiens discolor DC., Prodr. 1: 687. 1824; FEH 1: 195. 1966; FB 2(1): 94.1991; FI 4: 141. 1997.

Perennial to 25cm tall. Stems decumbent, rooting at lower nodes. Leaves elliptic-lanceolate. Raceme 1-3 (-4) flowered, flowers pale pink or white, generally with some deeper spotting in throat. Capsule narrowly clavate

Flowers & Fruits: July-October
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 1943,*** dated 30.06. 2003.
Status: Common
Local Distribution: All three hill gardens.
General Distribution: India, Nepal, Bhutan

Impatiens racemosa DC., Prodr. 1: 687. 1824; FEH 1: 196. 1966.

Small, erect, annual; branches slender, glandular; lamina elliptic-lanceolate, crenate, acunicate; peduncles subterminal; flowers yellow; standard orbicular, wings with filiform processes; lip spur long, slender, incurved; capsule linear, acuminate, glabrous.

Flowers & Fruits: June – September
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1839,*** dated 10.06. 2003
Status: Less Common.
Local Distribution: Found only in Makaibari garden.
General Distribution: Kashmir – Sikkim, Tibet, Meghalaya.

BASELLACEAE Moq.– Tand.

BASELLA L.

Basella rubra L. Sp.Pl. 272. 1753; FBI 5: 20. 1886; FB 1(2): 197. 1984.
Basella alba L., Sp. Pl. 272. 1753.

Fleshy, glabrous, perennial twiner. Lamina broadly ovate to elliptic, acute, rounded or cordate; petioles 1 –3 cm. Spike, bearing flowers in upper half. Bracteoles and perianth 3 – 4 mm, segments obtuse, pinkish, tube green. Fruits subglobose, black when ripe.

Flowers & Fruits: December – April.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1919***, dated 10.06. 2003.
Status: Rare
Local Distribution: In all gardens.
General Distribution: Native to tropical Asia & Africa.

BEGONIACEAE C.A. Agardh.

BEGONIA L.

Begonia picta Smith, Exot. Bot. 2: t. 101. 1805; FBI 2:638. 1879; FEH 1:215. 1966; 2:84. 1971; EFPN 2:182. 1979; TBRI 50(4): 106. 1987; FB 2(1):242. 1981.

Small tuberous herbs to 20cm high. Basal leaf one, petioles 2-11 cm; cauline leaf-lamina 4.5-14.5 x 3.5-8.5 cm, ovate, serrate, obliquely cordate. Outer tepals larger, 1-1.5 x 0.9-1 cm, elliptic, white or pink; stamens in globose mass; styles 3, united at base. Largest capsule wing 2-2.5 cm.

Flowers: August - September *Fruits:* September - November
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1808***, dated 17.05.2003; Tamsong TE, ***AP Das & Chandrâ 2155***, dated 30.06. 2003.
Status: Common
Local Distribution: All three hill gardens.
General Distribution: Himalayas (Punjab – Bhutan), Assam.

Begonia hatacoa Buch. – Ham. ex D.Don, Prodr. 223. 1825; FB 2(1): 243. 1991.
Begonia rubro-venia Hook. in Bot. Mag. 79.t. 4689. 1853; FBI 2: 645. 1879.

Succulent herbs, rhizomatous. Stems 10 – 30 cm. Lamina ovate –lanceolate, acuminate, base obliquely rounded, scarcely cordate, subentire or distantly dentate, pubescent on veins beneath;

stipules ovate, acuminate, persistent. Peduncles bearing few flowers terminally. Outer tepals ovate, pink or white. Capsules becoming reflexed, largest wing oblong.

Flowers & Fruits: July – October.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ*** 2896, dated 10.04. 2004.
Status: Rare
Local Distribution: Found only in Tamsong garden.
General Distribution: Eastern Himalaya, Meghalaya, Manipur.

Begonia flaviflora (Clarke) Hara in Journ. Jap. Bot. 45:91. 1970; FEH 2:84. Pl.3b.1971; TBRI 50(4):106. 1987; FB 2(1): 245. 1991.
Begonia laciniata Roxb. var. *flava* Clarke in FBI 2: 645. 1879.

Herbs, 20-55cm, densely tomentose. Rootstock creeping, rigid. Leaves ovate, acuminate, base obscurely cordate, margin deeply lobed, serrate. Flowers yellow. Capsules winged, wings variable in size.

Flowers : July - August *Fruits:* August - September
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ*** 2363, dated 05.11. 2003
Status: Less common.
Local Distribution: All three hill gardens.
General Distribution: E. Himalaya (Darjeeling - Sikkim); endemic.

BETULACEAE S.F. Gray

ALNUS Miller

Alnus nepalensis D. Don, Prodr. Fl. Nep. 58. 1825; FBI 5: 600. 1888; FEH 1: 48. 1966; 2: 17. 1971; EFPN 3: 213. 1982; FB 1(1): 72. 1983; TBRI 50 (4) : 105. 1987.

Local Name: *Utis* (Nep).

Deciduous trees upto 21m. Leaves alternate, broadly elliptic, entire, acute, base cuneate or rounded, coriaceous, brownish glandular below. Flowers unisexual, monoecious in catkins. Achenes triangular, membranous.

Flowers & Fruits: February - May
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2331,*** dated 05.11. 2003
Status: Very common..
Local Distribution: All three hill gardens.
General Distribution: Himalayas (Garhwal-Bhutan), Assam, Myanmar, Tibet, W. China.

BETULA Tourn.

Betula alnoides D. Don, Prodr. Fl. Nep. 58. 1825; FBI 5: 599. 1888; FEH 1: 48. 1966; 2: 18. 1971; EFPN 3: 213. 1982; FB 1(1):71. 1983; TBRI 50 (4):107. 1987.
B. cylindrostachya Wallich, Pl. As. Rar. 2: 7. 1831.

Local Name: *Saur* (Nep).

Tall deciduous trees to 16 m high. Bark with vertical strips, reddish brown. Young shoot tomentose. Leaves ovate, unequally serrate, acuminate, base rounded, subglabrous upper surface, pubescent beneath. Male catkins slender, pendulous; female catkins in shorter raceme. Achenes broadly winged.

Flowers & Fruits: January - June
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2014,*** dated 30.06. 2003.
Status: Less common.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Himalayas (Nepal-Bhutan), Meghalaya, Tibet, W. China.

BIGNONIACEAE A. Jussieu

JACARANDA Jussieu

Jacaranda mimosifolia D. Don in B. Reg. 8: t. 631. 1822; EFPN 3: 137. 1982; FB 2(3): 1242. 2001.

Trees 6-12 m with leaflets elliptic to lanceolate, sessile, cuspidate, sparsely glandular pubescent on upper surface, glabrous, margins revolute. Flowers mauve.

Flowers & Fruits: March – June
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1384,*** dated 20.10. 2002; Kamalpur TE, ***AP Das & Chandrâ 0641,*** dated 20.04. 2002
Status: Commonly planted
Local Distribution: In Terai gardens.
General Distribution: Native of tropical S. America; cultivated in the tropics.

OROXYLUM Ventenat

Oroxylum indicum (L.) Kurz., For. Fl. Br. Burma 2: 237. 1877; FBI 4: 378. 1884; FEH 1: 295. 1966; Fl. Nep. 3: 137. 1982.
Bignonia indica L., Sp. Pl. 625. 1753.

Local Name: *Totola* (Beng, Nep)

Trees 4-6m with leaflets acute or apiculate. Flowers with corolla tube reddish-purple outside, yellow within, lobes creamy, opening after sunset. Capsule 50-62×4-9cm. with papery winged seeds.

Flowers & Fruits: September – March.
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 0104,*** dated 03.02. 2002
Status: Very common.
Local Distribution: All Terai gardens.
General Distribution: Tropical Himalaya, India to Indochina, Malaysia, China.

BORAGINACEAE A. Jussieu

CYNOGLOSSUM L.

Cynoglossum lanceolatum Forsskal, Fl. Aegypt. - Arab. 41. 1775; FBI 4:156. 1883; FB 2(2): 907. 1999.
Cynoglossum micranthum Desf., Tab. Ecole Bot. ed. 1: 220. 1804; FBI 4:156. 1883.

Local Name: *Khirpatey* (Nep)

Densely hispid annual/ biennial/ perennial much branched; rootstock stout, erect. Leaves petiolate; lamina subaute to acute, shortly attenuate, greyish hispid. Inflorescence intricately branched, furcated, widely divaricate at fruit; corolla white with blue center.

Flowers & Fruits: January – December
Specimen Cited: Kamalpur Mohurgong & Gulma TE, ***AP Das & Chandrâ 0920,*** dated 04.05. 2002; TE, ***AP Das & Chandrâ 0594,*** dated 20.04. 2002
Status: Common.
Local Distribution: In all gardens.
General Distribution: West Asia, Himalayas, India, Sri Lanka, Myanmar, China, Malaysia, Africa.

HELIOTROPIUM L.

Heliotropium indicum L., Sp. Pl. 130. 1753; FBI 4:152.1883; FB 2(2): 878.1999.

Erect annuals with few upper branches, much hairy. Leaves alternate or sub-oppposite; lamina ovate, undulate to crenate-subserrate, sub-acute, cordate; petioles partially winged. Cymes scorpioid; flowers in 2 rows, white. Fruits ovoid, strongly ribbed, glabrous, deeply 2- fid.

Flowers & Fruits: January – December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0325,*** dated 16.02.2002; Kamalpur TE, AP Das & Chandrâ 1250, dated 18.10.2002.
Status: Common.
Local Distribution: All Terai gardens
General Distribution: India, Myanmar, East to West and South Malaysia, tropical Africa and America.

BRASSICACEAE Burnett, nom. alt.

[CRUCIFERAE A. Jussieu, nom. cons.]

CAPSELLA Moench.

Capsella bursa-pastoris (L.) Medicus, Pfl.-Gatt. 1: 85. 1792; FEH 1: 108. 1966; EFPN 2: 40. 1979; FB 1(2): 423. 1984; TBRI 50 (4): 108. 1987; FWB 1:188. 1997.

Small annual rosette herb, 20-34 cm. Stem hairy. Basal leaves deeply pinnatifid, runcinate, base short stalked, lateral lobes 5-6 pairs, unequally serrate, oblanceolate, densely pubescent; stem leaves sessile, smaller, ovate-lanceolate, acute, base auricled. Flowers in ebracteate racemes, white; petals obovate, white. Pods short, obcordate, angular, flattened dorsiventrally; seeds oblong , punctate.

Flowers & Fruits: April – August.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2945***, dated 10.04. 2004.
Status: Abundant.
Local Distribution: All three hill gardens.
General Distribution: Temperate Eurasia and E. Canada.
Note: Young shoots eaten as vegetable.

CARDAMINE L.

Cardamine debilis D. Don, Prodr. Fl. Nep. 201. 1825.

Small annual rosette herb; leaflets rounded; raceme upto 20 cm long; pods ascending.

Flowers & Fruits: January – May.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0002***, dated 27.01.2002; Hansqua TE, ***AP Das & Chandrâ 0098***, dated 03.02. 2002
Status: Common
Local Distribution: All Terai gardens.
General Distribution: Himalayas

Cardamine hirsuta L., Sp. Pl. ed. 1(2): 655. 1753; FB 1(2): 431. 1984.

Small, annual, erect to 25 cm, pubescent herb. Basal leaves many, in rosette; leaflets variable, usually ovate-orbicular; terminal larger. Flowers white, clustered in ebracteate racemes; sepals elliptic; petals longer than sepals, narrow; stamens 4-6. Pods cylindric; seeds upto 13, pale brown.

Flowers & Fruits: March – October
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2507,*** dated 11.11. 2003; Soom TE, ***AP Das & Chandrâ 2645***, dated 27.12. 2003; Tamsong TE, ***AP Das & Chandrâ 2401***, dated 05.11. 2003
Status: Abundant
Local Distribution: All three hill gardens.
General Distribution: Tempetrate Eurasia

ERUCA Miller

Eruca sativa Miller, Gard. Dict., ed. 8, no. 1. 1768; FBI 1: 158. 1872; FI 2: 143. 1993.
Brassica eruca L., Sp. Pl. 667. 1753.

Erect, glabrous, soft herb; branches few; leaves lyrate; flowers yellow, violet veined inside; pods closely adpressed to the peduncle.

Flowers & Fruits: February – April.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2805***, dated 25.03. 2004
Status: Rare

Local Distribution: Found only in Makaibari garden.
General Distribution: Canary islands, Africa, Arabia, Pakistan, India, Himalayas.

NASTURTIUM Br.

Nasturtium officinale Brown, Hook. Kew ed. 2(4): 110. 1812; FBI 1: 133. 1872; FEH 1: 110. 1966; FB 1(2): 436. 1984; FWB 1:195. 1997.
Rorippa nasturtium-aquaticum (L.) Hayek, Sched. Fl. Stir. Exs. 22. 1905; TBRI 50 (4): 125. 1987.

Local Name: *Simrayo* (Nep.)

Perennial marshy herb. Stem erect-spreading, 5-9 cm, rooting from lower nodes. Leaves imperipinnate. Lateral leaflets elliptic, terminal slightly broader longer than lateral ones, ovate-cordate, sinuate or entire, obtuse-acute. Flowers in short and ebracteate racemes white. Pods cylindric, curved upwardly.

Flowers: April - June *Fruits:* May - October
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3101,*** dated 03.05. 2004
Status: Common in moist & marshy places.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Eurasia, N. Africa; naturalised.
Note: Eaten as vegetable.

RORIPPA Scopoli

Rorippa benghalensis (DC.) Hara in J. Jap. Bot. 49: 132. 1974; FI 2: 128. 1993.
Nasturtium benghalensis DC., Syst. Nat. 2: 198. 1821

Stems 20-30 (-60) cm with lateral segments of leaves oblong – elliptic , 3-5 pairs, terminal segments ovate, obtuse, margins crenately toothed , +/- glabrous. Racemes bracteate.

Flowers & Fruits: December – March
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1485***, dated 20.10. 2002; Kamalpur TE, ***AP Das & Chandrâ 0684***, dated 20.04.2002
Status: Less Common.
Local Distribution: All Terai gardens.
General Distribution: India, Nepal, Bhutan, Indo –China, Myanmar

Rorippa dubia (Persoon) Hara in J. Jap. Bot. 30: 196. 1955; FEH 1: 110. 1966
Sisymbrium dubium Persoon, Synop. Pl. 2: 199. 1806.

Small, erect, hispid herb; branching near base; radical leaves deeply pinnatisect below, upper part entire; upper leaves sessile, auriculate; sepals yellowish green; corolla absent; pods cylindric, ascending.

Flowers & Fruits: September – December.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2268,*** dated 05.09. 2003.
Status: Common
Local Distribution: Found only in Soom & Tamsong gardens.


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General Distribution: India to Japan; naturalized in America.

Rorippa indica (L.) Hiern, Cat. Afr. Pl. Welw. 1: 26. add. et corr. 1896 et 2: 481, errata 1899; FI 2: 129. 1993.
Sisymbrium indicum L., Mant. Pl. 1: 93. 1767.

Like *R. benghalensis* but much shorter plant; leaved much dissected; scape not leafy.

Flowers & Fruits: January – March.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0823***, dated 04.05. 2002; Tamsong TE, ***AP Das & Chandrâ 2906***, dated 10.04. 2004.
Status: Less Common.
Local Distribution: All Terai gardens and in lower areas of hill gardens.
General Distribution: India, Nepal, Bhutan, China, Japan, Malaysia

CAESALPINIACEAE R. Brown

BAUHINIA L.

Bauhinia acuminata L., Sp. Pl. 376. 1753.

Shrub to small tree; bushy; lamina obcordate, tips acute, glabrous; flowers solitary, white; pods oblong with curved persistent style; seeds compressed.

Flowers & Fruits: January – December.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2976***, dated 10.04. 2004.
Status: Rarely planted
Local Distribution: Found only in Tamsong garden.
General Distribution: India, Nepal, Bhutan, China, Myanmar

Bauhinia purpurea L., Sp.Pl. 375. 1753; FBI 2: 284. 1878; FB 1(3): 633. 1987.

Local Name: *Tanki* (Nep).

Small trees to 12m. Lamina broadly elliptic, deeply obcordate, lobes subacute or obtuse with a subulate point, base truncate or cordate, glabrous or minutely puberulous beneath, veins 9 –11. Racemes 10 –12 flowered, axillary or terminal, buds 2 –2.5 cm, 5 ridged in upper half. calyx spathulate. Petals pink or mauve. Fertile stamens 3. Pods linear oblong; seeds ellipsoid.

Flowers & Fruits: January - December
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1867***, dated 16.06. 2003 ; Tamsong TE, ***AP Das & Chandrâ 2928***, dated 10.04. 2004.
Status: Commonly planted
Local Distribution: In all gardens.
General Distribution: Tropical Himalayas, S.W. China

Bauhinia variegata L., Sp. Pl. ed. 1:375. 1753; FBI 2:284. 1978; FEH 3:57. 1975; EFPN 2:109. 1979; FB 1(3): 634. 1987.

Local Name: *Koiralo* (Nep).

Trees upto 10 m tall, deciduous; branches pendulous. Leaves 8-18 x 7-15cm, broadly ovate, cordate, ± 1/3 part bifid, lobes obtuse, 9-11 veined. Flowers subsessile, fragrant, appearing with leaves. Hypanthium ± 3 cm long; petals 4-5 cm, elliptic, white. Pods 16-22 cm, linear oblong.

Flowers & Fruits: February – December
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2208***, dated 30.06. 2003
Status: Common; also planted
Local Distribution: In all gardens.
General Distribution: Himalaya, India, Myanmar, China.

CASSIA L.

Cassia alata L., Sp Pl. 378.1753; FBI 2: 264. 1878; FB 1(3): 629. 1987.

Shrubs to 4 m. Leaves 30 –60 cm; leaflets 8 – 12 pairs, oblong/ obovate, obtuse, mucronate, base rounded, glabrous; stipules triangular, persistent. Racemes 40 –60 cm, bracts orange, deciduous. Petals yellow, oblong/ obovate, clawed. Pods 4-angled, winged, with 50 –60 flat-rhombic seeds.

Flowers & Fruits: August – October.
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1655***, dated 13.11.2002
Status: Very common.
Local Distribution: All Terai gardens.
General Distribution: India, Pantropical

Cassia fistula L., Sp Pl. 377.1753; FBI 2: 261. 1878; FB 1(3): 628. 1987.

Local Name: *Raj Birse, Sunalo, Bandarlata* (Nep).

Deciduous trees, to 20m. Leaves 15 –40 cm, leaflets 3 –4 pairs, ovate, acute, base rounded, glabrous; stipules deltoid, deciduous. Recemes axillary, pendent, 10 – 40 cm, pedicels 4 – 6cm. Petals yellow, obovate. Pods terete, woody, indehiscent, black, transversly α-septate. Seeds ovate, glossy, brown.

Flowers & Fruits: January – December.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0487***, dated 17.04. 2002
Status: Very common.
Local Distribution: All Terai gardens.
General Distribution: India, Nepal, Bhutan, China, Polynesia, Malaysia, Malaya Island, Myanmar, Africa

Cassia nodosa Buch. –Ham.in Mem. Wern. Soc. 6: 312. 1832.

A short height but much spreading tree with branches curving downword; stipules large-foliaceous; lamina of leaflets oblong, slightly oblique; corymbs much branched, spreading; corolla with beautiful mosaic of colours; filaments of large staments globose-swollen at the middle; fruits woody, terete.

Flowers & Fruits: April – June.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0785***, dated 04.05. 2002.

Status: Sometimes planted
Local Distribution: Terai gardens.
General Distribution: Plant of Africal origin but widely cultivated.

Cassia occidentalis L., Sp Pl. 377.1753; FBI 2: 262. 1878; FB 1(3): 631. 1987.

Annuals, to 3 m. Leaves to 20 cm; leaflets 3 –5 pairs, ovate/ lanceolate, acuminate, base rounded, ciliate, glandular pubescent beneath; petiole with a globose gland. Corymbs axillary; bracts ovate, acute, deciduous. Petals obovate, yellow. Pods linear, compressed, brown with a broad pale band along both suture.

Flowers & Fruits: July – December.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0499***, dated 17.04. 2002
Status: Common
Local Distribution: All Terai gardens.
General Distribution: India, Nepal, Bhutan, tropical America

Cassia sophera L., Sp Pl. 379.1753; FBI 2: 262. 1878; FB 1(3): 631. 1987.

Local Name: *Kalkasunda* (Beng)

Undershrubs to 3 m. Leaves to 20 cm, leaflets 4 –9 pairs, ovate, lanceolate, acuminate, base rounded, glabrous; petiole with an erect club–shaped gland; stipules ovate, caducous. Racemes axillary, 4 –10 flowered. Petals yellow. Pods subterete, straight or curved, septate; seeds 30 –40, ovate, greyish.

Flowers & Fruits: January - December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0875***, dated 04.05. 2002; Kamalpur TE, ***AP Das & Chandrâ 0713***, dated 20.04. 2002
Status: Very common.
Local Distribution: All Terai gardens.
General Distribution: India, Nepal, Bhutan, China, Malaysia, Polynesia, Australia, Africa

Cassia tora L. Sp. Pl. 376. 1753; FBI 2: 263. 1878;
C. obtusifolia L., Sp. Pl. 377. 1753; KB 13: 248. 1958; BBSI 18: 94. 1979.

Local Name: *Tapray* (Nep).

Annuals, to 1 m tall. Stipules linear, subulate. Petiolules 0.2 cm long; leaflets 3 pairs, 2 glands between lowermost leaflet pair; obovate. Flowers in small axillary corymb, 1.25 cm diam., yellow; sepals obtuse; petals obovate, veined; stamens 7, staminodes 3. Pod slender, septate.

Flowers & Fruits: July - December.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0921***, dated 04.05. 2002; Kamalpur TE, ***AP Das & Chandrâ 1319***, dated 18.10.2002.
Status: Common.
Local Distribution: All Terai gardens.
General Distribution: Pantropic.

PELTOPHORUM (Vogel) Bentham

Peltophorum ferrugineum Bentham, Fl. Austral. 2: 279. 1864; FBI 2: 257. 1878; FB 1(3): 621. 1987.

Tree 10-15 m. Leaves pinnate 8-10 (-15) pairs, leaflets 8-18 pairs , oblong , emarginate, base oblique , truncate or rounded, sessile, glabrous . Flowers yellow in brown pubescent panicle. Pods leathery.

Flowers & Fruits: April – January.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0864***, dated 04.05. 2002.
Status: Commonly planted as a decorative wayside tree.
Local Distribution: All Terai gardens.
General Distribution: Native of Australia and SE Asia

CAMPANULACEAE A. Jussieu

WAHLENGERGIA Schrad ex Roth

Wahlenbergia marginata (Thunb.) A. DC., Monogr. Campan. 143. 1840; FEH 2: 131. 1971; Fl. Nep. 3: 53. 1982.
Campanula marginata Thunb., Fl. Jap. 89. 1784.

Glabrous to sparsely hairy. Stems erect to procumbent, 8-60cm, branched at base and above. Leaves oblanceolate, margin undulate, obscurely denticulate, sparsely pilose. Flowers erect with campanulate blue corolla. Capsule obconical, 5-7mm.

Flowers & Fruits: January – April.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0425***, dated 05.04. 2002; Hansqua TE, ***AP Das & Chandrâ 0993***, dated 09.05.2002.
Status: Less Common.
Local Distribution: All Terai gardens.
General Distribution: Subtropical Himalaya, India, China, Japan, Malaysia, Australia, New Zealand.

CANNABACEAE Lindley

CANNABIS L.

Cannabis sativa L., Sp. Pl. ed. 1. 1827. 1753; FBI 5: 487. 1888; FEH 1: 53. 1966; FB 1(1): 134. 1983.

Local Name: *Bhang, Gaanja* (Nep & Beng); *Hemp* (Eng)

Erect annual herbs, 1 – 1.6m tall. Leaves alternate, opposite at base, palmately compound; lealets narrow elliptic or lanceolate, acuminate, base attenuate, scabrid above, pubescent beneath. Male panicles pendulous; Female flowers sessile, arranged in leafy spikes minutely resinous-glandular.

Flowers & Fruits: June - August
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 1338***, dated 18.10.2002; Makaibari TE, ***AP Das & Chandrâ 1719***, dated 17.05.2003; Tamsong TE, ***AP Das & Chandrâ 2118***, dated 30.06. 2003.
Status: Abundant
Local Distribution: All gardens.
General Distribution: Native of C. Asia. Cultivated and naturalized in temperate and tropical world.
Note: Used as an intoxicant.

CAPPARACEAE A. Jussieu

CAPPARIS L.

Capparis acutifolia Sweet, Hort. Brit. ed. 2. 585. 1830; FI 2: 255. 1993.
Capparis sabiaefolia Hooker f. & Thomson in FBI 1: 179. 1872.

Local Name: *Chila pati* (Nep).

Climbing shrub, branches unarmed or with short (2-5mm) straight stipular spines, shoots minutely brownish stellate at first. Leaves ovate elliptic, abruptly acuminate or acute, base rounded or cuneate , minutely stellate pubescent at first. Flowers white, 2-4 in vertical rows at or above leaf-axils, sometimes solitary.

Flowers & Fruits: March - May
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 3338***, dated 26.09. 2003.
Status: Rare
Local Distribution: Found only in Makaibari garden.
General Distribution: Himalayas, Myanmar

CRATEVA L.

Crateva religiosa Forster f., Pl. Escul. Ins. Occ. Austral. 45. 1786; FBI 1: 172. 1872; FI 2: 325. 1993.

Local Name: *Chipli, chiple kath* (Nep).

Trees 3-15m, young shoots brown. Leaflets sub-coriaceous , ovate, obovate, or elliptic, shortly acuminate , middle leaflet largest , symmetrically cuneate at base lateral ones oblique, rounded at base, glabrous. Flowers cream coloured. Fruits 3-5.5 cm diameter, thick walled.

Flowers & Fruits: February – April
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1862,*** Dated 10.06. 2003.
Status: Rare
Local Distribution: Common in low altitude.
General Distribution: India, Nepal, Bhutan, china, Indo –China, Myanmar

CAPRIFOLIACEAE A. Jussieu

LONICERA L.

Lonicera micrantha Trautv. ex Regel, Act. Hort. Petrop. 5: 609. 1877; FB 2(3): 1358. 2001.

Large scandent shrub with pendulous branches. Branchlets brown, villous, pith hollow. Leaves oblong to oblong-lanceolate, acuminate, base subcordate to truncate, nearly glabrous above except for pilose hairs on midrib and major veins, villous beneath, whitish when young, less hairy and darker when mature, ciliate. Flowers zygomorphic, creamy white.

Flowers & Fruits: September – December..
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2987***, dated 10.04. 2004.
Status: Rare
Local Distribution: Found only in Tamsong garden.
General Distribution: India, Nepal, Bhutan, China, Taiwan, Myanmar.

CARLEMANNIACEAE Airy Shaw

CARLEMANNIA Bentham

Carlemannia griffithii Bentham in Hooer's J. Bot. Kew Gard. Misc. 5: 308. 1853; FB 2(3): 1363. 2001.

Tall herb or sub-shrub, 1-3m, woody at base, branches slender. Leaves obliquely elliptic, base cuneate margins serrate, glabrous except on veins beneath. Flowers white in lax cymes. Capsule sparsely puberulous.

Flowers & Fruits: July – September
Specimen Cited: Soom TE, ***AP Das & Chandrâ*** 3469, dated 12. 10. 2004.
Status: Rare
Local Distribution: Found only in Soom garden.
General Distribution: E. Himalayas, Khasia Hills, N. Myanmar.

CARYOPHYLLACEAE A. Jussieu

BRACHYSTEMMA D. Don

Brachystemma calycinum D. Don, Prodr. Fl. Nepal. 216. 1825; FBI 1: 235. 1874; FI 2: 519. 1993; FB 1(2): 209. 1984.

Stems 4 angled, glossy. Lamina linear-lanceolate, acuminate, base cuneate, sparsely pubescent above. Panicle branches minutely pubescent, bracts linear -lanceolate up to 4 mm, recurved. Sepals elliptic, weakly 3 nerved. Petals lanceolate, white.

Flowers & Fruits: October – February.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1770,*** dated 17.05.2003; Tamsong TE, ***AP Das & Chandrâ 2348,*** dated 05.11. 2003.

Status: Less Common.
Local Distribution: Found only in Makaibari garden.
General Distribution: Eastern Himalaya, Assam, W. China.

CERASTIUM L.

Cerastium glomeratum Thuillier, Fl. Env. Paris ed. 2:226. 286. 1799; Sci. Rep. Thoku Univ. Ser. 4, Biol. 29: FB 1(2): 205. 1984; FWB 1:243. 1997.
C. vulgatum L., Fl. Suec. Ed. 2: 158. 1755, nom ambing.; F;. 38, f. 24. 1936.

Slender, suberect herb to 30 cm. Leaves oblanceslate or ovate, acute or obtuse, base norrowed or rounded, eglanduler pubescent, sometimes glandular. Flowers in terminal cymes. Capsule cylindrical, 10-valved, straw - coloured.

Flowers & Fruits: May - September
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2059***, dated 30.06. 2003.
Status: Common.
Local Distribution: Found only in Soom & Tamsong garden.
General Distribution: Cosmopolitan.

DRYMARIA Schultes

Drymaria diandra Blume, Bijdr. 62. 1825; FI 2:533. 1993; FWB 1(2):243. 1997.
Drymaria cordata (L.) Willdenow ex Roemer & Schultes, Syst. Veg. 5: 406.1819; FBI 1:244.1874; FB 1(2): 215.1984.

Local Name: *Abijalo* (Nep)

Prostrate or trailing herb, rooting at nodes. Stipules short, lacerate. Lamina suborbicular, obtuse, glabrous, 5-nerved.. Flowers in axillary or terminal cymes; pedicels papillose; sepals elliptic-ovate, scarious, 3-nerved; petals white; stamens few to 5. Capsules 3-valved; seeds tuberculate.

Flowers & Fruits: May - July
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0016***, dated 27.01.2002; Hansqua TE, ***AP Das & Chandrâ 1035***, dated 09.05. 2002; Kamalpur TE, ***AP Das & Chandrâ 0701***, dated 20.04.2002; Makaibari TE, ***AP Das & Chandrâ 1805***, dated 17.05.2003; Soom TE, ***AP Das & Chandrâ 2637***, dated 27.12. 2003; Tamsong TE, ***AP Das & Chandrâ 2244***, dated 03.09. 2003.
Status: Abundant.
Local Distribution: In all the gardens.
General Distribution: Tropical and Subtropical Asia, Formosa, W. & S. China, Oceania, Hawaii.
Note: An important folk medicinal plant.

Drymaria villosa Chamisso *et* Schlechtendal in Linnaea 5: 232. 1830; FEH 3:31. 1975; EFPN 2:54. 1979; FB 1(2): 216.1984; FI 2:532. 1993; FWB 1:245. 1997.

Local Name: *Abijalo* (Nep).

Diffuse, much branched, villous, annuals, >16 cm. Leaves opposite, ovate-cordate, obtuse-mucronatre, villous with long whitish hairs; stipules entire. Cymes axillary and terminal, much branched; flowers white; bracts small. Capsule 3-valved, ovoid many seeded.

Flowers: April – August; *Fruits:* July – December
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1661***, dated 13.11. 2002; Tamsong TE, ***AP Das & Chandrâ 2180,*** dated 30.06. 2003; Soom TE, ***AP Das & Chandrâ 2602***, dated 27.12. 2003.
Status: Very common.
Local Distribution: All three hill gardens and in Terai during winter.
General Distribution: C. America along Pacific coast of S. America to Peru. Highly naturalised in Himalayas (Nepal-Bhutan), India, Malaysia and Africa.
Note: Medicinally useful plant.

POLYCARPON L.

Polycarpon prostratum (Forsskal) Aschers. & Schweinf. In Oesterr. Bot. Z. 39: 128. 1889; FI 2: 553. 1993; FB 1(2): 216. 1984.
Alsine prostrata Forsskal, Fl. Aegypt. - Arab.207. 1775.
Polycarpon loeflingiae (Wight & Arn.) Benth. In Benth. & Hook.f., Gen. Pl. 1: 153. 1862; FBI 1: 245. 1874.

Stems 15 –30 cm, weakly pubescent. Leaves oblanceolate, 5 –20 x 2 –5mm, acute, base narrowed, subsessile, sparsely pubescent beneath; stipules lanceolate, 2 – 3 mm. Sepals narrowly ovate, 2 – 2.5 mm. petals half as long as sepals. Capsule ovoid, 1.5mm.

Flowers & Fruits: June – October.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 1586***, dated 22.10.2002; Kamalpur TE, ***AP Das & Chandrâ 1329,*** dated 18.10.2002.
Status: Common.
Local Distribution: All Terai gardens.
General Distribution: Tropical Himalaya, India, Tropical Asia, Africa.

SAGINA L.

Sagina japonica (Swartz) Ohwi in Journ. Bot. 13:438. 1937, excl. *syn. S. maxima* A. Gray, Mizushima Journ. Jap. Bot. 35. 257. 1960; FEH 1: 81. 1966; 2: 26. 1971; 3: 33. 1975; FB 1(2): 214. 1984; FI 2:558. 1993; FWB 1:246. 1997.
Spergula japonica Swartz in Gex. Naturf. Freninde Berl. Neue Schr. 3: 164, t. i, f. 2. 1801.

Small perennial herb to 7-13 cm. Leaves opposite, basally connate, acuminate with awn-like tip, glandular above, ciliate near base, nerves indistinct Flowers both axillary and terminal, solitary, globose, white; Capsule 5-valved; seeds rough and papillate, brownish.

Flowers: May - July; *Fruits:* August - December
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2998***, dated 10.04. 2004.
Status: Very common.
Local Distribution: All three hill gardens.

General Distribution: E. Himalaya (Nepal-Bhutan), Korea, China, E. Tibet, Formosa, Japan.

STELLARIA L.

Stellaria media (L.) Villars, Hist. Pl. Dauph. 3: 615, 1789; FEH 1: 82. 1966; FB 1(2): 207. 1984; TBRI 50 (4):128. 1987; FWB 1:250. 1997.

English Name: Chickweed.

Diffuse or mattted herb. Stem quadrangular. Petioles upto 1.35 cm; lamina ovate, acute, cordate or rounded, glabrous or ciliate. Cymes few to numerous flowered, terminal, leafy. Pedicels to 1.5 cm; sepals ovate, glandular; petals bifid; stamens 3-8; ovary 1-celled. Capsule ovoid.

Flowers & Fruits: February - November
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0706***, dated 20.04.2002; Soom TE, ***AP Das & Chandrâ 2690,*** dated 09.01.2004; Tamsong TE, ***AP Das & Chandrâ 2997***, dated 10.04. 2004.
Status:Abundant.
Local Distribution: All three hill gardens.
General Distribution: Temperate regions of the world.

Stellaria patens D. Don, Prodr. Fl. Nep. 215. 1825; FEH 1: 84. 1966; 2: 26. 1971; 3: 35. 1979; EFPN 2: 58. 1979; FB 1(2): 207. 1984; TBRI 50 (4):128. 1987; FWB 1:251. 1997.
S. longissima Edgeworth et Hook. f. in FBI 1: 232. 1874.

Decumbent slender herb, tufted stem 4-angled, white-pilose. Leaves sessile, lamina linear lanceolate, entire, white-pilose below. Cymes few flowered; peduncle white-hairy; bracts scarious. Flowers white; sepals lanceolate; petals 2-partite, white; stamens 10; Capsule ovoid.

Flowers & Fruits: April – June
Specimen Cited: Soom TE, ***AP Das & Chandrâ 2646,*** dated 27.12.2004; Tamsong TE, ***AP Das & Chandrâ 1934***, dated 30.06. 2003.
Status: Common.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Himalayas (Punjab-Bhutan).

Stellaria sikkimensis Hook.f., FBI 1: 230. 1874; FI 2: 588. 1993; FB 1(2): 207. 1984.

Weak, prostrate, stellately –pubescent, yellowish pilose throughout. Lamina ovate –lanceolate, 0.7 –2x 0.3 –0.8cm, acute or acuminate, base rounded, sessile. Flowers in loose terminal cymes. Sepals lanceolate, 4 –5mm; petals 3 –4mm. Capsules ovoid.

Flowers & Fruits: June - December.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 3010,*** dated 10.04. 2004.
Status: Rare
Local Distribution: Found only in Tamsong garden.
General Distribution: Eastern Himalaya (Nepal – Bhutan).

Stellaria uliginosa Murray, Prodr. Strip. Gotting. 55. 1770; var. ***undulata*** (T.hunberg) Ohwi in Acta Phytotax. Geobot.10:136. 1941; EFPN 1:58. 1979; FB1(2):208. 1984; TBRI 50(4):128. 1987.
S. undulata Thunberg, Fl. Jap. 185. 1785.
Stellaria alsine Grimm

Glabrous annual, profusely branched. Stem 4-angled, brownish. Leaves subsessile, elliptic–lanceolate, repund, acute, glabrous. Cymes terminal/ axillary, few flowered. Flowers 0.55-0.6cm across, bracteate. Sepals lanceolate; petals shorter than sepals, bifid; stamens 10; capsules ovoid.

Flowers & Fruits: October – March
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0724***, dated 20.04.2002; Soom TE, ***AP Das & Chandrâ 2671***, dated 09.01. 2004; Tamsong TE, ***AP Das & Chandrâ 3027***, dated 10.04. 2004.
Status: Rare.
Local Distribution: All three hill gardens. Rarely in Terai during winter.
General Distribution: Himalayas (Nepal- Bhutan), east to China, Japan .

Stellaria wallichiana Benth. Ex Haines in Bull. Misc. Inf. Kew 1920: 66. 1920; FI 2: 591. 1993.

Stems slender, pubescent and scattered hairy. Leaves petiolate, ovate to ovate –lanceolate, broadly cordate; petioles slender, pubescent. Sepals 4, ovate, acute or acuminate, 2.5 –3mm. Petals 4, ovate, 2 –fid. Stamens hypogynous. Ovary ovoid; styles 2 –3, recurved. Capsules 6 valved. Seeds 10 –15.

Flowers & Fruits: June - December.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0405***, dated 27.02.2002
Status: Abundant.
Local Distribution: All Terai gardens.
General Distribution: Tropical parts of Indian subcontinent.

CELASTRACEAE R. Br.

CELASTRUS L.

Celastrus paniculatus Willdenow, Sp. Pl. 1: 1125. 1797; FBI 1: 617. 1875; FEH 1: 189. 1966; EFPN2: 88. 1979; FB 2(1): 122. 123. 1991. sub.sp. ***paniculatus***: FWB 1:419. 1997.

Local Name: *Bhainsay Lahara* (Nep).

Scandent shrubs. Branchlets terete, pubescent. Stem grooved, lenticellate, grayish green. Leaves simple, alternate, obovate to orbicular, crenate-serrulate, abruptly acuminate, base attenuate, glabrous, soft, lower surface light whitish green. Paniculate cymes terminal, pendulous, pubescent with whitish-green flowers. Capsule globose.

Flowers & Fruits: June – December.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0651,*** dated 20.04.2002.
Status: Rare
Local Distribution: Found only in low altitude areas

General Distribution: Himalayas, India, Sri Lanka, Myanmar, Indo-China, Malaysia, China, Formosa, Australia.

EUONYMUS

Euonymus frigidus Wallich in Roxburgh, Fl. Ind. ed. Carey, 2: 409. 1824; FEH 1: 189. 1966.

Local Name: *Chure Lahara* (Nep).

Small shrub, young stems grooved; leaves thick, oblong-lanceolate, sharply serrate, acute; flowers and fruits not seen.

Specimen Cited: Soom TE, ***AP Das & Chandrâ 3499***, dated 12. 10. 2004.
Status: Rare
Local Distribution: Found only in Soom garden.
General Distribution: Eastern Himalaya, Assam, Manipur, Myanmar, China.

CHENOPODIACEAE Ventenat

CHENOPODIUM L.

Chenopodium album L., Sp. Pl. 219. 1753; FBI 5: 3. 1886; FB 1(2): 217. 1984.

Erect, annual, 30 –100 cm tall. Lamina ovate-deltoid, subacute, cuneate, entire or shallowly dentate, sometimes weakly 3 lobed, mealy beneath. Flower-clusters dense, sessile in slender panicles. Flowers minute, bisexual or lower ones female. Tepals 5. Seeds black, faintly striate.

Flowers & Fruits: October – February.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 1532***, dated 22.10. 2002; Hansqua TE, ***AP Das & Chandrâ*** 0126, dated 03.02.2002; Kamalpur TE, ***AP Das & Chandrâ 0720,*** dated 20.04.2002; Makaibari TE, ***AP Das & Chandrâ 1914***, dated 10.06.2003.
Status: Abundant.
Local Distribution: In all gardens.
General Distribution: Cosmopolitan weed.

Chenopodium ambrosioides L., Sp Pl. 1: 219. 1753.

Aromatic herb to 125 cm. Lamina lanceolate, acute or acuminate, base attenuate, irregularly serrate –dentate or entire, yellowish gland –dotted beneath. Flower-clusters rather distant on slender spikes forming panicles. Flowers bisexual. Tepals 5. Stamens 4 –5. Seeds smooth.

Flowers & Fruits: April – November

Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1754***, dated 17.05.2003; Tamsong TE, ***AP Das & Chandrâ 2453,*** dated 05.11. 2003.
Status: Abundant.
Local Distribution: All Terai gardens and in lower areas of hill gardens.
General Distribution: India, Nepal, Bhutan, Pakistan, China.

Chenopodium giganteum D. Don, Prodr. Fl. Nep.: 75. 1825; FB 1(2): 218. 1984

A larger, often reddish plant, 1-3 m. Leaves rhombic-ovate, unlobed or shallowly 3-lobed, acute, base cuneate, margins coarsely irregular-dentate. Flower clusters dense, sessile, forming slender panicles.

Flowers & Fruits: January – April
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 0229***, dated 09.02. 2002
Status: Common; also cultivated as a green vegetable.
Local Distribution: In all gardens.
General Distribution: India, Nepal, Bhutan, China, Korea, Japan, introduced in Europe, Africa, Malaysia, N. America.

CLEOMACEAE Horan.

CLEOME L.

Cleome rutidosperma DC., Prodr. 1: 241. 1824; FI 2: 313. 1993; FWB 1: 208. 1997.

Annual, erect/ decumbent herb. Leaves 3 –foliolate, lower two long petiolate, elliptic to obovate, acute or acuminate, attenuate or cuneate, glabrous. Racemes lax, few flowered, leafy. Flowers violet, with pink streaks; pedicels filiform. Petals oblanceolate to elliptic, apiculate. Capsules linear –cylindric, compressed.

Flowers & Fruits: June – February.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0078,*** Dated 27.01. 2002; Hansqua TE, ***AP Das & Chandrâ 0165***, dated 03.02. 2002; Kamalpur TE, ***AP Das & Chandrâ 1320***, dated 18.10.2002; Matigara TE, ***AP Das & Chandrâ 3156***, dated 10.05. 2004.
Status: Abundant
Local Distribution: In Terai gardens
General Distribution: A naturalized Tropical American weed.

Cleome spinosa Jacq., Pl. Carib. 26. 1760; FI 2: 321. 1993.

Erect, annual. Stems with dense patent gland –tipped hairs. Leaves 5 –7 foliolate; 2 spiny stipules at base; leaflets lanceolate, acute, subentire to slightly serrulate. Flowers large, purple pink or white, numerous in terminal racemes. Petals long –clawed. Gynophore 4 cm long. Capsules –cylindric linear.

Flowers & Fruits: January – May.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1712,*** dated 17.05.2003.
Status: Rare
Local Distribution: In Terai and low altitude areas.
General Distribution: A naturalized Tropical American ornamental plant.

Cleome viscosa L., Sp.Pl. 672. 1753; FBI 1: 170. 1872; FI 2:312. 1993; FB 1(2): 416. 1984.

Stems up to 60 cm, glandular - pubescent. Leaves 5 foliolate, exstipulate; petioles 1.5 -5cm, leaflets elliptic–oblanceolate, acute or acuminate, cuneate, glandular -pubescent. Bracts leafy, 3 foliolate. Sepals lanceolate. Petals oblanceolate, yellow. Stamens 12 -25. Ovary sessile.

Flowers & Fruits: July – October.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0847***, dated 04.05. 2002; Kamalpur TE, ***AP Das & Chandrâ 1336,*** dated 18.10. 2002.
Status: Abundant
Local Distribution: All Terai gardens
General Distribution: Pantropical.

GYNANDROPSIS DC.

Gynandropsis pentaphylla (L.) DC. Prodr. 1: 238. 1824; FBI 1: 171. 1872; FI 2: 309. 1993.
Cleome gynandra L., Sp. Pl. ed. 1. 671. 1753.

Stems erect, 15-45 cm, glandular-pubescent leaflets 5, obovate, lowest pair smallest, middle largest, acute, base alternate, margins entire, glandular-pubescent beneath. Flowers white. Capsule valves papery.

Flowers & Fruits: September – January
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0798***, dated 04.05. 2002.
Status: Rare
Local Distribution: Found only in Mohurgong & Gulma garden.
General Distribution: India, Nepal, Bhutan, China, Sri Lanka, Malaysia.

COMBRETACEAE R. Brown

COMBRETUM Loefl.

Combretum decandrum Roxburgh, Pl. Corom. 1: t. 59. 1796; FBI 2: 452. 1878; FB 2(1): 306. 1991.

Local Name: *Kali lahara* (Nep).

Evergreen climbling shrub, branches subscandant or pendent, bark reddish brown, somewhat flaking. Leaves oblong-elliptic to obovate, acuminate, base rounded to rounded truncate, glabrous with pilose veins on lower surface. Spikes short, densely villous-pubescent.

Flowers & Fruits: December – February
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1916,*** dated 10.06. 2003.
Status: Common
Local Distribution: Common in low altitude.
General Distribution: India, Myanmar, Nepal, Indo-china, & W. China.

TERMINALIA L.(*nom. cons.*)

Terminalia bellirica (Gaertn.) Roxburgh, Pl. Corom. 2: 54, t. 198. 1805; FBI 2: 445. 1878; FB 2(1): 304. 1991.
Myrobalanus bellirica Gaertn., Fruct. 2: 90. 1791.

Local Name: *Borrah* (Nep); *Baherha* (Beng)

Large semi evergreen tree, 20 m or more. Leaves clustered towards ends of branches coriaceous, elliptic to obovate, acute or very shortly acuminate, base cuneate, margin subentire, papillose when dry, glabrescent; spikes 4-12 cm in axils of upper leaves. Fruits a drupe, sub globose to obovoid, pubescent.

Flowers & Fruits: March – June
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 1347***, dated 18.10.2002.
Status: Common; also planted.
Local Distribution: All Terai gardens.
General Distribution: India, Sri Lanka to Malaya-peninsula.

Terminalia chebula Retzius, Obs. Bot. 5:31. 1789; FBI 2:446. 1878; FEH 1:220. 1966; EFPN 2:168. 1979; FB 2(1): 304. 1991.

Local Name: *Harra* (Nep), *Haritaki* (Beng).

Deciduous trees to 22m high; young parts reddish brown hairy. Petiole with two apical outgrowths; lamina elliptic or ovate-oblong, acute, entire, coriaceous, veins hairy. Spikes panicled, axillary or terminal;. Disc densely hairy. Drupe subglobose, 5-ridged, glabrous.

Flowers & Fruits: April – June
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1660***, dated 13.11.2002
Status: Rare
Local Distribution: Found only in Hansqua garden.
General Distribution: Himalayas (Kumaon-Bhutan), India, Sri Lanka, Myanmar, Malaysia.
Note: Fruits edible and generally consumed medically for cough. Its wood essentially used as good firewood.

Terminalia myriocarpa Heurcket Muell.-Arg., Obs. Bot. 215. 1870-71; FBI 2: 448. 1878; FEH 1: 220. 1966; EFPN 2:168. 1979; FB 2 (1): 305. 1991.

Local Name: *Paanisaaj* (Beng & Nep).

Tree to 42 m high, young shoot reddish pubescent. Petioles with stalked glands; lamina oblong to oblong-elliptic, shortly acuminate, subcordate, subentire, pubescent bellow. Spikes panicled, dense flowered, pinkish. Disc sparesly hairy or glabrous. Nut 2-winged, hairy.

Flowers: October - November *Fruits*: May.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2479***, dated 11.11. 2003.
Status: Common; also planted for timber.
Local Distribution: All Terai gardens.
General Distribution: Himalayas (Nepal – Bhutan), Assam, Myanmar, Thailand, Indo-China, W. China.
Note: Durable timber, used for house building.

CONVOLVULACEAE A. Jussieu

ARGYREIA Loureiro

Argyreia hookeri C. B. Clarke in FBI 4: 185. 1883; FEH 1: 263. 1966; EFPN 3: 105. 1982; FB 2(2): 842. 1999.

Large herbaceous climber to at least 8mm. Stems shortly appressed hispidulous. Leaves broadly ovate, acuminate, base deeply cordate, densely and minutely scabrid above with short hairs on and near veins. Flowers pink darker at base of tube, in few flowered dichotomous cymes. Fruit globose.

Flowers & Fruits: Jun – February.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2521,*** dated 11.11. 2003
Status: Rare
Local Distribution: Found in low altitude areas.
General Distribution: India, Nepal, Bhutan.

Argyreia roxburghii Choisy in Mem. S. Phys. Hist. Nat. Geneve 6: 419. 1834; FBI 4: 185. 1883; FEH 1:207. 1966; EFPN 3: 105. 1982; FB 2(2): 841. 1999.

Large climbers 4cm or more. Stems densely apressed pubescent with whitish hairs. Leaves broadly ovate , shortly acuminate , base cordate, moderately villous above , densely grey-villous beneath. Flowers purplish pink with darker throat in lax, dichotomous up to 5 flowered cymes. Fruit globose, blackish.

Flowers & Fruits: February - October
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 1317,*** dated 18.10.2002.
Status: Common
Local Distribution: Common in low altitude areas.
General Distribution: India, Nepal, Bhutan.

EVOLVULUS L.

Evolvulus nummularius (L.) L., Sp. Pl. (ed.2) 391. 1762.
Convolvulus nummularius L., Sp. Pl. 157. 1753.

Perennial with numerous prostrate annual branches 7-35cm, Leaves rounded, very shortly petiolate, entire, shallowly emarginated, appressed hirsute, sometimes glabrous above. Flowers white. Capsule globose, 4 valved.

Flowers & Fruits: January – December.
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 0179,*** dated 03.02.2002; Kamalpur TE, ***AP Das & Chandrâ 1054***, dated 09.05.2002.
Status: Less common.
Local Distribution: All Terai gardens.
General Distribution: Native of West Indies; widely naturalized in Africa, Asia & America.

IPOMOEA L.

Ipomoea batatas (L.) Lam., Tabl. Encycl. 1: 465. 1792; FBI 4: 202. 1883; FB 2(2): 849. 1999.
Convolvulus batatas L., Sp. Pl. 1: 154. 1753.

Common Nane: *Sweet potato* (Eng); *Misti alu* (Beng)

Tubers red, white, or yellow, stems prostrate, ascending or twinning, 1-5 m, glabrous or sparsely hairy, +/- terete or angular. Leaves broadly ovate to orbicular in outline, entire or 3-7 lobed, acute or usually shortly acuminate, base cordate, glabrous or sparsely pubescent. Cymes few-flowered or sub umbellate with corolla lavender, pink or purplish with darker throat.

Flowers & Fruits: (February)
Specimen Cited: Soom TE, ***AP Das & Chandrâ*** 3393, dated 12.10. 2004
Status: Cultivated
Local Distribution: Found only in Soom garden.
General Distribution: Native of America, grows as a root crop throughout the tropics and sub tropics.

Ipomoea nil (L.) Roth, Cat. B. 1: 36. 1797; EFPN 3: 107. 1982; FB 2(2): 846. 1999.
Convolvulus nil L., Sp. Pl. ed. 2, 1: 219. 1792.

Herbaceous, usually annual twiner, sometimes prostrate. Stems retrorsely hirsute or setulose. Leaves broadly ovate to orbicular in outline, entire or 3 lobed, acute to acuminate, base cordate, appressed hairy on both surfaces . Flowers blue, turning red or reddish purple, 1- several in small umbellate cymes.

Flowers & Fruits: August – September
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0967***, dated 04.05. 2002; Kamalpur TE, ***AP Das & Chandrâ 0614***, dated 20.04.2002; Soom TE, ***AP Das & Chandrâ 3106***, dated 03. 05. 2004.
Status: Common
Local Distribution: In all gardens.
General Distribution: Tropical and temperate regions of the New World.

Ipomoea purpurea (L.) Roth, B. Abh. 27. 1787; FBI 4: 200. 1883; FEH 1: 265. 1966; EFPN 3: 107. 1982; FB 2(2): 854. 1999.
Convolvulus purpureus L., Sp. Pl. ed. 2. 219. 1762.

Herbaceous annual twinner. Stems with short appressed hairs and longer retrorsely patent bristles. Leaves broadly ovate to sub orbicular in outline, usually unlobed but occasionally 3-lobed, apex shortly acuminate, base deeply cordate surfaces shortly appressed pilose . Cymes 1-5 flowered with corolla tube white or pink, limb white, deep pink, red or purple.

Flowers & Fruits: May – October
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0447***, dated 05.04. 2002
Status: Rare
Local Distribution: In all gardens.
General Distribution: Native to America (New Mexico to Argentina).
Note: Morning glory is widely cultivated in tropical and sub tropical countries as an ornamental, sometimes becoming naturalized. Potentially an invasive weed.

Ipomaea quamoclit L., Sp.Pl. ed. 1. 159. 1753; FBI 4: 199. 1883; FEH 1: 265. 1966

Slender twiner. Leaves pinnatipartite, segments filiform. Cymes few flowered, axillary, long peduncled Sepals 5, elliptic; corolla tube slender, funnel- like, scarlet red or rarely white; stamens 5, exerted unequal; ovary 4-celled, glabrous. Capsules 4-seeded.

Flowers & Fruits: May – August
Specimen cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0876***, dated 04.05. 2002.
Status: Common.
Local Distribution: All Terai gardens.
General Distribution: Native of New World Tropicas, naturalised in circumtropical regions.
Note: Generally grown in gardens; naturalized.

MERREMIA Dennst. Ex Endl.

Merremia hirta (L.) Merrill in Philip. J. Sci. Bot. 7: 244. 1912; FB 2(2): 854. 1999.
Convolvulus hirtus L., Sp.Pl.159. 1753.

Twining or prostrate herb. Stems very slender, glabrous. Lamina linear, oblong –lanceolate, obtuse to slightly emarginate, base obtuse to shallowly cordate, glabrous. Cymes 1 –6 flowered, peduncles 1 –3 cm. Corolla pale yellow or whitish, glabrous; mid –petal bands with 5 distinct dark veins. Capsules broadly ovoid to globose, papery, 4 –valved. Seeds dark brown.

Flowers & Fruits: **October – January**.
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1415***, dated 20.10.2002; Kamalpur TE, ***AP Das & Chandrâ 1356***, dated 18.10.2002.
Status: Raredens.
Local Distribution: Hansqua and Kamalpur gar
General Distribution: Tropical Asia.

PORANA Burman f.

Porana paniculata Roxburgh, Pl. Corom. 3:31, t. 235. 1891; FBI 4:222. 1883; FEH 1: 265 1966; EFPN 3:108. 1982.

An extensive climber, densely tomentose, profusely branched. Leaves ovate-cordate, acute, entire, pubescent both sides. Panicles many flowered, white, terminal. Capsules globose.

Flowers & Fruits: October – March.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2847***, dated 25.03. 2004.
Status: Rare
Local Distribution: Found in low altitude areas.
General Distribution: Himalayas, N. India, Myanmar

CRASSULACEAE DC.

KALANCHOE Adanson

Kalanchoe pinnata (Lamk.) Pers., Syn. 446. 1805; FB 1(3): 478. 1987.
Cotyledon pinnatum Lamk., Ency. 2: 141. 1786.

Name: *Patharkuchi* (Beng)

Stems 0.3-2 m, somewhat woody at base.Leaves simple or 3-5 foliate, thickly fleshy, leaves or leaflets ovate-oblong, obtuse, base rounded, margins crenately serrate, glaucous beneath . Flowers reddish, pedunculous in panicles 10-30 cm.

Flowers & Fruits: February - May
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 1159,*** dated 18.10.2002.
Status: Rare
Local Distribution: All Terai gardens.
General Distribution: Native of Tropical Africa.

CUCURBITACEAE A. Jussieu.

CITRULUS Schrad. *ex* Eckl. & Zeyh.

Citrullus vulgaris Schr. ex Eckl & Zeyh., Enum. Pl. Afr. Austr. 279. 1836; FBI 2: 621. 1879.

A trailing climber, never climbs up; lamina deeply and palmately lobed; flowers small, yellow, solitary in leaf-axiles; fruits globose, solid due to enlarged placenta.

Flowers: (September)
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2277,*** dated 05.09. 2003.
Status: Rare; an escape.
Local Distribution: Found only in Tamsong garden.
General Distribution: India, Nepal, Bhutan, Myanmar, Indo –China.

CUCUMIS L.

Cucumis melo L., Sp. Pl. 1011. 1753; FB 2(1): 259. 1991.

Leaves broadly ovate, acute, base cordate, 5 angular, hispid, petioles 10 cm. Flowers yellow. Fruits of various shapes and sizes, smooth, softly hairy.

Flowers & Fruits: July – October.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0935,*** dated 04.05. 2002; Kamalpur TE, ***AP Das & Chandrâ 1177,*** dated 18.10.2002.
Status: Common
Local Distribution: All Terai gardens.
General Distribution: Tropical and warm countries.

EDGARIA Clarke

Edgaria darjeelinsis Clarke, J. Lin. Soc. 15:113. 1876; FBI 2:632. 1879; FEH 1:322. 1966; EFPN 2:178. 1979; Fascl. Fl. Ind. 11:49. 1982; TBRI 50(4):112. 1987; FB 2(1): 268. 1991.

Large, annual, monoecious climber, glandular-hairy. Tendrils 2-fid. Lamina ovate, denticulate, shallowly lobed, cordate, acuminate, pubescent. One male peduncle 1-flowered, another racemed. Hypanthium glabrous; corolla rotate, yellow; stamens 3. Females solitary. Fruits trigonous.

Flowers: June - August *Fruits:* September - November
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2434,*** dated 05.11. 2003

Status: Abundant
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Himalayas (Garhwal – Bhutan).

GYNOSTEMMA Blume

Gymnostemma pentaphylla (Thunberg) Makino in Bot. Mag. Tokyo 16:179. 1902; FEH 1: 323. 1966; EFPN 2: 179. 1979; TBRI 50(4): 115. 1987; FB 2(1): 270. 1991.
Vitis pentaphylla Thunberg, Fl. Jap. 105. 1784.
G. pedata Blume, Bijdr. 23. 1825; FBI 2: 633. 1879.

A small slender climber. Stem much branched, hairy. Leaves ovate to oblong-lanceolate, acuminate, base narrowed or subcordate to rounded, adpressed hairy both sides. Flowers 4-merous, or very rarely 5-merous, calyx-tube with dense tufts of stellate hair.

Flowers: August - October *Fruits:* September - November
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2474,*** dated 11.11. 2003
Status: Rare
Local Distribution: All three hill gardens.
General Distribution: Himalayas, India, Sri Lanka, Myanmar, east to China, Japan, Malaysia.

MELOTHRIA L.

Melothria heterophylla (Loureiro) Cogn. in DC., Monog. Phan. 3: 618. 1881; FB 2(1): 257. 1991.
Solena heterophylla Loureiro, Fl. Cochinch. 514. 1790.

Local Name: *Gol Kakri* (Nep)

Leaves 7 –15 x 1 –10cm, acute or acuminate, cordate or angular, denticulate, glabrous. Flowers white or creamy. Calyx 5mm, teeth triangular; corolla tubes similar, broader. Ovary ellipsoid, 1 cm with scattered elliptic glands. Fruits red, puberulous, glands diffuse; seeds ellipsoid, smooth.

Flowers & Fruits: June - December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0751***, dated 04.05. 2002.
Status: Rare
Local Distribution: Found only in Gulma garden.
General Distribution: India, Nepal, Bhutan, Afghanistan, China, Indo –China, Taiwan, Sri Lanka, Myanmar, Malaysia, Australia.

MUKIA Arnott

Mukia maderaspatana (L.) Roem., Fam. Syn. Mon. 2: 47. 1846; FB 2(1): 258. 1991.
Cucumis maderaspatana L., Sp. Pl. 1012. 1753.

Stems stiffly hairy. Tendrils simple. Lamina broadly ovate, 4 –10 x 4 –10cm, acuminate, cordate, toothed, hispid. In males:, calyx narrow, including hispid teeth; corolla ± 2 mm, yellow. Ripe fruits 1 cm in diameter, red & glossy; seeds ovoid, low margined, surface roughened.

Flowers & Fruits: June - December

Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 1161***, dated 04.05. 2002; Mohurgong & Gulma TE, ***AP Das & Chandrâ 0733,*** dated 18.10.2002.
Status: Common
Local Distribution: All Terai gardens.
General Distribution: India, Nepal, Bhutan, China, Taiwan, Malaysia, Australia, New Zealand, Africa.

TRICHOSANTHES L.

Trichosanthes lepiniana (Naudin)Cogniaux in DC., Monogr. Phan. 3:377. 1881; FEH 1:325. 1966; Fasc. Fl. Ind. 11:116. 1982; TBRI 50(4): 129. 1987; FB 2(1): 266. 1991.
T. tricuspidata Loureiro, Fl. Cochinch. 589. 1790; EFPN 2: 180. 1979.
T. palmata Roxburgh, Fl. Ind. 3: 704. 1832; FBI 1: 606. 1879.

Local Name: *Indreni* (Nep).

A liana; stem angular-sulcate, lenticellate. Tendrils 2-3 fid. Lamina sub-orbicular, cordate, 3-7 lobed and nerved from base, serrate, acute or acuminate. Racemes 16-29 cm long; bracts obovate, fimbriate. Female flowers on short peduncles. Corolla white, fimbriate. Fruits globose / ellipsoid.

Flowers: June - September; *Fruits.:* October - November
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1063***, dated 09.05.2002.
Status: Less common.
Local Distribution: All Terai gardens and in lower areas of hill gardens.
General Distribution: E. Himalaya, India, east to China, Japan, Malaysia.
Note: Fruits and seeds highly poisonous but eaten by Lepchas

Trichosanthes tricuspidata Loureiro, Fl. Cochinch. 589. 1790;
Trichosanthes palmata Roxburgh, FI 3: 704. 1832; FBI 1: 606. 1879.

Flowers & Fruits: June - December
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 3339***, dated 26.09. 2004.
Status: Rare
Local Distribution: All three hill gardens.
General Distribution: India, Nepal, Bhutan, China, Japan, Malaysia, Australia.

ZANONIA L.

Zanonia indica L., Sp.Pl. ed. 2. 2: 1457. 1763; FB 2(1): 268. 1991.

Woody climber. Lamina, coriaceous, ovate, 8 –12 x 5 –8 cm, acute, cordate, entire, glabrous; tendrils simple or bifid. Dioecious, flowers in racemes or panicles; male peduncles 15 –30 cm; calyx lobes broadly ovate; corolla yellowish, 6 –8 mm. Fruits brownish. Seeds yellowish, winged.

Flowers & Fruits: December – April.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0298,*** dated 16.02.2002; Kamalpur TE, ***AP Das & Chandrâ 0460***, dated 17.04.2002; Tamsong TE, ***AP Das & Chandrâ 2880***, dated 10.04. 2004.
Status: Common
Local Distribution: All Terai gardens and in lower areas of hill gardens.
General Distribution: Tropical Asia.

ZEHNERIA Endlicher

Zehneria maysorensis (Wight & Arnott) A. in Hook., J. Bot. 3: 275. 1841; FB 2(1): 258. 1991.
Bryonia maysorensis Wight & Arnott, Prodr. 1: 345. 1834.

Herbaceous climber with simple tendril. Leaves blackish when dry, ovate or weakly lobed, acuminate, cordate, denticulate, glabrous beneath. Monoecious; male peduncles 2 –2.5 cm, 3 –7 flowered; corolla tubes ovate triangular, 2.5 mm. Female flowers solitary. Ripe fruits globose, 10 –12 mm in diameter, red. Seeds obovoid, compressed, narrowly margined.

Flowers & Fruits: (June)
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1832***, dated 10.06. 2003.
Status: Common
Local Distribution: Common in low altitude.
General Distribution: Eastern Himalaya, Assam, Myanmar, China, Malaysia, Melanesia.

CUSCUTACEAE Dum.

CUSCUTA L.

Cuscuta reflexa Roxburgh, Pl. Corom. 2: 3,t. 104. 1798; FBI 4: 225. 1883; FB 2(2): 863. 1999.

Stem reddish or light to dark brown, branched. Flowers creamy white, sweetly scented in a short lax raceme of upto 12 flowers.

Flowers & Fruits: February – October.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0065***, dated 27.01.2002.
Status: Less Common.
Local Distribution: Found only in Mohurgong & Gulma garden.
General Distribution: India, Sri Lanka, Malaysia.

EHRETIACEAE Lindley

EHRETIA P. Br.

Ehretia acuminata R. Brown, Fl. Nov. Hall. 497. 1810; EFPN 3: 104. 1982.

Medium trees; bark much fissured, greyish-black; lamina oblong, closely serrate, acute to acuminate, nearly glabrous; flowers in terminal panicle, 10 – 17 cm long, white, minute; fruits bilobed, turns yellow on ripening.

Flowers & Fruits: May – September.
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ*** 1138, dated 09.05.2002; Kamalpur TE, ***AP Das & Chandrâ 0622,*** dated 20.04.2002
Status: Common
Local Distribution: All Terai gardens.
General Distribution: Himalayas, Assam, S. Tibet, Myanmar.

ELAEOCARPACEAE DC.

ELAEOCARPUS L.

Elaeocarpus lanceifolius Roxb., Fl. Ind., ed. 2, 1:598. 1832; FBI 1:402. 1872; Ind. Trs. 102. 1906; FEH 1:201. 1966; FB 2(1):170. 1991.

Local Name: *Bhadrase* (Nep)

Tree upto 21 m high. Leaves narrowly elliptic, acute or acuminate, base attenuate, scarcely thin pubescent beneath or usually glabrous, minutely blistered on drying. Racemes usually 10-flowered, whitish. Fruits ovoid to ellipsoid; stone 3-grooved, rugose, one seeded.

Flowers & Fruits: August - October
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2332,*** dated 05.11. 2003
Status: Less common.
Local Distribution: Found only in Tamsong gardens.
General Distribution: E. Himalaya (Nepal-Bhutan), Assam, Myanmar, S. China.
Note: Wood has timber value for house-building, tea-boxes and charcoal boxes.
Fruits edible.

Elaeocarpus sphaericus (Gaertner)Schumann in Engl., Pfl.-fam. 3(6):5. 1890; FEH 1:202. 1966; FB 2(1):168. 1991.
Ganitrus sphaericus Gaertn., Fruct. and Sem. 2:271. Pl. 139, f. 6. 1791.

Local Name: *Rudraksha* (Beng); *Rudrakshay* (Nep).

Trees, 10-20m high, butressed at base, puberulous when young. Leaves oblong-lanceolate, subentire to serrate, acute to acuminate, base cunea, glandular along veins beneath. Recemes whitish flowers. Fruits globose, deep blue, stone 5 grooved, tubercled.

Flowers: May - July *Fruits:* September - December
Specimen Cited: Soom TE, ***AP Das & Chandrâ*** 3175, dated 26.06. 2004.
Status: Sometimes planted.
Local Distribution: Found only in Soom gardens.
General Distribution: Himalayas (Nepal-Sikkim), India, Malaysia.
Note: A sacred plant, usually grown in the compound of the holy places like temple.

ERICACEAE A. Jussieu

GAULTHERA L.

Gaultheria nummularioides D. Don,. Prodr. Fl. Nep. 150. 1825; FBI 3:457. 1882; FEH 1:235. 1966; EFPN 3:55. 1982; TBRI 50 (4):115. 1987; FB 2(1): 391. 1991.

Procumbent, prostrate under shrub with closely branched leafy shoot. Stem brownish, densely hirsute. Leaves alternate, rounded-ovate, margin slightly recurred downwards, entire, ciliate obtuse-acute, base shallowly cordate or rounded, glabrous above, bristly beneath. Flowers axillary, solitary, pinkish white or creamy. Capsule blackish-blue when dry.

Flowers & Fruits: August – March
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2063,*** dated 30.06. 2003
Status: Rare
Local Distribution: Found only in Tamsong garden.
General Distribution: Himalayas (Garhwal-Bhutan), Meghalaya, S. Tibet, N. MyanMarch

RHODODENDRON L.

Rhododendron arboreum Smith, Exot. Bot. 1: 9, t. 6. 1805; FBI 3:465 1882; FEH 1: 237. 1966, 2: 95. 1971; EFPN 3: 56. 1982; TBRI 50 (4): 125. 1987; FB 2(1): 372. 1991.

Local Name: *Lali Guras/ Rato Guras* (Nep).

Large shrub to robust trees upto 15m, bark reddish brown. Leaves clustered at branch tips, elliptic-oblanceolate, entire acute-shortly acuminate, base cuneate, glossy green with deeply impressed viens above, lower surface silvery tomentose. Racemes many flowered, compact. Flowers colours ranging from pinkish white to red. Capsule cylindric and curved, light brown.

Flowers & Fruits: January – October.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2165,*** dated 30.06. 2003
Status: Very common
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Himalayas (Kashmir-Arunachal Pradesh), Meghalaya, S. Tibet.
Note: 1.Important ornamental and firewood plant. Flowers are consumed medicinally for dysentry. Flowers also chewed and swallowed in case fish bones stick at the throat while eating.
2. People prepare a wine called *Gurans ko rakshi* by traditionally fermenting its flowers, which they believe to be antidote to high altitude sickness.

EUPHORBIACEAE A. Jussieu

ANTIDESMA L.

Antidesma acidum Retzius, Obs. Bot. 5: 30. 1788; FB 1(3): 786. 1987.

Deciduous tree, 3 –10m, branchlets glabrous. Lamina membranous, obovate or oblanceolate, acute, cuneate, glabrous or sparsely pubescent on veins, stipules lanceolate. Spikes slender. Fruits 5 –6mm, style terminal.

Flowers & Fruits: April – November
Specimen Cited: Makaibari TE, **AP Das & Chandrâ 1726**, dated 17.05.2003.
Status: Less common
Local Distribution: Found only in Makaibari garden.
General Distribution: Eastern Himalaya, India, Myanmar, China, Java.

BALIOSPERMUM Blume

Baliospermum nepalense Hurus & Y. Tanaka in FEH 1: 174. 1966; FB 1(3): 810.1987.

Erect dioecious undershrub. Lamina broadly ovate, 8-10 cm broad, base truncate, rounded or shallowly cordate, 3 veined, margins coarsely glandular-dentate. Male panicles widely-branched 10-30cm; female spikes 5-25 cm, on peduncles; flowers small.

Flowers: June - August
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0897,*** dated 04.05. 2002.
Status: Less common
Local Distribution: Terai gardens.
General Distribution: Eastern Himalaya.

BREYNIA J. R. & J. G. A. Forster, *nom. cons.*

Breynia retusa (Dennst.) Alston in Ann. R.B.G. peradeniya 11: 204. 1929; FB 1(3): 782. 1987.
Phyllanthus retusus Dennst., Schluss. Hort, Malab. 31. 1818.

Glabrous shrubs, branchlets narrowly winged. Lamina elliptic, obtuse or subacute, base rounded, pale beneath. Male flowers 1-3 per axil, pedicels 2-6mm, slender, deflexed; female flowers solitary on short (1-4 mm) straight pedicel. Fruits subtended by enlarged persistent calyx.

Flowers: May – June
Status: Rare
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ*** 0513, dated 17.04.2003
Local Distribution: All Terai gardens.
General Distribution: Nepal, India, Sri Lanka, Maynmar.
Note: Sap used medicinally to treat eye diseases.

BRIDELIA Willdenow

Bridelia retusa (L.) Sprengel, Syst. Veg. 3:48. 1826; FBI 5: 268.1887; FB 1(3): 769.1987.
Clutia retusa L., Sp. Pl. 1042. 1753.

Local Name: *Gayo, Kuhir* (Nep).

Medium trees; bark grayish-black. Leaves petiolate, alternate; lamina ovate or elliptic-oblong, entire or crenate, obtuse, coriaceous, glabrous. Flowers dioecious, greenish in axillary clusters or in long spikes. Fruits globose, succulent, purplish-black with persistent calyx.

Flowers & Fruits: August – January
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0900,*** dated-04.05. 2002.
Status: Comon
Local Distribution: All Terai gardens.
General Distribution: India, Myanmar, Malaysia and Sri Lanka.
Note: Foliage used as fodder; timber durable; bark used for tannin; fruits edible.

CLEIDION Blume

Cleidion spiciflorum Merrill, Inter. Rumph. Herb. Amboin. 322. 1917; FB 1(3): 803. 1987.
Cleidion javanicum Blume, Biidr. Fl. Ned. Ind. 613. 1827.

Local Name: *Bepari, Hare Bepari* (Nep)


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Evergreen, small tree to 12m. Leaves coriaceous, elliptic, 13 –25 x 5 –11cm, bluntly apiculate or shortly acuminate, cuneate, serrate, discoid glands 4 –6, near base; 2 disc –glands at petiole tip; stipules caducous. Male spikes 6 –25 cm; sepals elliptic, 2 mm. Female flowers pedicellate. Capsules deeply 2 –3 lobed.

Flowers & Fruits: March – June.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2333***, dated 05.11. 2003.
Status: Rare
Local Distribution: Found only in Tamsong garden.
General Distribution: Eastern Himalaya, India, China, Malaysia.

CROTON L.

Croton bonplandianum Baillon in Adansonia 4:339. 1864; FB 1(3): 793.1987.

Erect much-branched annual; stems trichomous. Leaves crowded at branch tips, petiolate; lamina lanceolate, serrate, acute-acuminate, 2-glandular at the base. Flowers greenish white, in terminal mixed raceme; males towards apex; females below. Capsules 3-lobed, stellate-hairy.

Flowers & Fruits: January – December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0449***, dated 05.04. 2002; Kamalpur TE, ***AP Das & Chandrâ 1229***, dated 18.10.2002.
Status: Very common.
Local Distribution: All Terai gardens.
General Distribution: Native to S. America, now pantropical.

DRYPETES Vahl

Drypetes lancefolia Pax & Hoffmann in Engler Plf. Euph. Phyll.-Phyll. 277. 1922; FB 1(3): 785. 1987.

Local Name: *Hare* (Nep).

Tree 10-15 m , leaves thinly coriaceous, ovate-lanceolate, abruptly caudate-acuminate, petioles 2-4 mm. Flowers solitary or few in short racemes. Fruit ellipsoid.

Flowers & Fruits: October – March.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1689***, dated 17.05.2003.
Status: Rare
Local Distribution: Found only in Makaibari garden.
General Distribution: NE India.

EUPHORBIA L.

Euphorbia hirta L., Sp. Pl. 454. 1753; FB 1(3): 766.1987.
Euphorbia pilulifera sensu FBI 5: 250. 1887. *non* L. 1753.
Chamaesca hirta (L.) Millsp in Publ. Field Mus. Bot. 2: 303. 1909; FEH 1:176. 1966.

Erect or decumbent annual, much hispid; stem simple, often dichotomously branched. Leaves opposite, shortly petiolate; lamina elliptic oblong, oblique, dentate or serrulate, acute, cordate. Cyathia in sub-sessile or pedunculate globose heads, greenish, becoming pinkish at maturity.

Flowers & Fruits: January – December.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0057***, dated 27.01.2002; Hansqua TE, ***AP Das & Chandrâ 0215***, dated 09.02.2002; Kamalpur TE, ***AP Das & Chandrâ 1174***, dated 18.10.2002.
Status: Abundant
Local Distribution: All Terai gardens.
General Distribution: A pantropic weed.

Euphorbia heyneana Spreng. In L., Syst. Veg. (ed. 16) 3: 791. 1826.
Euphobia microphylla Heyne *ex* Roth, Nov. Pl. Sp. 229. 1821, *non* Lam., 1788; FBI 5: 252. 1887.

Prostrate, glabrous, spreading herbs; internodes ribbed; leaves opposite, subsessile; lamina obovate to oblanceolate, serrulate, subacute to obtuse, base obliquely rounded; cyathea axillary. Capsule glabrous.

Flowers & Fruits: January – December.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0878,*** dated 04.05. 2002; Hansqua TE, ***AP Das & Chandrâ 1036***, dated 09.05.2002; Kamalpur TE, ***AP Das & Chandrâ 0505***, dated 17.04.2002.
Status: Very common.
Local Distribution: All Terai gardens.
General Distribution: Indo-Malaysia

FLUEGGEA Willdenow

Flueggea virosa (Roxburgh *ex* Willdenow) Voigt, Hort. Suburb. Calcutta 152.1845; ssp. ***virosa***.: FB 1(3): 775.1987.
Phyllanthus virosus Roxburgh *ex* Willdenow, Sp. Pl. 4:578.1805.
Flueggea microcarpa Bl., Bijdr. 580.1825; FBI 5:328.1887.

Local Name: *Darim Pate, Phalame* (Nep).

Small dioecious glabrous shrubs,. Lamina ovate-elliptic to rhomboid or obovate, entire, repand, obtuse/ acute, often mucronate, base cuneate, glaucous beneath. Flowers greenish-yellow in axillary clusters, males many; females 1-5 or more. Fruits depressed globose, fleshy, milky white.

Flowers & Fruits: May – September
Status: Very common.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0890***, dated 04.05. 2002.
Local Distribution: All Terai gardens.
General Distribution: Tropical Africa and Asia, northward to Japan and eastward to Australia and Polynesia.

JATROPHA L.

Jatropha curcas L., Sp. Pl. ed. 1, 1006. 1753; FBI 5: 383. 1887; FEH 1: 179. 1966. FB 1(3): 790.1987.

Local Name: *Sada Bharenda* (Beng); *Poison Nut, Physic Nut* (Eng)

Shrubs, soft wooded, young shoots tomentose; bark papery, yellowish-brown. Lamina ovate, sub-orbicular, palmately 3-5 lobed, acute to shortly acuminate, cordate, glabrous. Male and female flowers greenish yellow on long cymes. Fruits 1.75-2.5 cm long, oblong; seeds ecarunculate.

Flowers & Fruits: May – August
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 0995***, dated 09.05.2002.
Status: Less common
Local Distribution: All Terai gardens.
General Distribution: Pantropic. Possibly a native of Tropical America.
Note: Cultivated as a hedge plant & food plant for silkworms. Sap used by children for bubble blowing, seeds contain a violent purgative and oil used in lamps and the biodiesel.

MACARANGA Thon.

Macaranga denticulata Mull. Arg. in DC., Prodr. 15: 2. 1000. 1866; FB 1(3): 804. 1987.

Local Name: *Malata* (Nep).

Medium trees, 8-12m tall, with rusty pubescent branches. Leaves alternate, broadly ovate, obscurely sinuate-dentate, acute to shortly acuminate, base shallowly cordate or truncete, veins palmately 5-7 at base, glabrous above, densely gland-dotted beneath. Capsules brownish tomentose with persistent styles.

Flowers & Fruits: October - February
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2375***, dated 05.11. 2003
Status: Common; often planted.
Local Distribution: All three hill gardens.
General Distribution: Himalayas (Kumaon-Sikkim).

MALLOTUS Loureiro

Mallotus philippensis (Lamarck) Mueller in Linnaea 34:196.1865; FBI 5:442.1887; FB 1(3): 802. 1987.
Croton philippense Lam., Enc. Meth. Bot. 2:206.1786.

Local Name: Sindure (Nep)

Shrubs or small trees; branchlets tomentose. Lamina ovate/ ovate-lanceolate, entire/ closely toothed, acuminate, glaucous and red-glandular beneath, two glands at petiole tip. Panicles terminal; flowers dioecious; perianth yellowish. Capsules globose, 3- lobed, tomentose, red.

Flowers & Fruits: October – March
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 1549***, dated 22.10. 2002; Kamalpur TE, ***AP Das & Chandrâ 0560***, dated 17.04.2002.
Status: Very common.
Local Distribution: All Terai gardens.
General Distribution: India, Sri Lanka, Myanmar, China, Malay Islands, and Australia.
Note: The red glands from the capsules are used to prepare a red dye.

OSTODES Blume

Ostodes paniculata Bl., Bijdr. 620. 1826; FBI 5: 400. 1887; Man. Ind. Timb. 616. 1902; Ind. Trees 580. 1906, Fl. Asm. 4: 197. 1940; Fl. Meg. 2: 197. 1987; TBRI 50 (4):121. 1987.

Local Name: *Bepari, Sindure* (Nep).

Trees upto 23 m tall, crown dense and spreading. Bark grayish or brownish. Leaves often crowded at branchlet ends, ovate or ovate-elliptic, margin serrate distantly, acuminate, base rounded or rarely oblique, glabrous, dark green above, paler beneath, 3- nerved. Panicles hairy with pinkish-white flowers. Capsules subglobose.

Flowers & Fruits: March - August
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 1984***, dated 30.06. 2003
Status: Rare
Local Distribution: Found only in Tamsong gardens.
General Distribution: Himalayas (Nepal-Bhutan), Assam, Meghalaya, Myanmar, S. China, W. Malaysia.

PHYLLANTHUS L.

Phyllanthus amarus Schumacher & Thonning, Kongl. Danske Vidensk. Selsk. Skr. 4:195.1829.
P. nanus Hook.f. FBI 5: 298.1887.
P. niruri auct.non L. (1753): Muell.-Arg. in DC., Prodr. 15(2): 406.1886

Local Name: *Bhnui-amla* (Beng)

Tall, erect, annuals with stems simple or branched, glabrous. Leaves petiolate, elliptic-oblong, entire, obtuse, minutely apiculate, base obtuse, slightly oblique. Stipules triangular-acuminate. Flowers axillary unisexual on deciduous branchlets. Capsules oblate, smooth; seeds triangular.

Flowers & Fruits: July – January
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0955***, dated 04.05. 2002.
Status: Abundant.
Local Distribution: All Terai gardens.
General Distribution: Probably native to S. America, now pantropical.

Phyllanthus emblica L., Sp.Pl. 982. 1753; FBI 5: 289. 1887; FB 1(3): 772. 1987.
Emblica officinalis Gaertn., Fruct. 122 –123, pl. 108, f. 2. 1790.

Local Name: *Amala* (Nep)

Deciduous trees to 10m, young shoots slender. Leaves appearing with flowers, numerous, distichous, oblong, subacute, glabrous, subsessile; stipules triangular. Male flowers in dense, crowded clusters at base of young leafy shoots, yellow. Female flowers few, sessile, borne above males. Fruits a globose, fleshy, capsules, later spliting into 3 woody 2 –celled vaives, 6 seeded.

*Flowers & Fruits:*March – December.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1704***, dated 17.05.2003.
Status: Very common; generally planted; also wild.
Local Distribution: In all gardens.

General Distribution: Himalayas, Assam, Myanmar, China.

Phyllanthus glaucus Wallich in Hooker f. FBI 5: 288. 1887; FB 1(3): 774.1987.

Erect unarmed shrubs. Lamina ovate or elliptic, acute or obtuse, base rounded, glabrous or pubescent; stipules membranous. Flowers in axillary clusters of 4-12, usually with 1 female per cluster. Fruits fleshy, 3-seeded, bearing stylar remains.

Flowers: April – May
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0925***, dated 04.05. 2002.
Status: Rare
Local Distribution: Found only in Mohurgong & Gulma garden.
General Distribution: Nepal – Bhutan.

Phyllanthus reticulatus Poiret in Lamarck, Enc. Meth. Bot. 5:298. 1804; FBI 5: 288. 1887; FB 1(3): 773 .1987.
Kirganelia reticulata (Poiret) Baillon, Etud. Gen. Euphorb. 613, 614. 1858.

Much-branched glabrous shrubs; branches rambling. Petiole minute; lamina elliptic, obovata, entire, acute, base tapering. Males in axillary fascicles and females solitary, axillary; perianth light yellow. Berries globose, dark purple when ripe.

Flowers & Fruits: May – October..
Status: Less common
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0948***, dated 04.05. 2002.
Local Distribution: In Terai gardens.
General Distribution: India, Myanmar, Bangladesh, Sri Lanka, China, Malayan Islands and tropical Africa.

Phyllanthus simplex Retz., Obs. B. 5: 29. 1789; FBI 5: 295. 1887; FEH 1: 181. 1966.

Annual or perennial glabrous herb with spreading or ascending branches 8-45 cm from woody base; leaves numerous, lanceolate, acute, base rounded, sub sessile, veins not prominent. Flowers 2-4 in axillary fascicles containing both sexes. Capsules globose, minutely warted.

Flowers & Fruits: May – October.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0814***, dated 04.05. 2002; Kamalpur TE, ***AP Das & Chandrâ 1358***, dated 18.10.2002; Tamsong TE, ***AP Das & Chandrâ 2034***, dated 30.06. 2003.
Status: Less common
Local Distribution: In all gardens.
General Distribution: Himalayas, Indo-china, China, Malaysia.

Phyllanthus urinaria L., Sp. Pl. 982. 1753; FBI 5: 293. 1887; FEH 1: 181. 1966; Fl. Nep. 3: 198. 1982; FB 1(3): 772. 1987.

Annual, erect, stems with short branches throughout, young shoots pubescent. Lamina oblong, obtuse or sub acute, margins minutely hispidulous, veins prominent beneath. Flowers 1 –2 of only 1 sex in each axil, males towards apex, sessile; seeds with 12 –15 transverse ridges.

Flowers & Fruits: April – November.

Phyllanthus urinaria L., Sp. Pl. 982. 1753; FBI 5: 293. 1887; FEH 1: 181. 1966; Fl. Nep. 3: 198. 1982; FB 1(3): 772. 1987.

Annual, erect, stems with short branches throughout, young shoots pubescent. Lamina oblong, obtuse or sub acute, margins minutely hispidulous, veins prominent beneath. Flowers 1 -2 of only 1 sex in each axil, males towards apex, sessile; seeds with 12 -15 transverse ridges.

Flowers & Fruits: April – November.
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ*** 1018, dated 09.05.2002.
Status: Abundant
Local Distribution: All Terai gardens.
General Distribution: Pantropical.

Phyllanthus virgatus Forst. f., Fl. Ins. Austrl. Prodr.65.1786.
P. simplex Retz., Obs. Bot. 5:29. 1789; FBI 5: 295.1887; FB 1(3): 772.1987.

Erect or diffuse herbs with glabrous, rarely branched stems. Leaves distichous, linear-oblong, apiculate, base rounded, glaucous beneath. Stipules sagittate, reddish brown. Flowers solitary, axillary and long pedicelled. Capsules trilobed, long stalked, smooth with red-tubercled seeds.

Flowers & Fruits: July – December
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 1286***, dated 18.10.2002; Tamsong TE, ***AP Das & Chandrâ 2103***, dated 30.06. 2003
Status: Less common
Local Distribution: Found in low altitude areas.
General Distribution: India, S. Asia to Pacific Islands.

RICINUS L.

Ricinus communis L., Sp. Pl. 1007.1753; FBI 5:457.1887; FB 1(3): 808.1987.

Local Name: *Reri* (Nep); *Rehrhi* (Beng)

Evergreen short-lived glaucous shrubs; stems fistular, much branched. Leaves alternate, peltate; lamina palmate, 6-12 lobed, glandular, serrate, petiole biglandular at tip. Flowers greenish white, monoecious in terminal panicle. Capsules globose, 3-lobed; seeds oblong, carunculate.

Flowers & Fruits: July – October.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0930***, In all gardens.dated 04.05. 2002.
Status: Common
Local Distribution: In all gardens
General Distribution: Probably native of Africa; cultivated and naturalized in the tropics.
Note: Seed oil used as fuel for lamps and as medicine; seeds poisonous; leaves used for silkworms rearing.

SAUROPUS Blume

Sauropus quadrangularis (Willdenow) Mueller in Linnaea 32:73. 1863; FBI 5:335. 1887; var. ***compressus*** (Mueller) Airy Shaw in Kew Bull. 26:337. 1972; EFPN 3:199. 1982; FB 1(3): 783.1987.
S. compressus Mueller in DC., Prodr. 15 (2):243. 1866; FBI 5:336. 1887; FEH 1:182. 1966.

Evergreen monoecious undershrubs; branchlets compressed, narrowly winged, glabrous. Leaves alternate; lamina elliptic, entire, glabrous or pubescent beneath, minutely stipulate. Flowers dark red, 1-2 (-4) per axil. Fruits globose, subtended by enlarged calyx.

Flowers & Fruits: April – December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0820***, dated 04.05.2002; Hansqua TE, ***AP Das & Chandrâ 1672***, dated 13.11.2002; Kamalpur TE, ***AP Das & Chandrâ 0568***, dated 17.04.2002; Tamsong TE, ***AP Das & Chandrâ 2426,*** dated 05.11. 2003.
Status: Common
Local Distribution: In all gardens.
General Distribution: Himalayas (Nepal - Bhutan), Myanmar.

TRAGIA L.

Tragia involucrata L., Sp. Pl. 980. 1753; FBI 5: 465. 1888; Fl. Nep. 3: 199. 1982.

Shrubby climber, thickly covered with stinging hairs. Lamina ovate-lanceolate, acuminate. Inflorescence axillary, separate monoecious. Fruits deeply 3-lobed.

Flowers & Fruits: May – October.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 1362***, dated 18.10.2002.
Status: Rare
Local Distribution: Found only in Kamalpur garden.
General Distribution: Warmer areas of Indian subcontinent & China.

TREWIA L.

Trewia nudiflora L., Sp. Pl. 1193. 1753; FBI 5: 423. 1887; EFPN 3: 199. 1982; FB 1(3): 779. 1987.

Local Name: *Aule kapase, Pitali* (Nep).

Tree 10-15 m, branchlets wolly. Leaves ovate, acuminate, base truncate or cordate, softly pubescent beneath. Flowers greenish in clusters of 2-3 in male and female racemes. Fruit subglobose , greyish-green.

Foliage used as cattle fodder. Wood soft, used for carving, planking, packing cases and plywood.

Flowers & Fruits: February – July.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 1227***, dated 18.10.2002.
Status: Common
Local Distribution: Terai gardens.
General Distribution: India, Sri Lanka to Thailand, Malaysia, Indonesia.

FABACEAE Lindley

ABRUS Adanson

Abrus pulchellus Wallich ex Thw., Enum. 91. 1859; FBI 2: 175. 1876; FB 1(3): 655. 1987.

Leaves 5-12cm, rachis ending in a fine bristle. Leaflets 6-10 pairs, oblong, obtuse rounded at apex and base, sparsely appressed white pubescent beneath, glabrous above. Flowers purplish. Pods sparsely appressed white pubescent. Seeds oblong, ± compressed brown with a pale coloured aril.

Flowers & Fruits: August – October
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0464***, dated 17.04.2002
Status: Abundant
Local Distribution: All Terai gardens.
General Distribution: Tropical Himalayas, S. E. asia, China; Sri Lanka, Malaysia

ATYLOSIA Wight & Arnott

Atylosia scarabaeoides (L.) Bentham in Miq., Pl. Jungh. 245. 1852; FBI 2: 215. 1876.
Dolichos scarabaeoides L., Sp. Pl. 726. 1753.

Densely hispid herbaceous, annual climber; branches wiry; leaves 3-foliolate; lateral leaflets obliquely ovate, entire, acute, terminal leaflet slightly larger, ovate, acute; racemes small, many flowered; flowers dirty yellow; pods oblong, thickly clothed, transversely constricted.

Flowers & Fruits: September – January.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0501***, dated 17.04.2002.
Status: Abundant
Local Distribution: Terai gardens.
General Distribution: India, Nepal, Bhutan, China, Malaysia, introduce to Africa

BUTEA Roxburgh

Butea monosperma (Lamarck) Taub. In Pfamilien. 3(3): 366. 1894; FB 1(3): 688. 1987.
Erythrina monosperma Lamk., Ency. 1: 391. 1783.

Local Name: Palas (Beng), Mauwa (Nep).

Tree to 20m. Leaves coriaceous, leaflets ovate or rhombic, obtuse or emarginate, base cuneate, brownish pubescent especially beneath. Flowers in dense racemes forming terminal panicles 20-40cm, orange red appearing while almost leafless. Pods densely brownish pubescent.

Flowers & Fruits: February – April
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0895***, dated 04.05. 2002.
Status: Less Common.
Local Distribution: All Terai gardens.
General Distribution: India, Nepal, Bhutan, Sri Lnka, S.E. Asia, Malaysia Note: Excellent host plant for lac insect.

CAJANUS Adanson

Cajanus cajan (L.) Huth in Helios 11: 133. 1893; FB 1(3): 703. 1987.
Cytisus cajan L., Sp. Pl. 739. 1753.
Common Name: Arharh (Beng); Pigeon pea (Eng).
Cultivated for young pods and seeds, eaten raw or boiled. Mature seeds boiled, eaten as dhal. Cultivated as a host plant for lac insect. Thick main stems used for firewood.

Erect grey silky shrub 1-4m, young stems angular. Leaves pinnately trifoliate. Leaflets ovate-elliptic, acuminate, base cuneate, greyish pubescent especially beneath. Racemes 10-20-flowered, 5-15cm, forming leafy panicles, bracts deciduous. Flowers yellow or tinged red. Pods acuminate, grooved obliquely between seeds, 3-6-seeded. Seeds subglobose, compressed, white, red, brown or blackish, almost glossy.

Flowers & Fruits: October – December
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0690***, dated 20.04.2002
Status: Commonly cultivated; also escapes.
Local Distribution: All Terai gardens.
General Distribution: Cultivated in tropical Asia and Africa

CROTALARIA L.

Crotalaria alata D. Don, Prodr. Fl. Nep. 241. 1825; FBI 2:71. 1876; FEH 3: 61. 1975; EFPN 2: 113. 1979; TBRI 50 (4): 110. 1987; FB 1(3): 735. 1987.
C. bialata Schrank, Pl. Rar. Hort. Monac. t. 13. 1819; FEH 1: 146. 1966; 2: 63. 1971.

Pubescent undershrubs ±60 cm high. Lamina elliptic-obovate, acute, mucronate, appressed hairy. Stipules triangular, decurrent on internodes. Racemes ± 5-flowered. Upper calyx teeth broader, brown silky; petals equaling calyx, yellowish. Pods oblong, black on maturity, glabrous.

Flowers: Sep. - Feb.   Fruits.: Dec. - Apr.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0886***, dated 04.05. 2002.
Status: Abundant.
Local Distribution: All Terai gardens.
General Distribution: Himalayas (Kumaon-Bhutan), India, S.E. Asia, China, Malaysia.

Crotalaria cytisoides Roxburgh *ex* DC., Prodr. 2: 131. 1825; FB 1(3): 732. 1987.
Priotropis cytisoides (Roxburgh *ex* DC.) Wight & Arnott, Prodr. 180. 1834; FBI 2: 65. 1876.

Shrubs to 5 m, densely appressed sericeous. Leaflets elliptic, acute or acuminate, base cuneate or attenuate, puberulous beneath; stipules minute, subulate. Racemes 10 –30 flowered, leaf-opposed, sometimes terminal. Calyx broadly campanulate. Corolla yellow. Pods oblong–elliptic, scarcely inflated, finely pubescent; seeds 3 –6, brown.

Flowers & Fruits: July – September
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 1622***, dated 22.10. 2002; Kamalpur TE, ***AP Das & Chandrâ 0728***, dated 20.04.2002; Makaibari TE, ***AP Das & Chandrâ 2522***, dated 11.11. 2003; Soom TE, ***AP Das & Chandrâ 2643***, dated 27.12. 2003; Tamsong TE, ***AP Das & Chandrâ 2281***, dated 05.09. 2003.

Status: Abundant.
Local Distribution: In all gardens.
General Distribution: Himalayas, Khasia Hills, Myanmar, West China

Crotalaria ferrugina Bentham in Hooker, Lond. J. Bot. 2:476. 1843; FBI 2:68. 1876; FEH 1:146. 1966; 2:63. 1971; EFPN 2:113. 1979; FB 1(3):735. 1987; TBRI 50(4):110. 1987.

Annual herbs ±1 m high, pubescent. Stem brownish pubescent. Lamina elliptic-ovate, mucronate, appressed sericeous. Stipules lanceolate. Racemes ±8-flowered, leaf-opposite. Bracts elliptic. Calyx teeth lanceolate, silky; petals equaling calyx, yellow. Ripe pods oblong, glabrous, blackish.

Flowers & Fruits: September – November
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 1330***, dated 18.10.2002.
Status: Rare
Local Distribution: All Terai gardens.
General Distribution: Himalayas (Nepal-Bhutan), India, S.E. Asia, Sri Lanka, China, Malaysia.

Crotalaria pallida Ait., Hort. Kew. 3: 20. 1789; FB 1(3): 732. 1987.

Shrub 1-5m, stems densely appressed sericeous. Leaflets obovate, apex rounded, emarginated and shortly mucronata, base cuneate. Racemes terminal, elongate, c 50-flowered i.e. yellow finely lined with reddish purple. Pods oblong, inflated, ± cylindrical with numerous, reniform seeds.

Flowers & Fruits: September – May.
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1479***, dated 20.10.2002; Kamalpur TE, ***AP Das & Chandrâ 1232***, dated 18.10.2002.
Status: Very common.
Local Distribution: All Terai gardens.
General Distribution: India, Nepal, Bhutan, central and tropical America
Note: Fibre prepared from stems.

Crotalaria retusa L., Sp. Pl. 715. 1753; FBI 2: 75. 1876.

Tall annual herb; stem ribbed; stipules broadly subulate; leaves simple, oblong-ovate, entire, acute; racemes terminal; flowers showy, yellow; pods flaccid, oblong.

Flowers & Fruits: August – October
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1658***, dated 13.11.2002
Status: Less Common.
Local Distribution: All Terai gardens.
General Distribution: India, Nepal, Bhutan

DALBERGIA L.f.

Dalbergia sissoo Roxburgh, Fl. Ind. 3: 223. 1832; FBI 2: 231. 1876; FB 1(3): 652. 1987.

Local Name: *Sissoo* (Nep).

Tree 10-25m. Leaves 10-18cm, rachis ± zigzag, leaflets (3-) 4-6, suborbicular or broadly ovate, abruptly acute or acuminate, base cuneate, appressed pubescent beneath. Panicles axillary, 4-6.5cm, flowers ± sessile, creamy white, bracts caduceus. Pods elliptic.

Flowers & Fruits: March – April
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1446,*** dated 20.10.2002; Kamalpur TE, ***AP Das & Chandrâ 0562,*** dated 17.04.2002.
Status: Abundant.
Local Distribution: All Terai gardens.
General Distribution: Tropical Himalayas, Tropical and sub tropical Africa
Note: Useful timber.

Dalbergia stipulacea Roxburgh in Fl. Ind. 3: 233. 1832; FB 1(3): 653. 1987

Local Name: Lahara Siris (Nep).

Sprawling tree or scandent 17-21, oblong, obtuse base rounded or cuneate, sparsely appressed pubescent beneath. Panicles 8-12cm, branches bearing numerous oblong bracts in lower parts with pale blue flowers. Pods oblong – elliptic, thickened over the solitary seeds.

Flowers & Fruits: April – May.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0566***, dated 17.04.2002.
Status: Common
Local Distribution: All Terai gardens.
General Distribution: India, Nepal, Bhutan, China

DESMODIUM Desv. (*nom. cons.*)

Desmodium heterocarpon (L.) DC., Prodr. 2: 335. 1825; FB 1(3): 674. 1987.
Hedysarum heterocarpon L., Sp. Pl. 747. 1753.

Prostrate or ascending, up to 3 m. Leaves usually 3 foliate, leaflets elliptic or obovate, obtuse or emarginate, base rounded, appressed greyish pubescent beneath; stipels subulate; stipules lanceolate. Racemes elongate, axillary or terminal. Corolla purplish. Pods undulate along lower suture.

Flowers & Fruits: January - December
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1030***, dated 09.05.2002; Kamalpur TE, ***AP Das & Chandrâ 1192***, dated 18.10.2002.
Status: Less Common.
Local Distribution: All Terai gardens.
General Distribution: Himalayas, China, Japan, Sri Lanka, Pacific Islands, Malaysia, Australia

Desmodium laxiflorum DC., Ann. Sci. Nat. Ser. 1(4):100. 1825; FBI 2:164. 1876; FEH1:151. 1966; 3:63. 1975, incl. subsp. *laxiflorum* Ohashi, EFPN 2:118. 1979; TBRI 50(4):111. 1987; FB 1(3):678. 1987.

Undershrubs, branches gray-hairy. Stem angled. Leaves 3-foliate; leaflets ovate-elliptic, acute to long acuminate, appressed pubescent beneath. Stipules triangular. Racemes c.28cm long. Petals longer than calyx, white, standard obovate. Pods densely pubescent with hooked hairs.

Flowers & Fruits: August - January
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1425***, dated 20.10. 2002; Kamalpur TE, ***AP Das & Chandrâ 0503***, dated 17.04.2002; Tamsong TE, ***AP Das & Chandrâ 1978***, dated 30.06. 2004.
Status: Abundant.
Local Distribution: In all gardens.
General Distribution: Himalayas, India, S.E. Asia, China, Malaysia.
Note: Pods sticky on the clothes as well as on the wools of animals.

Desmodium laxum DC. in Ann. Sci. Nat. Paris 4: 102. 1825; FB 1(3): 676. 1987.
Desmodium gardneri Benth. in Miq., Pl. Jungh. 226. 1852 *p.p.*; FBI 2: 165. 1876 *p.p.*

Erect herbs to 150 cm. Leaves 3 foliate, leaflets subcoriaceous, ovate –elliptic, entire, acuminate, rounded or cuneate, sparsely pubescent, lateral veins forming network before reaching margin; stipules ovate –lanceolate. Racemes slender, axillary & terminal. Podsegments 7 –18 x 4 –6 mm.

Flowers & Fruits: January - December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 1598***, dated 22.10. 2002; Hansqua TE, ***AP Das & Chandrâ 0257***, dated 09.02.2002.
Status: Common
Local Distribution: All Terai gardens.
General Distribution: India, Nepal, Bhutan, China, Indo –China, Sri Lanka, Japan

Desmodium multiflorum DC., Ann. Sci. Nat. Ser. 1(4):101. 1825; FEH 2:65. 1971; 3:63. 1975; EFPN 2:118. 1979; TBRI 50(4): 111. 1987; FB 1(3): 676. 1987.
D. floribundum (D. Don) G. Don, Gen. Syst. 2:241. 1832; FBI 2:167. 1876, excl. syn.

Shrubs, upto 2 m high. Leaves 3- foliate, coriaceous; leaflets elliptic-obovate, acute or obtuse, appressed hairy beneath. Stipules lanceolate. Stipels subulate. Racemes upto 10 cm. Corolla upto 0.75cm, purple blue. Fruits 2-3.2cm, undulate at sutures, pubescent, segments upto 8.

Flowers & Fruits: July – November.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 1176***, dated 18.10.2002.
Status: Less Common.
Local Distribution: Found only in Kamalpur garden.
General Distribution: Himalayas (Kashmir-Bhutan), Assam, S.E. Asia, China.
Note: Pods sticky.

Desmodium sequax Wall., PAR 2: 46. t. 157. 1831; FBI 2: 170. 1876; FB 1(3): 677. 1987.
Desmodium sinuatum Blume ex Baker in FBI 2: 166. 1876.

Shrubs, 0.5 –2m. Leaves coriaceous, 3 foliate, rhombic or ovate, acute or acuminate, rounded at base, margins undulate, appressed pubescent; stipels filiform; stipules linear, deciduous. Petals obovate. Pods dividing into 9 –14, ellipsoid segments, densely covered with short hooked hairs.

Flowers & Fruits: January - December
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3577***, dated 12. 10. 2004.
Status: Rare
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Himalayas, S. E. Asia, China, Malaysia, Formosa

Desmodium triflorum (L.) DC., Prodr. 2: 334. 1825; FBI 2: 173. 1876; FB 1(3): 673. 1987.
Hedysarum triflorum L., Sp. Pl. 749. 1753.

Annual, slender, prostrate, diffuse herbs. Leaves 3 foliate; leaflets ovate, emarginate, base broadly cuneate; stipules ovate. Racemes 2 –5 flowered at leaf axils; corolla purplish; pods oblong, 6 –17 x 2 –3 mm, undulate along lower suture, segments 2 –5.

Flowers & Fruits: January - December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0026***, dated 27.01.2002; Hansqua TE, ***AP Das & Chandrâ 1472***, dated 20.10. 2002; Kamalpur TE, ***AP Das & Chandrâ 1270***, dated 18.10.2002; Matigara TE, ***AP Das & Chandrâ 3138***, dated 10.05. 2004; Tamsong TE, ***AP Das & Chandrâ 2160***, dated 30.06. 2003.
Status: Abundant.
Local Distribution: In all gardens.
General Distribution: India, Nepal, Bhutan, S. E. Asia, China, Pacific Islands, Australia, America, Africa

DUMASIA DC.

Dumasia villosa DC., Mem. Leg. 257. t. 44; FB 1(3): 696. 1987.

Twining perennial herb. Leaves pinnately 3-foliate, leaflets ovate, acute or obtuse, mucronata, base cuneate or rounded, ± appressed pubescent. Racemes 5-30-flowered, flowers widely spaced usually in pairs, yellow. Pods ± appressed pubescent with 2-4 seeds, glaucous, blue-black.

Flowers & Fruits: August – September
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2875***, dated 25.03. 2004.
Status: Rare
Local Distribution: Found only in Makaibari garden.
General Distribution: India, Nepal, Bhutan, S. E. Asia, China, Sri Lanka, Malaysia, Africa

ERYTHRINA L.

Erythrina arborescens Roxburgh, Fl. Ind. ed. 2, 3:256. 1832; FBI 2:190. 1876; FEH 1:156. 1966; 3:63. 1975; EFPN 2:120. 1979; TBRI 50(4):113. 1987; FB 1(3): 684. 1987.

Local Name: *Phaledo* (Nep).

Deciduous prickly trees, 8-20m high. Leaflets 3, broadly ovate, acute to shortly acuminate, pubescent beneath. Stipules lanceolate. Racemes 20-30cm long, axillary; appearing with leaves; calyx campanulate, bilabiate; corolla scarlet. Pods oblong-ellipsoid; seeds reniform, blackish.

Flowers: Jul. - Sep. *Fruits*: Oct. - Jan.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2066***, dated 30.06. 2003
Status: Very common.
Local Distribution: All three hill gardens.
General Distribution: Himalayas (Kumaon – Bhutan), Assam, Myanmar, China.
Note: Planted to assist regeneration of vegetation.

Erythrina stricta Roxburgh, Fl. Ind. 3: 251. 1832; FBI 2: 189. 1876;

Local Name: *Phaledo* (Nep), *Madar* (Beng).

Upto 30 m tall trees. Bark deeply furrowed, gray. Prickles conical. Stipule falcate. leaflets 3, rhomboid-orbicular, laterals oblique, acuminate, gabrous. Peduncles 10-15 cm long. Racemes 12-25 cm long. Bracts subulate. Flowers coral-red. Pods spindle-shaped; seeds 2-3, reniform.

Flowers & Fruits: January - June
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1876***, dated 10.06. 2003; Tamsong TE, ***AP Das & Chandrâ 1939***, dated 30.06. 2003.
Status: Common
Local Distribution: In all gardens.
General Distribution: Nepal, India, E. Tibet, Myanmar, Indo-China, China.

GLIRICIDIA Humboldt, Bonpland & Kunth

Gliricidia sepium (Jacquin) Kunth ex Walp., Repert. 1: 679. 1842; FB 1(3): 660. 1987.
Robinia sepium Jacq., Enum. Syst. Pl. 28. 1760.

Tree 3-10m. Leaves 15-25cm, leaflets oblong-ovate, bluntly acute, base rounded often oblique, pubescent beneath on veins otherwise glabrous. Racemes 7-15cm with pinkish – white flowers. Pods on basals stalks.

Flowers & Fruits: February – April
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3189***, dated 26.06. 2004.
Status: Commonly grown for green manure and as ornamental plant.
Local Distribution: In Terai and low altitude areas.
General Distribution: Native of South America; introduced in India.

INDIGOFERA L.

Indigofera hebepetala Baker in FBI 2: 101. 1876; FEH 3:65. 1975; EFPN 2:123. 1979; FB 1(3):666. 1987.

1-2m tall shrubs. Leaves upto 16 cm long, leaflets 5-13, lamina elliptic, obtuse, mucronate, base cuneate, pubescent. Stipules lanceolate. Racemes c.17cm long. Bracts boat-shaped, narrowing to subulate point. Calyx shortly toothed; corolla crimson. Pods straight; seeds 8-10, glabrous.

Flowers & Fruits: May – November.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 1603***, dated 22.10. 2002.
Status: Rare.
Local Distribution: Todey-Tangta, Dhamdhamay Danra, Chouda Feri. 2100-2600m.
General Distribution: Himalayas (Kashmir-Bhutan).

MUCUNA Adans.(*nom. cons.*)

Mucuna macrocarpa Wallich ex Baker in FBI 2:186.1876; FEH 2:67. 1971; EFPN 2:126. 1979; FPK 27. 1981; TBRI 50 (4):120. 1987; FB 1(3):686. 1987.

Local Name: *Baldengra* (Nep).

Woody liana. Branches terete. Leaves 3-foliate; petioles 7-12.5 cm, glabrous; lamina ovate cuspidate, entire, acuminate, glabrous, subcoriaceous. Racemes fascicled on old wood, over 14 cm long. Flowers greenish-white; calyx with brown irritating bristles. Pods upto 30 cm.

Flowers & Fruits: March – September.
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3175***, dated 26.06. 2004.
Status: Rare
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: E. Himalaya (Nepal-Bhutan), India, S. E. Asia, China, Japan.
Note: Seeds crushed and paste is applied to mumps.

Mucuna pruriens (L.) DC., Prodr. 2: 405. 1825; FBI 2: 187. 1876; FB 1(3): 687. 1987.
Dolichos pruriens L. in Stickman, Diss. Herb. Amb. 23. 1754.

Annual or short –lived perennial. Stems silvery pubescent at first. Leaflets elliptic or ovate, acute, rounded at base. Racemes 5 –30 cm, pendent. Calyx appressed silvery pubescent intermixed with some longer fine brown bristles. Corolla dark purple. Pods S shaped, terete, sometimes fleshy; seeds oblong-ellipsoid, blackish, glossy.

Flowers & Fruits: November – June
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0409***, dated 27.02.2002
Status: Very common.
Local Distribution: All Terai gardens.
General Distribution: Himalayas, S. E. Asia, Sri Lanka, Malaysia

PAROCHETUS Buch.-Ham. ex D. Don

Parochetus communis Buch. –Ham.ex D. Don, Prodr. Fl. Nep.: 240. 1825.

Prostrate, perennial, rooting at nodes. Leaflets broadly ovate, subentire, retuse, base cuneate, glabrous above, pubescent beneath; stipules lanceolate. Peduncles longer than petioles, bracts connate in ring. Corolla blue, standard obovate. Pods 15 –20x 3 –4mm, seeds rounded, blackish.

Flowers & Fruits: June - October
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2365***, dated 05.11. 2003.
Status: Very common.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: India, Nepal, Bhutan, S.E. Asia, China, Sri Lanka, Malaysia, Africa

PUERARIA DC.

Pueraria phaseoloides Bentham, J. Linn. Soc. 9: 125. 1867; FB 1(3): 693. 1987 .

Herbaceous twiner, stems and petioles spreading brown hirsute. Leaflets broadly ovate- elliptic with sinuate or lobed margins. Racemes (7-) 25-40cm with purplish flowers. Pods appressed pubescent.

Flowers & Fruits: August – October

Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0928***, dated 04.05. 2002; Kamalpur TE, ***AP Das & Chandrâ 0686***, dated 20.04.2002; Tamsong TE, ***AP Das & Chandrâ 2220***, dated 05.09. 2003.
Status: Abundant.
Local Distribution: All Terai gardens and in lower areas of hill gardens.
General Distribution: India, Nepal, Bhutan, Myanmar, Thailand, Malaysia

SESBANIA Adanson

Sesbania rostrata Bremek & Oberm.in Ann. Transvall Mus. 16: 419. 1935.

Tall annual herbs; leaves pinnate; racemes on lateral branches; flowers yellow; fruits narrowly oblong.

Flowers & Fruits: November – March.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2010***, dated 30.06. 2003.
Status: Rare
Local Distribution: Found only in Tamsong garden.
General Distribution: Himalayas

TEPHROSIA Persoon

Tephrosia candida (Roxb.) DC., Prodr. 2: 249. 1825; FBI 2: 111. 1876; FB 1(3): 659. 1987.
Robinia candida Roxb., Fl. Ind. 3: 327. 1832.

Local Name: *Bun Mara* (Nep)

Stems erect, 2 m, densely brown tomentose. Leaves 10 –25 cm, leaflets elliptic –oblong, narrowly revolute, acute, mucronate or acuminate, base cuneate, sparsely pubescent above, pale sericeous beneath; stipules lanceolate. Standard 2 x 2 cm, wings & keel 20 x 8 mm. Pods sericeous; seeds ellipsoid.

Flowers & Fruits: January – March
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1119***, dated 09.05.2002; Kamalpur TE, ***AP Das & Chandrâ 1256***, dated 10.10.2002; Matigara TE, ***AP Das & Chandrâ 3123***, dated 10.05. 2004.
Status: Abundant.
Local Distribution: All Terai gardens.
General Distribution: India, Nepal, Bhutan, Myanmar, Malaysia

TRIFOLIUM L.

Trifolium repens L., Sp. Pl. 767.1753; EFPN 2:131. 1979; TBRI 50(4): 129. 1987; FB 1(3):731. 1987.

Local Name: *Tin Pattay* (Nep).

Perennial, runners slender herbaceous, rooting at nodes. Stipules oblong- subulate; petioles 3-7 cm, glabrous; leaflets 3, palmate, broadly obovate, denticulate, emarginate, glabrous, pubescent beneath. Heads globose. corolla longer than calyx, white. Pods oblong; 3-4 seeded.

Flowers & Fruits: April – September.
Specimen Cited: Soom TE, ***AP Das & Chandrâ 2668***, dated 09.01. 2004; Tamsong TE, ***AP Das & Chandrâ 2351***, dated 05.11. 2003.
Status: Abundant
Local Distribution: All three hill gardens.
General Distribution: Native of Europe, N. Africa, W. & C. Asia.

URARIA Desveaux

Uraria prunellaefolia Graham in Wallich Cat. n. 5686. ; FB 1(3): 679. 1987

Herbecious, stems 15-30cm, densely pubescent with minute hooked hairs. Leaves 1-foliate, oblong or ovate, acute or obtuse, base rounded or cordate, pubescent especially on veins beneath. Racemes 3-6cm, pods segments 6-7, triangular becoming coiled into a flat circle.

Flowers & Fruits: April – July
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2272***, dated 05.09. 2003.
Status: Rare
Local Distribution: Found only in Tamsong garden.
General Distribution: Himalayas, India, Sri Lanka, SE Asia, China, Malaysia.

Uraria rufescens (DC.) Schindl. in Fedde. Repert. 21: 14. 1925; FB 1(3): 680. 1987.
Desmodium rufescens DC. in Ann. Sci. Nat. Paris 4: 101. 1825.

Shrubs, up to 2 m. Leaves 1 –3 foliate, leaflets ovate elliptic, acute or obtuse, base rounded, entire. Inflorescence lax, bracts ovate, 8 –12 mm, long acuminate, deciduous; calyx 3 –4 mm. Petals 6 –7 mm, purplish. Pod segments 5 –6, rounded, 2 mm diameter, black, tightly folded on each other.

Flowers & Fruits: November – January.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0374***, dated 27.02.2002
Status: Rare
Local Distribution: Found only in Kamalpur garden.
General Distribution: India, Nepal, Bhutan, China, Malaysia

VICIA L.

Vicia angustifolia L., Amoen. Acad. 4: 105. 1759; FEH 1: 165. 1966.
Vicia sativa L., Sp. Pl. 2. 1753.

Annual twiner, glabrous. Leaf rachis ending in a branched tendril, leaflets 3 –6 pairs, linear, elliptic, acute, obtuse or emarginate, mucronate, base cuneate; stipules 5 –9 mm,. Flowers solitary, subsessile. Corolla purplish, standard broadly ovate. Pods leathery; seeds dark brown.

Flowers & Fruits: January - December
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 0096***, dated 03.02. 2002.
Status: Common.
Local Distribution: All Terai gardens.
General Distribution: India, Nepal, Bhutan, Europe, Africa, Australia

VIGNA Savi.

Vigna pilosa Baker in J. D. Hooker, FBI 2: 207.1876; FB 1(3): 700. 1987.

Slender twiner; leaflets usually broader, sparsely hirsute, ovate-lanceolate, acuminate, base rounded. Racemes 3-13cm bearing 10-20 flowers. Pods densely brown hirsute with spreading hairs.

Flowers & Fruits: July – September
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0507***, dated 17.04.2002.
Status: Rare
Local Distribution: Found only in Kamalpur garden.
General Distribution: Tropical and subtropical regions.

FAGACEAE Dumort

CASTANOPSIS Spach

Castanopsis indica (Roxburgh) A. DC. in Journ. Bot. 1: 182. 1863; FBI 5: 620. 1888; Les Chataigners 280. 1929; Fl. Asm. 4: 321. 1940; FEH 1: 49. 1966; FB 1(1): 80. 1983.
Castanea indica Roxb. [Hort. Beng. 68. 1814, *nom. nud.*] Fl. Ind. ed. 2, 3 : 643. 1832.

Local Name: Aulay Katus (Nep.).

Evergreen trees, 5-20m tall with gray, warty and deeply fissured barks. Leaves oblong-elliptic, margins sharply serrate with subulate teeth, acute to acuminate, base cuneate or often rounded, occasionally unequal sided, coriaceous, glabrous above, rusty-tomentose beneath; Spikes in lax panicles, suberect and tomentose. Cupule globose. Nuts ovoid, pubescent.

Flowers & Fruits: February - December
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2860***, dated 25.03. 2004; Soom TE, ***AP Das & Chandrâ*** 3494, dated 12. 10. 2004.
Status: Rare
Local Distribution: All three hill gardens.
General Distribution: Himalayas (Nepal-Arunachal Pradesh), Meghalaya, Myanmar, W. China.
Note: Nuts edible.

LITHOCARPUS Blume

Lithocarpus elegens (Blume) Hatus ex Soepadmo in Reinwardtia 8: 236. 1970; FB 1(1): 80. 1983.
Quercus elegens Blume, Verh. Bat. Gen. K. & W. 9: 208. 1823.

Local Name: *Arkaula* (Nep).

Tree 10-20 m.Leaves coriaceous, elliptic to oblanceolate or obovate, acute or acuminate, base cuneate to rounded or cordate, glabrous, sessile or on petioles up to 1.5 cm. Flowers in clusters in pubescent spikes 8-23cm.

Flowers & Fruits: Mar - July
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2829***, dated 25.03. 2004.
Status: Rare
Local Distribution: Found only in Makaibari garden.
General Distribution: Himalayas, Khasia Hills, Nagaland, China, Malaysia.

FLACOURTIACEAE DC.

CASEARIA Jacq.

Casearia glomerata Roxburgh, Fl. Ind. ed. 2, 2:419.1832; FBI 2:591. 1879; FEH 2:83.1971; FB 2(1): 220.1991.

Shrub or tree to 11m. Leaves entire, elliptic to oblong-elliptic, shortly acuminate, base cuneate, sometimes rounded, crenate- serrulate, often denticulate, glabrous on maturity. Flowers bisexual, yellowish green. Capsule ellipsoidal, yellow-orange.

Flowers & Fruits: April - May
Specimen Cited: Soom TE, ***AP Das & Chandrâ*** 2719, dated 27.01.2004.
Status: Common in low altitude.
Local Distribution: Found in Terai gardens and at Soom.
General Distribution: Himalayas (Punjab-Arunachal Pradesh), India east to China.

FUMARIACEAE DC.

DICENTRA Berntham

Dicentra scandens (D. Don) Walpers, Rep. 1: 228. 1842; FEH 1: 104. 1966; FB 1(2): 382. 1984; FWB 1:200. 1997.
Dielytra scandens D. Don, Prodr. Fl. Nep. 198. 1825.
Dicentra thalictrifolia (Wallich) Hk. f *et* Thoms., Fl. Ind. 1: 273. 1855; FBI 1: 121. 1872.

Herbaceous slender climbing herb with perennial root-stock. Stem flexuous. Leaves decompound, 2-3 ternate; leaflets ovate-elliptic, entire, obtuse or acute, base cuneate, 4-6 nerved. Flowers on short stalked pendulous corymbs, yellow. Capsules narrowly ovoid-ellipsoid; Pericarp membranous or nearly fleshy.

Flowers & Fruits: June – October.
Specimen Cited: Soom TE, ***AP Das & Chandrâ*** 3453, dated 12. 10. 2004.
Status: Common
Local Distribution: Found in Soom & Tamsong gardens.
General Distribution: E. Himalaya (Nepal-Bhutan), Meghalaya, Myanmar, W. China.
Note: An important folk medicine.

GESNERIACEAE Dumort

AESCHYNANTHES Jack

Aeschynanthus sikkimensis (C.B.Clarke) Stapf in B. Mag. 148: t. 8938. 1922; FEH 1: 297. 1966; EFPN 3: 133. 1982; 2(3): 274. 2001.
Aeschynanthus maculatus var. *sikkimensis* C.B. Clarke in DC., Monogr. Phan. 5: 24. 1883.

Shrub c1m. Stems spreading, laxly branched. Leaves opposite, fleshy, elliptic, long acuminate, base cuneate, margins entire. Flowers scarlet, several, clustered at tip of stem.

Flowers & Fruits: May – July
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 3001***, dated 10.04.2004.
Status: Less Common.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution:Eastern Himalaya, Khasia Hills.

DIDYMOCARPUS Wallich

Didymocarpus pulcher C.B. Clarke in DC., Mongr. Phan. 5: 79. 1883; FBI 4: 348. 1884; FEH 3: 105. 1975.

Peberulous annual, branches few, long, weak, brown at nodes. Lamina oblong-elliptic, incised-serrate, coriaceous, whitish below. Bracts foliaceous. Calyx & corolla brown. Capsule stalk longer than calyx.
Flowers & Fruits: July – October
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2971***, dated 10.04. 2004.
Status: Less Common.
Local Distribution: Found only in Tamsong garden.
General Distribution: Eastern Himalaya.

LOXOSTIGMA Clarke

Loxostigma kurzii (Clarke) Burtt. in NRBGE 34: 104. 1975.
Didymocarpus kurzii Clarke Comm. & Cyrt. Beng. 96, t. 66. 1874.
Chirita kurzii (Clarke) Clarke in J. Lin. Soc. Bot. 15:145. 1876; FBI 4: 358. 1884.

Small villous herb; branches sub-erect, 20-40 cm tall. Lamina elliptic-lanceolate, serrate, acuminate, cuneate, pubescent. Peduncles flowered. Bracts elliptic. Calyx divided to free lanceolate lobes; corolla funnel-like, purplish, lower lip yellow marked, throat purple spotted. Capsule linear.

Flowers & Fruits: July - November
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3427***, dated 12.10.2004.
Status: Less common
Local Distribution: Found only in Soom & Tamsong gardens.

General Distribution: E. Himalaya (Nepal – Bhutan), N. Myanmar, W. China.

RHYNCHOGLOSSUM Blume

Rhynchoglossum obliquum Blume, Bijdr. 471. 1826; FBI 4:367. 1884; FEH 1:299. 1966; EFPN 3:135. 1982; TBRI 50(4):125. 1987.
R.. obliquum var. *β. parviflora* Clarke in DC., Monogr. Phaner. 5:162. 1883; FBI 4:367. 1884.

Scabrid, succulent, erect annual herb, 20-40cm. Stem transluscent, nodes swollen. Leaves alternate, elliptic, entire, acuminate, base unequally cordate. Racemes many, upto 16cm with many bluish flowers. Capsules ellipsoid, included.

Flowers & Fruits: August – December
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3363***, dated 12.10.2004.
Status: Less common
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Himalayas (Garhwal-Arunachal Pradesh), India, Sri Lanka, Myanmar, W. & S. China, Malaysia.

HAMAMELIDACEAE R. Brown

EXBUCKLANDIA R. Brown

Exbucklandia populnea (Griffith) R.W. Brown in J. Wash. Acad. Sci. 36: 348. 1946; FEH 2:49. 1971: EFPN 2:166. 1979; FB 1(3):470. 1987; TBRI 50 (4): 114. 1987.
Bucklandia populnea Griff. in Asiat. Res. 19: 95, t. 13 &14. 1836; FBI 2: 429. 1878.
Cymingtonia populnea (R. Brown *ex* Griffith) Van Steenis in Act. Bot. Neerl. 1:144. 1952; FEH 1: 118. 1966.

Local Name: *Peepli* (Nep).

Large evergreen tree, glabrous. Leaves alternate, obovate-oblong, ovate-cordate, entire, acuminate, base truncate or shallowly cordate, glabrous, 5-veined at base. Flower heads 2-4 in each axil, many flowered, polygamous. Capsules in compact heads, sub-globose, woody.

Flowers: April - May *Fruits:* June - August to year ahead.
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3413***, dated 12.10.2004; Tamsong TE, ***AP Das & Chandrâ 3033,*** dated 10.04. 2004.
Status: Commonly planted for its timber.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: E. Himalaya (Nepal-Bhutan), Assam, Manipur, W. China, N. Myanmar, Thailand, Malaysia, Sumatra.

HYPERICACEAE A. Jussieu

HYPERICUM L.

Hypericum hookerianum Wight & Arnott, Prodr. Fl. Ind. Or. 1: 99. 1834; FBI 1: 254. 1874, p.p.; EFPN 2: 61. 1979; FB 1(2): 375. 1984; FI 3:64. 1993; FWB 1:264. 1997.

H. patulum auct. non. Thunb. *ex* Murray; Prodr. Fl. Nep. 218. 1825.

Local Name: *Mehandi Phool* (Nep).

Small bushy shrub. Branches terete, hollow, slightly pendent. Leaves distichous, sessile, very shortly stalked, thick and comparatively large, lanceolate to narrowly ovate, entire, subacute, sparsely hairy above and indistinctly superficial-glandular beneath. Flowers in terminal clusters. golden yellowish.

Flowers & Fruits: June – December.
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3227***, dated 26.06. 2004.
Status: Rare.
Local Distribution: Found only in Soom garden.
General Distribution: E. Himalaya (Nepal-Bhutan), Meghalaya, Mishmi Hills.

Hypericum japonicum Murray, Syst. Veg. ed. 14: 702. 1784; FBI 1:256. 1874; EFPN 2:62. 1979; FI 3:69. 1993; FB 1(2): 376.1984.

Annual erect or decumbent herbs, 8-30 cm long; stem quadrangular, dichotomously branched. Leaves sessile, lamina elliptic-ovate or oblanceolate, obtuse or rounded, cordate. Flowers in monochasia with persistent sepals and yellow petals. Capsules ovoid.

Flowers: Almost year round. *Fruist:* October - February.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0318***, dated 16.02.2002; Hansqua TE, AP Das & Chandrâ 0121, dated 03.02.2002; Kamalpur TE, AP Das & Chandrâ 0521, dated 17.04.2002; Makaibari TE, AP Das & Chandrâ 1779, dated 17.05.2003; Soom TE, ***AP Das & Chandrâ 3191***, dated 26.06. 2004.
Status: Abundant.
Local Distribution: In all gardens.
General Distribution: Subtropical and temperate Himalayas; West Bengal, Sikkim, Orissa, Meghalaya, Assam; Myanmar, Bangladesh, New Zealand, Australia, Japan and China.

Hypericum uralum Buch. –Ham. ex D. Don in Sims, Bot. Mag. t. 2375. 1823; FI 3: 77. 1993; FB 1(2): 375. 1984.
Hypericum patulum auct. non Thunberg ex Murray; Wallich ex Dyer in FBI 1: 254. 1874.

Bushy shrub, branchlets numerous spreading, compressed and 4 – winged or ribbed. Leaves ovate lanceolate, acute, cuneate, sessile, glaucous – white beneath with blackish gland-dots. Cymes 3 –5 flowered; sepals obovate, obtuse, petals asymmetrically obovate; ovary subglobose.

Flowers & Fruits: June - December
Specimen Cited: Soom TE, ***AP Das & Chandrâ 0358***, dated 12. 10. 2004.
Status: Less common.
Local Distribution: All three hill gardens.
General Distribution: Himalayas, Khasia Hills, Myanmar, Malaysia.

ICACINACEAE Miers

NATSIATUM Arnott

Natsiatum herpeticum Arnott in Edinb. New Philos. J.16:314.1834; FBI 1: 595. 1875; FEH 1:191. 1966; EFPN 2: 87. 1979; FB 2(1): 135.1991.

Extensive woody climber; shoots strigose. Lamina broadly ovate, acuminate, coarsely dentato-serrate, palmately 7-9 veined at base. Flowers pale green in pendulous racemes. Females similar to males excepting with reduced to staminodes, 2-3 lobed styles. Drupes ovoid, 1-seeded.

Flowers & Fruits: November – April
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0352***, dated 16.02.2002; Hansqua TE, ***AP Das & Chandrâ 0091***, dated 03.02.2002; Kamalpur TE, ***AP Das & Chandrâ 0653***, dated 20.04.2002.
Status: Endemic to the Eastern Himalaya and Assam.
Local Distribution: All Terai gardens
General Distrib: E. Himalaya (Darjeeling-Sikkim), Assam, Meghalaya, Nepal, Bangladesh, Myanmar, China, Thiland.

JUGLANDACEAE A. Rich. *ex* Kunth.

ENGELHARDIA Leschen.

Engelhardia spicata Leschen. *ex* Bl., Bijdr. 528. 1826; FBI 5: 595. 1888; TBRI 50 (4):113. 1987.

Local Name: *Mauwa* (Nep).

Large deciduous trees to 20-32 m tall, base sometimes buttressed. Bark peeling off in small flakes, gray or grayish-brown, rough. Leaflets 4-13, sub-opposite, oblong- oblanceolate or oblong-elliptic, margin almost entire, acute to shortly acuminate, base rounded oblique, pubescent beneath but ultimately glabrate. Catkins pendulous. Fruiting catkins with nut-like, globose fruits, bristly hairy pale brown on maturity.

Flowers & Fruits: November - May
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1881,*** dated 10.06. 2003; Tamsong TE, ***AP Das & Chandrâ 2308,*** dated 05.09. 2003.
Status: Common
Local Distribution: All three hill gardens.
General Distribution: Himalayas (Nepal-Bhutan), Assam, S. Tibet, east to W. Chinam Malaysia.

LAMIACEAE Lindley, *nom. alt.*
[LABIATAE A. Jussieu, *nom. cons.*]

ACHYROSPERMUM Blume

Achyrospermum wallichianum Bentham ex Hooker f., FBI 4: 673. 1885; 2(2): 967.1999.

Stems 28 –100cm, pubescent to glabrescent. Leaves elliptic –ovate, shortly acuminate, base cuneate with lamina extending along petiole, margins serrate, upper surface appressed pilose, lower surface pubescent on veins, otherwise glabrous. Flowers white with pink markings, pink or pale purple.

Flowers & Fruits: October – January.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2496,*** dated 11.11. 2003
Status: Less Common.
Local Distribution: All three hill gardens.
General Distribution: Eastern Himalaya, Assam, Myanmar.

AJUGA L.

Ajuga lobata D. Don, Prodr. Fl. Nep. 108. 1825; FBI 4 702. 1885; FEH 1: 271. 1966; 2: 113. 1971; 3:92. 1975; EFPN 3:149. 1982.

Prostrate aromatic perennial herbs; rooting at nodes, brown, softly hairy. Lamina broadly oblong, sinuate-lobed, cordate, white hairy, deep brown beneath. Bracts oblong, dentate. Flowers in lax, axillary whorls, lilac, violet; calyx teeth lanceolate; upper corolla lip violet; fruiting calyx tubular.

Flowers: Apr. - Jun. *Fruits.*: Jun. - Sep.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2276,*** dated 05.09. 2003; Soom TE, ***AP Das & Chandrâ 2681***, dated 09.01. 2004; Makaibari TE, ***AP Das & Chandrâ 2793***, dated 25.03. 2004;
Status: Common
Local Distribution: All three hill gardens.
General Distribution: Himalayas, India, Tibet, Myanmar, S. W. China.

Ajuga macrosperma Wallich *ex* Bentham in Wallich, Pl. As. Rar. 1:58. 1830. var. ***breviflora*** Hook. f. , FBI 4: 704. 1885; FEH 1:271. 1966; 2:113. 1971; EFPN 3: 149. 1982.

Perennial small prostrate herbs. Branches slender, decumbent, villous. Lamina ovate-oblong, sinuate-crenate, hairy, subcordate; young lamina violet beneath. Spikes terminal, whorls interrupted. Bracts ovate. Calyx obconic, teeth short; corolla base inflated. Nutlets deeply pitted.

Flowers: May – Jul *Fruits*: June - Sep.
Specimen Cited: Soom TE, ***AP Das & Chandrâ 2689,*** dated 09.01.2004; Tamsong TE, ***AP Das & Chandrâ 3092***, dated 10.04. 2004.
Status: Very common.
Local Distribution: All three hill gardens.
General Distribution: E. Himalaya (Nepal-Arunachal Pradesh).

ANISOMELES R. Brown

Anisomeles indica (L.) O. Kuntze, Rev. Gen. Pl. 2:512.1881; FB 2(2): 967.1999.
Nepeta indica L., Sp. Pl. 571. 1753.
Anisomeles ovata R. Br. in Ait., Hort. Kew. (ed.2) 2:364.1811; FBI 4: 672.1885.

Tall, erect herbs; villous-pubescent. Lamina ovate/ broadly ovate, acute or acuminate, serrate-crenate, sparsely hairy to densely villous-pubescent. Flowers sessile or shortly pedicillate in axillary verticel, yellow or greenish-white with red or purple markings.

Flowers & Fruits: September – February
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0763***, dated 04.05. 2002; Kamalpur TE, ***AP Das & Chandrâ 1339***, dated 18.10.2002.
Status: Common
Local Distribution: All Terai gardens.
General Distribution: India, Bangladesh, Sri Lanka, Malayan Archipelago, China, and the Philippines.

CLINOPODIUM L.

Clinopodium piperitum (D. Don) Press. in EFPN 3: 150. 1982.
Thymus piperitus D. Don, Prodr. Fl. Nep. 112. 1825.

Annual; branches slender; lamina rounded-ovate, serrate, acute, densely pubescent; verticillaster lax, few flowered; corolla pink.

Flowers & Fruits: June - October
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2379***, dated 05.11. 2003.
Status: Rare.
Local Distribution: Found only in Tamsong garden.
General Distribution: India, Nepal, Bhutan, Pakistan

Clinopodium umbrosum (M.-Bieb.) C. Koch in Linnaea 21: 673. 1848; FEH 1: 272. 1966; 2: 114. 1971; 3: 92. 1975; EFPN 3: 150. 1982.
Melissa umbrossa M.- Bieb., Fl. Taur. Cauc. 2: 63. 1808.
Calmintha umbrosa (M.-Bieb.) Fisch. & Mey., Ind. Sem. Hort. Petrop. 6:6. 1840; FBI 4: 650. 1885.

Procumbent annual aromatic slender herbs, slightly woody base; nearly unbranched above. Lamina ovate, dentate, subacute, pubescent. Verticillaster dense, globose, pubescent. Flowers purple; calyx 13 nerved, bilipped; corolla throat villous; stamens included; Nutlets subglobose.

Flowers & Fruits: June - October
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2228,*** dated 05.09. 2003; Soom TE, ***AP Das & Chandrâ 3508***, dated 13.10.2004.
Status: Less common
Local Distribution: In all gardens
General Distribution: Iran, Afganistan, Pakistan, Himalayas (Kashmir-Bhutan), India, Myanmar, Tibet, China.

COLEBROOKIA Sm.

Colebrookea oppositifolia Sm., Exot. B. 2: 111, t. 115. 1805; FBI 4: 642. 1885; FEH 1: 272. 1966; EFPN 3: 151. 1982; 2(2): 990.1999.

Local Name: *Dosro, Chusre* (Nep)

Shrub 1.5 –3m, softly pubescent throughout, often sericeous on young growth. Leaves elliptic to ovate –elliptic, acuminate, base cuneate, margin crenulate to serrulate, whitish tomentose beneath. Flowers whitish in spikes, arranged in panicle, becoming dull pink and plumose in fruit.

Flowers & Fruits: December –February
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2087,*** dated 30.06. 2003
Status: Common
Local Distribution: In Terai and low altitude areas.
General Distribution: India, Nepal, Bhutan, Myanmar, China, Indo –China

CRANEOTOME Reichb.

Craneotome furcata (Link.) O. Kuntze, Rev. Gen. Pl. 2:516. 1891; EFPN 3:152. 1982; TBRI 50(4):110. 1987.
Ajuga furcata Link., Enum. Pl. H. Berol. 2: 99. 1822.
A. versicolor Reichb., Icon. Exot. 1:39. 1824; FBI 4:672. 1885; FEH 1:273. 166; 3:92. 1975.

Much branched, erect, hispid herb, 20-55 cm, with small perennial root-stock. Leaves broadly ovate-cordate, crenate, acuminate, densely hipid. Cymes in dense terminal panicles with mauve-purple flowers. Nutlets minute, subglobose, shiny.

Flowers & Fruits: July – December.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 1997***, dated 30.06. 2003.
Status: Common
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: W. Pakistan, Himalayas (Kashmir-Bhutan), Myanmar, S. W. China.

ELSHOLTZIA Willdenow

Elsholtzia blanda (Bentham) Bentham, Lab. Gen. Sp. 162. 1833; FBI 4:643. 1885; FEH 1: 273. 1966; EFPN 3:152. 1982; TRBI 50(4):113. 1987.
Aphanochilus balndus Bentham in Wallich, Pl. As. Rar. 1:29. 1830.

Suffrutescent, slender, strongly aromatic undershrubs, 55-110cm, pubescent, scarcely branched. Leaves elliptic-lanceolate, serrate, acuminate, base narrowed, puberulous above, gland-dotted beneath. Spikes terminal and short lateral branches, panicled, secund. Flowers sessile, white. Nutlets minute, ellipsoid.

Flowers & Fruits: September – February.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2254***, dated 05.09. 2003.
Status: Common
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Himalaya (Nepal-Bhutan), Assam, Myanmar, China, Malaysia.

HYPTIS Jacquin, *nom. cons.*

Hyptis suaveolens (L.) Poiteau, Ann. Mus. Hist. Nat. Paris 7:472, t. 29. f. 2. 1806; FBI 4: 630. 1885; FB 2(2): 990. 1999.
Ballota suaveolens L., Syst. ed. 10:1100.1759.


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Local Names: *Gande Jhar* (Nep); *Bon Tulsi* (Beng)

Annual, erect, strongly aromatic; stems 4-angled, hispid. Lamina broadly ovate, serrulate, acuminate, base cuneate, sparsely pilose above and densely pubescent beneath. Flowers blue in lax 2-5-flowered second cymes in the axils of smaller leaves. Nutlets ovoid, flat, brown.

Flowers & Fruits: August – January
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0968***, dated 04.05. 2002.
Status: Common
Local Distribution: All Terai gardens.
General Distribution: Naturalized in India, tropical Asia; native of tropical America.

ISODON (Schrad. ex Bentham) Kudo

Isodon coetsa (Buch.-Ham. *ex* D. Don) Kudo in Mem. Fac. Sci. Agr. Taihoku Univ. 2: 113. 1929; FEH 1: 275. 1966; 2(2): 998.1999.
Plectranthus coetsa Buch.-Ham. ex D. Don, Prodr. Fl. Nep. 117. 1825; FBI 4: 619. 1885.

Perennial herb or subshrub. Stems branched pubescent. Leaves broadly ovate to narrowly ovate, base truncate –cuneate, or rounded –cuneate, apex acuminate, margins crenate –serrate, both surfaces densely pilose. Flowers purple or purple –blue in narrowly paniculate cymes, 2 –7 flowered terminal and axillary.

Flowers & Fruits: August –November

Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2376,*** dated 05.11. 2003; Soom TE, ***AP Das & Chandrâ 3364***, dated 12.10.2004.
Status: Abundant
Local Distribution: All three hill gardens.
General Distribution: India, Sri Lanka, Myanmar, China.

LEUCAS R. Brown

Leucas indica (L.) R. Brown *ex* Vatke in Oesterr. Bot. Zeits. 25:95.1875; FB 2(2): 963.1999.
Leonurus indicus L., Syst. ed. 10:1101.1760.
Leucas linifolia (Roth) Sprengel, Syst. 2:743.1825; FBI 4: 690.1885.

Local Name: *Dandakalash* (Beng)

Erect, much branched annual; stems 4-gonous. Leaves sessile, opposite; lamina linear-lanceolate, entire, membranous, apex and base narrowed, both surfaces pubescent. Bracts subulate; verticillasters upto 1.5 cm in diameter; flowers many; corolla 2-lipped, white. Nutlets black.

Flowers & Fruits: August – February
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0075***, dated 27.01.2002; Hansqua TE, ***AP Das & Chandrâ 0247***, dated 09.02. 2002; Kamalpur TE, ***AP Das & Chandrâ 1268***, dated 18.10.2002; Matigara TE, ***AP Das & Chandrâ 3625***, dated 20.10.

2004; Soom TE, ***AP Das & Chandrâ 3582***, dated 12.10. 2004; Tamsong TE, ***AP Das & Chandrâ 2393***, dated 05.11. 2003.
Status: Very common.
Local Distribution: In all gardens.
General Distribution: The plains of India, Bangladesh, Sri Lanka, Myanmar, Malayasia, China, Nepal.

Leucas mollissima Wallich *ex* Bentham in Wallich, Pl. As. Rar. 1: 62. 1830; FBI 4: 682. 1885; FB 2(2): 962. 1999.

Perennial herbs, branches ascending, slender, to 120 cm, densely appressed retrorsely hairy. Lamina ovate –oblong, serrate, acute, base cuneate. Verticillasters distant, in leaf axils. Calyx apex straight; teeth 10, triangular. Corolla white, annulate; upper lip 4 mm.

Flowers & Fruits: April – December.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2944,*** dated 10.04. 2004; Makaibari TE, ***AP Das & Chandrâ 2513,*** dated 11.11. 2003
Status: Less common
Local Distribution: Found only in Makaibari & Tamsong gardens.
General Distribution: India, Nepal, Bhutan, China, Sri Lanka, Myanmar

LEUCOCEPTRUM Smith

Leucoceptrum canum Smith, Exot. Bot. 2: 113. t.116. 1805; FBI 4:699. 1885; FEH 1:278. 1966; 2:115. 1971.

Local Name: *Ghurpis* (Nep).

Small trees to 10 m tall. Bark greyish. Branches horizontal, densely tomentose. Lamina elliptic-lanceolate, crenate-serrate, acute, coriaceous, grey tomentose beneath, Spikes cylindric, terminal. Bracts oblong. Flowers dull white or yellowish white; corolla exceeding calyx; stamens exerted. Nutlets obovoid.

Flowers & Fruits: January - April.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2513***, dated 11.11. 2003; Tamsong TE, ***AP Das & Chandrâ 2944***, dated 10.04. 2004.
Status: Common.
Local Distribution: All three hill gardens.
General Distribution: Himalayas (Kumaon – Bhutan), Assam, Myanmar, S. W. China.
Note: Corolla stores sweet juice.

NOTOCHAETE Bentham

Notochaete hamosa Bentham in Wallich, Pl. As. Rar. 1:63. 1830; FBI 4:694. 1885; FEH 1: 279. 1966; 2: 116. 1971; 3: 94. 1975; EFPN 3: 159. 1982.

Erect, small suffrutesent herbs, thinly pubescent, stem 4-angled, stout. Lamina broadly ovate, toothed, acuminate, white hairy. Verticillaster axillary, c.3.5cm in diam., many flowered, spiny. Bracts slender. Calyx tube teeth spinous, hooked; corolla white. Nutlets oblong, narrow, smooth.

Flowers & Fruits: July – November.

Specimen Cited: Soom TE, ***AP Das & Chandrâ 3370***, dated 12. 10. 2004.
Status: Rare
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: E. Himalaya (Nepal – Bhutan), India, Myanmar.

PLECTRANTHUS L'Herit.

Plectranthus barbatus Andr., Bot. Rep. 9: t. 594. 1809; FB 2(2): 993. 1999.

Semi –succulent herb with fleshy root stock. Stems 25 –80cm, lanate –villose often branched near base. Leaves ovate to elliptic, base cuneate to attenuate, apex acute to obtuse, margin crenate –serrate, both surfaces villose. Flowers blue-purple, rarely white in long lax spike.

Flowers & Fruits: August – December.
Specimen Cited: Tamsong TE, *AP Das & Chandrâ 2424*, dated 05.11. 2003.
Status: Rare
Local Distribution: Found only in Tamsong garden.
General Distribution: Himalayas, India, Myanmar, Malaysia.

Plectranthus gerardianus Bentham in Wallich, Pl. As. Rar. 2: 17. 1831; FBI 4: 617. 1885; FB 2(2): 996. 1999.

Perennial herb, upto 150cm with stems erect to ascending slender, distinctly quadrangular, white tomentose. Leaves larger, ovate, serrate –dentate margin, more attenuate base and longer petioles. Flowers white, pink or mauve with purple or crimson marking.

Flowers & Fruits: September – December.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2369,*** dated 05.11. 2003.
Status: Very common.
Local Distribution: All three hill gardens.
General Distribution: India, Nepal, Bhutan, China, Indo –China, Myanmar

Plectranthus rugosus Wallich ex Bentham in Wallich, Pl. As. Rar. 2: 17. 1831; FBI 4: 620. 1885; FB 2(2): 997. 1999.

Aromatic, bushy shrub 1 –2m. Stems much branched. Leaves ovate to oblong –ovate, base cuneate to rounded, apex acute to rounded, margin crenulate –serrulate, densely white dendroid tomentose on lower surface. Flowers white tinged with pink, lilac or pale blue in terminal and axillary panicles.

Flowers & Fruits: September – January.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 1368,*** dated 18.10.2002.
Status: Very common.
Local Distribution: All Terai gardens.
General Distribution: India, Nepal, Bhutan, China, Afghanistan, Pakistan

POGOSTEMON Desf.

Pogostemon andersoni (Prain) Panigrahi in Phytologia 32: 479. 1976; FB 2(2): 985. 1999.
Dysophylla andersoni Prain in JASB 59: 298. 1891.

Small herb, 8 –15cm. Stems erect, appressed pubescent. Leaves lanceolate or oblong lanceolate, acute, margins entire, appressed pubescent. Spikes softly pubescent.

Flowers & Fruits: December – March.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 1195***, dated 18.10.2002.
Status: Common
Local Distribution: All Terai gardens.
General Distribution: India, Nepal, Myanmar.

Pogostemon benghalensis (Burman f.) O. Kuntze, Rev. Gen. Pl. 2: 529. 1891; FB 2(2): 987.1999.
Origanum benghalense Burm.f., Fl. Ind. 128. t. 38. f.e. 1768.
Pogostemon plectranthoides Desf. in Ann. Mus. Natl. Hist. Nat. 2: 155.t.6. 1803; FBI 4: 632. 1885.

Undershrubs, to 3 m, erect, stout, branched, glabrescent, often dark purple. Lamina ovate, doubly serrate, acuminate, base truncate or cuneate. Spikes subsecund, pubescent, panicle; bracts ovate. Calyx teeth narrowly triangular. Corolla pink or white. Nutlets ellipsoid.

Flowers & Fruits: January – March.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1767,*** dated 17.05.2003.
Status: Less common
Local Distribution: Found in low altitude areas.
General Distribution: Himalayas, India.

PRUNELLA L.

Prunella vulgaris L., Sp. Pl. ed. 1: 600. 1753; FBI 4: 670. 1885; FEH 1: 281. 1966; 2: 117. 1971; 3: 95. 1975; EFPN 3: 162. 1982.

Small, erect, suffrutescent hispid herb. Root-stock creeping. Upper leaves sessile; lamina ovate, dentate-ciliate, rounded-acute. Spike compact, 1-2.8cm, cylindric. Bracts ovate-cordate. Flowers deep purple; calyx reticulate, teeth variable; stamens 4, exerted. Nutlets oblong, smooth.

Flowers & Fruits: September – March.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2107***, dated 30.06. 2003
Status: Abundant.
Local Distribution: In all gardens.
General Distribution: All over Europe and Temperate Asia.

SALVIA L.

Salvia coccinea Buc'hoz ex Etl., Comm. Bot. Med. Salvia 23. 1777; FB 2(2): 975. 1999.

Erect herb with stems 40 –100cm and leaves ovate to triangular –ovate, acute, base truncate to cordate, serrulate, pubescent. Flowers scarlet to deep red in distant 2 –8 flowered verticillasters.

Flowers & Fruits: October – March.
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3326***, dated 26.06. 2004.

Status: Cultivated ornamental; often escapes.
Local Distribution: Rare as escape. Found only in Soom garden.
General Distribution: Native of South America.

SCUTELLARIA L.

Scutellaria violacea Heyne ex Bentham in PAR1: 66. 1830; FBI 4: 668. 1885; FB 2(2): 951. 1999.

Decumbent herb with stems upto 68cm, pubescent with longer hairs. Leaves distributed along stem, ovate –ovate elliptic, acute or obtuse, base rounded to cordate, margin clearly serrulate or serrate –crenate, both surface hairy. Flowers blue –violet, or mauve, always opposite in verticillasters arranged in lax spike.

Flowers & Fruits: August – November.
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3183***, dated 26.06. 2004.
Status: Less common
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: India, Nepal, Bhutan, Sri Lanka

LAURACEAE A. Jussieu

ACTINODAPHNE Nees

Actinodaphne obovata (Nees) Blume Mus. B. Lugd.–Bat.1: 342. 1851; FBI 5: 153. 1886; EFPN 3: 182. 1982; FB 1(2): 280. 1984.
Tetradenia obovata Nees in Wallich, Pl. As. Rar. 2: 64. 1831.

Local Name: *Runchey, Runchey kath, Runchepat* (Nep)

Tree to 20m. Young stems red –brown tomentose. Leaves drooping, obovate, acute or apiculate, base cuneate, glaucous and thinly pubescent beneath. Flowers in male panicles and female panicles. Fruits ellipsoid, born on enlarged perianth cup.

Flowers & Fruits: March – May.
Specimen Cited: Soom TE, **AP Das & Chandrâ 3546**, dated 12.10.2004.
Status: Common
Local Distribution: Found in low altitude areas.
General Distribution: India, Nepal, Bhutan, Myanmar, Thailand, Malaysia

Actinodaphne sikkimensis Meisner in DC., Prodr. 15(1):213. 1864; FBI 5:147. 1886; FEH 2: 99. 1966; EFPN 3: 183. 1982; FB 1(2):281. 1984; TBRI 50 (4):104. 1987.

Local Name: *Siksiki, Rudilo, Phurkay Sissi* (Nep).

Large shrub to medium tree, 6-10m high, branching from base. Leaves crowded; lamina lenceolate, acuninate, glabrous, pale beneath, lateral veins c.11 pairs. Flowers in sub-sessile clusters; bracts 2-4; tepals 6. Fruits ellipsoid, embedded on penianth cup.

Flowers & Fruits: October – August.

Specimen Cited: Makaibari TE, **AP Das & Chandrâ 2781**, dated 25.03. 2004; Soom TE, **AP Das & Chandrâ3511** , dated 12.10.2004.
Status: Common
Local Distribution: Found in low altitude areas.
General Distribution: E. Himalayas (Nepal – Bhutan), Manipur.

CINNAMOMUM Blume

Cinnamomum bejolghota (Buch.-Ham.) Sweet, H. Br. 344. 1827; EFPN 3: 183. 1982; FB 1(2): 258. 1984.
Laurus bejolghota Buch. -Ham. in Tr. Linn. Soc. 13: 559. 1822.

Local Name: *Bhale Sinkoli, Sinkaule* (Nep).

Tree upto 20m. Leaves coriaceous, opposite or sub –opposite, elliptic, obtuse or shortly and bluntly acuminate, base cuneate, glossy above. Panicles 12 –20cm. Fruits ellipsoid born on enlarged perianth cup.

Flowers & Fruits: March –May.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2756***, dated 25.03. 2004
Status: Less Common.
Local Distribution: All three hill gardens.
General Distribution: India, Andaman Island, Nepal, Bhutan, Tibet, Myanmar, China

Cinnamomum impressinervium Meisner in DC., Prodr. 15(1): 21. 1864; EFPN 3: 183. 1982; FB 1(2): 258. 1984.

Local Name: *Khorsanay* (Nep).

Small trees. Branches green, slender; buds silky. Leaves subopposite; lamina curved downwards, elliptic-lanceolate, acuminate, drying brown, pale beneath, glabrous, 3-nerves impressed. Panicles pubescent. Flowers few, greenish-yellow; fruiting perianth cupular. Fruits obovoid to globose.

Flowers & Fruits: June – December.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1844,*** dated 10.06. 2003.
Status: Rare
Local Distribution: All three hill gardens.
General Distribution: E. Himalaya (Nepal – Bhutan), India, Myanmar, S.W. China.

LITSEA Lamkarck (*nom. cons.*)

Litsea citrata Blume, Bijdr. 565. 1826; FBI 5: 155. 1886.

Local Name: *Timur* (Nep).

Evergreen shrub or small tree to 6m. Leaves membranous, aromatic when crushed, lanceolate, long acuminate, base cuneate, dark green above when dry, pale beneath. Umbels 5 –10 flowered. Fruit subglobose, 6 –7mm.

Flowers & Fruits: December – May
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1820***, dated 17.05.2003; Tamsong TE, ***AP Das & Chandrâ 2099***, dated 30.06. 2003.
Status: Less common
Local Distribution: All three hill gardens.
General Distribution: Nepal to Bhutan, Assam, Myanmar, China.
Note: Silkworms are reared on the leaves.

Litsea cubeba (Loureiro) Persoon, Pl. 2(1): 4. 1806; FEH 1: 101. 1966; 2: 38. 1971; EFPN 3: 185. 1982; FB 1(2): 274. 1984.
Laurus cubeba Loureiro, Fl. Cochinch. 1:252. 1790.

Local Name: *Siltimbur* (Nep).

Small trees to 6 m, aromatic, deciduous, no proper winter buds. Branches slender, smooth, drying black. Leaves sub-opposite to alternate; lamina lanceolate, half contortate, acuminate, bright green, glabrous. 2-4-umbel clusters, 4-10 flowered. Flowers silky hairy. Fruits subglobose.

Flowers & Fruits: December – May.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2911***, dated 10.04. 2004.
Status: Less common
Local Distribution: Found only in Tamsong garden.
General Distribution: Nepal to Bhutan, Assam, Meghalaya, Myanmar, Taiwan, China.
Note: Fruits edible as well as medicinal.

Litsea monopetala (Roxb.)Pers. Syn. Pl. 2: 4. 1807; FEH !: 102. 1966; EFPN 3: 185. 1982.
Tetranthera monopetala Roxb., Pl. Corom. 2. 26.t. 148. 1798.

Local Name: *Bonsum, Kut mero, Pat mero* (Nep).

Tree to 12m, branchlets brownish tomentose. Leaves broadly elliptic, obtuse or apiculate, base rounded, greenish beneath when dry, softly tomentose and prominently reticulate beneath. Umbels densely pubescent forming dense clusters. Fruit subglobose.

Flowers & Fruits: March – August.
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 0114***, dated 03.02.2002; Soom TE, ***AP Das & Chandrâ 3107***, dated 03. 05.2004.
Status: Common
Local Distribution: All Terai gardens.
General Distribution: Kumaun to Sikkim, Pakistan, Myanmar, China.
Note: Silkworms reached on leaves.

Litsea sebifera (Willd.) Pers., Syn. Pl. 2: 4. 1807; FB 1(2): 277. 1984.
Tomex sebifera Willd., Sp. Pl. 2 (2): 840. 1799.

Local Name: *Kawala* (Nep).

Tree to 15m, young shoots whitish pubescent: Leaves coriaceous, ovate –lanceolate, ovate or elliptic, acute, base rounded or cuneate, glabrous or pale pubescent beneath. Umbels large, whitish pubescent on slender peduncles. Fruit globose.

Flowers & Fruits: May – August.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 1582***, dated 22.10. 2002; Hansqua TE, ***AP Das & Chandrâ 0214***, dated 09.02.2002
Status: Very common.
Local Distribution: All Terai gardens.
General Distribution: Himalayas (Kashmir – Bhutan), India, Sri Lanka, Myanmar, China, Malaysia.

PHOEBE Nees

Phoebe attenuata (Nees) Nees, Syst. Laurie. 104. 1836; FBI 5: 143. 1886;
Ocotea attenuata Nees in Wallich, Pl. As. Rar. 2: 71. 1831.

Large trees to 22 m high, branches horizontal. Young shoots rusty-tomentose. Leaves crowded at branch ends; lamina oblanceolate, subacute, attenuate, cariaceous, tomentose beneath. Peduncles 13-24 cm long. Flowers yellowish-white, perianth campanulate, cariaceous. Fruits ellipsoid.

Flowers & Fruits: March - Oct.ober.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1768***, dated 17.05.2003.
Status: Rare
Local Distribution: Found only in Makaibari garden.
General Distribution: Himalayas (Nepal – Bhutan), Assam.
Note: Good quality timber.

LINACEAE A. Gray

REINWARDTIA Dumortier.

Reinwardtia indica Dumort., Comm. Bot. 19. 1822; FB 1(3): 752. 1987; FI 3: 581. 1993.

Shrub to 1m. Leaves obovate –oblanceolate, acute or obtuse, base attenuate, margins entire or minutely serrulate, glabrous. Flowers yellow, solitary or few in axillary and terminal clusters or cymes.

Flowers & Fruits: October-December
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2399***, dated 05.11. 2003; Makaibari TE, ***AP Das & Chandrâ 2514***, dated 11.11. 2003
Status: Less common.
Local Distribution: Found only in Soom & Makaibari gardens.
General Distribution: India, Nepal, Bhutan, China, Indo –China, Myanmar, Thailand

LOBELIACEAE R. Brown

LOBELIA L.

Lobelia heyneana Roth ex Roem. & Schult., Syst. Veg. 5: 50. 1819; FB 2 (3): 1394.2001.
Lobelia trialata Buch. – Ham. ex D.Don, Prodr. Fl. Nep. 157. 1825; FBI 3: 425. 1881.

Glabrous or subglabrous annual. Stems ascending to erect, narrowly winged. Lamina ovate to elliptic, serrulate –crenate, upper narrower than lower, base cuneate or truncate. Pedicels to 18 mm. Calyx lobes linear. Corolla pink or lilak. Seeds ellipsoid, sometimes trigonous.

Flowers & Fruits: October - March.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 1602***, dated 22.10. 2002.
Status: Very common.
Local Distribution: All Terai gardens
General Distribution: Africa, Himalayas, India, Sri Lanka, Thailand, China, Malaysia.

Lobelia nummularia Lamkarck, Encyclimber Meth. 3:589. 1791-92; FB 2(3): 1395. 2001.
Pratia nummularia (Lamarck) A. Brown & Ascherson, Ind. Sem. Hort. Berol 1861, app. 6: 1861; FEH 1: 328. 1966; EFPN 3: 53. 1982; TBRI 50(4): 124. 1987;
Pratia begonifolia (Wallich) Lindley in Bot. Reg. t. 1373. 1830; FBI 3: 422. 1881.

Small crecping, much branched, rooting at nodes, densely pubescent, greenish. Leaves alternate; lamina ovate, denticulate, acute, oblique. Flowers axillary, solitary; calyx bulbous, greenish, teeth 5, linear, persistent; corolla bilabiate, pinkish; anthers blackish. Berries ellipsoid, purplish red.

Flowers: Apr. - Sep.   *Fruits:* Aug. - Nov.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1895***, dated 10.06. 2003; Soom TE, ***AP Das & Chandrâ 2661***, dated 27.12.2003; Tamsong TE, ***AP Das & Chandrâ 2282***, dated 05.09. 2003.
Status: Common
Local Distribution: In all gardens
General Distribution: Himalayas, Meghalaya, Myanmar, east to China, Malaysia.

Lobelia pyramidalis Wallich in As. Res. 13:376. 1820; FBI 3:426. 1881, p.p. FEH 1: 327. 1966; EFPN 3:52. 1982; TBRI 50 (4):118. 1987; FB 2(3): 1395. 2001.

Upto 1 m tall annual, branched upward. Stem ±terete, glabrous. Leaves alternate, rarely opposite, sessile upwards; lamina linear-lanceolate, serrulate, acuminate. Recemes terminal & axillary. Calyx bell-shaped; corolla oblique, bilabiate, with white vertical lines. Capsules subglobose.

Flowers: Mar. - Jun.   *Frui.:* May - Aug.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2416***, dated 05.11. 2003
Status: Less common
Local Distribution: Found only in Soom & Tamsong gardens
General Distribution: Himalayas (Kumaon – Arunachal Pradesh), Meghalaya, Myanmar, China.

Lobelia zeylanica Clarke in Hook.f., FBI 3: 425. 1881; FB 2 (3): 1395.2001.
Lobelia dichotoma Miq., Fl. Ind. Bat. 2: 576. 1856.

Stems ascending to suberect, 7 –28 cm, 4-angled, succulent. Lamina broadly ovate, serrulate – crenate, truncate, somewhat decurrent,. Pedicels 5 –15 mm, slightly longer in fruit. Calyx lobes linear. Corolla purplish –blue. Anthers tips bearded. Capsules 5 –7 x 3 –4 mm. Seeds trigonous.

Flowers & Fruits: Jun. - Dec.

Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 1265***, dated 18.10.2002.
Status: Rare
Local Distribution: Found only in Kamalpur garden
General Distribution: Tropical Himalayas, India, Sri Lanka, Thailand, China, Malaysia, Fiji.

LYTHRACEAE Jaume St. Hil

AMANNIA Blume

Amannia baccifera L., Sp. Pl. 120. 1753; FBI 2: 569. 1879; 2(1): 271.1991..

Erect, much branched herb 10 –60cm. Leaves oblong to oblanceolate, acute, base cuneate, rounded or weakly cordate. Cymes dense, sessile, 5 –20 flowered. Capsules globose, irregularly circumscissile.

Flowers & Fruits: October –January
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0529***, dated 17.04.2002.
Status: Common
Local Distribution: All Terai gardens.
General Distribution: India, Nepal, Bhutan, China, Japan, Malaysia, Australia, Tropical Africa

CUPHEA Browne

Cuphea procumbens Cavanilles, Ic. 4: 55.t. 380. 1798; FB 2(1): 274.1991.

Erect, annual, bristly-pubescent herbs. Lamina lanceolate, bluntly pointed, cuneate, sparsely bristly; lower leaves petiolate, upper subsessile. Flowers borne laterally between petioles; calyx tube purplish; corolla bright pink. Capsules ellipsoid, enclosed in persistent calyx tube.

Flowers: July – August
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0294***, dated 16.02.2002; Kamalpur TE, ***AP Das & Chandrâ 0712***, dated 20.04.2002.
Status: Common
Local Distribution: All Terai gardens.
General Distribution: Native to Mexico, cultivated and naturalized in India.

LAGERSTROEMIA L.

Lagerstroemia reginae Roxburgh, Pl. Corom. 46, t. 65. 1795.

Local Name: *Jarul* (Beng, Nep).

Tree 6 –10 (–20)m, branchlets smooth. Leaves thinly coriaceous, elliptic –oblong, shortly acuminate or acute, base rounded, glabrous. Flowers bluish-purple in terminal panicles, brown puberulous. Capsule subglobose, woody.

Flowers & Fruits: May – September.
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1442***, dated 20.10.2002.
Status: Commonly planted
Local Distribution: All Terai gardens.

General Distribution: India, Nepal, Bhutan, Myanmar, Indo –nesia, Thailand
Note: Cultivated for it's showy flowers and valuable timber.

MAGNOLIACEAE A. Jussieu

MICHELIA L.

Michelia champaca L., Sp. Pl. 536. 1753; FBI 1: 42. 1872; FB 1(2): 236. 1984; FI 1: 175. 1993.

Local Name: *Chanp, Aule Champ* (Nep); *Swarna Chanpa* (Beng)

Ever-green trees to 20 m tall. Lamina ovate-lanceolate, entire, acute/ acuminate; flowers axillary, sweet-scented; tepals 3 x 3, fleshy, creamy/ yellow; infructescence 15 cm or longer.

Flowers & Fruits: September – May
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ1292,*** dated 18.10.2002
Status: Commonly planted.
Local Distribution: All Terai gardens & Makaibari
General Distribution: Indian subcontinent.
Note: Much valuable timber species.

Michelia doltsopa DC., FEH 2:37. 1971; FB 1(2):235. 1984; TBRI 50(4):120. 1987.
Magnolia excelsa Wallich, Tent. Fl. Nep. 1:5, t. 2. 1824.
Michelia excelsa (Wallich) Blume *ex* Wight, Ill. Ind. Bot. 1:14. 1838; FBI 1:43. 1872.

Local Name: *Seto Champ, Rani Champ* (Nep).

Evergreen tree, 10-25m tall with sericeous greyish-brown buds. Branches silky pubescent. Lamina oblong- lanceolate, acuminate, base cuneate, browinsh pubescent beneath, mid-rib silky above. Flowers terminal whitish scented; Fruits aggregate, suborbicular.

Flowers: April- June *Fruits:* October - December
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3371,*** dated 12. 10. 2004.
Status: Less common; often planted.
Local Distribution: Soom & Tamsong gardens.
General Distribution: E. Himalaya (Nepal-Arunachal Pradesh), Meghalaya, S. Tibet, Manipur N. Myanmar, Yunnan.
Note: The species is a threatened plant. It has got a high price timber value.

TALAUMA A. Jussieu

Talauma hodgsonii Hk.f. *et* Thom., Fl. Ind. 74. 1855, *Fl.* Asm. 1(1): 17. 1935; TBRI 50 (4) 128. 1987.

Local Name: Bhalu Kath (Nep.).

Large tree upto 25 m tall. Branches spreading. Leaves simple; lamina oblanceolate, elliptic margin entire, acuminate, base narrowly cuneate, glabrous greenish and glossy above, nerves prominent beneath. Flowers solitary, terminal, white; Follicles dehiscent by ventral suture and separating off from axis; Seeds red.

Flowers & Fruits: April - June
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2214,*** dated 05.09. 2003
Status: Rare
Local Distribution: Found only in Tamsong garden
General Distribution: E. Himalaya (Nepal-Bhutan), Meghalaya, Naga Hills and Myanmar.

MALVACEAE A. Jussieu

MALVA L.

Malva neglecta Wallr., Syll. Pl. Nov. Ratisbon 1: 140. 1824; FB 2(1):189.1991; FI 3: 359. 1993.
Malva rotundifolia L., Sp. Pl. 689. 1753; FBI 1: 320. 1874.

Annual, prostrate to ascending, sparsely pubescent to glabrescent with short, stellate and long, simple hairs. Lamina unlobed or 3 –5 lobed, cordate, crenate, pubescent; stipules lanceolate. Flowers axillary; petals 1 –1.5 cm, much exceeding calyx. Mericarps 13 –15, smooth, pubescent.

Flowers & Fruits: February – April.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2761,*** dated 25.03. 2004.
Status: Common; cultivated as vegetable.
Local Distribution: All Terai gardens.
General Distribution: India, Pakistan, Afghanistan, Nepal, Bhutan, Myanmar, Australia, Europe

MALVASTRUM A. Gray

Malvastrum coromandelianum (L.) Garcke in Bonplandia 5: 295. 1857; FI 3: 277. 1993.
Malva coromandeliana L., Sp. Pl. 687. 1753.

Annual, much branched herbs, 4 armed appressed stellate hairy. Lamina ovate to oblong, serrate. Epicalyx linear to lanceolate. Calyx lobes deltoid to ovate. Petals obliquely obovate, emarginate. Staminal column 1.5 –3cm. Mericarp 10 –14, stronly curved. Seeds glabrous, blackish.

Flowers & Fruits:
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 1526,*** dated 22.10. 2002;
Hansqua TE, ***AP Das & Chandrâ 0991,*** dated 09.05.2002.
Status: Less Common.
Local Distribution: All Terai gardens.
General Distribution: Pantropical

MALVAVISCUS Adanson

Malvaviscus arboreus Cav., Diss. 3: 131, t. 48. f. 1. 1787; FI 3: 393. 1993.
Hibiscus malvaviscus L., Sp. Pl. 694. 1753

Local Name: *Lanka Jaba* (Beng)

Erect or climbing shrub, shoots stellate-pubescent and with simple hairs. Leaves ovate to broadly ovate, entire or 3-5-lobed, acute, base rounded or cordate, margin serrate, thinly pubescent. Flowers scarlet.

Flowers & Fruits: January – December
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2127***, dated 30.06. 2003
Status: Often grown for ornamental flowers
Local Distribution: In Terai and low altitude areas.
General Distribution: Tropical America; introduced as an ornamental.

SIDA L.

Sida acuta Burman f., Fl. Ind. 147. 1768 ssp. ***acuta***; Blumea 14: 186. 1966; FB 2(1): 192.1991 FWB 1:308. 1997.
S. carpinifolia sensu Masters in FBI 1: 323. 1874 (*non* L.f.. 1781).

Local Name: *Jharoo/ Khareto* (Nep).

Erect annual herbs to 1m tall, branched throughout. Lamina narrowly lanceolate to lanceolate serrate, acute, base cuneate to rounded, glabrescent; stipules in unequal pairs, narrowly lanceolate. Flowers solitary, axillary, yellow. Mericarps reticulate, awns 2; seeds triangular.

Flowers & Fruits: December – May
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0321,*** dated 16.02. 2002 Hansqua TE, ***AP Das & Chandrâ 1079***, dated 09.05.2002; Kamalpur TE, ***AP Das & Chandrâ 0547***, dated 17.04.2002; Makaibari TE, ***AP Das & Chandrâ 1889***, dated 10.06 2003; Soom TE, ***AP Das & Chandrâ*** 3401, dated 12. 10. 2004; Tamsong TE, ***AP Das & Chandrâ 2411***, dated 05.11. 2003.
Status: Abundant
Local Distribution: In all gardens.
General Distribution: Pantropical.
Note: Sweeping-broom is made from its dried shoots.

Sida cordifolia L., Sp. Pl. 684. 1753; FBI 1: 324. 1874; FB 2(1): 192.1991; FI 3: 285. 1993.

Erect annual woody herb to 1 m, branched, densely stellate-tomentose. Lamina ovate to oblong rarely orbicular, crenate, obtuse to acute, cordate, tomentose. Flowers cream to pale yellow axillary, solitary below, crowded at the ends of branches. Mericarps reticulate, awns hairy.

Flowers & Fruits: July – January
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 1512,*** dated 22.10. 2002 Kamalpur TE, ***AP Das & Chandrâ 0572***, dated 20.04.2002.
Status: Common
Local Distribution: All Terai gardens.
General Distribution: Pantropical.

Sida rhombifolia L., Sp. Pl. 684. 1753 ssp. ***Rhombifolia***: Borssum in Blumea 14: 195. 1966 FEH 1: 205. 1966; FWB 1:310. 1997, FB 2(1): 193.1991.
S. rhombifolia var. *rhomboidea* (DC.) Masters in FBI 1: 324. 1874.
S. rhombifolia var. *obovata* Wallich *ex* Masters in FBI 1: 324 1874.

Erect or prostrate, annual to perennial, stellate-pubescent undershrub, upto 1 m tall. Leaves lanceolate – orbicular or rhombic, acute/ rounded/ retuse, serrate, pubescent beneath. Flowers axillary solitary or fascicles of 2-3, orange or yellow. Mericarps reticulate, glabrous or hairy.

Flowers & Fruits: July – December

Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0367***, dated 16.02. 2002; Hansqua TE, ***AP Das & Chandrâ 1102***, dated 09.05.2002; Kamalpur TE, ***AP Das & Chandrâ 0570***, dated 17.04.2002.

Status: Common.

Local Distribution: All Terai gardens.

General Distribution: S.E. Asia.

Note: Fibers obtained from this plant is used to make rope.

URENA L.

Urena lobata L., Sp. Pl. ed. 1, 2:692. 1753; FBI 1:329. 1874; FEH 1:206. 1966; EFPN 2:69. 1979; FI 19.228. 1988; FB 2(1): 194.1991. FWB 1: 312. 1997.

Local Name: *Kurey Paat* (Nep).

Tall annual herbs. Lamina ovate to orbicular, unlobed or shallowly to deeply 5 lobed, apex and base obtuse to acute or rounded, entire or serrate, stallate hairy, glabrescent. Epicalyx segments 5. Flowers solitary or few in clusters, axillary, pink. Mericarps with hooked bristles.

Flowers & Fruits: August – February

Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0829***, dated 04.05. 2002; Hansqua TE, ***AP Das & Chandrâ 0241,*** dated 09.02. 2002; Kamalpur TE, ***AP Das & Chandrâ 1346***, dated 18.10.2002; Makaibari TE, ***AP Das & Chandrâ 1802***, dated 17.05.2003; Soom TE, ***AP Das & Chandrâ 3377***, dated 12. 10. 2004; Tamsong TE, ***AP Das & Chandrâ 2337***, dated 05.11. 2003.

Status: Abundant

Local Distribution: In all gardens.

General Distribution: Pantropical.

Note: A fiber yielding plant.

MELASTOMATACEAE A. Jussieu

MELASTOMA L.

Melastoma malabathricum L., Sp. Pl. ed. 1(1): 390. 1753 *-ut malabathrica* FBI 2:523. 1879; FEH 1:221. 1966; EFPN 2:170. 1979; TBRI 50(4): 119. 1987; FB 2(1): 296.1991.

Local Name: *Chulasi* (Nep); *Dnatrangi* (Beng)

Bushy shrub, >4m high, young parts densely appressed hairy. Stem and petioles strigose with subulate-echinate scales. Leaves opposite, lanceolate-elliptic, acuminate, 5-veined, shortly hairy below. Flowers mauve-purple, clustered at branch ends. Fruits subglobose, apically truncate.

Flowers & Fruist: January – December

Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0750***, dated 04.05. 2002; Hansqua TE, ***AP Das & Chandrâ 0218,*** dated 09.02.2002; Kamalpur TE, ***AP Das & Chandrâ 0654***, dated 20.04.2002; Makaibari TE, ***AP Das & Chandrâ 1722***, dated 17.05.2003; Tamsong TE, ***AP Das & Chandrâ 2125***, dated 30.06. 2003.

Status: Abundant
Local Distribution: In all gardens.
General Distribution: Tropical Himalayas, India, China, Sri Lanka, Myanmar, Malaysia and Australia.

OSBECKIA L.

Osbeckia muralis Naud.in Ann. Sci. Nat. Bot. Ser.3, 14: 56. 1850.

Erect annual herb 16-30cm. Stems branched or not, ± villous, hairs spreading. Leaves ovate-elliptic, acute, base rounded to cuneate, appressed hairy on both surfaces. Flowers purple in terminal cluster of few to 12 flowers.

Flowers & Fruits: April – October
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0553***, dated 17.04.2002.
Status: Rare.
Local Distribution: Found only in Makaibari garden.
General Distribution: India, Bangladesh.

Osbeckia nepalensis Hooker, Exot. Fl. t. 31. 1822; FB 2(1): 295.1991.

Upto 2m tall undershrubs; stems appressed hairy. Leaves sessile or petiolate, narrowly ovate-oblong to elliptic, acute, base cordate, appressed hairy, upper surface striate. Flowers in terminal, panicle, few-to many, white. Capsules hairy at tip.

Flowers: July - October
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0794,*** dated 04.05. 2002; Tamsong TE, ***AP Das & Chandrâ 2176***, dated 30.06. 2003.
Status: Very common.
Local Distribution: In Terai and low altitude areas.
General Distribution: Eastern Himalayas, Khasia, Myanmar, Thailand, Indo –China.

Osbeckia stellata Ker-Gawl. in Edgw. Bot. Reg. 8: t. 674. 1822; FBI 2: 517. 1879; FEH 1: 222. 1966.
O. crinita Naud. in Ann. Sci. Nat. Bot. Ser. III, 14: 72. 1850; FBI 2: 517. 1879 p.p.

A small shrub to 150 cm tall. Stem much branched, hairy. Leaves ovate to oblong-lanceolate, acuminate, base narrowed or subcordate to rounded, adpressed hairy both sides. Flowers 4-merous, or very rarely 5-merous, calyx-tube with dense tufts of stellate hair.

Flowers: July - October *Fruits:* November - January
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2421,*** dated 05.11. 2003.
Status: Common
Local Distribution: All three hill gardens.
General Distribution: Himalayas, Assam, Myanmar and China.

OXYSPORA A. DC.

Oxyspora paniculata (D. Don) DC., Prodr. 3:123. 1828; FBI 2:525. 1879; FEH 1:222. 1966; 2:89. 1971; EFPN 2:171. 1979; TBRI 50 (4): 121. 1987; FB 2(1): 297. 1991.
Arthrostemma paniculatum D. Don. in Mem. Wern. Nat. Hist. Soc. 4:299. 1822.

Local Name: Tulashi (Nep).

Shrubs to 2 m; branches drooping, stellate-pubescent. Leaves opposite; lamina ovate to ovate-elliptic, shortly acuminate, rounded, coarse, rusty stellate beneath, nerves 5. Panicles terminal, drooping, decussate. Flowers pendulous; calyx 4-toothed; petals deep pink; Capsule ellipsoid.

Flowers: Aug. - Oct.   *Fruits*: Oct. - Dec.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2407,*** dated 05.11. 2003; Soom TE, ***AP Das & Chandrâ 3500***, dated 12.10.2004.
Status: Common
Local Distribution: All three hill gardens.
General Distribution: Himalayas (Nepal – Arunachal Pradesh), Assam, W. China.

MELIACEAE A. Jussieu

AMOORA Roxburgh

Amoora rohituka (Roxburgh) Wight & Arntt in Wight, Cat. Ind. Pl. 24. 1833; FBI 1: 559. 1875.
Andersonia rohituka Roxb., Fl. Ind. 2: 213. 1832.

Local Name: *Lali* (Beng); *Lahasune* (Nep)

Tree 6-10m with leaves 60 -75cm, leaflets ovate, acute, base obliquely rounded, glabrous. Panicles as long as leaves. Fruit obovoid, glabrous.

Flowers & Fruits: Not recorded.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0741***, dated 04.05. 2002.
Status: Common
Local Distribution: All Terai gardens.
General Distribution: Himalayas.

AZADIRACHTA A. Jussieu

Azadirachta indica A. Jussieu in Mem. Mus. Hist. Nat. 19: 221.t.13.f. 5. 1830; FI 4: 478. 1997; FB 2(1): 32. 1991.
Melia azadirachta L., Sp. Pl. 385. 1753; FBI 1: 544. 1875.

Local Name: *Neem* (Beng)

Tree, 8 –25m. Leaves 15 –30cm; leaflets 5 –9 pairs, ovate –lanceolate, acuminate, cuneate, serrate, glabrous at maturity. Thyrses axillary; flowers white. Calyx 1mm. Petals oblanceolate. Staminal tube 4mm. Drupes ovoid, greenish –yellow, 1 –seeded.

Flowers & Fruits: January - December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0899***, dated 04.05. 2002.
Status: Common.
Local Distribution: All Terai gardens.
General Distribution: A native of Myanmar; growing in warm areas of Southeast Asia including India.

CHUKRASSIA A. Jussieu

Chukrassia tabularis A. Juss.in Mem. Mus. Hist. Nat. 19: 251. t. 22. 1830; FBI 1: 568. 1875; FI 4: 481. 1997.

Local Name: *Hallonre, Chukrassi* (Nep)

Tree 20m with leaves 40-75cm, leaflets ovate or oblong, acuminate, base obliquely rounded, pubescent. Panicles terminal with yellow flowers. Capsule ovoid-ellipsoid.

Flowers & Fruits: May – September.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2823***, dated 25.03. 2004
Status: Often planted
Local Distribution: Common in low altitude areas.
General Distribution: Nepal, India, China, Malaysia.
Note: Cultivated for its valuable timber.

CIPADESSA Blume

Cipadessa baccifera (Roth) Miquel in Ann. Mus. Bot. Lugduno-Batavum 4: 6. 1868; FI 4: 482. 1997; FB 2(1): 33.1991.
Melia baccifera Roth, Nov. Pl. Sp. 215. 1821.

Shrubs or trees, 2 –4m. Leaves 15 –40cm; leaflets 3 –6 pairs, ovate –elliptic, acuminate, rounded, entire or bluntly serrate, sparsely pubescent along veins beneath. Thyrses small. Calyx lobes 1 mm. Petals white. Stamens 2.5 mm. Drupes 5 –6mm in diameter, 5 –lobed, scarlet.
Flowers & Fruits: **January - December**
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1870***, dated 10.06. 2003.
Status: Rare
Local Distribution: Found only in Makaibari garden.
General Distribution: Himalayas, India, Sri Lanka, Myanmar, Thailand, Malaysia.

MELIA L.

Melia azedarach L., Sp. Pl. 384. 1753; FBI 1: 544. 1875; FI 4: 494. 1997; FB 2(1): 31.1991.

Local Name: *Bakaina, Bakain, Lapsi* (Nep) *Ghora Neem* (Beng)

Deciduous trees, >10m high; bark reddish. Leaves 2-pinnate, leaflets 3-6-jugate, ovate-lanceolate, crenate, acuminate, glabrescent. Flowers white or purplish, in axillary stellately tomentose scurfy panicles. Drupes ellipsoid, yellow, glabrous, pulpy, 1- seeded.

Flowers & Fruits: March – November
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0765***, dated 04.05. 2002; Hansqua TE, ***AP Das & Chandrâ 0982***, dated 09.05.2002; Kamalpur TE, ***AP Das & Chandrâ 0700***, dated 20.04.2002; Soom TE, ***AP Das & Chandrâ 3319***, dated 26.06. 2004; Tamsong TE, ***AP Das & Chandrâ 2044***, dated 30.06. 2003.
Status: Commonly planted
Local Distribution: In all gardens.
General Distribution: Tropical regions of Africa, S.E. Asia and Australia.

Note: Rapid-growing species often planted as ornamental and temporary shade trees in tea gardens. Wood used to make furniture. Sometimes fruit extract used as biopesticide. Stones from fruit used as beads.

SWIETENIA Jacq.

Swietenia macrophylla King in Hooker's Ic. Pl. 16, t. 1550. 1886; FI 4: 526. 1997.
Flowers & Fruits: March to June

Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0962***, dated 04.05. 2002.
Status: Commonly planted
Local Distribution: All Terai gardens.
General Distribution: Myanmar, Malaysia.

Swietenia mahagoni (L.) Jacq., Enum. Syst. Pl. 20. 1760; FI 4: 525. 1997.

Flowers & Fruits: March to June
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1486***, dated 20.10.2002.
Status: Commonly planted.
Local Distribution: All Terai gardens.
General Distribution: Myanmar, Malaysia.

TOONA (Endlicher) Roemer

Toona ciliata Roem., Syn. Hesper 139. 1846; Nam. Chang. Flowers Pl. 268. 1987; FB 2 (1): 38. 1991; FWB 1:406. 1997.
Cedrela toona Roxb. *ex* Rottl., Ger. Naturf. Fr. Neve Schr. 2: 198. 1803; FBI 1: 568. 1875.

Local Name : *Toon* (Beng); *Tooni* (Nep).

A large deciduous tree to 16-37 m tall. Leaves generally paripinnate, 30-60 cm long; leaflets 5-24, opposite or alternate, obscurely ovate - lanceolate or oblong-lanceolate, margin entire or subentire, obtuse, glabrous. Panicles large, pyramidal with white, slightly fragrant flowers. Capsule ellipsiod, 5-valved, usually smooth.

Flowers & Fruits: November - September
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0773***, dated 04.05. 2002; Makaibari TE, ***AP Das & Chandrâ 2820***, dated 25.03. 2004
Status: Common. Often planted.
Local Distribution: Common in low altitude.
General Distribution: Afganistan, Himalayas, India, Sri Lanka, East to China.
Note: Wood is a good quality timber used to make furniture, doors, windows etc. The timber of this tree is much in demand.

MENISPERMACEAE A. Jussieu

CYCLEA Arnott ex Wight

Cyclea bicristata (Griff.) Diels in Pfl.-reich, 4-94. Ht. 46. 317. F. 93 A-E. 1910; FEH 2:35. 1971; FB 1(2):338. 1984;

Lophophyllum bicristatum Griff., Notul. 4:313. 1854; FBI 1:105. 1872.

Shruby dextrorse climbers with whitish bark. Stem terete, pubescent. Leaves ovate-cordate, acute cordate at base, margin entire, pilose beneath. Panicles axillary, tomentose with green flowers. Drupes stony, tubercled.

Flowers: March - April *Fruits:* April - May
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2877***, dated 25.03. 2004.

Status: Rare
Local Distribution: Found only in Makaibari garden
General Distribution: E. Himalaya (Darjeeling-Bhutan), Meghalaya, Manipur.

PERICAMPYLUS Miers

Pericampylus glaucus (Lamarck) Merrill, Interpr. Rumph. Herb. Amboin. 219. 1917; FB 1(2): 336. 1984; FI 1: 330. 1993.
Menispermum glaucum Lamarck, Encycl. Meth. 4: 100. 1797.

Local Name: *Pipal-pati lahara* (Nep)

Twiner with a root-stock. Lamina broadly ovate, acute, base rounded, truncate or cordate, not peltate, slightly repund, finely pilose above, pubescent beneath. Flowers in axillary paniculate cyme, brownish-pubescent. Fruits suborbicular, purple or blackish.

Flowers: March – May
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0353***, dated 16.02. 2002; Hansqua TE, ***AP Das & Chandrâ 0130***, dated 03.02.2002; Kamalpur TE, ***AP Das & Chandrâ 0726***, dated 20.04.2002; Makaibari TE, ***AP Das & Chandrâ 1885***, dated 10.06. 2003; Tamsong TE, ***AP Das & Chandrâ 2224***, dated 05.09. 2003.
Status: Common
Local Distribution: All gardens.
General Distribution: Eastern Himalaya, Assam, Myanmar, Thailand, China, Taiwan, Japan, Malaysia.

STEPHANIA Loureiro

Stephania glandulifera Miers, Contr. Bot. 3:220. 1871; FEH 1:95. 1966; 2:36. 1971; EFPN 2:28. 1879; FB 1(2):37. 1984; TBRI 50(4):101. 1987; FI 1: 334. 1993.

Stephania rotunda auct. non Loureiro: Hook. f. & Thomson, Fl. Ind. 197. 18551; FBI 1:103. 1872 p.p., non Loureiro

Local Name: *Tamarkay* (Nep).

Sinistrorse shrubby twinner; rootstock tuberous. Lamina peltate, ovate, base rounded, entire, glabrous. Cymes umbellate, on old stem. Male sepals flowers obovate, glandular papillose near apex; petals 0; staminal column to 0.2cm across; females like males. Fruits globose.

Flowers: Feb. - May *Fruits*: Aug. - Nov.

Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1811***, dated 17.05.2003; Tamsong TE, ***AP Das & Chandrâ 2009***, dated 30.06. 2003.
Status: Common
Local Distribution: All three hill gardens. Rarely in Terai.
General Distribution: E. Himalaya (Nepal - Bhutan), Meghalaya.
Note: Ethnobotanically much important plant.

Stephania japonica (Thunbergh) Miers in Ann. Mag. Nat. Hist. ser.3, 18:14.1866; FBI 1:103. 1872; FB 1(2): 337.1984; FI 1:335.1993.
Menispermum japonicum Thunberg, Fl.Jap. 193. 1784.
Cissampelos hernandifolia Willdenow, Sp. Pl. 4: 861. 1806.

Slender twiner. Lamina deltoid, acuminate, rounded, entire, pale and sparsely pubescent beneath; Umbels axillary, 6 -7 rayed, peduncles 2 -6 cm; male flowers sessile in dense capitate clusters, sepals 6–8, oblanceolate, petals 3–4, obovate; females similar, sepals fewer. Fruits suborbicular.

Flowers & Fruits: May – December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0299***, dated 16.02. 2002; Hansqua TE, ***AP Das & Chandrâ 1414***, dated 20.10.2002; Kamalpur TE, ***AP Das & Chandrâ 1370***, dated 18.10.2002; Makaibari TE, ***AP Das & Chandrâ 1811***, dated 11.11. 2003.
Status: Common
Local Distribution: In all gardens
General Distribution: Tropical to temperate regions of Asia and Africa.

TINOSPORA Miers

Tinospora cordifolia (Willdenow) Hook.f. & Thomson, Fl. Ind. 184. 1855; FBI 1: 97. 1872; FB 1(2): 335. 1984; FI 1: 347. 1993.
Menispermum cordifolium Willdenow, Sp. Pl. 4: 826. 1806.

Large twiner. Lamina broadly ovate, abruptly acuminate, cordate, glandular domatia in vein axils below, otherwise glabrous. Inflorescence 5 -12 cm; male in few flowered clusters, females borne singly along axis. In males outer sepals ovate, inner elliptic, petals obovate. Females with sepals and petals similar to male; staminodes linear. Drupes red.

Flowers & Fruits: January - December
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1017***, dated 09.05.2002.
Status: Common
Local Distribution: All Terai gardens
General Distribution:Nepal, India, Sri Lanka, Myanmar.

Tinospora sinensis (Loureiro) Merrill in Sunyatsenia 1: 193. 1934; FB 1(2): 335. 1984; FI 1: 349. 1993.
Campylus sinensis Loureiro, Fl. Cochinch. 113. 1790.

Twiner. Leaves broadly ovate, abruptly acuminate, cordate, pubescent. Inflorescence 5 -12 cm; male in few flowered clusters, female flowers borne singly along axis. Outer sepals ovate, inner elliptic, petals obovate; stamens club -shaped; staminodes linear. Drupes red; stones warted.

Flowers & Fruits: May – September.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1758***, dated 17.05.2003.
Status: Common.
Local Distribution: In Terai and low altitude areas.
General Distribution: Nepal, India, Sri Lanka, Myanmar, Thailand, Vietnam, China, Malaysia.

MIMOSACEAE R. Brown

ACACIA Miller

Acacia auriculiformis A. Cunn.ex Bentham in Hooker Lond. J. Bot. 1: 377. 1842.

Local Name: *Swarna Jhuri* (Beng).
Tall trees, bark fissured; normal leaves replaced by phyllodes; spikes axillary, dense-flowered; flowers yellow; fruits spirally coiled, constricted; seeds shiny, black with elongated golden funiculus.

Flowers & Fruits: April – October.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0740***, dated 04.05. 2002; Kamalpur TE, ***AP Das & Chandrâ 0584***, dated 20.04.2002.
Status: Very common; frequently planted.
Local Distribution: All Terai gardens.
General Distribution: Native of Australia.

Acacia pennata (L.) Willd., Sp. Pl. 4: 1090. 1805; FBI 2: 297. 1878; FB 1(3): 641. 1987.
Mimosa pennata L., Sp. Pl. 1507. 1753.

Local Name: *Arare* (Nep).

Climber or tree 3-8m, shoots bearing scattered recurved prickles. Leaves bipinnate, 15-20cm, pinnae 12-26 pairs; leaflets 60-70 pairs, linear-oblong, obtuse or subacute, base truncate, asymmetric, attached very obliquely, finely ciliate. Flower heads globose, forming terminal panicles. Pods leathery.

Flowers & Fruits: June – August
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1717***, dated 17.05.2003.
Status: Less Common.
Local Distribution: In Terai and low altitude areas.
General Distribution: India, Nepal, Bhutan, South East Asia, china, Sri Lanka, Malaysia
Note: Stems and fruit used to poison fish.

ADENANTHERA L.

Adenanthera pavoniana L., Sp. Pl. 384. 1753.

Trees to 20 m. Leaf rachis 15 –25 cm, pinnae 3 –5 pairs, leaflets 11 –19 per pinna, oblong, obtuse or emarginate, base rounded, sparsely appressed pubescent, pale beneath. Panicle to 15 cm. Calyx pubescent. Petals yellow, elliptic. Pods 12 –20 x 1 –2 cm; seeds 10 –15, red.

Flowers & Fruits: January - December
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1663***, dated 13.11. 2002.
Status: Commonly planted
Local Distribution: All Terai gardens.
General Distribution: Asia, Australia, Pacific Islands.

ALBIZIA Durazzini

Albizia chinensis (Osbeck) Merrill in Amer. J. Bot. 3: 575. 1916; FB 1(3): 646. 1987.
Mimosa chinensis Osbeck, Dagbok Ostind Resa 233. 1757.

Local Name: *Rato siris* (Nep); *Kalo Siris* (Beng).

Tree to 40m. Leaf pinnae (4-)7-12(-14) pairs, 4-10cm, leaflets 18-35 pairs, oblong-lanceolate, acute, very asymmetric, base obliquely truncate, glabrous above, pubescent beneath. Stipules deciduous. Panicles 15-20cm, heads 15-25-flowered. Pods thinly coriaceous.

Flowers & Fruits: April – July
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1475***, dated 20.10.2002; Tamsong TE, ***AP Das & Chandrâ 1955***, dated 30.06. 2003.
Status: Common
Local Distribution: In Terai and low altitude areas.
General Distribution: India, Nepal, Bhutan, China, Sri Lanka, Malaysia
Note: Used as a shade tree in tea gardens. Branched lopped for cattle fodder.

Albizia lebbeck (L.) Bentham in Hooker, Lond. J. Bot. 3:87. 1844; FBI 2:298. 1878; FEH 1:136. 1966; 2:61. 1971; EFPN 2: 104. 1979; FB 1(3): 644. 1987.
Mimosa lebbeck L., Sp. Pl. 516. 1753.

Local Name: *Siris* (Nep).

Trees to 28 m tall, deciduous. Leaf rachis c.14 cm long, glandular at base & apex, glands oval; pinnae 2-4 pairs; leaflets upto 16 pairs, obovate, asymmetric, glabrous, pale-green. Heads many flowered, solitary, axillary. Calyx pubescent; corolla segmented to middle; Pods oblong.

Flowers & Fruits: April - December.
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1389***, dated 20.10.2002; Makaibari TE, ***AP Das & Chandrâ 1849***, dated 10.06. 2003.
Status: Very common.
Local Distribution: In Terai and low altitude areas.
General Distribution: Tropical Himalayas, S.E.Asia, Sri Lanka, China
Note: Produce timber and firewood. Extensively planted in tea gardens for shade.

Albizia odoratissima (L.f.) Bentham in Lond. J. Bot. 3: 88. 1844; FBI 2: 299. 1878; FB 1(3): 644. 1987.
Mimosa odoratissima L.f., Suppl. Pl. 437. 1781.

Trees to 25m; leaves 10 –20 cm, pinnae 3 –5 pairs, leaflets oblong, 6 –18 pairs, acute, base rounded, glabrous above, appressed pubescent beneath, leaf rachis with gland at base & apex;

panicles much branched, heads 12 flowered; corolla tubular. Pods thinly coriaceous; seeds 6 –12, ovoid, compressed.

Flowers & Fruits: January - December
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3234***, dated 26.06. 2004.
Status: Common
Local Distribution: In Terai and low altitude areas.
General Distribution: India, Nepal, Bhutan, Sri Lanka

LEUCAENA Bentham

Leucaena leucocephala (Lam.) de Wit in Taxon 10: 54. 1961.
Mimosa leucocephala Lam., Enc. Meth. Bot. 1: 12. 1783.

Small trees to 12m; Leaf rachis 15 –20 cm, pinnae 3 –8 pairs, leaflets 7 –20 pairs, obliquely oblong –ovate, acute, base cuneate, glabrous. Heads 1.5 cm in diameter, creamy white, on peduncles. Corolla oblong, 4 x1 mm, pubescent. Pods glabrous; seeds 15 –25, ovate, brown, glossy, transversely arranged.

Flowers & Fruits: April – November.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 1554***, dated 22.10.2002; Hansqua TE, ***AP Das & Chandrâ 1006***, dated 09.05.2002; Kamalpur TE, ***AP Das & Chandrâ 0719***, dated 20.04.2002.
Status: Common
Local Distribution: All Terai gardens.
General Distribution: Tropical and sub tropical regions

MIMOSA L.

Mimosa himalayana Gamble, KB 1920:4. 1920; FB 1(3):639. 1987.
M. rubicaulis sensu FBI 2:291. 1878, p.p.; FEH 1:159. 1966; 3:67. 1975.
M. rubicaulis Lamk. subsp. *himalayana* (Gamble) Ohashi, EFPN 2:126. 1979.

Local Name: *Arhari Kanra* (Nep).

4-5m high woody scrambler, prickles recurved. Leaves bipinnate; pinnae 6-9 pairs; leaflets 12-20 pairs, oblong, thinly appressed hairy beneath. Stipules subulate. Flower heads in axillary clusters, c.1.5cm across, pinkish. Corolla oblong; stamens 8. Pods jointed; seeds ovoid, brownish.

Flowers: August - October; Fruits: November - February.
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1466***, dated 20.10.2002; Kamalpur TE, ***AP Das & Chandrâ 1258***, dated 18.10.2002.
Status: Frequent is lower hill belts.
Local Distribution: In Terai and low altitude areas.
General Distribution: Himalayas (Kashmir – Bhutan).
Note: Prickly twigs of this plant are used in the death-ceremony (Anthesti kriya) in Hindu rituals.

Mimosa pudica L., Sp. Pl. 1, 518 1753; FEH 1: 159. 1966.

Local Name: *Lajjaboti* (Beng); *Bhuwari Jhar* (Nep.).

Highly sensitive, spreading & straggling undershrub. Branches prickly. Stipules linear-lanceotate. Leaves sensitive, pinnae 4, digitate; leaflets 11-19 pairs, narrowly oblong acute, adpressed bristly beneath. Heads axillary. Flowers pink or white. Pods prickly along sutures, joints 3-5.

Flowers & Fruits: July – December.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0060***, dated 27.01.2002; Hansqua TE, ***AP Das & Chandrâ 0163***, dated 03.02.2002; Kamalpur TE, ***AP Das & Chandrâ 0414***, dated 27.02. 2002; Makaibari TE, ***AP Das & Chandrâ 1821***, dated 17.05.2003.
Status: Common.
Local Distribution: In all gardens.
General Distribution: Pantropic

SAMANIA (DC.) Merrill

Samanea saman (Jacquin) Merrill in J. Wash. Acad. Sci. 6: 47. 1916; FB 1(3): 647. 1987.
Mimosa saman Jacq., Fragm. 15, t. 19. 1809

Common Name: *Khirish* (Beng); *Rain tree* (Eng)

Tree 20(-50)m. Leaf pinnae 2-6 pairs each with 3-9 pairs of leaflets with a small gland near insertion of each pair, rhombic-oblong, asymmetric, increasing in size from base to apex, acute or obtuse, base cuneate, glabrous above, softly pubescent beneath. Heads c20 flowered on peduncles. Pods thick, brown or blackish.

Flowers & Fruits: March – June
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0959***, dated 04.05. 2002; Kamalpur TE, ***AP Das & Chandrâ 0627***, dated 20.04.2002.
Status: Common; also planted.
Local Distribution: All Terai gardens.
General Distribution: Native of Tropical Central America, planted as a wayside tree.
Note: Pods edible and are relished by cattle and pigs.

MORACEAE Link

ARTOCARPUS Forster

Artocarpus heterophyllus Lam., Encyl. Meth. B. 3: 209. 1789; Fl. Nep. 3: 208. 1982.

Evergreen monoecious tree, shoots glabrous. Leaves ovate, elliptic to obovate, apiculate, base cuneate, glabrous. Heads club-shaped, dioecios. Infructescence giant.

Flowers & Fruits: December – July.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 1173***, dated 18.10.2002.
Status: Very common; generally cultivated
Local Distribution: All Terai gardens.
General Distribution: Native of S.W. India.


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Artocarpus lacucha Buch.-Ham. in Mem. Wern Soc. 5.333. 1826; EFPN 3: 209.1979; FB 1(1):101.1983.
A. lakoocha Roxburgh, Fl. Ind. 3:524.1832; FBI 5:543.1888 p.p.

Deciduous, erect trees to 33m high. Petioles 2-5cm long. Leaves alternate, lamina to 25-34 x 12-21cm, elliptic-obovate, glossy greenish and glabrous above; juvenile foliage often pinnatifid. Stipules lateral, smooth. Flowers partially crowded into fleshy and subglobose heads. Syncarps subglobose, smooth and irregularly lobed.

Flowers & Fruits: February - May
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1025***, dated 09.05.2002.
Status: Common
Local Distribution: Terai gardens.
General Distribution: Himalayas (Kumaon-Bhutan), India, Sri Lanka, Myanmar, Malaysia.
Note: Fruits are eaten.

FICUS L.

Ficus benghalensis L., Sp. Pl. 1059. 1753; Fl. Nep. 3: 209. 1982.

Local Name: *Bot* (Beng); *Bar* (Nep)

Wide branching tree to 30m with numerous aerial roots from branches forming additional props, often epiphytic. Leaves ovate, obtuse or bluntly apiculate, base rounded or sub-cordate, finely puberulous beneath at first, glabrous, shiny above. Figs subglobose, solitary or in axillary pairs, sessile.

Flowers & Fruits: January – December.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 1550***, dated 22.10. 2002.
Status: Common
Local Distribution: All Terai gardens.
General Distribution: India, Pakistan, Bangladesh.
Note: Planted as a sacred tree.

Ficus glomerata Roxburgh, Pl. Corom. 2: 13, t. 123. 1798; FBI 5: 535. 1888.

Local Name: *Dumur* (Beng); *Dumri* (Nep)

Tree 3-10m. with leaves more coriaceous, ovate-elliptic, base rounded, sometimes cuneate, margins entire, glabrous. Figs borne on longer more slender lateral leafless shoots, rarely axillary, subglobose, glabrous or pubescent.

Flowers & Fruits: January – December.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0475***, dated 17.04.2003
Status: Common
Local Distribution: All Terai gardens.
General Distribution: Nepal, India, Pakistan, Sri Lanka, China, Malaysia, Australia.

Ficus hederacea Roxburgh, Fl. Ind. ed. 2(3):538. 1832; FEH 1:53. 1966; EFPN 3:210. 1982; FB 1(1):98. 1983; TBRI 50(4):100. 1987.
F. scandens Roxburgh, Fl. Ind. ed. 2 (3):536. 1832; FBI 5:526. 1888, *non* Lamarck.

Shrubby climber on rocks and trees, rooting from nodes. Leaves alternate, ovate-elliptic, acute, base rounded, margin entire, coriaceous, scabrid above, pubescent beneath. Hypanthodia globose, either solitary or axillary pairs, hairy, greenish yellow on ripening.

Flowers & Fruits: July – December.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2784***, dated 25.03. 2004.
Status: Very common.
Local Distribution: In all gardens.
General Distribution: Himalayas (Kashmir-Arunachal Pradesh), Assam, Myanmar, S. China.

Ficus heterophylla L.f., Suppl. Pl. 442. 1781; Fl. Nep. 3: 210. 1982.

Creeping shrub, stems pubescent at first. Leaves broadly ovate, acute, base obliquely cordate, unlobed or 1-5 lobed, denticulate, scabrid above, softly pubescent beneath. Figs solitary, axillary obovoid, pubescent at first, borne on peduncles.

Flowers & Fruits: January – December.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 3044***, dated 10.04. 2004.
Status: Less common
Local Distribution: Found only in Tamsong garden.
General Distribution: India, Bangladesh, Sri Lanka, China, Malayan Islands.

Ficus hirta Vahl, Enum. Pl. 2:201. 1806; FBI 5:531. 1888; EFPN 3:210. 1982; FB 1(1): 93. 1983.
F. triloba Wallich, Cat. 160, n. 4491.1831, *nom. nud.*

Local Name: *Khasray* (Nep).

Shrub to small tree, 2-3.5m high, hirsute. Petioles 4-13cm long. Lamina 12-38 x 9-30 cm, broadly ovate, usually unlobed or sometimes 3-5 lobed, acuminate, base rounded, margins serrulate, rarely cordate, thickly hirsute beneath, scabrid above. Figs sessile, axillary and in pairs, 2-4 cm, globose or ovoid, brownish hirsute.

Flowers & Fruits: June - March
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3542***, dated 12.10.2004.
Status: Less common
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Himalayas (Nepal-Arunacahal Pradesh), Myanmar, S. China, Malaysia.
Note: Figs are edible.

Ficus hispida L.f., Suppl. 442.1781; FBI 5: 522.1888; FB 1(1): 89.1983.

Local Name: *Koksa* (Nep)

Small trees without aerial roots; branches hispid; bark grey. Leaves decussate, ovate- oblong, coriaceous, dentate, acute, scabrid. Petiole hairy with a sub-nodal gland. Figs in cauliflorous clusters, dioecious, greens, obovoid, stiff-grey hairy.

Flowers & Fruits: April – January

Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1451,*** dated 20.10.2002; Kamalpur TE, ***AP Das & Chandrâ 1276***, dated 18.10.2002.
Status: Abundant
Local Distribution: All Terai gardens.
General Distribution: India, Sri Lanka, Bangladesh, Myanmar, Malayan Islands, China, Australia.
Note: Foliage used as fodder; figs edible.

Ficus neriifolia J.E. Smith in Rees, Cyclop. 14. no. 21. 1810; FEH 1: 54. 1966; FB 1(1): 95. 1983; TBRI 50 (4): 114. 1987.
F. gemella Wallich *ex* Miquel in Hooker's Lond. J. Bot. 7: 454. 1848.
F. nemoralis Wallich *ex* Miquel var. *gemella* (Wallich *ex* Miq.) King in ARBGC 1(2): 162. 1888; FBI 5: 534. 1888.

Local Name: *Dudhilo* (Nep).

Shrub or small tree, 4-9 m tall. Stem much branched and branchlets reddish. Leaves lanceolate or elliptic-lanceolate, entire, sharply acuminate, base cuneate, glabrous both surfaces, dark coloured beneath. Figs ellipsoidal-globose, scaly at base, sessile, sometimes peduncled.

Flowers & Fruits: July – February.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2090,*** dated 30.06. 2003; Makaibari TE, ***AP Das & Chandrâ 2842,*** dated 25.03. 2004.
Status: Very common.
Local Distribution: All three hill gardens.
General Distribution: Himalayas (Nepal-Arunachal Pradesh), E. Tibet, S.W. China.
Note: Figs are edible. Foliage excellent fodder for cattle.

Ficus religiosa L., Sp. Pl. 1059. 1753; FEH 1: 54. 1966; Fl. Nep. 3: 211. 1982.

Local Name: *Asatthwa* (Beng); *Pipli* (Nep)

Tree to 20m, often epiphytic, leaves more abruptly and longer caudate-acuminate, margins sinuate, petioles slender. Figs smaller, purplish when ripe.

Flowers & Fruits: April – September.
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1004,*** dated 09.05.2002.
Status: Common.
Local Distribution: All Terai gardens.
General Distribution: India, Sri Lanka, Bangladesh, Myanmar, Malaysia & China.
Note: Planted as a sacred tree used as a host for the lac insect.

MORUS L.

Morus australis Poiret in Lamarck, Ency. 4:380.1797; FB 1(1): 101. 1983.
M. indica auct. non L.: Hook.f., FBI 5:492. 1888.

Local Name: *Sano Kimbu* (Nep), *Tunt* (Beng).

Deciduous shrub to small tree. Stipules upto 1cm, lateral; lamina, ovate, caudate-acuminate, cordate, coarsely serrate, sometimes trilobed, pubescent beneath, strigose above. Male spikes ±2.5cm, axillary. Females shorter; tepals ovate, succulent in fruit. Infructescens purplish-black.

Flowers & Fruits: March - May.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1703,*** dated 17.05.2003; Tamsong TE, ***AP Das & Chandrâ 2000***, dated 30.06. 2003; Soom TE, ***AP Das & Chandrâ 3103***, dated 03.05. 2004.
Status: Sparse.
Local Distribution: In all gardens.
General Distribution: Himalayas (Kumaon – Bhutan), Assam, Myanmar, W. China.
Note: Fruits are eaten.

Morus macroura Miquel, Pl. Jungh. 42. 1851; FEH 1:55. 1966; 2:20. 1971; EFPN 3:212. 1982; FB 1(1):102. 1983.
M. laevigata Wallich ex Brandis, For. Fl. Ind. 409. 1874; FBI 5:492. 1885.

Local Name: *Kimbu* (Nep).

Large deciduous trees to 30m high. Leaves alternate; lamina 6-16.5 x 6-13cm, elliptic-ovate, unlobed, base rounded, finely serrate, thinly pubescent. Male catkins subsessile, long, villous. Female catkins 3.2 – 5.2cm; styles bifid. Fruiting catkins elongated, yellowish white on ripening.

Flowers & Fruits: March – June
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1860,*** dated 10.06. 2003*;* Tamsong TE, ***AP Das & Chandrâ 2177,*** dated 30.06. 2003.
Status: Only few plants seen.
Local Distribution: All three hill gardens.
General Distribution: Himalayas (Kumaon – Bhutan), India, S.W. China.

STREBLUS Loureiro

Streblus asper Lour., Fl. Cochinch. 615. 1790; FBI 5: 489. 1888; FEH 1: 55. 1966; EFPN 3: 212. 1982.

Local Name: *Ayash Saorha* (Ben.); *Kakshi* (Nep)

Unarmed evergreen shrub or tree to 12m. Shoots pubescent at first. Leaves elliptic-obovate, acute, base cuneate, margins sinuate or weakly serrate, scabrid, sessile or petiolate.

Flowers & Fruits: March – December.
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 0156,*** dated 03.02.2002.
Status: Common
Local Distribution: All Terai gardens.
General Distribution: India, Sri Lanka, Bangladesh, Malayan Islands, China, Thailand.

MYRSINACEAE R. Brown

ARDISIA Swartz, *nom. cons.*

Ardisia colorata Roxburgh, Hort. Bengal. 16. 1814; FB 2(2): 513. 1999.

Shrub or small tree to 4m, glabrous. Leaves coriaceous, elliptic, acute or shortly acuminate, base cuneate, margin entire, with short petioles. Flowers pink, borne in terminal panicles. Fruit red.

Flowers & Fruits: November – March
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0042***, dated 27.01.2002.
Status: Rare
Local Distribution: Found only in Mohurgong & Gulma gardens.
General Distribution: Nepal, India, Sri Lanka, China, Malaysia, Singapore.

Ardisia solanacea Roxburgh, Cor. Pl. 1:27, t.27.1795; FB 2(2): 514 .1999.
A. humilis sensu Wight, Ic. t. 1212.1848; FBI 3:529.1882, *p.p.*

Shrubs; branches glabrous. Lamina coriaceous, obovate, entire, apiculate, base attenuate, glabrous with scattered minute gland dots beneath; petiole winged. Flowers pink in axillary sub-umbellate racemes (3-12 flowered). Fruits crimson, globose.

Flowers & Fruits: April – January
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0080,*** dated 27.01.2002.
Status: Less common
Local Distribution: Common in low altitude areas.
General Distribution: India, Pakistan, Sri Lanka, Southwestern China, Singapore, etc.

MAESA Forskal

Maesa chisia Buch.–Ham. ex D. Don, Prodr. Fl. Nep. 148. 1825; FBI 3: 509. 1882; FEH 1: 243. 1966; EFPN 3: 76. 1982; FB 2(2): 507. 1999.

Shrub or more rarely small tree, 2 –6m, branchlets glabrous. Leaves membranous, lanceolate or elliptic, acuminate, base cuneate, margins subentire, sinuate or distantly and shallowly serrate, glabrous. Flowers white in simple or branched racemes.

Flowers & Fruits: February – August
Specimen Cited: Makaibari TE, **AP Das & Chandrâ 2497,** dated 11.11. 2003; Soom TE, ***AP Das & Chandrâ 3447***, dated 12. 10. 2004.
Status: Common
Local Distribution: All three hill gardens.
General Distribution: India, Nepal, Bhutan, Northern Myanmar

Maesa montana A. DC. in DC., Prodr. 8: 79. 1844; FEH 1: 243. 1966.
M. indica auct. non (Roxb.) A. DC.: Cl. in FBI 3: 509. 1882 p.p.
M. elongata Mez in Pfreich. Ht. 9: 31. 1902.

Shrub to 4.5 m high. Branches slender. Bark warty, dark brown. Leaves highly variable from ovate or obovate-elliptic, oblanceolate, elliptic-lanceolate, obscurely dentate at distant, acute to caudate-acuminate, base cuneate, rounded, sometimes obtuse, glabrous. Racemes branched with white flowers. Frtuis subglobose, creamy white, many seeded.

Flowers & Fruits: February – November.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 1547***, dated 22.10. 2002.
Status: Less common
Local Distribution: Common in low altitude areas.
General Distribution: Tropical Himalayas (Nepal-Bhutan), Assam, east to West China.

MYRTACEAE A. Jussieu

SYGYGIUM Gaertner

Syzygium cumini (L.) Skeels in U.S. Dept. Agric. Bur. Pl. Ind. Bull. 248. 25. 1912; FB 2(1): 284.1991.
Myrtus cumini L., Sp. Pl. 471. 1753.

Trees to 25 m. Leaves coriaceous, elliptic/ ovate / obovate, acuminate, cuneate, glausescent. Cymes borne in axils of older and fallen leaves, many flowered. Flowers sessile. Calyx funnel – shaped, tapering to stalk-like base, persistent. Petals creamy, shed as a cap. Ripe fruits black.

Flowers & Fruits: Jun. - Dec.
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1137***, dated ; 09.05.2002; Makaibari TE, ***AP Das & Chandrâ 2834***, dated 25.03. 2004
Status: Very common.
Local Distribution: In Terai and low altitude areas.
General Distribution: Tropical and Subtropical India; Sri Lanka, Malaya and Australia.

Syzygium operculatum (Roxburgh) Niedenzu in Pfamilien. 3, 7: 85. 1893; FB 2(1): 284. 1991.
Eugenia operculata Roxburgh, Fl. Ind. 2: 486. 1832; FBI 2: 498. 1878.

Tree with leaves thinly coriaceous, broadly ovate or elliptic, obtuse or bluntly apiculate base rounded to truncate or cuneate; turn bright red in cool season. Flowers white in cymes in axils of lower and fallen leaves, many flowered. Fruit globose, black, crowned.

Flowers & Fruits: July – September.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2174***, dated 30.06. 2003.
Status: Common
Local Distribution: In Terai and low altitude areas.
General Distribution: Eastern Himalaya (Nepal – Bhutan), China.

NYCTAGINACEAE A. Jussieu

BOERHAVIA L.

Boerhavia coccinea Mill., Gard. Dict., ed. 8. n. 4. 1768; FB 1(2): 194 .1984.

Local Name: *Punarnava* (Beng)

Diffuse, perennial scandent with terete stems, purple tinged, glandular hairy, nodes swollen. Leaf pairs unequal, broadly ovate, oblong or orbicular, entire, rounded at both ends, slightly hairy beneath. corymbose umbels axillary; flowers pink or purple. Fruits 5-ribbed, glandular hairy.

Flowers & Fruits: April – December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0064***, dated 27.01.2002.
Status: Abundant.
Local Distribution: All Terai gardens.
General Distribution: Pantropical.

MIRABILIS L.

Mirabilis jalapa L., Sp. Pl. 177. 1753; Fl. Nep. 3: 167. 1982; FB 1(2): 192. 1984.

Common Name: *Four-O-Clock Plant*

Robust herb, 60-150cm with leaves triangular-ovate, acuminate, base truncate glabrous or sparsely puberculous. Flowers with red or white, trumpet-shaped or narrowly funnel shaped perianth.

Flowers & Fruits: April – November
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 1178***, dated 18.10.2002.
Status: Common; grown as an ornamental.
Local Distribution: All Terai gardens.
General Distribution: Native of tropical America; seminaturalised.

OLEACEAE Hoffmann & Link

JASMINUM L.

Jasminum caudatum Wallich ex Lindl. in B. Reg. 28: t. 26. 1842; FBI 3: 601. 1882; Fl. Nep. 3: 80. 1982.

Local Name: *Kagaji phul* (Nep)

Large twining or sprawling climber to 3m tall. Leaves opposite, (1-)3-foliate, indistinct. Leaflets ovate-lanceolate, apex acuminate to acute, base obtuse to cuneate, glabrous but not coriaceous. Terminal leaflet large, lateral smaller. Flowers large, sweet-scented, white in terminal or axillary cyme, wide spreading.

Flowers & Fruits: June – November
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2499,*** dated 11.11. 2003
Status: Rare
Local Distribution: Found only in Makaibari garden.
General Distribution: India, Nepal, Bhutan.

Jasminum dispermum Wallich in Roxburgh, Fl. Ind. ed. Carey, 1:99. 1820; FBI 3: 602. 1882; FEH 1:251. 1966; EFPN 3:80. 1982; TBRI 50(4): 117. 1987.

Local Name: *Harhey Lahara, Charpatay Lahara* (Nep).

Climbing shrub or liana, glabrous, woody, terete. Leaves opposite 3-foliate; laterals smaller, terminal one 4-8.5 x1.7-3.7cm, ovate-lanceolate, entire, acuminate. Cymes terminal & axillary, 5-15 flowered. Flowers ebracteate; sepal teeth triangular; corolla white-pinkish; stamens included.

Flowers & Fruits: February – March.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 1946,*** dated 30.06. 2003.
Status: Less Common.
Local Distribution: Found only in Tamsong garden
General Distribution: Himalayas (Kashmir – Arunachal Pradesh), N. Assam, Thailand, W. China.

Jasminum grandiflorum L., Sp. Pl. ed. 2, 9. 1762; Fl. Ind. 1: 98. 1820; FB 2(2): 592. 1999.

Robust, scrambling shrub to 3m tall. Leaves opposite, pinnate with (5-) 7-13 sub-sessile leaflets. Leaflets very variable, apex acute, base obtuse to cuneate, hirsute to glabrous. Flowers sweet-scented, white, rarely solitary in widely branching cyme, 3-many flowered.

Flowers & Fruits: June – October
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2802***, dated 25.03. 2004; Soom TE, ***AP Das & Chandrâ 3552***, dated 12. 10. 2004.
Status: Rare
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: India, Nepal.

Jasminum nervosum Lour., Fl. Cochinch. 20. 1790; FB 2(2); 587. 1999

Twining shrub 3-10m tall; Leaves opposite, simple, ovate to ovate-lanceolate, apex acuminate to acute, base truncate to cuneate, glabrous. Terminal or axillary cyme of 1-5-flowered. Fruit ellipsoid.

Flowers & Fruits: March – July.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2871***, dated 25.03. 2004.
Status: Less Common.
Local Distribution: In Terai and low altitude areas.
General Distribution: Indian subcontinent.

Jasminum pubescens (Retz.) Willd., Sp. Pl. 1: 37. 1797; FBI 3: 592. 1882.
Nyctanthes pubescens Retz., Obs. 5: 9. 1788.

Local Name: *Kunda* (Beng).

Shrubby slimber, twining; leaves simple; lamina ovate, entire, acute to acuminate, pubescent; flowers in dense cymose panicle, white, aromatic; fruits globose, black on ripening.

Flowers & Fruits: April – september.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0070***, dated 27.01.2002.
Status: Common; generally cultivated for flowers.
Local Distribution: All Terai gardens.

General Distribution: Subtropical Himalaya, India, Sri Lanka, Myanmar, China.

Jasminum scandens Vahl, Symb. Bot. 3: 2. 1794; FB 2(2): 588.1999.

Local Name: *Hara Lahara* (Nep).

Large shrubby climber; young stems minutely hirsute. Leaves opposite, simple; lamina ovate-lanceolate, acuminate, broadly cordate to rounded, semi-coriaceous, glabrous. Flowers sweetly scented, white, sometimes pink-flushed in axillary or terminal contracted cymes.

Flowers: December – March
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2835,*** dated 25.03. 2004.
Status: Less Common.
Local Distribution: Found only in Makaibari garden
General Distribution: India, Sri Lanka

ONAGRACEAE A. Jussieu

LUDWIGIA L.

Ludwigia octovalvis (Jacq.) Raven in KB 15: 476. 1962; FB 2(1): 312. 1991.
Oenothera octovalvis Jacq., Enum. 19. 1760.

Robust, much branched perennial herb, sometimes woody at base to 4m tall, subglabrous or with appressed or spreading pubescent. Leaves sublinear to subovate, apex attenuate, base cuneate. Flowers yellow. Capsules terete, readily and irregularly loculicidal.

Flowers & Fruits: January – March
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0476***, dated 17.04.2002.
Status: Very common.
Local Distribution: All Terai gardens.
General Distribution: India, Japan, Malaysia, Australia, Polynesia, Africa, Tropical America.

Ludwigia perennis L., Sp. Pl. ed. 1(1): 119. 1753; FEH 1:225. 1966; EFPN 2:176. 1979; FB 2(1): 312.1991.
L. parviflora Roxburgh, Fl. Ind. ed. Carey 1:440.1820; FBI 2:588. 1879.

Annual herbs, >1m; young parts puberulous. Lamina narrowly elliptic to lanceolate, subacute, entire; petioles long, winged. Flowers with yellowish elliptic petals, borne singly or clustered, axillary. Capsules glabrous or puberulent, loculicidal, sessile or stalked.

Flowers & Fruits: August – March
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0431***, dated 05.04.2002; Matigara TE, ***AP Das & Chandrâ 3615***, dated 20.10.2004; Makaibari TE, ***AP Das & Chandrâ 1708***, dated 17.05.2003; Soom TE, ***AP Das & Chandrâ 3556***, dated 12. 10. 2004.
Status: Abundant
Local Distribution: In Terai and low altitude areas.
General Distribution: India, Sri Lanka, Madagascar, Continental S.E. Asia and Malaysia to tropical Africa, Australia and New Caledonia.

OXALIDACEAE R. Brown

BIOPHYTUM DC.

Biophytum sensitivum (L.) DC., Prodr. 1: 690. 1824; FBI 1: 436. 1874. FB 1(3): 1987; FI 4:238. 1997.
Oxalis sensitiva L., Sp. Pl. 434. 1753.

Small, erect, unbranched annual, pubescent. Leaves sensitive, crowded at tip; rachis 5 –10 cm; leaflets opposite, 5 –15 pairs. Peduncles apressed –strigose & glandular hairy. Bracts lanceolate. Sepals ovate –lanceolate, strigose & glandular hairy. Petals lanceolate, yellow.

Flowers & Fruits: June – December.
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1147***, dated 14.06.2002
Status: Abundant
Local Distribution: In all gardens
General Distribution: Tropica Asia, Africa & America.

OXALIS L.

Oxalis corniculata L., Sp. Pl. 435. 1753; FBI 1: 436. 1874; FEH 1:168. 1966; EFPN 2: 77. 1979; FWB 1:373. 1997; FB 1(3): 742.1987. var. ***corniculata***

Local Name: *Chari-amilo* (Nep), *Amruli, Amrul* (Beng).

Annual prostrate herbs; runners spreading, leafy, pubescent. Leaves palmate-trifoliate, radicals clustered; stipules adnate. Leaflets broadly obcordate, lobes rounded, base cuneate. Peduncles axilary, 2-5 yellow flowered. Capsules subcylindric, pubescent, transversely ribbed, many seeded.

Flowers & Fruits: January – December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0053,*** dated 27.01.2002; Hansqua TE, ***AP Das & Chandrâ 0150***, datcd 03.02.2002; Makaibari TE, ***AP Das & Chandrâ 1743***, dated 17.05.2003; Soom TE, ***AP Das & Chandrâ 2648***, dated 27.12. 2003; Tamsong TE, ***AP Das & Chandrâ*** 2143, dated 30.06. 2003.
Status: Abundant.
Local Distribution: In all gardens
General Distribution: Cosmopolitan.
Note: Edible and medicinal; leaves used to cure scurvy, dysentery, to improve appetite, also taken as sauce after cooking.

Oxalis corniculata L. var. ***villosa*** Watson

Like the type variety but a smaller and densely branched plant; leaves smaller, densely villous.

Flowers & Fruits: January – December
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2870***, dated 25.03. 2004; Soom TE, ***AP Das & Chandrâ 2710***, dated 27.01. 2004; Tamsong TE, ***AP Das & Chandrâ 2260***, dated 05.09. 2003.
Status: Common

Local Distribution: Found only in Soom & Tamsong gardens
General Distribution: Eastern Himalaya.

Oxalis corymbosa DC., Prodr. 1:696. 1824; FEH 1: 168. 1966; EFPN 2:77. 1979; FB 1(3): 743.1987.

Small rosette herb with tunicated bulbs. Bulbils many, ovoid, outer scales 3-nerved. Leaflets obcordate, pilose, gland dotted beneath. Umbels compound, upto 12 flowered with spathulate pink petals. Capsules subcylindric, many seeded.

Flowers & Fruits: March – July
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1933,*** dated 20.10.2002; Kamalpur TE, ***AP Das & Chandrâ 0661***, dated 20.04.2002; Soom TE, ***AP Das & Chandrâ 3597***, dated 12. 10. 2004; Tamsong TE, ***AP Das & Chandrâ 2883***, dated 10.04. 2004.
Status: Abundant.
Local Distribution: In all gardens
General Distribution: Native of tropical America naturalized in Asia.

Oxalis latifolia Humboldt, Bonpland & Kunth., Nov. Gen. Sp. 5:184, t. 467. 1821; FEH 1: 168. 1966; EFPN 2:77. 1979; TBRI 50(4): 121. 1987; FB 1(3): 743. 1987.

Like *O. corymbosa* but bulbil scales many nerved; leaflets 3-6 x 2.5-4cm, obtriangular, shallowly emarginate, eglandular, glabrous; umbels simple; flowers campanulate; sepals with 2 hastate apical glands; petals red-pink.

Flowers: May - July; *Fruits*.: Jun. - Aug.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2419***, dated 05.11. 2003.
Status: Frequent in open places.
Local Distribution: All three hill gardens
General Distribution: Native of tropical America naturalized in Asia.

PAPAVERACEAE A. Jussieu

ARGEMONE L.

Argemone mexicana L., Sp. Pl. 508.1753; FBI 1:117.1872; FI 2:2.1993; FB 1(2): 402.1984.

Local Name: *Siyalknata* (Beng), *Mexican Poppy, Prickly Poppy* (Eng)

Erect annual herbs; sap yellowish. Leaves deeply pinnatified, spinulose-dentate, both surfaces prickly, shortly petiloed, upper sessile, clasping at base. Bracts leafy. Flowers yellow, terminal, solitary on short branches, shortly pedicelled. Capsules oblong-ellipsoid, spiny, many seeded.

Flowers & Fruits: December – January
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0015***, dated 27.01.2002; Kamalpur TE, ***AP Das & Chandrâ 1189***, dated 18.10.2002.
Status: Common.
Local Distribution: All Terai gardens
General Distribution: A native of America naturalized throughout India.

Note: Seeds used as adulterants to mustard seeds, produces oil used for burning lamps and also to treat skin diseases.

PASSIFLORACEAE A. Jussieu

PASSIFLORA L.

Passiflora foetida L., Sp. Pl. 969. 1753; FBI 2: 599. 1879.

Annual climber, thickly glandular hairy, sticky; stipuled much dissectes; tendril axillary, simple; lamina ovate, trilobed; flowers axillary, corolla white; corona purple; fruits globose, yellow on ripening, remain covered with enlarged bipinnatisect & glandular-tipped bracts.

Flowers & Fruits: August – April.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0436***, dated 05.04.2002; Kamalpur TE, ***AP Das & Chandrâ 1287***, dated 18.10.2002.
Status: Very common.
Local Distribution: All Terai gardens
General Distribution: Native of Tropical America; naturalized in the tropics.

PIPERACEAE C. A. Agardh.

PEPEROMIA Ruiz. et Pav.

Peperomia pellucida (L.) Humboldt, Bonpland & Kunth, Nov. Gen. 1: 64. 1815; FEH 1: 42. 1966; FB 1(2): 345. 1984.
Piper pellucidum L., Sp. Pl. 1: 30. 1753.

Succulent creeping or erect herb, 15 –40 cm, glabrous throughout. Leaves thin, broadly ovate, acute base cordate, palmately 5 –veined from base. Spikes 2.5 –5 cm, terminal, leaf –opposed. Drupes 0.5 mm.

Flowers & Fruits: January - December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 1555***, dated 22.10. 2002; Hansqua TE, ***AP Das & Chandrâ 1101,*** dated 09.05.2002; Makaibari TE, ***AP Das & Chandrâ 19**33*, dated 30.06. 2003; Soom TE, ***AP Das & Chandrâ*** 3518, dated 12.10.2004; Tamsong TE, ***AP Das & Chandrâ 1837***, dated 10.06. 2003.
Status: Abundant
Local Distribution: In all gardens.
General Distribution: Native of South America; now a pantropic weed.

PIPER L.

Piper attenuatum Buch.-Ham. *ex* Miquel, Syst. Pip. 306. 1843; FBI 5: 92. 1886; FB 1(2): 347. 1984.
Piper trioicum Roxburgh, Fl. Ind. 1: 151. 1820.

Climbing shrub. Leaves membranous, green or yellow –green when dry, broadly ovate, shortly acuminate, truncate or weakly cordate, 7 –9 veined, glabrous or sparsely pubescent beneath;

stipules narrow, adnate to petiole. Flowering spikes slender, 6 –12cm. Drupes globose, sessile, loosely aggregated.

Flowers & Fruits: January - December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 1513,*** dated 22.10.2002; Makaibari TE, ***AP Das & Chandrâ 1904,*** dated 10.06. 2003.
Status: Less common
Local Distribution: Found in Terai gardens.
General Distribution: India, Bangladesh, Bhutan, Sri Lanka, Myanmar, China.

Piper boehmeriifolia (Miquel) DC., Prodr. 16(1) : 348. 1869; FBI 5: 85. 1886; FEH 1: 43. 1966; Fl. Nep. 3: 183. 1982.
Chavica boehmeriaefolia Miq., Syst. Pip. 265. 1843.

Flowers & Fruits: September – December.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2410,*** dated 05.11. 2003.
Status: Common
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Himalayas, Meghalaya, Assam & Myanmar.

Piper chuvya (Miquel) C. DC. : FB 1(2): 350. 1984.

Local Name: *Chaba* (Nep)

A stouter climber, leaves thinly coriaceous ovate, often broadly ovate, puberulous and gland-dotted beneath. Female spikes elongated than male spikes. Fruiting spikes interrupted with only some drupes ripening.

Flowers & Fruits: January – April.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2028,*** dated 30.06. 2003.
Status: Less common
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Eastern Himalaya

Piper longum L., Sp. Pl. 29. 1753; FBI 5: 83. 1886; FEH 2: 14. 1971; EFPN 3: 183. 1982; FB 1(2): 348. 1984.

Local Name: *Peepla* (Nep).

Slender climbing shrub, stems puberulous, striate when dry. Leaves membranous, broadly ovate on creeping stems, sub-acute or shortly and bluntly acuminate, base deeply cordate-auriculate, symmetric. Male spikes slender and female spikes cylindric. Fruiting spikes swollen with densely arranged drupes.

Flowers & Fruits: September – January.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 1342,*** dated 18.10.2002.
Status: Very common.
Local Distribution: All Terai gardens.
General Distribution: India, Bangladesh, Bhutan, Malaysia, Nepal, Sri Lanka.
Note: Cultivated and possibly naturalised. Fruit used as a pepper and roots used medicinally.

Piper mullesua D. Don, Prodr. 20. 1825; FEH 1: 43. 1966; FB 1(2): 347. 1984.
P. brachystachyum Wallich ex Hook. f., FBI 5: 87. 1886.

Local Name: *Peepla* (Nep).

Shrubby climbers; branches ascending; nodes swollen, rooting. Old stem warted. Lamina ovate-cordate or elliptic-ovate, long acuminate, base cuneate, glabrescent, 5-nerved. Male spikes to 7 cm long, erect. Stamens 2; anthers reniform. Female spikes cylindric or globose. Drupes densely clustered.

Flowers & Fruits: March - October
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2511***, dated 11.11. 2003.
Status: Common.
Local Distribution: All three hill gardens.
General Distribution: Himalayas (Kumaon – Bhutan), India.

Piper pedicellatum C. DC. in Prodr. 16 (1): 343. 1869; FBI 5:81. 1886; FB 1(2):349. 1984; TBRI 50(4):123. 1987.
P. boehmeriifolium sensu Wallich ex C. DC., Prodr. 16(1):348. 1869; FBI 5:85. 1886; FEH 1:43. 1966; EFPN 3:181. 1982.

Local Name: *Bhalay Chabo* (Nep).

Shrubby climber; stem glabrous, soft, warted; lamina broadly ovate, acuminate, base narrowed, nerves 5-8 with lateral nervules, glabrous, upper subsessile, elliptic. ♂spikes 10-21 cm long, flexuous; bracts peltate; stamens 2; anthers subsessile. ♀ spikes 5-10cm. Drupes c.0.15cm across.

Flowers & Fruits: March – January.
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3441***, dated 12.10.2004.
Status: Common.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Himalayas (Nepal – Bhutan), India, Myanmar.
Note: Leaves are sometimes chewed with bettle-nuts; used as a sacred plant in Hindu rituals.

Piper peepuloides Roxb., Fl. Ind. 1: 159. 1820; FBI 5: 83. 1886; FEH 1: 43. 1966; EFPN 3: 183. 1982; FB 1(2): 348. 1984.

Local Name: *Ruk peepla* (Nep).

Terrestrial or epiphytic shrub, sometimes climbing, stems pubescent. Leaves on aerial branches tapering to a round, shallowly cordate, usually oblique base, prominently 5-veined in basal. Female spikes shortly cylindric, rarely subglobose in fruit.

Flowers & Fruits: November – February.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2250***, dated 05.09. 2003.
Status: Common
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Temperate Himalayas, Meghalaya, Assam & Manipur.

Piper suipiqua Ham. *ex* D. Don, Prodr. Fl. Nep. 20. 1825; EFPN 3:181. 1982; FB 1(2):350. 1984.
P. nepalense Miquel, Syst. Pip. 318. 1843; FBI 5:49. 1886; FEH 1:43. 1966; EFPN 3:186. 1982.

Local Name: *Dankhlay Chabo* (Nep).

Large climbing shrub, with glabrous stem. Leaves petiolate, ovate, acuminate, base obliquely cuneate, coriaceous, glabrous. Fruiting spikes whitish pubescent. Drupes sessile, ovoid.

Flowers & Fruits: May – January.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2503***, dated 11.11. 2003.
Status: Less common
Local Distribution: Found only in Makaibari garden.
General Distribution: Himalayas (Garhwal-Bhutan).

Piper sylvaticum Roxburgh, Fl. Ind. 1: 156. 1832; FBI 5: 84. 1886; FB 1(2): 348. 1984.

Climbing shrub, stems deeply straiate when dry. Leaves broadly ovate-cordate, membranous, ovate to lanceolate, acuminate, base cuneate or rounded, symmetric or slightly oblique, 5 veined at base. Drupes globose, densely arranged on fruiting spikes.

Flowers & Fruits: March – July
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3539***, dated 12. 10. 2004.
Status: Rare.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: India, Bhutan, Nepal, China.

PLANTAGINACEAE A. Jussieu

PLANTAGO L.

Plantago erosa Wallich in Roxburgh, Fl. Ind. 1: 423. 1820; FEH 1: 306. 1966; EFPN 3:166 1982; TBRI 50(4): 123. 1987.
P. major auct. non. L.: Hook.f. in FBI 4: 705. 1885 p.p.

Small rosette scapigerous perennial herbs. Leaves radical; lamina oblong/ oblong-ovate, entire to repand/ irregular-dentate, acute/ obtuse, glabrous, 3-5 nerved. Spikes to 3.5cm, axillary. Flowers sessile, crowded, white; sepals 4, glabrous, medianly black thick-lined. Capsules few seeded.

Flowers: April - July; *Fruits*: June - October.
Specimen Cited: Makaibari TE, AP Das & Chandrâ 1905, dated 10.06. 2003; Soom TE, ***AP Das & Chandrâ 3202,*** dated 26.06. 2004; Tamsong TE, AP Das & Chandrâ 2427, dated 05.11 2003.
Status: Abundant.
Local Distribution: Makaibari, Soom, Tamsong
General Distribution: India, Sri Lanka, Himalayas (Kumaon – Bhutan), Assam, Meghalaya, Myanmar, S.E. Tibet, W. China.

POLYGALACEAE A. Juss.

POLYGALA L.

Polygala glomerata Loureiro, Fl. Cochinch. 426. 1790.
Polygala chinensis L., Sp. Pl. 2: 704. 1753; FBI 1: 204. 1872; FI 2: 464. 1993.

Small, erect annual herb, to 30 cm tall, densely pubescent; leaves sessile, linear-lanceolate, glabrous; racemes slightly extra-axillary, 2-3 flowered; flowers nodding, outer sepals acuminate, ciliate; wings acuminate, awned.

Flowers & Fruits: July – October.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2812***, dated 25.03. 2004
Status: Less common
Local Distribution: Terai & low altitude hills.
General Distribution: Tropical Asia.

POLYGONACEAE A. Jussieu

ACONOGONUM (Meisner)Reichenbach

Aconogonum molle (D. Don) Hara in FEH 1:68. 1966; 2:21. 1971; EFPN 3: 172. 1982; FB 1(1): 156. 1983; TBRI 50(4): 104. 1987. var. ***molle***.
Polygonum molle D. Don, Prodr. Fl. Nep. 72. 1825; FBI 5: 50. 1886.

Local Name: *Thotney* (Nep).

Bushy straggling shrubs. Branches zigzag, terete, grooved. Stipules oblique tubular, caducous; lamina elliptic-lanceolate, entire, acute/ acuminate, lateral nerves 12-17 pairs. Panicles axillary & terminal, hirsute. Flowers white; tepals 5, spreading; stamens 8; ovary cylindric. Nutlets 3-angled.

Flowers & Fruits: June - September.
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3452,*** dated 12.10.2004.
Status: Common.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Himalayas, Meghalaya, Malaysia, Indo-Chin and China.
Note: Young stems are taken raw and also consumed as curry.

PERSICARIA L.

Persicaria barbata (L.) Hara in FEH 1: 70. 1966; Fl. Nep. 3: 175. 1982.
Polygonum barbatum L., Sp. Pl. 362. 1753; FBI 5: 37. 1886.

Tall annual, much brached; stipulescylindric, with numerous long bristles; panicles dense-flowered; perianth white; achenes triangular.

Flowers & Fruits: January - December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0856***, dated 04.05. 2002; Kamalpur TE, ***AP Das & Chandrâ 1364***, dated 18.10.2002.

Status: Very common.
Local Distribution: All Terai gardens.
General Distribution: Pantropical.

Persicaria capitata (D. Don) H. Gross in Engler, Bot. Jahrb. 49:277. 1913; FBI 5:44. 1886; FEH 1:70. 1966; FB 1(1): 165. 1983.
Polygonum capitatum D. Don, Prodr. Fl. Nep. 73. 1875.

Prpstrate annual with leafy stems. Ocreae truncate, pubescent. Lamina ovate-elliptic, entire-ciliate, acute, base cuneate or rounded. Peduncles 1.5-4 cm long, glandular at apex with globose, solitary flower heads.

Flowers & Fruits: April – September
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2792***, dated 25.03. 2004; Soom TE, ***AP Das & Chandrâ 3531***, dated 12.10.2004
Status: Abundant.
Local Distribution: All hill gardens.
General Distribution: Himalayas (Punjab – Bhutan), Assam, N. Myanmar, Tibet, Indo-China, W. China.
Note: Medicinal.

Persicaria chinensis (L.) H. Gross in Engler, Bot. Jaharb. 49:269. 277 & 315. 1913; FB 1(1):163. 1983; TBRI 50(4):122. 1987.
Polygonum chinense L., Sp. Pl. ed. 1, 1:363. 1753; FBI 5:44. 1886. var. *ovalifolia* (Meisn.) Hara in FEH 1:71. 1966; 2:22. 1971; EFPN 3:175. 1982.
Polygonum auriculatum Meisner, Monog. Polu. 59, t. 6. 1826.

Local Name: Ratnewlo (Nep).

Erect or rambling, pubescent; stem grooved. Stipule membranous; leaves amplexicauled, lamina variable, oblong-lanceolate to oblong-ovate. Flowers in corymbose glandular hairy heads, pinkish-white; stamens 8; filaments glandular; styles united below. Nuts red-turning black.

Flowers: Jun. - Oct. *Fruits*: Aug. - Dec.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0024***, dated 27.01.2002; Makaibari TE, ***AP Das & Chandrâ 2757***, dated 25.03. 2004; Tamsong TE, ***AP Das & Chandrâ 3053***, dated 10.04.2004; Soom TE, ***AP Das & Chandrâ 3182***, dated 26.06. 2004.
Status: Common.
Local Distribution: In all gardens.
General Distribution: Himalayas, India east to China, Japan, Malaysia.
Note: Good fodder for cattle

Persicaria chinensis var. auriculata [= Per auriculata]
Polygonum auriculatum Meissn., Mon. Gen. Polyg. 59, t. 6. 1826;

Like the type variety but leaves auriculate at base and flower-heads & flowers smaller.

Flowers & Fruits: June – December.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1700***, dated 17.05.2003; Soom TE, ***AP Das & Chandrâ 3180***, dated 26.06. 2004.
Status: Common

Local Distribution: All hill gardens.
General Distribution: Himalayas, India east to China, Japan, Malaysia.

Persicaria hydropiper (L.) Spach, Hist. Veg. 10:536. 1841; FEH 2:23. 1971; EFPN 3:176. 1982; FB 1(1):162. 1983; TBRI 50 (4):122. 1987.
Polygonum hydropiper L., Sp. Pl. 361. 1753; FBI 5:39. 1886.

Ascending weak herbs to 60cm, much branched. Ochrea glabrous, mouth ciliated. Upper leaves sessile; lamina lanceolate, aciminate, glabrous, punctate, margins setulose. Racemes ± 8 cm long, slender. Perianth 4-5 cleft; stamens 6; styles 2, capitate. Achenes biconvex, dark brown.

Flowers & Fruits: May - August.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0461***, dated 17.04.2002; Soom TE, ***AP Das & Chandrâ 2702***, dated 09.01.2004; Tamsong TE, ***AP Das & Chandrâ 2057***, dated 30.06. 2003.
Status: Sparse.
Local Distribution: in all gardens
General Distribution: Europe, N. Africa, Himalayas, India, Meghalaya, Japan, N. America.

Persicaria lapathifolia (L.) S.F.Gray, Nat. Arr. Br. Pl. 2: 270. 1821; EFPN 3: 176. 1982; FB 1(1): 161. 1983.
Polygonum lapathifolium L., Sp. Pl. 360. 1753; FBI 5: 35. 1886.

Glabrous herb – c1m, stems lanate. Leaves lanceolate, sparsely lanate above, more densely white or pink in drooping racemes, racemousely arranged.

Flowers & Fruits: July - December
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1026***, dated ; Kamalpur TE, ***AP Das & Chandrâ 0561***, dated 17.04.2002.
Status: Common
Local Distribution: All Terai gardens.
General Distribution: India, Nepal, Bhutan, Myanmar, Taiwan, Malaysia

Persicaria microcephala (D. Don) H. Gross in Engl., Bot. Jahrb. 49: 277. 1913; FEH 1: 72. 1966; 2: 23. 1971; EFPN 3: 170. 1982; FB 1(1): 165. 1983.
Polygonum microcephalum D. Don, Prodr. Fl. Nep. 72. 1825: FBI 5:42. 1886. var. *microcephala*.

Small herbs, root-stock woody. Branches dichotomous, grooved, sparsely short hairy; stipules membranous, sparsely hairy. Leaves swollen at base, thick, ovate-lanceolate, slightly repund, acuminate, densely white glandular-dotted. Heads sub-terminal; perianth white or pinkish-white.

Flowers & Fruits: April - November
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1924***, dated 10.06. 2003; Tamsong TE, ***AP Das & Chandrâ 2386***, dated 05.11.2003; Soom TE, ***AP Das & Chandrâ 3176***, dated 26.06. 2004.
Status: Very common.
Local Distribution: All three hill gardens.
General Distribution: Himalayas (Garhwal-Bhutan), Meghalaya, Manipur, Naga Hills, S. and W. China.

Persicaria nepalensis (Meisner) H. Gross in Engl., Bot. Jahrb. 49:277. 1913; FBI 5: 41. 1886; FEH 1:72. 1966; EFPN 3:177. 1982; FB 1(1): 164. 1983;
P. nepalense Meisner, Monog. Polyg. 84, t. 7. fig. 2: 1826.
P. alatum Hamilton *ex* Sprengel, Syst. Veg. Cur. Post. 154. 1827.

Erect or procumbent small annual, sparsely hairy. Lamina ovate or deltoid-ovate, slightly repund, acute, narrowed to winged petiole, dark green above, sparsely glandular hairy beneath. Heads axillary & terminal, involucre green; bracts ovate, glabrous, membranous; perianth light pink.

Flowers & Fruits: May - November
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2905***, dated 10.04. 2004; Soom TE, ***AP Das & Chandrâ 3194,*** dated 26.06. 2004.
Status: Abundant
Local Distribution: All three hill gardens.
General Distribution: Tropical Africa, Afghanistan, Himalayas, India, Sri Lanka, Malaysia, China, Korea and Japan.

Persicaria orientalis (L.) Assenov, Fl. Reip. Pop. Bulgar. 3: 250. 1966' FB 1(1); 161. 1983.
Polygonum orientale L., Sp. Pl. 362. 1753.

Densely pubescent herb, 1-3m. Leaves ovate, acuminate, base rounded or cordate. Flowers in small fascicles in spike like racemes with white or pink perianth.

Flowers & Fruits: April – December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0450***, dated 05.04.2002; Hansqua TE, ***AP Das & Chandrâ 1668***, dated 13.11. 2002; Kamalpur TE, ***AP Das & Chandrâ 0669***, dated 20.04.2002.
Status: Very common.
Local Distribution: All Terai gardens.
General Distribution: Tropical Asia.

Persicaria perfoliata (L.) H. Gross in Engler, Bot. Jahrb. 14: 275 & 281. 1913; EFH 1: 72. 1966.

Much prikly climber; leaves long petiolate; lamina deltoid-cuspidate, entire; flowers in heads; fruits globose with fleshy pericarp.

Flowers & Fruits: September – December.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2352***, dated 05.11. 2003
Status: Less Common.
Local Distribution: All three hill gardens.
General Distribution: India, Nepal, Bhutan, China, Korea, Japan, Malaya

Persicaria posumbu (Hamilton *ex* D.Don) Gross in Bot. Jahrb. 49: 313. 1913; FEH. 1: 73. 1966; FB 1(1): 162.
Polygonum posumbu Ham.ex D.Don, Prodr. 71. 1825; FBI 5: 38. 1886 *p.p.*

Slender flaccid herb, 15-60cm, stems glabrous. Leaves ovate-elliptic, acuminate base cuneate, sparsely pilosa on both surfaces, sometimes minutely whitish dotted beneath. Racemes very slender, interrupted with glandular, white or pink perianth.

Flowers & Fruits: April – December
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1835***, dated 10.06. 2003; Soom TE, ***AP Das & Chandrâ 2662***, dated 27.12.2003.
Status: Common
Local Distribution: All three hill gardens.
General Distribution: India, Nepal, Bhutan, China, Malaysia

Persicaria runcinata (D. Don) H. Gross in Engler, Bot. Jahrb. 49:277. 1913; FBI 5:43. 1886.FEH 1:74. 1966; EFPN 3:178. 1982; FB 1(1): 164. 1983.
Polygonum runcinatum D. Don, Prodr. Fl. Nep. 73. 1825.

Local Name: *Ratnawlo* (Nep).

Small ascending annual herbs, >33cm. Stem flaccid, grooved, basal part creeping; stipules cylindric, truncate. Lamina runcinate, terminal lobe rhombic-ovate, laterals linear-oblong, 1-3 pairs, amplexicled, dotted above. Heads globose; perianth & bracts membranous, pink or white.

Flowers & Fruits: April - December
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1906***, dated 10.06. 2003; Soom TE, ***AP Das & Chandrâ 2617***, dated 27.12. 2003; Tamsong TE, ***AP Das & Chandrâ 2235***, dated 05.09. 2003.
Status: Abundant
Local Distribution: In all Hill gardens.
General Distribution: Himalayas, Meghalaya, Myanmar, Thailand, W. and C. China, Formosa and Malaysia.
Note: Good fodder for cattle.

Persicaria tenella (Blume) Hara in J.Jap. B. 44: 375. 1969; EFPN 3: 178. 1982; FB 1(1): 163. 1983.
Polygonum tenellum Blume, Bijdr. 530. 1825.

Weak herb, 10-25cm, sometimes prostrate. Leaves narrowly elliptic-lanceolate, acuminate, base attenuate, subsessile, margins and veins beneath sparsely setulose. Racemes slender, terminal with eglandular, pink perianth.

Flowers & Fruits: April - December
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3380***, dated 12. 10. 2004.
Status: Less Common.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: India, Nepal, Bhutan, China, Japan, Malaysia

POLYGONUM L.

Polygonum plebeium R.Brown, Prodr. 420. 1810 (*'plebejum'*); FBI 5: 27. 1886; FB 1(1): 170. 1983.

Smaller, prostrate or ascending annual, internodes often shorter than leaves. Leaves linear or oblanceolate, obtuse, glabrous. Perianth white or pink.

Flowers & Fruits: December – June.

Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 0242***, dated 09.02.2002; Kamalpur TE, AP Das & Chandrâ 0413, dated 27.02.2002
Status: Very common.
Local Distribution: All Terai gardens.
General Distribution: India, Sri Lanka, Bangladesh, Myanmar, Nepal.

RUMEX L.

Rumex nepalensis Sprengel, Syst. Veg. 2:159. 1825; FBI 5:60. 1886; FEH 1:75. 1966; EFPN 3:179. 1982; FB 1(1): 173. 1983.

Local Name: *Halhaley* (Nep).

Perennial rosette herbs, >90 cm tall; root-stock woody. Stem vertically ridged; ochrea transparent, membranous, persistent. Lamina oblong-ovate, repund, subacute, cordate, mucilagenous, thinly pubescent beneath. Racemes axillary and terminal; flowers polygamous, yellowish-green.

Flowers & Fruits: June – October
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3113***, dated 03. 05.2004; Tamsong TE, ***AP Das & Chandrâ 2144***, dated 30.06. 2003.
Status: Very common
Local Distribution: All hill gardens.
General Distribution: S. W. Europe, W. Asia, Afganistan, Himalayas, Nilgiri, Meghalaya, Manipur, Myanmar, Tonkin, W. and C. China, C. Japan and Java.
Note: Leaves used as vegetable; also reported to use against eczema.

PORTULACACEAE A. Jussieu

PORTULACA L.

Portulaca oleracea L., Sp. Pl. ed. 1, 1: 445. 1753; FBI 1: 246. 1874; FEH 1: 79. 1966; FB 1(2): 196. 1984; TBRI 50 (4):123. 1987; FWB 1:254. 1997.

Prostrate or decumbent fleshy annuals. Leaves closely spiral, shortly petiolate; lamina spathulate or obovate, obscurely emarginate or rounded, cuneate, fleshy. Flowers 5-10 in axillary or terminal clusters, bisexual, actinomorphic; sepals strongly keeled; petals yellowish; Capsule ovoid.

Flowers & Fruits: January - December
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1094***, dated 09.05.2002; Kamalpur TE, ***AP Das & Chandrâ 0655***, dated 20.04.2002.
Status: Common.
Local Distribution: All Terai Gardens.
General Distribution: Pantropic.

Portulaca quadrifida L., Mant. Pl. 1: 73. 1767; FBI 1: 247. 1874; FI 3: 6. 1993.

Flowers & Fruits: January – December.

Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0454***, dated 05.04.2002; Hansqua TE, ***AP Das & Chandrâ 1120***, dated 09.05.2002.
Status: Rare
Local Distribution: In Terai gardens.
General Distribution: Pantropic.

PRIMULACEAE Ventenat

LYSIMACHIA L.

Lysimachia alternifolia Wallich in Roxburgh, Fl. Ind. ed. Carey, 2:26. 1824; FBI 3:504. 1882; FEH 1:345. 1966; EFPN 3:64. 1982; TBRI 50(4):119. 1987.

Erect herb, 15-40cm high; branches many, upto 24cm long, ridged, pubescent. Leaves subsessile; lamina ovate-elliptic, acute, entire. Peduncles axillary, 1-flowered. Sepals lanceolate; corolla shorter than sepals, rotate, yellowish, gland-dotted. Capsules glabrous, dehiscing by valves.

Flowers & Fruits: May – December.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2561,*** dated 11.11. 2003; Tamsong ***TE, AP Das & Chandrâ 2943,*** dated 10.04. 2004; Soom TE, ***AP Das & Chandrâ 3276***, dated 26.06. 2004.
Status: Very common.
Local Distribution: All three hill gardens.
General Distribution: Himalayas (Garhwal – Bhutan), Meghalaya, Myanmar.

Lysimachia debilis Wallich in Roxburgh, Fl. Ind. ed. Carey 2: 25. 1824; FEH 1:245. 1966; 2:101. 1971; EFPN 3:64. 1982; TBRI 50(4):119. 1987.
L. japonica auct. non Thunberg in Hook. f., FBI 3:505. 1882, p.p.

Like *L. congestiflora* but branches ferruginous-villous; peduncles axillary, elongating in fruit, 1-flowered, not congested; corolla campanulate, lobes smaller, reflexed in fruit.

Flowers & Fruits: May – December.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2037***, dated 30.06. 2003.
Status: Rare
Local Distribution: Found only in Tamsong garden.
General Distribution: Himalayas (Kashmir – Sikkim), Meghalaya, N. Assam, Myanmar, Thailand.

Lysimachia evalvis Wallich in Roxburgh, Fl. Ind., ed. Carey & Wallich 2: 27. 1824; FB 2(2): 567. 1999.

Stems erect or creeping, upto 75cm, glabrous. Leaves alternate, broadly ovate to elliptic, acuminate, glabrous, base abruptly attenuate. Flowers yellow, solitary, axillary on pedicels forming loose leafy racemes. Capsule subglobose.

Flowers & Fruits: May – August.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2020***, dated 30.06. 2003.

Status: Rare
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Himalaya, Khasi Hills, Myanmar

Lysimachia oppositifolia Fletcher, Kew Bull. 41. 1936.

Erect annual herbs; leaves opposite, lamina ovate lanceolate, entire, ciliated, acute; flowers axillary, solitary; small dull yellow; fruits globose.

Flowers & Fruits: June – September.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2405***, dated 05.11. 2003.
Status: Rare
Local Distribution: Found only in Tamsong garden.
General Distribution: Eastern Himalaya, Myanmar, Thiland, China.

PRIMULA L.

Primula melacoides. Franchet in Bull. Soc. Bot. France 33:64. 1886; TBRI 50(4): 124. 1987.

Local Name: *Pandar Phul* (Nep.).

Annual rosette herbs, upto 30 cm high. Lamina ovate-spathulate, double serrate, obtuse, cordate, nerves hispid, mealy beneath. Scapes c.21 cm, glandular, mealy hairy. Flowers in 2-3 whorls; calyx subcampanulate, farinose; corolla funnel-shaped, pinkish purple. Capsule subglobose.

Flowers: November - February; *Fruits:* February - March.
Specimen Cited: Soom TE, ***AP Das & Chandrâ 2699***, dated 09.01. 2004; Tamsong TE, ***AP Das & Chandrâ 2005***, dated 30.06. 2003.
Status: Frequent.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Native of China & Myanmar; naturalized in Darjeeling and Sikkim.

PROTEACEAE A. Juss.

GRAVELLEA

Grevillea robusta A. Cunn.ex R. Br., Bot. Nov. 24. 1830.

Tall tree; leaves alternate; lamina deeply dissected, silvery below. Flowers and fruits not seen.

Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0970***, dated 04.05. 2002.
Status: Often planted.
Local Distribution: In Terai gardens only.
General Distribution: A native of Australia.

RANUNCULACEAE A. Jussieu

CLEMATIS L.

Clematis acuminata DC., Syst. Nat. 1:148. 1817 & Prodr. 1:6. 1824; FBI 1:5. 1872; FEH 2:29. 1971; FB 1(2):289. 1984; FI 1:154. 1993; FWB 1:121.1997.

A large woody climber with slender, terete branches. Leaves ternate, 3-foliolate; lanceolate or ovate, serrate, acuminate, base rounded, veins 5 at base, usually glabrous or sparsely pubescent. Panicles axillary, few-flowered, branches slender. Achenes with slender, elongated persistent styles.

Flowers & Fruits: October - February
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3454***, dated 12. 10. 2004.
Status: Rare
Local Distribution: Found only at Soom.
General Distribution: Himalayas (Punjab-Arunachal Pradesh), Meghalaya, Assam.

Clematis buchananiana DC., Syst. Nat. 1:140. 1817; FBI 1:6. 1872, p.p.; FEH 1: 88.1966; FB 1(2): 289.1984; FI 1:60. 1993; FWB 1:121. 1997.

Local Name: Pinasay Lahara (Nep.).

Shrubby perennial pubescent climbers; leaves pinnately 1-5 foliate, exstipulate, broadly thickened and narrowly connate at base, brownish pubescent, straight or loosely tendrillar, broadly ovate, 3-lobed, coarsely serrate, acute to acuminate, base slightly cordate, dark-green, thinly pubescent above, shining pale and more densely hairy. Flowers large, fragrant in axillary and terminal, many flowered panicles.

Flowers: July - October *Fruits:* November - January
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2794***, dated 25.03. 2004; Soom TE, ***AP Das & Chandrâ 3522***, dated 12. 10. 2004; Tamsong TE, ***AP Das & Chandrâ 2313***, dated 05.09. 2003.
Status: Less common.
Local Distribution: Makaibari, Soom & Tamsong gardens.
General Distribution: Himalayas (Kashmir-Arunachal Pradesh), Meghalaya, N. Myanmar, W. China.

RANUNCULUS L.

Ranunculus diffusus DC., Prodr.1:38. 1824; FBI 1:19.1872; FEH 1:90. 1966; FB 1(2):303. 1984; FI 1:119. 1993; FWB 1:130. 1997.

Small diffuse herb; root-stock perennial; branches decumbent or prostrate. Stem soft, basally branched, densely hirsute, hairs yellowish, spreading. Leaves 3-lobed or deeply divided; lobes obovate, sharply and shallowly lobed/toothed, rounded or acute, pubescent. Flowers solitary, axillary and terminal, yellow.

Flowers: April – September; *Fruits:* June - October

Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2372***, dated 05.11. 2003; Soom TE, ***AP Das & Chandrâ 3416***, dated 12. 10. 2004.
Status: Common
Local Distribution: Makaibari, Soom & Tamsong gardens.
General Distribution: Himalayas (Kashmir-Arunachal Pradesh), Meghalaya, N. Myanmar, China.

ROSACEAE A. Jussieu

AGRIMONIA L.

Agrimonia pilosa Lodebour in Ind. Sem. Hort. Derpat. Suppl. 1:1823; TBRI 50 (4):105. 1987 var. ***nepalensis*** (D. Don) Nakai in Bot. Mag. Tokyo 47:247. 1933; FEH 1:118. 1966; EFPN 2:133. 1987; FB 1(3):582. 1987.
A. nepalensis ***D. Don, Prodr. Fl. Nep. 229. 1825.***
A. eupatorium L. *sensu* FBI 2:361. 1878, p.p.

Perennial erect pilose herbs with woody root-stock. Stem 40-95cm tall, covered with spreading hairs. Leasves interruptedly pinnate, leaflets extermely variable in size, suborbicular or elliptic-obovate, serrate, acute, base cuneate to rounded, glandular pilosa. Racemes many flowered, terminal.

Flowers & Fruits: May - November
Speciemn Cited: Soom TE, ***AP Das & Chandrâ 3548***, dated 12. 10. 2004.
Status: Less common.
Local Distrib: Found only in Soom & Tamsong gardens.
General Distribution: Himalayas(Kashmir-Bhutan), Meghalaya, S. Tibet, Myanmar, Indochina, China.

DUCHESNEA Small

Duchesnea indica (Andrews) Focke in Pfamilien. III, 3: 33. 1888; FEH 1: 120. 1966; FB 1(3): 579. 1987.
Fragaria indica Andrews, Bot. Refxs. 7: t. 479. 1807; FBI 2: 343. 1878.

Silky pubescent herb; runners slender. Stipules foliaceous, adnate. Leaflets 3, obovate, toothed, cuneate, nerves paralled, pubescent. Peduncles equalling petioles. Flowers solitary, axillary; calyx & bracteoles persistent; petals obovate. Achenes numerous on spherical fleshy red receptacle.

Flowers & Fruits: Often throughout the year.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2213***, dated 05.09. 2003; Soom TE, ***AP Das & Chandrâ 3224***, dated 26.06. 2004.
Status: Abundant.
Local Distribution: In all gardens; but as winter weed in Terai.
General Distribution: Afghanistan, Himalayas, India, east to China, Japan.

ERIOBOTRYA Lindley

Eriobotrya petiolata Hook. f., FBI 2:370. 1878; FEH 3:51. 1975; TBRI 50 (4):113. 1987; FB 1(3):602. 1987.

Local Name: *Maya* (Nep.).

Tree, 8-15m high with spreading branches. Leaves simple, oblong-elliptic, acuminate, base cuneate, margin entire to shallowly serrate above middle, glabrous. Panicles upto 16cm, tomentose. Pomes 1-1.5cm across, subglobose with persistent calyx lobes.

Flowers: March - June *Fruits:* May - August
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 3046***, dated 10.04. 2004.
Status: Less common; often planted.
Local Distribution: All three hill gardens.
General Distribution: E. Himalaya (Darjeeling-Bhutan), Assam, E. India.

POTENTILLA L.

Potentilla fulgens Wallich *ex* Hooker in Bot. Mag. 53: t. 2700. 1826; FB 1(3): 571. 1987.

Rosette perennial. Stems 20 –45 cm, whitish hairy. Leaves interruptedly pinnate; larger lateral leaflets 4 –8 pairs, elliptic or narrowly obovate, obtuse, base rounded or cuneate, sharply serrate, silvery white sericeous beneath. Flowers in corymbose cymes. Corolla yellow. Achenes glabrous.

Flowers & Fruits: September – February.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 1965***, dated 30.06. 2003.
Status: Less common.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Eastern Himalaya, Meghalaya, China.

Potentilla sundaica (Blume) O. Kuntze, Rev. Gen. 1:219. 1891; FB 1(3): 567. 1987.
Potentilla kleiniana Wight et Arnott in Wallich, Ill. Ind. Bot. 1: t. 85. 1831; FBI 2:359. 1878.

Rosette sarmentose herbs, appressed pubescent. Stipules adnate; leaflets 3-5, obovate, serrate, rounded, cuneate, glabrous, nerves silky pubescent beneath. Flowers 2-5 in terminal cymes; calyx lobes 5, unequal; epicalyx lobes 5; petals obovate, yellowish. Achenes ellipsoid, glabrous.

Flowers: October – December; *Fruits*: December - March.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2267***, dated 05.09. 2003.
Status: Less Common.
Local Distribution: All three hill gardens.
General Distribution: Himalayas (Kashmir – Arunachal Pradesh), Meghalaya, S. China, Java.

PRUNUS L.

Prunus cerasoides D. Don, Prodr. 239. Feb. 1825; EFPN 2:141. 1979; FB 1(3):540. 1987.
Prunus puddum (Wallich) Roxburgh ex Brandis, FBI 194. 1874; FBI 2:314. 1878
Maddenia podicellata Hook. f., FBI 2: 318. 1878.


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Local Name: Painyun (Nep).

Large deciduous trees to 20m high. Bark peeling off in strips. Stipules linear, glandular-fimbriate. Leaves simple; lamina ovate-elliptic/-lanceolate, glandular serrate, acuminate. Flowers 1-3 in corymbs, pink, fading to white; calyx-tube campanulate; petals obovate. Drupes ellipsoid, yellow.

Flowers & Fruits: Octover - June
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2959***, dated 10.04. 2004; Soom TE, ***AP Das & Chandrâ 3185***, dated 26.06. 2004.
Status: Frequent.
Local Distribution: All three hill gardens.
General Distribution: E. Himalaya (Nepal – Bhutan), Naga Hills, Manipur, N. Myanmar, W. China.
Note:
1. Branchlets are used to make handles for khukuri, sickle (traditional weapons of Nepali community) etc.
2. Twigs are also used as walking stick.
3. Highly ornamental as its bloom adds scenic beauty to its habitat

RUBUS L.

Rubus calycianus Wallich ex D. Don, Prodr. Fl. Nep. 235. 1825; FBI 2: 327. 1878.

Long creeping, slightly woody; prickles scattered, slender. Leaves simple, cordate –orbicular to reniform, denticulate, apex rounded, deeply cordate, unlobed or shallowly lobed, veins prickly beneath; stipules broadly ovate, serrulate. Flowers white; Petals obovate. Fruits red, globose.

Flowers & Fruits: July – October.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2960***, dated 10.04. 2004.
Status: Less common.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Eastern Himalaya, Meghalaya, Manipur, Myanmar, China.

Rubus ellipticus Smith in Rees, Cyclop. 30: no.16. 1819; FBI 2:336. 1878; FEH 1:129. 1966; EFPN 2:144. 1979; TBRI 50(4):125. 1987; FB 1(3):557. 1987.

Local Name: *Ainselu* (Nep).

Bushy shrub; branches angled, densely pubescent with flexuous stiff brown hairs; prickles deflexed, scattered. Stipules linear; leaflets 3, pinnate, terminal one larger, suborbicular, serrate. Panicles terminal, many flowered; calyx segments 5, ovate. Drupes orange-yellow, crowded.

Flowers: December - February; *Fruits*: March - May.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1831***, dated 10.06. 2003; Tamsong TE, ***AP Das & Chandrâ 2078***, dated 30.06. 2003.
Status: Abundant.
Local Distribution: All three hill gardens.
General Distribution: Himalayas (Sirmore – Arunachal Pradesh), Assam, Meghalaya, Sri Lanka, Myanmar, Indo-China.

Note: Fruits edible; also sold in market.

Rubus moluccanus *sensu* Hooker f., FBI 2: 330. 1878 *p.p. non* L.; FB 1(3): 554. 1987.
Rubus alceifolius Poir.in Lamk., Ency. 6: 247. 1804.

Local Name: *Thalumbo* (Nep)

Scrambling with slender shoots; branchlets dense gland –tipped bristly, much prickly. Lamina suborbicular, 3 –5 lobed, cordate, lobes broadly acute, serrate, softly pilose beneath. Flowers 3 – 5 in short axillary racemes. Calyx lobes ovate, 3 –5 toothed, tomentose, bristly & prickly. Petals pink. Fruits with many druplets.

Flowers & Fruits: January - December
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2768***, dated 25.03. 2004; Soom TE, ***AP Das & Chandrâ 3314***, dated 26.06. 2004; Tamsong TE, ***AP Das & Chandrâ 2907***, dated 10.04. 2004.
Status: Very common.
Local Distribution: All three hill gardens.
General Distribution: India, Sri Lanka, Myanmar, China.

RUBIACEAE A. Jussieu

BORRERIA G.F.W. Meyer, *nom. cons.*

Borreria alata (Aublet) DC., Prodr. 4:544. 1830; EFPN 2:200. 1979; FEH 1:307. 1966.
Borreria latifolia Schumann in Mart., Fl. Braz. 6 (6):61. 1888; FEH 1:307. 1966; TBRI 50(4):107. 1987.
Spermococce alata Aubl., Hist. Pl. Guien. 1:60. T. 22. F. 7. 1775; FB 2(2): 817. 1999.

Local Name: *Bakkhu Jhar* (Nep).

Perennial or annual ramous herbs; root-stock stout; stem procumbent; branches >40cm, 4-angled, glabrous, angles obscurely winged. Lamina ovate, acuminate, entire. Stipules with long setae. Flowers crowded in dense fascicles, white. Capsules with single- seeded 2 lobes,.

Flowers & Fruits: August – December.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0300,*** dated 16.02. 2002; Hansqua TE, ***AP Das & Chandrâ 0112***, dated 03.02.2002; Kamalpur TE, ***AP Das & Chandrâ 0617***, dated 20.04.2002; Matigara TE, ***AP Das & Chandrâ 3148***, dated 10.05. 2004; Makaibari TE, ***AP Das & Chandrâ 1918***, dated 10.06. 2003; Soom TE, ***AP Das & Chandrâ 3437***, dated 12. 10. 2004; Tamsong TE, ***AP Das & Chandrâ 3098,*** dated 10.04. 2004.
Status: Abundant.
Local Distribution: In all gardens.
General Distribution: Native of tropical America; naturalized in tropical and subtropical Asia.

Borreria ocymoides **(Burman f.)** DC., Prodr. 4: 544. 1830; PPB 238. 2002.
Spermacocce ocymoides Burman f., FBI 3: 200. 1881.

Small diffuse herb; stem narrowly winged; lamina broadly ovate; flowers white, minute, crowded at the nodes.

Flowers & Fruits: July – October.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0938***, dated 04.05. 2002; Hansqua TE, ***AP Das & Chandrâ 0124***, dated 03.02.2002; Kamalpur TE, ***AP Das & Chandrâ 0373***, dated 27.02.2002; Soom TE, ***AP Das & Chandrâ 3507***, dated 12. 10. 2004; Tamsong TE, ***AP Das & Chandrâ 2461***, dated 05.11. 2003.
Status: Abundant
Local Distribution: In all gardens.
General Distribution: Tropical America, Africa, Subtropical Himalayas, India, West Indies, Malaysia & Philippines.

COFFEA L.

Coffea arabica L., Sp. Pl. 172. 1753.

Much branched shrub; lamina oblong-ovate, lateral veins parallel; flowers crowded at nodes, white; fruits globose turns red on ripening.

Flowers & Fruits: September – December.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1915,*** dated 10.06. 2003.
Status: Sometimes planted.
Local Distribution: Some Terai & hill gardens.
General Distribution: Arabian plant, cultivated in moist tropical regions.

DENTELLA J. & G. Forster

Dentella repens (L.) J. et G. Forster, Charact. Gen. 26.t. 13. 1776; FBI 3: 42. 1880; FB 2(2): 755. 1999.
Oldenlandia repens L., Mant. Pl. 40. 1767.

Leaves elliptic or somewhat obovate, apex acute and minutely apiculate, base attenuate with few pellucid submarginal hairs. Flowers white. Hypanthium and fruit covered in pellucid trichomes.

Flowers & Fruits: February – June.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0625***, dated 20.04.2002.
Status: Abundant
Local Distribution: All Terai gardens.
General Distribution: India, China, Malaya, Tropical Australia

Dentella serpyllifolia Wallich ex Craib., Fl. Siam. Enum. 2: 27. 1932; FB 2(2): 755. 1999.

Similar to *Dentella repens* but differs in its glabrous hypanthium, fruit and larger corolla.

Flowers & Fruits: February – June.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0635***, dated 20.04.2002.
Status: Rare
Local Distribution: Found only in Kamalpur garden.
General Distribution: Tropical Asia.

GALIUM L.

Galium asperifolium Wallich *ex* Roxburgh, Fl. Ind. 1: 391. 1820; FEH 1: 308. 1966; EFPN 2: 201. 1979; TBRI 50(4):114.1987.
G. mollugo L. *sensu* FBI 3: 207. 1881.

Highly variable, perennial scrambler; branches short, filiform. Leaves 3-6 in whorls, sessile; lamina linear or linear-obovate, entire, acute, slightly scabrid, mid-vein strong beneath. Cymes divaricately branched. Pedicels recurved in fruits. Corolla white. Fruit small, granulated, black.

Flowers: June - September; *Fruits:* October - December
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2148,*** dated 30.06. 2003
Status: Abundant at places.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Himalayas (Punjab – Bhutan), Sri Lanka, Myanmar, China.

Galium elegans Wallich *ex* Roxburgh, Fl. Ind. 1: 382. 1820; FEH 1: 308. 1966; TBRI 50(4):114. 1987; FB 2(2): 828. 1999
G. rotundifolium L. *sensu* FBI 3:204. 1881.

Small trailing diffuse scrambler, unbranches few, white pubescent. Leaves in whorl of 4, sub sessile; lamina ovate to rounded, entire, mucronate, hirsute and scabrid, basally 3-nerved. Cyme branches divaricate; corolla white, small. Fruits with adpressed hooked hairs.

Flowers: June - August; *Fruits:* July - December
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2923,*** dated 10.04. 2004.
Status: Abundant.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Himalayas (Kashmir – Bhutan), Meghalaya, Assam, Myanmar, Thailand, China.

HEDYOTIS L.

Hedyotis scandens Roxburgh, Fl. Ind. 1:361. 1820; FBI 3: 57. 1880; FEH 1: 310. 1966; FB 2(2): 758. 1999.
Oldenlandia scandens (Roxburgh) O. Kuntze, Rev. Gen. Pl. 293. 1891.

Local Name: *Bokri Lahara, Baksi Lahara, Pinase Lahara* (Nep).

Shrubby climber; stems glabrous or minutely pubescent, ± terete. Leaves ± sessile, opposite, glabrous, thick, elliptic-lanceolate, acumionate, margin revolute. Flowers white, sweet scented, in terminal, trichotomously branched cymose panicle. Capsules globose; seeds numerous.

Flowers & Fruits: March – December
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0674,*** dated 20.04.2002; Tamsong TE, ***AP Das & Chandrâ 2391,*** dated 05.11. 2003; Soom TE, ***AP Das & Chandrâ 3423,*** dated 12.10.2004.
Status: Very common
Local Distribution: In all gardens.
General Distribution: Himalayas (Nepal – Bhutan), Meghalaya, Myanmar, China.

Hedyotis stipulata R. Brown *ex* Hook.f. in FBI 3: 63. 1880; TBRI 50 (4): 116. 1987.

Local Name: *Guyelo* (Nep.).

Diffuse small hairy herb with decumbent branches, rooting from nodes. Leaves ovate, entire, acute, base rounded, membranous, white pubescent both sides. Cymes capitate, sessile with white, glabrous flowers. Fruits globose, indehiscent.

Flowers & Fruits: August - October
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0017,*** dated ; Hansqua TE, ***AP Das & Chandrâ 1055***, dated 09.05.2002; Kamalpur TE, ***AP Das & Chandrâ 0634***, dated 20.04. 2002.
Status: Rare
Local Distribution: All Terai gardens.
General Distribution: Himalayas, Meghalaya, Java, Japan.

LUCULIA Sweet

Luculia gratissima (Wallich) Sweet, Brit. Fl. Gard. 2: t. 145. 1826; FBI 3: 36. 1880; FEH 1: 311. 1966; FB 2(2): 748. 1999.
Cinchona gratissima Wallich in Roxburgh, Fl. Ind. ed. Carey 2: 154. 1824.
748/August – October/

Local Name: *Gadauri, Dawari* (Nep)

Shrub 1-3m with leaves elliptic to oblanceolate, abruptly or gradually acuminate, base acute or attenuate, glabrous and shiny above, pale green beneath, matt and pilose. Flowers white or pink, very fragrant. Inflorescence and hypanthium tomentosa or puberulous.

Flowers & Fruits: September to April
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2443,*** dated 05.11. 2003.
Status: Rare; sometimes grown in gardens.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Eastern Himalaya, Mrghalaya, Tibet & China.
Note: Leaves used for dyeing.

MITRACARPUS Zucc.

Mitracarpus verticillatus (Schumann & Thonn.) Vatke in Linnaea 40: 196. 1876; PPB. 251. 2002.
Stauropspermum verticillatum Schumann & Thonn. In Beskr. Guin. Pl. 73, 1827
Mitracarpus hirtus (L.) DC. sensu FB 2(2): 820. 1999.

Tall erect annual; branches few; lamina ovate-lanceolate; flowers minute, white, crowded at nodes, calyx lobes 2, narrow, unequal.

Flowers & Fruits: January to December.
Specimen Cited: Matigara TE, ***AP Das & Chandrâ 3115,*** dated 10.05. 2004
Status: Abundant.
Local Distribution: All Terai gardens.

General Distribution: Native of South America & West Indies; naturalized in tropical other areas.

MORINDA L.

Morinda angustifolia Roxburgh, Pl. Corom. 3 (2): t. 237. 1815; FBI 3: 156. 1880; FEH 1: 312. 1966; FB 2(2): 804. 1999; PPB 251. 2002.

Local Name: *Haldi Kath* (Nep); *Nani* (Beng)

Large shrub to 10 m high. Bark grayish -brown, peeling off. Lamina oblanceolate, oblong-elliptic or narrow-lanceolate, entire, long acuminate, glabrescent, lateral nerves 10-15 on each side. Heads pedunculate, globose. Flowers white, fragrant; corolla salver- shaped. Drupes turbinate.

Flowers & Fruits: February – September.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 1508***, dated 22.10. 2002; Hansqua TE, ***AP Das & Chandrâ 0983***, dated 09.05.2002.
Status : Less Frequent.
Local Distribution: Terai gardens.
General Distrib: Himalyas (Nepal – Bhutan), Myanmar, Meghalaya.

MUSSAENDA L.

Mussaenda macrophylla Wallich in Roxburgh, Fl. Ind. 2:228. 1824; FBI 3:89. 1880; EFPN 2:205. 1979; TBRI 50(4):120. 1987; FB 2(2): 783. 1999; PPB 253. 2002.

Local Name: Dhobini Phul, Shitalu (Nep.).

Erect shrubs, 2-4m high. Branches straggling, hirsute or villous. Lamina elliptic or oblong-lanceolate, entire, acuminate, pubescent, lateral nerves subparallel. Stipules bifid, recurved. Cymes trichotomous; one calyx-lobe white-petaloid; corolla orange yellow. Berries globose.

Flowers: Jun. - Nov. *Fruits.:* Oct. - Jan.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2982***, dated 10.04. 2004.
Status: Rare.
Local Distribution: Found only in Tamsong garden.
General Distribution: Himalayas (Nepal – Bhutan), Assam, Myanmar, W. China.

Mussaenda roxburghii Hook.f. in FBI 3: 87. 1880; FEH 1: 312. 1966; FB 2(2): 782. 1999; PPB 253. 2002.

Local Name: *Dhobi Kat, Dhobine ghas, Dhobine* (Nep).

Much branched shrub 1-4.5m. Stems glabrous or pilose with spreading hairs. Leaves petiolate, elliptic, rarely ovate or oblong acuminate at both ends, sub-glabrous or thinly pilose above. Flowers densely covered in long silky hairs in a dense terminal heads, many flowered.

Flowers & Fruits: June to October.

Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1058,*** dated 09.05.2002; Makaibari TE, ***AP Das & Chandrâ 1688***, dated 17.05.2003; Tamsong TE, ***AP Das & Chandrâ 2370,*** dated 05.11. 2003
Status: Common
Local Distribution: In all gardens.
General Distribution: Eastern Himalaya, Meghalaya, Bangladesh, Myanmar.

NEANOTIS W.H. Lewis

Neanotis gracilis (Hook. f.) W. H. Lewis in Ann. Miss. Bot. Gard. 53:38. 1966; FEH 1:313. 1966; EFPN 2:205. 1979; TBRI 50(4):120. 1987; FB 2(2): 768. 1999; PPB 255. 2002.
Anotis gracilis Hook.f. in FBI 3: 71. 1880.

Small diffuse herbs, perennial. Branches slender, prostrate, nodes rooting. Lamina ovate, entire, acuminate, thinly hairy. Cymes axillary and terminal, dichotomously forked. Flowers clustered; corolla slightly longer than sepals,, white, glabrous. Capsules laterally compressed.

Flowers & Fruits: July – January.
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3419,*** dated 12. 10. 2004.
Status: Common
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Himalayas (Nepal – Bhutan), Meghalaya.

Neanotis hirsuta (L.f.) Lewis in Ann. Miss. Bot. Gard. 53: 38. 1966; FB 2(2): 768. 1999; PPB 256. 2002.
Oldenlandia hirsuta L.f., Suppl. Pl. 127. 1781.
Hedyotis stipulata R. Brown *ex* Hook. f. in FBI 3: 63. 1880; TBRI 50 (4): 116. 1987.

Local Name: Guyelo (Nep).

Diffuse small herb; branches decumbent, rooting at nodes. Stipules long-bristled, membranous, with long teeth. Lamina ovate, entire, acute, base rounded, membranous, white pubescent. Cymes capitate, sessile; flowers white, glabrous. Fruits globose, indehiscent.

Flowers & Fruits: August - October
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3444,*** dated 12.10.2004
Status: Less common
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Himalayas, Meghalaya, Java, Japan.

Neanotis wightiana (Wallich *ex* Wight *et* Arnott) W. H. Lewis in Ann. Miss. Bot. Gard. 53: 40. 1966; FEH 1:313. 1966; EFPN 2:205. 1979; TBRI 50(4):12. 1987; FB 2(2): 770. 1999.
Anotis wightiana Wallich *ex* Hook.f., FBI 3:65. 1880.

Small perennial diffuse tomentose herbs. Branches prostrate. Lamina ovate, entire, acute, pubescent. Stipules deeply toothed. Cymes terminal and axillary, capitate, involucrate. Flowers few, minute, white; corolla longer than sepals. Capsule orbicular, flattened; seeds rugose.

Flowers & Fruits: May - October
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2437,*** dated 05.11. 2003; Soom TE, ***AP Das & Chandrâ 3532,*** dated 12.10.2004.

Status: Very common
Local Distribution: All three hill gardens.
General Distribution: Himalayas (Nepal – Sikkim), India, Myanmar.

NEOLAMARCKIA Boissier

Neolamarckia cadamba (Roxburgh) J. Bosser in Bull. Mus. Nation Hist. Nat. 3: 247. 1984; FB 2(2): 739 .1999.
Nauclea cadamba Roxburgh in Fl. Ind. 1: 512. 1820.
Anthocephalus cadamba (Roxburgh) Miquel, Fl. Ind. Bot. 2: 135. 1856; FBI 3: 23. 1880.
Anthocephalus chinensis (Lamarck) A. Rich ex Walper, Repert. 2: 491. 1843; PPB 236. 2002.

Local Name: Kadam (Nep); Kadamba, Kadam (Beng).

Evergreen trees to 60 m; branches spreading, subwhorled. Lamina ovate/ oblong-elliptic, bluntly acuminate, entire, base rounded, coriaceous, shiny, glabrous. Flower heads c 3.5-cm in diameter, orange, scented at night. Pseudocarps fleshy, turns orange on ripening.

Flowers & Fruits: May – January
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0845***, dated 04.05. 2002; Hansqua TE, ***AP Das & Chandrâ 1021***, dated 09.05.2002; Kamalpur TE, ***AP Das & Chandrâ 0606***, dated 20.04.2002.
Status: Abundant; commonly planted.
*Local Distrib*ution: All Terai gardens.
General Distribution: India, Sri Lanka, Nepal, Pegu, Malacca, Sumatra and Borneo.
Note: Timber useful; an ornamental tree; fruits edible.

OLDENLANDIA L.

Oldenlandia corymbosa L., Sp. Pl. ed. 1 (1): 119. 1753; FBI 3:64. 1880. FEH 1:309. 1966; FB 2(2): 766.1999.
Hedyotis corymbosa (L.) Lamarck, Tab. Encyclo. Meth. 1:272. 1791; PPB 243. 2002.

Small diffuse, prostrate or sprawling to 30cm annual herbs; stem 4 angled, slender, branched, scabrid. Leaves opposite, sessile, linear to elliptic-lanceolate, entire, contorted, acuminate with false petiole. Stipules membranous. Flowers white in axillary pedunculate (1-) 3-5 flowered cymes.

Flowers & Fruits: January – December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0030,*** dated 27.01.2002; Matigara TE, ***AP Das & Chandrâ 3141***, dated 10.05. 2004; Soom TE, ***AP Das & Chandrâ 3366,*** dated 12.10.2004
Status: Abundant.
Local Distribution: In all gardens.
General Distribution: Himalayas, India, Sri Lanka, Tropical Asia, Africa, America.

Oldenlandia diffusa (Willdenow) Roxburgh, Hort. Beng. 11.1814 & Fl. India 1:444.1820; FBI 3: 65. 1880. FB 2(2): 764.1999.
Hedyotis diffusa Willdenow, Sp. Pl. 1:566.1797; PPB 244. 2002.

Diffuse, glabrous, annual herbs; branches >25 cm or longer. Lamina linear, base decurrent. Flower solitary or in axillary pairs, short pedicelled, white. Capsules loculicidal with persistent calyx lobes.

Flowers & Fruits: January – December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0049,*** dated 27.01.2002; Hansqua TE, ***AP Das & Chandrâ 1423***, dated 18.10.2002; Kamalpur TE, ***AP Das & Chandrâ 0531***, dated 17.04.2002; Matigara TE, ***AP Das & Chandrâ 3124***, dated 10.05. 2004; Soom TE, ***AP Das & Chandrâ*** 3445, dated 12. 10. 2004.
Status: Abundant.
Local Distribution: In all gardens.
General Distribution: Tropical and sub-tropical eastern Asia, India, S. China, Japan, Malaysia, Borneo and Philippines.

OPHIORRHIZA L.

Ophiorrhiza nutans C. B. Clarke *ex* Hooker f. in FBI 3: 84. 1880; FB 2(2): 779. 1999.

Stems 15-30cm, herbaceous, pubescent with brown multicellular hairs. Leaves equal, oblong-elliptic, shortly acuminate, base cuneate, thinly pilose above, pubescent with multicellular hairs on beneath, dark green above, paler beneath. Cymes solitary, and terminal, nodding, pilose with multicellular hairs, compact, subcapitate.

Flowers & Fruits: May – August
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2413,*** dated 05.11. 2003.
Status: Common
Local Distribution: Found only in Tamsong garden.
General Distribution: India, Nepal, Bhutan

Ophiorrhiza thomsonii Hk. f., FBI 3:82. 1880; FEH 1:314. 1966; TBRI 50(4):121. 1987.

Perennial herb, 15-30 cm. Older stem prostrate, pubescent and rooting below. Leaves elliptic-ovate, acute, entire, pubescent beneath. Cymes both axillary and terminal with whitish flowers. Capsule glabrous.
Flowers: July - September *Fruits:* August - October
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2968,*** dated 10.04. 2004.
Status: Less common.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution : E. Himalaya (Darjeeling-Bhutan).

PAEDERIA L.

Paederia foetida L., Mant. Pl. 1: 52. 1767; Fl. Ind. 2:517. 1824; FBI 3:195. 1881; FEH 1:314. 1966; EFPN 2:206. 1979; TBRI 50(4):121. 1987; FB 2(2): 812. 1999; PPB 260. 2002.

Slender shrubby twinner, foetid. Lamina ovate-lanceolate, entire, acuminate, hairy on nerve axils. Panicles terminal or axillary, oppositely branched. Calyx teeth triangular; corolla infundibular, grey purple, red tinged. Fruits ellipsoid, compressed; pyrenes separating from carpophore.

Flowers & Fruits: July - January.

Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 0266,*** dated 09.02. 2002; Makaibari TE, ***AP Das & Chandrâ 2772***, dated 25.03. 2004
Status: Common
Local Distribution: In all gardens.
General Distribution: Himalaya, C. and E. India-China and Malaysia.
Note: An important medicinal plant.

PSILANTHUS Hook.f.

Psilanthus bengalensis (Schultes) Leroy: FB 2(2): 803.1999.
Coffea bengalensis Schultes, Fl. Ind. 1: 540. 1820; FBI 3: 153. 1880; FEH 1:308. 1966; PPB 239. 2002.

Local Name: *Kafi, Chitu, Morichi-kat* (Nep); *Chaiti phul* (Beng).

Deciduous shrubs, >5 m tall; branches spreading. Lamina, elliptic/ oblong-lanceolate to ovate-lanceolate, entire, caudate-acuminate, base rounded to acute, nerves hairy beneath. Flowers white, fragrant. Drupes ovoid or subglobose, black on ripening; seeds grooved.

Flowers & Fruits: February – November.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0356,*** dated 16.02. 2002; Tamsong TE, ***AP Das & Chandrâ 3083***, dated 10.04. 2004.
Status: Very common
Local Distribution: All Terai gardens and at Tamsong.
General Distribution: Subtropical Himalayas (Kumaon-Bhutan), Assam, W. Bengal, Bangladesh, Myanmar.
Note: Berries reputedly used for coffee by Terai inhabitants.

PSYCHOTRIA L.

Psychortia erratica Hook.f., FBI 3:168. 1880; FEH 1:315. 1966; EFPN 2:206. 1979; TBRI 50(4):124. 1987; PPB 262. 2002.

Evergreen bushy shrub upto 3.5 m high. Bark greyish or pale brown. Leaves elliptic-lanceolate, oblanceolate, entire, acuminate, base cuneate, narrowing to the petiole, glabrous both sides. Cymes terminal, trichotomous with white or greenish-white flowers. Fruit globose, red to reddish-yellow.

Flowers & Fruits: May - January
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3566,*** dated 12.10.2004.
Status: Rare.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Himalayas (Nepal-Bhutan), Assam, Meghalaya.

RICHARDIA Houst.

Richardia scabra L., Sp.Pl. 330. 1753; PPB 264. 2002.

Tufted, much branched, prostrate annual herb; lamina rounded-ovate, acute, hirsute; flowers crowded at tips of branches, white.

Flowers & Fruits: August to February.
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 0107,*** dated 03.02. 2002
Status: Common
Local Distribution: All Terai gardens.
General Distribution: Native of Tropical America; naturalized in India.

RUBIA L.

Rubia charaefolia Wallich *ex* G. Don, Gen. Hist. 3:643. 1834; FEH 1:315. 1966; EFPN 2: 207. 1979; TBRI 50 (4):101. 1987; PPB 264. 2002.
R. angustissima Wallich, *sensu* FBI 3: 203. 1881, p.p.

Highly branched scandent climber with perennial root-stock. Stems ribbed, scabrid. Leaves sessile in whorls of 4-8; linear, keeled, sparingly scabrid. Cymes 3-4 flowered. Fruits globose, didymous.

Flowers : September - October; *Fruits:* October - March
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2568,*** dated 11.11. 2003.
Status: Less common.
Local Distribution: Found only in Makaibari garden..
General Distribution: E. Himalaya (Nepal-Bhutan).

Rubia manjith Roxburgh *ex* Fleming in Asia Res. 11: 177. 1810; FEH 1:315. 1966; EFPN 2: 207. 1979; TBRI 50(4):125. 1987.
R. cordifolia L. *sensu* Hook. f., FBI 3: 202. 1881, p.p.

Local Name: *Majito* (Nep).

Suffrutescent climber, branches herbaceous. Stem 4-angled, old part armed with deflexed prickly-bristles; stipules normal-leafy. Leaves whorl of 4 those includes 2-stipules; lamina ovate, entire, scabrid, rusty when young. Panicles axillary. Corolla rust-coloured. Ripe berries globular, black.

Flowers: July - September; *Fruits:* September - March
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 3026,*** dated 10.04. 2004; Soom TE, ***AP Das & Chandrâ 3505,*** dated 12.10.2004.
Status: Abundant.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Himalayas (Simla-Bhutan), Meghalaya.
Note: Red dye obtained from fruits is used as ink and as mehandi by teenagers. Also used as medicine in Ayurvedic system. Plant is indiscriminately collected and sold threatening its status.

SPERMACOCE L.

Spermacoce mauritiana O. Gideon in Kew Bull. 37(4): 547. 1983; FB 2(2): 760 .1999;

Robust suberect annual, densely but minutely pubescent. Lamina upper surface drying deep green or yellow-green, minutely scabrid, ovate to narrowly lanceolate, acuminate, base attenuate; petiole short or missing,. Flowers white or lilac, sessile, on axillary, dense, sessile cymes.

Flowers & Fruits: April – December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0756,*** dated 04.05. 2002.
Status: Rare
Local Distribution: Found only in Mohurgong & Gulma TE.
General Distribution: India, Nepal, Bhutan, Myanmar, China, Malaya, Australia, Tropical Africa

RUTACEAE A. Jussieu

CLAUSENA Burman f.

Clausena excavata Burm.f., Fl. Ind. 87, t. 29, 2. 1768; FBI 1: 504. 1875; FB 2(1): 16. 1991; FI 4: 325. 1997.

Shrub or small tree, branchlets and leaf rachises spreading pubescent. Leaves upto 50cm, with 7-15 pairs leaflets, ovate, acuminate, base very asymmetrically cuneate, margin entire, pubescent especially beneath. Flowers in terminal panicles. Fruit broadly oblong.

Flowers & Fruits: April – May.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 1274***, dated 18.10.2002.
Status: Rare.
Local Distribution: Found only in Kamalpur gardens.
General Distribution: India, Nepal, Bhutan, Indochina, Malaysia.

MURRAYA L.

Murraya koenigii (L.) Sprengel, Syst. Veg. 2:315.1825; FBI 1:503.1875; FEH 3:75. 1975; EFPN 2:82. 1979; FB 2(1): 17.1991.
Bergera koenigii L., Mant. Pl. 2:563. 1771; Fl. Ind. ed. 2, 2:375. 1832.

Local Name: *Mechia Saag* (Nep), *Curry pata* (Beng).

Evergreen shrubs upto 3 m tall. Leaves 13-23 foliolate, pinnate. Leaflets alternate, ovate, crenate, acuminate, base asymmetrically rounded or cuneate, sparsely pubescent or glabrous. Corymbs with numerous bisexual white flowers. Fruits ovoid, crimson.

Flowers & Fruits: February – April
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0323***, dated 16.02. 2002.
Status: Common. Sometimes grown.
Local Distribution: In all gardens.
General Distribution: Tropical Himalayas (Garhwal-Bhutan), India, Sri Lanka.
Note: Leaves used as aromatic agent in food.

PARAMIGYNA Wight

Paramignya monophylla Wight, Ill. Ind. Bot. 1: 108, t. 42. 1840; FBI 1: 510. 1875; FB 2(1): 19. 1991; FI 4: 312. 1997.

Local Name: *Natkanta* (Nep)

Evergreen scrambler, spines axillary recurved. Lamina oblong –elliptic, acute or shortly acuminate, base rounded; petioles 5 –15mm. Calyx 3 mm, lobes rounded. Petals white, oblong – elliptic. Ovary & styles densely pubescent, 3 –5 celled. Fruits globose, ±3.5cm; rind thick yellow.

Flowers & Fruits: June - December
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1797***, dated 17.05. 2003
Status: Rare
Local Distribution: Found only in Makaibari garden.
General Distribution:: India, Nepal, Bhutan.

SKIMMIA Thunberg

Skimmia arborescens T. Anderson ex Gamble in J. Linn. Soc. Bot. 43: 491. 1916; FB 2(1): 19.1991; FI 4: 398. 1997.

Local Name: *Tsaulane, Chumlani, Limbuniphul* (Nep)

Shrub or small trees, 2 –10 m. Leaves coriaceous, elliptic –oblanceolate, 6 –15 x 2 –5.5 cm, caudate acuminate, base cuneate, membranous, primary lateral veins 5 –8 pairs; racemes small. Calyx 1 –1.5 mm; petals 3 –5 mm. Stamens 2 –4 mm. Ovary 1.5 mm; fruits ellipsoid, red.

Flowers & Fruits: Jun. - Dec.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 3049***, dated 10.04. 2004.
Status: Rare.
Local Distribution: Found only in Tamsong garden.
General Distribution: India, Nepal, Bhutan, Thailand, Western China.

TETRADIUM Loureiro

Tetradium fraxinifolium (Hooker) T.G. Hartley in Gard. Bull. Straites Settlem. 34: 102. 1981; FB 2(1): 8. 1991; FI 4: 371. 1997.
Philagonia fraxinifolia Hooker, Ic. Pl. t. 710. 1848.
Evodia fraxinifolia (Hooker) Bentham, Fl. Hongkong 59. 1861; FBI 1: 490. 1875.

Trees to 12 m. Leaves 25 –60 cm; leaflets 2 –7 pairs, ovate –elliptic, crenulate, acuminate, base asymetrically rounded, glabrous, marginal oil glands larger. Inflorescence branches pubescent. Flowers 4 –merous. Petals greenish. Fruits 4 carpilate. Seeds 2 per cell.

Flowers & Fruits: December – April
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1806***, dated 17.05. 2003.
Status: Rare.
Local Distribution: All three hill gardens.

General Distribution: India, Nepal, Bhutan, China, Indo –China, Malaya.

TODDALIA A. Jussieu (nom. cons.)

Toddalia asiatica (L) Lamk., Tab. Encycl. 2:116. 1797; FEH 1:171.1966; FB 2(1):11. 1991.
Paulinia asiatica L., Sp. Pl. 1:365. 1753.

Local Name: *Main Kanra, Singhanay Kanra* (Nep).

Large evergreen, prickly scandent shrub. Leaves long, palmately 3 foliate, oblanceolate, acute or acuminate, base narrowed, rounded or truncate, margin crenate, glabrous. Inflorescence upto 9cm long with unisexual yellow flowers; Fruit upto 1cm in diam., globose, obsucrely grooved, orange yellow.

Flowers: February – May; *Fruits:* July - November
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2785***, dated 25.03. 2004.
Status: Rare.
Local Distribution: Found only in Makaibari garden.
General Distribution: Tropical Africa, Sub-Tropical Himalayas, Meghalaya, Sri Lanka, Myanmar, Indo-China, China, Malaysia.
Note: Fruits edible (Cowan & Cowan 1929.)

ZANTHOXYLUM L.

Zanthoxylum acanthopodium DC., Prodr. 1. 727. 1824; FBI 1:493. 1875; FEH 1:171. 1966; FB 2 (1):13.1991; FWB 1:388. 1997.

Local Name: *Boke Timbur* (Nep).

Prickly shrub, young branchlets ferruginous, tomentose, sometimes glabrous. Leaves imperipennate, upto 24cm, lacceolate or ovate-lanceolate, obscurely serrate, shortly acuminate or acute, rounded, glabrous above, pubescent beneath. Inflorescence axillary, small crowded cymes, shortly pedunculate. Fruits sub-globose, red; seeds globular, blackish.

Flowers & Fruits: October – June.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2910***, dated 10.04. 2004.
Status: Less common.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Himalayas (Kumaon-Bhutan), Meghalaya, Myanmar, Thailand, Indo-China, W. China.
Note: Fruits chewed to cure indigestion and flatulence.

SAMBUCACEAE Link

SAMBUCUS L.

Sambucus canadensis L., Sp. Pl. ed. 1, 1: 267. 1753; FEH 1: 319. 1966; Fl. Nep. 2: 197. 1979.

Medium shrubs to 3m high; Branches weak and narrow. Leaves upto 48cm long, imparipinnate; leaflets 5-9, oblong-lanceolate, serrate, acuminate, glabrous. Corymbs terminal, villous with whitish or pink flowers. Drupes globose, enclosed by persistent calyx, orange on ripening.

Flowers & Fruits: June - December.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 3032***, dated 10.04. 2004.
Status: Less common
Local Distribution: In hill gardens.
General Distribution: A native of America.

SANTALACEAE R. Brown

DUFRENOYA Chatin

Dufrenoya granulata (A. DC.) Stauffer in Vierteljahrsschr. Nat. Ges. Zurich cxiv (Mitt. Bot. Mus. Univ. Zurich) ccxlii, 70. 1969. EFPN 3: 192. 1983.

Henslowia granulate Hooker f. et Thomson ex DC., Prodr. 14: 632. 1857; FBI 5: 232. 1886; FEH 1: 63. 1966.

Semi-stem parasitic shrub with spreading and twining branches; leaves alternate, obovate to spatulate, thickly coriaceous, 5-9 nerved; flowers in axillary clusters, green; drupes ovoid.

Flowers & Fruits: April - June
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2961***, dated 10.04. 2004.
Status: Rare
Local Distribution: Found only at Tamsong.
General Distribution: Eastern Himalaya, Khasia Hills.

SAURURACEAE A. Rich

HOUTTUYNIA Thunberg

Houttuynia cordata Thunberg in Vet. Akad. Stockh. Handl. 4: 149. t. 5. 1783; FBI 5: 78. 1886; EFPN 3: 182. 1982; FB 1(2): 341. 1984

Perennial, prostrate, branches 15 –40 cm. Leaves broadly ovate, acute or shortly acuminate, cordate; stipules oblong, 1 –2.5cm, adnate to petiole in lower half. Flowers spikes 1 –3 cm; basal bracts white, oblong or obovate, 1 –2 x 0.5 –1cm, obtuse. Fruits capsules.

Flowers & Fruits: June - December.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2925***, dated 10.04. 2004.
Status: Very common.
Local Distribution: All Hill gardens.
General Distribution: Himalayas, Khasia Hills, Manipur, Thailand, China and Japan.

SAXIFRAGACEAE A. Jussieu
[HYDRANGEACEAE Dumort.]

DICHROA Loureiro

Dichroa febrifuga Loureiro, Fl. Cochinch. 1 : 301. 1790; FBI 2: 406. 1878; SFSH f. 150. 1963; FEH 1: 114. 1966; EFPN 2: 157. 1979; TBRI 50 (4): 111. 1987; FB 1(3): 552. 1987.
Adamia cyamia Wallich, Tent. Fl. Nep. 2: 46, t. 36. 1826.

Local Name : Basak (Nep).

Small shrub upto 2m. Leaves opposite, elliptic-oblanceolate, serrate, acuminate, base cuneate or attenuate, surfaces sparsely pubescent. Panicles both axillary and terminal with pale blue or purplish flowers; Berries subglobose, bluish with persistent scales.

Flowers: May - September *Fruits:* July - December
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2915***, dated 10.04. 2004.
Status: Common
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Himalayas, N. Assam, Manipur, Myanmar, Thailand, Indo-China, Malaysia, C. and S. China.

SCROPHULARIACEAE A. Jussieu

HEMIPHRAGMA Wallich

Hemiphragma heterophylla Wallich in Trans. Linn. Soc. 13: 612 (*ut heterophyllum*) 1822; FBI 4:289. 1884; FEH 1: 286.1966; EFPN 3: 114. 1982; TBRI 50 (4): 116. 1987.

Local Name: *Mala Phul* (Nep).

Prostrate perennial running herb covering the ground. Branches spreading, rooting at nodes. Leaves dimorphic: normal cauline leaves opposite, sessile -shortly stalked, orbicular, crenate, acute or obtuse, cordate, pubescent; axillary leaves acicular, fascicled, ciliate. Flowers small pinkish, solitary, axillary, sessile. Fruit globose, shining red.

Flowers & Fruits: March - October
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2100***, dated 30.06. 2003
Status: Very common.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution:Himalayas (Garhwal-Bhutan), Meghalya, Myanmar, W. and C. China, Taiwan, Philippines.
Note: A medicinal plant. Fruits edible.*Flowers & Fruits:*

LINARIA Mill.

Linaria ramosissima Wallich, PAR 2: 43, t. 153. 1831; FBI 4: 251. 1884; FB 2(3): 1097. 2001.

Prostrate suffrutescent perennial; stems to 40cm, slender, glabrous. Leaves ovate or narrowly ovate, acute, base obtuse or hastate, sometimes with small lateral teeth just above base, glabrous. Flowers pale yellow with brown spots. Capsule subglobose.

Flowers & Fruits: June – October.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0965***, dated 04.05. 2002.
Status: Rare
Local Distribution: Found only in Mohurgong & Gulma garden.
*General Distribution:*Pantropic.

LINDENBERGIA Lehmann

Lindenbergia grandiflora (D. Don) Bentham, Scroph. Ind. 22. 1835; FBI 4:261. 1884; FEH 1:287. 1966; EFPN 3:115. 1982; FB 2(3): 1106.2001.
Stemodia grandiflora D. Don, Prodr. Fl. Nep. 89. 1825.

Erect suffrutescent herbs; rootstock woody. Stem and branches flexuous, softly hairy.

Leaves opposite; lamina ovate, coarsely serrate, acute, glandular pubescent. Spikes

terminal, rarely panicled; bracts ovate; corolla yellow. Capsules ovoid.

Flower: June – November; *Fruit:* September – February
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1487***, dated 20.10.2002; Tamsong TE, ***AP Das & Chandrâ 2001***, dated 30.06. 2003; Soom TE, ***AP Das & Chandrâ 2598***, dated 27.12.2004.
Status: Very common.
Local Distribution: All three hill gardens.
General Distribution: Himalayas (Nepal – Bhutan), Assam, Tibet, Myanmar and W. China.

Lindenbergia indica (L.) Vatke in Oestr. Bot. Zeits. 25:10. 1875; FEH 1:287. 1966; EFPN 3:115. 1982; TBRI 50(4):118. 1987.
Dodartia indica L., Sp. Pl. ed. 1:633. 1753.
L. urticifolia Lehm. in Link & Otto, Ic. Pl. Rar. 95, t. 48. 1831; FBI 4:262. 1884.

Erect annual, glandular villous herbs, 10-30cm, branches many, slender, villous. Lamina ovate, cranate-serrate, obtuse, pubescent. Flowers axillary, solitary or 2-nate; calyx lobes recurved; corolla yellow, throat reddish, 3 + 2. Capsule to 0.3cm, ovoid.

Flowers & Fruits: July – December.
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1498***, dated 20.10.2002; Tamsong TE, ***AP Das & Chandrâ 2025***, dated 30.06. 2003; Soom TE, ***AP Das & Chandrâ 3580***, dated 12.10.2004.
Status: Common.
Local Distribution: In all gardens.
General Distribution: Afghanistan, Himalayas, India, Myanmar, east to west China.

LINDERNIA Allioni

Lindernia anagallis (Burm.f.) Pennell in J. Arn. Arb. 24: 252. 1943; EFPN 3: 116. 1982; FB 2(3): 1123. 2001.
Ruellia anagallis Burm.f., Fl. Ind. 135. 1768; FBI 4: 285. 1884.

Annual, 20-60cm with stems creeping and rooting at nodes, branched, glabrous. Leaves subsessile or very shortly petiolate, linear, linear-lanceolate, ovate or broadly deltoid-ovate, pinnately veined, entire or crenate, glabrous. Flowers solitary, axillary, white to pale purple.

Flowers & Fruits: June – October.
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3186,*** dated 26.06. 2004.
Status: Common
Local Distribution: Found in low altitude areas.
General Distribution: Tropical Asia.

Lindernia ciliata (Colsm.) Pannell in Brittonia 2:182. 1936; FBI 4:284. 1884; FEH 1:293. 1966; FEPN 3:116. 1982; FB 2(3): 1125.2001.
Gratiola ciliata Colsm., Prodr. Descr. Gratiola 1:14. 1793.

Small annual, erect or diffusely branched, >18 cm. Leaves sessile, opposite; lamina oblong, sharply serrate with mucronate teeth, acute, base rounded, glabrous. Flowers bracteate, white in terminal racemes upto 8.5cm long. Capsules linear oblong.

Flowers & Fruits: June – November
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1100***, dated 09.05.2002; Kamalpur TE, ***AP Das & Chandrâ 0549***, dated 17.04.2002; Soom TE, ***AP Das & Chandrâ 3449***, dated 12. 10. 2004; Tamsong TE, ***AP Das & Chandrâ 2188***, dated 30.06. 2003.
Status: Abundant
Local Distribution: In all gardens.
General Distribution: Himalayas (Kumaon-Sikkim), India, Myanmar east to W. & S. China, Taiwan, Malaysia and Australia.

Lindernia crustacea (L.) F. Muell., Syst. Census Austr. Pl. 97. 1882; EFPN 3:116. 1982.
Copraria crustacea L., Mant. Pl. 1:87. 1767.
Vandellia crustacea (L.) Benth., Scroph. Ind. 35. 1835; FBI 4:279. 1884; FEH 1:293. 1966.

Upto 25cm high creeping-decumbent diffuse herb. Branches 4-angled, nodes rooting. Leaves opposite; lamina ovate, serrate, obtuse, base rounded-cuneate, pubescent. Peduncles terminal or axillary. Corolla bilabiate, violet-blue; stamens 4, filaments appendiculate. Capsules obovate.

Flowers: Jul. - Oct. *Fruits.:* Sep. - Nov.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0964***, dated 04.05. 2002; Kamalpur TE, ***AP Das & Chandrâ 1201***, dated 18.10.2002; Makaibari TE, ***AP Das & Chandrâ 1763***, dated 17.05.2003; Soom TE, ***AP Das & Chandrâ 3303***, dated 26.06. 2004; Tamsong TE, ***AP Das & Chandrâ 2382***, dated 05.11. 2003
Status: Abundant
Local Distribution: In all gardens.
General Distribution: Tropical Africa, Himalayas, India, Sri Lanka, east to China, Korea and Japan, Malaysia, Australia, America.

Lindernia multiflora (Roxburgh) Mukherjee in JIBS 24: 131. 1945.
Torinia multiflora Roxb., Fl. Ind. 3: 96. 1832.

Much branched prostrate herb; all leaves opposite; flowers in terminal paniculate inflorescence; corolla purple; fruits globose with persisten style.

Flowers & Fruits: October – April.
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 0145***, dated 03.02. 2002; Kamalpur TE, ***AP Das & Chandrâ 1196***, dated 18.10.2002.
Status: Less common
Local Distribution: All Terai gardens.
General Distribution: Pantropic.

Lindernia nummularifolia (D. Don) Wettst. In Engl., Pflfam. 4. 3b. 79. 1891; EFPN 3: 117. 1982; FB 2(3): 1124. 2001.
Vandellia nummularifolia D. Don, Prodr. Fl. Nep. 86. 1825; FBI 4: 282. 1884; FEH 1: 293. 1966.

Erect annual herb, 4-10cm with stem simple or laxly branched. Leaves sub-sessile semi-amplexicaul, ovate-orbicular or suborbicular, pinnately veined, acutely crenate-serrate, glabrous above, sparsely hirsute beneath. Margins shortly ciliate. Flowers violet or pink, solitary and axillary or in lax racemes.

Flowers & Fruits: May – September.
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3241***, dated 26.06. 2004.
Status: Less common
Local Distribution: Found only in Soom garden.
General Distribution: Himalayas (Kashmir – Sikkim), India, Sri Lanka, Myanmar, China.

Lindernia parviflora (Roxburgh) Haines, Bot. Bihar Orissa 4: 635. 1922; FBI 4:283. 1884; FEH 1:287. 1966; EFPN 3:117. 1982.
Gratiola parviflora Roxburgh, Pl. Corom. 3:3, t. 204. 1819.

Annual slender decumbent herbs; stem 4-anguled, glabrous. Leaves opposite, sessile; lamina ovate-elliptic, obtuse or acute, base attenuate. Racemes axillary and terminal; flowers bluish white. Capsules cylindric-ellipsoid.

Flowers & Fruits: May – December
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0485***, dated 17.04.2002; Makaibari TE, ***AP Das & Chandrâ 2577***, dated 11.11. 2003.
Status: Very common.

***Local Distribution*: In all gardens.**
General Distribution: Tropical Africa, Himalayas, India, Myanmar and China.

Lindernia pyxidaria L., Mant. Pl. 2: 252. 1771.

Like *L. crustacea* but lamina more rounded and thick.

Flowers & Fruits: June - December

Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0021***, dated 27.01.2002; Makaibari TE, ***AP Das & Chandrâ 2467***, dated 11.11. 2003.
Status: Common
Local Distribution: Found in low altitude areas.
General Distribution: Tropical Asia

Lindernia ruellioides (Colesmann) Pennel in Brittonia 2:182. 1936; FB 2(3): 1125. 2001.
Gratiola ruellioides Colsm, Prodr. Desc. Grat. 12. 1793.

Prostrate, perennial, creeping, rooting at nodes. Stems 10 –50 cm. Leaf pairs distant; petioles pubescent; lamina elliptic, pinnately veined, obtuse, attenuate, finely dentate, teeth incurved, acute. Flowers in lax racemes. Calyx cylindric. Corolla pale purple. Capsules cylindric.

Flowers & Fruits: (June)
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3255***, dated 26.06. 2004.
Status: Rare
Local Distribution: Found only in Soom garden.
General Distribution: Tropical Asia.

MAZUS Loureiro

Mazus pumilus (Burman f.) Van Steenis in Nova Guin. n. 5. 9: 31. 1958; EFPN 3:117. 1982; TBRI 50(4): 119. 1987.
Lobelia pumila Burman f., Fl. Ind. 186, t. 60, f. 3. 1768.
Mazus japonicus O. Kuntze, Rev. Gen. Pl. 462. 1891; FEH 1:288. 1966.
Mazus rugosus Loureiro, Fl. Cochinch. 385. 1790; FBI 4:259. 1884.

Rosannette, annual herb, scape 10-30 cm high, hairy. Lamina of radical leaves obovate-spathulate, obtuse, narrowed to petiole. Racemes to 14cm long, terminal. Flowers alternate; calyx campanulate, lobes ovate-lanceolate; corolla bluish, 3+ 2. Capsules globose with persistent calyx.

Flowers & Fruits: May – November.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0069***, dated 27.01.2002; Kamalpur TE, ***AP Das & Chandrâ 0384***, dated 27.02.2002; Makaibari TE, ***AP Das & Chandrâ 1783***, dated 17.05.2003; Tamsong TE, ***AP Das & Chandrâ 2162***, dated 30.06. 2003.
Status: Very common.
Local Distribution: In all gardens.
General Distribution: Himalayas (Kashmir – Bhutan), India, east to China, Korea, Japan, Malaysia.

Mazus surculosus D. Don, Prodr. Fl. Nep. 87. 1825, *ut surculosa*; FBI 4: 260. 1884; FEH 1: 288. 1966; EFPN 3: 118. 1982; TBRI 50(4): 119. 1987.

Small perennial rosette herbs, runners profuge. radicals leaves larger, opposite, lamina obovate-spathulate/ subpinnatifid, crenate, narrowed to petiole, pubescent. Calyx lobes triangular, suberect in fruits; corolla bluish white/ pinkish violet, upper lip dark, 2-lobed, lower larger 3-lobed.

Flowers & Fruits: May - October.

Specimen Cited: Tamsong TE, **AP Das & Chandrâ 1980**, dated 30.06. 2003.
Status: Common
Local Distribution: All three hill gardens.
General Distribution: Himalayas (Kashmir – Bhutan), Assam, Tibet, W. China.

MECARDONIA Ruiz & Pavon

Mecardonia procumbens (Miller) Small, Fl. South-east U.S. 1065, 1338. 1903; FB 2(3): 1114. 2001.
Erinus procumbens Miller, Gaed. Dict. ed. 8, Ni.6. 1768.
Mecardonia dianthera (Swartz) Miller in Sp., Field Mus. Nat. Hist. Bot. Ser. 2: 765. 1903.

Stems 10 –50cm, prostrate. Leaves ovate, serrate in upper part. Pedicels erecto –patent. Calyx 6 –8mm, lobes obtuse. Corolla yellow with brown veins; tube pubescent; upper lip ovate, emarginate; middle lobe of lower lip suborbicular. Capsules ovoid or ellipsoid; seeds ellipsoid.

Flowers & Fruits: June - December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0062***, dated 27.01.2002; Hansqua TE, ***AP Das & Chandrâ 0240***, dated 09.02.2002
Status: Very common.
Local Distribution: All Terai gardens.
General Distribution: Native of America; naturalized in India.

MIMULUS L.

Mimulus nepalensis Bentham, Scroph. Ind. 29. 1835; FEH 1: 289. 1966; 2: 119. 1971; EFPN 3: 118. 1982; TBRI 59(4): 120. 1987.

Small prostrate herb, 6-15cm. Leaves opposite, ovate, coarsely serrate, acute, base slightly rounded, glabrous or sparsely hairy. Flowers yellow solitary. Capsules included with inflated sepals.

Flowers & Fruits: May - October
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2266***, dated 05.09. 2003
Status: Less common
Local Distribution: All three hill gardens.
General Distribution: E. Himalaya (Nepal-Bhutan), Assam, W. and C. China.

SCOPARIA L.

Scoparia dulcis L., Sp. Pl. ed. 1, 116. 1753; FBI 4: 289. 1884; FEH 1:290. 1966; EFPN 3:126. 1982.

Suffrutescent, much branched, to 90 cm high. Leaves sessile, opposite / ternate; lamina elliptic or rhomboid, seerrate, punctate. Flowers axillary, white; calyx 3 nerved, segments imbricate; corolla 0.32 cm diam., white; filament base wooly. Capsule globose, septicidal; seeds obovoid, angular.

Flowers & Fruits: June – December.

Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0040***, dated 27.01.2002; Kamalpur TE, ***AP Das & Chandrâ 0421***, dated 27.02.2002; Makaibari TE, ***AP Das & Chandrâ 1784***, dated 17.05.2003.
Status: Very common.
Local Distribution: All Terai gardens.
General Distribution: America, commonly naturalised in tropical Asia.
Note: Young leaves are taken orally in diabetes.

SCROPHULARIA Ser. ex Pfeiff.

Scrophularia elatior Wallich *ex* Bentham, Scroph. Ind. 18. 1835; FBI 4: 255. 1883; EFPN 3: 126. 1982.

Tall, stout, 90 –150 cm, winged throughout, glandular above. Lamina ovate, dentate, acute, base shallowly cordate, glabrous. Panicles large, terminal & axillary. Bracteoles narrowly ovate. Corolla green. Stamens long –exserted; staminodes spathulate. Capsules ovoid or subglobose.

Flowers & Fruits: June - December
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2377***, dated 05.11. 2003.
Status: Rare
Local Distribution: Found only in Tamsong gardens.
General Distribution: Eastern Himalaya.

TORENIA L.

Torenia asiatica L., Sp. Pl. 619. 1735; FBI 4:277. 1884, p.p.; EFPN 3:127. 1982; TBRI 50(4):125. 1987.
T. cordata (Griffith)Dutta in BBSB 19:25. 1963; FEH 1:291. 1966.

Pubescent annual herbs, 20-30cm, diffused, branches creeping, slender. Stem 4-angled. Lamina ovate, serrate, acuminate, pubescent. Flowers axillary, solitary, subumbellate. Calyx tubular, bilipped, keeled; corolla violet, lower lip whitish. Capsules oblong, with persistent calyx.

Flowers & Fruits: May – January
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0402***; dated 27.02.2002; Soom TE, ***AP Das & Chandrâ 3462***, dated 12.10.2004.
Status: Common
Local Distribution: In all gardens.
General Distribution: Himalayas, India, Sri Lanka, Myanmar east to China, Malaysia.

Torenia bicolor Dalz. in Hook. Kew. J. 3: 38. 1851.

Flowers & Fruits: June – December.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0931***, dated 04.05. 2002; Soom TE, ***AP Das & Chandrâ 3286***, dated 26.06. 2004.
Status: Rare
Local Distribution: Found in low altitude areas.
General Distribution: Himalayas, India, Sri Lanka, Myanmar, Malaysia.

Torenia peduncularis Benth.ex Hook. f., FBI 4: 276. 1884; FB 2(3): 1120. 2001.
Torenia edentula Benth.ex Hook. in Bot. Mag. t. 4229. 1846, *non* Griff.

Erect or prostrate annual; branches 10 –40 cm. Petioles narrowly winged. Lamina ovate, serrate or crenate serrate, subacute, truncate. Flowers solitary, axillary in upper axils. Bracts linear. Calyx 5 –winged, teeth 5. Corolla violet, lobes violate. Capsules narrowly lanceolate –ellipsoid.

Flowers & Fruits: June – December.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1707***, dated 17.05.2003; Tamsong TE, ***AP Das & Chandrâ 1949***, dated 30.06. 2003; Soom TE, ***AP Das & Chandrâ 3178***, dated 26.06. 2004.
Status: Common
Local Distribution: All three hill gardens.
General Distribution: Central & Eastern Himalayas, China.

VERONICA L.

Veronica javanica Blume, Bijdr. 742. 1826; FBI 4: 296. 1884; FEH 1: 294. 1966; EFPN 3: 129. 1982.

Small, erect, much branched annual. Leaves opposite; lamina ovate, crenate or bicrenate – serrate, obtuse or subscute, shallowly cordate,. Racemes axillary; bracts linear . Calyx lobes linear –oblong. Corolla whitish or pale blue. Capsules obcordate, shorter than calyx. Seeds elliptic.

Flowers & Fruits: June – December
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2909***, dated 10.04. 2004.
Status: Abundant
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Subtropical to temperate regions of Asia.

Veronica serpyllifolia L., Sp. Pl. 12. 1753.

Perennial. Stems creeping, nodes rooting, 10 –30 cm. Lamina sessile, ovate/ oblong, apex & base obtuse, glabrous. Racemes terminal, bracteate, dense. Lowest bracts leafy, smaller, upper narrowly oblong. Calyx lobes ovate oblong. Corolla pale blue. Anthers blue. Capsules obcordate.

Flowers & Fruits: August - December
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2058***, dated 30.06. 2003.
Status: Rare
Local Distribution: Found only in Tamsong garden.
General Distribution: Temperate to subalpine Himalayas, Nilgiris, Europe, Africa & S. America.

SOLANACEAE A. Jussieu

CESTRUM L.

Cestrum aurantiacum Lindley, Bot. Reg. 71. 1844; EFH 1:282. 1966; EFPN 3:108. 1982; TBRI 50(4):108. 1987; FB 2(3): 1071. 2001.

Local Name: Malami Phul (Nep).

Large shrubs, 2-4m high, young shoots sparsely hairy. Branches spreading, lenticellate. Leaves alternate, ovate-elliptic, entire acute, glabrous on both sides. Cymes terminal and axillary, laxly branched, 1-5 flowers on each branch, terminal flowers fascicled. Flowers tubular, orange yellow. Berry globose, obscurely 2-lobed, white.

Flowers & Fruits: July - June
Specmen Cited: Tamsong TE, ***AP Das & Chandrâ 2316***, dated 05.09. 2003.
Status: Very common.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Central America, now cultivated and naturalised everywhere.

DATURA L.

Datura metel L., Sp. Pl. 179. 1753; FBI 4: 243. 1883; FEH 1: 283. 1966; EFPN 3: 109. 1982; FB 2(3): 1067. 2001.

Local Name: *Kalo dhutura* (Nep).

Erect, soft-stemmed shrub 1-2.5m. Branches ± zigzag, green, black or tinged with red or purple, minutely pubescent to glabrous. Leaves elliptic, to broadly ovate, acute, or shortly acuminate, base obtuse, asymmetrical, margin entire, repand or angulate. Flowers solitary in axils, erect, white or purple.

Flowers & Fruits: April –October
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 1179***, dated 18.10.2002; Tamsong TE, ***AP Das & Chandrâ 1940***, dated 30.06. 2003.
Status: Common inTerai; rare in other places.
Local Distribution: Found in low altitude areas only.
General Distribution: Tropical America; naturalized wlsewhere.
Note: An important narcotic & Medicinal Plant.

Datura stramonium L., Sp. Pl. 179. 1753; FBI 4: 242. 1883; FEH 1: 283. 1966; EFPN 3: 109. 1982; FB 2(3): 1067. 2001.

Local Name: *Sada Dhutra* (Beng)

Plant narcotic, especially seeds, which have a stupefying effect and can be fatal.
Erect branched annual, sometimes woody at base. Leaves ovate, rhomboid or elliptic acuminate, base cuneate, symmetrical, margin deeply sinuate-dentate, surfaces ± glabrous. Flowers solitary, axillary, erect, white or less commonly purplish.

Flowers & Fruits: March-October
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0005***, dated 27.01.2002; Tamsong TE, ***AP Das & Chandrâ 2178***, dated 30.06. 2003.
Status: Common inTerai; rare in other places.
Local Distribution: Found in low altitude areas only.
General Distribution: Tropical America; naturalized wlsewhere.

Datura suaveolens Humb. & Bonpl. ex Willd., Enum. Pl. H. Berol. 227. 1809; FEH 1: 283. 1966; EFPN 3: 109. 1982; FB 2(3): 1068. 2001.


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Local Name: Dhokrey phul (Nep).

Shrub or small tree, 1-6m, branches brittle, young stems minutely pubescent. Leaves ovate-elliptic, acute or shortly acuminate, base cuneate, subglabrous. Flowers pendulous, fragrant or not, creamy at first, turning white, 20-30cm.

Flowers & Fruits: January – December.
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3389***, dated 12. 10. 2004.
Status: Very common.
Local Distribution: All three hill gardens.
General Distribution: Tropical America; naturalized wlsewhere.
Note: Plant narcotic, used as an ornamental hedge plant.

NICOTIANA L.

Nicotiana plumbaginifolia Viv., Elench. Pl. Hort. Dinegro 26.t. 5. 1802; FBI 4:1074. 246. 1883; FB 2(3): 1074. 2001.

Rosette annual, radical leaves with petioles 2.5 –3 cm; lamina broadly oblong –spathulate to obovate, obtuse, attenuate, shortly hispid on veins, lower ones similar to basal but uppermost narrowly lanceolate, acuminate. Racemes lax, few-flowered false. Corolla greenish –ivory or purplish. Capsules narrowly ovoid; seeds roundish ellipsoid, reticulate.

Flowers & Fruits: January - May
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0857***, dated 04.05. 2002; Hansqua TE, ***AP Das & Chandrâ 1657***, dated 18.10.2002; Kamalpur TE, ***AP Das & Chandrâ 1357***, dated 18.10.2002.
Status: Less common
Local Distribution: All Terai gardens.
General Distribution: Tropical America; naturalized wlsewhere.

LYCOPERSICON Miller

Lycopersicon esculentum Miller, Gard. Dict. (ed.8) n.2. 1768; FBI 4:237.1883; FB 2(3): 1063.2001.

Local Name: *Tomato* (Beng), *Tomator* (Nep)

Sticky-pubescent herbs. Leaves pinnatisect, chartaceous, lobes obliquely triangular-ovate, shortly petiolulate, terminal lobes acute. Flowers in axillary small cymose fascicles, pedicellate, yellow. Berries 4-6 lobed, depressed-globose, pulp juicy.

Flowers & Fruits: January – December
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0667***, dated 20.04.2002.
Status: Rare
*Local Distirb*ution: Found in Kamalpur & Matigara gardens only.
General Distribution: A native of tropical America; cultivated elsewhere; sometime escapes.

PHYSALIS L.

Physalis divaricata D. Don, Prodr. Fl. Nep. 97. 1825; EFPN 3: 110. 1982; FB 2(3): 1045 .2001.
Physalis minima auct. non. L.: Roxb. Fl. Ind. ed.2. 1: 563. 1832.

Local Name: *Makai, Fokfoke* (Nep)

Erect succulent hispid herbs, stems striated. Lamina ovate or narrowly elliptic, entire or distantly and shallowly serrate, acute, base obtuse, glabrous. Flowers light yellow, solitary, axillary. Berries enclosed in inflated bladder like calyx.

Flowers & Fruits: August – March
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3221***, dated 26.06. 2004.
Status: Less common
Local Distibution: All Terai gardens and in lower areas of hill gardens.
General Distribution: Pantropical.

Physalis minima L., Sp. Pl. 183. 1753; FBI 4: 238. 1883; FB 2(3): 1045. 2001.

Diffusedly branched annual, 15 –45cm. Lamina ovate, repand or subentire, acute or acuminate, base cordate or oblique. Calyx campanulate, globose –ovoid; lobes triangular. Corolla yellow, without basal spots. Berry orange, globose. Seeds brownish –yellow, minutely reticulate.

Flowers & Fruits: August – March
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2388***, dated 05.11. 2003
Status: Less common
Local Distribution: All Terai gardens and in lower areas of hill gardens.
General Distribution: Pantropic.

SOLANUM L.

Solanum myriacanthum Dunal, Hist. Solan. 218, t. 19. 1813; EFPN 3:111. 1982; TBRI 50(4):127. 1987 (*ut. myrianthum*).
S. khasianum ***CB. Clarke, FBI 4:234. 1833.***

Local Name: *Kalchunray Kanra, Bhere Kanra* (Nep).

Small annual stout herb, to 1m tall, much branched, prickly, densely hirsute. Lamina ovate, deeply acute-lobed, lobes, hirsute. Racemes lateral, few flowered. Sepals lanceolate, hirsute; corolla whitish, lobes lanceolate. Berries globose, green and white masaic, yellow at ripening.

Flowers & Fruits: June – March.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0037***, dated 27.01.2002; Hansqua TE, ***AP Das & Chandrâ 0994***, dated 0952; Makaibari TE, ***AP Das & Chandrâ 1892***, dated 10.06. 2003.
Status: *Common.*
Local Distribution: In all gardens.
General Distribution: Eastern Himalaya & Khasia Hills.
Note: Fruits and seeds poisonous; an important medicinal plant.

Solanum nigrum L., Sp. Pl. ed. 1, 186. 1753; FBI 4: 229. 1883; FEH 1: 284. 1966. FB 2(3): 1052. 2001

Suffrutesscent, unarmed herb. Leaves ovate-lanceolate or ovate-oblong, entire/ sinuate/ toothed, acute to acuminate, base narrowed to petioles, glabrous. Flowers in cymes sub-umbellate; calyx lobes pubescent, rounded; corolla rotate, glabrous; style base hairy. Ripe berries globose, black.

Flowers & Fruits: Throughout the year.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0291***, dated 16.02. 2002; Kamalpur TE, ***AP Das & Chandrâ 1379***, dated 18.10.2002; Makaibari TE, ***AP Das & Chandrâ 1785***, dated 17.05.2003.
Status: Very common..
Local Distribution: In all gardens.
General Distribution: Cosmopolitan.

Solanum sisymbriifolium Lam., Tabl. Encycl. 2: 25. 1794.

Tall much prickly annual herb; much branched. Flowers white. Fruits globose, turn red on ripening.

Flowers & Fruits: January – December.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0579***, dated 20.04.2002.
Status: Less common
Local Distribution: All Terai gardens.
General Distribution: Tropical America; naturalized wlsewhere.

Solanum torvum Swartz, Prodr. 47. 1788; FBI 4: 234. 1883; FEH 1: 284. 1966; FB 2(3): 1055.2001.

Local Name: Bin (Nep.)

Shrubs or undershrubs, 1.5-2.8 m high, unevenly armed, stellate, pubescent. Lamina ovate, lobed or serrate, shortly acuminate, base unequal, membranous, sparsely stellate-pubescent. Cymes usually extra-axillary, dense, often branched; flowers white. Berry globose, reddish, glabrous.

Flowers & Fruits: January – December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0041***, dated 27.01.2002; Makaibari TE, ***AP Das & Chandrâ 1775***, dated 17.05.2003.
Status: Common.
Local Distribution: Common in low altitude areas.
General Distribution: West Indies extensively naturalized everywhere.
Note: Root used as an antidote to poison, leaves used against snakebite and enlargement of the spleen, fruits eaten.

SONNERATIACEAE Engler *et* Gilg.

DUABANGA Hamilton

Duabanga grandiflora (Roxburgh *ex* DC.) Walpers, Repert. 2:114. 1843; JAA 48:96.1967; FB 2 (1): 287. 1991.
Lagerstoemia grandiflora Roxburgh *ex* DC., Mem. Soc. Hist. Nat. Geneve 32:84. 1826.

Local Name: *Lampate* (Nep).

Large trees to 29m high, branches drooping. Leaves opposite, simple; lamina ovate-oblong, acuminate, cordate, dark green, pale beneath, veins parallel. Corymbs terminal, drooping, 4-22 flowered. Flowers showy-white; stamens numerous. Capsule subglobose; seeds filiform.

Flowers & Fruits.: December - April
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1912***, dated 10.06. 2003.
Status: Frequent in lower areas, specially on spring and river side.
Local Distribution: Found in Makaibari garden only.
General Distribution: Himalayas (Kumaon-Bhutan), Assam, S.E. Tibet, Myanmar, China, Malaysia.

STERCULIACEAE Ventenat

AMBROMA L.f.

Ambroma augusta L.f., Suppl Pl. 341. 1782; FB 2(1): 206. 1991.

Local Name: *Sanu Kapasi* (Nep).

Shrub 2-4m; Leaves ovate to suborbicular unlobed or shallowly 3-5 lobed, acuminate base truncate or cordate, margins distantly serrulate, long petiolate. Flowers pendent purplish brown in cymes of 2-5 flowered. Capsule obovoid, 5 winged.

Flowers & Fruits: June – January.
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3418***, dated 12. 10. 2004.
Status: Less Common.
Local Distribution: In Terai and low altitude areas.
General Distribution: India, Nepal, Bhutan, China, Micronesia, Malaysia
Note: Root used medicinally for menstrual disorders and snake bites, stems used as a fibre crop. Seeds edible.

MELOCHIA L.

Melochia corchorifolia L., Sp. Pl. 675. 1753; FBI1:374. 1874; FEH 1:206. 1966; EFPN 2:70. 1979.

Annual much-branched herbs, entire plant brownish. Leaves oblong-ovate, crenate-serrate, acuminate, base cordate, stellate-hairy; stipules lanceolate. Flowers in dense heads, pinkish white. Capsules depressed-globose, loculicidal, pubescent, 5 valved with gray seeds.

Flowers & Fruits: June – December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0949***, dated 04.05. 2002; Hansqua TE, ***AP Das & Chandrâ 1048***, dated 09.05. 2002; Kamalpur TE, ***AP Das & Chandrâ 1327,*** dated 18.10.2002.
Status: Abundant
Local Distribution: All Terai gardens.
General Distribution: Pantropical.
Note: Leaves are sometimes eaten as vegetable.

THEACEAE D. Don

SCHIMA Blume

Schima wallichii (DC.) Korthals, Bijdr. Ternstr. in Temminck, Verh. Nat. Gesch. Bot. 143. 1839-42; FBI 1: 289. 1874; FB 1(2): 365. 1984; FWB 1:276. 1997.
Gordonia wallichii DC., Prodr. 1: 528. 1824.

Local Name: *Aulay Chilaunay* (Nep).

Evergreen large tree upto 30 m. Buds and young parts adpressed pubescent. Lamina ovate-elliptic, entire, acute to acuminate, cuneate or rounded, glabrous, pubescent beneath. Flowers axillary solitary, white; Capsule 2-2.4 cm across, subglobose, woody; seeds surrounded by wing.

Flowers: May - Jul. *Fruits.*: Nov. - Feb.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2801***, dated 25.03. 2004; Tamsong TE, ***AP Das & Chandrâ 2979***, dated 10.04. 2004.
Status: Frequent.
Local Distribution: **In all hill gardens.**
General Distribution: E. Himalaya (Nepal-Bhutan), Assam, Tibet, China.
Note: Branches and twigs are used as excellent firewood and manure. Trunk is used as timber for building houses and ploughshares. Bark juice medicinal.

THYMELIACEAE A. Juss.

EDGWARTHIA Meissner

Edgeworthia gardneri (Wallich) Meisner in Denkschr. B. Ges. Regensb. 3: 280. t. 6. 1841; FBI 5: 195. 1886. FEH 2: 85. 1971; Fl. Nep. 3: 188. 1982.
Daphne gardneri Wallich in As. Res. 13: 388. t. 9. 1820.

Large shrubs to 4 m. Lamina elliptic –oblanceolate, entire, acute, base cuneate or attenuate, glabrous above, appressed silky beneath. Flowers in pendulous heads 3 –4.6 cm diameter, scented. Perianth tube creamy white, silky; lobes yellow. Fruits ovate with long, stiff, pale hairs.

Flowers & Fruits: Jun. - Dec.
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3235***, dated 26.06. 2004.
Status: Rare
Local Distribution: In Tamsong & Soom gardens only.
General Distribution: Central & Eastern Himalayas, Manipur, Myanmar, China & Japan.

DAPHNE L.

Daphne cannabina Wallich in As. Res. 13: 385. t. 7, 8. 1820, *non* Loureiro 1790; FBI 5: 193. 1886; FB 2(1): 212. 1991.
Daphne papyracea Wallich in Steud. Nomencl. "ed. 2",1: 483. 1841.

Shrubs, 1 –3.5 m, evergreen. Branchlets glabrascent. Leaves clustered at branch ends, thinly coriaceous, elliptic–oblanceolate, acute or acuminate, cuneate, glabrous, sessile. Flowers 5 –15 in terminal clusters, fragrant, sessile. Perianth tube purplish; lobes white, ovate. Drupes ovoid.

Flowers & Fruits: November – May
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 1963***, dated 30.06. 2003
Status: Rare
Local Distribution: Found in Tamsong only.
General Distribution: Eastern Himalaya.

TILIACEAE A. Jussieu

GREWIA L.

Grewia sclerophylla Roxburgh ex G. Don, Gen. Hist. 1: 550. 1831; FB 2(1): 176. 1991; FI 3: 509. 1993.
Grewia scabrophylla Roxburgh, Fl. Ind. 2: 584. 1832; FBI 1: 387. 1874.

Shrub to c1m with stout main stems, erect leafy shoots, branches stellate tomentose. Leaves coriaceous, broadly ovate or suborbicular, obtuse or subacute base broadly rounded, margins irregularly serrate, rugose and rough to touch above. Flowers white. Drupe subglobose.

Flowers & Fruits: May – June.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2482***, dated 11.11. 2003.
Status: Less Common.
Local Distribution: Found only in Makaibari garden.
General Distribution: India, Nepal, Bhutan.

Grewia serrulata DC., Prodr. 1: 510. 1824; FI 3: 509. 1993; FB 2(1): 178.1991.
Grewia multiflora auct. non a. l. Juss. 1804: FBI 1: 388. 1874.

Local Name: *Chiple, Kuail* (Nep).

Shrubs or small trees 4-6m tall; branches stellate pilose. Lamina membranous, ovate- lanceolate, cuneate at base, stellate pilose beneath. Peduncles 1-2 per axil, each 3-5 flowered. Drupes c 1.0 cm across.

Flowers: July – September
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 1517***, dated 22.10. 2002.
Status: Less Common.
Local Distribution: Terai gardens.
General Distribution: India, Nepal, Bhutan, Malaysia, Australia.

TRIUMFETTA L.

Triumfetta pilosa Roth, Nov. Sp. 223. 1821; FBI 1:394. 1874; FEH 1:203. 1966; EFPN 2:72. 1979; TBRI 50(4):101. 1987; FB 2(1):175. 1991.

1 to 2 m high suffrutescent herb, densely stellate hairy. Lamina ovate-lanceolate, irregularly serrate, often shallowly 2-lobed, acuminate, cordate or rounded, 5-veined. Stipules subulate. Cymes lateral. Sepals linear, pubescent; petals yellow. Capsule pilose, bristls hooked spines.

Flowers: Aug. - Dec. *Fruits*: Oct. - Jan.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0880***, dated 04.05. 2002; Makaibari TE, ***AP Das & Chandrâ 2518***, dated 11.11. 2003
Status: Less Common.
Local Distribution: In all gardens.
General Distribution: Himalayas, India to Indochina.

ULMACEAE Mirbel

TREMA Loureiro

Trema orientalis (L.) Blume, Mus. Bot. Lugd. Bot. 2:58. 1856; FBI 5:484. 1888; FEH 1:52. 1966; EFPN 3: 207. 1982; FB1(1): 86.1983.

Local Name: Kunyel (Nep).

Semideciduous small trees, branchelts drooping, appresed pubescent; bark silver-grey. Lamina ovate-laneolate, closely serrate, acuminate, cordate, scabrous above, silvery white beneath, thinly adpressed hairy; stipules deciduous. Flowers in axillary cymes. Drupes ovoid, black.

Flowers & Fruits: March – October
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0448***, dated 05.04. 2002; Hansqua TE, ***AP Das & Chandrâ 1472***, dated 20.10.2002; Kamalpur TE, ***AP Das & Chandrâ 0573***, dated 20.04.2002.
Status: Common
Local Distribution: In Terai gardens
General Distribution: Tropical Africa, Himalayas (Kumaon-Bhutan), India, Sri Lanka, W. & S. China and Australia.
Note: A very first growing species, often referred as 'Tree Weed'.

Trema politoria (Plancheon) Blume, Mus. Bot. Lugd.- Bat. 2:58.1856; FBI 5:484. 1888; FEH 2: 82.1960; FB 1(1): 86. 1983.

Small scabrid tree, 2-8m high. Lamina ovate-lanceolate, serrate, acuminate, serrate, pale green beneath, dark green when dry, rough above with whitish papillae, basally 3–veined. Cymes axillary, Male Flowers 4- merous, tepals linear–lanceolate; Drupes ovoid and black.

Flowers & Fruits.: May - Aug.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0861***, dated 04.05. 2002.
Status: Less Frequent.
Local Distribution: **Found in Mohurgong & Gulma garden only.**
General Distribution: Himalayas (Kumaon-Bhutan), India, S. W. China.

URTICACEAE A. JUSSIEU

BOEHMERIA Jacquin

Boehmeria glomerulifera Mig. in Zoll., Syst. Verz. Ind. Archip. 101, 104 1854; FB 1(1): 124. 1983.
B. malabarica Wedd. in Arch. Mus. Hist. Nat. Paris 8: 355. 1855-56; FBI 5: 575. 1888.

Local Name: Ka*m*le (Nep).

Shrubs upto 3 m tall, branches pubescent. Leaves altemete, ovate, acuminete, base rounded, margins crenulate or sometimes serrulate, glabrous and rugose above, minutely hairy beneath. Flowers aggregated in globose chusters, 0.4-0.7 cm in diam.

Flowers & Fruits: March – July.

Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0563***, dated 17.04.2002.
Status: Rare
Local Distribution: Found in low altitude areas.
General Distribution: E. Himalaya (Darjeeling-Bhutan), Meghalaya, Sri Lanka.

Boehmeria hamiltoniana Weddell in Ann. Sci. nat. ser. 4, 1; 199. 1854; FBI 5: 579. 1888; FEH 1: 56. 1966; FB 1(1): 127. 1983.

Local Name: *Kamley, Chiplay* (Nep).

A robust shrub. Branches slender, glabrous. Lamina lanceolate, crenulate or serrulate, acuminate, base cuneate or narrowly rounded, glabrous, basally 3-nerved. Spikes c.12 cm long, slender. Achenes ellipsoid, glabrous, crowned with persistent style

Flowers & Fruits: September – February.
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3279***, dated 26.06. 2004.
Status: Common
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Tropical Himalayas (Nepal – Bhutan), Khasia and Mishmi Hills.
Note: Foliage commonly used as fodder.

Boehmeria macrophylla D.Don, Prodr. Fl. Nep. 60. 1825; FEH 3: 18. 1975; FBI 5: 579. 1888; EFPN 3: 201. 1982. var. ***macrophylla***: FB 1(1): 126. 1983.

Monoecious or dioecious subshrub, 1-3m. Lamina ovate, cuspidate, base rounded, serrate; minor veins inconspicuous; pubescent. Petiole slender, stipule lanceolate, deciduous. Female spikes solitary, 10-30 cm. Male spikes 7-10 cm, paniculately branched.

Flowers & Fruits: June - December
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3181***, dated 26.06. 2004.
Status: Rare
Local Distribution: Found only in Soom garden.
General Distribution: Eastern Himalaya, Mayanmar.

Boehmeria macrophylla Hornem.var. ***canescens*** (Weddel) Long in NRBGE 40: 129. 1982; FB 1(1): 126. 1983.

Monoecious or dioecious subshrub, 1 –3m. Lamina membranous ovate, cuspidate, base rounded, serrate; minor veins inconspicuous; whitish pubescent. Petiole slender, stipule lanceolate, deciduous. Female spikes simple, solitary, to 30 cm. Male spikes to 10 cm, paniculately branched.

Flowers & Fruits: August – February.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0304,*** dated 16.02. 2002.
Status: Less common
Local Distribution: All Terai gardens.
General Distribution: Eastern Himalaya.

Boehmeria macrophylla var. ***scabrella*** (Roxburgh) Long in NRBGE 40: 129. 1982; FB 1(1): 127. 1983.
Urtica scabrella Roxburgh, Fl. Ind. 3: 581. 1832.

Leaves usually ovate, apex gradually acuminate, texture rather rigid, surface rugose stiffy hispid above, pubescent beneath. Spikes rigid, mostly 5-15 cm long.

Flowers & Fruits: Not recorded
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0486***, dated 17.04.2002.
Status: Less common
Local Distribution: Found only in Kamalpur garden.
General Distribution: Eastern Himalaya, Myanmar.

Boehmeria penduliflora Long in NRBGE 40: 130. 1982; FB 1(1): 125. 1983.
Boehmeria macrophylla D. Don, Prodr. 60. 1825, non Hornem. 1815; FBI 5: 577. 1888.

Monoecious shrub, 1 –3 m. Leaves lanceolate, acuminate, cuneate, sharply serrulate, glabrous, roughened above, softly pubescent beneath; stipule lanceolate. Male spikes borne below, clusters few flowered. Female borne above, flowers numerous; style hooked.

Flowers & Fruits: August – December.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2088***, dated 30.06. 2003.
Status: Rare
Local Distribution: Found only in Tamsong garden.
General Distribution: India, Nepal, Bhutan, Malaysia.

Boehmeria polystachya Weddel [in Ann. Sci. Nat. Ser. 4:11. 1854. nom. nud.] Monogr. Urtic. 370. 1856; FBI 5: 579. 1888; FEH 3: 18. 1975; Fl. Nep. 3: 201. 1982

Monoecious or dioecious, 1 –3 m. Lamina ovate, regularly serrate, base rounded or cordate, paler beneath, secondary veins conspicuous, numerous, parallel, spreading from main veins; petioles stout, 3 –8cm; spikes forming short, dense, much –branched panicles, 5 –10cm long.

Flowers & Fruits: June - December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 1624,*** dated 22.10. 2002.
Status: Less common
Local Distribution: All Terai gardens.

General Distribution: Eastern Himalaya, Nepal, Bhutan, Myanmar, Malaysia.

Boehmeria rugulosa Weddell in Ann. Sci. Nat. Ser. 4, 1:200. 1854; FBI 5:577. 1888; FEH 1:57. 1966; FB 1(1):125. 1983.

Local Name: *Daar* (Nep).

Small trees to 9m tall, dioecious. Leaves opposite; lamina ovate-lanceolate, crenulate, acuminate, subcuneate/ rounded, strongly 3-veined, rugose, whitish pubescent beneath. Spikes ±15 cm long; male flowers globose, polyphyllous. Female perianth ovoid, compressed, enclosing anchenes.

Flowers & Fruits.: September - December.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2243***, dated 05.09. 2003.
Status: Less common.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Himalayas (Garhwal – Bhutan).
Note: Different types of traditional bowls and domestic utensils are made from its wood by a community called Chundaray.

Boehmeria ternifolia D.Don, Prodr. 59. 1825; FEH 1: 57. 1966; FB 1(1): 127. 1983.

Monoecious or dioecious subshrub, 1 – 3 m. Leaves orbicular or suborbicular, abruptly cuspidate, base rounded, crenate –serrate or dentate, larger towards apex; minor veins inconspicuous; appressed pubescent. Petiole slender; stipule lanceolate, deciduous. Spikes slender and flexuose.

Flowers & Fruits: **May – August.**
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1850,*** dated 10.06.2002.
Status: Found only in Makaibari garden.
Local Distribution: Found only in Makaibari garden.
General Distribution: Himalayas.

CHAMABIANA Wight

Chamabiana cuspidata Wight, Icon. t. 1981. 1853; FBI 5: 580. 1888; FEH 1: 57. 1966; 3: 19. 1975; EFPN 3: 202. 1982; FB 1(1): 128. 1983; TBRI 50 (4): 109. 1987.

Local Name: *Kurkuray Jhar* (Nep).

Slender diffuse, creeping or tufted, densely pubescent herbs. Leaves opposite; lamina broadly ovate, serrate, acute, base rounded or cuneate, basally 3-nerved, pubescent. Flowers in axillary sessile clusters, 4-merous; male perianth deeply divided; female minute. Achenes compressed.

Flowers & Fruits.: Mar. - Nov.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2210,*** dated 30.06. 2003
Status: Abundant.
*Local Distrib*ution: Found only in Soom & Tamsong gardens.
General Distribution: Himalayas (Garhwal – Bhutan), India, Sri Lanka, Myanmar, east to China, Formosa, Java.

DEBREGESIA Gaud.

Debregeasia longifolia (Burman f.) Weddel in DC.; Prodr. 16(1):235. 1869; FEH 1:56. 1966; FBI (1):132. 1983;
Urtica longifolia Burman f., Fl. Ind. 297. 1768.
Debregeasia velutina Gau., Bot. Bonite Voy. t. 90. 1842-43; FBI 5:590. 1888.

Local Name: *Tusaray* (Nep)

Large evergreen shrubs, 2.5-7.5 m high. Bark dark brown. Young parts silky pubescent. Leaves alternate, elliptic-lanceolate, margin finely serrate, acuminate, base rounded, 3-veined at base, white tomentose beneath. Male flowers usually 4-merous, clustered into a compact cyme of 0.6 cm diam. Female cymes 1-1.5 cm diam. Achenes enclosed by fleshy perianth, orange yellow.

Flowers & Fruits: May - November
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1776***, dated 17.05.2003.
Status: Common
Local Distribution: Found only in Makaibari garden.
General Distribution: Himalayas (Kumaon-Arunachal Pradesh), India, Sri Lnaka, Myanmar, W. E. China, Malaysia.
Note: The fibres obtained from the stem is commonly used to make rope and fishing nets. Fruit is also edible.

DENDROCNIDE Miquel

Dendrocnide sinuata (Blume) Chew in Gard. Bull. Singap. 21:206. 1965 & 25:36. 1969, FB 1(1):111. 1983;
Urtica sinuata Blume, Bijdr. 505. 1825.
Laportea crenulata Weddel, Arch. Mus. Hist. Nat. Paris 9: 133. 1856, FBI 5: 550. 1888.

Local Name: Morungay (Nep).

Tall shrubs to 9 m high. Lamina elliptic or ovate, entire or crenate-sinuate, acute to acuminate, cordate or rounded, sparsely stinging hairy beneath. Male panicles smaller. Flowers greenish; ovary apically beaked. Achenes obliquely ovate, whitish.

Flowers & Fruits: May - September

Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1814***, dated 17.05.2003.
Status: Less common.
Local Distribution: Found only in Makaibari garden..
General Distribution: Subtropical Himalayas (Nepal-Bhutan), India, Sri Lanka, Myanmar, east to China, Malaysia.

ELASTOTEMA Forster

Elatostema hookerianum Weddel, Monogr. Urtic. 309. 1856; FBI 5: 567. 1888; FEH 1:58. 1966; 3:20. 1975; FB 1(2):122. 1983; TBRI 50 (4): 112. 1987.

Perennial, dioecious erect herb, 12-30cm, glabrous; Lower stem creeping. Leaves sessile, obscurely oblong-elliptic, acuminate, base obliquely cordate-auriculate, margin serrate on upper half. Flowers dioecious. Achenes ellipsoid, irregularly ribbed.

Flowers & Fruits: April – September

Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2510***, dated 11.11. 2003; Tamsong TE, ***AP Das & Chandrâ 2312***, dated 05.09. 2003.
Status: Less common
Local Distribution: All three hill gardens.
General Distribution: E. Himalaya (Darjeeling-Arunachal Pradesh), Meghalaya, Naga Hills, S. Tibet.

Elatostema lineolantum Wight, Ic. Pl. Ind. Or. 6: t. 1984. 1853; FBI 5: 565. 1888; FEH 1: 58. 1966; Fl. Nep. 3: 203. 1982.

Flowers & Fruits: September - November
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2545***, dated 11.11. 2003
Status: Rare
Local Distribution: Found only in Makaibari garden.
General Distribution: Himalayas

Elatostema rupestre Wedd. in Arch. Mus. Par. 9: 304. 1855 –56.

Small, erect, undershrubs, woody, pubescent, to 30 cm. Lamina asymmetric elliptic –lanceolate, acuminatebase, cuneate, finely serrate from below middle, rigid, 3 veined at base. Stipules lanceolate. Flowers in dense, solitary, globose heads.

Flowers & Fruits: June - December
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 3039***, dated 10.04. 2004.
Status: Less common
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Himalayas, China, Malaysia.

Elatostema sessile Forster, Char. Gen. 106. 1776; FBI 5: 563. 1888; FEH 1: 59. 1966; FB 1(1): 118. 1983; TBRI 50 (4): 113. 1987.

Local Name: *Gagleto* (Nep).

Comparatively larger herbs, 20-60 cm, often appearing undershrub. Stem hollow, creeping at base. Leaves sessile, alternate, assymetrically elliptic, margin deeply serrate, acuminate, base obliquely cuneate, dark green, scarcely appressed pilose. Flowers heads axillary, usually sessile or rarely short peduncled. Achenes ellipsoidal.

Flowers & Fruits: May - November
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2775***, dated 25.03. 2004.
Status: Less common
Local Distribution: Found only in Makaibari garden.
General Distribution: Himalayas (Garhwal-Bhutan), India, Myanmar, east to China, Malayasia

GIRARDINIA Gaud.

Girardinia diversifolia (Link) Fries in KB 36: 145. 1981; FB 1(1): 111. 1983; TBRI 50 (4):150. 1987.
Urtica diversifolia Link, Enum. 2: 385.1822, non Bl. 1825.
Girardinia heterophylla Decne in jacquemont, Voy. Inde. 4, Bot. 151. 1844; FBI 5: 550. 1888.

Local Name: *Bhangray Sisnu* (Nep).

undershrubs to 2m high, stinging hairs dense & stout. Leaves alternate; lamina broadly ovate, deeply palmate-lobed or unlobed, acuminate, coarsely serrate, 3-nerved. Male panicles axillary, spreading; Female panicles prickly, condensed spike-like. Achencs compressed, blackish.

Flowers & Fruits: Jun. - Sep.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1691***, dated 17.05.2003.
Status: Very common.
Local Distribution: All three hill gardens.
General Distribution: Himalayas (Punjab – Bhutan), India, Sri Lanka, Myanmar, east to C. China, Malaysia.
Note: Bow-strings and ropes are made from the fibres.

LAPORTEA Gaud.(nom. cons.)

Laportea terminalis Wight., Icon. t. 1972. 1853; FBI 5: 549. 1888; FEH 1: 60. 1966; EFPN 3: 204. 1982; FB 1(1): 110. 1983; TBRI 50 (4):118. 1987.

Local Name: *Patle Sisnu* (Nep).

A, suffrutescent plant upto 125 cm high, stinging hairs white. Stipules lanceolate. Leaves alternate; lamina ovate, serrate, acute to acuminate, rounded, 3 nerved at base. Male panicles longer. Tepals 4-5 in male flowers. Female pedicel winged, tepals unequal. Achenes flattened.

Flowers & Fruits: May – February
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 1964***, dated 30.06. 2003.
Status: Less Common.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Himalayas (Kumaon – Bhutan), India, Sri Lanka, Tibet, Myanmar, east to China, Malaysia.

LECANTHUS Weddel

Lecanthus peduncularis (Royle) Weddel in DC., Prodr. 16(1): 164. 1869; FEH 1:60. 1966; FB 1(1): 116. 1983; TBRI 50 (4):118. 1987.
Procris peduncularis Royle, Ill. Bot. Himal t. 83. 1836.

Succulent, dioecious herbs, shoots decumbent. Leaves opposite; lamina asymmetric, ovate serrate, acuminate, oblique-rounded, pilose, 3-nerved, veins pilose hairy. Peduncles to 25cm long, simple. Receptacles upto 2.6cm across, fleshy. Flowers reddish-green. Achenes ovoid, warted.

Flowers & Fruits: July – October.
Specimen Cited: Soom TE, ***AP Das & Chandrâ 2678***, dated ; Tamsong TE, AP Das & Chandrâ 2325, dated 05.11. 2003.
Status: Common.
Local Distribution: All three hill gardens.
General Distribution: Africa, Himalayas, India, Myanmar, W. & C. China, Taiwan, Java.

Lecanthus wightii Weddel, in Ann. Sci. Nat. Ser. 4, 1: 187. 1854; FBI 5: 559. 1888.
Like *L. peduncularis*, but a small semi-erect plant; peduncle and disc very small. Prefer open places.
Flowers & Fruits: July – October.
Specimen Cited: Soom TE, ***AP Das & Chandrâ 2707***, dated 27.01.2002; Tamsong TE, ***AP Das & Chandrâ 1415***, dated 05.11. 2003.
Status: Less common
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Himalayas, India, Myanmar, China, Taiwan, Java

MAOUTIA Weddel

Maoutia puya (Hooker) Weddel in Ann. Sci. Nat. Ser. 4.1: 193. 1854; FBI 5: 592. 1888; EFPN 3: 204. 1982.
Boehmeria puya Hook. in Lond. J.B. 3: 316. t. 7. 1851.

Shrubs to 3 m. Lamina ovate –elliptic, acuminate, coarsely dente-serrate, base rounded or cuneate, pilose above, white tomentose beneath; stipules 9 –12 mm. Cyme clusters terminal and along slender branches; males 4 –7 mm and females 2 mm in diameter. Achenes strigose.

Flowers & Fruits: June – December.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1737***, dated 17.05.2003.
Status: Common
Local Distribution: Found only in Makaibari garden.
General Distribution: Himalayas, India, Myanmar, China, Taiwan, Africa.

OREOCNIDE Miquel

Oreocnide frutescens (Thunberg) Miquel, Ann. Mus. Bot. Lugd.-Bat. 3:131. 1867; FEH 3:23. 1975; EFPN 3:204. 1982; FB 1(1):131. 1983; TBRI 50(4):121. 1987.
Urtica frutescens Thunberg, Fl. Jap. 70. 1784.
Villebrunea frutescens (Thunberg) Blume, Mus. Bot. Lugd.-Bat. 2:168. 1875; FBI 5:590. 1888; FEH 1:162. 1966.

Local Name: *Kirma* (Nep).

Bushy shrubs, 2-4 m high, young twigs lenticellate, silky pubescent. Leaves alternate; lamina elliptic-lanceolate, acuminate, serrate-crenate, 3-veined, whitish pubescent. Flowers dioecious, clustered. Male heads subsessile, 0.6-1 cm diam. Female heads smaller. Ripe achenes ovoid, red.

Flowers & Fruits: March - November
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1816***, dated 17.05.2003.

Status: Less common
Local Distribution: Found only in Makaibari garden.
General Distribution: Himalayas (Punjab-Bhutan), N. India, Myanmar, W. and S. China, S. Japan.

PILEA Lindley (nom. cons.)

Pilea anisophylla Weddel, Monogr. Urtic. 193. 1856; FBI 5: 552. 1888; Fl. Nep. 3: 205. 1982.
Lower stem prostrate; lamina obliquely oveta-lanceolate; inflorescence branches in one plain.
Flowers & Fruits: August – December.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2257***, dated 05.09. 2003.
Status: Common
Local Distribution: Found only in Soom & Tamsong gardens.
*General Distribution:*Himalayas

Pilea bracteosa Weddel, Monogr. Urtic. 245. 1856; FBI 5: 555. 1888; FEH 3:24. 1975; EFPN 3: 205. 1982; FB 1(1): 114. 1983; TBRI 50 (4): 123. 1987.

Glabrous herbs, 30-52 cm high. Stem woody. Leaves opposite, broadly ovate, margin sharply serrate, acuminate, base rounded, glabrous or rarely sparsely pubescent above, strongly 3-veined. Panicles spreading with male and female flowers.

Flowers & Fruits: May - August
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2242***, dated 05.09. 2003.
Status: Rare
Local Distribution: Found only in Tamsong garden.
General Distribution: Himalayas (Nepal-Bhutan), Meghalaya, Myanmar, W. China.

Pilea scripta (Buch. –Ham. ex D. Don) Weddel, in Ann. Sci. Nat. Ser. 4, 1: 187. 1854; FBI 5: 556. 1888; Fl. Nep. 3: 205. 1982; FB 1(1): 113. 1983.
Urtica scripta Buch. –Ham. ex D. Don. Prodr. Fl. Nep. 61. 1825.

Local Name: *Sheta Gaglata* (Nep).

Monoecious or dioecious herb upto 1 or 1.5 m, Woody at base, glabrous, stems succulent, swollen above nodes. Leaves elliptic or lanceolate , often slightly asymmetric ,acuminate ,base tapering but rounded at incersion, margins finely serrate , lateral veins numerous. Male panicles often large in lower axils and female panicles in upper axils.

Flowers & Fruits: July – December.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2242***, dated 05.09. 2003.
Status: Less common
Local Distribution: Found only in Tamsong garden.
*General Distribution:*Himalayas.

Pilea symmeria Weddel, Monogr. Urtic. 246. 1856; FBI 5: 554. 1888; FEH 1: 62. 1966; 3: 25. 1975; EFPN 3: 206. 1982; FB 1(1): 113. 1983; TBRI 50 (4) : 123. 1987.

Local Name: *Phusray Gakleto* (Nep).

Small robust herb, woody at base, glabrous. Lamina ovate, serrate, acute, rounded, dark green, glabrous, or sparsely pilose above, strongly 3-veined. Panicles axillary. Male flowers 3-merous. Female flowers with 3 minute and unequal perianth segments. Achenes compressed, smooth.

Flowers & Fruits: June – November.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1736***, dated 17.05.2003; Soom TE, ***AP Das & Chandrâ 2620***, dated 27.12. 2003; Tamsong TE, ***AP Das & Chandrâ 2071***, dated 30.06. 2003.
Status: Common.
Local Distribution: All three hill gardens.
General Distribution: Himalayas (Kumaon – Bhutan), Meghalaya, W. & C. China.

Pilea umbrosa Weddel in Ann. Sci. Nat. ser. 4, 1: 187. 1854; FBI 5: 556. 1888; FEH 1: 62. 1966: FB 1(1): 113. 1983; TBRI 50 (4):123. 1987.

Annual herbs, 28-45 cm high, ± pubescent. Leaves opposite; lamina broadly elliptic-ovate, serrate, caudate-acuminate with long acumen, sub-cuneate or rounded, 3-nerved , dark geen. Male panicles much branched; females shorter. Achenes smooth, flattened, with intra-marginal ridge.

Flowers: May - Aug. Fruits: Aug. - Nov.
Specimen Cited: Soom TE, ***AP Das & Chandrâ 2652***, dated 27.12. 2003.
Status: Common.
Local Distribution: In all hill gardens.
General Distribution: Himalayas (Kashmir-Bhutan), Meghalaya, Myanmar, W. China.

POUZOLZIA ***Gaud.***

Pouzolzia hirta (Blume) Hasskarl, Cat. Hort. Bogor. 80. 1844; FBI 5:586. 1888; FEH 1: 59. 1966; FB 1(1): 130. 1983.
Urtica hirta Bl., Bijdr. 495. 1825.
Gonostegia hirta (Blume) Miquel, Ann. Mus. Bot. Lugd.-Bat. 4:303. 1869; FEH 1:59. 1966; EFPN 3:204. 1982.

Local Name: *Chiplay* (Nep).

Prostrate to suberect perennial herbs. Leaves sessile, opposite; lamina ovate to lanceolate, acuminate, entire, subcordate to rounded, 3–veined, minutely pubescent. Flowers in globose clusters around nodes. Male flowers subglobose; female tepals ovoid, ribbed. Fruits 2-4 winged.

Flowers & Fruits: Jun. - Aug.
Specimen Cited: Makaibari TE, **AP Das & Chandrâ 1836,** dated 10.06. 2003; Tamsong TE, ***AP Das & Chandrâ 1985,*** dated 30.06. 2003; Soom TE, ***AP Das & Chandrâ 2649*** dated 27.12. 2003.
Status: Abundant.
Local Distribution: All three hill gardens.
General Distribution: Himalayas, India, Myanmar, W. & C. China, Taiwan.
Note: Roots are medicinally used for treating the bone dislocation and fractures.

Pouzolzia zeylanica (L.) Bennett & Brown, Pl. Jav. Rar. 67. 1838; FB 1(1): 130. 1983.
Parietaria zeylanica L., Sp. Pl. 1052. 1753.

Monoecious, suberect herbs, up to 50 cm. Leaves opposite and alternate, smaller, rounded or cuneate, 3 -veined. Petiole 2cm, stipule free, lateral. Flower cluster smaller, strigose with straight or hooked hairs; male flower globose, segments convex, not angled.

Flowers & Fruits: January – December.
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1484***, dated 20.10.2002; Kamalpur TE, ***AP Das & Chandrâ 0404,*** dated 27.02.2002; Makaibari TE, ***AP Das & Chandrâ 1925***, dated 10.06. 2003; Tamsong TE, ***AP Das & Chandrâ 2079***, dated 30.06. 2003
Status: Abundant
Local Distribution: In all gardens.
General Distribution: India, Sri Lanka, Bangladesh, Myanmar, Malaysia, China.

URTICA L.

Urtica dioica L., Sp. Pl. 984. 1753; FBI 5: 548. 1888; Fl. Nep. 3: 207. 1982.

Local Name: *Sishnu* (Nep)

Plants to 2 m, monoecious, densely covered with white stinging hairs. Lamina ovate –lanceolate, acuminate, sharply serrate, base rounded / cordate; stipules lanceolate. Panicles 2 –5 cm. Male tepals orbicular. Female tepals: 2 ovate, 2 lanceolate. Achenes ovoid or ellipsoid, white.

Flowers & Fruits: June – December.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1731***, dated 17.05.2003; Tamsong TE, ***AP Das & Chandrâ 2337,*** dated 05.11. 2003; Soom TE, ***AP Das & Chandrâ 3504***, dated 12. 10. 2004.
Status: Abundant.
Local Distribution: All three hill gardens.
General Distribution: Pantemperate

Urtica mairei H. Lev., Fedde Repert. 12: 183. 1913; FEH 3:28. 1975.
U. parviflora Roxburgh, Fl. Ind. ed. 2, 3: 581. 1832; FBI 5:548. 1888; FB 1(1): 108. 1983.

Local Name: *Sisnu* (Nep).

Undershrubs upto 3m tall, pubescent, woody at base. Branches 4-angled, sting-hairs stiff. Leaves opposite; lamina ovate-lanceolate rarely ovate, doubly crenate or serrate, acuminate, base rounded or cordate. Panicles ±10 cm long. Male perianth 4-lobed. Achenes compressed..

Flowers & Fruits: March – January.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1803***, dated 17.05.2003; Soom TE, ***AP Das & Chandrâ 3493***, dated 12. 10. 2004.
Status: Very common.
Local Distribution: All three hill gardens.
General Distribution: Temperate Himalayas and Nilgiris.

VALERIANACEAE Batsch.

VALERIANA L.

Valeriana hardwickii Wallich in Roxb., Fl. Ind. 1: 166. 1820; FBI 3: 213. 1881; FEH 1: 320. 1966; EFPN 2: 209. 1979; TBRI 50 (4): 129. 1987; FB 2(3): 1367. 2001.

Perennial erect, 30-80 cm tall glabrous herb with small root-stock. Branching upwards, nodes pillose. Leaflets 3, lateral ones smaller, terminal one larger, ovate-lanceolate, remotely obscure-serrate, acuminate, base cuneate or rounded, thin to thickly white pubescent, usually shrivel at flowering time. Corymbs large, lax with white flowers.

Flowers: June - October; *Fruits:* August - December
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2409***, dated 05.11. 2003
Status: Very common.
Local Distribution: All three hill gardens.
General Distribution: Himalayas (Kashmir-Bhutan), Meghalaya, Myanmar, east to China, Java.
Note: Roots substitute valerian.

VERBENACEAE Jaume St. Hil.

CALLICARPA L.

Callicarpa arborea Roxburgh *ex* Clarke in FBI 4:567. 1885; FEH 1: 268. 1966; EFPN 3: 145. 1982; TBRI 150(4): 108. 1987.

Local Name: *Guenlo* (Nep).

Small evergreen trees, 5-10m tall, branches stellate hairy. Leaves opposite, ovate-lanceolate, acute, narrowed at base, margin entire, glabrous above, stellate tomentose beneath. Cymes axillary with mauve-purple flowers. Drupe globose, purplish.

Flowers & Fruits: April – November.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1734***, dated 17.05.2003.
Status: Less common
Local Distribution: Found in low altitude areas.
General Distribution: Himalayas (Kumaon-Bhutan), India, Myanmar, S. China, Malaysia.

CARYOPTERIS Bunge

Caryopteris odorata (Buch. –Ham. ex Roxburgh) B. L. Robinson in Boc. Amer. Ac. Arts & Sci. 51: 531. 1916; FEH 2: 112. 1971.
Volkameria odorata Buch. –Ham. ex Roxburgh, Beng. 46. 1814, *nom. nud.*

Small shrub, branches ashy –pubescent. Leaves elliptic, dentate, acuminate, base cuneate. Flowers in terminal thyrses; calyx minute, teeth lanceolate, 1 –3 ribbed; corolla tube 1cm. Limbs spreading, lower middle lobe larger and crisped, white.

Flowers & Fruits: Jun. - Dec.

Specimen Cited: Tamsongi TE, ***AP Das & Chandrâ 3088,*** dated 10.04. 2004.
Status: Rare
Local Distribution: Found only in Tamsong garden.
General Distribution: Subtropical Himalayas.

CLERODENDRUM L.

Clerodendrum indicum (L.) O. Kuntze, Rev. Gen. 586. 1891. FBI 4: 595.1885. FB 2(2): 931.1999.
Siphonanthus indica L., Sp. Pl. 109. 1753.
Clerodendrum siphonanthus R.Br. in Ait.f., Hort. Kew. 4: 65. 1812; FBI 4: 595. 1885.

Local Name: *Bamunhati* (Beng)

Tall glabrous shrubs upto 3 m tall; stems ridged. Leaves whorled, subsessile, lanceolate-oblong, sub-entire, acuminate, base tapering, glabrous. Panicle lax, terminal, elongated; flowers white, narrowly funnel-shaped. Nutlets 4, in a persistent bright red enlarged calyx.

Flowers & Fruits: June – February.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0894,*** dated 04.05.2002; Hansqua TE, ***AP Das & Chandrâ 1012***, dated 09.05.2002; Kamalpur TE, ***AP Das & Chandrâ 1290***, dated 18.10.2002.
Status: Less common.
Local Distribution: In Terai gardens.
General Distribution: India, Sri Lanka, Bangladesh, Myanmar, Nepal, S. China, Indo-China and Malaya.
Note: Widely cultivated as an ornamental and for medicinal uses.

Clerodendrum viscosum Ventenat, Jard. Malamina 1: 25, 1803; FB 2(2): 934.1999.
Clerodendrum infortunatum Lour., Fl. Cochinch. ed. 1, 2: 387. 1790; FBI 4: 594. 1885.

Local Name: *Chitu, Barte* (Nep); *Vant* (Beng)

Undershrubs >80 cm high. Lamina 7.5-19 x 6.5-14 cm, ovate, subentire to serrate, dentate, acute or acuminate, base sub-truncate or rounded. Panicles pyramidal, corymbose, terminal, bracteate; flowers pink tinged white; Drupes bluish-black, glossy, hidden in red persistent calyx.

Flowers & Fruits: February – August
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0050***, dated 20.04.2002; Hansqua TE, ***AP Das & Chandrâ 0123***, dated 03.02.2002.
Status: Abundant
Local Distribution: All Terai gardens.
General Distribution: Indo-Malaysia.

DURANTA L.

Duranta repens L., Sp. Pl. 637. 1753; FEH 1: 269. 1966; Fl. Nep. 3: 147. 1982.

Shrub 2-5 m, stems quadrangular, finely appresed pubescent, older shoots with straight axillary spines. Leaves membranous obovate or elliptic, acute, base cuneate or alternate, margin serrate in upper half, rarely entire, glabrous above. Flowers blue with white eye in slender, curved racemes.

Flowers & Fruits: April - October
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1013***, dated 09.05.2002.
Status: Often cultivated as a hedge plant
Local Distribution: All Terai gardens.
General Distribution: Native of Central America.

GMELINA L.

Gmelina arborea Roxburgh, Pl. Corom. 3:42.t.246. 1819 & in Fl. Ind. 3:84.1832; FBI 4:581.1885; FB 2(2): 928.1999.

Local Name: *Gamar, Khamari* (Nep.); *Gammari* (Beng.)

Tall deciduous trees; lamina broadly ovate, chartaceous, entire, acuminate, cordate or truncate, glabrous above, stellately fulvous-tomentose beneath. Flowers yellow in terminal corymbose panicles. Drupes ovoid or pyriform, fleshy, yellow when ripe.

Flowers & Fruits: February – June
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0855*** dated 04.05.2002; Kamalpur TE, ***AP Das & Chandrâ 1200***, dated 18.10.2002.
Status: Commonly planted for timber.
Local Distribution: In Terai gardens.
General Distribution: India, Sri Lanka, Bangladesh, Myanmar, Islands of Malaya and the Philippines.
Note: The light weight timber is durable, highly estimated for the manufacture of furnitures and a valuable firewood crop.

LANTANA L.

Lantana camara L., Sp. Pl. 627. 1753; FBI 4: 562. 1885; FEH 1: 270. 1966; FB 2(2): 914.1999.

Local Name: Barra Mase (Nep.); Lantana (Eng.)

Straggling prickly aromatic shrubs with grayish-brown bark. Leaves opposite, ovate, crenate, acute or acuminate, base cuneate or rounded scabrous, rugose. Flowers mostly orange, often varying to white or pinkish in capitate spikes. Fruits greenish blue when ripe, shining.

Flowers & Fruits: January – December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 1615***, dated 22.10. 2002; Hansqua TE, ***AP Das & Chandrâ 0169***, dated 03.02.2002; Kamalpur TE, ***AP Das & Chandrâ 1298***, dated 18.10.2002; Tamsong TE, ***AP Das & Chandrâ 3059***, dated 10.04. 2004.
Status: Abundant
Local Distribution: In all gardens.
General Distribution: Native of Tropical America; naturalized in the Himalayas, India, Bangladesh, Myanmar, China, Malaysia and Australia.

Note: Introduced from tropical America and runs wild through India, common both in hills and in plains. Some showy forms are cultivated as ornamentals.

PHYLA Loureiro

Phyla nodiflora (L.) Greene in Pittonia 4:46.1899. FBI 4:563.1885; FB 2(2): 916.1999.
Verbena nodiflora L., Sp. Pl. 20. 1753.
Lippia nodiflora (L.) Michaux, Fl. Bor. Amer. 2:15.1803;

Local Name: Okra (Beng)

Slender, diffuse, prostrate herbs, often rooting at nodes; lamina obovate, serrated towards tip, entire towards base, obtuse, base cuneate, glabrous. Spikes cylindric, axillary, solitary from each node; corolla bilabiate, white, tinged with purple. Drupes globose, enclosed by calyx.

Flowers & Fruits: January – December
Specimen Cited: Matigara TE, ***AP Das & Chandrâ 3614***, dated 20. 10. 2004
Status: Rare
Local Distribution: In Terai gardens
General Distribution: Pantropical
Note: Occasionally cultivated as a tropical ground-cover plant.

VITEX L.

Vitex negundo L., Sp. Pl. 638. 1753; FBI 4: 583. 1885; FEH l: 270. 1966

Local Name: *Nisinda* (Beng)

Large shrubs, branches suberect, foetid. Leaves digitately 3-5 foliolate; leaflets ovate-lanceolate, entire, crenulate acute or acuminate, glaucous beneath. Panicles 12-18 cm long. Flowers bluish or purplish Drupe ca. 0.5cm diam., obscurely ribbed and glandular.

Flowers & Fruits.: Apr. - Oct.
Specimen Cited: Hansqua TE, **AP Das & Chandrâ 1454**, dated 20.10.2002.
Status: Common.
Local Distribution: In Terai gardens.
General Distribution: Afganistan, India, Himalayas, Sri Lanka, China, Myanmar, Malaysia.

VIOLACEAE Batsch.

VIOLA L.

Viola diffusa Ging. In DC., Prodr.1: 298. 1824; FBI 1: 183. 1872; FB 2(1): 224. 1991; FI 2: 361. 1993.

Small tufted perenial. Lamina ovate, obtuse, rounded, decurrent on petiole, sparsely pubescent with straight hairs; petioles pubescent; stipules pale, lanceolate, ciliate. Flowers on slender, glabrous peduncles. Sepals lanceolate, acute, sparsely ciliate. Petals pale blue, greenish yellow at base, glabrous within; lowest petal purple streaked. Capsule oblong ovoid, glabrous.

Flowers & Fruits: May – October.

Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1786***, dated 17.05.2003; Soom TE, ***AP Das & Chandrâ 3430***, dated 12.10.2004; Tamsong TE, ***AP Das & Chandrâ 2259***, dated 05.09. 2003.
Status: Very common.
Local Distribution: All three hill gardens.
General Distribution: Himalayas, Myanmar, China.

Viola hamiltoniana D. Don, Prodr. Fl. Nep. 206. 1825; EFPN 2: 47. 1979; Fasc. Fl. Ind. 12: 23. 1983; Nam. Chang. Flowers Pl. 391. 1987. FB 2(1): 228. 1991; FWB 1:219. 1997.
V. distans Wallich in Tr. Med. Phys. S. Calc. 7: 227. 1835; FBI 1: 183. 1872.

Perennial and stolonierous herb. Stolons slender. Leaves stipulate, lanceolate, fimbriate, brownish, ovate, crenate-serrate, acute to rounded, deep cordate or deltoid, sparsely pubescent above, glabrous beneath. Flowers white. Capsule many seeded.

Flowers: March - June *Fruits:* April - August
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2788***, dated 25.03. 2004.
Status: Rare.
Local Distribution: Found only in Makaibari garden.
General Distribution: Himalayas (Simla-Arunachal Pradesh), Myanmar, China, Malaysia, Philippines.

Viola hookeri Thomson in FBI 1: 183. 1872; FB 2(1): 226. 1991.
Viola sikkimensis W. Becker in Beih. Bot. Centralbl. Abt. 2, 34: 260. 1916; FI 2: 374. 1993.

Stoloniferous perennial. Lamina broadly ovate or rounded-ovate, subacute, cordate, broadly & shallowly crenate, glabrous; stipules ovate –lanceolate, sparsely fimbriate. Peduncles glabrous, bracts linear. Sepals oblong, acute. Petals white, glabrous within, lower most violet –streaked; spur saccate, rounded.

Flowers & Fruits: May - October
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2253***, dated 05.09. 2003.
Status: Rare.
Local Distribution: Found only in Tamsong garden.
General Distribution: Eastern Himalaya.

Viola pilosa Blume, Cat. Gew. Buitenz. 57. 1823; FB 2(1): 228. 1991; FI 2: 371. 1993.
Viola serpens Wallich ex Ging. In DC., Prodr. 1: 296. 1824; FBI 1: 184. 1872.

Stoloniferous perennial. Leaves acute, cordate, crenate –serrate, sparsely pubescent; petioles densely retrorse –pubescent; stipules ovate lanceolate, deeply fimbriate, pubescent. Peduncles 2 –6cm, sparsely pubescent; bract linear lanceolate. Sepals ciliate, pubescent at base; appendages acute. Petals 8 –10mm, mauve, pubescent within; spur 3 –4mm, rounded.

Flowers & Fruits: May – October.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1705***, dated 17.05.2003; Tamsong TE, ***AP Das & Chandrâ 1972***, dated 30.06. 2003; Soom TE, ***AP Das & Chandrâ 2616***, dated 27.12. 2003.
Status: Abundant
Local Distribution: All three hill gardens.
General Distribution: Himalayas.

VITACEAE A. Juss.

AMPELOCISSUS Planch.

Ampelocissus sikkimensis (M. Lawson) Planchon in J. Vigne Amer. 8: 375. 1884; FI 5: 259. 2000; FB 2(1):152.1991.
Vitis sikkimensis M. Lawson in FBI 1: 650. 1875.

Climbers, softly glandular bristly; tendrils leafo-pposite, bifid, one branch again bifid. Leaves simple, unlobed or shallowly 3 -5 lobed, broadly ovate, acuminate, deeply cordate, irragularly dentate, softly tomentose beneath. Flowers yellowish green in panicles. Berry black, globose.

Flowers & Fruits: Jun. - Dec.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 1535***, dated 22.10. 2002.
Status: Common
Local Distribution: In all gardens.
General Distribution: India, Nepal, Bhuta, Myanmar.

CISSUS L.

Cissus javana DC., Prodr. 1: 628. 1824; FB 2(1): 158. 1991.
Cissus discolor Blume, Cat. 39. 1823; FI 5: 282. 2000.
Vitis discolor (Blume) Dalz. In Hook., Kew J. Bot. 2: 39. 1850; FBI 1: 647. 1875.

Climbers. Branches red, long, slender, angular, tufts of hair at nodes. Leaves simple, lanceolate to ovate, acuminate, cordate or truncate, sometimes asymmetric, serrulate, purple beneath, above often blotched with white between veins. Flowers yellow, cymes leaf opposed; Berry red – purple.

Flowers & Fruits: Jun. - Dec.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1853***, dated 10.06. 2003.
Status: Rare
Local Distribution: Only in Makaibari garden.
General Distribution: Eastern Himalaya.

TETRASTIGMA Planch.

Tetrastigma bracteolatum (Wallich) Planchon in DC., Monogr. Phan. 5: 428. 1887; FI 5: 310. 2000; FB 2(1): 154.1991.
Vitis bracteolata Wallich in Roxb., Fl. Ind. 2: 483. 1824; FBI 1: 654. 1875.

Large climbers; stems puberulous, glabrascent; tendrils simple. Leaves trifoliolate; stipules caducous. Leaflets membranous, ovate or elliptic, acuminate, rounded, distantly and shallowly serrate, puberulous on veins beneath. Flowers in lax puberulous cymes. Berry subglobose.

Flowers & Fruits: Jun. - Dec.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 3146***, dated 30.06. 2003
Status: Very common.
Local Distribution: In hill gardens.
General Distribution: Himalayas.

Tetrastigma dubium (M. Lawson) Planchon in DC., Monogr. Phan. 5: 437. 1887; FI 5: 311. 2000; FB 2(1): 154. 1991.
Vitis dubia M. Lawson in FBI 1:661. 1875.

Large climbers; stems glabrous; tendrils simple. Leaves pedately 5 or 3–foliolate; stipules caducous. Leaflets lanceolate, acuminate, rounded, distantly and shallowly serrate, glabrous or puberulous on veins beneath. Flowers in compact sparsely pubescent cymes. Berry subglobose.

Flowers & Fruits: Jun. - Dec.
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3392***, dated 12. 10. 2004.
Status: Common.
Local Distribution: In Hill gardens.
General Distribution: Nepal, Sikkim, Assam, China, etc.

LILIOPSIDA
[MONOCOTYLEDONS]

AMARYLLIDACEAE J. St. Hilaire

CRINUM L.

Crinum amoenum Roxburgh, Fl. Ind. 2: 127. 1832; FBI 6: 282. 1892; FB 3(1): 83.1994.

Bulbous perennial. Bulbs subglobose. leaves spreading, ensiform acute, with narrow membranous margins. Umbels on a long solid, purplish scape with 3-10 white, sessile fragrant flowers; perianth white; anthers versatile. Capsules subglobose; seeds rounded, greenish.

Flower: June – August
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0939,*** dated 04.05. 2002.
Status: **Common.**
Local Distribution:
General Distribution: India, Sri Lanka, Java, Malaya & Western Polynesia.

ZEPHYRANTHES Herbert

Zephyranthes carinata Herb. Bot. Mag. t. 2594. 1832; FB 3(1): 84. 1994.

Local Name: *Piyaji phul* (Nep)

Bulb ovoid, tunics dark brown. Leaves 3-6 linear, 40cm; spathe larger than pedicel, membranous, purplish with pink flowers.

Flowers & Fruits: April-August
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1939,*** dated 04.05. 2002; Kamalpur TE, ***AP Das & Chandrâ 1760,*** dated 17.05.2003.
Status: Common.
Local Distribution: All three hill gardens.
General Distribution: Native of Mexico; naturalized in India.

ARACEAE A. Jussieu

ALOCASIA (Schott) G. Don

Alocasia macrorrhiza (L.) G. Don in Sweet, Hort. Brit. ed. 3, 631.1839. FB 3(1): 139.1994.
Arum macrorrhizon L., Sp. Pl. 965.1753.
Alocasia indica Spach, Hist. Nat. Veg. Phan. 12:47.1846; FBI 6:525.1893.

Local Name: *Man-kachu* (Beng)

Rootstock massive, upto 1.5 m long, stout. Leaves ovate, large, undulate, obtuse-rounded, deeply sagittate-cordate, bright green. Spathes pale yellowish green. Fertile male inflorescence white; females yellow. Berries red.

Flowers & Fruits: April – September
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 1606***, dated 22.10. 2002; Kamalpur TE, ***AP Das & Chandrâ 0472,*** dated 17.04.2002.
Status: Very common.
Local Distribution: In Terai gardens.
General Distribution: India, Bangladesh, Nepal, Sri Lanka; S.E. Asia to Pacific.
Note: Cultivated near houses; rootstocks eaten cooking.

AMORPHOPHALUS Blume ex Decn. (nom. cons.)

Amorphophallus bulbifer (Roxburgh) Blume in Rumphia 1:148. 1835; FBI 6: 515. 1893; FEH 1:394. 1966; FB 3(1): 122. 1994; Fl. Sik. 1:186. 1996.
Arum bulbifer Roxburgh, Fl. Ind. ed. 2, 3:510. 1832.

Perennial herbs, growing from a corm-like subglobose tuber. Cataphylls membranous, brownish. Leaves narrow-oblong, acuminate, cuneate; bulbils developed at primary or secondary divisions of leaf and leaflets. Peduncle stout and smooth. Spathe ovate, subacute, margins overlapping basally, usually grrenish outside, pinkish crimson inside towards base. Spadix equalling spathe, swollen, subacute, pink, sometime whitish.

Flowers & Fruits: April – June.
Specimen Cited: Kamalpur TE, AP ***Das & Chandrâ 0541***, dated 17.04.2002.
Status: Less Common.
Local Distribution: All Terai gardens.
General Distribution: Tropical E. Himalaya (Sikkim, Darjeeling), Khasia, other tropical parts of India.

COLOCASIA Schott

Colocassia affinis Schott in Bonpl. 7: 28. 1859; FB 3(1): 137.1994.

Local Name: *Bon Kachu* (Beng)

Rhizome narrow, stout, stolons filiform. Evergreen; leaves more ovate, thinner; petioles slender; sheaths yellowish-green. Spadix delicate; appendix smooth, shorter, and stouter, blunt, neuter zone between female and male narrowed.

Flowers & Fruits: July – September.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0640***, dated 04.05. 2002; Hansqua TE, ***AP Das & Chandrâ0224*** , dated 09.02.2002; Kamalpur TE, ***AP Das & Chandrâ 0710***, dated 20.04.2002.
Status: Abundant.
Local Distribution: All Terai gardens.
General Distribution: Originating in tropical Asia; now pantropic.

Colocasia esculenta (L.) Schott in Schott & Endlicher, Melet. Bot. 18. 1832; EFPN 1:91. 1978; FB 3(1): 136. 1994.
Arum esculentum L., Sp. Pl. 965. 1753.
Colocasia antiquorum Schott in Schott & Endlicher, Melet. Bot. 18. 1832; FBI 6:523. 1893.


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Local Name: *Mane* (Nep), *Kachu* (Beng)

Rhizome vertical to horizontal. Petiole sheathing below for one-third to two-third, greenish. Lamina oblong-ovate to suborbicular, broadly cuspidate, shallow-cordate, glaucous. Spathe tube greenish, blade creamy yellow. Female flowers at base; males above a sterile zone on spath.

Flowers & Fruits: June - December
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 1341,*** dated 18.10.2002
Status: Common; often cultivated.
Local Distribution: In Terai gardens.
General Distribution: Himalayas, India, Bangladesh, Sri Lanka.
Note: Rhizomes and petioles are cooked and consumed as vegetable; an ideal fodder for pigs.

POTHOS L.

Pothos cathcartii Schott, Aroid. 1:22, t.44, 45. 1853; FBI 6:552. 1894; FEH 1:397. 1966; FB 3(1): 125. 1994.

Local Name: *Sanu kanchirna, Chepari lahara* (Nep.)

Epiphytic or lithophytic shrubby climbers; much branched, rooting at nodes. Leaves distichous; petioles with phyllodic wings, triangular, apex truncate; lamina narrowly elliptic, acuminate, base cuneate to rounded. Spathe suborbicular, spreading, greenish. Spadix on a short stipe, subglobose.

Flowers: December - April *Fruits:* April - June
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1117,*** dated 09.05.2002.
Status: Rare
Local Distribution: Found in Hansqua garden only.
General Distribution: Tropical and Subtropical Himalayas, Assam, Manipur, Myanmar and China.

Pothos scandens L., Sp. Pl. 968. 1753; FBI 6: 551. 1893; FB 3(1): 125.1994.

Epiphytic or lithophytic much branched climbers. Leaves distichous, smaller, acute; leaf blades simple, coriaceous, separated from winged, subequalling petioles. Spadix smaller, axillary, short- peduncled, subtended at base by overlapping bracts; flowers bisexual. Berries red.

Flowers: December - April *Fruits:* April - June
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0052,*** dated 27.01.2002; Makaibari TE, ***AP Das & Chandrâ 2517***, dated 11.11. 2003.
Status: Common.
Local Distribution: in Terai and low altitude hill regions.
General Distribution: Tropical and Subtropical Himalayas; Assam, Manipur, Myanmar and China.

REMUSATIA Schott

Remusatia pumila (D. Don) H. Li *et* A. Hay, Acta Bot. Yunn., Suppl. 5:28. 1929; FB 3(1):135. 1994; Fl. Sik. 1:193. 1996.

Gonatanthus pumilus (D. Don) Engler and Krause in Pfreich. Heft. 71:19.1920; FEH 1:397.1966.

Small herbs to 20cm; rootstock tuberous with small bulbils. Lamina peltate, long stalked, ovate, entire, acuminate, cordate, dark green above. Spathe ovoid, inflated, greenish, blade conical, golden-yellow; Female inflorescence in the swollen limb base. Spadix included.

Flowers & Fruits: May – July
Specimen Cited: Tamsongi TE, ***AP Das & Chandrâ 2378,*** dated 05.11. 2003.
Status: Rare

Local Distribution: Found in Tamsong & Soom garden only.
General Distribution: Himalayas (Simla-Sikkim), Khasia, Manipur, Thailand and W. China.

Remusatia vivipara (Roxburgh) Schott in Schott & Endl., Melet. Bot. 18. 1832; FBI 6: 521. 1893; FB 3(1): 134.1994.
Arum viviparum Roxburgh, Fl. Ind. ed. 2, 3: 496. 1832.
Remusatia vivipara (Roxb.) Schott./134/
Bulbiferous stolons stout, erect, simple, bulbils large, ellipsoid, stout. Leaves oblong-ovate-lanceolate, glossy on both sides, yellowish green with pale, narrow margin.

Flowers & Fruits: March – May.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 3030***, dated 10.04. 2004.
Status: Rare
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Africa, India, Sri Lanka, Nepal, Java.

RHAPHIDOPHORA Schott

Rhaphidophora grandis Schott in Oester. Bot. Wochenbl. 349.1858; FB 3(1): 128. 1994; Fl. Sik. 1:194. 1996.

Local Name : *Thulo Kanchirna* (Nep).

A massive liana, stems upto 4cm thick. Leaves oblong, blunt, not glaucous beneath; pinnae broad, 6-12 each side, truncate at apex, sinuses narrow, lateral costae not parallel. Peduncles stouter with stout spadix. Fruits fibrous, domed.

Flowers & Fruits: May – March
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1898,*** dated 10.06. 2003; Soom TE, ***AP Das & Chandrâ 3407***, dated 12. 10. 2004.
Status: Rare
Local Distribution: All three hill gardens.
General Distribution: Tropical and subtropical Himalayas; Kumaon, Sikkim, Darjiling and Khasi Hills.

TYPHONIUM Schott

Typhonium diversifolium Wallich ex Schott var. ***microspadix*** Engler in Aroid: 13, t.20.1855; FBI 6:510.1893; FB 3(1): 140.1994.

Heterostalis diversifolia (Wall. ex Schott) Schott in Oesterr. Bot. Wochenbl. 7:261.1857.

Local Name: *Kharkon, Ghatkol* (Beng)

Rhizome globose, conical above. Leaves ±3; lamina variable, hastate to 3 lobed, lobes linear, upto 12cm long; petioles upto 30cm long. Spathes erect, upto 8cm long, acuminate, white. Spadix slender, appendix narrowed into much longer stipe, neuters shorter-stalked with smaller heads.

Flowers & Fruits: July - September
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0825,*** dated 04.05. 2002.
Status: Less Common.
Local Distribution: Found only in Mohurgong & Gulma garden.
General Distribution: India, Nepal and S. Tibet.

Typhonium trilobatum (L.) Schott in Wien. Zeitschr. 3: 72.1829; FBI 6: 509.1893; FB 3(1): 139.1994.
Arum trilobatum L., Sp. Pl. 965.1753.

Local Name: *Kharkon, Ghatkol* (Beng)

Rhizome globose; leaves 3-4; lamina hastately 3-lobed, middle lobe ovate-ellipic, acuminate. Spathe pinkish green below the basal constriction, dark red above. Spadix exserted with a long barren, dark red, linear-cylindric appendage; female flowers at base, males above sterile zone.

Flowers & Fruits: April – September.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0772***, dated 04.05. 2002; Kamalpur TE, ***AP Das & Chandrâ 1254***, dated 18.10.2002.
Status: Abundant.
Local Distribution: All Terai gardens.
General Distribution: India, Myanmar, Sri Lanka, Nepal, Indo-China, Thailand and Malaysia.

ARECACEAE Schultz. [*nom. alt.*]

CALAMUS L.

Calamus erectus Roxburgh, Fl. Ind. 3:774. 1832; FBI 6:438. 1892; FB 3 (1): 419. 1994; Fl. Sik. 1:181. 1996.

Local Name: *Phekre* (Nep).

Shrubs with stems upto 6.5m, tufted, scarcely branched. Sheaths wide, spiny on the upper side, eflagellate; Leaves upto 5 m long with 35 leaflets on each side of sub-opposite, linear-lanceolate, lateral veins numerous, acuminate apex with wide terminal pinnae. Inflorescence 40-98 cm, pendent, branched, covered with brown felt. Female inflorescence and male inflorescence alike. Fruit ellipsoid.

Flowers & Fruits: November – August.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1777***, dated 17.05.2003.
Status: Common

Local Distribution: In Terai and low altitude areas.
General Distribution: Eastern Himalayas (Sikkim, Bhutan, Assam, Khasi Hills), Bangladesh.
Note: Fruits edible and chewed as stimulant

CARYOTA L.

Caryota urens L., Sp. Pl. 1189. 1753; FBI 6: 422. 1892; FB 3(1): 428.1994.

Local Name: *Rungbong, Rangbhang* (Nep).

Trunk 15m, grey, smooth with conspicuous annular leaf scars. Crown elongate. Leaf sheaths long. Leaves very large, drooping at apex, irregularly triangular, cuneate, apex oblique, irregularly lobed, green on both sides. Fruit c1.3cm diameter, reddish.

Flowers & Fruits: (February)
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3420***, dated 12.10.2004; Tamsong TE, ***AP Das & Chandrâ 3095***, dated 10.04. 2004.
Status: Common
Local Distribution: All three hill gardens.
General Distribution: Himalayas.

Note: Seeds and young shoots eaten, fruits chewed by children, inner part of pith eaten raw. Leaves used as a source of fibre. Ornamental plant.

COMMELINACEAE R. Brown

AMISCHOTOLYPE Hasskarl

Amischotolype hookeri (Hasskarl) Hara, FEH 1: 399. 1966; FB 3(1): 223.1994.
Forrestia hookeri Hassk. in Fl. 1864: 629. 1864; FBI 6: 384. 1892.

Stem stout, rooting below. Leaves elliptic, finely acuminate to caudate, margins with densely appressed, silky hairs, undersurface with short, appressed hairs, glabrous above, narrowed to petiole like base. Inflorescence to c.15 flowered of white or pink, bracteoles small, ovate, membranous ciliate.

Flowers & Fruits: May – October
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2329***, dated 07.11.2003
Status: Common
Local Distribution: Found only in Makaibari & Tamsong gardens.
General Distribution: Eastern Himalaya, India, Myanmar, China.

COMMELINA L.

Commelina benghalensisL., Sp. Pl. 41. 1753; FBI 6: 370. 1892; FB 3(1): 238.1994.

Local Name: *Kaney jhar* (Nep).

Stems 20-45cm, much branched, hispid especially above, base sometimes with weak decumbent stolons. Leaves with distinct petiole like bases, oblong-elliptic, rounded to subacute, margins densely shortly ciliate, base rounded to truncate, surfaces usually with many long white hairs. Flowers blue in cyme of c 3 bisexual flowers.

Flowers & Fruits: July – August

Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0833***, dated 04.05. 2002; Kamalpur TE, ***AP Das & Chandrâ 0731***, dated 20.04.2002; Makaibari TE, ***AP Das & Chandrâ 1841***, dated 10.06. 2003; Tamsong TE, ***AP Das & Chandrâ 1954***, dated 30.06. 2003.

Status: Very common.

Local Distribution: In all gardens.

General Distribution: Africa, Himalaya, India, China, Malaysia.

Commelina diffusa Burman f., Fl 18. 1768; FEH 1: 400. 1966; FB 3(1): 237. 1994; Fl. Sik. 1:168. 1996.

C. nudiflora L. *sensu* Clarke in DC., Monog. Phan. 3: 144. 1881; FBI 6: 369. 1892.

Small diffuse perennial herbs; roots thickened, rooting from lower nodes. Leaves alternate, lamina narrowly lanceolate, acuminate, contracted into a short petiole. Cymes in unequal paired peduncles; flowers bisexual, bluish. Capsules ellipsoid, greenish-brown; seeds blackish-brown.

Flowers & Fruits: April – October

Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0435,*** dated 05.04.2002; Kamalpur TE, AP Das & Chandrâ 1332, dated 18.10.2002; Makaibari TE, AP Das & Chandrâ 1827, dated 10.06. 2003; Tamsong TE, ***AP Das & Chandrâ 2452***, dated 05.11.2003; Soom TE, ***AP Das & Chandrâ 2698***, dated 09.01.2004.

Status: Abundant.

Local Distribution: In all gardens.

General Distribution: Pantropic and warm temperate regions.

Commelina maculata Edg. in Trans Linn. Soc. 20: 89. 1846; FB 3(1): 235.1994.

Perennating with narrow, vertical tubers; funnel-shaped spathes; smaller, more slender usually hairy stems 12-46cm. Leaves usually hairy with joined hairs on upper surface, sometimes also with short, conical bristles, occasionally glabrous. Flowers smaller in smaller inflorescence, occasionally reduced to a single spathe.

Flowers & Fruits: July – October

Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2488***, dated 11.11. 2003; Soom TE, ***AP Das & Chandrâ 3496***, dated 12.10.2004.

Status: Very common.

Local Distribution: All three hill gardens.

General Distribution: Himalayas, India, Sri Lanka, Myanmar, China.

Commelina paludosa Blume, Enum. Pl. Java 1: 2 1827; FEH 1: 400. 1966; FB 3(1): 235. 1994; Fl. Sik. 1:169. 1996.
C. obliqua Buch-Ham. *ex* D. Don, Prodr. 45. 1825, *non* Vahl 1806, FBI 6: 372. 1892.

Straggling herbs upto 150 cm, highly branched. Lamina lanceolate, acuminate, cuneate, granulated above, glabrous beneath. Cymes solitary; flowers 6-7 white or pale blue. Capsules oblong, truncate-triangular, glossy, greenish brown; seeds oblong, slightly granular, gray.

Flowers & Fruits: May – November
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 3076***, dated 10.04. 2004; Soom TE, ***AP Das & Chandrâ 2670***, dated 09.01.2004.
Status: Common
Local Distribution: In hill gardens
General Distribution: India, Sri Lanka, Nepal, Myanmar, Malaysia, Indochina and China.

Commelina suffruticosa Blume, Enum. Pl. Jav. 1: 3. 1827 –28; FBI 6: 374. 1892; FB 3(1): 236.1994.

Stems 23-45cm, much branched above, sometimes shortly hairy above. Leaves lanceolate, acuminate, cuneate to short, petiole like base, minutely rough above, usually shortly hairy beneath. Flowers usually white, sometimes blue in single cyme of c-10 flowered.

Flowers & Fruits: June – October
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0786***, dated 04.05. 2002; Kamalpur TE, ***AP Das & Chandrâ 0645***, dated 20.04.2002; Makaibari TE, ***AP Das & Chandrâ 1854***, dated 10.06. 2003; Soom TE, ***AP Das & Chandrâ 3439***, dated 12. 10. 2004; Tamsong TE, ***AP Das & Chandrâ 2206***, dated 30.06. 2003.
Status: Very common.
Local Distribution: In all gardens.
General Distribution: Himalayas, India, Malaysia.

CONVALLARIACEAE Horan.

OPHIOPOGON Ker Gawler

Ophiopogon clarkei Hook.f., FBI 6: 268. 1892; FB 3(1): 54.1994.

Stoloniferous, stolons initially slender, covered with pale brown papery scales; leaves borne in tufts, often swollen at base, initially minutely serrate on margins. Flowers usually pure white (occasionally flushed pink or lilac), spreading to erect, born tingly, cup shaped.

Flowers & Fruits: July – October
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2219***, dated 05.09. 2003.
Status: Common
Local Distribution: All three hill gardens.
General Distribution: Eastern Himalaya, Assam.

PELIOSANTHES Andrews

Paliosanthes macrophylla Wallich ex Baker in J. Linn. Soc. Bot. 17: 505. 1879; EFPN 1: 76. 1978.

Local Name: *Chille dhotisara* (Nep).

Rhizome stout, oblique. Rosettes 2-4 leaved; Leaves narrowly elliptic, cuspidate, margins sometimes crimped, gradually tapered to base. Raceme 30-60 flowered, stout, bracts each bearing a single greenish or greenish-purple flower.

Flowers & Fruits: February – May.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2867***, dated 25.03. 2004
Status: Very common.
Local Distribution: All three hill gardens.
General Distribution: Eastern Himalaya, China.

COSTACEAE (K. Schum.) Nak.

COSTUS L.

Costus speciosus (Koen.) J.E. Smith in Trans. Linn. Soc. London 1: 249. 1800; FBI 6: 249. 1892; FB 3(1): 210.1994.

Leafy stems 1-3m; leaf blade elliptic to obovate, acute or shortly acuminate, sparsely to densely hairy beneath, petioles densely pubescent. Inflorescence terminal, ovoid with red, on disintegrating bracts with tips sharply pointed; flowers with red calyx and white corolla.

Flowers & Fruits: July – November
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3485***, dated 12. 10. 2004.
Status: Abundant.
Local Distribution: In Terai and low altitude areas.
General Distribution: Himalayas, Sri Lanka, Indo –China, Malaysia, Taiwan, New Guinea

CYPERACEAE A. Jussieu

BULBOSTYLIS Kunth

Bulbostylis densa (Wallich) Handel-Mazzetti , Vegetations 20 (7): 16. 1930; FEH 1:380. 1966; FB. 3 (1):298. 1994; Fl. Sik. 1:198. 1996.
Scirpus densus Wallich *ex* Roxb. , Fl. Ind. ed. Carey, 1: 231. 1820.

Densely tufted annual, stems filiform 5-18 cm. Leaves erect, basal, half or more of stem length. Sheaths membranous, pale brown. Inflorescence umbellate, rarely reduced to single spikelet. Spikelets sessile ovoid, acute; glumes spiral or distichous. Nuts strongly trigonous.

Flowers & Fruits: April – October
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 0990***, dated 09.05.2002.
Status: Common.
Local Disrtibution: In all gardens.

General Distribution: E. Himalaya, China, Japan.

CAREX L.

Carex filicina Nees *ex* Wight, Contrib. Bot. Ind. 123. 1834; FBI 6: 717, 1894. var. ***meiogyna*** Kukenthal, Pfl.-reich IV-20, Ht. 38: 274. 1909, FEH 1: 381. 1966; TBRI 50(4): 108. 1987; FB 3(1): 337. 1994; Fl. Sik. 1: 202. 1996.
C. meiogyna Nees, Contrib. Bot. Ind. 123. 1834, p.p.
C. filicina Nees var. *meiogyna* (Nees) Strachey, Cat. Pl. Kumaon 73. 1854, Pfl.-reich IV-20, Ht. 38: 274. 1909.

Stout herbs with creeping and woody rhizomes. Leaves blades almost equal to culm; leaf sheath bases reddish-purple, persisting without turning into fibres, sometimes bladeless. Culm 25-93 cm long. Partial panicles open, triangular with hispid axis, bracteate, occuring in unequal pairs. Spikes variable in sizes, sharply becoming shorter upwards.

Flowers & Fruits: April - February
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2381***, dated 05.11. 2003
Status: Common
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: India, Myanmar, Indo-Chin, Malaysia, China, etc.
Note: Highly variable species, taxonomic review essential.

Carex spiculata Boott in Proc. Linn. Soc. 1: 288. 1845; FB 3(1): 381.1994.

Rhizomes short, thick, woody. Stems tufted. Bases of leaf sheaths reddish to brownish purple, dull, persisting as fibres. Leaves inserted along lower half of culm, blades coarse. A slender to massive panicle 9-64cm with long leaf like bracts, long sheaths, close-fitting. Spikes androgynous, all similar, drooping, sometimes stiffer, ± erect.

Flowers & Fruits: August – July
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2581***, dated 11.11. 2003..
Status: Common
Local Distribution: Found only in Makaibari garden.
General Distribution: Himalayas.

CYPERUS L.

Cyperus castaneus Willd., Sp. pl. 1: 278. 1797; FBI 6: 598. 1893; FB 3(1): 306. 1994.

Small, densely tufted annual. Stems trigonous, slender. Leaves subbasal, blade slightly exceeding stem, sheaths reddish – purple. Inflorescence a head of 5 – 31 sessile spikelets. Partial inflorescence umbellate. Spikelets oblong fimbriate. Glumes 14 –34, overlap to one another, oblong elliptic, mucronate, midrib green, 3 – veined, keeled, side golden to reddish – brown. Stamen 1, nut longer, narrowly oblong with parallel sides.

Flowers & Fruits: September – November.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2483***, dated 11.11. 2003.
Status: Rare
Local Distribution: Found only in Makaibari garden.

General Distribution: India, Nepal, Bhutan, Indo –China, Malaysia, Northern Australia

Cyperus compressus L., Sp. Pl. ed. 1, 46. 1753; FBI 6: 605. 1893; FEH 1: 385. 1966; FIEM 44. 1989; FB 3(1): 310. 1994; Fl. Sik. 1:214. 1996.

Tufted annual, 8-35 cm tall. Leaves usually sub-basal, blades half to as long as stems, 0.15-0.25 cm wide. Inflorescence with few spreading elliptic to oblong sessile, compressed spikelets, sometimes compound bearing 1-4 stiff hairs; nuts more than 4, strongly compressed.

Flowers & Fruits: April - October
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0803***, dated 04.05. 2002; Kamalpur TE, ***AP Das & Chandrâ 0378***, dated 27.02.2002.
Status: Fairly Common.
Local Distribution: In Terai gardens.
General Distribution: Cosmopolitan.

Cyperus cuspidatus Kunth in Humb., Bonpl. & Kunth, Nov. Gen. Sp. 1: 204. 1816; FBI 6: 598.1893; FB 3(1): 306. 1994.
Cyperus uncinatus Clarke in Durand *et* Schinz. Consp. Fl. Afr. 5: 580. 1895.

Small, densely tufted annual. Stems trigonous, slender. Leaves subbasal, blade slightly exceeding stem, sheaths reddish. Inflorescence a head of 5 – 31 sessile spikelets. Partial inflorescence umbellate. Spikelets oblong fimbriate. Glumes 14 –34, erect at first, finely spreading obliquely, oblong elliptic, mucronate, midrib green, 3 – veined, keeled, side golden to reddish – brown. Stamens 2 –3, nut apiculate, dark brown.

Flowers & Fruits: August – October.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 3086***, dated 10.04. 2004.
Status: Common
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: Pantropical.

Cyperus cyperoides (Retzius) O. Kuntze, Rev. Gen. Pl. 3(2): 333. 1898, FEH 1: 386. 1966, FIEM 64. 1989; FB 3 (1): 307. 1994.
Scirpus cyperoides L., Mant. 2: 181. 1771.

Perennial herbs, 30-60 cm. Leaves shorter or equal to stem; sheaths purplish-red. Inflorescence 3-11 x 2-6.5 cm, spicate. Spikes 1.3-3.9 x 0.65-1.2 cm, cylindric; spikelets many, linear, acute. Glumes appressed, upper ones fertile, linear-lanceolate. Nuts slightly curved, brownish, papillose.

Flowers & Fruits: April – October
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0842***, dated 04.05. 2002; Hansqua TE, ***AP Das & Chandrâ 0978***, dated 09.05.2002; Soom TE, ***AP Das & Chandrâ 3179***, dated 26.06. 2004; Tamsong TE, ***AP Das & Chandrâ 2952***, dated 10.04. 2004.
Status: Common.
Local Distribution: In all gardens.
General Distribution: Subtropical and temperate regions of both the hemisphere.

Cyperus iria L., Sp. Pl. ed. 1, 45, 1753; FBI 6: 666.1893, FEH 1: 387. 1966; FIEM 45. 1989; FB 3(1):312. 1994; Fl. Sik. 1:215. 1996.

Local Name: *Mothey* (Nep).

Tufted annual, to 40 cm. Leaves equalling from lower half of stem, ± 0.4 cm wide; sheath bases dark brownish. Inflorescence 6-9 cm long. Spikes 3-5, sessile, narrowly oblong, lower ones spreading; spikelets 10-15, erect oblong. Glumes 6-12, oblique, overlapping, suborbicular, emarginate, minutely apiculate. Nuts elliptic-obovate, apiculate, blackish.

Flowers & Fruits: May - October
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0410***, dated 27.02.2002; Tamsong TE, ***AP Das & Chandrâ 2404***, dated 05.11. 2003
Status: Common.
Local Distribution: In all gardens.
General Distribution: Cosmopolitan.

Cyperus pangorei Rottboel, Descr. Pl. Rar. Progr. 18. 1772; FB 3(1): 314.1994.

Rhizomes short, not creeping. Stems triquetrous, 50-90cm, long basal sheaths apparently sometimes developing laminar blades. Partial inflorescence bearing rayed and unrayed spikes which is cylindric, up to 13 spreading to suberect, linear spikelets

Flowers & Fruits: August – December.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2548***, dated 11.11. 2003; Tamsong TE, ***AP Das & Chandrâ 2309***, dated 05.09. 2003.
Status: Rare
Local Distribution: All three hill gardens.
General Distribution: India, Nepal, Bhutan, Sri Lanka, Myanmar

Cyperus pilosus Vahl, Enum. 2: 354. 1805; FBI 6: 609.1893; FB 3 (1): 315. 1994.
Cyperus obliquus Nees in Wt. Contr. Bot. Ind. 86. 1834.

Perennial; rhizomes stoloniferous. Stems 90 cm. Leaves 10 mm wide. Inflorescence compound umble; spike pilose; spikelets linear-lanceolate, 10-20 flowered. Glumes broadly ovate. Stamens 3. Achene 1 mm long, ovate-elliptic, black.

Flowers & Fruits: July- November.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1875***, dated 10.06. 2003.
Status: Less Common.
Local Distribution: Found only in Makaibari garden.
General Distribution: India, Nepal, Bhutan, China, Japan, Malaysia, Tropical Africa

Cyperus pseudokyllingioides Kuekenth.in Engl. Pflanzenr. *Heft* 101: 501. 1936; FB 3(1): 309.1994.

Annual. Stems tufted, trigonous, 18-57cm. Leaves 2-3 on lower half of stem, blades shorter than to exceeding stem, sheaths very long, pale. Partial inflorescence composed of dense heads of sessile spikelets which is flat, elliptic, acute.

Flowers & Fruits: June – December
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0838***, dated 04.05. 2002; Hansqua TE, ***AP Das & Chandrâ 1108***, dated 09.05.2002; Kamalpur TE, ***AP Das & Chandrâ 0497***, dated 17.04.2002.
Status: Abundant.
Local Distribution: All Terai gardens.
General Distribution: India, Nepal, Bhutan, Myanmar, Indo –China, Malaysia

Cyperus sikkimensis Kukenthal, in Engler Pflanzenr. Cyperac. Scirp. Cyp. 467. 1936; FB 3 (1): 306. 1994.

Perennial, rhizomes short. Stems 62-73 cm. Leaves 1-2, shorter than stem, sheath long. Inflorescence a dense head of 15 spikes, bracts 4-5. Glumes 2.1-2.7X 1.4 mm, narrowly ovate, 3-veined. Stamens 3; stigma 0.3 mm. Nut curved, shortly apiculate.

Flowers & Fruits: June-July.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1745***, dated 17.05.2003.
Status: Rare
Local Distribution: Found only in Makaibari garden.
General Distribution: Eastern Himalaya.

Cyperus tenuispica Steudel, Syn. Pl. Glum. 2: 11. 1855; FB 3 (1): 314. 1994.
Cyperus flavidus Clarke in J. Linn. Soc. (Bot.) 20: 287. *et* 21: 122. 1884; FBI 6: 600. 1893.

Annual; rhizome absent. Stems weak, 5-40 cm. Leaves with trigonous blade. Inflorescence compond umble, yellow; primary rays 5cm; secondary rays 2.5 cm; bracts 1-3. Glumes oblong. Stamen 1-2; achene 0.5 mm long, rounded, white.

Flowers & Fruits: June.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0738***, dated 04.05. 2002.
Status: Less Common.
Local Distribution: Found only in Mohurgong & Gulma garden.
General Distribution: Tropical and Subtropical Asia and Africa

FIMBRISTYLIS Vahl *(nom. cons.)*

Fimbristylis aestivalis (Retzius) Vahl, Enum. Pl. 2: 288. 1806; FBI 6: 637. 1893; FEH 1: 390. 1966; FB 3 (1): 296. 1994; Fl. Sik. 1:219. 1996.
Scirpus aestivalis Retz., Obo. Bot. 4:12. 1786.

Tufted filiform annual 2-9 cm. Leaves eligulate, basal and sub-basal, ±4.5 x 0.025-0.065 cm, acute; sheaths pilose, membranous. Inflorescence umbellate, 0.3-2.6 x 0.25-2 cm; spikelets linear-lanceolate, acute, angled; glumes oblong-elliptic, mucronate, keeled. Nuts obovate, biconvex.

Flowers & Fruits: April – September
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 1214***, dated 18.10.2002.

Status: Common.
Local Distribution: Found only in Kamalpur garden.
General Distribution: Temperate-Tropical regions of Asia; India, China, eastward to Japan, Malaysia and N. Australia.

Fimbristylis dichotoma (L.) Vahl, Enum. Pl. 2: 287. 1806;-FEH 1: 391. 1966; TBRI 50(4): 114. 1987; FB 3 (1): 294. 1994; Fl. Sik. 1: 220. 1996.
Scirpus dichotomus L., Sp. Pl. ed. 1, 50. 1753.

Densely tufted small variable annual, stem compressed. Leaves ±basal, half of stem length, ligulate, acute; sheaths hairy, brownish. Inflorescence 2-12.5cm, compound; primary rays unequal, upto 8 cm; spikelets borne singly; glumes ovate, acute.

Flowers & Fruits: March – October
Specimen Cited: Matigara TE, ***AP Das & Chandrâ 3165***, dated 10.05. 2004
Status: Common.
Local Distribution: All Terai gardens.
General Distribution: Tropical and subtropical regions of the world.

Fimbristylis fimbristyloides (Muell.) Druce in Rep. Bot. Exch. Cl. Brit. Isl. 1916: 623. 1917; FB 3(1): 291.1994.
Abildgaardia fimbristyloides Muell., Fragm. Phyt. Austral. 8: 273. 1874.
Fimbristylis fimbristyloides (F.von Mueller) Druce/291/Fr. – October

Dwarf annual. Stems 5-grooved, 2-8cm long. Leaves basal, curved, ± flat, apiculate, margins minutely serrate, much shorter than stems, eligulate. Inflorescence of 2-4 unequally rayed spikelets which is compressed lanceolate, acute, sometimes becoming twisted.
Flowers & Fruits: June – October.
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1145***, dated 14.06. 2004
Status: Common
Local Distribution: In Terai and low altitude areas.
General Distribution: India, Nepal, Bhutan, China and Australia

Fimbristylis rigidula Nees in Wight in Contr. Bot. Ind. 99. 1834; FB 3 (1): 295. 1994.

Rhizomes woody, shortly creeping. Stems grooved, base swollen, sheaths 10-21 cm. Leaves flat, minutely serrate, half of stem. Inflorescence 1.8-3.3 X 1.0-2.8 cm; ray 1-2 cm. Spikelets ovoid, 5-6.5X 2.5-4 mm. Glumes ovate, apiculate, concave, 3-veined. Stamens 3; stigma 2. Nuts smooth.

Flowers & Fruits: February.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0389***, dated 27.02.2002
Status: Rare
Local Distribution: All Terai gardens.
General Distribution: India, Nepal, Bhutan, China

Fimbristylis fuscinux C.B. Clarke. : FB 3 (1): 295. 1994.

Rhizomes short. Stems with old leaf sheaths at base, 19-76 cm. Leaves basal, flat, eligulate. Inflorescence lax, longest ray 3-11 cm. Spikelets borne singly. Glumes ovate, mucronate, keeled, 3-veined. Stamens 2-3, dark brown. Stigmas 2. Nut biconvex.

Flowers & Fruits: August-October.
Specimen Cited: Hansqua TE, **AP Das & Chandrâ 0128**, dated 03.02.2002.
Status: Rare
Local Distribution: Found only in Hansqua garden.
General Distribution: Tropical & subtropical Himalayas

Fimbristylis tetragona R. Br., Prodr. 226. 1810; FBI 6: 631. 1893.

Glabrous, perennial herbs, rhizomes short. Stems 50 cm, 4-angular. Leaves bladeless. Inflorescence solitary, terminal; spikelets ebracteate; glumes oblong-ovate, obtuse. Stamens 1-2; stigmas 2-3. Nuts pale, linear-oblong.

Flowers & Fruits: September-December.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0590***, dated 20.04.2002.
Status: Common
Local Distribution: All Terai gardens.
General Distribution: India, Bangladesh, Sri Lanka, E. Asia to tropical Australia.

KYLLINGA Rottboell *(nom. cons.)*

Kyllinga nemoralis (J. R. & G. Forster) Dandy ex Hutchinson & Dalziel, Fl. W. Trop. Africa 2: 486, 487. 1936; FB 3 (1): 325. 1994.
Thryocephalon nemorale J.R. & C. Forster, Char. Gen. Pl. 130. 1776.
Kyllinga monocephala Rottb., Descr. *et* Ic. 13, t. 4. 1773, *nom. illegit.*

Rhizomes slender, creeping; stems leafy. Leaves longer than stem, bracts long. Heads compact, white. Glumes broad, opaque, ciliate wing, acute. Nuts brown.

Flowers & Fruits: July – March.
Specimen Cited: Mohurgong & Gulma TE, **AP Das & Chandrâ 0445**, dated 05.04.2002; Kamalpur TE, **AP Das & Chandrâ 0466**, dated 17.04.2002; Makaibari TE, **AP Das & Chandrâ 2852**, dated 25.03. 2004; Tamsong TE, **AP Das & Chandrâ 2164**, dated 30.06. 2003.
Status: Abundant.
Local Distribution: In all gardens.
General Distribution: Pantropical to sub-tropical regions.

Kyllinga brevifolia Rottboell, Descr. and Ic. 13. t. 4, f. 3. 1773; FBI 6:588. 1893; FB 3 (1):324. 1994; Fl. Sik. 1:227. 1996.

Perennial, rhizome creeping, 5-40 cm tall, triquetrous. Leaves shorter than stem, > 0.38 cm wide; sheaths reddish brown. Inflorescence 0.55-0.95 x 0.55-0.7 cm, hemispheric, subsidary heads 1-2, sessile; spikelets lanceolate; glumes 3, oblong-ovate; upper glume fertile. Nuts oblong-obovate.

Flowers & Fruits: April – August

Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0853***, dated 04.05. 2002; Matigara TE, ***AP Das & Chandrâ 3629***, dated 20. 10. 2004; Soom TE, ***AP Das & Chandrâ 3229***, dated 26.06. 2004; Tamsong TE, ***AP Das & Chandrâ 2901***, dated 10.04. 2004.
Status: Common.
Local Distribution: In all gardens.
General Distribution: Cosmopolitan.

PYCREUS P. Beauvois

Pycreus polystachyos (Rottboell) Beauvois, Fl. Owar. 2: 48. t. 86. f. 2. 1807.
Cyperus polystachyos Rottboell, Progr. 21. 1772 & Descr. *et* Ic. 39, t. 11, f. 1. 1773.

Stems erect, compressed, 65 cm. Leaves almost half of stem; bracts 3-6. Spikelets compact, many flowered; glumes 0.17 cm, imbricate, elliptic ovate. Nuts 8-12 mm long, black, biconvex, apiculate.

Flowers & Fruits: May – September.

Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1833***, dated 10.06. 2003.
Status: Rare
Local Distribution: Found only in Makaibari garden.
General Distribution: Throughout the tropical and sub-tropical regions.

RHYNCHOSPORA Vahl, *nom. cons.*

Rhynchospora rubra (Loureiro) Makino in Bot. Mag. Tokyo 17: 180. t. 7. f. 1a,b. 1903.
Schoenus ruber Lour., Fl. Cochinch. 1: 41. 1790.

Perennial herbs; stems 3-quetrous. Leaves 4-8, 0.3 cm broad. Inflorescence a single, terminal; bracts 4-8. Spikelets many, 0.5-0.8 cm, brown; glumes 5-7, keeled, ovate, mucronate; stamens 3. Nuts sessile, obovoid.

Flowers & Fruits: June-December.
Specimen Cited: Mohurgong & Gulma TE, **AP Das & Chandrâ 0961**, dated 04.05. 2002; Hansqua TE, **AP Das & Chandrâ 0158**, dated 03.02.2002; Kamalpur TE, **AP Das & Chandrâ 0483**, dated 17.04.2002.
Status: Common
Local Distribution: All Terai gardens.
General Distribution: India, Sri Lanka, Nepal, China, Japan, Myanmar, Malaysia, tropical Africa, tropical Australia.

SCHOENOPLECTUS (Reichenbach) Palla

Schoenoplectus juncoides (Roxburgh) Palla in Bot. Jahrb. 10: 299. 1888; FB 3 (1): 283. 1994.
Scirpus juncoides Roxb., Fl. Ind. 1: 218. 1820.

Local Name: *Swirey, Suire* (Nep)

Annual. Stems densely tufted, erect, 9-73 cm. Basal sheaths 1-3, apiculate, oblique. Inflorescence of 1-7 spikelets. Glumes widely ovate, concave, apiculate, golden brown. Stamens 1-3; stigma 2-3, brown; bristles 6, unequal, longest 1.9-2.3 mm.

Flowers & Fruits: February to October.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2489***, dated 11.11. 2003.
Status: Rare
Local Distribution: Found only in Makaibari garden.
General Distribution.: India, China, Japan, Malaysia, Australia.

DIOSCOREACEAE R. Brown

DIOSCOREA L.

Dioscorea anguinea Roxburgh, Fl. Ind. 3: 803. 1832; FBI 6: 293. 1892; FB 3(1): 14.1994.

Local Name: *Pangla torul* (Nep).

Tubers 1 or 2, narrowly cylindric, rootlets few, flesh lemon yellow. Plant shortly pubescent. Stem twining to right, lacking prickles, bulbils sometimes produced. Leaves alternate to sub-opposite, ovate, cuspidate to shortly caudate, base shallowly cordate, margins cartilaginous persistently pubescent beneath, scattered hairy becoming glabrous above.

Flowers & Fruits: August – January
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 1314***, dated 18.10.2002.
Status: Less Common.
Local Distribution: In Terai and low altitude areas.
General Distribution: Himalayas, India, Myanmar, Sumatra, Java.
Note: Root-stock edible

Dioscorea bulbifera L., Sp. Pl. ed. 1:1033. 1753; FEH 1:419. 1966; FB 3(1): 9.1994.
Dioscorea sativa Thunberg, Fl. Jap. 151. 1784; *non* L. (1753); FBI 6:295. 1892.

Local Name: *Gittha, Githa Lahara* (Nep).

Tubers globose, pale yellow when cut. Stem twining left without prickles, glabrous, sharply angled. Leaves alternate; petioles equaling leaf blade; lamina ovate, acuminate, cordate. Spikes in fascicles, axillary, in groups of 2-5; flowers whitish, scented. Capsules oblong-elliptic, winged.

Flowers: June – September; *Fruits*: September – October
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0868***, dated 04.05. 2002; Tamsong TE, ***AP Das & Chandrâ 2142***, dated 30.06. 2003
Status: Common; generally cultivated.
Local Distribution: In all gardens.
General Distribution: Tropics of the old World.

Dioscorea deltoidea Wallich ex Griseb.in Mart., Fl. Brasil. 3(1): 43. 1842; FBI 6: 291. 1892; FEH 1: 419. 1966; FB 3(1): 8.1994.

Stem twining to left, lacking prickles, bulbils few or absent. Plant glabrous, leaves usually smaller, thinner-textured, distinctly hastate with base lobes present at least when young, finally ovate, usually hispid on veins beneath. Male spikes: flower clusters rather distant, absent from lower part of filiform axis. Female spikes borne singly in axils.

Flowers & Fruits: April – October
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0947***, dated 04.05. 2002; Kamalpur TE, ***AP Das & Chandrâ 0647***, dated 20.04.2002; Makaibari TE, ***AP Das & Chandrâ 1843***, dated 10.06. 2003; Tamsong TE, ***AP Das & Chandrâ 2171***, dated 30.06. 2003.
Status: Common
Local Distribution: In all gardens.
General Distribution: Himalayas (Kashmir – Assam), China.
Note: Tuber used as soap

Dioscorea kamoonensis Kunth, Enum. Pl. 5: 395. 1850; FB 3(1): 12.1994.

Plant hairy, hairs simple, grayish white. Stem lacking prickles, densely appressed hairy or subglabrous, bulbils usually present. Leaves (3-or) 5-foliate, rugose, middle largest, narrowly elliptic to oblanceolate, cuspidate, narrowed to sessile base, densely white bristly above and beneath, subglabrous beneath, distinctly petiolulate. Male inflorescence usually short, 3-5 clustered, axillary spikes with male flowers larger; female spikes slender.

Flowers & Fruits: August – November
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1913***, dated 10.06. 2003.
Status: Common
Local Distribution: All Terai gardens and in lower areas of hill gardens.
General Distribution: Himalayas, Myanmar, Thiland, China.

Dioscorea pentaphylla L., Sp. Pl. 1032. 1753; FBI 6: 289. 1892; FEH 1:420. 1966; FB 3(1):10. 1994.
D. jacquemontii Hk. f., FBI 6:290. 1892.

Local Name: *Bhegur* (Nep).

Twinning greyish-white plant. Tubers ovoid-globose, sometimes with rootlets on surface. Stems subglabrous to appressed pubescent, sometimes often bearing prickles. Leaves 3 to 5 foliolate, elliptic to oblanceolate, middle one generally largest, cuspidate, base narrowed, densely white-hairy above, subglabrous beneath. Spikes solitary or pairs, greyish-white, pubescent.

Flowers & Fruits: July – December.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1847***, dated 10.06. 2003; Tamsong TE, ***AP Das & Chandrâ 2061***, dated 30.06. 2003.
Status: Common.
Local Distribution: In Terai and low altitude areas.
General Distribution: Himalayas (Simla-Mishmi), India, Myanmar, Thiland, Indo-China, Malaysia, China.

HEMEROCALLIDACEAE R. Brown

HEMEROCALLIS L.

Hemerocallis fulva (L.) L. : FB 3(1): 72.1994

Glabrous herbs with fascicle of swollen roots. Leaves basal, linear. Scape terete, bearing a lanceolate leaf like bract below inflorescence. Flowers dull orange in (4-) 6-9-flowered inflorescence with small, partly scarious bracteoles at base of pedicels and inflorescence branches.

Flowers & Fruits: May – July.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2988***, dated 10.04. 2004.
Status: Very common; nicely naturalized in hills.
Local Distribution: Found only in Europe, Naturalised elsewhere.

HYPOXIDACEAE R. Brown

CURCULIGO Gaertner

Curculigo orchioides Gaertner, Fruct. 1: 63, t. 13. 1788; FBI 6: 279. 1892; FB 3(1): 69. 1994; Fl. Sik. 1:139. 1996.
Curculigo malabarica Wight, Ic. t. 2043 A, f. 1. 1853.

Local Name: *Bnash pata, Talmuli* (Beng)

Small rosette herbs; rootstock bulbous. Leaves subsessile, lanceolate, acuminate, membranous, plicate glabrous. Scape subterranean, clavate, covered. Bracts lanceolate, membranous. Flowers subsessile, distichous. Capsules sessile, oblong with a few, shiny black, wavy seeds.

Flowers & Fruits: May – August
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 3040,*** dated 10.04. 2004.
Status: Rare
Local Distribution: Found only in Tamsong garden.
General Distribution: Sub-tropical Himalaya (Kumaon and eastward upto 1800m), Khasi Hills, Manipur, Western Ghats.

MOLINERIA Colla

Molineria gracilis Kurz, Ann. Mus. Bot. Lugduno –Batavi 4: 177. 1869.

Perennial herb with stout rhizome. Leaves in basal rosette, lanceolate, acute, base narrowed into tomentose petiole, usually glabrous above, beneath with dense appressed and scattered hairs. Scape longer sometimes very shorter, densely brownish tomentose. Flowers lanceolate, glabrous above and hairy underside, yellowish in capitate raceme very condensed, ovoid.

Flowers & Fruits: April - August
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1131,*** dated 09.05.2002; Makaibari TE, ***AP Das & Chandrâ 2796***, dated 25.03. 2004; Tamsong TE, ***AP Das & Chandrâ 2216***, dated 05.09. 2003.
Status: Less Common.
Local Distribution: In all gardens.

General Distribution: Subtropical and temperate Himalayas, Sri Lanka, Myanmar, Indochin, Malaysia, China and Australia.

JUNCACEAE A. Jussieu

JUNCUS L.

Juncus ochraceus Buchenau in Abh. Nat. Ver. Brem. 3:292. 1872; FBI 6:394. 1894; FEH 1:403. 1966; TBRI 50 (4):117. 1987; FB 3 (1):253. 1994; Fl. Sik. 1: 176. 1996.

Small robust herbs, 17-35 cm. Stem simple, slender, grooved. Leaves sheathed, as long as stem or shorter, filiform, glabrous, channeled above; sheaths auricled. Cyme compound in small head, loosely branched, partly or all reduced to sterile spikelets of golden yellow bracts and glumaceous tepals. Flowers small, shortly pedicellate, pale green, 1 or 2, developed at the second axil of head.

Flowers & Fruits: August – October
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0470***, dated 17.04.2002.
Status: Rare
Local Distribution: Found only in Kamalpur garden.
General Distribution: Temperate E. Himalaya and Assam.

MARANTACEAE Petersen

PHRYNIUM Willdenow

Phrynium pubinerve : FB 3(1): 214.1994

Local Name: *Kopat, Kawaipat* (Nep).

Rhizome thick bearing c.4-leaved rosettes. Leaf blade oblong-elliptic, very shortly cuspidate; flowers pinkish or blue-veined in condensed, c.3 narrow spike like cymules. Prophylls reddish-brown, broadly oblong, becoming fibrous-torn at apex.

Flowers & Fruits: June – September.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2764***, dated 25.03. 2004
Status: Common
Local Distribution: In Terai and low altitude areas.
General Distribution: Eastern Himalaya.

ORCHIDACEAE A. Jussieu

AERIDES Loueriro

Aerides multiflorum Roxburgh, Pl. Corom. 3: 67, t. 271. 1820; FB 3(3): 493. 2002.

Erect to pendent; root fleshy. Leaves oblong, apex broadly 2 –lobed, distichous. Densely many –flowers in racemes or paniculate. Flowers white to pink –purple. Sepals oblong to orbicular, rounded. Petals oblong –elliptic, rounded. Fruits stalked, ovoid.

Flowers & Fruits: March to June
Specimen Cited: Hansqua TE, ***AP Das & Chandra 1324***, dated 26. 06. 2002.
Status: Common
Local Distribution: In Terai garden
General Distribution: NW Himalayas, India, Nepal, Bangladesh, Myanmar, Thailand, Laos, Cambodia and Vietnam.

ANTHOGONIUM Wallich ex Lindley

Anthogonium gracile Lindley, Gen. Sp. Orchid. Pl.: 426. 1840; FB 3(3): 279. 2002.

Plants 14 –40cm, pseudobulbs ovoid. Leaves oblong lanceolate to narrowly elliptic, acuminate, many veined. Inflorescence laxly 5 –10 flowered, peduncles slender glabrous. Floral bracts lanceolate, long acuminate. Flowers dark pink to white, lip spotted dark purple, anthers bright yellow. Petals elongate –spathulate. Fruit narrowly ellipsoid.

Flowers & Fruits: August – October.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 3002***, dated 10.04. 2004.
Status: Common.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: India: North india; Nepal, Myanmar, China, Thailand, Laos, Combodia, Vietnam.

ARUNDINA Blume

Arundina graminifolia (D.Don) Hochreutiner in Bull. New York Bot. Gard. 6: 270. 1910; FB 3(3): 319. 2002.
Bletia graminifolia D. Don, Prodr. Fl. Nep.: 29. 1825.

Plant 3m tall, erect, leafy throughout. Leaves linear lanceolate, acuminate, sessile. Inflorescence erect racemose or panicle, few to many flowered; peduncles glabrous. Bracts lanceolate, acute. Flowers magenta to pinkish –white, sometimes with a yellow throat. Petals spreading, broadly elliptic, obtuse. Fruit long –ellipsoid.

Flowers & Fruits: September – November.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1815***, dated 17.05.2003.
Status: Common at places
Local Distribution: All three hill gardens
General Distribution: India, Bhutan, Nepal, Myanmar, China, S. E. Asia, Sri Lanka, Malaysia.

DENDROBIUM Swartz

Dendrobium candidum Wall.ex Lindl. in Bot. Reg. 24: misc. 36, non. 54. 1838; Fb 3(3): 407. 2002.

Plants epiphytic or lithophytic; roots fasciculate. Stems slender, erect, cylindric; internodes yellow. Leaves narrowly lanceolate, obtuse, obliquely emarginate, sessile, prominently 5 –veined. Inflorescence lateral, flowering at leafless stems, 1 –3 flowered. Flowers fragrant, white, lip with a yellow spots at base. Sepals broadly lanceolate, 5 –veined. Petals lanceolate, acute, 3 –veined. Fruit ovoid.

Flowers & Fruits: February – October.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2140,*** dated 30.06. 2003
Status: Less Common.
Local Distribution: Found only in Tamsong garden.
General Distribution: India: Himalayas; Nepal and Myanmar

NERVILIA Commerson ex Gaudichaud

Nervilia macroglosa (Hooker f.) Schltr. In Bot. Jahrb. Syst. 45: 403. 1911; FB 3(3): 58. 2002.
Pogonia macroglossa Hook.f., FBI 6(1): 120. 1890; FB 3(3): 58. 2002.

Pogonia macroglosa Hooker f.
Plant small, 8 –18cm. Stems slender glabrous. Leaf petiolate, orbicular cordate, margins entire. Inflorescence 1 –flowered. Flowers white flushed with pink. Sepals and petals linear lanceolate, acute or acuminate. Lip 3 –lobed, narrowly oblong. Fruit ovoid.

Flowers & Fruits: (May)
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1702,*** dated 17.05.2003.
Status: Rare
Local Distribution: Found only in Makaibari garden.
General Distribution: NE India, Nepal, Myanmar.

PAPILIONANTHE Schltr.

Papilionanthe teres (Roxburgh) Schltr. in Orchis 9: 78.t.12. 1915; FB 3(3): 536. 2002.
Vanda teres sensu Lindl., Gen. Sp. Orchid. Pl.: 217. 1833, *non* Roxburgh 2355. 1832.

Plant scrambling; roots piercing through leaf sheaths. Stem branched, terete, long; sheath ridged, tubular. Leaves suberect, curved, terete, linear, pointed. Inflorescence leaf –opposed, racemose, laxly 3 –6 flowered. Sepals and petals white to pink, lip darker pink, spur with a yellow mouth. Petals suborbicular, rounded, margin undulate. Fruit strongly ridged, cylindric, stalked.

Flowers & Fruits: May – July.
Specimen Cited: **Mohurgong & Gulma TE, *AP Das & Chandrâ 826,* dated** 04.05. 2002.
Status: Common
Local Distribution: In all Terai gardens.

General Distribution: India, Nepal, Bangladesh, Myanmar, China, Thailand and Vietnam.

PLATANTHERA L.C. Richard

Platanthera clavigera Lindley, Gen. Sp. Orchid. Pl.: 289; FB 3(3): 186. 2002; FB 3(3): 186. 2002
Habenaria densa Wallich ex Lindley, Gen. Sp. Orchid. Pl.: 326. 1835.

Plants 30 –40 cm; tuber cylindric. Stem erect, bracteate above. Stem bracts narrowly lanceolate, acuminate. Leaves 3 –4; lanceolate to narrowly elliptic, acute, sessile. Inflorescence many flowered; bracts lanceolate, acuminate. Flowers uniformly green. Petals elliptic –oblong, btuse, base oblique, 1 –veined. Fruits sessile, ovoid, ridged.
Gen. Distr:

Flowers & Fruits: July – October.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2293***, dated 05.09. 2003.
Status: Common
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: India: Himalayan range; Nepal, China.

RHYNCHOSTYLIS Blume

Rhynchostylis retusa (L.) Blume, Bijdr.: 286, t. 49. 1825; FB 3(3): 552. 2002.
Epidendrum retusum L., Sp. Pl. 2: 953. 1753.

Plant pendent; roots grey. Stems 10 –30cm. Leaves distichous, spreading to arching, apex obliquely 2 –lobed to retuse, deeply channelled, sessile, jointed. Inflorescence densely many flowered. Flowers white. Dorsal sepal broadly elliptic, obtuse; lateral sepals obliquely ovate. Petals spreading, oblong –ovate, rounded, 5 –veined. Fruit ellipsoid, 6 –ribbed.

Flowers & Fruits: May – July.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 1950***, dated 30.06. 2003
Status: Common
Local Distribution: In all gardens.
General Distribution: India, Nepal, China, Sri Lanka, Myanmar, Thailand, Philippines, Malaya, Sumatra, Java, Borneo.

ZEUXINE Lindley

Zeuxine membranacea Lindl., Gen. Sp. Orchid. Pl.: 486. 1840; FB 3(3): 113. 2002.

Plant up to 35cm tall. Leaves linear, apiculate, reticulate. Inflorescence densely many flowered; floral bracts lanceolate, acuminate, margins fringed, 3 –veined. Flowers white; ovary papilose or pubescent. Dorsal sepal oblong –lanceolate, acute; lateral sepals oblong, obtuse. Petals not adnate. Lip membranous, saccate at base.

Flowers & Fruits: November – January.
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1662,*** dated 13.11. 2002.
Status: Rare

Local Distribution: Found in Hansqua garden only.
General Distribution: NE India.

POACEAE Barnhart, *nom. alt.*
[GRAMINEAE A. Juss., *nom. cons.*]

AGROSTIS L.

Agrostis micrantha Steudel, Syn. Pl. Glum. 1: 170. 1854; EFPF 1: 120. 1978.

Annual, small, erect; leaves narrowly linear; panicle dense, much branched; spikelets minute, blackish.

Flowers & Fruits: September – November.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2460***, dated 05.11. 2003.
Status: Less common.
Local Distribution: Found only in Tamsong
General Distribution: Tropical Asia, malaysia and North Australia

ALLOTEROPSIS C. Presler

Alloteropsis semialata (R. Br.) Hitch. in Contrib. U. S. Nat. Herb. 12: 210. 1909; FB 3(2): 742. 2000.
Panicum semialum R. Br., Prodr. 192. 1810.

A small semierect grass; leaves small subulate, panicle branches few; spikelets one sided.

Flowers & Fruits: September – October.
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0399***, dated 27.02.2002.
Status: Rare
Local Distribution: Found o.nly at Kamalpur garden
General Distribution: Indian subcontinent

ARUNDO L.

Arundo donax L., Sp. Pl. 81. 1753; FBI 7: 302. 1896; FB 3(2): 646. 2000.

Stout, rhizomatous perennial with stout culms of 2(-6)m, lateral branches slender . Leaves tapering from just above base to very acute apex, glabrous, occationally with lateral, basal tufts of hairs at junction with ligule, sheaths glabrous. Spikelets with purplish glumes.

Flowers & Fruits: October – December
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1809***, dated 17.05.2003; Tamsong TE, ***AP Das & Chandrâ 2279***, dated 05.09. 2003.
Status: Very common.
Local Distribution: In Terai and low altitude areas.
General Distribution: Tropical Asia.

AXONOPUS P. Beauvois

Axonopus compressus (Swartz) P. Beauvois, Ess. Agrost. 12: 154, 167. 1812; FB 3 (2): 717. 2000.

Milium compressum Swartz, Prodr. Veg. India Occ. 24. 1788.

Local Name: *Chaparey jhar* (Nep).

Mat-forming. Culms 2.5-6 cm.Leaf blade 4.5-11.2 X 0.7-1 cm; ligule 0.3 mm. Sheath of upper leaf 6-11.5 mm. Longest peduncled partial inflorescence with 3 racemes, the lowest slightly distant, 3.5-6 cm. Glume 2-2.5X 1 mm. Palea 1.5-1.6 X 0.8 mm, glabrous.

Flowers & Fruits: July to December.

Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0286***, dated 16.02. 2002; Hansqua TE, ***AP Das & Chandrâ 0161***, dated 03.02.2002; Kamalpur TE, ***AP Das & Chandrâ 0411***, dated 27.02.2002; Makaibari TE, **AP Das & Chandrâ 1929,** dated 10.06. 2003; Soom TE, ***AP Das & Chandrâ 2636***, dated 27.12. 2003; Tamsong TE, ***AP Das & Chandrâ 2926***, dated 10.04. 2004.
Status: Abundant.
Local Distribution: In all gardens.
General Distribution: India, Bangladesh, Mexico, Brazil, USA.

CALAMOGROSTIS Adanson

Calamagrostis emodensis Griseb in Goett. Nachr. 80.1868; FBI 7: 261. 1896; FEH 1: 354. 1966; TBRI 50(4): 107. 1987; Fl. Sik. 1: 283. 1996; FB 3 (2):610. 2000.

Stout grass upto 1.5 cm tall. Culms erect, developing from geniculate base; culm base covered with persistent old sheaths-remains. Leaves apex tapered into a sharp point, flat, glabrous, many-nerved. Sheaths loose and striate. Panicle upto 19 cm, effuse, glazy, branched into whorls, branchelets capillary. Spikelets condensed. Grain 0.1 cm long, spindle-shaped.

Flowers & Fruits: April – October.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2360***, dated 05.11.2003.
Status: Less Common.
Local Distribution: Found only in Tamsong garden.
General Distribution: Himalayas (Kashmir-Bhutan), W. China.

CAPILLIPEDIUM Stapf

Capillipedium assimile (Steudel) A. Camus: FEH 354. 1966; FB 3 (2): 794. 2000.

Local Name: *Murse karuki, Hati khurki* (Nep)

Scrambling; culms 1.5 m. Leaf blades 12-0.7 cm; ligule 0.7 mm. Inflorescence 3.5-11 cm, racemes 1-2 paired; spikelets sessile, 2.1-2.9 mm; glume 2-2.7 X 0.5-0.8 mm, sessile, 5-veined; lemma 1.6-3.2 mm.

Flowers & Fruits: June to December.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1795***, dated 17.05.2003; Tamsong TE, ***AP Das & Chandrâ 2202***, dated 30.06. 2003; Soom TE, ***AP Das & Chandrâ 3376***, dated 12.10.2004.
Status: Abundant.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: India, Nepal, Bhutan, China, Indo –Cina, Tibet, Myanmar, Malaysia

Capillipedium parviflorum (Retz.) Trin., Fund. Agrost. 188. 1822; FB 3(2): 796. 2000.

Plant tufted, erect, culms not branched. Leaf blades truncate at base. Racemes reduced to a single triad. Spikelets often dark purplish, pedicelled spikelets shorter than sessile.

Flowers & Fruits: August – October
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3434***, dated 12. 10. 2004.
Status: Rare
Local Distribution: Found only in Soom garden.
General Distribution: India, Nepal, Bhutan, China, Japan, Australia, Tropics of the World

CHLORIS Swartz

Chloris dolichostachya Lag., Gen. et Sp. Nov. 5. 1816; FB 3(2): 675. 2000.

Perennial with culms to 100cm, base sometimes decumbent, rooting from nodes. Leaves inserted along culm, upper surface of blades with scattered, long, spreading hairs , shortly appressed hairy beneath. Sheaths sparsely hairy. Racemes hispid with linear, not gaping spikelets.

Flowers & Fruits: October – December.
Specimen Cited: Matigara TE, ***AP Das & Chandrâ 3607***, dated 20. 10. 2004; Makaibari TE, ***AP Das & Chandrâ 2527***, dated 11.11. 2003.
Status: Rare
Local Distribution: In Terai and low altitude areas.
General Distribution: India, Nepal, Bhutan, Afghanistan, China, Sri Lanka, Myanmar, South East Asia

Chloris virgata Swartz, Fl. Ind. Occid. 1: 203. 1797; FB 3(2): 674. 2000.

Tufted perennial with erect culms. Leaves mainly basal with several evenly inserted along culms, blades very acute, upper surface minutely hispid, glabrous beneath, margins minutely serrate, sheaths glabrous. Racemes hispid with gaping spikelets.

Flowers & Fruits: June – October
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2565***, dated 11.11. 2003; Tamsong TE, ***AP Das & Chandrâ 2457***, dated 05.11. 2003.


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Status: Common
Local Distribution: In hill gardens.
General Distribution: Tropics of both hemispheres

CHRYSOPOGON Trinius

Chrysopogon aciculatus (Retzius) Trinius, Fund. Agrost. 188. 1820; FEH 1: 355. 1966; Fl. Sik. 1:247. 1996; FB 3 (2):791. 2000.
Andropogon aciculatus Retzius, Obs. Bot. 5: 22. 1789; FBI 7: 188. 1896.

Local Name: *Chor-knata* (Beng).

Perennial with creeping rhizome; upto 55 cm tall. Leaf sheaths rounded, throat usually glabrous or slightly hairy; ligules membranous. Panicle 3-9 cm long, erect, spreading. Spikelets both sessile and pedicelled with spinous awn. Caryopsis linear.

Flowers & Fruits: March - September
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0806***, dated 04.05. 2002; Hansqua TE, ***AP Das & Chandrâ 0101***, dated 03.02.2002; Kamalpur TE, ***AP Das & Chandrâ 0462***, dated 17.04.2002; Makaibari TE, ***AP Das & Chandrâ 1825***, dated 10.06. 2003.
Status: Abundant
Local Distribution: In Terai and low altitude areas.
General Distribution: E. Himalaya (Nepal-Darjeeling), India, Myanmar, Indo-China, Malaysia, China, Formosa, N. Australia.

COIX L.

Coix lachryma-jobi L., Sp. Pl. 972. 1753; FBI 7: 100. 1896; FB 3 (2): 839. 2000.

Local Name: *Garday mala, ghanrey mala* (Nep).

Culms 70-210 cm. Leaf blades 1.5-4 cm wide; ligule 0.6-1.2 mm. Urticles 7-14.7 X 4.3-8 mm; In female inflorescence, sterile florets 5.6-15.7 mm, fertile florets 7.5-143.2 mm. Male raceme 16-33 mm, 3-6 nodes. Glume 6.7-9.1 x 2.3-4 mm; palea 5.9-8.2 x 1.5-2.2.

Flowers & Fruits: March to December.

Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 0977***, dated 09.05.2002; Kamalpur TE, ***AP Das & Chandrâ 0459***, dated 17.05.2003; Soom TE, ***AP Das & Chandrâ 3374***, dated 12.10.2004.
Status: Less Common.
Local Distribution: In Terai and low altitude areas.
General Distribution: Tropical Asia

Note: Used for fodder. The utricles are made in to necklaces by children.

CYMBOPOGON Sprengel

Cymbopogon citratus Stapf, Kew Bull. 322. 1906.

Flowers & Fruits: November – February
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2195***, dated 30.06. 2003.
Status: Rare
Local Distribution: Found in Tamsong garden only.
General Distribution: Himalayas

Cymbopogon nardus (L.) Rendle, Cat. Welw. Afr. Pl. 2: 155. 1899; FB 3(2): 808. 2000.
Andropogon nardus L., Sp. Pl. 1046. 1753.

Culms to 80 cm. Leafblades glaucous, margins sharply serrate. Sheath apex appressed hairy at junction with underside of leaf blade. Racemes pale brown, extremely dense, 30 cm with 2 spikelet pairs and a traid.

Flowers & Fruits: September – December.
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 1938***, dated 30.06. 2003.
Status: Commonly cultivated.
Local Distribution: All three hill gardens.
General Distribution: India, Nepal, Bhutan

Cymbopogon pendulus (Nees ex Steud.) Wats. in Atkins., Gaz., N. W. Prov. Ind. 392. 1882; FB 3(2): 805. 2000.
Andropogon pendulus Nees ex Steud., Syn. Pl. Glum. 1: 388. 1854.

Local Name: *Gandari, Baid ghas* (Beng).

Lemon scented; culms grooved or flattened on one side in upper part upto 3m. Leaf blades glaucous, sheath apex glabrous. Racemes 31 –113cm, rather lax, spreading, never dark purplish with (3-) 4 -5 spikelet pairs and a traid.

Flowers & Fruits: August –January
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1089***, dated 09.05.2002.
Status: Very common.
Local Distribution: All Terai gardens.
General Distribution: India, Nepal, Bhutan

CYNODON Richard

Cynodon dactylon (L.) Persoon, Syn. Pl. 1: 85. 1805; FBI 7: 288. 1896; FB 3 (2): 678. 2000.
Panicum dactylon L., Sp. Pl. 58. 1753.

Local Name: *Dubba ghaas* (Beng); *Dubo* (Nep).

Perennial, creeping. Erect part of culms 10-19 cm. Leaf blades 1.7-4.5 X 0.1-0.2 mm; ligule 0.2 mm. Racemes 3-4; spikelets 1.9-2.7 mm. Lemma 1.7-2.5 mm, each half semilanceolate. Palea 1.5-2 X 0.3-0.5 mm.

Flowers & Fruits: March to September.

Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 0084***, dated 27.01.2002; Soom TE, ***AP Das & Chandrâ 3322***, dated 26.06. 2004; Tamsong TE, ***AP Das & Chandrâ 3064***, dated 10.04. 2004.
Status: Abundant.
Local Distribution: In all gardens.
General Distribution: Cosmopolitan.

DACTYLOCTENIUM Willdenow

Dactyloctenium aegyptium (L.) Willdenow, Enum. Pl. Horti. Berol 1029. 1809; FB 3 (2): 670. 2000.
Cynosurus aegyptius L., Sp. Pl. 72. 1753.
Eleusine aegyptiaca (L.) Desf., F At. 1: 85. 1798; FBI 7: 295. 1896.

Stolons creeping.Culms 20-40 cm. Leaf blades 5.5-18 X 0.3-0.5 cm; sheaths glabrous; ligule 0.3-1 mm. Racemes 3-6, 1.2-4.5 X 0.5-0.8 cm. Spikelets 3.5-4 mm, fertile florets 2-4. Palea 2.2-2.6 X 0.9-1.5 mm.

Flowers & Fruits: April – October.

Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0688***, dated 20.04.2002; Soom TE, ***AP Das & Chandrâ 3551***, dated 12. 10. 2004.
Status: Less Common.
Local Distribution: In Terai and low altitude areas.
General Distribution: Tropical World

DICANTHIUM Willemet

Dicanthium annulatum : FB 3(2): 793. 2000

Tufted perennial. Culms slender to 50 (-100) cm, simple or with several, simple, erect inflorescence bearing branches, nodes bearded. Leaves mainly basal with some evenly scattered along culm. Sheaths glabrous. Racemes 3 -5, 3 -4cm, with sessile spikelets.

Flowers & Fruits: March – May.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2498***, dated 11.11. 2003.
Status: Rare
Local Distribution: Found only in Makaibari garden.
General Distribution: India, Nepal, Bhutan, Myanmar, Tropical and Northern Africa

DIGITARIA Haller

Digitaria ciliaris (Retzius) Koeler, Descr. Gram. 27. 1802; TBRI 50(4): 112. 1987; Fl. Sik. 1:251. 1996; FB 3 (2):728. 2000.
Panicum ciliare Retzius, Obs. Bot. 4: 16. 1786.
Digitaria sanguinalis Scopoli, f. *ciliaris* (Retzius) Haines, Bot. Bihar and Orissa 5: 1008. 1922.

Local Name: *Chittrey banso* (Nep).

Annual tufted herbs, 30-60 cm tall; rarely branched from lower nodes, glabrous. Leaves 11 x 0.35-0.7 cm, linear-lanceolate, margins cartilaginous, narrowed into sharp tip, base slightly contracted; ligules membranous. Recemes 4-9, subdigitate, basally pubescent.

Flowers: June – December
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1852***, dated 10.06. 2003; Tamsong TE, ***AP Das & Chandrâ 2190***, dated 30.06. 2003.
Status: Abundant.
Local Distribution: In all gardens.
General Distribution: Pantropic.

Digitaria compacta (Roth *ex* Roemer & Schultes) Veldkhamp in Blumea 21:71. 1973; Fl. Sik. 1.251. 1996; FB 3 (2):731. 2000.
Paspalum compactum Roemer *et* Schultes, Syst. Veg. 2: 316. 1817.
P. sanguinale var. *commutatum* sensu Hk. f., FBI 7: 15. 1897 p.p.

An annual grass, 15-25 cm tall. Culms ascending from a decumbent base, branches and sometimes roots arise from lower nodes, densely hairy at nodal regions, often leafy to top. Leaves lanceolate, margins ciliate, acuminate, base rounded, hairy both surfaces. Leaf sheaths loose, striate with white and shiny hairs. Raceme of false shorter spikes with spikelets arranged in 2 rows, ovate-lanceolate, seated upon short pedicels

Flowers: ***May - August***
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1713***, dated 17.05.2003.
Status: Rare
Local Distribution: Found only in Makaibari garden.
General Distribution: E. Himalaya (Nepal-Darjeeling), Assam, W. China.

Digitaria cruciata (Nees ex Steud.) A. Camus in Lecomte, Fl. Gen. de. 1' Indo –Chine 7: 399. 1922.
Panicum cruciatum Nees ex Steud., Syn. Pl. Glum. 1: 30. 1854.
Like *D. ciliaris* but a much robust plant; leaves longer to 14 cm; spikelets shorter and wider.
Flowers & Fruits: September – Novemver.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2558***, dated 11.11. 2003.
Status: Rare
Local Distribution: Found only in Makaibari garden.
General Distribution: India, Nepal, Bhutan, China. Indo –China, Myanmar

Digitaria griffithii (Hooker f.) Hem. in Blumea 1: 100. 1934.
Paspalum sanguinale (L.) Lamk. Var. *griffithii* Hooker f., FBI 7: 15. 1896.
Annual, upto 90 cm tall; lower leaves linear, glabrous; ligule membranous; spikelets lanceolate, ciliate.

Flowers & Fruits: September – December.

Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2349***, dated 05.11. 2003.
Status: Rare
Local Distribution: Found only in Tamsong garden.
General Distribution: Tropical Asia

Digitaria sanguinalis (L.) Scopoli, Fl. Carn. ed. 2, 1: 52. 1772; FB 3 (2):728. 2000.
Paspalum sanguinale L., Sp. Pl. 1: 57. 1753.

Annual. Culms decumbent, branched; nodes slightly swollen. Ligules truncate, membranous. Sheaths loose, often hirsute; lamina 3-13 x 0.45-0.6 cm, linear-lanceolate, margin white, acute. Panicles many spiked, erect; rachis very short, flexuous. Spikelets 0.3 cm long linear-lanceolate.

Flowers: August – November
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3297***, dated 26.06. 2004.
Status: Abundant.
Local Distribution: In all gardens.
General Distribution: E. Himalaya, Meghalaya, Assam, China.

Digitaria ternata (A. Rich.) Stapf ex Dyer, Fl. Cap. 7: 376. 1898; FB 3(2): 736. 2000.
Cynodon ternatus A. Rich., Tent. Fl. Abyss. 2: 405. 1851.

Annual. Culms erect, 10 -88cm, hairy above. Leaf blades oblong, acute, base truncate with few long hairs scattered above and tufted of long hairs at extreme base above, margins smooth. Sheaths glabrous. Raemes (2-) 3 -5, silvery, erect, digitate, sometimes slightly distant with spikelets in groups.

Flowers & Fruits: July – October

Specimen Cited: Soom TE, ***AP Das & Chandrâ*** 3526, dated 12.10.2004.
Status: Less Common.
Local Distribution: Found only in Soom garden.
General Distribution: India, Nepal, Bhutan, China, Myanmar, Tropical Eastern and South Africa

ELEUSINE Gaertner

Eleusine indica (L.) Gaertner, Fruct. 1: 8. 1788; FBI 7: 293. 1896; FB 3 (2): 667. 2000.

Cynosurus indicus L., Sp. Pl. 72. 1753.

Local Name: Shade jhar, Kodho jhar.

Culms 13-45 cm. Leaf blades 7-24 X 0.2-0.6 cm; ligule 0.5-1 mm. Inflorescence digitate. Racemes 3-5, 3.5-9 X 0.3-0.5 cm. Spikelets 4.4-5.4 mm, florets 4-5. Palea 2.4-3 X 0.6-0.9 mm; keels very narrowly winged.

Flowers & Fruits: May to December.

Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 1599***, dated 22.10. 2002; Hansqua TE, ***AP Das & Chandrâ 1133***, dated 09.05.2002; Kamalpur TE, ***AP Das & Chandrâ 0403***, dated 27.02.2002; Makaibari TE, ***AP Das & Chandrâ 1747***, dated 17.05.2003; Soom TE, ***AP Das & Chandrâ 2663***, dated 27.12. 2003; Tamsong TE, ***AP Das & Chandrâ 2390***, dated 05.11. 2003.
Status: Abundant.
Local Distribution: In all gardens.

General Distribution: Tropical and sub-tropical region of the World.

ERAGROSTIS N.M. Wolf

Eragrostis gangetica (Roxburgh) Steud., Syn. Pl. Glum. 1: 266. 1854; FB 3(2): 665. 2000.
Poa gangetica Roxburgh, Fl. Ind. 1: 321. 1820.

Slender, tufted, annual or short lived perennial. Culms simple or with few, erect branches, base slightly decumbent, upper part leafless. Leaf blade inrolled, linear, very acute, with sparse, long spreading hairs above, densely hairy at base, glabrous beneath. Sheaths glabrous. Inflorescence broadly cylindric, moderately lax, glabrous in axils with greylsh–green spikelets.

Flowers & Fruits: January – March
Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 0180***, dated 0322; Kamalpur TE, ***AP Das & Chandrâ 0372***, dated 27.02.2002.
Status: Common
Local Distribution: All Terai gardens.
General Distribution: India, Nepal, Bhutan, Myanmar

Eragrostis nigra Nees *ex* Steudel, Nom. ed. 2. (1): 563. 1840; FBI 7: 324. 1896; FEH 1: 362. 1966; TBRI 50(4): 113. 1987; Fl. Sik. 1:290. 1996; FB 3 (2): 662. 2000.

Variable, 20-90 cm tall. suberect, simple. Leaves basal, lanceolate, elongate, margins smooth or few hairs at base, acute, glabrous. Sheath margins smooth/ ciliate, obscurely compressed. Ligule ciliate. Panicle 35 cm, spreading. Pedicels longer than linear-oblong, olive grey spikelets.

Flowers & Fruits: June – October
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0548***, dated 17.04.2002; Makaibari TE, ***AP Das & Chandrâ 2469***, dated 11.11. 2003; Tamsong TE, ***AP Das & Chandrâ 2311***, dated 05.09. 2003; Soom TE, ***AP Das & Chandrâ 3218***, dated 26.06. 2004.
Status: Fairly Common.
Local Distribution: In all gardens.
General Distribution: India, Sri Lanka, Nepal, Bhutan, Myanmar, Indochina, Malaysia, China.

Eragrostis pilosa (L.) P.Beauvois, Ess. Agrost. 71. 162. 175. 1812; FBI 7: 323. 1896; FB 3 (2): 665. 2000.
Poa pilosa L., Sp. Pl. 68. 1753.

Annual. Culms 12-55 cm. Leaf blades 8-13 X 0.2-0.3 cm. Inflorescence 9-24 X 2-5 cm. Spikelets 2.6-4.9 X 0.6-0.7 mm, florets 5-11, glumes, lemmas, paleas deciduous. Palea 1.1 X 0.4 mm, keels hispid.

Flowers & Fruits: June to August.

Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2822***, dated 25.03. 2004; Soom TE, ***AP Das & Chandrâ 3497***, dated 12. 10. 2004.
Status: Less Common.

Local Distribution: All three hill gardens.
General Distribution: Tropical and warm regions of Old World

Note: Fooder, native medicinal plant.

Eragrostis tenella (L.) P.Beauvois ex Roemer & Schultes, Syst. Veg. 2: 576. 1817; FB 3 (2): 657. 2000.
Poa tenella L., Sp. Pl. 69. 1753.

Annual. Culms 5-31 cm, simple. Leaf blades 1.7-6 X 0.2-0.5 cm; ligule a line of cilia0.2-0.4 mm. Inflorescence 2.5-11 X 1-3.5 cm, cylindric. Spikelets 1.3-2.1 X 0.9-1.6 mm, florets 3-7. Palea 0.8-1 X 0.2-0.4 mm, oblanceolate.

*Flowers & Fruits:*April-October.

Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1152***, dated 14.06. 2002; Kamalpur TE, ***AP Das & Chandrâ 1252***, dated 18.10.2002; Matigara TE, ***AP Das & Chandrâ 3137***, dated 10.05. 2004; Soom TE, ***AP Das & Chandrâ 3486***, dated 12. 10. 2004.
Status: Very common.
Local Distribution: All Terai gardens and in lower areas of hill gardens.
General Distribution: Pantropic weed.

Eragrostis unioloides (Retzius) Nees ex Steudel, Syn. Pl. Glum. 1: 264. 1854; FB 3 (2): 663. 2000.
Poa unioloides Retzius, Obs. Bot. 5: 19. 1789.

Annual. Culms 4.5-41 cm, rooting from nodes. Leaf blades 3.7-14X 0.2-0.5 cm. Inflorescence 3.5-20 X 1-6 cm; florets 19-69. Glumes lanceolate to ovate, acuminate. Palea 1.4-1.8 X 0.6-0.9 mm, narrow elliptic, keels hispid.

*Flowers & Fruits:*February to December.

Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 1148***, dated 14.06. 2002; Matigara TE, ***AP Das & Chandrâ 3161***, dated 10.04. 2004; Makaibari TE, ***AP Das & Chandrâ 2526***, dated 11.11. 2003; Soom TE, ***AP Das & Chandrâ*** 3386, dated 12. 10. 2004.
Status: Abundant.
Local Distribution: All Terai gardens and in lower areas of hill gardens.
General Distribution: Tropical Asia and Africa.

ERIANTHUS Michx.

Erianthus rufipilus (Steudel) Griseb in Nachr. Ges. Wiss. Gottingen 93. 1868; FB 3 (2):765. 2000.
Saccharum rufipilum Steud., Syn. Pl. Glum. 1: 409. 1855.
Erianthus fulvus Nees *ex* Steud., Syn Pl. Glum. 1: 409. 1855. FBI 7: 123. 1896.

Perennial shrubs upto 2.5m. Culms erect, robust. Stem stout, nodes pubescent. Leaves upto 90cm, linear, flat or convolute, margins scaberulous, glaucous, scabrid beneath. Leaf-sheaths margins hairy; ligule ciliate, rounded. Panicle upto 40 cm long, silky villous, erect with villous rachis. Spikes condensed with brownish paired spikelets.

Flowers & Fruits: *October - December*
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2222***, dated 05.09. 2003.
Status: Less Common.
Local Distribution: Found only in Tamsong garden.
General Distribution: India, Nepal, Bhutan, Myanmar, Malaysia, China.

IMPERATA Cirillo

Imperata cylindrica (L.) Rauschel, Nom. Bot. ed. 3: 10. 1797; Fl. Sik. 1:257. 1996; FB 3 (2):770. 2000.
Lagurus cylindricus L., Syst. Nat. ed. 10, 2: 878. 1759.

Local Name: *Siru, Khar* (Nep); *Kush* (Beng)

Perennial, much variable. Culms solid, basally fistular, glabrous. Ligules ciliate, membranous. Sheaths loose, exceeding internodes, glabrous. Leaves >1.5 m, margins scabrid, white hairy, acuminate. Panicles cylindric, finely whitehairy. Spikelets lanceolate, hairy.

Flowers: April – November
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0307***, dated 16.02. 2002; Tamsong TE, ***AP Das & Chandrâ 2920***, dated 10.04. 2004.
Status: **Very common.**
Local Distribution: **In all gardens.**
General Distribution: Tropical and temperate regions of Asia, Australia, Africa, etc.
Note: Used for thatching, young shoot eaten in some areas.

ISACHNE R. Brown

Isachne albens Trinius, Sp. Gram. Ic. t. 25. 1828; FBI 7: 22. 1896; FEH 1: 366. 1966; TBRI 50(4): 117. 1987; Fl. Sik. 1:296. 1996; FB 3 (2):743. 2000.

Perennial, 25-45 cm tall; erect or spreading,. Leaves 3-10 x 0.35-0.7 cm, linear to linear-lanceolate, margins ciliate, scabrid. Sheaths smooth, striate. Ligule of stiff hairs. Panicles decompound, 6.5-28 cm long, branches capillary. Spikelets ±globose.

Flowers: August – November; *Fruits:* October – December
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2573***, dated 11.11. 2003; Soom TE, ***AP Das & Chandrâ 3308***, dated 26.06. 2004.
Status: Common
Local Distribution: All hill gardens.
General Distribution: Temperate regions of south-east Asia.

Isachne gracilis C. E. Hubb. in Kew Bull. 1927: 77. 1927.
Like *I. albens*, but a very slener plant; sheath margin ciliate; spikelets smaller.
Flowers & Fruits: August – November.
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3480***, dated 12. 10. 2004.
Status: Rare

Local Distribution: Found only in Soom garden.
General Distribution: India, Nepal, Bhutan

Isachne miliacea Roth ex R. & S., Syst. Veg. 2: 476. 1817; FBI 7: 25. 1896; FB 3(2): 746. 2000.

Slender perennial. Culms 10 -25cm, base decumbent, rooting from nodes. Leafblades lanceolate, subacute, hispid on both surfaces and margins. Sheaths glabrous. Inflorescence 2 -6cm, branched to 2 orders, branches with glandular bands.

Flowers & Fruits: May – October

Specimen Cited: Soom TE, ***AP Das & Chandrâ 3555***, dated 12.10.2004.
Status: Rare.
Local Distribution: Found only in Soom garden.
General Distribution: India, Nepal, Bhutan, China, Malaysia, South East Asia

NEYRAUDIA Hook.f.

Neyraudia arundinacea (L.) Henrard, in Med. Herb. Leid. No. 58, 8. 1929; FB 3 (2): 650. 2000.
Aristida arundinacea L., Mant. 146. 1771.

Local Name: *Situ, Siku, Ghungring* (Nep)

Culms 1-3 m, 2-10 mm in diameter. Leaf blades 70 cm, 0.3-2.2 cm wide. Inflorescence 8-70 X 2-16 cm. Spikelets 6.1-9.3 mm, fertile florets 4-6; glumes 1.7-2.7 X 0.4-0.8 mm; palea 2.2-3.1 X 0.3-0.5 mm.

Flowers & Fruits: October-April.

Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1741***, dated 17.05.2003.
Status: Less Common.
Local Distribution: Found only in Makaibari garden.
General Distribution: India, Nepal, Bhutan, Tropical Africa

Note: Poisonous to buffalo.

OPLISMENUS P. Beauvois

Oplismenus burmannii (Retzius) P. Beauvois, Ess. Agrost. 54: 168-169. 1812; FBI 7: 68. 1896; FB 3 (2): 686. 2000.

Panicum burmannii Retz., Obs. Bot. 3: 10. 1783.

Culms 22-56 cm. Leaf blades 2.5-5.7 X 0.7-1.4 cm, ovate, acuminate; ligule 0.6-1 mm. Inflorescence 3-9 cm, racemes 5-9, dense. Spikelets 2.4-3 mm. Palea usually absent or linear-oblanceolate, 2.2 X 0.6 mm.

Flowers & Fruits: January to October.

Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0290***, dated 16.02. 2002; Hansqua TE, ***AP Das & Chandrâ 0129***, dated 03.02.2002; Kamalpur TE, ***AP Das & Chandrâ 0598***, dated 20.04.2002; Tamsong TE, ***AP Das & Chandrâ***, dated 07.11.2003; Makaibari TE, **AP Das & Chandrâ 1709**, dated 17.05.2003; Soom TE, ***AP Das & Chandrâ 2635***, dated 27.12. 2003.

Status: Abundant.

Local Distribution: In all gardens.

General Distribution: Tropical World.

Oplismenus compositus (L.) P. Beauvois, Ess. Agrost. 54: 168. 1812; FB 3 (2): 684. 2000.
Panicum compositum L., Sp. Pl. 57. 1753.

Culms 25-63 cm. Leaf blades 6.5-16 X 1.3-2 cm, lanceolate, acuminate. Inflorescence 12-23 cm; racemes 5-10; spikelets 3.7-4 mm. Palea 2.5-2.9 x 0.9-1.3 mm.

Flowers & Fruits: August to December.

Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0055***, dated 27.01.2002; Hansqua TE, ***AP Das & Chandrâ 0139***, dated 03.02.2002; Kamalpur TE, ***AP Das & Chandrâ 0696***, dated 20.04.2002; Makaibari TE, ***AP Das & Chandrâ*** 1701, dated 17.05.2003; Soom TE, ***AP Das & Chandrâ 2629***, dated 27.12. 2003; Tamsong TE, AP Das & Chandrâ 2193, dated 30.06. 2003.

Status: Abundant.

Local Distribution: In all gardens.

General Distribution: Tropical World.

PANICUM L.

Panicum crus-galli L., Sp. Pl. 1: 56. 1753; FBI 7: 30. 1896; FB 3(2): 704. 2000.

Perennial. Culms 30-70cm, decumbent at base. Leaf blades linear-lanceolate, very acute, glabrous or shortly appressed – hispid above and with long and short, spreading hairs beneath. Racemes suberect, upper crowded, lower distant with spikelets 4.8-6mm.

Flowers & Fruits: November – December

Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 1589***, dated 22.10. 2002; Kamalpur TE, ***AP Das & Chandrâ 0555***, dated 17.04.2002.

Status: Abundant.

Local Distribution: All Terai gardens.

General Distribution: **A pantropic weed.**

Panicum glaucum L., Sp. Pl. 1: 56. 1753.

Flowers & Fruits: September – June

Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0523***, dated 17.04.2002.

Status: Common
Local Distribution: All Terai gardens.
General Distribution: Tropical and Subtropical Asia and Africa

PASPALUM L.

Paspalum conjugatum Bergius in Act. Helv. Phys. Math. 7: 129, t. 8. 1772; FBI 7: 11. 1896; FB 3 (2): 716. 2000.

Local Name: *Bonso jhar, Hathi doubo* (Nep).

Stolons spreading. Culms 11-46 cm. Leaf blades 3.5-8 X 0.4-0.9 cm, oblong-lanceolate; ligule 0.2-0.7 mm. Racemes 4-10.2 cm; spikelets 1.5-1.8 mm; pedicels hooked. Glume 1.5-1.8 X 1-1.4 mm. Palea 1.4-1.8 X 0.9- 1.1 mm, margins thickened, inrolled.
Flowers & Fruits: August to December.

Specimen Cited: Hansqua TE, ***AP Das & Chandrâ 0253***, dated 09.02.2002; Kamalpur TE, ***AP Das & Chandrâ 0370***, dated 27.02.2002; Makaibari TE, ***AP Das & Chandrâ 2493***, dated 11.11. 2003; Soom TE, ***AP Das & Chandrâ 3428,*** dated 12.10.2004; Tamsong TE, ***AP Das & Chandrâ 2133***, dated 30.06. 2003.
Status: Very common.
Local Distribution: In all gardens.
General Distribution: India, Nepal, Bhutan, America, Africa, Tropics of the World

Paspalum distichum L., Syst. Nat. ed. 10, 2: 855. 1759; FB 3(2): 715. 2000.

Local Name: *Chittrey* (Nep).

Rhizomatous. Culms 9-82 cm. Leaf blades 5-14.5 X 0.2-0.6 cm, linear; ligule 0.8-1 mm. Racemes paired, 3-7 cm. Spikelets 3-3.4 mm. Palea 2.1- 2.5 X 1.1-1.2 mm, crustaceous, back flat, margins inflexed.

Flowers & Fruits: July to October.

Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2508***, dated 11.11. 2003.
Status: Less Common.
Local Distribution: Found only in Makaibari garden.
General Distribution: Tropics and Subtropics of Old World

Paspalum scrobiculatum L., Mant. 1: 29. 1767; FBI 7: 10. 1896; FEH 1: 372. 1966; EFPN 1: 139. 1978; TBRI 50(4): 121. 1987; Fl. Sik. 1: 265. 1996; FB 3 (2):712. 2000.
Paspalum orbiculare G. Forster, Fl. Insul. Austree Prodr. 7. 1786.

Tufted, upto 58 cm tall, spongy at base, hairy on collar at leaf juncture. Leaves >28 x 0.5- 0.9 cm, sublanceolate-linear, tapered into a fine point, base obscurely contracted, glabrous. Sheaths loose, scarious. Inflorescence of false spikes, erect, often drooping. Spikelets in 2 rows, overlapping.

Flowers & Fruits: *April – October*
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0035***, dated 27.01.2002; Soom TE, ***AP Das & Chandrâ 2703***, dated 09.01. 2004; Tamsong TE, ***AP Das & Chandrâ 2024***, dated 30.06. 2003.
Status: Very common.
Local Distribution: In all gardens.
General Distribution: Tropics of the Old World.

PENNISETUM Rich. ex Persoon

Pennisetum clandestinum Hochst.ex Chiov., in Ann. Ist. Bot. Roma, 8: 41. 1903; FB 3(2): 741. 2000.

Local Name: Hatie dubo (Nep).

Rhizomatous perennial. Culms much branched, decumbent and rooting at nodes so mat forming. Leaf blades apex subacute, glabrous, or with few, short, tubercle based hairs above and beneath. Sheaths with sparse or dense, spreading, tubercle based hairs, margins usually glabrous. Inflorescence concealed in upper leaf sheaths with 2-3 spikelets on short axis.

Flowers & Fruits: July – December
Specimen Cited: Soom TE, ***AP Das & Chandrâ 2685***, dated 09.01. 2004
Status: Less Common.
Local Distribution: Found only in Soom garden.
General Distribution: African grass; naturalized in temperate regions.

Pennisetum pedicellatum Trin. in Mem. Acad. Sci. Petersb. Ser. 6, 3: 184. 1834; FBI 7: 86. 1896; FB 3(2): 740. 2000.

Stout, tufted annual. Culms 20-150cm, erect, much branced. Leaf blades with dense, spreading, tubercle-based hairs above and beneath, margins with long cilia at base. Margins of sheaths densely short-ciliate. Inflorescence purplish, cylindric, axis glabrous. Spikelets borne in groups of (1-)3, unequally pedicelled.

Flowers & Fruits: December – April
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2435***, dated 05.11. 2003.
Status: Rare
Local Distribution: In Terai and low altitude areas.
General Distribution: Native of Africa; nicely naturalized in India.

POA L.

Poa annua L., Sp.Pl. ed. 1, 68. 1753; FBI 7: 345. 1896; FEH 1: 372. 1966; Fl. Sik. 1:300. 1996; FB 3 (2):556. 2000.

Annual, tufted, >30 cm high. Ligules oblong to ovate. Sheaths loose, slightly compressed. Lamina 2.2-3.5 x 0.27-0.35 cm, linear, margin scaberulous, acute, flaccid. Panicles >8.2 cm long, branched, stiff, often sub-secund. Spikelets 3-8 flowered, ovate or lanceolate, green or purple.

Flowers & Fruits: March – November
Specimen Cited: Soom TE, ***AP Das & Chandrâ 3466***, dated 12. 10. 2004; Tamsong TE, ***AP Das & Chandrâ 2269***, dated 05.09. 2003.
Status: Very common.
Local Distribution: All three hill gardens.
General Distribution: Cosmopolitan in the subtropical and temperate regions of the world.

POGONATHERUM P. Beauvois

Pogonatherum crinitum (Thunberg) Kunth, Enum. Pl. 1: 478. 1833; FBI 7: 141. 1896; Fl. Sik. 1:287. 1996; FB 3 (2):778. 2000.
Andropogon crinitus Thunberg, Fl. Jap. 40, t. 7. 1784.

Tufted caespitose perennial; >50 cm tall. Branches filiform, glabrous. Ligules reduced. Sheaths slightly compressed, throat fimbriate. Upper lamina shorter, 2.5-6.8 x 0.15-0.39 cm, linear to linear-lanceolate, acuminate, base rounded. Racemes solitary. Spikelets truncate; callus hairy.

Flowers: May – August
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2251***, dated 05.09. 2003.
Status: Less Common.
Local Distribution: Found only in Soom & Tamsong gardens.
General Distribution: E. Himalaya (Nepal – Sikkim), India, Thailand, Indo-China, China, Japan and Malaysia.

SACCHARUM L.

Saccharum spontaneum L., Mant. Pl. 2: 183. 1771; FBI 7: 118. 1896; FB 3(2): 764. 2000.

Local Name: *Sanu Kans, Kash* (Nep).

Rhizomatous, extensively spreading, forming clumps. Culms sometimes branched below with appressed, silky hairs below inflorescence. Leaf blades linear, tapered to very acute apex, lamina of culm leaves sometimes scarcely developed. Sheaths glabrous, lower sometimes hairy. Panicle white, broadly cylindric in life, narrow when dry.

Flowers & Fruits: December – January.

Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0366***, dated 16.02. 2002; Hansqua TE, ***AP Das & Chandrâ 0134***, dated 03.02.2002; Kamalpur TE, ***AP Das & Chandrâ 0577***, dated 20.04.2002; Soom TE, ***AP Das & Chandrâ 3562***, dated 12.10.2004.
Status: Abundant.

Local Distribution: In Terai and low altitude areas.
General Distribution: Warm regions of Old World

SACCIOLEPIS Nash

Sacciolepis indica (L.) A. Chase in Proc. Biol. Soc. Wash. 21: 8. 1908; FB 3 (2): 697. 2000.

Panicum indicum L.,Mant. Pl. 2: 184. 1771 non *Panicum indicum* Mill 1768: FBI 7: 41. 1896.

Annual. Culms 15-70 cm. Leaf blades 4-16 X 0.1-0.8 cm; ligule 0.7 mm. Inflorescence 2.5-12 X 0.5-0.7 cm; spikelets 2.1-2.5 X 0.9-1.2 mm. Palea 1.1-1.5 X 0.5 mm, narrowly elliptic.

*Flowers & Fruits:*July to October.

Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0481***, dated 17.04.2002.
Status: Very common.
Local Distribution: All Terai gardens.
General Distribution: Himalayas, Tropical Asia, Polynesia, Australia. Introduced to Africa and America

SETARIA P.Beauvois

Setaria forbesiana (Nees ex Steud.) Hooker f., FBI 7: 81. 1896; FB 3(2): 724. 2000.
Panicum forbesianum Nees ex Steud., Syn. Pl. Glum. 1: 98. 1854.

Perennial. Rhizome woody, knotted. Culms to 1m, ascending. Leaf blades ± oblong, glabrous. Margins of sheaths long ciliate. Panicle narrowly crlindric, axis hispid, branches rather distant, very short, bearing 3-6(-14) spikelets, each spikelet subtended by a stiff, antrorsely scabrid bristle.

Flowers & Fruits: August – October
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2576***, dated 11.11. 2003
Status: Rare
Local Distribution: Found only in Makaibari garden.
General Distribution: Himalayas, India.

Setaria geniculata P. Beauv. Ess. Agrostogr. 51, 178. 1812.

Like *S. forbesiana* but a larger plant

Flowers & Fruits: October – April.
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 2583***, dated 11.11. 2003
Status: Very common.
Local Distribution: All three hill gardens.
General Distribution: India, Nepal, Bhutan, Tropical and Subtropical America.

Setaria glauca (L.) P. Beauvois, Ess. Agrost. 51: 178. 1812; FBI 7: 78. 1896.

Panicum glaucum L., Sp. Pl. 56. 1753.

Annual. Lamina linear lanceolate; ligule ciliate. Inflorescence panicle; bristles 6-14, spikelets 2-flowered; stamens 3; upper bisexual. Caryopsis rounded elliptic.

Flowers & Fruits: August to February.

Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0907***, dated 04.05. 2002; Kamalpur TE, ***AP Das & Chandrâ 0500***, dated 17.04.2002; Tamsong TE, ***AP Das & Chandrâ 2294***, dated 05.09.2002; Makaibari TE, ***AP Das & Chandrâ 2476***, dated 11.11. 2003.

Status: Very common.

Local Distribution: In all gardens.

General Distribution: India, America and Australia.

Setaria palmifolia (J. Konig) Stapf in J. Lin. Soc. Bot. 42: 186. 1914; FEH 1: 376. 1966; Fl. Sik. 1: 273. 1996; FB 3 (2):723. 2000.

Panicum palmaefolium J. Koenig in Naturf. 22: 208. 1788.

Local Name: *Dhoti Sara* (Nep); *Bans pata* (Beng)

Perennial, 1-2 m high, root-stock stout woody; nodes strigillose. Lamina 15-45 x 1.3-5.2 cm, linear-lanceolate, acuminate, glabrous or sparsely hairy, plicate folded, sheath margin ciliate, smooth or hispid. Panicles 30-60 cm, spreading, loose. Spikelets solitary, ± sessile, bristle single.

Flowers: May – February

Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0929***, dated 04.05. 2002; Kamalpur TE, ***AP Das & Chandrâ 1224***, dated 18.10.2002; Makaibari TE, ***AP Das & Chandrâ 1724***, dated 17.05.2003; Soom TE, ***AP Das & Chandrâ 2612***, dated 27.12. 2003; Tamsong TE, ***AP Das & Chandrâ 2026***, dated 30.06. 2003.

Status: Very common.

Local Distribution: In all gardens.

General Distribution: Tropics of the Old World.

Note: Excellent fodder for cattle.

Setaria plicata (Lamarck) T. Cooke, Fl. Bombay 2: 919. 1908.

Panicum plicatum Lamarck, Encycl. Meth. Bot. 4: 736. 1797.

Perennial. Culms 1 m. Lamina narrowly lanceolate, plicate; ligule hairy. Spikelets ovate-oblong, loose panicle; glume 5-7 nerved. Upper floret fertile; lemma ovate, acute; stamens 3. Caryopsis globose.

Flowers & Fruits: August to January.

Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0754***, dated 04.05. 2002; Hansqua TE, ***AP Das & Chandrâ 0132***, dated 03.02.2002; Kamalpur TE, ***AP Das &***

Chandrâ ***1255***, dated 18.10.2002; Tamsong TE, ***AP Das & Chandrâ 2374***, dated 05.11.2003; Soom TE, ***AP Das & Chandrâ 3559***, dated 12.10.2004.
Status: Less Common.
Local Distribution: In all gardens.
General Distribution: Indo-Malaysia, China, Nepal, Sri Lanka.

Setaria pumila (Poiret) Roemer & Schultes, Syst. Veg. 2: 191. 1817; FB 3 (2): 720. 2000.

Panicum pumilum Poiret in Lamarck, Ency. Meth. Bot. Suppl. 4: 273. 1816.

Setaria pallide-fusca (Schum.) Stapf & Hubbard in Kew Bull. 1930: 259. 1930.

Local Name: *Bala bansu*, , *Gogey banso* (Nep).

Annual or perennial. Culms 10-75 cm. Leaf blades 3.5-17 cm; ligule a fringe of hairs. Panicle 1.2-11 cm, cylindric, spikelets 2.5-3.1 mm. Glumes 1-1.9 mm, 3-veined; lemma 2.3-2.9 mm; palea crustaceous, back flat, inrolled.

Flowers & Fruits: March to December.

Specimen Cited: Soom TE, ***AP Das & Chandrâ 3378***, dated 12. 10. 2004.
Status: Less Common.
Local Distribution: Found only in Soom garden.
General Distribution: Tropical World.

SPOROBOLUS R. Brown

Sporobolus fertilis (Steud.) W. D. Clayton in Kew Bull. 19: 294. 1965; FB 3(2): 671. 2000.
Agrostis fertilis Steud., Syn. Pl. Glum. 1: 170. 1854.

Stout, tufted perennial. Culms 22-56cm. Leaf blades flat or inrolled, linear to oblong, very acute, glabrous. Sheaths glabrous, margins sometimes minutely ciliate above. Inflorescence narrowly cylindric, spike like branches appressed, overlapping bearing silvery-grey spikelets to base, slightly distant. Grain oblong in outline, apex truncate.

Flowers & Fruits: March – December
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0515***, dated 17.04.2002; Makaibari TE, ***AP Das & Chandrâ*** *2857*, dated 25.03. 2004; Tamsong TE, ***AP Das & Chandrâ 2108***, dated 30.06. 2003.
Status: Abundant.
Local Distribution: In all gardens.
General Distribution: India, Nepal, Bhutan, China, Sri Lanka, Myanmar, Thailand, Japan, Malaysia

THYSANOLAENA Nees

Thysanolaena latifolia (Roxburgh *ex* Horneman) Honda, J. Fac. Sc. Tokyo Sect. Ill. Bot. 3:312. 1930; Fl. Sik. 1:305. 1996; FB 3 (2):648. 2000.
Thysanolaena maxima (Roxburgh) O. Kuntze, Rev. Gen. Pl. 794. 1891; FEH 1: 378. 1966.

Local Name: *Amliso, Kuccho* (Nep), *Phul Jharu* (Beng)

Perennial 1.5-3 m tall, solid, glabrous. Ligules truncate, cartilagenous. Sheaths tight. Leaves numerous, sub-amplexicul, 25-55 x 5-10 cm, broadly lanceolate, margin scabrid, acuminate. Panicle upto 60 cm, branches & branchlets filiform. Spikelets ovoid-lanceolate, acuminate.

Flowers: December – August
Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0671***, dated 20.04.2002; Soom TE, ***AP Das & Chandrâ 3594***, dated 12.10.2004; Tamsong TE, ***AP Das & Chandrâ 2940***, dated 10.04. 2004.
Status: Very common; often cultivated.
Local Distribution: In all gardens.
General Distribution: Subtropical and temperate regions of India, Nepal, Bhutan, Myanmar, Indochina, China, etc.
Note: Brooms made with inflorescence; roots medicinal.

TRIPSACUM L.

Tripsacum laxum Nash, N. Amer. Fl. 17: 81. 1909.

Local Name: *Guatemala grass* (Eng).
A large bushy shrub; leabes large much broad; flowers not seen.

Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 0519***, dated 17.04.2002; Makaibari TE, ***AP Das & Chandrâ 2575,*** dated 11.11. 2003
Status: Generally grown
Local Distribution: In all gardens.
General Distribution: South America.

UROCHLOA P. Beauvois

Urochloa ramosa (L.) T.Q.Nguyen, in Novit. Syst. Pl. Vasc., Acad. Sci. URSS: 13. 1966.
Panicum ramosum L., Mant. 1: 29. 1767.

Local Name: *Pashipang.*

Perennial. Culms 20-66 cm. Leaf blades 6-13.5 X 1.1-1.5 cm, lanceolate; ligule hairs 1-1.3 mm. Panicle 5-17 cm; racemes 12-20, oblique. Spikelets borne in pairs; 2.7-3 X 1.4-1.6 mm. Glume 1.5 X 1.4 mm,3-6 veined; lemma 2.6-3 mm, 5-veined; palea 1.9-2.1 mm, elliptic, blunt.

Flowers & Fruits: May to September.
Specimen Cited: Matigara TE, ***AP Das & Chandrâ 3603***, dated 20.10. 2004.
Status: Common
Local Distribution: Terai gardens
General Distribution: Asia and Africa.

PONTEDARIACEAE Kunth

EICHHORNIA Kunth

Eichhornia crassipes (Mart.) Solms in A. DC., Monogr. Phan. 4: 527. 1883.
Pontederia crassipes Mart., Nov. Gen. Sp. 9, t. 1823.

Common Name: *Kachuri Pana* (Beng); *Water hyacinth* (Eng).

Floating perennial. Roots feathery. Leaves in rosette, blades rhombic to suborbicular to widely, transversely elliptic, subacute to rounded, very shallowly cordate to cuneate, firm textured, shining. Petioles spongy. Scape usually exceeding leaves. Spike 6-20, pale mauve flowered, peduncle largely hidden by sheathing, membranous spathes.

Flowers: May – July.
Specimen Cited: Mohurgong & Gulma TE, ***AP Das & Chandrâ 0933***, dated 04.05. 2002; Soom TE, ***AP Das & Chandrâ 3524***, dated 12. 10. 2004.
Status: Less Common.
Local Distribution: Found only in Soom and Mohurgong & Gulma gardens.
General Distribution: Native to South America, but widely introduced and now a troublesome, pantropical weed.

SMILACACEAE Ventenat

SMILAX L.

Smilax ovalifolia Roxburgh, FI 3:794. 1832; FEH 1:417. 1966; FB 3(1):30. 1994; Fl. Sik. 1:165. 1996.
Smilax macrophylla Roxburgh, FI 3:793. 1832; FBI 6:310. 1892, *non* Willdenow 1805.
Smilax zeylanica L., Sp. Pl. 1029. 1753; FBI 6:309. 1892; FEH 3:135. 1975.

Local Name: *Kukurdaine* (Nep); *Rajdan-tini, Kumarika* (Beng).

Shrubby climbers; branchlets striated, glabrous, prickly. Tendrils simple, sinistrorse, glabrous. Lamina ovate-elliptic, entire, acute, cuneate. Umbels with many pedicellate flowers on branched peduncles. Berries reddish on ripening.

Flowers: March – August *Fruits:* September - December

Specimen Cited: Kamalpur TE, ***AP Das & Chandrâ 1375***, dated 18.10.2002.
Status: Less common

Local Distribution: In Terai garden.

General Distribution: Tropical Himalaya, India, Bangladesh, Myanmar, Central provinces and Concan.

Smilax roxburghii Kunth, Enum. Pl. 5: 852. 1850; FB 3(1): 28.1994.

Climber, stems usually prickly. Leaves lanceolate, cuspidate, base rounded to cuneate, occasionally shallowly cordate, coriaceous. Inflorescence of 1-2(-3) peduncled, bracteate umbels, axis sometimes developing vegetatively above, arising from brown, coriaceous, ovate, keeled, mucronata prophyll in axils of leaves of lateral branches.

Flowers & Fruits: March - August
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1716,*** dated 17.05.2003..
Status: Common
Local Distribution: Found only in Makaibari garden.
General Distribution: India, Nepal, Bhutan

ZINGIBERACEAE Lindley

AMOMUM L.

Amomum subulatum Roxburgh, Pl. Corom. 3: 75.t. 277. 1819; FBI 6: 240. 1892; FB 3(1): 207.1994.

Local Name: *Aleichi* (Nep).

Leafy shoots to 2m. Leaves lanceolate, acuminate, sessile or shortly petiolate, glabrous. Inflorescence subglobose to ovoid with ovate-obtuse with subulate tiped, reddish-brown, ± glabrous bracts and tubular calyx, corolla tube white, shorter than calyx, petals yellow, lip yellow.

Flowers & Fruits: April – November
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 2053***, dated 30.06. 2003.
Status: Much cultivated
Local Distribution: All three hill gardens.
General Distribution: Native to Bhutan, Nepal, Sikkim, Assam, W.B.
Note: Seeds used for flavouring sweet dishes, as a masticatory, medicinally.

GLOBBA L.

Globba hookeri C.B. Clarke *ex* Baker in FBI 6: 201 1890; FB 3(1): 190.1994.

Leafy shoots over 1m. Leaves lanceolate, long caudate, sessile, ± glabrous or lightly pubescent beneath, upper surface usually sparsely hairy. Inflorescence lax, 25 – 40cm, bulbils produced in upper part or ± throughout inflorescence. Bracts soon deciduous, each subtending a cincinnus of 2-3 tightly clustered, bright yellow flowers.

Flowers & Fruits: May – September
Specimen Cited: Tamsong TE, ***AP Das & Chandrâ 1988***, dated 30.06. 2003.
Status: Very common.
Local Distribution: All three hill gardens.

General Distribution: Himalayas.

Globba racemosa Smith, *Exot*. Bot. 2: 15. t. 117. 1804; FBI 6: 201. 1890; FB 3(1): 191. 1994; Fl. Sik. 1:127. 1996.
Globba clarkei Baker in FBI 6:201. 1890; FEH 1:421.1966.

Local Name: *Alipat* (Nep)

Herbs upto 40 cm tall; rhizome short; pscdostem leafy, crect. Leaf oblong-lanceolate, entire, subcaudate, base narrowed, dark green, glabrous or scantly hairy beneath. Panicles 10-17 cm long, narrow with deep yellow flowers and small, caducous bracts. Capsule smooth.

Flowers & Fruits: June - September
Specimen Cited: Makaibari TE, ***AP Das & Chandrâ 1746***, dated 17.05.2003; Soom TE, ***AP Das & Chandrâ 3568***, dated 12. 10. 2004; Tamsong TE, ***AP Das & Chandrâ 2138***, dated 30.06. 2003.
Status: Abundant.
Local Distribution: All Terai gardens and in lower areas of hill gardens.
General Distribution: E. Himalaya, Assam, Meghalaya, Manipur.

CHAPTER - 7

Vegetation Analysis

7.1. Introduction

Each and every plant or animal is a product of the conditions under which it grows and is, therefore a measure of environment. Vegetation may broadly be defined as the sum total of plants growing an area. However, it is not just the mere grouping of individual plants growing there. The environment of a place is having a great role behind permitting a species to enter in a locality, its multiplication and population structure. The habitat and habits of the population of different inhabiting species determine the structure and function of vegetation. So, it arises from the coming together of individual plants and is a product of the interactions of numerous factors both biotic and abiotic. Thus, the vegetation of a particular place or location has a definite structure and composition derived by the interactions operating at various levels leading to the organization and development of distinct plant communities. Any change in the status of these factors especially biotic, perturbs the vegetation system. Persistent perturbations caused by biotic exploitation triggers such changes in vegetation that finally result in its degradation and or abrupt modification.

Braun Blanquet (1932) defined Phytosociology or Plant Sociology as "the science of plant communities or the knowledge of vegetation in the widest sense that includes all the phenomena, which touch upon the life of plants in social units ".

Philips (1959) regarded phytosociology as the study involving the structure, nature, organization and development of plant communities that gives us an idea about the correlation of species in association. The determination of the associates of a species has important ecological implications and the information thus obtained can be utilized for the formulation of any strategy for their conservation and utilization (Das & Lahiri 1997).

The hills of Darjeeling exhibit a very wide range of physiographic, climatic and edaphic conditions. These coupled by biotic factors are responsible for the great floristic richness and variety of life-forms in the region. The configuration of the hills and mountains, pattern of rainfall distribution over the lower, middle and upper elevation ranges and high humidity have a great role in the determination of the type of vegetation of the area. The evenly distributed highly humid climate is regarded as tree-producing and as such the timber line or the upper vegetation in this sector goes up to 4750 m above m.s.l. (Sahni 1981).

Similarly, the vegetation in Terai and Duars, located at the feet of the hills of Darjiling, is also quite rich from the biodiversity points of view. The ambient environment of this region is also conducive for the growth of trees. And, even today, wide area in Terai-Duars is covered with different types of dense forests.

Tea Gardens in all these three regions have certainly replaced such rich vegetation and are creating numerous problems for the survival naturally growing plants. Realizing such a situation, it has been decided to understand the structure of weedy vegetation occurring in tea plantations in Terai, Duars and Hills of Darjiling.

The basic survey for acquiring different types of phytosociological data sampling through quadrate method has been adopted. Details of the methods of survey and processing of collected data have been presented in the fifth chapter under section 5.3. The determination of the values of **Frequency [F], Density [D], Abundance [A], Relative Frequency [RF], Relative Density [RD], Relative Abundance [RA]** and **Importance Value Index [IVI]** for different species of weeds will certainly be helpful in understanding the problems of their survival. As the weeds are mostly herbaceous plants a standard size of the quadrate, 1 x 1 m, has been used in all cases. The data obtained have been computed and presented in Tables 7.1 – 7.70.

7.2. The Floristic Diversity:

The weed flora of Tea Gardens of Terai and Darjiling Hills has been prepared separately through completely free and random survey, round the year, for three consecutive years. This flora is expected to be exhaustive and can depict the actual floristic picture including their distribution and flowering pattern. On the other hand, a flora also can be appeared when the plants were recorded through quadrate sampling are taken together and compiled into a single list. Floras prepared through such sample survey are prone to the avoiding many plants growing in small patches and with a very low population structure. Even then, it is expected that dominant and/or common elements of the vegetation with be recorded in this process. One such flora will be enumerated at the end of this chapter.

7.3. Analysis of Phytosociological Data Collected from Tea Gardens in Darjiling Terai:

Four Tea Gardens from the Terai region of Darjiling has been selected for the survey. These are (1) Mohurgong & Gulma Tea Estate, (2) Hansqua Tea Estate, (3) Kamalpur Tea Estate, (4) Matigara Tea Estate. The Survey has been conducted in three different seasons (i) Winter, (ii) Pre-Monsoon and (iii) Post-Monsoon.

7.3.1. Mohurgong & Gulma Tea Estate

I. Survey in the Winter: A total of 14 quadrates have been studied and the analysis of the recorded data has been presented in Table 7.1. As much as 46 species of plants has been recorded through the process. As for any other vegetation, the population size for different species varies greatly. The total number of 1369 individuals has been recorded of which *Ageratum conyzoides* (311), *Borreria alata* (211), *Borreria ocymoides* (114), Oxalis corniculata (74), *Gamochaeta pensylvanicum* (65), *Diplazium esculentum* (48), *Youngia japonica* (48) etc. are well represented species. The first species, again, has been recorded from the 11 quadrates. So, on calculation, the species is presented with high degree of values for Frequency [F = 78.57; RF = 8.33], Density [D = 2221; RD = 22.72] and Abundance [A = 2827; RA = 7.99] and thereby the highest IVI for the season in this garden [IVI = 39.04]. *Borreria alata*, another common herb of the local flora has recorded an IVI Of 29.89. Five species with highest IVI from this analysis has been presented separately in Table 7.2.

Table 7.1: Analysis of winter sample data from Mohurgong & Gulma Tea Estate

Name of Plants	NI	NQ	F	D	A	RF	RD	RA	IVI
Ageratum conyzoides	311	11	78.57	22.21	28.27	8.33	22.71	7.99	**39.03**
Ageratum houstonianum	27	3	21.43	1.93	9	2.27	1.97	2.54	**6.78**
Argemone mexicana	6	2	14.29	0.43	3	1.52	0.44	0.85	**2.81**
Axonopus compressus	22	4	28.57	1.57	5.5	3.03	1.61	1.55	**6.19**
Boerhavia coccinea	4	2	14.29	0.29	2	1.52	0.3	0.56	**2.38**
Borreria alata	211	6	42.86	15.07	35.17	4.55	15.41	9.93	**29.89**
Borreria ocymoides	114	5	35.71	8.14	22.8	3.79	8.32	6.44	**18.55**
Cardamine hirsuta	9	3	21.43	0.64	3	2.27	0.65	0.85	**3.77**
Pityrogramma calomelanos	8	2	14.29	0.57	4	1.52	0.58	1.13	**3.23**
Cleome rutidosperma	13	1	7.14	0.93	13	0.76	0.95	3.67	**5.38**
Clerodendrum viscosum	32	4	28.57	2.29	8	3.03	2.34	2.26	**7.63**

Cuscuta reflexa	1	1	7.14	0.07	1	0.76	0.07	0.28	**1.11**
Cynodon dactylon	17	3	21.43	1.21	5.67	2.27	1.24	1.6	**5.11**
Desmodium triflorum	19	1	7.14	1.36	19	0.76	1.39	5.37	**7.52**
Digitaria ciliaris	15	4	28.57	1.07	3.75	3.03	1.09	1.06	**5.18**
Diplazium esculentum	48	6	42.86	3.43	8	4.55	3.51	2.26	**10.32**
Drymaria diandra	18	2	14.29	1.29	9	1.52	1.32	2.54	**5.38**
Dryopteris filix-mas	18	2	14.29	1.29	9	1.52	1.32	2.54	**5.38**
Emilia sonchifolia	13	5	35.71	0.93	2.6	3.79	0.95	0.73	**5.47**
Euphorbia hirta	4	1	7.14	0.29	4	0.76	0.3	1.13	**2.19**
Gamochaeta pensylvanicum	65	3	21.43	4.64	21.67	2.27	4.75	6.12	**13.14**
Hydrocotyle sibthorpioides	3	1	7.14	0.21	3	0.76	0.21	0.85	**1.82**
Imperata cylindrica	71	5	35.71	5.07	14.2	3.79	5.19	4.01	**12.99**
Ixeris polycephala	2	2	14.29	0.14	1	1.52	0.14	0.28	**1.94**
Leucas indica	12	3	21.43	0.86	4	2.27	0.88	1.13	**4.28**
Lindernia pyxidaria	4	1	7.14	0.29	4	0.76	0.3	1.13	**2.19**
Mazus pumilus	12	3	21.43	0.86	4	2.27	0.88	1.13	**4.28**
Mecardonia procumbens	8	2	14.29	0.57	4	1.52	0.58	1.13	**3.23**
Mikania micrantha	10	2	14.29	0.71	5	1.52	0.73	1.41	**3.66**
Mimosa pudica	8	4	28.57	0.57	2	3.03	0.58	0.56	**4.17**
Mitracarpus verticillatus	7	1	7.14	0.5	7	0.76	0.51	1.98	**3.25**
Murraya koenigii	2	2	14.29	0.14	1	1.52	0.14	0.28	**1.94**
Neanotis hirsuta	14	2	14.29	1	7	1.52	1.02	1.98	**4.52**
Nelsonia canescens	7	2	14.29	0.5	3.5	1.52	0.51	0.99	**3.02**
Oplismenus compositus	43	5	35.71	3.07	8.6	3.79	3.14	2.43	**9.36**
Oxalis corniculata	74	5	35.71	5.29	14.8	3.79	5.41	4.18	**13.38**
Oxalis corymbosa	15	2	14.29	1.07	7.5	1.52	1.09	2.12	**4.73**
Paspalum scrobiculatum	2	1	7.14	0.14	2	0.76	0.14	0.56	**1.46**
Persicaria hydropiper	6	2	14.29	0.43	3	1.52	0.44	0.85	**2.81**
Phaulopsis imbricata	13	2	14.29	0.93	6.5	1.52	0.95	1.84	**4.31**
Piper longum	5	1	7.14	0.36	5	0.76	0.37	1.41	**2.54**
Rungia pectinata	10	1	7.14	0.71	10	0.76	0.73	2.82	**4.31**
Seedlings (Leguminous)	6	1	7.14	0.43	6	0.76	0.44	1.69	**2.89**
Solanum aculeatissimum	3	1	7.14	0.21	3	0.76	0.21	0.85	**1.82**
Solanum nigrum	9	2	14.29	0.64	4.5	1.52	0.65	1.27	**3.44**
Youngia japonica	48	8	57.14	3.43	6	6.06	3.51	1.69	**11.26**
TOTAL:	**1369**	**132**	**942.9**	**97.78**	**354**				

Table 7.2: Top Five high IVI scoring species of plants in the winter vegetation of Mohorgong & Gulma Tea Estate

Species	RF	RD	RA	IVI
Ageratum conyzoides	8.33	22.71	7.99	**39.03**
Borreria alata	4.55	15.41	9.93	**29.89**
Borreria ocymoides	3.79	8.32	6.44	**18.55**
Oxalis corniculata	3.79	5.41	4.18	**13.38**
Gamochaeta pensylvanicum	2.27	4.75	6.12	**13.14**

II. Survey in the Pre-Monsoon Period: A total of 15 quadrates have been studied and the analysis of the recorded data has been presented in Table 7.3. As much as 43 species of plants has been recorded through the process during this dry period. As for any other vegetation, the population size for different species varies greatly. The total number of 1281 individuals has been recorded of which *Borreria alata* (379), *Oxalis corniculata* (251), *Digitaria ciliaris* (79), *Mecardonia procumbens* (72), *Ageratum houstonianum* (70), *Mitracarpus verticillatus* (69) etc. are well represented species. Of these, *Oxalis corniculata* has been recorded in all the 15 quadrate. *Ageratum houstonianum* also has been reported in 9 quadrates. So, on calculation, *Borreria alata* and *Oxalis corniculata* are presented with high degree of values for Frequency [F = 33.33 & 100; RF = 4.27 & 12.8], Density [D = 2527 & 1673; RD = 29.6 & 19.6] and Abundance [A = 7580 & 1673; RA = 23.7 & 5.23], respectively, and thereby recorded two highest IVIs for the season in this garden [IVI = 57.56 & 37.64]. Five species with highest IVI from this analysis has been presented separately in Table 7.4.

Table 7.3: Analysis of Pre-Monsoon sample data from Mohurgong & Gulma Tea Estate

Name of Plants	NI	NQ	F	D	A	RF	RD	RA	IVI
Ageratum conyzoides	55	6	40	3.67	9.17	5.13	4.3	2.87	**12.3**
Ageratum houstonianum	70	9	60	4.67	7.78	7.69	5.47	2.43	**15.59**
Axonopus compressus	30	4	26.67	2	7.5	3.42	2.34	2.34	**8.1**
Borreria alata	379	5	33.33	25.27	75.8	4.27	29.6	23.7	**57.57**
Crotalaria pallida	8	2	13.33	0.53	4	1.71	0.62	1.25	**3.58**
Cyanthillium cinereum	1	1	6.67	0.07	1	0.86	0.08	0.31	**1.25**
Cynodon dactylon	7	1	6.67	0.47	7	0.86	0.55	2.19	**3.6**
Cyperus compressus	14	1	6.67	0.93	14	0.86	1.09	4.38	**6.33**
Cyperus cyperoides	2	1	6.67	0.13	2	0.86	0.15	0.63	**1.64**
Desmodium triflorum	3	1	6.67	0.2	3	0.86	0.23	0.94	**2.03**
Digitaria ciliaris	79	6	40	5.27	13.17	5.13	6.17	4.12	**15.42**
Dioscorea alata	1	1	6.67	0.07	1	0.86	0.08	0.31	**1.25**
Diplazium esculentum	14	4	26.67	0.93	3.5	3.42	1.09	1.09	**5.6**
Dryopteris filix-mas	11	5	33.33	0.73	2.2	4.27	0.86	0.69	**5.82**
Eleusine indica	9	2	13.33	0.6	4.5	1.71	0.7	1.41	**3.82**
Euphorbia hirta	9	2	13.33	0.6	4.5	1.71	0.7	1.41	**3.82**
Hedyotis scandens	2	2	13.33	0.13	1	1.71	0.15	0.31	**2.17**
Hydrocotyle sibthorpioides	3	1	6.67	0.2	3	0.86	0.23	0.94	**2.03**
Imperata cylindrica	1	1	6.67	0.07	1	0.86	0.08	0.31	**1.25**
Ixeris polycephala	11	4	26.67	0.73	2.75	3.42	0.86	0.86	**5.14**
Juncus bufonius	12	1	6.67	0.8	12	0.86	0.94	3.75	**5.55**
Kyllinga nemoralis	12	2	13.33	0.8	6	1.71	0.94	1.88	**4.53**
Leucas indica	2	1	6.67	0.13	2	0.86	0.15	0.63	**1.64**
Lindernia crustacea	30	2	13.33	2	15	1.71	2.34	4.69	**8.74**
Lygodium salicifolium	1	1	6.67	0.07	1	0.86	0.08	0.31	**1.25**

Mecardonia procumbens	72	6	40	4.8	12	5.13	5.62	3.75	**14.5**
Mimosa pudica	2	2	13.33	0.13	1	1.71	0.15	0.31	**2.17**
Mitracarpus verticillatus	69	4	26.67	4.6	17.25	3.42	5.39	5.39	**14.2**
Mukia maderaspatana	8	2	13.33	0.53	4	1.71	0.62	1.25	**3.58**
Oldenlandia corymbosa	2	1	6.67	0.13	2	0.86	0.15	0.63	**1.64**
Oplismenus compositus	23	2	13.33	1.53	11.5	1.71	1.79	3.6	**7.1**
Oxalis corniculata	251	15	100	16.73	16.73	12.8	19.6	5.23	**37.64**
Paspalum conjugatum	5	1	6.67	0.33	5	0.86	0.39	1.56	**2.81**
Phyllanthus urinaria	12	2	13.33	0.8	6	1.71	0.94	1.88	**4.53**
Physalis divaricata	1	1	6.67	0.07	1	0.86	0.08	0.31	**1.25**
Pouzolzia zeylanica	11	2	13.33	0.73	5.5	1.71	0.86	1.72	**4.29**
Pupalia lappacea	6	2	13.33	0.4	3	1.71	0.47	0.94	**3.12**
Scoparia dulcis	12	3	20	0.8	4	2.56	0.94	1.25	**4.75**
Setaria plicata	5	2	13.33	0.33	2.5	1.71	0.39	0.78	**2.88**
Solanum aculeatissimum	2	2	13.33	0.13	1	1.71	0.15	0.31	**2.17**
Sonchus asper	1	1	6.67	0.07	1	0.86	0.08	0.31	**1.25**
Typhonium trilobatum	12	1	6.67	0.8	12	0.86	0.94	3.75	**5.55**
Typhonium diversifolium	21	2	13.33	1.4	10.5	1.71	1.64	3.28	**6.63**
TOTAL:	**1281**	**117**	**780**	**85.38**	**319.9**				

Table 7.4: Top Five IVI scoring species of plants in the Pre-Monsoon vegetation of Mohorgong & Gulma Tea Estate

Species	RF	RD	RA	IVI
Borreria alata	4.27	29.6	23.7	**57.57**
Oxalis corniculata	12.8	19.6	5.23	**37.64**
Ageratum houstonianum	7.69	5.47	2.43	**15.59**
Digitaria ciliaris	5.13	6.17	4.12	**15.42**
Mecardonia procumbens	5.13	5.62	3.75	**14.5**

Generally, *Ageratum conyzoides* starts flowering earlier so they are withered earlier than *Ageratum houstonianum.* That is why, towards the end of dry pre-monsoon period more individuals of second species is available in the vegetation. This is again the seed dispersal season for most of these herbaceous plants. With the onset of monsoon, a new crop of weed will develop and the plants of the present generation will gradually decompose and will mix with the soil.

III. Survey in the Post-Monsoon Period: A total of 21 quadrates have been studied and the analysis of the recorded data has been presented in Table 7.5. A comparatively lesser number of 38 species of plants has been recorded through the process during this post-monsoon period. As for any other vegetation, the population size for different species varies greatly though the population is becoming much sparse. The total number of only 538 individuals has been recorded of which *Borreria ocymoides* (156), *Ageratum conyzoides* (70), *Borreria alata* (67), *Ageratum* *houstonianum* (62) etc. are well represented species. Of these, *Borreria ocymoides* has been recorded in maximum of 17 quadrates. *Borreria lalata* also has been reported in 11 quadrates. On calculation, *Borreria ocymoides* is presented with high degree of values for Frequency [F = 80.95; RF = 15.46], Density [D = 742.9; RD = 7.51] and Abundance [A = 917.7; RA = 7.51], and thereby recorded the highest IVIs for the season in this garden [IVI = 51.97]. Five species with highest IVI from this analysis has been presented separately in Table 7.6.

Table 7.5: Analysis of Pre-Monsoon sample data from Mohurgong & Gulma Tea Estate

Name of Plants	NI	NQ	F	D	A	RF	RD	RA	IVI
Ageratum conyzoides	70	9	42.86	3.33	7.78	8.18	12.98	6.37	**27.53**
Ageratum houstonianum	62	7	33.33	2.95	8.86	6.36	11.5	7.25	**25.11**
Axonopus compressus	6	2	9.52	0.29	3	1.82	1.13	2.46	**5.41**
Borreria alata	67	11	52.38	3.19	6.09	10	12.43	4.99	**27.42**
Borreria ocymoides	156	17	80.95	7.43	9.18	15.46	28.96	7.52	**51.94**
Pityrogramma calomelanos	2	1	4.76	0.1	2	0.91	0.39	1.64	**2.94**
Crinum amoenum	10	2	9.52	0.48	5	1.82	1.87	4.09	**7.78**
Cyanthillium cinereum	1	1	4.76	0.05	1	0.91	0.19	0.82	**1.92**
Digitaria ciliaris	29	4	19.05	1.38	7.25	3.64	5.38	5.94	**14.96**
Diplazium esculentum	11	7	33.33	0.52	1.57	6.36	2.03	1.29	**9.68**
Euphorbia hirta	12	1	4.76	0.57	12	0.91	2.22	9.83	**12.96**
Gamochaeta pensylvanicum	3	1	4.76	0.14	3	0.91	0.55	2.46	**3.92**
Indigofera tasmanii	1	1	4.76	0.05	1	0.91	0.19	0.82	**1.92**
Kyllinga brevifolia	3	1	4.76	0.14	3	0.91	0.55	2.46	**3.92**
Kyllinga nemoralis	2	2	9.52	0.1	1	1.82	0.39	0.82	**3.03**
Lindenbergia indica	6	2	9.52	0.29	3	1.82	1.13	2.46	**5.41**
Lindernia crustacea	11	3	14.29	0.52	3.67	2.73	2.03	3	**7.76**
Lindernia pyxidaria	9	2	9.52	0.43	4.5	1.82	1.68	3.68	**7.18**
Lygodium microphyllum	1	1	4.76	0.05	1	0.91	0.19	0.82	**1.92**
Lygodium salicifolium	2	1	4.76	0.1	2	0.91	0.39	1.64	**2.94**
Mazus pumilus	5	2	9.52	0.24	2.5	1.82	0.94	2.05	**4.81**
Melochia corchorifolia	1	1	4.76	0.05	1	0.91	0.19	0.82	**1.92**
Mitracarpus verticillatus	11	5	23.81	0.52	2.2	4.55	2.03	1.8	**8.38**
Murdannia nudiflora	4	1	4.76	0.19	4	0.91	0.74	3.28	**4.93**
Oldenlandia corymbosa	2	1	4.76	0.1	2	0.91	0.39	1.64	**2.94**
Oplismenus compositus	2	2	9.52	0.1	1	1.82	0.39	0.82	**3.03**
Oxalis corniculata	16	5	23.81	0.76	3.2	4.55	2.96	2.62	**10.13**
Oxalis corymbosa	1	1	4.76	0.05	1	0.91	0.19	0.82	**1.92**
Pericampylus glaucus	2	2	9.52	0.1	1	1.82	0.39	0.82	**3.03**
Pouzolzia zeylanica	4	2	9.52	0.19	2	1.82	0.74	1.64	**4.2**
Pseudognaphalium affine	1	1	4.76	0.05	1	0.91	0.19	0.82	**1.92**
Pteris biaurita	2	1	4.76	0.1	2	0.91	0.39	1.64	**2.94**
Pupalia lappacea	2	1	4.76	0.1	2	0.91	0.39	1.64	**2.94**
Scoparia dulcis	3	2	9.52	0.14	1.5	1.82	0.55	1.23	**3.6**

Seedlings (Leguminous)	1	1	4.76	0.05	1	0.91	0.19	0.82	**1.92**
Selaginella monospora	4	1	4.76	0.19	4	0.91	0.74	3.28	**4.93**
Typhonium trilobatum	3	2	9.52	0.14	1.5	1.82	0.55	1.23	**3.6**
Youngia japonica	10	3	14.29	0.48	3.33	2.73	1.87	2.73	**7.33**
TOTAL:	**538**	**110**	**523.74**	**25.66**	**122.13**				

Table 7.6: Top Five IVI scoring species of plants in the Post-Monsoon vegetation of Mohorgong & Gulma Tea Estate

Species	RF	RD	RA	IVI
Borreria ocymoides	15.46	28.96	7.52	**51.94**
Ageratum conyzoides	8.18	12.98	6.37	**27.53**
Borreria alata	10	12.43	4.99	**27.42**
Ageratum houstonianum	6.36	11.5	7.25	**25.11**
Digitaria ciliaris	3.64	5.38	5.94	**14.96**

It is quite interesting to note that out of the five species presented in Table 7.6 for their higher IVI, two species each for two genera, *Borreria* and *Ageratum*, are there with the 5th odd species a grass. It is also interesting to note that, in the sample pieces of vegetation out of the counted 538 individuals, 355 are represented by these four species only, though a good number of 38 species are growing there.

IV: The Annual Picture: While bringing data from all three seasons under a single head, i.e. data from a total of 50 quadrates that will produce the annual structure for the vegetation. This has been presented in Table 7.7. It shows that 81 species of weeds growing in garden as recorded through quadrate sampling. Maximum number of individuals recorded for *Borreria alata* (657) *and this is followed by Ageratum conyzoides* (436), *Oxalis corniculata* (341), *Borreria ocymoides* (270), *Ageratum houstonianum* (159), etc. The ten species recorded with high IVI are also in conformity (Table 7.8) with the seasonal data. Three species *Digitaria ciliaris, Diplazium esculentum* and *Mitracarpus verticillatus* are newly recognised important species. But, they are constantly present in the vegetation and are dominating elements in the local vegetation outside the garden. *Ageratum conyzoides* is the most uniformly distributed species and has been recorded from 26 out of 50 quadrates and thereby showing F = 52 and RF = 7.24. On the other hand, though *Borreria alata* has been recorded in only 22 quadrates, its population structure is quite high and thereby recording D = 1314 and RD = 20.61. Though positioned 1st & 2nd *Borreria alata* and *Ageratum conyzoides* both are equally important weed in Mohorgong & Gulma Tea Estate.

Table 7.7: Analysis with the whole year quadrate sample data from Mohurgong & Gulma Tea Estate

Name of Plants	NI	NQ	F	D	A	RF	RD	RA	IVI	SD
Ageratum conyzoides	436	26	52	8.72	16.77	7.24	13.68	3.87	24.79	-0.27209
Ageratum houstonianum	159	19	38	3.18	8.37	5.29	4.99	1.93	12.21	-0.14954
Argemone mexicana	6	2	4	0.12	3	0.56	0.19	0.69	1.44	-0.01181
Axonopus compressus	58	10	20	1.16	5.8	2.79	1.82	1.34	5.95	-0.07289
Boerhavia coccinea	4	2	4	0.08	2	0.56	0.13	0.46	1.15	-0.00838
Borreria alata	657	22	44	13.14	29.86	6.13	20.61	6.88	33.62	-0.3255
Borreria ocymoides	270	22	44	5.4	12.27	6.13	8.47	2.83	17.43	-0.20908
Cardamine hirsuta	9	3	6	0.18	3	0.84	0.28	0.69	1.81	-0.01657
Pityrogramma calomelanos	10	3	6	0.2	3.33	0.84	0.31	0.77	1.92	-0.01808
Cleome rutidosperma	13	1	2	0.26	13	0.28	0.41	3	3.69	-0.02244
Clerodendrum viscosum	32	4	8	0.64	8	1.11	1	1.84	3.95	-0.04619
Crinum amoenum	10	2	4	0.2	5	0.56	0.31	1.15	2.02	-0.01808
Crotalaria pallida	8	2	4	0.16	4	0.56	0.25	0.92	1.73	-0.01503
Cuscuta reflexa	1	1	2	0.02	1	0.28	0.03	0.23	0.54	-0.00253
Cyanthillium cinereum	2	2	4	0.04	1	0.56	0.06	0.23	0.85	-0.00463
Cynodon dactylon	24	4	8	0.48	6	1.11	0.75	1.38	3.24	-0.03681
Cyperus compressus	14	1	2	0.28	14	0.28	0.44	3.23	3.95	-0.02384
Cyperus cyperoides	2	1	2	0.04	2	0.28	0.06	0.46	0.8	-0.00463
Desmodium triflorum	22	2	4	0.44	11	0.56	0.69	2.54	3.79	-0.03434
Digitaria ciliaris	123	14	28	2.46	8.79	3.9	3.86	2.03	9.79	-0.12558
Dioscorea alata	1	1	2	0.02	1	0.28	0.03	0.23	0.54	-0.00253
Diplazium esculentum	73	17	34	1.46	4.29	4.74	2.29	0.99	8.02	-0.08648
Drymaria diandra	18	2	4	0.36	9	0.56	0.56	2.07	3.19	-0.02923
Dryopteris filix-mas	29	7	14	0.58	4.14	1.95	0.91	0.95	3.81	-0.04275
Eleusine indica	9	2	4	0.18	4.5	0.56	0.28	1.04	1.88	-0.01657
Emilia sonchifolia	13	5	10	0:26	2.6	1.39	0.41	0.6	2.4	-0.02244
Euphorbia hirta	25	4	8	0.5	6.25	1.11	0.78	1.44	3.33	-0.03802
Gamochaeta pensylvanicum	68	4	8	1.36	17	1.11	2.13	3.92	7.16	-0.08207
Hedyotis scandens	2	2	4	0.04	1	0.56	0.06	0.23	0.85	-0.00463
Hydrocotyle sibthorpioides	6	2	4	0.12	3	0.56	0.19	0.69	1.44	-0.01181
Imperata cylindrica	72	6	12	1.44	12	1.67	2.26	2.77	6.7	-0.08561
Indigofera tasmanii	1	1	2	0.02	1	0.28	0.03	0.23	0.54	-0.00253
Ixeris polycephala	13	6	12	0.26	2.17	1.67	0.41	0.5	2.58	-0.02244
Juncus bufonius	12	1	2	0.24	12	0.28	0.38	2.77	3.43	-0.02101
Kyllinga brevifolia	3	1	2	0.06	3	0.28	0.09	0.69	1.06	-0.00656
Kyllinga nemoralis	14	4	8	0.28	3.5	1.11	0.44	0.81	2.36	-0.02384
Leucas indica	14	4	8	0.28	3.5	1.11	0.44	0.81	2.36	-0.02384
Lindenbergia indica	6	2	4	0.12	3	0.56	0.19	0.69	1.44	-0.01181
Lindernia crustacea	41	5	10	0.82	8.2	1.39	1.29	1.89	4.57	-0.05599
Lindernia pyxidaria	13	3	6	0.26	4.33	0.84	0.41	1	2.25	-0.02244
Lygodium microphyllum	1	1	2	0.02	1	0.28	0.03	0.23	0.54	-0.00253
Lygodium salicifolium	3	2	4	0.06	1.5	0.56	0.09	0.35	1	-0.00656
Mazus pumilus	17	5	10	0.34	3.4	1.39	0.53	0.78	2.7	-0.02791
Mecardonia procumbens	80	8	16	1.6	10	2.23	2.51	2.31	7.05	-0.09247

Melochia corchorifolia	1	1	2	0.02	1	0.28	0.03	0.23	0.54	-0.00253
Mikania micrantha	10	2	4	0.2	5	0.56	0.31	1.15	2.02	-0.01808
Mimosa pudica	10	6	12	0.2	1.67	1.67	0.31	0.38	2.36	-0.01808
Mitracarpus verticillatus	87	10	20	1.74	8.7	2.79	2.73	2.01	7.53	-0.09828
Mukia maderaspatana	8	2	4	0.16	4	0.56	0.25	0.92	1.73	-0.01503
Murdannia nudiflora	4	1	2	0.08	4	0.28	0.13	0.92	1.33	-0.00838
Murraya koenigii	2	2	4	0.04	1	0.56	0.06	0.23	0.85	-0.00463
Neanotis hirsuta	14	2	4	0.28	7	0.56	0.44	1.61	2.61	-0.02384
Nelsonia canescens	7	2	4	0.14	3.5	0.56	0.22	0.81	1.59	-0.01344
Oldenlandia corymbosa	4	2	4	0.08	2	0.56	0.13	0.46	1.15	-0.00838
Oplismenus compositus	68	9	18	1.36	7.56	2.51	2.13	1.74	6.38	-0.08207
Oxalis corniculata	341	25	50	6.82	13.64	6.96	10.7	3.14	20.8	-0.23909
Oxalis corymbosa	16	3	6	0.32	5.33	0.84	0.5	1.23	2.57	-0.02657
Paspalum conjugatum	5	1	2	0.1	5	0.28	0.16	1.15	1.59	-0.01013
Paspalum scrobiculatum	2	1	2	0.04	2	0.28	0.06	0.46	0.8	-0.00463
Pericampylus glaucus	2	2	4	0.04	1	0.56	0.06	0.23	0.85	-0.00463
Persicaria hydropiper	6	2	4	0.12	3	0.56	0.19	0.69	1.44	-0.01181
Phaulopsis imbricata	13	2	4	0.26	6.5	0.56	0.41	1.5	2.47	-0.02244
Phyllanthus urinaria	12	2	4	0.24	6	0.56	0.38	1.38	2.32	-0.02101
Physalis divaricata	1	1	2	0.02	1	0.28	0.03	0.23	0.54	-0.00253
Piper longum	5	1	2	0.1	5	0.28	0.16	1.15	1.59	-0.01013
Pouzolzia zeylanica	15	4	8	0.3	3.75	1.11	0.47	0.86	2.44	-0.02522
Pseudognaphalium affine	1	1	2	0.02	1	0.28	0.03	0.23	0.54	-0.00253
Pteris biaurita	2	1	2	0.04	2	0.28	0.06	0.46	0.8	-0.00463
Pupalia lappacea	8	3	6	0.16	2.67	0.84	0.25	0.62	1.71	-0.01503
Rungia pectinata	10	1	2	0.2	10	0.28	0.31	2.31	2.9	-0.01808
Scoparia dulcis	15	5	10	0.3	3	1.39	0.47	0.69	2.55	-0.02522
Seedling (Leguminous)	7	2	4	0.14	3.5	0.56	0.22	0.81	1.59	-0.01344
Selaginella monospora	4	1	2	0.08	4	0.28	0.13	0.92	1.33	-0.00838
Setaria plicata	5	2	4	0.1	2.5	0.56	0.16	0.58	1.3	-0.01013
Solanum aculeatissimum	5	3	6	0.1	1.67	0.84	0.16	0.38	1.38	-0.01013
Solanum nigrum	9	2	4	0.18	4.5	0.56	0.28	1.04	1.88	-0.01657
Sonchus asper	1	1	2	0.02	1	0.28	0.03	0.23	0.54	-0.00253
Typhonium trilobatum	15	3	6	0.3	5	0.84	0.47	1.15	2.46	-0.02522
Typhonium diversifolium	21	2	4	0.42	10.5	0.56	0.66	2.42	3.64	-0.03309
Youngia japonica	58	11	22	1.16	5.27	3.06	1.82	1.21	6.09	-0.07289
TOTAL:	**3188**	**359**	**718**	**63.76**	**433.83**					-3.09

Table 7.8: Top Ten IVI scoring species of weedy plants in the vegetation of Mohorgong & Gulma Tea Estate

Species	RF	RD	RA	IVI
Borreria alata	6.13	20.61	6.88	**33.62**
Ageratum conyzoides	7.24	13.68	3.87	**24.79**
Oxalis corniculata	6.96	10.7	3.14	**20.8**
Borreria ocymoides	6.13	8.47	2.83	**17.43**
Ageratum houstonianum	5.29	4.99	1.93	**12.21**

Digitaria ciliaris	3.9	3.86	2.03	**9.79**
Diplazium esculentum	4.74	2.29	0.99	**8.02**
Mitracarpus verticillatus	2.79	2.73	2.01	**7.53**
Gamochaeta pensylvanicum	1.11	2.13	3.92	**7.16**
Mecardonia procumbens	2.23	2.51	2.31	**7.05**

The recognition of two species both for *Borreria* and *Ageratum* as important weeds of Mohorgong & Gulma Tea Estate is not surprising. Both the species of *Borreria* are growing almost in all types of vegetation (except aquatic) with varying soil characteristics including wide range of soil pH. On the other hand, *Ageratum conyzoides* is a pantropic weed with quite broad ecological amplitude and *Ageratum houstonianum*, a recently naturalised plant is also behaving like its sister. Again, except *Diplazium esculentum*, which is pteridophytic, the remaining nine high-IVI weeds are all annuals and are angiosperms.

Species Diversity [Shannon-Weiner Index] for this Tea Garden has been determined to -3.09. This is a moderate value of diversity. Such a value was under expectation because the habitate is highly disturbed one.

Species Richness has been determined through **Menhinick's Index** and the obtained value is **1.417**.

7.3.2 Hansqua Tea Estate

I. Survey in the Winter: A total of 14 quadrates have been studied and the analysis of the recorded data has been presented in Table 7.9. As much as 55 species of plants has been recorded through the process. As for any other vegetation, the population size for different species varies greatly in this garden too. The total number of 1883 individuals has been recorded of which *Gamochaeta pensylvanicum* (544), *Oxalis corniculata* (268), *Ageratum conyzoides* (213), *Cynodon dactylon* (153), *Axonopus compressus* (96) etc. are well represented species. Interestingly, the population of *Borreria alata* (15) is very poor in this garden in winter. This needs not to be treated as unusual. Both the species of *Borreria*, *B. alata* and *B. ocymoides* are annuals and die during this dry and cold season. *Gamochaeta pensylvanicum*, again, has been recorded from the 8 quadrates. So, on calculation, the species is presented with comparatively higher degree of values for Frequency [F = 57.14; RF = 4.94], Density [D = 3885.71; RD = 28.89] and Abundance [A = 6800; RA = 16.48] and thereby the highest IVI for the season in this garden [IVI = 50.31]. But, *Oxalis corniculata* is the most evenly distributed species and has been recorded in all the 14 quadrates securing F = 100 and RF = 8.64, highest in the garden. This species has followed in the second rank with its record of IVI = 27.23. Five species with highest IVI from this analysis has been presented separately in Table 7.10.

Table 7.9: Analysis of winter sample data from Hansqua Tea Estate

Name of Plants	NI	NQ	F	D	A	RF	RD	RA	IVI
Ageratum conyzoides	213	12	85.71	15.21	17.75	7.41	11.31	4.3	**23.02**
Ageratum houstonianum	5	1	7.14	0.36	5	0.62	0.27	1.21	**2.1**
Albizia chinensis	2	2	14.29	0.14	1	1.23	0.1	0.24	**1.57**
Axonopus compressus	96	10	71.43	6.86	9.6	6.17	5.1	2.33	**13.6**
Blumea lacera	6	2	14.29	0.43	3	1.23	0.32	0.73	**2.28**
Borreria alata	17	5	35.71	1.21	3.4	3.09	0.9	0.82	**4.81**
Borreria ocymoides	66	6	42.86	4.71	11	3.7	3.5	2.67	**9.87**
Cardamine hirsuta	25	1	7.14	1.79	25	0.62	1.33	6.06	**8.01**
Centella asiatica	3	1	7.14	0.21	3	0.62	0.16	0.73	**1.51**
Aleuritopteris albo-marginata	11	3	21.43	0.79	3.67	1.85	0.59	0.89	**3.33**
Chrysopogon aciculatus	4	1	7.14	0.29	4	0.62	0.22	0.97	**1.81**
Crassocephalum crepidioides	2	1	7.14	0.14	2	0.62	0.1	0.48	**1.2**
Cyanthillium cinereum	4	2	14.29	0.29	2	1.23	0.22	0.48	**1.93**
Cynodon dactylon	153	8	57.14	10.93	19.13	4.94	8.13	4.64	**17.71**
Cyperus compressus	20	3	21.43	1.43	6.67	1.85	1.06	1.62	**4.53**
Cyperus pseudokyllingioides	12	1	7.14	0.86	12	0.62	0.64	2.91	**4.17**
Cyperus sp	15	2	14.29	1.07	7.5	1.23	0.8	1.82	**3.85**
Desmodium laxum	5	1	7.14	0.36	5	0.62	0.27	1.21	**2.1**
Desmodium triflorum	2	1	7.14	0.14	2	0.62	0.1	0.48	**1.2**
Digitaria ciliaris	11	2	14.29	0.79	5.5	1.23	0.59	1.33	**3.15**
Digitaria sanguinalis	29	2	14.29	2.07	14.5	1.23	1.54	3.51	**6.28**
Diplazium esculentum	15	1	7.14	1.07	15	0.62	0.8	3.64	**5.06**
Dryopteris filix-mas	25	5	35.71	1.79	5	3.09	1.33	1.21	**5.63**
Ehretia serrata	1	1	7.14	0.07	1	0.62	0.05	0.24	**0.91**
Eleusine indica	31	7	50	2.21	4.43	4.32	1.64	1.07	**7.03**
Emilia sonchifolia	2	1	7.14	0.14	2	0.62	0.1	0.48	**1.2**
Eragrostis tenella	4	1	7.14	0.29	4	0.62	0.22	0.97	**1.81**
Fimbristylis dichotoma	9	1	7.14	0.64	9	0.62	0.48	2.18	**3.28**
Gamochaeta pensylvanicum	544	8	57.14	38.86	68	4.94	28.89	16.48	**50.31**
Hydrocotyle sibthorpioides	17	3	21.43	1.21	5.67	1.85	0.9	1.37	**4.12**
Ixeris polycephala	23	6	42.86	1.64	3.83	3.7	1.22	0.93	**5.85**
Kyllinga brevifolia	15	1	7.14	1.07	15	0.62	0.8	3.64	**5.06**
Lindernia crustacea	6	1	7.14	0.43	6	0.62	0.32	1.45	**2.39**
Mazus pumilus	57	5	35.71	4.07	11.4	3.09	3.03	2.76	**8.88**
Mecardonia procumbens	6	1	7.14	0.43	6	0.62	0.32	1.45	**2.39**
Mikania micrantha	5	1	7.14	0.36	5	0.62	0.27	1.21	**2.1**
Mimosa pudica	4	2	14.29	0.29	2	1.23	0.22	0.48	**1.93**
Mitracarpus verticillatus	5	2	14.29	0.36	2.5	1.23	0.27	0.61	**2.11**
Natsiatum herpeticum	1	1	7.14	0.07	1	0.62	0.05	0.24	**0.91**
Oldenlandia corymbosa	28	2	14.29	2	14	1.23	1.49	3.39	**6.11**
Oldenlandia diffusa	6	2	14.29	0.43	3	1.23	0.32	0.73	**2.28**
Oplismenus compositus	7	1	7.14	0.5	7	0.62	0.37	1.7	**2.69**

Oxalis corniculata	264	14	100	18.86	18.86	8.64	14.02	4.57	**27.23**
Oxalis corymbosa	2	1	7.14	0.14	2	0.62	0.1	0.48	**1.2**
Pericampylus glaucus	1	1	7.14	0.07	1	0.62	0.05	0.24	**0.91**
Pouzolzia zeylanica	19	3	21.43	1.36	6.33	1.85	1.01	1.53	**4.39**
Pseudognaphalium affine	24	3	21.43	1.71	8	1.85	1.27	1.94	**5.06**
Rungia pectinata	1	1	7.14	0.07	1	0.62	0.05	0.24	**0.91**
Saccharum spontaneum	2	1	7.14	0.14	2	0.62	0.1	0.48	**1.2**
Scoparia dulcis	2	1	7.14	0.14	2	0.62	0.1	0.48	**1.2**
Seedlings (Leguminous)	2	1	7.14	0.14	2	0.62	0.1	0.48	**1.2**
Solanum nigrum	3	2	14.29	0.21	1.5	1.23	0.16	0.36	**1.75**
Sonchus asper	10	1	7.14	0.71	10	0.62	0.53	2.42	**3.57**
Trichosanthes lepiniana	1	1	7.14	0.07	1	0.62	0.05	0.24	**0.91**
Youngia japonica	40	12	85.71	2.86	3.33	7.41	2.13	0.81	**10.35**
TOTAL:	**1883**	**162**	**1157.1**	**134.49**	**412.57**				

Table 7.10: Top Five IVI scoring species of plants in the winter vegetation of Hansqua Tea Estate

Species	RF	RD	RA	IVI
Gamochaeta pensylvanicum	4.94	28.89	16.48	**50.31**
Oxalis corniculata	8.64	14.02	4.57	**27.23**
Ageratum conyzoides	7.41	11.31	4.3	**23.02**
Cynodon dactylon	4.94	8.13	4.64	**17.71**
Axonopus compressus	6.17	5.1	2.33	**13.6**

The most striking feature in the list of high IVI plants presented in Table 7.10 is the presence of two grasses, *Cynodon dactylon* and *Axonopus compressus*. Both are perennials, but the first one is heliophytic and the second one can grow well in light shade. Erect and tall gregariously growing annuals generally cover these prostrate grasses in the vegetation and thereby eliminate them or considerably reduce their population. Most probably, much spacious very old tea bushes of Hansqua Tea Estate permitted these grasses to grow well.

II. Survey in the Pre-Monsoon Period: A total of 15 quadrates have been studied and the analysis of the recorded data has been presented in Table 7.11. A little less number of 31 species of plants has been recorded through the process. As for any other vegetation, the population size for different species varies greatly in this garden too. The total number of 1094 individuals has been recorded of which *Borreria alata* (512), *Ageratum conyzoides* (180), *Oxalis corniculata* (136), *Gamochaeta pensylvanicum* (31), *Cyperus iria* (24) etc. are better represented species. The vegetation is very poor and only *Borreria alata* is completely dominating over all other species [F = 73.33, RF = 11.96; D = 3746.7; RD = 51.37 and A = 5109.1; RA = 26.94]. However, *Ageratum conyzoides* is a better distributed plant as this has been recorded in all the 15 quadrates (F = 100; RF = 16.3). *Borreria alata* with its IVI score of 90.27 is more than double the IVI scored (39.08) by next important species *Ageratum conyzoides*. All the five high IVI species are annuals. Pre-monsoon vegetation is drought and cold affected bus many annuals continue to grow there due to regular irrigation and the shade provided by the tea bushes. Five species with highest IVI from this analysis has been presented separately in Table 7.12.

Table 7.11: Analysis of Pre-Monsoon sample data from Hansqua Tea Estate.

Name of Plants	NI	NQ	F	D	A	RF	RD	RA	IVI
Ageratum conyzoides	180	15	100	12	12	16.3	16.45	6.33	**39.08**
Axonopus compressus	10	4	26.67	0.67	2.5	4.35	0.92	1.32	**6.59**
Borreria alata	562	11	73.33	37.47	51.09	11.96	51.35	26.94	**90.25**
Coix lachryma-jobi	4	1	6.67	0.27	4	1.09	0.37	2.11	**3.57**
Conyza canadensis	7	2	13.33	0.47	3.5	2.17	0.64	1.85	**4.66**
Crotalaria cytisoides	7	2	13.33	0.47	3.5	2.17	0.64	1.85	**4.66**
Crotalaria pallida	5	3	20	0.33	1.67	3.26	0.45	0.88	**4.59**
Cynodon dactylon	1	1	6.67	0.07	1	1.09	0.1	0.53	**1.72**
Cyperus compressus	8	1	6.67	0.53	8	1.09	0.73	4.22	**6.04**
Cyperus iria	24	2	13.33	1.6	12	2.17	2.19	6.33	**10.69**
Desmodium laxum	10	2	13.33	0.67	5	2.17	0.92	2.64	**5.73**
Desmodium triflorum	6	1	6.67	0.4	6	1.09	0.55	3.16	**4.8**
Digitaria ciliaris	15	2	13.33	1	7.5	2.17	1.37	3.95	**7.49**
Diplazium esculentum	7	2	13.33	0.47	3.5	2.17	0.64	1.85	**4.66**
Dryopteris filix-mas	10	5	33.33	0.67	2	5.43	0.92	1.05	**7.4**
Ehretia serrata	3	2	13.33	0.2	1.5	2.17	0.27	0.79	**3.23**
Gamochaeta pensylvanicum	31	5	33.33	2.07	6.2	5.43	2.84	3.27	**11.54**
Ixeris polycephala	6	2	13.33	0.4	3	2.17	0.55	1.58	**4.3**
Lindernia pyxidaria	5	1	6.67	0.33	5	1.09	0.45	2.64	**4.18**
Mikania micrantha	2	2	13.33	0.13	1	2.17	0.18	0.53	**2.88**
Oplismenus burmanii	11	1	6.67	0.73	11	1.09	1	5.8	**7.89**
Oplismenus compositus	14	2	13.33	0.93	7	2.17	1.27	3.69	**7.13**
Oxalis corniculata	136	11	73.33	9.07	12.36	11.96	12.43	6.52	**30.91**
Phyllanthus reticulatus	2	1	6.67	0.13	2	1.09	0.18	1.05	**2.32**
Portulaca oleracea	7	1	6.67	0.47	7	1.09	0.64	3.69	**5.42**
Pothos scandens	4	2	13.33	0.27	2	2.17	0.37	1.05	**3.59**
Seedlings (unidentified)	1	1	6.67	0.07	1	1.09	0.1	0.53	**1.72**
Setaria palmifolia	10	3	20	0.67	3.33	3.26	0.92	1.76	**5.94**
Smilax zeylanica	1	1	6.67	0.07	1	1.09	0.1	0.53	**1.72**
Solanum nigrum	4	2	13.33	0.27	2	2.17	0.37	1.05	**3.59**
Triumfetta rhomboidea	1	1	6.67	0.07	1	1.09	0.1	0.53	**1.72**
TOTAL:	**1094**	**92**	**613.32**	**72.97**	**189.65**				

Table 7.12: Top Five IVI scoring species of plants in the Pre-Monsoon vegetation of Hansqua Tea Estate

Species	RF	RD	RA	IVI
Borreria alata	11.96	51.35	26.94	**90.25**
Ageratum conyzoides	16.3	16.45	6.33	**39.08**
Oxalis corniculata	11.96	12.43	6.52	**30.91**
Gamochaeta pensylvanicum	5.43	2.84	3.27	**11.54**
Cyperus iria	2.17	2.19	6.33	**10.69**

III. Survey in the Post-Monsoon Period: A total of 21 quadrates have been studied and the analysis of the recorded data has been presented in Table 7.13. And, a moderate number of 44 species of plants has been recorded through the process. As for any other vegetation, the population size for different species varies greatly in this garden too. The total number of 1110 individuals has been recorded that expresses a sperse picture of the vegetation. Here the highest population and the highest IVI score was for *Oxalis corniculata* (268; IVI = 25.93). In the list of five high-IVI plants the sequence is at per with their recoded population structure and the plants are *Ageratum houstonianum* (120; IVI = 21.54), *Desmodium triflorum* (100; IVI = 20.17), *Ageratum conyzoides* (99; IVI = 18.31) and *Cynodon dactylon* (72; IVI = 16.24). Except *Oxalis corniculata, Borreria ocymoides* and *Cynodon dactylon* no other species has been recorded from 50% or more quadrates. And, except *Cynodon dactylon* all the four other species are annuals. Dominance of prostrate plants like *Oxalis corniculata, Desmodium triflorum* and *Cynodon dactylon* express a low water relation that might be due to the nature of well drained soil. Interestingly, the populations of *Borreria alata* (16) and *B. ocymoides* (61) are very poor in this garden in post-monsoon season, when they were expected more. Five species with highest IVI from this analysis has been presented separately in Table 7.14.

Table 7.13: Analysis of Post-Monsoon sample data from Hansqua Tea Estate

Name of Plants	NI	NQ	F	D	A	RF	RD	RA	IVI
Ageratum conyzoides	99	8	38.1	4.71	12.38	5.13	8.91	4.26	**18.3**
Ageratum houstonianum	120	6	28.57	5.71	20	3.85	10.8	6.88	**21.53**
Aleuritopteris albomarginata	1	1	4.76	0.05	1	0.64	0.09	0.34	**1.07**
Axonopus compressus	25	5	23.81	1.19	5	3.21	2.25	1.72	**7.18**
Borreria alata	16	6	28.57	0.76	2.67	3.85	1.44	0.92	**6.21**
Borreria ocymoides	61	12	57.14	2.9	5.08	7.69	5.49	1.75	**14.93**
Commelina suffruticosa	9	1	4.76	0.43	9	0.64	0.81	3.1	**4.55**
Crassocephalum crepidioides	1	1	4.76	0.05	1	0.64	0.09	0.34	**1.07**
Cymbopogon nardus	1	1	4.76	0.05	1	0.64	0.09	0.34	**1.07**
Cynodon dactylon	72	12	57.14	3.43	6	7.69	6.49	2.06	**16.24**
Cyperus compressus	25	1	4.76	1.19	25	0.64	2.25	8.6	**11.49**
Cyperus iria	16	1	4.76	0.76	16	0.64	1.44	5.51	**7.59**

Desmodium laxiflorum	2	1	4.76	0.1	2	0.64	0.19	0.69	**1.52**
Desmodium triflorum	100	4	19.05	4.76	25	2.56	9.01	8.6	**20.17**
Dicranopteris linearis	1	1	4.76	0.05	1	0.64	0.09	0.34	**1.07**
Digitaria ciliaris	26	2	9.52	1.24	13	1.28	2.35	4.47	**8.1**
Diplazium esculentum	15	6	28.57	0.71	2.5	3.85	1.34	0.86	**6.05**
Dryopteris filix-mas	13	7	33.33	0.62	1.86	4.49	1.17	0.64	**6.3**
Eleusine indica	16	4	19.05	0.76	4	2.56	1.44	1.38	**5.38**
Euphorbia hirta	2	1	4.76	0.1	2	0.64	0.19	0.69	**1.52**
Evolvulus alsinoides	7	1	4.76	0.33	7	0.64	0.62	2.41	**3.67**
Gamochaeta pensylvanicum	67	5	23.81	3.19	13.4	3.21	6.04	4.61	**13.86**
Hydrocotyle sibthorpioides	30	3	14.29	1.43	10	1.92	2.71	3.44	**8.07**
Kyllinga brevifolia	6	1	4.76	0.29	6	0.64	0.55	2.06	**3.25**
Kyllinga nemoralis	3	1	4.76	0.14	3	0.64	0.26	1.03	**1.93**
Leucas indica	5	2	9.52	0.24	2.5	1.28	0.45	0.86	**2.59**
Lindernia crustacea	47	6	28.57	2.24	7.83	3.85	4.24	2.69	**10.78**
Luffa aegyptiaca	1	1	4.76	0.05	1	0.64	0.09	0.34	**1.07**
Mazus pumilus	12	3	14.29	0.57	4	1.92	1.08	1.38	**4.38**
Mecardonia procumbens	3	1	4.76	0.14	3	0.64	0.26	1.03	**1.93**
Oldenlandia corymbosa	15	3	14.29	0.71	5	1.92	1.34	1.72	**4.98**
Oplismenus compositus	15	1	4.76	0.71	15	0.64	1.34	5.16	**7.14**
Oxalis corniculata	151	13	61.9	7.19	11.62	8.33	13.6	4	**25.93**
Oxalis corymbosa	8	2	9.52	0.38	4	1.28	0.72	1.38	**3.38**
Paspalum scrobiculatum	15	4	19.05	0.71	3.75	2.56	1.34	1.29	**5.19**
Peperomia pellucida	21	3	14.29	1	7	1.92	1.89	2.41	**6.22**
Persicaria hydropiper	4	1	4.76	0.19	4	0.64	0.36	1.38	**2.38**
Pouzolzia zeylanica	9	3	14.29	0.43	3	1.92	0.81	1.03	**3.76**
Rungia pectinata	13	7	33.33	0.62	1.86	4.49	1.17	0.64	**6.3**
Selaginella monospora	30	3	14.29	1.43	10	1.92	2.71	3.44	**8.07**
Solanum nigrum	3	1	4.76	0.14	3	0.64	0.26	1.03	**1.93**
Stephania japonica	2	1	4.76	0.1	2	0.64	0.19	0.69	**1.52**
Torenia violacea	5	1	4.76	0.24	5	0.64	0.45	1.72	**2.81**
Youngia japonica	17	8	38.1	0.81	2.13	5.13	1.53	0.73	**7.39**
TOTAL:	**1110**	**156**	**742.83**	**52.85**	**290.58**				

Table 7.14: Top Five IVI scoring species of plants in the Post-Monsoon vegetation of Hansqua Tea Estate

Species	RF	RD	RA	IVI
Oxalis corniculata	*8.33*	13.6	4	**25.93**
Ageratum houstonianum	3.85	10.8	6.88	**21.53**
Desmodium triflorum	2.56	9.01	8.6	**20.17**
Ageratum conyzoides	5.13	8.91	4.26	**18.3**
Cynodon dactylon	7.69	6.49	2.06	**16.24**

IV: The Annual Picture: While bringing data from all three seasons under a single head, i.e. data from a total of 50 quadrates that will produce the annual structure for the vegetation. This has been presented in Table 7.15. It shows that 84 species of weeds with a total of 4087 individuals growing in the garden as recorded through quadrate sampling. Maximum number of individuals recorded for *Gamochaeta pensylvanicum* (642 from 18 Quadrates), and this is followed by *Borreria alata* (595 from 22 quadrates), *Oxalis corniculata* (551 from 38 quadrates), *Ageratum conyzoides* (492 from 35 quadrats), *Cynodon dactylon* (226 from 21 quadrates), etc. The ten species recorded with high IVI are also nearly in conformity (Table 7.16) with the seasonal data. Through the annual calculation, only one species, *Youngia japonica* has been recognised as an important plant. Though *Gamochaeta pensylvanicum* is recorded with very high number of individuals but it is not well distributed as this has been recorded only in 18 out of 50 quadrates. On the other hand, *Oxalis corniculata* has been recirded in 38 quadrates, thereby scored an RF value 9.27. *Gamochaeta pensylvanicum* is a very small herb and a very large number of plants can grow in a small area and that is why the species recoded the highest RD value of 15.71. If compared *Borreria alata* with *Ageratum conyzoides*, the first species is represented by much larger number of individuals but the second species is much better in distribution. *Gamochaeta pensylvanicum* has been recorded as most important weed only during winter and has been occupied 4th position in the Pre-monsoon vegetation. But, some other species like *Oxalis corniculata, Borreria alata* and *Ageratum conyzoides* emerged as important weed in almost in all the seasons. So, all these species are to be treated as very important weeds in the Hansqua *Tea* Estate.

Table 7.15: Analysis with the data collected round the year from Hansqua Tea Estate

Name of Plants	NI	NQ	F	D	A	RF	RD	RA	IVI	SD
Ageratum conyzoides	492	35	70	9.84	14.06	8.54	12.04	2.75	**23.33**	-0.2548586
Ageratum houstonianum	125	7	14	2.5	17.86	1.71	3.06	3.49	**8.26**	-0.1066569
Albizia chinensis	2	2	4	0.04	1	0.49	0.05	0.2	**0.74**	-0.0037301
Axonopus compressus	131	19	38	2.62	6.89	4.63	3.21	1.35	**9.19**	-0.1102736
Blumea lacera	6	2	4	0.12	3	0.49	0.15	0.59	**1.23**	-0.0095774
Borreria alata	595	22	44	11.9	27.05	5.37	14.56	5.29	**25.22**	-0.2805403
Borreria ocymoides	127	18	36	2.54	7.06	4.39	3.11	1.38	**8.88**	-0.1078701
Cardamine hirsuta	25	1	2	0.5	25	0.24	0.61	4.89	**5.74**	-0.0311762
Centella asiatica	3	1	2	0.06	3	0.24	0.07	0.59	**0.9**	-0.0052975
Aleuritopteris albo-marginata	12	4	8	0.24	3	0.98	0.29	0.59	**1.86**	-0.0171196
Chrysopogon aciculatus	4	1	2	0.08	4	0.24	0.1	0.78	**1.12**	-0.0067818
Coix lachryma-jobi	4	1	2	0.08	4	0.24	0.1	0.78	**1.12**	-0.0067818
Commelina suffruticosa	9	1	2	0.18	9	0.24	0.22	1.76	**2.22**	-0.0134732

Conyza canadensis	7	2	4	0.14	3.5	0.49	0.17	0.68	**1.34**	-0.0109096
Crassocephalum crepidioides	3	2	4	0.06	1.5	0.49	0.07	0.29	**0.85**	-0.0052975
Crotalaria cytisoides	7	2	4	0.14	3.5	0.49	0.17	0.68	**1.34**	-0.0109096
Crotalaria pallida	5	3	6	0.1	1.67	0.73	0.12	0.33	**1.18**	-0.0082042
Cyanthillium cinereum	4	2	4	0.08	2	0.49	0.1	0.39	**0.98**	-0.0067818
Cymbopogon nardus	1	1	2	0.02	1	0.24	0.02	0.2	**0.46**	-0.0020346
Cynodon dactylon	226	21	42	4.52	10.76	5.12	5.53	2.1	**12.75**	-0.1600874
Cyperus compressus	53	5	10	1.06	10.6	1.22	1.3	2.07	**4.59**	-0.0563493
Cyperus iria	40	3	6	0.8	13.33	0.73	0.98	2.61	**4.32**	-0.045282
Cyperus pseudokyllingioides	12	1	2	0.24	12	0.24	0.29	2.35	**2.88**	-0.0171196
Cyperus niveus	15	2	4	0.3	7.5	0.49	0.37	1.47	**2.33**	-0.0205806
Desmodium laxiflorum	2	1	2	0.04	2	0.24	0.05	0.39	**0.68**	-0.0037301
Desmodium laxum	15	3	6	0.3	5	0.73	0.37	0.98	**2.08**	-0.0205806
Desmodium triflorum	108	6	12	2.16	18	1.46	2.64	3.52	**7.62**	-0.0960144
Dicranopteris linearis	1	1	2	0.02	1	0.24	0.02	0.2	**0.46**	-0.0020346
Digitaria ciliaris	52	6	12	1.04	8.67	1.46	1.27	1.7	**4.43**	-0.0555285
Digitaria sanguinalis	29	2	4	0.58	14.5	0.49	0.71	2.84	**4.04**	-0.0351113
Diplazium esculentum	37	9	18	0.74	4.11	2.2	0.91	0.8	**3.91**	-0.0425916
Dryopteris filix-mas	48	17	34	0.96	2.82	4.15	1.17	0.55	**5.87**	-0.0521971
Ehretia serrata	4	3	6	0.08	1.33	0.73	0.1	0.26	**1.09**	-0.0067818
Eleusine indica	47	11	22	0.94	4.27	2.68	1.15	0.83	**4.66**	-0.0513518
Emilia sonchifolia	2	1	2	0.04	2	0.24	0.05	0.39	**0.68**	-0.0037301
Eragrostis tenella	4	1	2	0.08	4	0.24	0.1	0.78	**1.12**	-0.0067818
Euphorbia hirta	2	1	2	0.04	2	0.24	0.05	0.39	**0.68**	-0.0037301
Evolvulus alsinoides	7	1	2	0.14	7	0.24	0.17	1.37	**1.78**	-0.0109096
Fimbristylis dichotoma	9	1	2	0.18	9	0.24	0.22	1.76	**2.22**	-0.0134732
Gamochaeta pensylvanicum	642	18	36	12.84	35.67	4.39	15.71	6.97	**27.07**	-0.290758
Hydrocotyle sibthorpioides	47	6	12	0.94	7.83	1.46	1.15	1.53	**4.14**	-0.0513518
Ixeris polycephala	29	8	16	0.58	3.63	1.95	0.71	0.71	**3.37**	-0.0351113
Kyllinga brevifolia	21	2	4	0.42	10.5	0.49	0.51	2.05	**3.05**	-0.0270839
Kyllinga nemoralis	3	1	2	0.06	3	0.24	0.07	0.59	**0.9**	-0.0052975
Leucas indica	5	2	4	0.1	2.5	0.49	0.12	0.49	**1.1**	-0.0082042
Lindernia crustacea	53	7	14	1.06	7.57	1.71	1.3	1.48	**4.49**	-0.0563493
Lindernia pyxidaria	5	1	2	0.1	5	0.24	0.12	0.98	**1.34**	-0.0082042
Luffa aegyptiaca	1	1	2	0.02	1	0.24	0.02	0.2	**0.46**	-0.0020346
Mazus pumilus	69	8	16	1.38	8.63	1.95	1.69	1.69	**5.33**	-0.0689065
Mecardonia procumbens	9	2	4	0.18	4.5	0.49	0.22	0.88	**1.59**	-0.0134732
Mikania micrantha	7	3	6	0.14	2.33	0.73	0.17	0.46	**1.36**	-0.0109096
Mimosa pudica	4	2	4	0.08	2	0.49	0.1	0.39	**0.98**	-0.0067818
Mitracarpus verticillatus	5	2	4	0.1	2.5	0.49	0.12	0.49	**1.1**	-0.0082042
Natsiatum herpeticum	1	1	2	0.02	1	0.24	0.02	0.2	**0.46**	-0.0020346
Oldenlandia corymbosa	43	5	10	0.86	8.6	1.22	1.05	1.68	**3.95**	-0.0479172
Oldenlandia diffusa	6	2	4	0.12	3	0.49	0.15	0.59	**1.23**	-0.0095774
Oplismenus burmanii	11	1	2	0.22	11	0.24	0.27	2.15	**2.66**	-0.0159272

Oplismenus compositus	36	4	8	0.72	9	0.98	0.88	1.76	**3.62**	-0.0416818
Oxalis corniculata	551	38	76	11.02	14.5	9.27	13.48	2.84	**25.59**	-0.270152
Oxalis corymbosa	10	3	6	0.2	3.33	0.73	0.24	0.65	**1.62**	-0.0147125
Paspalum scrobiculatum	15	4	8	0.3	3.75	0.98	0.37	0.73	**2.08**	-0.0205806
Peperomia pellucida	21	3	6	0.42	7	0.73	0.51	1.37	**2.61**	-0.0270839
Pericampylus glaucus	1	1	2	0.02	1	0.24	0.02	0.2	**0.46**	-0.0020346
Persicaria hydropiper	4	1	2	0.08	4	0.24	0.1	0.78	**1.12**	-0.0067818
Phyllanthus reticulatus	2	1	2	0.04	2	0.24	0.05	0.39	**0.68**	-0.0037301
Portulaca oleracea	7	1	2	0.14	7	0.24	0.17	1.37	**1.78**	-0.0109096
Pothos scandens	4	2	4	0.08	2	0.49	0.1	0.39	**0.98**	-0.0067818
Pouzolzia zeylanica	28	6	12	0.56	4.67	1.46	0.69	0.91	**3.06**	-0.034141
Pseudognaphalium affine	24	3	6	0.48	8	0.73	0.59	1.56	**2.88**	-0.0301689
Rungia pectinata	14	8	16	0.28	1.75	1.95	0.34	0.34	**2.63**	-0.0194449
Saccharum spontaneum	2	1	2	0.04	2	0.24	0.05	0.39	**0.68**	-0.0037301
Scoparia dulcis	2	1	2	0.04	2	0.24	0.05	0.39	**0.68**	-0.0037301
Seedlings (Leguminous)	2	1	2	0.04	2	0.24	0.05	0.39	**0.68**	-0.0037301
Seedlings	1	1	2	0.02	1	0.24	0.02	0.2	**0.46**	-0.0020346
Selaginella monospora	30	3	6	0.6	10	0.73	0.73	1.96	**3.42**	-0.0360732
Setaria palmifolia	10	3	6	0.2	3.33	0.73	0.24	0.65	**1.62**	-0.0147125
Smilax zeylanica	1	1	2	0.02	1	0.24	0.02	0.2	**0.46**	-0.0020346
Solanum nigrum	10	5	10	0.2	2	1.22	0.24	0.39	**1.85**	-0.0147125
Sonchus asper	10	1	2	0.2	10	0.24	0.24	1.96	**2.44**	-0.0147125
Stephania japonica	2	1	2	0.04	2	0.24	0.05	0.39	**0.68**	-0.0037301
Torenia violacea	5	1	2	0.1	5	0.24	0.12	0.98	**1.34**	-0.0082042
Trichosanthes lepiniana	1	1	2	0.02	1	0.24	0.02	0.2	**0.46**	-0.0020346
Triumfetta rhomboidea	1	1	2	0.02	1	0.24	0.02	0.2	**0.46**	-0.0020346
Youngia japonica	57	20	40	1.14	2.85	4.88	1.39	0.56	**6.83**	-0.0595873
TOTAL:	**4087**	**410**	**820**	**8174**	**511.42**					**-3.03**

Table 7.16: Top Ten IVI scoring species of weedy plants in the vegetation of Hansqua Tea Estate

Species	RF	RD	RA	IVI
Gamochaeta pensylvanicum	4.39	15.71	6.97	**27.07**
Oxalis corniculata	9.27	13.48	2.84	**25.59**
Borreria alata	5.37	14.56	5.29	**25.22**
Ageratum conyzoides	8.54	12.04	2.75	**23.33**
Cynodon dactylon	5.12	5.53	2.1	**12.75**
Axonopus compressus	4.63	3.21	1.35	**9.19**
Borreria ocymoides	4.39	3.11	1.38	**8.88**
Ageratum houstonianum	1.71	3.06	3.49	**8.26**
Desmodium triflorum	1.46	2.64	3.52	**7.62**
Youngia japonica	4.88	1.39	0.56	**6.83**

Species Diversity [Shannon-Weiner Index] for this Tea Garden has been determined to -3.03. This is a moderate value of diversity. Such a value was under expectation because the habitate is highly disturbed one.

Species Richness has been determined through **Menhinick's Index** and the obtained value is **1.314**.

7.3.3 Kamalpur Tea Estate

I. Survey in the Winter: A total of 14 quadrates have been studied and the analysis of the recorded data has been presented in Table 7.17. A good number of 40 species of plants has been recorded through the process. As for any other vegetation, the population size for different species varies greatly. The total number of 1261 individuals has been recorded of which *Ageratum conyzoides* (224), *Gamochaeta pensylvanicum* (172), *Oxalis corniculata* (127), Polygonum plebejum (84) and *Borreria alata* (83) are well represented species. The first and second species, again, have been recorded from the 7 quadrates. So, on calculation, the first species (*Ageratum conyzoides*) is presented with high degree of values for Frequency [F = 50; RF = 6.14], Density [D = 1600; RD = 17.76] and Abundance [A = 3200; RA = 9.75] and thereby the highest IVI for the season in this garden [IVI = 33.65]. The second secies, *Gamochaeta pensylvanicum* has scored an IVI of 27.26 due its slightly low population size. The IVI of *Oxalis corniculata,* the 3rd in the scoring sequence, has also scored high IVI of 21.78. Five species with highest IVI from this analysis has been presented separately in Table 7.18.

Table 7.17: Phytosociological analysis of winter sample data from Kamalpur Tea Estate

Name of Plants	NI	NQ	F	D	A	RF	RD	RA	IVI
Ageratum conyzoides	224	7	50	16	32	6.14	17.77	9.75	**33.66**
Axonopus compressus	37	7	50	2.64	5.29	6.14	2.93	1.61	**10.68**
Borreria alata	83	4	28.57	5.93	20.75	3.51	6.59	6.32	**16.42**
Borreria ocymoides	43	4	28.57	3.07	10.75	3.51	3.41	3.27	**10.19**
Centella asiatica	3	2	14.29	0.21	1.5	1.75	0.23	0.46	**2.44**
Crassocephalum crepidioides	5	4	28.57	0.36	1.25	3.51	0.4	0.38	**4.29**
Crotalaria cytisoides	1	1	7.14	0.07	1	0.88	0.08	0.3	**1.26**
Cyanthillium cinereum	1	1	7.14	0.07	1	0.88	0.08	0.3	**1.26**
Cynodon dactylon	38	6	42.86	2.71	6.33	5.26	3.01	1.93	**10.2**
Cyperus compressus	41	4	28.57	2.93	10.25	3.51	3.25	3.12	**9.88**
Cyperus cyperoides	3	2	14.29	0.21	1.5	1.75	0.23	0.46	**2.44**
Desmodium triflorum	59	5	35.71	4.21	11.8	4.39	4.68	3.59	**12.66**
Digitaria ciliaris	79	5	35.71	5.64	15.8	4.39	6.26	4.81	**15.46**

Digitaria sanguinalis	9	3	21.43	0.64	3	2.63	0.71	0.91	**4.25**
Dryopteris filix-mas	3	1	7.14	0.21	3	0.88	0.23	0.91	**2.02**
Eleusine indica	3	1	7.14	0.21	3	0.88	0.23	0.91	**2.02**
Emilia sonchifolia	2	1	7.14	0.14	2	0.88	0.16	0.61	**1.65**
Eragrostis gangetica	4	3	21.43	0.29	1.33	2.63	0.32	0.41	**3.36**
Gamochaeta pensylvanicum	172	7	50	12.29	24.57	6.14	13.65	7.48	**27.27**
Hydrocotyle sibthorpioides	13	2	14.29	0.93	6.5	1.75	1.03	1.98	**4.76**
Hypericum japonicum	10	1	7.14	0.71	10	0.88	0.79	3.05	**4.72**
Imperata cylindrica	2	1	7.14	0.14	2	0.88	0.16	0.61	**1.65**
Ixeris polycephala	5	1	7.14	0.36	5	0.88	0.4	1.52	**2.8**
Kyllinga brevifolia	10	2	14.29	0.71	5	1.75	0.79	1.52	**4.06**
Leucas indica	6	1	7.14	0.43	6	0.88	0.48	1.83	**3.19**
Mazus pumilus	28	4	28.57	2	7	3.51	2.22	2.13	**7.86**
Mitracarpus verticillatus	1	1	7.14	0.07	1	0.88	0.08	0.3	**1.26**
Oldenlandia corymbosa	9	1	7.14	0.64	9	0.88	0.71	2.74	**4.33**
Oplismenus compositus	27	5	35.71	1.93	5.4	4.39	2.14	1.64	**8.17**
Oxalis corniculata	127	6	42.86	9.07	21.17	5.26	10.07	6.45	**21.78**
Oxalis corymbosa	18	4	28.57	1.29	4.5	3.51	1.43	1.37	**6.31**
Paspalum scrobiculatum	10	2	14.29	0.71	5	1.75	0.79	1.52	**4.06**
Polygonum plebeium	84	3	21.43	6	28	2.63	6.66	8.53	**17.82**
Pouzolzia zeylanica	10	1	7.14	0.71	10	0.88	0.79	3.05	**4.72**
Pseudognaphalium affine	5	1	7.14	0.36	5	0.88	0.4	1.52	**2.8**
Saccharum spontaneum	14	2	14.29	1	7	1.75	1.11	2.13	**4.99**
Scoparia dulcis	9	2	14.29	0.64	4.5	1.75	0.71	1.37	**3.83**
Stellaria media	47	2	14.29	3.36	23.5	1.75	3.73	7.16	**12.64**
Trema orientalis	2	1	7.14	0.14	2	0.88	0.16	0.61	**1.65**
Youngia japonica	14	3	21.43	1	4.67	2.63	1.11	1.42	**5.16**
TOTAL:	**1261**	**114**	**814.27**	**90.03**	**328.36**				

Table 7.18: Top FIVE IVI scoring species of plants in the winter vegetation of Kamalpur Tea Estate

Species	RF	RD	RA	IVI
Ageratum conyzoides	6.14	17.77	9.75	**33.66**
Gamochaeta pensylvanicum	6.14	13.65	7.48	**27.27**
Oxalis corniculata	5.26	10.07	6.45	**21.78**
Polygonum plebeium	2.63	6.66	8.53	**17.82**
Borreria alata	3.51	6.59	6.32	**16.42**

However, the weedy vegetation was looking very sperse that may be due to prolong dry spell and low winter temperature. Also, the healthy and close set tea-bushes control the growth of weedy species on the floor by cutting a considerable amount of sun-light.

II. Survey in the Pre-Monsoon Period: A total of 15 quadrates have been studied and the analysis of the recorded data has been presented in Table 7.19. As much as 51 species of plants has been recorded through the process during this dry period. As for any other vegetation, the population size for different species varies greatly. The total number of 2144 individuals has been recorded of which *Borreria alata* (706), *Digitaria ciliaris* (229), *Oxalis corniculata* (215), *Ageratum conyzoides* (174), *Gamochaeta pensylvanicum* (156) etc. are well represented species. Though recorded in only 9 quadrates, *Borreria alata* became most important species in the vegetation due to its very high population structure. *Digitaria ciliaris*, on the other hand, recorded from 14 quadrates, but its population structure is quite low. *Oxalis corniculata* is also with better frequency of distribution in the vegetation as it has been recorded in 11 quadrates. *Ageratum conyzoides* and *Gamochaeta pensylvanicum* have been reported in 7 quadrates. But, whatever may be aquired frequency of the important species of weeds in this Tea Garden, the wode differences in their recorded population structure, which reflected through the differences in their RD has determined their final score of IVI and thereby the position in the list of 5 most important species of weeds. Five species with higher IVI from this analysis has been presented separately in Table 7.20.

Table 7.19: Analysis of Pre-Monsoon quadrate sample data from Kamalpur Tea Estate

Name of Plants	NI	NQ	F	D	A	RF	RD	RA	IVI
Ageratum conyzoides	174	7	46.67	11.6	24.86	4.19	8.11	6.45	**18.75**
Ageratum houstonianum	97	3	20	6.47	32.33	1.8	4.53	8.38	**14.71**
Axonopus compressus	12	6	40	0.8	2	3.59	0.56	0.52	**4.67**
Borreria alata	706	9	60	47.07	78.44	5.39	32.93	20.34	**58.66**
Borreria ocymoides	20	2	13.33	1.33	10	1.2	0.93	2.59	**4.72**
Centella asiatica	3	2	13.33	0.2	1.5	1.2	0.14	0.39	**1.73**
Clerodendrum viscosum	1	1	6.67	0.07	1	0.6	0.05	0.26	**0.91**
Conyza canadensis	1	1	6.67	0.07	1	0.6	0.05	0.26	**0.91**
Crassocephalum crepidioides	46	5	33.33	3.07	9.2	2.99	2.15	2.39	**7.53**
Cyanthillium cinereum	1	1	6.67	0.07	1	0.6	0.05	0.26	**0.91**
Cynodon dactylon	43	6	40	2.87	7.17	3.59	2.01	1.86	**7.46**
Cyperus compressus	40	2	13.33	2.67	20	1.2	1.87	5.19	**8.26**
Cyperus cyperoides	3	3	20	0.2	1	1.8	0.14	0.26	**2.2**
Cyperus pseudokyllingioides	4	2	13.33	0.27	2	1.2	0.19	0.52	**1.91**
Desmodium triflorum	16	6	40	1.07	2.67	3.59	0.75	0.69	**5.03**
Digitaria ciliaris	229	14	93.33	15.27	16.36	8.38	10.68	4.24	**23.3**

Diplazium esculentum	8	4	26.67	0.53	2	2.4	0.37	0.52	**3.29**
Dryopteris filix-mas	44	3	20	2.93	14.67	1.8	2.05	3.8	**7.65**
Eleusine indica	18	4	26.67	1.2	4.5	2.4	0.84	1.17	**4.41**
Emilia sonchifolia	16	2	13.33	1.07	8	1.2	0.75	2.07	**4.02**
Eragrostis tenella	10	2	13.33	0.67	5	1.2	0.47	1.3	**2.97**
Eragrostis unioloides	35	5	33.33	2.33	7	2.99	1.63	1.81	**6.43**
Fimbristylis dichotoma	10	2	13.33	0.67	5	1.2	0.47	1.3	**2.97**
Gamochaeta pensylvanicum	156	7	46.67	10.4	22.29	4.19	7.28	5.78	**17.25**
Hedyotis scandens	6	3	20	0.4	2	1.8	0.28	0.52	**2.6**
Hydrocotyle sibthorpioides	10	3	20	0.67	3.33	1.8	0.47	0.86	**3.13**
Hypericum japonicum	7	2	13.33	0.47	3.5	1.2	0.33	0.91	**2.44**
Ixeris polycephala	2	2	13.33	0.13	1	1.2	0.09	0.26	**1.55**
Kyllinga nemoralis	2	1	6.67	0.13	2	0.6	0.09	0.52	**1.21**
Leucas indica	1	1	6.67	0.07	1	0.6	0.05	0.26	**0.91**
Lindernia ciliata	7	1	6.67	0.47	7	0.6	0.33	1.81	**2.74**
Lindernia crustacea	18	3	20	1.2	6	1.8	0.84	1.56	**4.2**
Mazus pumilus	11	2	13.33	0.73	5.5	1.2	0.51	1.43	**3.14**
Mecardonia procumbens	8	2	13.33	0.53	4	1.2	0.37	1.04	**2.61**
Mikania micrantha	2	2	13.33	0.13	1	1.2	0.09	0.26	**1.55**
Mimosa pudica	1	1	6.67	0.07	1	0.6	0.05	0.26	**0.91**
Mitracarpus verticillatus	68	6	40	4.53	11.33	3.59	3.17	2.94	**9.7**
Neolamarckia cadamba	3	1	6.67	0.2	3	0.6	0.14	0.78	**1.52**
Oldenlandia corymbosa	10	4	26.67	0.67	2.5	2.4	0.47	0.65	**3.52**
Oldenlandia diffusa	3	2	13.33	0.2	1.5	1.2	0.14	0.39	**1.73**
Oxalis corniculata	215	11	73.33	14.33	19.55	6.59	10.02	5.07	**21.68**
Oxalis corymbosa	3	2	13.33	0.2	1.5	1.2	0.14	0.39	**1.73**
Paspalum conjugatum	2	1	6.67	0.13	2	0.6	0.09	0.52	**1.21**
Paspalum scrobiculatum	37	3	20	2.47	12.33	1.8	1.73	3.2	**6.73**
Phyllanthus urinaria	5	3	20	0.33	1.67	1.8	0.23	0.43	**2.46**
Pouzolzia zeylanica	6	2	13.33	0.4	3	1.2	0.28	0.78	**2.26**
Pseudognaphalium affine	2	2	13.33	0.13	1	1.2	0.09	0.26	**1.55**
Scoparia dulcis	2	1	6.67	0.13	2	0.6	0.09	0.52	**1.21**
Seedlings (unidentified)	2	1	6.67	0.13	2	0.6	0.09	0.52	**1.21**
Torenia violacea	12	4	26.67	0.8	3	2.4	0.56	0.78	**3.74**
Youngia japonica	6	2	13.33	0.4	3	1.2	0.28	0.78	**2.26**
TOTAL:	**2144**	**167**	**1113.32**	**142.95**	**385.7**				

Table 7.20: Top FIVE IVI scoring species of plants in the Pre-Monsoon vegetation of Kamalpur Tea Estate

Species	RF	RD	RA	IVI
Borreria alata	5.39	32.93	20.34	**58.66**
Digitaria ciliaris	8.38	10.68	4.24	**23.3**
Oxalis corniculata	6.59	10.02	5.07	**21.68**
Ageratum conyzoides	4.19	8.12	6.44	**18.75**

Gamochaeta pensylvanicum	4.19	7.28	5.78	**17.25**

Though a good number of 51 species recorded from this Tea Garden but it was dominating by few species only. Most of the species has been recorded with extremely low population structure. Like the winter vegetation, none of the determined important genera is represented by more than one species in the list of top five weeds. All these are therophytic annuals and are with wide ecological amplitude.

III. Survey in the Post-Monsoon Period: A total of 21 quadrates have been studied and the analysis of the recorded data has been presented in Table 7.21. And, a good number of 52 species of plants has been recorded through the process. As for any other vegetation, the population size for different species varies greatly in this garden too. The total number of 1856 individuals has been recorded that expresses a picture of high occurrence of weeds in the vegetation. Here the highest population and the highest IVI score was for *Cyperus pseudokyllingoides* (181; IVI = 25.92). In the list of five high-IVI plants the sequence is at per with their recoded population structure and the plants are *Ageratum houstonianum* (227; IVI = 24.73), *Ageratum conyzoides* (210; IVI = 23.22), *Desmodium triflorum* (204; IVI = 22.48) and *Borreria ocymoides* (169; IVI = 21.27). It is interesting to note that *Borreria ocymoides* with lowest IVI score among the selected five species is recoded with highest distribution in 18 (out of 21) quadrates and RF value is 9.42. This small herb grows well on the semi-shaded floor of Tea Gardens. Both the species of *Ageratum* are recorded with almost similar number of individuals from the same number of nine quadrates. Out of the selected five weeds, only the *Borreria icymoides* is recorded from over 50% quadrates. Five species with highest IVI from this analysis has been presented separately in Table 7.22.

Table 7.21: Analysis of Post-Monsoon quadrate sample data from Kamalpur Tea Estate

Name of Plants	NI	NQ	F	D	A	RF	RD	RA	IVI
Ageratum conyzoides	210	9	42.86	10	23.33	4.62	11.31	7.29	**23.22**
Ageratum houstonianum	227	9	42.86	10.81	25.22	4.62	12.23	7.88	**24.73**
Aleuritopteris albo-marginata	1	1	4.76	0.05	1	0.51	0.06	0.31	**0.88**
Amaranthus spinosus	4	1	4.76	0.19	4	0.51	0.21	1.25	**1.97**
Amaranthus viridis	1	1	4.76	0.05	1	0.51	0.06	0.31	**0.88**
Axonopus compressus	10	4	19.05	0.48	2.5	2.05	0.54	0.78	**3.37**
Borreria alata	91	14	66.67	4.33	6.5	7.18	4.9	2.03	**14.11**
Borreria ocymoides	169	18	85.71	8.05	9.39	9.23	9.11	2.93	**21.27**
Cleome rutidosperma	8	4	19.05	0.38	2	2.05	0.43	0.62	**3.1**
Cynodon dactylon	32	4	19.05	1.52	8	2.05	1.72	2.5	**6.27**

Cyperus compressus	7	2	9.52	0.33	3.5	1.03	0.37	1.09	**2.49**
Cyperus pseudokyllingioides	181	8	38.1	8.62	22.63	4.1	9.75	7.07	**20.92**
Desmodium laxiflorum	1	1	4.76	0.05	1	0.51	0.06	0.31	**0.88**
Desmodium triflorum	204	10	47.62	9.71	20.4	5.13	10.98	6.37	**22.48**
Digitaria ciliaris	16	5	23.81	0.76	3.2	2.56	0.86	1	**4.42**
Diplazium esculentum	11	3	14.29	0.52	3.67	1.54	0.59	1.15	**3.28**
Ehretia serrata	1	1	4.76	0.05	1	0.51	0.06	0.31	**0.88**
Eleusine indica	11	3	14.29	0.52	3.67	1.54	0.59	1.15	**3.28**
Emilia sonchifolia	3	2	9.52	0.14	1.5	1.03	0.16	0.47	**1.66**
Fimbristylis dichotoma	12	4	19.05	0.57	3	2.05	0.64	0.94	**3.63**
Gamochaeta pensylvanicum	17	4	19.05	0.81	4.25	2.05	0.92	1.33	**4.3**
Hydrocotyle sibthorpioides	6	1	4.76	0.29	6	0.51	0.33	1.87	**2.71**
Imperata cylindrica	164	6	28.57	7.81	27.33	3.08	8.83	8.54	**20.45**
Kyllinga brevifolia	37	5	23.81	1.76	7.4	2.56	1.99	2.31	**6.86**
Leucas indica	1	1	4.76	0.05	1	0.51	0.06	0.31	**0.88**
Lindernia ciliata	9	4	19.05	0.43	2.25	2.05	0.49	0.7	**3.24**
Lindernia crustacea	22	6	28.57	1.05	3.67	3.08	1.19	1.15	**5.42**
Lindernia pyxidaria	20	1	4.76	0.95	20	0.51	1.07	6.25	**7.83**
Mazus pumilus	1	1	4.76	0.05	1	0.51	0.06	0.31	**0.88**
Mecardonia procumbens	1	1	4.76	0.05	1	0.51	0.06	0.31	**0.88**
Melastoma malabathricum	1	1	4.76	0.05	1	0.51	0.06	0.31	**0.88**
Melochia corchorifolia	2	2	9.52	0.1	1	1.03	0.11	0.31	**1.45**
Merremia hirta	1	1	4.76	0.05	1	0.51	0.06	0.31	**0.88**
Mikania micrantha	1	1	4.76	0.05	1	0.51	0.06	0.31	**0.88**
Mitracarpus verticillatus	2	2	9.52	0.1	1	1.03	0.11	0.31	**1.45**
Murdannia nudiflora	2	1	4.76	0.1	2	0.51	0.11	0.62	**1.24**
Oldenlandia corymbosa	7	6	28.57	0.33	1.17	3.08	0.37	0.37	**3.82**
Oplismenus compositus	17	2	9.52	0.81	8.5	1.03	0.92	2.66	**4.61**
Oxalis corniculata	80	10	47.62	3.81	8	5.13	4.31	2.5	**11.94**
Paspalum conjugatum	24	4	19.05	1.14	6	2.05	1.29	1.87	**5.21**
Paspalum scrobiculatum	106	5	23.81	5.05	21.2	2.56	5.71	6.62	**14.89**
Peperomia pellucida	11	5	23.81	0.52	2.2	2.56	0.59	0.69	**3.84**
Portulaca oleracea	2	1	4.76	0.1	2	0.51	0.11	0.62	**1.24**
Pouzolzia zeylanica	3	2	9.52	0.14	1.5	1.03	0.16	0.47	**1.66**
Pueraria phaseoloides	2	1	4.76	0.1	2	0.51	0.11	0.62	**1.24**
Rhynchospora rubra	1	1	4.76	0.05	1	0.51	0.06	0.31	**0.88**
Rungia pectinata	7	1	4.76	0.33	7	0.51	0.37	2.19	**3.07**
Saccharum spontaneum	16	3	14.29	0.76	5.33	1.54	0.86	1.66	**4.06**
Scoparia dulcis	8	1	4.76	0.38	8	0.51	0.43	2.5	**3.44**
Selaginella monospora	47	6	28.57	2.24	7.83	3.08	2.53	2.45	**8.06**
Torenia violacea	2	1	4.76	0.1	2	0.51	0.11	0.62	**1.24**
Youngia japonica	36	4	19.05	1.71	9	2.05	1.93	2.81	**6.79**
TOTAL:	**1856**	**195**	**928.55**	**88.4**	**320.14**				

Table 7.22: Top Five IVI scoring species of plants in the Post-Monsoon vegetation of Kamalpur Tea Estate

Species	RF	RD	RA	IVI
Ageratum houstonianum	4.62	12.23	7.88	**24.73**
Ageratum conyzoides	4.62	11.31	7.29	**23.22**
Desmodium triflorum	5.13	10.98	6.37	**22.48**
Cyperus pseudokyllingioides	4.1	9.75	7.07	**20.92**
Borreria ocymoides	9.42	9.11	2.74	**21.27**

Like winter and pre-monsoon vegetation, the five most important species in post-monsoon vegetation are alco annuals and are very common in local vegetation out side the Tea Estates. Here, both the species of *Ageratum* (*A. conyzoides* & *A. ocymoides*) appeared as quite important species and representing with very high RD values (12.23 & 11.31 respectively).

IV: The Annual Picture: While bringing data from all three seasons under a single head, i.e. data from a total of 50 quadrates that will produce the annual structure for the weedy vegetation in Kamalpur Tea Estate. This has been presented in Table 7.23. It shows that 78 species of weeds with a total of 5261 individuals growing in the garden as recorded through 50 quadrate samplings. Maximum number of individuals has been recorded for *Borreria alata* (880 from 27 quadrates), and this is followed by *Ageratum conyzoides* (608 from 23 quadrats), *Oxalis corniculata* (422 from 27 quadrates), *Gamochaeta pensylvanicum* (345 from 18 Quadrates), *Ageratum houstonianum* (324 from 12 quadrates), etc. The ten species recorded with high IVI are also in perfect conformity (Table 7.24) with the seasonal data. Through the annual calculation, only one new species, *Imperata cylindrica* has been recognised as an important plant. The 1st & 3rd species in Table 7.24 are similarly distributed in the vegetation as both the plant has been recorded in 27 quadrates but the 1st is represented by more than double the number of individuals of 3rd species. Again, only these two species (*Borreria alata* & *Oxalis corniculata*) have been recorded from more than 50% of the quadrates. Other two plants in Table 7.24, *Ageratum houstonianum* and *Digitaria ciliaris* are recorded with similar number of 324 individuals. But, the first species has been recorded from 12 quadrates and the second from 24 quadrates. That means the frequency of distribution for *Digitaria ciliaris* is much better or, in other words, it is a better competitor and can survive in much more diversified association and habitat conditions.

The population structure of *Borreria alata* starts increasing with the increase of ambient temperature after the winter is over and the habitat either receive a few showers of rain or some comfortable amount of moisture through irrigation in Tea Gardens. That explains the sudden increase of its population in the pre-monsoon period. However, the uses of weedicides in Tea Gardens change the vegetastion structure within a few days. And, that is the reason behind the sudden decrease of population of *Borreria alata* in post-monsoon vegetation. *Ageratum houstonianum* prefer cooler climate than *A. conyzoides*. The ambient temperature stats decreasing gradually in post-monsoon period and that helps the increase of population of *A. houstonianum* during this season. Other species like *Desmodium triflorum, Borreria ocymoides, Cyperus pseudokyllingoides* and *Imperata cylindrica,* a perennial grass, also emerged as important weeds in most most of the seasons. So, all these species are to be treated as very important weeds in the Kamalpur Tea Estate.

Table 7.23: Analysis with the whole year quadrate sample data from Kamalpur Tea Estate

Name of Plants	NI	NQ	F	D	A	RF	RD	RA	IVI	SD
Ageratum conyzoides	608	23	46	12.16	26.43	4.83	11.56	5.23	**21.62**	-0.24938
Ageratum houstonianum	324	12	24	6.48	27	2.52	6.16	5.34	**14.02**	-0.17166
Aleuritopteris albo-marginata	1	1	2	0.02	1	0.21	0.02	0.2	**0.43**	-0.00546
Amaranthus spinosus	4	1	2	0.08	4	0.21	0.08	0.79	**1.08**	-0.00163
Amaranthus viridis	1	1	2	0.02	1	0.21	0.02	0.2	**0.43**	-0.05036
Axonopus compressus	59	17	34	1.18	3.47	3.57	1.12	0.69	**5.38**	-0.2991
Borreria alata	880	27	54	17.6	32.59	5.67	16.73	6.44	**28.84**	-0.13765
Borreria ocymoides	232	24	48	4.64	9.67	5.04	4.41	1.91	**11.36**	-0.00773
Centella asiatica	6	4	8	0.12	1.5	0.84	0.11	0.3	**1.25**	-0.00163
Cleome rutidosperma	8	4	8	0.16	2	0.84	0.15	0.4	**1.39**	-0.00987
Clerodendrum viscosum	1	1	2	0.02	1	0.21	0.02	0.2	**0.43**	-0.00163
Conyza canadensis	1	1	2	0.02	1	0.21	0.02	0.2	**0.43**	-0.00163
Crassocephalum crepidioides	51	9	18	1.02	5.67	1.89	0.97	1.12	**3.98**	-0.04494
Crotalaria cytisoides	1	1	2	0.02	1	0.21	0.02	0.2	**0.43**	-0.00163
Cyanthillium cinereum	2	2	4	0.04	1	0.42	0.04	0.2	**0.66**	-0.00299
Cynodon dactylon	113	16	32	2.26	7.06	3.36	2.15	1.4	**6.91**	-0.08249
Cyperus compressus	88	8	16	1.76	11	1.68	1.67	2.17	**5.52**	-0.06843
Cyperus cyperoides	6	5	10	0.12	1.2	1.05	0.11	0.24	**1.4**	-0.00773
Cyperus pseudokyllingioides	185	10	20	3.7	18.5	2.1	3.52	3.66	**9.28**	-0.11772
Desmodium laxiflorum	1	1	2	0.02	1	0.21	0.02	0.2	**0.43**	-0.00163
Desmodium triflorum	279	21	42	5.58	13.29	4.41	5.3	2.63	**12.34**	-0.15575
Digitaria ciliaris	324	24	48	6.48	13.5	5.04	6.16	2.67	**13.87**	-0.17166
Digitaria sanguinalis	9	3	6	0.18	3	0.63	0.17	0.59	**1.39**	-0.0109
Diplazium esculentum	19	7	14	0.38	2.71	1.47	0.36	0.54	**2.37**	-0.02031
Dryopteris filix-mas	47	4	8	0.94	11.75	0.84	0.89	2.32	**4.05**	-0.04215
Ehretia serrata	1	1	2	0.02	1	0.21	0.02	0.2	**0.43**	-0.00163
Eleusine indica	32	8	16	0.64	4	1.68	0.61	0.79	**3.08**	-0.03103
Emilia sonchifolia	21	5	10	0.42	4.2	1.05	0.4	0.83	**2.28**	-0.02205
Eragrostis gangetica	4	3	6	0.08	1.33	0.63	0.08	0.26	**0.97**	-0.00546

Eragrostis tenella	10	2	4	0.2	5	0.42	0.19	0.99	**1.6**	-0.01191
Eragrostis unioloides	35	5	10	0.7	7	1.05	0.67	1.38	**3.1**	-0.03335
Fimbristylis dichotoma	22	6	12	0.44	3.67	1.26	0.42	0.73	**2.41**	-0.0229
Gamochaeta pensylvanicum	345	18	36	6.9	19.17	3.78	6.56	3.79	**14.13**	-0.17867
Hedyotis scandens	6	3	6	0.12	2	0.63	0.11	0.4	**1.14**	-0.00773
Hydrocotyle sibthorpioides	29	6	12	0.58	4.83	1.26	0.55	0.96	**2.77**	-0.02867
Hypericum japonicum	17	3	6	0.34	5.67	0.63	0.32	1.12	**2.07**	-0.01853
Imperata cylindrica	166	7	14	3.32	23.71	1.47	3.16	4.69	**9.32**	-0.10905
Ixeris polycephala	7	3	6	0.14	2.33	0.63	0.13	0.46	**1.22**	-0.00881
Kyllinga brevifolia	47	7	14	0.94	6.71	1.47	0.89	1.33	**3.69**	-0.04215
Kyllinga nemoralis	2	1	2	0.04	2	0.21	0.04	0.4	**0.65**	-0.00299
Leucas indica	8	3	6	0.16	2.67	0.63	0.15	0.53	**1.31**	-0.00987
Lindernia ciliata	16	5	10	0.32	3.2	1.05	0.3	0.63	**1.98**	-0.01763
Lindernia crustacea	40	9	18	0.8	4.44	1.89	0.76	0.88	**3.53**	-0.0371
Lindernia pyxidaria	20	1	2	0.4	20	0.21	0.38	3.95	**4.54**	-0.02118
Mazus pumilus	40	7	14	0.8	5.71	1.47	0.76	1.13	**3.36**	-0.0371
Mecardonia procumbens	9	3	6	0.18	3	0.63	0.17	0.59	**1.39**	-0.0109
Melastoma malabathricum	1	1	2	0.02	1	0.21	0.02	0.2	**0.43**	-0.00163
Melochia corchorifolia	2	2	4	0.04	1	0.42	0.04	0.2	**0.66**	-0.00299
Merremia hirta	1	1	2	0.02	1	0.21	0.02	0.2	**0.43**	-0.00163
Mikania micrantha	3	3	6	0.06	1	0.63	0.06	0.2	**0.89**	-0.00426
Mimosa pudica	1	1	2	0.02	1	0.21	0.02	0.2	**0.43**	-0.00163
Mitracarpus verticillatus	71	9	18	1.42	7.89	1.89	1.35	1.56	**4.8**	-0.0581
Murdannia nudiflora	2	1	2	0.04	2	0.21	0.04	0.4	**0.65**	-0.00299
Neolamarckia cadamba	3	1	2	0.06	3	0.21	0.06	0.59	**0.86**	-0.00426
Oldenlandia corymbosa	26	11	22	0.52	2.36	2.31	0.49	0.47	**3.27**	-0.02624
Oldenlandia diffusa	3	2	4	0.06	1.5	0.42	0.06	0.3	**0.78**	-0.00426
Oplismenus compositus	44	7	14	0.88	6.29	1.47	0.84	1.24	**3.55**	-0.04001
Oxalis corniculata	422	27	54	8.44	15.63	5.67	8.02	3.09	**16.78**	-0.20238
Oxalis corymbosa	21	6	12	0.42	3.5	1.26	0.4	0.69	**2.35**	-0.02205
Paspalum conjugatum	26	5	10	0.52	5.2	1.05	0.49	1.03	**2.57**	-0.02624
Paspalum scrobiculatum	153	10	20	3.06	15.3	2.1	2.91	3.03	**8.04**	-0.10288
Peperomia pellucida	11	5	10	0.22	2.2	1.05	0.21	0.43	**1.69**	-0.0129
Phyllanthus urinaria	5	3	6	0.1	1.67	0.63	0.1	0.33	**1.06**	-0.00661
Polygonum plebeium	84	3	6	1.68	28	0.63	1.6	5.54	**7.77**	-0.06606
Portulaca oleracea	2	1	2	0.04	2	0.21	0.04	0.4	**0.65**	-0.00299
Pouzolzia zeylanica	19	5	10	0.38	3.8	1.05	0.36	0.75	**2.16**	-0.02031
Pseudognaphalium affine	7	3	6	0.14	2.33	0.63	0.13	0.46	**1.22**	-0.00881
Pueraria phaseoloides	2	1	2	0.04	2	0.21	0.04	0.4	**0.65**	-0.00299
Rhynchospora rubra	1	1	2	0.02	1	0.21	0.02	0.2	**0.43**	-0.00163
Rungia pectinata	7	1	2	0.14	7	0.21	0.13	1.38	**1.72**	-0.00881
Saccharum spontaneum	30	5	10	0.6	6	1.05	0.57	1.19	**2.81**	-0.02946
Scoparia dulcis	19	4	8	0.38	4.75	0.84	0.36	0.94	**2.14**	-0.02031
Seedlings (unidentified)	2	1	2	0.04	2	0.21	0.04	0.4	**0.65**	-0.00299
Selaginella monospora	47	6	12	0.94	7.83	1.26	0.89	1.55	**3.7**	-0.04215

Stellaria media	47	2	4	0.94	23.5	0.42	0.89	4.65	**5.96**	-0.04215
Torenia violacea	14	5	10	0.28	2.8	1.05	0.27	0.55	**1.87**	-0.01578
Trema orientalis	2	1	2	0.04	2	0.21	0.04	0.4	**0.65**	-0.00299
Youngia japonica	56	9	18	1.12	6.22	1.89	1.06	1.23	**4.18**	-0.04835
TOTAL:	**5261**	**476**	**952**	**105.22**	**505.75**					**-3.16**

Table 7.24: Top Ten IVI scoring species of weedy plants in the vegetation of Kamalpur Tea Estate

Species	RF	RD	RA	IVI
Borreria alata	5.67	16.73	6.44	**28.84**
Ageratum conyzoides	4.83	11.56	5.23	**21.62**
Oxalis corniculata	5.67	8.02	3.09	**16.78**
Gamochaeta pensylvanicum	3.78	6.56	3.79	**14.13**
Ageratum houstonianum	2.52	6.16	5.34	**14.02**
Digitaria ciliaris	5.04	6.16	2.67	**13.87**
Desmodium triflorum	4.41	5.3	2.63	**12.34**
Borreria ocymoides	5.04	4.41	1.91	**11.36**
Imperata cylindrica	1.47	3.16	4.69	**9.32**
Cyperus pseudokyllingioides	2.1	3.52	3.66	**9.28**

Species Diversity [Shannon-Weiner Index] for this Tea Garden has been determined to -3.16. This is a moderate value of diversity. Such a value was under expectation because the habitate is highly disturbed one.

Species Richness has been determined through **Menhinick's Index** and the obtained value is **1.075**.

7.3.4 Matigara Tea Estate

I. Survey in the Winter: A total of 13 quadrates have been studied and the analysis of the recorded data has been presented in Table 7.25. Only 31 species of plants has been recorded through the process. As for any other vegetation, the population size for different species varies greatly. The total number of 1540 individuals, which is quite higher than the previously discussed gardens in Terai has been recorded in Matigara Tea Estate of which *Borreria alata* (415), *Borreria ocymoides* (203), *Ageratum conyzoides* (180), *Desmodium triflorum* (161), *Oldenlandia corymbosa* (111) etc. are well represented species. The first species, again, has been recorded from the 10 quadrates. So, on analysis, the species is presented with high degree of values for Frequency [F = 76.92; RF = 9.35], Density [D = 31.92; RD = 26.95] and Abundance [A = 41.5; RA = 14.09] and thereby the highest IVI for the season in this garden [IVI = 50.39]. *Borreria* *ocymoides*, another common herb of the local flora has recorded an IVI of 29.57 with a better population number (i.e. 203) and frequency of distribution (recoded in 7 quadrates) but less IVI score than *Ageratum conyzoides* with a much less population number (180) and frequency of distribution (recoded in 6 quadrates; IVI = 27.48). Five species with highest IVI from this analysis has been presented separately in Table 7.26.

Table 7.25: Analysis of winter quadrate sample data from Matigara Tea Estate

Name of Plants	NI	NQ	F	D	A	RF	RD	RA	IVI
Ageratum conyzoides	180	6	46.15	13.85	30	5.61	11.69	10.18	**27.48**
Ageratum houstonianum	87	4	30.77	6.69	21.75	3.74	5.65	7.38	**16.77**
Axonopus compressus	39	8	61.54	3	4.88	7.48	2.53	1.66	**11.67**
Borreria alata	415	10	76.92	31.92	41.5	9.35	26.95	14.09	**50.39**
Borreria ocymoides	203	7	53.85	15.62	29	6.54	13.19	9.84	**29.57**
Centella asiatica	1	1	7.69	0.08	1	0.93	0.07	0.34	**1.34**
Crassocephalum crepidioides	5	5	38.46	0.38	1	4.67	0.32	0.34	**5.33**
Crotalaria cytisoides	1	1	7.69	0.08	1	0.93	0.07	0.34	**1.34**
Cyanthillium cinereum	1	1	7.69	0.08	1	0.93	0.07	0.34	**1.34**
Cynodon dactylon	12	4	30.77	0.92	3	3.74	0.78	1.02	**5.54**
Cyperus compressus	5	3	23.08	0.38	1.67	2.8	0.32	0.57	**3.69**
Desmodium triflorum	161	9	69.23	12.38	17.89	8.41	10.45	6.07	**24.93**
Digitaria ciliaris	24	4	30.77	1.85	6	3.74	1.56	2.04	**7.34**
Emilia sonchifolia	20	4	30.77	1.54	5	3.74	1.3	1.7	**6.74**
Eragrostis unioloides	6	4	30.77	0.46	1.5	3.74	0.39	0.51	**4.64**
Euphorbia hirta	2	1	7.69	0.15	2	0.93	0.13	0.68	**1.74**
Imperata cylindrica	28	4	30.77	2.15	7	3.74	1.82	2.38	**7.94**
Kyllinga brevifolia	10	2	15.38	0.77	5	1.87	0.65	1.7	**4.22**
Leucas indica	10	3	23.08	0.77	3.33	2.8	0.65	1.13	**4.58**
Ludwigia perennis	3	1	7.69	0.23	3	0.93	0.19	1.02	**2.14**
Mitracarpus verticillatus	25	4	30.77	1.92	6.25	3.74	1.62	2.12	**7.48**
Oldenlandia corymbosa	111	3	23.08	8.54	37	2.8	7.21	12.56	**22.57**
Oldenlandia diffusa	72	3	23.08	5.54	24	2.8	4.68	8.15	**15.63**
Oxalis corniculata	2	1	7.69	0.15	2	0.93	0.13	0.68	**1.74**
Paspalum scrobiculatum	10	2	15.38	0.77	5	1.87	0.65	1.7	**4.22**
Pouzolzia zeylanica	10	1	7.69	0.77	10	0.93	0.65	3.39	**4.97**
Saccharum spontaneum	71	4	30.77	5.46	17.75	3.74	4.61	6.02	**14.37**
Trema orientalis	3	2	15.38	0.23	1.5	1.87	0.19	0.51	**2.57**
Urochloa ramosa	23	5	38.46	1.77	4.6	4.67	1.49	1.56	**7.72**
TOTAL:	**1540**	**107**	**823.06**	**118.45**	**294.62**				

Table 7.26: Top Five IVI scoring species of plants in the winter vegetation of Matigara Tea Estate

Species	RF	RD	RA	IVI
Borreria alata	9.35	26.95	14.09	**50.39**

Borreria ocymoides	6.54	13.19	9.84	**29.57**
Ageratum conyzoides	5.61	11.69	10.18	**27.48**
Desmodium triflorum	8.41	10.45	6.07	**24.93**
Oldenlandia corymbosa	2.8	7.21	12.56	**22.57**

All the five important weed species of Matigara Tea Estate as presented in Table 7.26 are therophytic herbs and all these generally starts their life in premonsoon, flourish during monsoon and early post-monsoon and starts withering during winter. Except *Borreria ocymoides*, all other species are generally available in the vegetation almost round the year with much variable status of their growth, reproduction and death.

II. Survey in the Pre-Monsoon Period: A total of 60 quadrates have been studied and the analysis of the recorded data has been presented in Table 7.27. As much as 47 species of plants has been recorded through the process during this dry period. Like any other vegetation, the population size for different species varies greatly. A total number of 6533 individuals has been recorded through the quadrate samples of which *Borreria alata* (2723), *Mitracarpus verticillatus* (601), *Digitaria ciliaris* (464), *Lindernia crustacea* (321), *Fimbristylis dichotoma* (275) etc. are well represented species. *Borreria alata* has been recorded in 47 quadrates, became most important species in the vegetation due to its extremely high population structure as well as very wide distribution. No other species during present survey in any one of the 7 gardens under study and in any season has scored such a high IVI of 67.47. A similar looking species, *Mitracarpus verticillatus* is coming next with the record of 601 individuals from 40 quadrates. This naturalised exotic shares similar type of habitat with *Borreria alata*. *Digitaria ciliaris*, on the other hand, recorded from 33 quadrates (more than 50%) with a moderate population structure (464) is also a common annual grass in the local flora. Generally it does not behave gregariously and never produce any rigid or big clumps. *Lindernia crustacea* is a small warm and moist season annual and generally prefer an open habitat. Presence of comparatively sparse vegetation in some quadrates probably allowed this species to proliferate. However, it is quite interesting that three out of five important weed species of this garden have been reported from more than50% of the quadrates. Another species *Desmodium triflorum*, though not listed with five important species of the garden but has been recoded from 32 quadrates. Five species with higher IVI from this analysis has been presented separately in Table 7.28.

Table 7.27: Analysis of Pre-Monsoon quadrate sample data from Matigara Tea Estate

Name of Plants	NI	NQ	F	D	A	RF	RD	RA	IVI
Ageratum conyzoides	154	10	16.67	2.57	15.4	2.19	2.36	4.12	**8.67**

Ageratum houstonianum	172	9	15	2.87	19.11	1.97	2.64	5.12	**9.73**
Axonopus compressus	18	7	11.67	0.3	2.57	1.53	0.28	0.69	**2.5**
Borreria alata	2723	47	78.33	45.38	57.94	10.28	41.68	15.51	**67.47**
Borreria ocymoides	211	9	15	3.52	23.44	1.97	3.23	6.28	**11.48**
Centella asiatica	10	3	5	0.17	3.33	0.66	0.16	0.89	**1.71**
Chromolaena odoratum	1	1	1.67	0.02	1	0.22	0.02	0.27	**0.51**
Cleome rutidosperma	1	1	1.67	0.02	1	0.22	0.02	0.27	**0.51**
Conyza canadensis	1	1	1.67	0.02	1	0.22	0.02	0.27	**0.51**
Crassocephalum crepidioides	194	29	48.33	3.23	6.69	6.35	2.97	1.79	**11.11**
Crotalaria pallida	2	1	1.67	0.03	2	0.22	0.03	0.54	**0.79**
Cyanthillium cinereum	4	2	3.33	0.07	2	0.44	0.06	0.54	**1.04**
Cynodon dactylon	25	9	15	0.42	2.78	1.97	0.39	0.74	**3.1**
Cyperus compressus	20	8	13.33	0.33	2.5	1.75	0.3	0.67	**2.72**
Cyperus iria	11	3	5	0.18	3.67	0.66	0.17	0.98	**1.81**
Desmodium triflorum	182	32	53.33	3.03	5.69	7	2.78	1.52	**11.3**
Digitaria ciliaris	464	33	55	7.73	14.06	7.22	7.1	3.76	**18.08**
Digitaria sanguinalis	8	1	1.67	0.13	8	0.22	0.12	2.14	**2.48**
Eleusine indica	3	2	3.33	0.05	1.5	0.44	0.05	0.4	**0.89**
Emilia sonchifolia	197	19	31.67	3.28	10.37	4.16	3.01	2.78	**9.95**
Eragrostis gangetica	8	3	5	0.13	2.67	0.66	0.12	0.71	**1.49**
Eragrostis tenella	20	2	3.33	0.33	10	0.44	0.3	2.68	**3.42**
Eragrostis unioloides	99	22	36.67	1.65	4.5	4.81	1.52	1.2	**7.53**
Fimbristylis dichotoma	275	16	26.67	4.58	17.19	3.5	4.21	4.6	**12.31**
Hydrocotyle sibthorpioides	3	1	1.67	0.05	3	0.22	0.05	0.8	**1.07**
Imperata cylindrica	22	2	3.33	0.37	11	0.44	0.34	2.95	**3.73**
Kyllinga nemoralis	14	3	5	0.23	4.67	0.66	0.21	1.25	**2.12**
Leucas indica	75	15	25	1.25	5	3.28	1.15	1.34	**5.77**
Lindernia crustacea	321	17	28.33	5.35	18.88	3.72	4.91	5.05	**13.68**
Lindernia pyxidaria	20	2	3.33	0.33	10	0.44	0.3	2.68	**3.42**
Mikania micrantha	3	3	5	0.05	1	0.66	0.05	0.27	**0.98**
Mitracarpus verticillatus	601	40	66.67	10.02	15.03	8.75	9.2	4.02	**21.97**
Murdannia nudiflora	6	2	3.33	0.1	3	0.44	0.09	0.8	**1.33**
Oldenlandia corymbosa	85	6	10	1.42	14.17	1.31	1.3	3.79	**6.4**
Oldenlandia diffusa	19	7	11.67	0.32	2.71	1.53	0.29	0.73	**2.55**
Oxalis corniculata	168	21	35	2.8	8	4.6	2.57	2.14	**9.31**
Paspalum conjugatum	71	11	18.33	1.18	6.45	2.41	1.08	1.73	**5.22**
Paspalum scrobiculatum	196	26	43.33	3.27	7.54	5.69	3	2.02	**10.71**
Phyllanthus urinaria	29	13	21.67	0.48	2.23	2.85	0.44	0.6	**3.89**
Pouzolzia zeylanica	37	2	3.33	0.62	18.5	0.44	0.57	4.95	**5.96**
Rhynchospora rubra	4	1	1.67	0.07	4	0.22	0.06	1.07	**1.35**
Saccharum spontaneum	17	4	6.67	0.28	4.25	0.88	0.26	1.14	**2.28**
Scoparia dulcis	16	6	10	0.27	2.67	1.31	0.25	0.71	**2.27**
Setaria palmifolia	1	1	1.67	0.02	1	0.22	0.02	0.27	**0.51**
Solanum nigrum	1	1	1.67	0.02	1	0.22	0.02	0.27	**0.51**
Tephrosia candida	20	2	3.33	0.33	10	0.44	0.3	2.68	**3.42**
Trema orientalis	1	1	1.67	0.02	1	0.22	0.02	0.27	**0.51**
TOTAL:	**6533**	**457**	**761.68**	**108.89**	**373.51**				

Table 7.28: Top Five IVI scoring species of plants in the Pre-Monsoon vegetation of Matigara Tea Estate

Species	RF	RD	RA	IVI
Borreria alata	10.28	41.68	15.51	**67.47**
Mitracarpus verticillatus	8.75	9.2	4.02	**21.97**
Digitaria ciliaris	7.22	7.1	3.76	**18.08**
Lindernia crustacea	3.72	4.91	5.05	**13.68**
Fimbristylis dichotoma	3.5	4.21	4.6	**12.31**

III. Survey in the Post-Monsoon Period: A total of 38 quadrates have been studied and the analysis of the recorded data has been presented in Table 7.29. And, a good number of 46 species of plants has been recorded through the process. As for any other vegetation, the population size for different species varies greatly in this garden too. The total number of 5278 individuals has been recorded that expresses a picture of high occurrence of weeds in the vegetation even during post-monsoon period. Like two previously discussed season in the garden, in this post-monsoon period also *Borreria alata* has been recorded with highest number of 949 individuals from 31 quadrates. So, the species has aquired values like RF = 9.45 and RD = 17.98 and a IVI score of 34.58. The other species of the same genus, *B. ocymoides*, also has been recorded from similar number of 31 quadrates though with a much less number (796) individuals. But, *Ageratum conyzoides* with its recorded 657 individuals from only 9 quadrates has a better IVI score of 32.25 where as it is only 30.35 for *Borreria ocymoides*. In this season too Desmodium triflorum has aquired the fourth position with its RF, RD & IVI scores 9.15, 14.17 & 29.15, respectively. The only perennial weed imerged as important in any season from this garden is the *Imperata cylindrical* is known to be a difficult grass in terrestrial farmland. But, the virulence and the population structure of the species generally decrease with age in a regularly cultivated farmland as it is strictly a heliophytic herb. Five species with highest IVI from this analysis for the Matigara Tea Estate has been presented separately in Table 7.30.

Table 7.29: Phytosociological analysis of Post-Monsoon quadrate sample data from Matigara Tea Estate

Name of Plants	NI	NQ	F	D	A	RF	RD	RA	IVI
Ageratum conyzoides	657	9	23.68	17.29	73	2.74	12.45	17.06	**32.25**
Ageratum houstonianum	202	11	28.95	5.32	18.36	3.35	3.83	4.29	**11.47**
Axonopus compressus	86	14	36.84	2.26	6.14	4.27	1.63	1.43	**7.33**

Bambusa sp	2	1	2.63	0.05	2	0.3	0.04	0.47	**0.81**
Borreria alata	949	31	81.58	24.97	30.61	9.45	17.97	7.15	**34.57**
Borreria ocymoides	796	31	81.58	20.95	25.68	9.45	15.08	6	**30.53**
Chloris dolichostachya	38	2	5.26	1	19	0.61	0.72	4.44	**5.77**
Cleome rutidosperma	20	7	18.42	0.53	2.86	2.13	0.38	0.67	**3.18**
Crassocephalum crepidioides	14	6	15.79	0.37	2.33	1.83	0.27	0.54	**2.64**
Cyanthillium cinereum	5	1	2.63	0.13	5	0.3	0.09	1.17	**1.56**
Cynodon dactylon	56	5	13.16	1.47	11.2	1.52	1.06	2.62	**5.2**
Cyperus compressus	4	1	2.63	0.11	4	0.3	0.08	0.93	**1.31**
Cyperus cyperoides	6	1	2.63	0.16	6	0.3	0.12	1.4	**1.82**
Cyperus iria	3	1	2.63	0.08	3	0.3	0.06	0.7	**1.06**
Cyperus pseudokyllingioides	287	16	42.11	7.55	17.94	4.88	5.43	4.19	**14.5**
Desmodium triflorum	748	30	78.95	19.68	24.93	9.15	14.17	5.83	**29.15**
Digitaria ciliaris	44	8	21.05	1.16	5.5	2.44	0.84	1.29	**4.57**
Diplazium esculentum	1	1	2.63	0.03	1	0.3	0.02	0.23	**0.55**
Dryopteris filix-mas	1	1	2.63	0.03	1	0.3	0.02	0.23	**0.55**
Ehretia serrata	1	1	2.63	0.03	1	0.3	0.02	0.23	**0.55**
Eleusine indica	7	3	7.89	0.18	2.33	0.91	0.13	0.54	**1.58**
Emilia sonchifolia	39	5	13.16	1.03	7.8	1.52	0.74	1.82	**4.08**
Eragrostis tenella	9	1	2.63	0.24	9	0.3	0.17	2.1	**2.57**
Eragrostis unioloides	17	5	13.16	0.45	3.4	1.52	0.32	0.79	**2.63**
Euphorbia hirta	5	1	2.63	0.13	5	0.3	0.09	1.17	**1.56**
Fimbristylis dichotoma	86	11	28.95	2.26	7.82	3.35	1.63	1.83	**6.81**
Imperata cylindrica	412	10	26.32	10.84	41.2	3.05	7.8	9.63	**20.48**
Kyllinga brevifolia	13	5	13.16	0.34	2.6	1.52	0.24	0.61	**2.37**
Leucas indica	9	5	13.16	0.24	1.8	1.52	0.17	0.42	**2.11**
Lindernia crustacea	25	8	21.05	0.66	3.13	2.44	0.48	0.73	**3.65**
Ludwigia perennis	1	1	2.63	0.03	1	0.3	0.02	0.23	**0.55**
Merremia hirta	1	1	2.63	0.03	1	0.3	0.02	0.23	**0.55**
Mitracarpus verticillatus	26	6	15.79	0.68	4.33	1.83	0.49	1.01	**3.33**
Murdannia nudiflora	5	3	7.89	0.13	1.67	0.91	0.09	0.39	**1.39**
Oldenlandia corymbosa	132	20	52.63	3.47	6.6	6.1	2.5	1.54	**10.14**
Oldenlandia diffusa	19	6	15.79	0.5	3.17	1.83	0.36	0.74	**2.93**
Oxalis corniculata	5	1	2.63	0.13	5	0.3	0.09	1.17	**1.56**
Paspalum conjugatum	63	9	23.68	1.66	7	2.74	1.19	1.64	**5.57**
Paspalum scrobiculatum	203	15	39.47	5.34	13.53	4.57	3.84	3.16	**11.57**
Phyllanthus urinaria	3	2	5.26	0.08	1.5	0.61	0.06	0.35	**1.02**
Rhynchospora rubra	6	1	2.63	0.16	6	0.3	0.12	1.4	**1.82**
Rungia pectinata	8	2	5.26	0.21	4	0.61	0.15	0.93	**1.69**
Saccharum spontaneum	175	20	52.63	4.61	8.75	6.1	3.32	2.04	**11.46**
Selaginella monospora	79	5	13.16	2.08	15.8	1.52	1.5	3.69	**6.71**
Solanum nigrum	1	1	2.63	0.03	1	0.3	0.02	0.23	**0.55**
Urochloa ramosa	9	3	7.89	0.24	3	0.91	0.17	0.7	**1.78**
TOTAL:	**5278**	**328**	**863.12**	**138.92**	**427.98**				

Table 7.30: Top Five IVI scoring species of plants in the Post-Monsoon vegetation of Matigara Tea Estate

Species	RF	RD	RA	IVI
Borreria alata	9.45	17.97	7.15	**34.57**
Ageratum conyzoides	2.74	12.45	17.06	**32.25**
Borreria ocymoides	9.45	15.08	6	**30.53**
Desmodium triflorum	9.15	14.17	5.83	**29.15**
Imperata cylindrica	3.05	7.8	9.63	**20.48**

IV: The Annual Picture: While bringing data from all three seasons under a single head, i.e. data from a total of 111 quadrates that will produce the annual structure for the weedy vegetation in Matigara Tea Estate. This has been presented in Table 7.31. It shows that 62 species of weeds with a total of 13,351 individuals growing in the garden as recorded through 111 quadrate samplings. Maximum number of individuals has been recorded for *Borreria alata* (4087 from 88 quadrates), and this is followed by *Borreria ocymoides* (1210 from 47 quadrates), *Desmodium triflorum* (1091 from 71 quadrates), *Ageratum conyzoides* (991 from 23 quadrats), *Mitracarpus verticillatus* (652 from 50 quadrates), *Digitaria ciliaris* (532 from 45 duadrates), *Imperata cylindrical* (462 from 16 quadrates), *Ageratum houstonianum* (461 from 24 quadrates), etc. Comparing with three other gardens of Terai under study, Matigara Tea Estate showed much more concentrated population structure. Two species for both of *Borreria* and *Ageratum* have been determined as important weeds in this garden. *Borreria alata* has recorded heighest IVI at the seasonal level (winter) and also at the annual level in Matigara Tea Estate. Population structure of *Borreria ocymoides* and *Desmodium triflorum* is also quite high. *Ageratum conyzoides*, which occupied second position during winter and post-monsoon vegetation appeared to be 4th important weed on the annual basis. Three species, *Ageratum houstonianum*, *Paspalum scrobiculatum* and *Fimbristylis dichotoma*, which were never determined as important species in any of the seasons in this garden but came under the list of ten high IVI species on the annual basis calculation. Again, two plants, *Lindernia crustacea* and *Oldenlandia corymbosa* were determined as important weeds in different seasons, but appeared to be not so important when considered annually. Both of these two plants are very small annuals and can not cause any concern about the yield of the crop. So, the the ten species recorded with high IVI are in good conformity (Table 7.32) with the seasonal data. Except *Imperata cylindrical* all other nine important weeds are annuals. It is also interesting to note that an amphibious species *Fimbristylis dichotoma* appeared as an important weed in this garden, which certainly reflects a good water relation of the habitat. A good water relation is also suitable for the growth of other selected species like *Borreria alata*, *Ageratum conyzoides*, *Ageratum houstonianum* and *Paspatum scrobiculatum*. Out of these ten important weeds only two Borreria alata and Desmodium triflorum have been recorded from more than 50% quadrates though the recorded diversity at the species level is not high and only 62 species has been recorded from this garden with the use of as much as 111 quadrates. Probably the extreme domination of Borreria alata exerted much stress towards the survival and/ or proliferation of many species. However, even under such situation, population structures of all the determined important species are quite high. So, all these species are to be treated as very important weeds in the Matigara Tea Estate.

Table 7.31: Analysis with the whole year quadrate sample data from Matigara Tea Estate

Name of Plants	NI	NQ	F	D	A	RF	RD	RA	IVI	SD
Ageratum conyzoides	991	25	22.52	8.93	39.64	2.8	7.42	8.03	**18.25**	-0.19304
Ageratum houstonianum	461	24	21.62	4.15	19.21	2.69	3.45	3.89	**10.03**	-0.11622
Axonopus compressus	143	29	26.13	1.29	4.93	3.25	1.07	1	**5.32**	-0.04859
Bambusa sp	2	1	0.9	0.02	2	0.11	0.02	0.41	**0.54**	-0.00132
Borreria alata	4087	88	79.28	36.82	46.44	9.87	30.61	9.41	**49.89**	-0.36238
Borreria ocymoides	1210	47	42.34	10.9	25.74	5.27	9.06	5.21	**19.54**	-0.2176
Centella asiatica	11	4	3.6	0.1	2.75	0.45	0.08	0.56	**1.09**	-0.00585
Chloris dolichostachya	38	2	1.8	0.34	19	0.22	0.28	3.85	**4.35**	-0.01668
Chromolaena odoratum	1	1	0.9	0.01	1	0.11	0.01	0.2	**0.32**	-0.00071
Cleome rutidosperma	21	8	7.21	0.19	2.63	0.9	0.16	0.53	**1.59**	-0.01015
Conyza canadensis	1	1	0.9	0.01	1	0.11	0.01	0.2	**0.32**	-0.00071
Crassocephalum crepidioides	213	40	36.04	1.92	5.33	4.49	1.6	1.08	**7.17**	-0.06602
Crotalaria cytisoides	1	1	0.9	0.01	1	0.11	0.01	0.2	**0.32**	-0.00071
Crotalaria pallida	2	1	0.9	0.02	2	0.11	0.02	0.41	**0.54**	-0.00132
Cyanthillium cinereum	10	4	3.6	0.09	2.5	0.45	0.07	0.51	**1.03**	-0.00539
Cynodon dactylon	93	18	16.22	0.84	5.17	2.02	0.7	1.05	**3.77**	-0.0346
Cyperus compressus	29	12	10.81	0.26	2.42	1.35	0.22	0.49	**2.06**	-0.01332
Cyperus cyperoides	6	1	0.9	0.05	6	0.11	0.04	1.22	**1.37**	-0.00346
Cyperus iria	14	4	3.6	0.13	3.5	0.45	0.11	0.71	**1.27**	-0.00719
Cyperus pseudokyllingioides	287	16	14.41	2.59	17.94	1.79	2.15	3.63	**7.57**	-0.08254
Desmodium triflorum	1091	71	63.96	9.83	15.37	7.96	8.17	3.11	**19.24**	-0.20466
Digitaria ciliaris	532	45	40.54	4.79	11.82	5.05	3.98	2.39	**11.42**	-0.12842
Digitaria sanguinalis	8	1	0.9	0.07	8	0.11	0.06	1.62	**1.79**	-0.00445
Diplazium esculentum	1	1	0.9	0.01	1	0.11	0.01	0.2	**0.32**	-0.00071
Dryopteris filix-mas	1	1	0.9	0.01	1	0.11	0.01	0.2	**0.32**	-0.00071
Ehretia serrata	1	1	0.9	0.01	1	0.11	0.01	0.2	**0.32**	-0.00071
Eleusine indica	10	5	4.5	0.09	2	0.56	0.07	0.41	**1.04**	-0.00539
Emilia sonchifolia	256	28	25.23	2.31	9.14	3.14	1.92	1.85	**6.91**	-0.07582
Eragrostis gangetica	8	3	2.7	0.07	2.67	0.34	0.06	0.54	**0.94**	-0.00445
Eragrostis tenella	29	3	2.7	0.26	9.67	0.34	0.22	1.96	**2.52**	-0.01332
Eragrostis unioloides	122	31	27.93	1.1	3.94	3.48	0.91	0.8	**5.19**	-0.04291
Euphorbia hirta	7	2	1.8	0.06	3.5	0.22	0.05	0.71	**0.98**	-0.00396
Fimbristylis dichotoma	361	27	24.32	3.25	13.37	3.03	2.7	2.71	**8.44**	-0.09762
Hydrocotyle	3	1	0.9	0.03	3	0.11	0.02	0.61	**0.74**	-0.00189

sibthorpioides										
Imperata cylindrica	462	16	14.41	4.16	28.88	1.79	3.46	5.85	**11.1**	-0.1164
Kyllinga brevifolia	23	7	6.31	0.21	3.29	0.79	0.17	0.67	**1.63**	-0.01096
Kyllinga nemoralis	14	3	2.7	0.13	4.67	0.34	0.11	0.95	**1.4**	-0.00719
Leucas indica	94	23	20.72	0.85	4.09	2.58	0.71	0.83	**4.12**	-0.03489
Lindernia crustacea	346	25	22.52	3.12	13.84	2.8	2.59	2.8	**8.19**	-0.09467
Lindernia pyxidaria	20	2	1.8	0.18	10	0.22	0.15	2.03	**2.4**	-0.00974
Ludwigia perennis	4	2	1.8	0.04	2	0.22	0.03	0.41	**0.66**	-0.00243
Merremia hirta	1	1	0.9	0.01	1	0.11	0.01	0.2	**0.32**	-0.00071
Mikania micrantha	3	3	2.7	0.03	1	0.34	0.02	0.2	**0.56**	-0.00189
Mitracarpus verticillatus	652	50	45.05	5.87	13.04	5.61	4.88	2.64	**13.13**	-0.14745
Murdannia nudiflora	11	5	4.5	0.1	2.2	0.56	0.08	0.45	**1.09**	-0.00585
Oldenlandia corymbosa	328	29	26.13	2.95	11.31	3.25	2.45	2.29	**7.99**	-0.09106
Oldenlandia diffusa	110	16	14.41	0.99	6.88	1.79	0.82	1.39	**4**	-0.03954
Oxalis corniculata	175	23	20.72	1.58	7.61	2.58	1.31	1.54	**5.43**	-0.05682
Paspalum conjugatum	134	20	18.02	1.21	6.7	2.24	1.01	1.36	**4.61**	-0.04618
Paspalum scrobiculatum	409	43	38.74	3.68	9.51	4.82	3.06	1.93	**9.81**	-0.10678
Phyllanthus urinaria	32	15	13.51	0.29	2.13	1.68	0.24	0.43	**2.35**	-0.01446
Pouzolzia zeylanica	47	3	2.7	0.42	15.67	0.34	0.35	3.17	**3.86**	-0.01989
Rhynchospora rubra	10	2	1.8	0.09	5	0.22	0.07	1.01	**1.3**	-0.00539
Rungia pectinata	8	2	1.8	0.07	4	0.22	0.06	0.81	**1.09**	-0.00445
Saccharum spontaneum	263	28	25.23	2.37	9.39	3.14	1.97	1.9	**7.01**	-0.07736
Scoparia dulcis	16	6	5.41	0.14	2.67	0.67	0.12	0.54	**1.33**	-0.00806
Selaginella monospora	79	5	4.5	0.71	15.8	0.56	0.59	3.2	**4.35**	-0.03035
Setaria palmifolia	1	1	0.9	0.01	1	0.11	0.01	0.2	**0.32**	-0.00071
Solanum nigrum	2	2	1.8	0.02	1	0.22	0.02	0.2	**0.44**	-0.00132
Tephrosia candida	20	2	1.8	0.18	10	0.22	0.15	2.03	**2.4**	-0.00974
Trema orientalis	4	3	2.7	0.04	1.33	0.34	0.03	0.27	**0.64**	-0.00243
Urochloa ramosa	32	8	7.21	0.29	4	0.9	0.24	0.81	**1.95**	-0.01446
TOTAL:	**13351**	**892**	**801.75**	**120.3**	**493.69**					**-2.73**

Table 7.32: Top Ten IVI scoring species of weedy plants in the vegetation of Matigara Tea Estate

Species	RF	RD	RA	IVI
Borreria alata	9.87	30.61	9.41	**49.89**
Borreria ocymoides	5.27	9.06	5.21	**19.54**
Desmodium triflorum	7.96	8.17	3.11	**19.24**
Ageratum conyzoides	2.8	7.42	8.03	**18.25**
Mitracarpus verticillatus	5.61	4.88	2.64	**13.13**
Digitaria ciliaris	5.05	3.98	2.39	**11.42**
Imperata cylindrica	1.79	3.46	5.85	**11.1**
Ageratum houstonianum	2.69	3.45	3.89	**10.03**
Paspalum scrobiculatum	4.82	3.06	1.93	**9.81**
Fimbristylis dichotoma	3.03	2.7	2.71	**8.44**

Species Diversity [Shannon-Weiner Index] for this Tea Garden has been determined to -3.73. This is a quite low value of diversity. Such a value was under expectation because the habitate is highly disturbed one at the same time extreme dominance of few species only.

Species Richness has been determined through **Menhinick's Index** and the obtained value is **0.537**.

7.3.5 Overall Weed Picture of Terai Tea Gardens:

Four Tea Gardens from Terai has been studied to understand the weeds and their social behaviour in association with the Tea bushes. The results of the survey have been discussed above at the garden level for different seasons and for round the year. Now, the results of all these four gardens compiled together to get a wholistic annual picture in Terai and that has been presented in Table 7.33.

In the selected four Tea Gardens altogether 261 quadrates have been studied at random and in different seasons. During the process altogether 25852 individuals have been counted representing 138 species of macrophytes (Pteridophytes and Angiosperms) covering 112 genera. At the family level these are representing 6 Pteridophytic, 35 Dicotyledonous and 8 Monocotyledonous families. Taxonomic distribution of recorded plants has been presented in Table 7.35.

Table 7.33: Analysis with the whole year quadrate sample data from four Tea Gardens in Terai of Darjiling.

Names of Plants	Present in T.Gs	Present in No. of T.Gs	NI	NQ	D	R	A	RD	RF	RA	IVI	SD
Ageratum conyzoides	G H K M	4	2527	109	9.68	41.76	23.18	9.77	5.13	2.9	17.81	-0.2273005
Ageratum houstonianum	G H K M	4	1069	62	4.1	23.75	17.24	4.14	2.92	2.16	9.21	-0.13172966
Albizia chinensis	H	1	2	2	0.01	0.77	1	0.01	0.09	0.13	0.23	-0.0007324
Amaranthus spinosus	K	1	4	1	0.02	0.38	4	0.02	0.05	0.5	0.56	-0.00135755
Amaranthus viridis	K	1	1	1	0	0.38	1	0	0.05	0.13	0.18	-0.00039301
Argemone mexicana	G	1	6	2	0.02	0.77	3	0.02	0.09	0.38	0.49	-0.00194222
Axonopus compressus	G H K M	4	391	75	1.5	28.74	5.21	1.51	3.53	0.65	5.7	-0.0633936
Bambusa sp	M	1	2	1	0.01	0.38	2	0.01	0.05	0.25	0.3	-0.0007324
Blumea lacera	H	1	6	2	0.02	0.77	3	0.02	0.09	0.38	0.49	-0.00194222
Boerhavia coccinea	G	1	4	2	0.02	0.77	2	0.02	0.09	0.25	0.36	-0.00135755
Borreria alata	G H K M	4	6219	159	23.83	60.92	39.11	24.1	7.49	4.89	36.43	-0.34274716
Borreria ocymoides	G H K M	4	1839	111	7.05	42.53	16.57	7.11	5.23	2.07	14.41	-0.18802345

Cardamine hirsuta	G H	2	34	4	0.13	1.53	8.5	0.13	0.19	1.06	1.38	-0.00872461
Centella asiatica	H K M	3	20	9	0.08	3.45	2.22	0.08	0.42	0.28	0.78	-0.00554264
Pityrogramma calomelanos	G	1	10	3	0.04	1.15	3.33	0.04	0.14	0.42	0.6	-0.00303944
Aleuritopteris albo-marginata	H K	2	13	5	0.05	1.92	2.6	0.05	0.24	0.33	0.61	-0.00381934
Chloris dolichostachya	M	1	38	2	0.15	0.77	19	0.15	0.09	2.38	2.62	-0.00958754
Chromolaena odoratum	M	1	1	1	0	0.38	1	0	0.05	0.13	0.18	-0.00039301
Chrysopogon aciculatus	H	1	4	1	0.02	0.38	4	0.02	0.05	0.5	0.56	-0.00135755
Cleome rutidosperma	G K M	3	42	13	0.16	4.98	3.23	0.16	0.61	0.4	1.18	-0.01043416
Clerodendrum viscosum	G K	2	33	5	0.13	1.92	6.6	0.13	0.24	0.83	1.19	-0.00850611
Coix lachryma-jobi	H	1	4	1	0.02	0.38	4	0.02	0.05	0.5	0.56	-0.00135755
Commelina suffruticosa	H	1	9	1	0.03	0.38	9	0.03	0.05	1.13	1.21	-0.00277217
Conyza canadensis	H K M	3	9	4	0.03	1.53	2.25	0.03	0.19	0.28	0.5	-0.00277217
Crassocephalum crepidioides	H K M	3	267	51	1.02	19.54	5.24	1.03	2.4	0.65	4.09	-0.04722895
Crinum amoenum	G	1	10	2	0.04	0.77	5	0.04	0.09	0.63	0.76	-0.00303944
Crotalaria cytisoides	H K M	3	9	4	0.03	1.53	2.25	0.03	0.19	0.28	0.5	-0.00277217
Crotalaria pallida	G H M	3	15	6	0.06	2.3	2.5	0.06	0.28	0.31	0.65	-0.0043239
Cuscuta reflexa	G	1	1	1	0	0.38	1	0	0.05	0.13	0.18	-0.00039301
Cyanthillium cinereum	G H K M	4	18	10	0.07	3.83	1.8	0.07	0.47	0.23	0.77	-0.00506173
Cymbopogon nardus	H	1	1	1	0	0.38	1	0	0.05	0.13	0.18	-0.00039301
Cynodon dactylon	G H K M	4	456	59	1.75	22.61	7.73	1.76	2.78	0.97	5.51	-0.07121958
Cyperus compressus	G H K M	4	155	14	0.59	5.36	11.07	0.6	0.66	1.38	2.64	-0.03067814
Cyperus cyperoides	G K M	3	8	6	0.03	2.3	1.33	0.03	0.28	0.17	0.48	-0.0025006
Cyperus iria	H M	2	54	7	0.21	2.68	7.71	0.21	0.33	0.96	1.5	-0.0128904
Cyperus pseudokyllingioides	H K M	3	484	27	1.85	10.34	17.93	1.87	1.27	2.24	5.39	-0.07447703
Cyperus sp	H	1	15	2	0.06	0.77	7.5	0.06	0.09	0.94	1.09	-0.0043239
Desmodium laxiflorum	H K	2	3	2	0.01	0.77	1.5	0.01	0.09	0.19	0.29	-0.00105155
Desmodium laxum	H	1	15	3	0.06	1.15	5	0.06	0.14	0.63	0.82	-0.0043239
Desmodium triflorum	G H K M	4	1500	100	5.75	38.31	15	5.8	4.71	1.88	12.39	-0.16518584
Dicranopteris linearis	H	1	1	1	0	0.38	1	0	0.05	0.13	0.18	-0.00039301
Digitaria ciliaris	G H K M	4	1031	89	3.95	34.1	11.58	3.99	4.19	1.45	9.63	-0.1284905
Digitaria sanguinalis	H K M	3	46	6	0.18	2.3	7.67	0.18	0.28	0.96	1.42	-0.01126602
Dioscorea alata	G	1	1	1	0	0.38	1	0	0.05	0.13	0.18	-0.00039301
Diplazium esculentum	G H K M	4	130	34	0.5	13.03	3.82	0.5	1.6	0.48	2.58	-0.02661454
Drymaria diandra	G	1	18	2	0.07	0.77	9	0.07	0.09	1.13	1.29	-0.00506173
Dryopteris filix-mas	G H K M	4	125	29	0.48	11.11	4.31	0.48	1.37	0.54	2.39	-0.02578055
Ehretia serrata	H K M	3	6	5	0.02	1.92	1.2	0.02	0.24	0.15	0.41	-0.00194222
Eleusine indica	G H K M	4	98	26	0.38	9.96	3.77	0.38	1.22	0.47	2.07	-0.02113443
Emilia sonchifolia	G H K M	4	292	39	1.12	14.94	7.49	1.13	1.84	0.94	3.9	-0.05064017
Eragrostis gangetica	K M	2	12	6	0.05	2.3	2	0.05	0.28	0.25	0.58	-0.0035627
Eragrostis tenella	H K M	3	43	6	0.16	2.3	7.17	0.17	0.28	0.9	1.35	-0.01064345
Eragrostis unioloides	K M	2	157	36	0.6	13.79	4.36	0.61	1.69	0.55	2.85	-0.03099613
Euphorbia hirta	G H M	3	34	7	0.13	2.68	4.86	0.13	0.33	0.61	1.07	-0.00872461
Evolvulus alsinoides	H	1	7	1	0.03	0.38	7	0.03	0.05	0.88	0.95	-0.00222419
Fimbristylis dichotoma	H K M	3	392	34	1.5	13.03	11.53	1.52	1.6	1.44	4.56	-0.063517

Gamochaeta pensylvanicum	G H K	3	1055	40	4.04	15.33	26.38	4.08	1.88	3.3	9.26	-0.13054246
Hedyotis scandens	G K	2	8	5	0.03	1.92	1.6	0.03	0.24	0.2	0.47	-0.0025006
Hydrocotyle sibthorpioides	G H K M	4	85	15	0.33	5.75	5.67	0.33	0.71	0.71	1.74	-0.01879881
Hypericum japonicum	K	1	17	3	0.07	1.15	5.67	0.07	0.14	0.71	0.92	-0.00481811
Imperata cylindrica	G K M	3	700	29	2.68	11.11	24.14	2.71	1.37	3.02	7.09	-0.09772335
Indigofera tasmanii	G	1	1	1	0	0.38	1	0	0.05	0.13	0.18	-0.00039301
Ixeris polycephala	G H K	3	49	17	0.19	6.51	2.88	0.19	0.8	0.36	1.35	-0.01188101
Juncus bufonius	G	1	12	1	0.05	0.38	12	0.05	0.05	1.5	1.59	-0.0035627
Kyllinga brevifolia	G H K M	4	94	17	0.36	6.51	5.53	0.36	0.8	0.69	1.86	-0.02042332
Kyllinga nemoralis	G H K M	4	33	9	0.13	3.45	3.67	0.13	0.42	0.46	1.01	-0.00850611
Leucas indica	G H K M	4	121	32	0.46	12.26	3.78	0.47	1.51	0.47	2.45	-0.02510779
Lindenbergia indica	G	1	6	2	0.02	0.77	3	0.02	0.09	0.38	0.49	-0.00194222
Lindernia ciliata	K	1	16	5	0.06	1.92	3.2	0.06	0.24	0.4	0.7	-0.00457221
Lindernia crustacea	G H K M	4	480	46	1.84	17.62	10.43	1.86	2.17	1.31	5.33	-0.07401561
Lindernia pyxidaria	G H K M	4	58	7	0.22	2.68	8.29	0.22	0.33	1.04	1.59	-0.01368492
Ludwigia perennis	M	1	4	2	0.02	0.77	2	0.02	0.09	0.25	0.36	-0.00135755
Luffa aegyptiaca	H	1	1	1	0	0.38	1	0	0.05	0.13	0.18	-0.00039301
Lygodium microphyllum	G	1	1	1	0	0.38	1	0	0.05	0.13	0.18	-0.00039301
Lygodium salicifolium	G	1	3	2	0.01	0.77	1.5	0.01	0.09	0.19	0.29	-0.00105155
Mazus pumilus	G H K	3	126	20	0.48	7.66	6.3	0.49	0.94	0.79	2.22	-0.02594795
Mecardonia procumbens	G H K	3	98	13	0.38	4.98	7.54	0.38	0.61	0.94	1.93	-0.02113443
Melastoma malabathricum	K	1	1	1	0	0.38	1	0	0.05	0.13	0.18	-0.00039301
Melochia corchorifolia	G K	2	3	3	0.01	1.15	1	0.01	0.14	0.13	0.28	-0.00105155
Merremia hirta	K M	2	2	2	0.01	0.77	1	0.01	0.09	0.13	0.23	-0.0007324
Mikania micrantha	G H K M	4	23	11	0.09	4.21	2.09	0.09	0.52	0.26	0.87	-0.00624969
Mimosa pudica	G H K	3	15	9	0.06	3.45	1.67	0.06	0.42	0.21	0.69	-0.0043239
Mitracarpus verticillatus	G H K M	4	815	71	3.12	27.2	11.48	3.15	3.34	1.44	7.93	-0.10898261
Mukia maderaspatana	G	1	8	2	0.03	0.77	4	0.03	0.09	0.5	0.63	-0.0025006
Murdannia nudiflora	G K M	3	17	7	0.07	2.68	2.43	0.07	0.33	0.3	0.7	-0.00481811
Murraya koenigii	G H	2	2	2	0.01	0.77	1	0.01	0.09	0.13	0.23	-0.0007324
Natsiatum herpeticum	H	1	1	1	0	0.38	1	0	0.05	0.13	0.18	-0.00039301
Neanotis hirsuta	G	1	14	2	0.05	0.77	7	0.05	0.09	0.88	1.02	-0.004073
Nelsonia canescens	G	1	7	2	0.03	0.77	3.5	0.03	0.09	0.44	0.56	-0.00222419
Neolamarckia cadamba	K	1	3	1	0.01	0.38	3	0.01	0.05	0.38	0.43	-0.00105155
Oldenlandia corymbosa	G H K M	4	401	47	1.54	18.01	8.53	1.55	2.21	1.07	4.83	-0.0646232
Oldenlandia diffusa	H K M	3	119	20	0.46	7.66	5.95	0.46	0.94	0.74	2.15	-0.02476951
Oplismenus burmanii	H	1	11	1	0.04	0.38	11	0.04	0.05	1.38	1.47	-0.00330283
Oplismenus compositus	G H K	3	148	20	0.57	7.66	7.4	0.57	0.94	0.93	2.44	-0.02955724
Oxalis corniculata	G H K M	4	1489	113	5.7	43.3	13.18	5.76	5.32	1.65	12.73	-0.16439841
Oxalis corymbosa	G H K	3	47	12	0.18	4.6	3.92	0.18	0.56	0.49	1.24	-0.01147183
Paspalum conjugatum	G K M	3	165	26	0.63	9.96	6.35	0.64	1.22	0.79	2.66	-0.03225834
Paspalum scrobiculatum	G H K M	4	579	58	2.22	22.22	9.98	2.24	2.73	1.25	6.22	-0.08508157
Peperomia pellucida	H K	2	32	8	0.12	3.07	4	0.12	0.38	0.5	1	-0.00828644
Pericampylus glaucus	G H	2	3	3	0.01	1.15	1	0.01	0.14	0.13	0.28	-0.00105155
Persicaria hydropiper	G H	2	10	3	0.04	1.15	3.33	0.04	0.14	0.42	0.6	-0.00303944

Phaulopsis imbricata	G	1	13	2	0.05	0.77	6.5	0.05	0.09	0.81	0.96	-0.00381934
Phyllanthus reticulatus	H	1	2	1	0.01	0.38	2	0.01	0.05	0.25	0.3	-0.0007324
Phyllanthus urinaria	G K M	3	49	20	0.19	7.66	2.45	0.19	0.94	0.31	1.44	-0.01188101
Physalis divaricata	G	1	1	1	0	0.38	1	0	0.05	0.13	0.18	-0.00039301
Piper longum	G	1	5	1	0.02	0.38	5	0.02	0.05	0.63	0.69	-0.00165378
Polygonum plebeium	K	1	84	3	0.32	1.15	28	0.32	0.14	3.5	3.97	-0.0186161
Portulaca oleracea	H K	2	9	2	0.03	0.77	4.5	0.03	0.09	0.56	0.69	-0.00277217
Pothos scandens	H	1	4	2	0.02	0.77	2	0.02	0.09	0.25	0.36	-0.00135755
Pouzolzia zeylanica	G H K M	4	109	18	0.42	6.9	6.06	0.42	0.85	0.76	2.03	-0.02305813
Pseudognaphalium affine	G H K	3	32	7	0.12	2.68	4.57	0.12	0.33	0.57	1.03	-0.00828644
Pteris biaurita	G	1	2	1	0.01	0.38	2	0.01	0.05	0.25	0.3	-0.0007324
Pueraria phaseoloides	K	1	2	1	0.01	0.38	2	0.01	0.05	0.25	0.3	-0.0007324
Pupalia lappacea	G	1	8	3	0.03	1.15	2.67	0.03	0.14	0.33	0.51	-0.0025006
Rhynchospora rubra	K M	2	11	3	0.04	1.15	3.67	0.04	0.14	0.46	0.64	-0.00330283
Rungia pectinata	G H K M	4	39	12	0.15	4.6	3.25	0.15	0.56	0.41	1.12	-0.00980066
Saccharum spontaneum	H K M	3	295	34	1.13	13.03	8.68	1.14	1.6	1.09	3.83	-0.05104381
Scoparia dulcis	G H K M	4	52	16	0.2	6.13	3.25	0.2	0.75	0.41	1.36	-0.01248889
Seedlings (Leguminous)	G H K	3	11	4	0.04	1.53	2.75	0.04	0.19	0.34	0.57	-0.00330283
Seedlings (unidentified)	H	1	1	1	0	0.38	1	0	0.05	0.13	0.18	-0.00039301
Selaginella monospora	G H K M	4	160	15	0.61	5.75	10.67	0.62	0.71	1.33	2.66	-0.03147126
Setaria palmifolia	H M	2	11	4	0.04	1.53	2.75	0.04	0.19	0.34	0.57	-0.00330283
Setaria plicata	G	1	5	2	0.02	0.77	2.5	0.02	0.09	0.31	0.43	-0.00165378
Smilax zeylanica	H	1	1	1	0	0.38	1	0	0.05	0.13	0.18	-0.00039301
Solanum aculeatissimum	G	1	5	3	0.02	1.15	1.67	0.02	0.14	0.21	0.37	-0.00165378
Solanum nigrum	G H M	3	21	9	0.08	3.45	2.33	0.08	0.42	0.29	0.8	-0.00578013
Sonchus asper	G H	2	11	2	0.04	0.77	5.5	0.04	0.09	0.69	0.82	-0.00330283
Stellaria media	K	1	47	2	0.18	0.77	23.5	0.18	0.09	2.94	3.22	-0.01147183
Stephania japonica	H	1	2	1	0.01	0.38	2	0.01	0.05	0.25	0.3	-0.0007324
Tephrosia candida	M	1	20	2	0.08	0.77	10	0.08	0.09	1.25	1.42	-0.00554264
Torenia violacea	H K	2	19	6	0.07	2.3	3.17	0.07	0.28	0.4	0.75	-0.0053032
Trema orientalis	K M	2	6	4	0.02	1.53	1.5	0.02	0.19	0.19	0.4	-0.00194222
Trichosanthes lepiniana	H	1	1	1	0	0.38	1	0	0.05	0.13	0.18	-0.00039301
Triumfetta rhomboidea	H	1	1	1	0	0.38	1	0	0.05	0.13	0.18	-0.00039301
Typhonium trilobatum	G	1	15	3	0.06	1.15	5	0.06	0.14	0.63	0.82	-0.0043239
Typhonium diversifolium	G	1	21	2	0.08	0.77	10.5	0.08	0.09	1.31	1.49	-0.00578013
Urochloa ramosa	M	1	32	8	0.12	3.07	4	0.12	0.38	0.5	1	-0.00828644
Youngia japonica	G H K	3	171	40	0.66	15.33	4.28	0.66	1.88	0.53	3.08	-0.03319511
TOTAL:		**305**	**25852**	**2124**	**99.05**	**813.8**						**-3.16**

Table 7.34 presents ten high IVI scored plants or in other words, ten most important weeds of Terai Tea Gardens. So, *Borreria alata* is the most important plant that has scored highest for IVI of 36.43 with highest values of RF (24.1%), RD (7.49%) and RA (4.89%). The second position is occupied by *Ageratum conyzoides* with the IVI score of 17.81 [RF: 9.77%; RD: 5.13%; RA: 2.9%]. Two species each for *Borreria* and *Ageratum* found place within this list

of ten most important weeds. Species like *Borreria alata*, *Borreria ocymoides*, *Ageratum conyzides* and *Ageratum haustonianum* are high biomass producing plants. These are considerably tall, much branched, very fast groing plants of quite broad ecological amplitude. On the other hand, *Oxalis corniculata*, *Desmodium triflorum*, *Digitaria ciliaris* and *Gamochaeta pensylvanicum* are very small plants, occupy much less space and produce very low amount of biomass. Among these ten plants there is only one perennial plant that is a very rigid and troublesome grass, *Imperata cylindrica*. All the selected gardens of Terai use good amount of Herbicides regularly. Under such condition, only therophytic plants can survive in the habitat if they become successful in producing mature seeds during the period between two successive applications of herbicides. However, all these plants are abundant in the natural vegetation outside the plantations and seeds from those places can easily enter into the plantation areas. *Imperata cylindrica* is a geophytic herb and herbicides can not destroy its stem or apical buds (i.e. underground parts). But, its population remain controlled by the shady environment in the garden floor and the very high amount of vegetal cover produced by dominant broad-leaved dicotylenous plants.

Table 7.34: Ten most important weeds of tea from Tea Gardens in Terai.

Ten high IVI Plants	RF	RD	RA	IVI
Borreria alata	24.1	7.49	4.89	**36.43**
Ageratum conyzoides	9.77	5.13	2.9	**17.81**
Borreria ocymoides	7.11	5.23	2.07	**14.41**
Oxalis corniculata	5.76	5.32	1.65	**12.73**
Desmodium triflorum	5.8	4.71	1.88	**12.39**
Digitaria ciliaris	3.99	4.19	1.45	**9.63**
Gamochaeta pensylvanicum	4.08	1.88	3.3	**9.26**
Ageratum houstonianum	4.14	2.92	2.16	**9.21**
Mitracarpus verticillatus	3.15	3.34	1.44	**7.93**
Imperata cylindrica	2.71	1.37	3.02	**7.09**

Table 7.35: Taxonomic distribution of plants recorded through quadrate samplings.

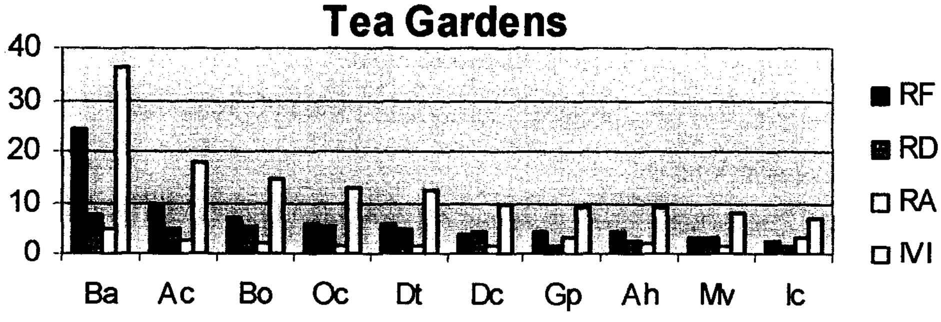
TAXA	Numerical Representation		
	Species	Genus	Family
Pteridophytes	09	07	06
Dicotyledons	89	77	35
Monocotyledons	40	28	08
TOTAL:	138	112	49

Table 7.36: Ten dominant families among the weeds of Terai Tea Gardens.

Sl. Nos.	Families	No. of Genera	No. of Species
1.	Poaceae	16	22
2.	Asteraceae	13	14
3.	Fabaceae	5	9
4.	Cyperaceae	4	9
5.	Rubiaceae	6	8
6.	Scrophulariaceae	6	8
7.	Acanthaceae	3	3
8.	Cucurbitaceae	3	3
9.	Amaranthaceae	2	3
10.	Euphorbiaceae	2	3
11.	Araceae	2	3
12.	Pteridaceae	2	3
13.	Solanaceae	2	3

When considering the dominant families, **Poaceae** appeared to be the largest with the record of 22 species under 16 genera. It is followed by **Asteraceae** with 14 species covering 13 genera, **Fabaceae** 9 species (5 genera), **Cyperaceae** 9 species (4 genera) etc. are dominant families. After this there are two families with 8 species each and 7 families with 3 species each [Table 7.36]. So, naturally, remaining families are recorded with either 2 or 1 species each. This is one direct indication about the existence of wide diversity in the weed flora of Tea Gardens in Terai.

Fig. 7.1: Most Dominant Weeds in Terai Tea Gardens



[Ba = Borreria alata; Ac = Ageratum conyzoides; Bo = *Borreria ocymoides;* Oc = *Oxalis corniculata;* Dt = *Desmodium triflorum*; Dc = *Digitaria ciliaris*; Gp = *Gamochaeta pensylvanicum*; Ah = *Ageratum houstonianum*; Mv = *Mitracarpus verticillatus*; Ic = *Imperata cylindrical*]

Out of the recorded recorded 112 genera *Cyperus* appeared to be the largest with 5 species; 3 genera (*Desmodium, Eragrostis* and *Lindernia*) with three species each and 15 genera (*Ageratum, Amaranthus, Borreria, Crotalaria, Digitaria, Kyllinga, Lygodium, Oldenlandhia,* *Oplismenus, Oxalis, Paspalum, Phyllanthus, Setaria, Solanum* and *Typhonium*) with two species each. And, naturally, all other genera recorded from these gardens are represented by single species only.

7.3.5.1 Diversity Indices: Three indices have been determined to understand the diversity and the similarity of vegetation in Terai Tea Gardens.

I. Species Diversity [Shannon-Weiner Index] for the Terai Tea Gardens as a whole has been determined to -3.16. This is a moderate value of diversity. Such a value was under expectation because the habitate is highly disturbed one. However, the worst situation has been observed in Matigara Tea Estate with its index value -2.73 and the condition is slightly better in Kamalpur Tea Estae where the value is -3.16.

II. Species Richness for the Terai Tea Garden habitat has been determined through **Menhinick's Index** and the obtained value is **1.865**. The value is quite low for this region. That can be realised easily from the fact that only some selected herbaceous plants can grow in any Tea Garden habitat due to a large number of factors making the habitat unsuitable for the survival of numerous species of local plants. Out of the four Tea Garden studied in Terai, Mohorgong & Gulma Tea Estate shows the highest Richness Index of 1.417. This is followed by Hansqua Tea Estate (1.314) and Kamalpur Tea Estate (1.089). And, on the contrary, Matigara Tea Estate showed extremely poor Species Richness Index on only 0.537.

III. Similarity Index: Many mathematical formulations are available for the determination of Similarity Index between two pieces of vegetation of which Sorensen's (1968) method has been adopted in the present study.

A. For Similarity Index between *Mohargong & Gulma Tea Estate* and *Hansqua Tea Estate*:

$$S = \frac{2C}{a + b} \quad \text{or, } (2x\ 52) / (80 + 84) = 104 / 164 = 0.634$$

Where; S: index value

C: number of species common to both sites [52 species]

a: number o species in site 'a' [Mohargong & Gulma Tea Estate: 80 species]

b: number of species in site 'b' [Hansqua Tea Estate: 84 species]

The value of S is more than 0.5 and less than one. So, the similarity between the two weed flora Mohargong & Gulma Tea Estate and Hansqua Tea Estate is quite good.

B. For Similarity Index between *Mohargong & Gulma Tea Estate* and *Kamalpur Tea Estate*: here C = 53, a = 80 and b = 78.

So, (2 x 53) / (80 + 78) = 106 / 158 = 0.671

The value of S is more than 0.5 and less than one. So, the similarity between the two weed flora Mohargong & Gulma Tea Estate and Kamalpur Tea Estate is quite good.

C. For Similarity Index between *Mohargong & Gulma Tea Estate* and *Matigara Tea Estate*: here C = 38, a = 80 and b = 62.

So, (2 x 38) / (80 + 62) = 76 / 142 = 0.535

The value of S is more than 0.5 and less than one. So, the similarity between the two weed flora Mohargong & Gulma Tea Estate and Matigara Tea Estate is good.

D. For Similarity Index between *Hansqua Tea Estate* and *Kamalpur Tea Estate*:

Here C = 61, a = 84 and b = 78.

So, (2 x 61) / (84 + 78) = 122 / 162 = 0.753

The value of S is more than 0.5 and less than one. So, the similarity between the two weed flora Hansqua Tea Estate and Kamalpur Tea Estate is very good.

E. For Similarity Index between *Hansqua Tea Estate* and *Matigara Tea Estate*:

Here C = 45, a = 84 and b = 62.

So, (2 x 45) / (84 + 62) = 90 / 146 = 0.616

The value of S is more than 0.5 and less than one. So, the similarity between the two weed flora Hansqua Tea Estate and Matigata Tea Estate is very good.

F. For Similarity Index between *Kamalpur Tea Estate* and *Matigara Tea Estate*:

Here C = 51, a = 78 and b = 62.

So, (2 x 51) / (78 + 62) = 102 / 140 = 0.728

The value of S is more than 0.5 and less than one. So, the similarity between the two weed flora Hansqua Tea Estate and Matigata Tea Estate is very good.

All these four Tea Estates are located in Darjiling Terai and enjoying almost similar habitat factors. So, a good level vale of S was under expectation.

7.4. Analysis of Phytosociological Data Collected from Tea Gardens in Darjiling Hills:

One Tea Gardens situated on Hills in Darjiling area does not mean its location in the temperate climatic zone. In fact most of the Tea Gardens in this area are located in sub-tropical zone. Again, the altitudinal expansion of many Gardens are quite broad, and covering both, subtropical and temperate zones. Three Gardens selected here are from completely three different conditions. (i) *Makaibari Tea Estate* is situated in subtropical zone but its lower reaches are quite warm. Not only that, it is completely exposed to the plains of Northern Bengal, which means it receives warm air from plains of the main body of the country and at the same time receive much more precipitation. (ii) *Soom Tea Estate* is partially in subtropical and temperate and is completely surrounded and well inside the hills. Its exposure is northern. So, this Garden does not face the warm air from plains but face cold northern air coming through Sikkim. (iii) *Tamsong Tea Estate* is located mostly in temperate zone. Only its lower reaches are extending to the subtropical zone inside the Bijanbari Valley. This is a cold region as it is surrounded by much high hills some of those also remain snow covered during for 1 – 4 months of the year. The garden is multifacial – south, west and north.

So, it is expected that a great diversity of flora will be recorded from these gardens and with some interesting phytosociological observations.

7.4.1 Makaibari Tea Estate

I. Survey in the Winter: A total of 32 quadrates have been studied and the analysis of the recorded data has been presented in Table 7.37. As much as 66 species of plants has been recorded through the process. As for any other vegetation, the population size for different species varies greatly. The total number of 1817 individuals has been recorded in Makaibari Tea Estate of which *Oplismenus compositus* (452 in 21 quadrates), *Oplismenus burmanii* (206 in 9 quadrates), *Drymaria diandra* (182 in 15 quadrates), *Persicaria microcephala* (116 in 16 quadrates), *Borreria alata* (57 in 2 quadrates), *Imperata cylindrica* (57 in 2 quadrates) etc. are well represented species. The first species, again, has been recorded from the highest number of 21 quadrates. So, on analysis, the species is presented with high degree of values for Frequency [F = 65.63; RF = 8.75], Density [D = 14.13; RD = 24.87] and Abundance [A = 21.52; RA = 5.8] and thereby the highest IVI for the season in this garden [IVI = 39.42]. *Oplismenus burmanii*, another common herb of the local flora has been recorded an IVI of 21.26 emerged as the second important species of the garden in winter. Only *Persicaria microcephala*and *Oplismenus compositus* have been recorde from 50% or more quadrates. Borreria alata and Imperata cylindrica have been recorded from 2 quadrates only. Five species with highest IVI from this analysis has been presented separately in Table 7.38.

Table 7.37: Analysis of winter quadrate sample data from Makaibari Tea Estate

Name of Plants	NI	NQ	F	D	A	RF	RD	RA	IVI
Ageratum conyzoides	63	5	15.63	1.97	12.6	2.08	3.47	3.4	**8.95**
Ageratina adenophora	4	3	9.38	0.13	1.33	1.25	0.23	0.36	**1.84**
Ageratum houstonianum	27	6	18.75	0.84	4.5	2.5	1.48	1.21	**5.19**
Athyrium oxyphyllum.	3	2	6.25	0.09	1.5	0.83	0.16	0.4	**1.39**

Axonopus compressus	11	5	15.63	0.34	2.2	2.08	0.6	0.59	**3.27**
Bambusa sp	2	1	3.13	0.06	2	0.42	0.11	0.54	**1.07**
Bidens pilosa	7	3	9.38	0.22	2.33	1.25	0.39	0.63	**2.27**
Borreria alata	57	2	6.25	1.78	28.5	0.83	3.13	7.68	**11.64**
Borreria ocymoides	13	2	6.25	0.41	6.5	0.83	0.72	1.75	**3.3**
Centella asiatica	5	1	3.13	0.16	5	0.42	0.28	1.35	**2.05**
Chromolaena odoratum	6	4	12.5	0.19	1.5	1.67	0.33	0.4	**2.4**
Commelina paludosa	3	1	3.13	0.09	3	0.42	0.16	0.81	**1.39**
Commelina suffruticosa	21	7	21.88	0.66	3	2.92	1.16	0.81	**4.89**
Crassocephalum crepidioides	3	1	3.13	0.09	3	0.42	0.16	0.81	**1.39**
Cyanthillium cinereum	8	3	9.38	0.25	2.67	1.25	0.44	0.72	**2.41**
Cyperus cyperoides	14	4	12.5	0.44	3.5	1.67	0.77	0.94	**3.38**
Desmodium triflorum	3	2	6.25	0.09	1.5	0.83	0.16	0.4	**1.39**
Dichrocephala integrifolia	58	7	21.88	1.81	8.29	2.92	3.19	2.23	**8.34**
Dicliptera bupleuroides	9	3	9.38	0.28	3	1.25	0.49	0.81	**2.55**
Dicranopteris linearis	1	1	3.13	0.03	1	0.42	0.05	0.27	**0.74**
Digitaria sanguinalis	8	2	6.25	0.25	4	0.83	0.44	1.08	**2.35**
Drymaria diandra	182	15	46.88	5.69	12.13	6.25	10.02	3.27	**19.54**
Eragrostis tenella	3	1	3.13	0.09	3	0.42	0.16	0.81	**1.39**
Fimbristylis dichotoma	12	3	9.38	0.38	4	1.25	0.67	1.08	**3**
Gamochaeta pensylvanicum	18	1	3.13	0.56	18	0.42	0.99	4.85	**6.26**
Hydrocotyle himalaica	14	2	6.25	0.44	7	0.83	0.77	1.89	**3.49**
Imperata cylindrica	57	2	6.25	1.78	28.5	0.83	3.13	7.68	**11.64**
Jasminum dispermum	4	2	6.25	0.13	2	0.83	0.23	0.54	**1.6**
Kyllinga brevifolia	7	1	3.13	0.22	7	0.42	0.39	1.89	**2.7**
Lepidagathis incurva	21	5	15.63	0.66	4.2	2.08	1.16	1.13	**4.37**
Leucas indica	4	2	6.25	0.13	2	0.83	0.23	0.54	**1.6**
Lobelia nummularia	2	1	3.13	0.06	2	0.42	0.11	0.54	**1.07**
Lygodium salicifolium	1	1	3.13	0.03	1	0.42	0.05	0.27	**0.74**
Melia azedarach	1	1	3.13	0.03	1	0.42	0.05	0.27	**0.74**
Mikania micrantha	4	1	3.13	0.13	4	0.42	0.23	1.08	**1.73**
Mitracarpus verticillatus	21	2	6.25	0.66	10.5	0.83	1.16	2.83	**4.82**
Morus australis	1	1	3.13	0.03	1	0.42	0.05	0.27	**0.74**
Nephrolepis cordifolia	22	4	12.5	0.69	5.5	1.67	1.21	1.48	**4.36**
Oplismenus burmanii	206	9	28.13	6.44	22.89	3.75	11.34	6.17	**21.26**
Oplismenus compositus	452	21	65.63	14.13	21.52	8.75	24.87	5.8	**39.42**
Oxalis corniculata	34	5	15.63	1.06	6.8	2.08	1.87	1.83	**5.78**
Oxalis corymbosa	12	1	3.13	0.38	12	0.42	0.67	3.23	**4.32**
Pericampylus glaucus	3	3	9.38	0.09	1	1.25	0.16	0.27	**1.68**
Persicaria chinensis	6	4	12.5	0.19	1.5	1.67	0.33	0.4	**2.4**
Persicaria microcephala	116	16	50	3.63	7.25	6.66	6.39	1.95	**15**
Phaulopsis imbricata	19	11	34.38	0.59	1.73	4.58	1.04	0.47	**6.09**
Pityrogramma calomelanos	1	1	3.13	0.03	1	0.42	0.05	0.27	**0.74**
Polystichum lentum	21	4	12.5	0.66	5.25	1.67	1.16	1.42	**4.25**
Pupalia lappacea	80	12	37.5	2.5	6.67	5	4.4	1.8	**11.2**
Rungia pectinata	6	4	12.5	0.19	1.5	1.67	0.33	0.4	**2.4**
Saccharum spontaneum	11	1	3.13	0.34	11	0.42	0.6	2.96	**3.98**

Sacciolepis indica	7	1	3.13	0.22	7	0.42	0.39	1.89	**2.7**
Selaginella biformis	11	3	9.38	0.34	3.67	1.25	0.6	0.99	**2.84**
Selaginella bisulcata	20	2	6.25	0.63	10	0.83	1.11	2.7	**4.64**
Setaria palmifolia	42	13	40.63	1.31	3.23	5.42	2.31	0.87	**8.6**
Setaria plicata	15	4	12.5	0.47	3.75	1.67	0.83	1.01	**3.51**
Strobilanthes divaricata	1	1	3.13	0.03	1	0.42	0.05	0.27	**0.74**
Thysanolaena latifolia	8	1	3.13	0.25	8	0.42	0.44	2.16	**3.02**
Unidentified 1	11	3	9.38	0.34	3.67	1.25	0.6	0.99	**2.84**
Unidentified 2	7	2	6.25	0.22	3.5	0.83	0.39	0.94	**2.16**
Urena lobata	1	1	3.13	0.03	1	0.42	0.05	0.27	**0.74**
Urochloa ramosa	5	1	3.13	0.16	5	0.42	0.28	1.35	**2.05**
Viola pilosa	12	3	9.38	0.38	4	1.25	0.67	1.08	**3**
Youngia japonica	10	3	9.38	0.31	3.33	1.25	0.55	0.9	**2.7**
TOTAL:	**1817**	**240**	**750.21**	**56.81**	**371.01**				

Table 7.38: Top Five IVI scoring species of plants in the winter vegetation of Makaibari Tea Estate

Species	RF	RD	RA	IVI
Oplismenus compositus	8.75	24.87	5.8	**39.42**
Oplismenus burmanii	3.75	11.34	6.17	**21.26**
Drymaria diandra	6.25	10.02	3.27	**19.54**
Persicaria microcephala	6.66	6.39	1.95	**15**
Borreria alata	0.83	3.13	7.68	**11.64**
Imperata cylindrica	0.83	3.13	7.68	**11.64**

II. Survey in the Pre-Monsoon Period: A total of 46 quadrates have been studied and the analysis of the recorded data has been presented in Table 7.39. As much as 66 species of plants has been recorded through the process during this dry period. Like any other vegetation, the population size for different species varies greatly. A total number of 5516 individuals has been recorded through the quadrate samples of which *Borreria alata* (1242 from 32 quadrates), *Eragrostis tenella* (474 from 8 quadrates), *Drymaria diandra* (466 from 21 quadrates), *Cyperus compressus* (123 from 1 quadrate), *Bulbostylis densa* (420 from 8 quadrates) etc. are well represented species. *Borreria alata* has been emerged as most important species (IVI : 36.8) in the vegetation due to its extremely high population structure as well as very wide distribution. *Eragrostis tenella* is a small grass recorded from 8 quadrates with its IVI score of 17.75 is now recognised as the next important species. Except Borreria alata other four recognised important species for this garden in pre-monsoon are all small herbs and can produce little amount of biomass. Some problem lies with the recognition of Cyperus compressus with its small population of 123 from 1 quadrate only. Its restricted distribution has increased its RA value and that has led to its position among the top five important weeds for this garden. Quite a few other species having better population structure and distribution could not score so high IVI value. Some such species include *Ageratum houstonianum* (242 in 12 quadrates), *Eragrostis unioloides* (377 in 7 quadrates), *Oxalis corniculata* (294 in 8 quadrates) and *Persicaria microcephala* (283 in 27 quadrates). Five species with higher IVI from this analysis has been presented separately in Table 7.40.

Table 7.39: Analysis of pre-monsoon quadrate sample data from Makaibari Tea Estate

Name of Plants	NI	NQ	F	D	A	RF	RD	RA	IVI
Ageratum conyzoides	13	3	6.52	0.28	4.33	0.93	0.23	0.49	**1.65**
Ageratum houstonianum	242	12	26.09	5.26	20.17	3.72	4.39	2.27	**10.38**
Athyrium oxyphyllum.	47	10	21.74	1.02	4.7	3.1	0.85	0.53	**4.48**
Bambusa sp	12	1	2.17	0.26	12	0.31	0.22	1.35	**1.88**
Bidens pilosa	23	8	17.39	0.5	2.88	2.48	0.42	0.32	**3.22**
Borreria alata	1242	32	69.57	27	38.81	9.91	22.52	4.37	**36.8**
Breynia retusa	2	1	2.17	0.04	2	0.31	0.03	0.23	**0.57**
Bulbostylis densa	420	8	17.39	9.13	52.5	2.48	7.61	5.92	**16.01**
Chromolaena odoratum	7	5	10.87	0.15	1.4	1.55	0.13	0.16	**1.84**
Commelina diffusa	25	5	10.87	0.54	5	1.55	0.45	0.56	**2.56**
Commelina paludosa	15	3	6.52	0.33	5	0.93	0.28	0.56	**1.77**
Commelina suffruticosa	85	9	19.57	1.85	9.44	2.79	1.54	1.06	**5.39**
Crassocephalum crepidioides	38	14	30.43	0.83	2.71	4.33	0.69	0.31	**5.33**
Cyanotis vaga	62	5	10.87	1.35	12.4	1.55	1.13	1.4	**4.08**
Cyanthillium cinereum	8	4	8.7	0.17	2	1.24	0.14	0.23	**1.61**
Cynodon dactylon	15	1	2.17	0.33	15	0.31	0.28	1.69	**2.28**
Cyperus compressus	123	1	2.17	2.67	123	0.31	2.23	13.86	**16.4**
Cyperus cyperoides	65	12	26.09	1.41	5.42	3.72	1.18	0.61	**5.51**
Dichrocephala integrifolia	6	3	6.52	0.13	2	0.93	0.11	0.23	**1.27**
Digitaria ciliaris	3	1	2.17	0.07	3	0.31	0.06	0.34	**0.71**
Dioscorea alata	8	3	6.52	0.17	2.67	0.93	0.14	0.3	**1.37**
Dioscorea bulbifera	3	2	4.35	0.07	1.5	0.62	0.06	0.17	**0.85**
Drymaria diandra	466	21	45.65	10.13	22.19	6.5	8.45	2.5	**17.45**
Dryopteris filix-mas	5	1	2.17	0.11	5	0.31	0.09	0.56	**0.96**
Duchesnea indica	8	2	4.35	0.17	4	0.62	0.14	0.45	**1.21**
Eragrostis nigra	115	2	4.35	2.5	57.5	0.62	2.09	6.48	**9.19**
Eragrostis tenella	474	8	17.39	10.3	59.25	2.48	8.59	6.68	**17.75**
Eragrostis unioloides	377	7	15.22	8.2	53.86	2.17	6.84	6.07	**15.08**
Fimbristylis dichotoma	145	2	4.35	3.15	72.5	0.62	2.63	8.17	**11.42**
Galinsoga parviflora	29	5	10.87	0.63	5.8	1.55	0.53	0.65	**2.73**
Globba racemosa	1	1	2.17	0.02	1	0.31	0.02	0.11	**0.44**
Guizotia abyssinica	24	3	6.52	0.52	8	0.93	0.43	0.9	**2.26**
Hydrocotyle himalaica	5	1	2.17	0.11	5	0.31	0.09	0.56	**0.96**
Hypoestes sanguinolenta	3	1	2.17	0.07	3	0.31	0.06	0.34	**0.71**

Ichnocarpus frutescens	3	2	4.35	0.07	1.5	0.62	0.06	0.17	**0.85**
Imperata cylindrica	44	3	6.52	0.96	14.67	0.93	0.8	1.65	**3.38**
Kyllinga brevifolia	32	2	4.35	0.7	16	0.62	0.58	1.8	**3**
Lantana camara	1	1	2.17	0.02	1	0.31	0.02	0.11	**0.44**
Mikania micrantha	10	5	10.87	0.22	2	1.55	0.18	0.23	**1.96**
Murdannia nudiflora	13	2	4.35	0.28	6.5	0.62	0.23	0.73	**1.58**
Nephrolepis cordifolia	11	2	4.35	0.24	5.5	0.62	0.2	0.62	**1.44**
Neyraudia arundinacea var. *zollingeri*	2	1	2.17	0.04	2	0.31	0.03	0.23	**0.57**
Oplismenus burmanii	155	3	6.52	3.37	51.67	0.93	2.81	5.82	**9.56**
Oplismenus compositus	64	3	6.52	1.39	21.33	0.93	1.16	2.4	**4.49**
Oxalis corniculata	294	8	17.39	6.39	36.75	2.48	5.33	4.14	**11.95**
Paspalum conjugatum	2	1	2.17	0.04	2	0.31	0.03	0.23	**0.57**
Pericampylus glaucus	1	1	2.17	0.02	1	0.31	0.02	0.11	**0.44**
Persicaria hydropiper	7	1	2.17	0.15	7	0.31	0.13	0.79	**1.23**
Persicaria runcinata	32	3	6.52	0.7	10.67	0.93	0.58	1.2	**2.71**
Persicaria microcephala	283	27	58.7	6.15	10.48	8.36	5.13	1.18	**14.67**
Pouzolzia hirta	16	4	8.7	0.35	4	1.24	0.29	0.45	**1.98**
Pteris biaurita	2	1	2.17	0.04	2	0.31	0.03	0.23	**0.57**
Pupalia lappacea	119	7	15.22	2.59	17	2.17	2.16	1.92	**6.25**
Remusatia pumila	4	1	2.17	0.09	4	0.31	0.08	0.45	**0.84**
Rhaphidophora hookeri	2	1	2.17	0.04	2	0.31	0.03	0.23	**0.57**
Setaria palmifolia	148	20	43.48	3.22	7.4	6.19	2.69	0.83	**9.71**
Setaria pumila	104	6	13.04	2.26	17.33	1.86	1.88	1.95	**5.69**
Sida acuta	1	1	2.17	0.02	1	0.31	0.02	0.11	**0.44**
Sporobolus fertilis	10	2	4.35	0.22	5	0.62	0.18	0.56	**1.36**
Stephania glabra	7	4	8.7	0.15	1.75	1.24	0.13	0.2	**1.57**
Synedrella nodiflora	9	3	6.52	0.2	3	0.93	0.17	0.34	**1.44**
Tectaria coadunata	19	7	15.22	0.41	2.71	2.17	0.34	0.31	**2.82**
Unidentified	2	1	2.17	0.04	2	0.31	0.03	0.23	**0.57**
Urena lobata	1	1	2.17	0.02	1	0.31	0.02	0.11	**0.44**
Youngia japonica	1	1	2.17	0.02	1	0.31	0.02	0.11	**0.44**
Zephyranthes carinata	1	1	2.17	0.02	1	0.31	0.02	0.11	**0.44**
TOTAL:	**5516**	**323**	**702.12**	**119.9**	**887.29**				

Table 7.40: Top Five IVI scoring species of plants in the Pre-Monsoon vegetation of Makaibari Tea Estate

Species	RF	RD	RA	IVI
Borreria alata	9.91	22.52	4.37	**36.8**
Eragrostis tenella	2.48	8.59	6.68	**17.75**
Drymaria diandra	6.5	8.45	2.5	**17.45**
Cyperus compressus	0.31	2.23	13.86	**16.4**
Bulbostylis densa	2.48	7.61	5.92	**16.01**

III. Survey in the Post-Monsoon Period: A total of 17 quadrates have been studied and the analysis of the recorded data has been presented in Table 7.41. And, a good number of 50 species of plants has been recorded through the process. As for any other vegetation, the population size for different species varies greatly in this garden too. The total number of 2763 individuals has been recorded that expresses a picture of moderate occurrence of weeds in the vegetation even during post-monsoon period. *Drymaria diandra* with its IVI score of 33.44 [RF = 8.42, RD = 19.04, RA = 5.98] appeared to be the most important weed of Makaibari Tea Estate during post-monsoon period. *Ageratum houstonianum* with the IVI score of 26.81 [RF = 6.84, RD = 14.4, RA = 5.57] stands in the second position. Two grasses, *Oplismenus burmanii* (IVI : 26.4) and *Eragrostis nigra* IVI : 15.94) are small grasses and are accupying the 3rd and 4th positions. *Borreria alata* [IVI : 13.37], like two other seasons data in the garden, also found a position in the list of 5 high IVI scored species in this garden [Table 7.42]. Of the determined important plants only *Ageratum houstonianum* and *Borreria alata* are high biomass or voluminous weeds and three others are smaller plants. In cold climate *Drymaria diandra*, sometimes, behave like small ramblers and climb on tea-bushes and if not cleaned for a long time then it can form a loose network of its branches there. At the same time, all the 5 plants in Table 7.42 are annuals and except *Ageratum houstonianum* all others are local plants.

Table 7.41: Analysis of post-monsoon quadrate sample data from Makaibari Tea Estate

Name of Plants	**NI**	**NQ**	F	D	A	RF	RD	RA	**IVI**
Ageratum conyzoides	22	3	17.65	1.29	7.33	1.58	0.79	1.33	**3.7**
Ageratum houstonianum	398	13	76.47	23.41	30.62	6.84	14.4	5.57	**26.81**
Axonopus compressus	12	3	17.65	0.71	4	1.58	0.44	0.73	**2.75**
Boehmeria	5	1	5.88	0.29	5	0.53	0.18	0.91	**1.62**
Borreria alata	130	13	76.47	7.65	10	6.84	4.71	1.82	**13.37**
Borreria ocymoides	4	1	5.88	0.24	4	0.53	0.15	0.73	**1.41**
Carex sp.	4	1	5.88	0.24	4	0.53	0.15	0.73	**1.41**
Centella asiatica	10	1	5.88	0.59	10	0.53	0.36	1.82	**2.71**
Chromolaena odoratum	1	1	5.88	0.06	1	0.53	0.04	0.18	**0.75**
Commelina paludosa	8	2	11.76	0.47	4	1.05	0.29	0.73	**2.07**
Commelina suffruticosa	14	3	17.65	0.82	4.67	1.58	0.5	0.85	**2.93**
Cyperus cyperoides	22	1	5.88	1.29	22	0.53	0.79	4	**5.32**
Cyperus pilosus	2	1	5.88	0.12	2	0.53	0.07	0.36	**0.96**
Dicliptera bupleuroides	23	3	17.65	1.35	7.67	1.58	0.83	1.4	**3.81**
Dicranopteris linearis	30	5	29.41	1.76	6	2.63	1.08	1.09	**4.8**
Digitaria ciliaris	103	5	29.41	6.06	20.6	2.63	3.73	3.75	**10.11**

Drymaria diandra	526	16	94.12	30.94	32.88	8.42	19.03	5.98	**33.43**
Dryopteris filix-mas	4	1	5.88	0.24	4	0.53	0.15	0.73	**1.41**
Elatostema alsinoides	40	1	5.88	2.35	40	0.53	1.45	7.28	**9.26**
Elatostema hookerianum	9	1	5.88	0.53	9	0.53	0.33	1.64	**2.5**
Eragrostis nigra	113	2	11.76	6.65	56.5	1.58	4.09	10.27	**15.94**
Eragrostis tenella	104	3	17.65	6.12	34.67	1.05	3.76	6.31	**11.12**
Hypoestes sanguinolenta	13	2	11.76	0.76	6.5	1.05	0.47	1.18	**2.7**
Hypoestes triflora	17	1	5.88	1	17	0.53	0.62	3.09	**4.24**
Impatiens balsamina	9	5	29.41	0.53	1.8	2.63	0.33	0.33	**3.29**
Lygodium salicifolium	1	1	5.88	0.06	1	0.53	0.04	0.18	**0.75**
Mikania micrantha	8	5	29.41	0.47	1.6	2.63	0.29	0.29	**3.21**
Murdannia nudiflora	13	2	11.76	0.76	6.5	1.05	0.47	1.18	**2.7**
Natsiatum herpeticum	2	1	5.88	0.12	2	0.53	0.07	0.36	**0.96**
Oplismenus burmanii	391	12	70.59	23	32.58	6.32	14.15	5.93	**26.4**
Oplismenus compositus	68	4	23.53	4	17	2.11	2.46	3.09	**7.66**
Oxalis corniculata	89	7	41.18	5.24	12.71	3.68	3.22	2.31	**9.21**
Oxalis corymbosa	1	1	5.88	0.06	1	0.53	0.04	0.18	**0.75**
Peperomia pellucida	70	8	47.06	4.12	8.75	4.21	2.53	1.59	**8.33**
Peristrophe speciosa	13	3	17.65	0.76	4.33	1.58	0.47	0.79	**2.84**
Persicaria chinensis	68	9	52.94	4	7.56	4.74	2.46	1.38	**8.58**
Persicaria posumbu	20	1	5.88	1.18	20	0.53	0.73	3.64	**4.9**
Persicaria microcephala	71	4	23.53	4.18	17.75	2.11	2.57	3.23	**7.91**
Pouzolzia hirta	25	3	17.65	1.47	8.33	1.58	0.9	1.52	**4**
Pteris biaurita	3	1	5.88	0.18	3	0.53	0.11	0.55	**1.19**
Pupalia lappacea	87	11	64.71	5.12	7.91	5.79	3.15	1.44	**10.38**
Rhopalephora scaberrima	7	2	11.76	0.41	3.5	1.05	0.25	0.64	**1.94**
Richardia scabra	1	1	5.88	0.06	1	0.53	0.04	0.18	**0.75**
Setaria palmifolia	77	5	29.41	4.53	15.4	2.63	2.79	2.8	**8.22**
Setaria plicata	53	6	35.29	3.12	8.83	3.16	1.92	1.61	**6.69**
Strobilanthes divaricata	21	4	23.53	1.24	5.25	2.11	0.76	0.95	**3.82**
Synedrella nodiflora	36	6	35.29	2.12	6	3.16	1.3	1.09	**5.55**
Tectaria coadunata	2	2	11.76	0.12	1	1.05	0.07	0.18	**1.3**
Torenia violacea	2	1	5.88	0.12	2	0.53	0.07	0.36	**0.96**
Urochloa ramosa	11	1	5.88	0.65	11	0.53	0.4	2	**2.93**
TOTAL:	**2763**	**190**	**1117.59**	**162.56**	**549.74**				

Table 7.42: Top Five IVI scoring species of plants in the Post-Monsoon vegetation of Makaibari Tea Estate

Species	RF	RD	RA	IVI
Drymaria diandra	8.42	19.04	5.98	**33.44**
Ageratum houstonianum	6.84	14.4	5.57	**26.81**
Oplismenus burmanii	6.32	14.15	5.93	**26.4**
Eragrostis nigra	1.58	4.09	10.27	**15.94**
Borreria alata	6.84	4.71	1.82	**13.37**

IV: The Annual Picture: While bringing data from all three seasons under a single head, i.e. data from a total of 95 quadrates that will produce the annual structure for the weedy vegetation in Matigara Tea Estate. This has been presented in Table 7.43. It shows that 114 species of weeds with a total of 10096 individuals growing in the garden as recorded through 95 quadrate samplings. Maximum number of individuals has been recorded for *Borreria alata* (1429 from 47 quadrates), and this is followed by *Drymaria diandra* (1174 from 52 quadrates), *Oplismenus burmanii* (752 from 24 quadrates), *Eragrostis tenella* (581 from 11 quadrates), *Ageratum houstonianum* (667 from 31 duadrates), *Persicaria microcephala* (470 from 47 quadrates), *Oplismenus compositus* (584 from 28 quadrates), *Bulbostylis densa* (420 from 8 quadrates), *Eragrostis unioloides* (377 from 7 quadrates) and *Oxalis corniculata* (417 from 20 quadrates) etc. have been recorded with quite high population structure. Of these *Borreria alata* (IVI : 23.41) has been appeared as the most important species in this garden. This species was also determined as most important species in pre-monsoon, 5th in post-monsoon and 4th in winter vegetation. The second position is occupied by *Drymaria diandra* (IVI : 20.75) that was determined as most important weed in post-monsoon and 3rd in pre-monsoon and winter vegetation. Two species of *Oplismenus*, *O. burmanii* and *O. compositus* are also determined as important species of which the first one occupied 2nd and 3rd positions (IVI : 13.78 & 11.58), respectively, in pre-monsoon and winter vegetations. And, *O. compositus* was determined as most important weed in winter vegetation. Another grass genus *Eragrostis* is also represented with two species [*E. tenella* and *E. unioloides*; (IVI : 12.25 & 10.13)] in the list of ten important species of Makaibari Tea Estate. So, out of ten important species of this garden 4 are grasses. In addition, one sedge Bulbostylis densa (IVI : 10.54) is also occupying a position in this list.

Out of these ten important weeds as much as 5 species has been recorded from 50% or more quadrates. These are *Borreria alata* (47), *Drymaria diandra* (52), *Ageratum houstonianum*

(31), *Polygonum* wt fl (47) and *Oplismenus compositus* (28). Othe two plants, *Oplismenus burmanii* (24) and *Oxalis corniculata* (20) are also broadly distributed in this garden.

Only two of these ten plants (Table 7.44), *Borreria alata* and *Ageratum houstonianum* are gregariously growing plants and can suppress the growth of other plants. On the other hand, plants like *Drymaria diandra*, *Eragrostis* spp., *Oplismenus* spp., *Bulbostylis densa* and *Oxalis corniculata* are much smaller plants and most of then produce low amount of biomass and are never growing gregariously. However, even under such situation, population structures of all the determined important species are quite high. So, all these species [in Table 7.44] are to be treated as very important weeds in the Makaibari Tea Estate.

Table 7.43: Analysis of whole year quadrate sample data from Makaibari Tea Estate

Name of Plants	NI	NQ	F	D	A	RF	RD	RA	IVI	SD
Ageratina adenophora	4	3	3.16	0.04	1.33	0.39	0.04	0.14	**0.57**	-0.0031
Ageratum conyzoides	98	11	11.58	1.03	8.91	1.44	0.97	0.9	**3.31**	-0.04499
Ageratum houstonianum	667	31	32.63	7.02	21.52	4.06	6.61	2.18	**12.85**	-0.17951
Athyrium oxyphyllum.	50	12	12.63	0.53	4.17	1.57	0.5	0.42	**2.49**	-0.02629
Axonopus compressus	23	8	8.42	0.24	2.88	1.05	0.23	0.29	**1.57**	-0.01386
Bambusa sp	14	2	2.11	0.15	7	0.26	0.14	0.71	**1.11**	-0.00913
Bidens pilosa	30	11	11.58	0.32	2.73	1.44	0.3	0.28	**2.02**	-0.01729
Boehmeria polystachya	5	1	1.05	0.05	5	0.13	0.05	0.51	**0.69**	-0.00377
Borreria alata	1429	47	49.47	15.04	30.4	6.16	14.16	3.09	**23.41**	-0.27674
Borreria ocymoides	17	3	3.16	0.18	5.67	0.39	0.17	0.58	**1.14**	-0.01075
Breynia retusa	2	1	1.05	0.02	2	0.13	0.02	0.2	**0.35**	-0.00169
Bulbostylis densa	420	8	8.42	4.42	52.5	1.05	4.16	5.33	**10.54**	-0.13228
Carex sp.	4	1	1.05	0.04	4	0.13	0.04	0.41	**0.58**	-0.0031
Centella asiatica	15	2	2.11	0.16	7.5	0.26	0.15	0.76	**1.17**	-0.00967
Chromolaena odoratum	14	10	10.53	0.15	1.4	1.31	0.14	0.14	**1.59**	-0.00913
Commelina diffusa	25	5	5.26	0.26	5	0.65	0.24	0.51	**1.4**	-0.01486
Commelina paludosa	26	6	6.32	0.27	4.33	0.79	0.25	0.44	**1.48**	-0.01535
Commelina suffruticosa	120	19	20	1.26	6.32	2.49	1.19	0.64	**4.32**	-0.05268
Crassocephalum crepidioides	41	15	15.79	0.43	2.73	1.97	0.4	0.28	**2.65**	-0.02236
Cyanotis vaga	62	5	5.26	0.65	12.4	0.65	0.61	1.26	**2.52**	-0.03127
Cyanthillium cinereum	16	7	7.37	0.17	2.29	0.92	0.16	0.23	**1.31**	-0.01022
Cynodon dactylon	15	1	1.05	0.16	15	0.13	0.15	1.52	**1.8**	-0.00967
Cyperus compressus	123	11	11.58	1.29	11.18	1.44	1.21	1.14	**3.79**	-0.0537
Cyperus cyperoides	101	17	17.89	1.06	5.94	2.23	1	0.6	**3.83**	-0.04607
Cyperus pilosus	2	1	1.05	0.02	2	0.13	0.02	0.2	**0.35**	-0.00169

Desmodium triflorum	3	2	2.11	0.03	1.5	0.26	0.03	0.15	**0.44**	-0.00241
Dichrocephala integrifolia	64	10	10.53	0.67	6.4	1.31	0.63	0.65	**2.59**	-0.03208
Dicliptera bupleuroides	32	6	6.32	0.34	5.33	0.79	0.32	0.54	**1.65**	-0.01824
Dicranopteris linearis	31	6	6.32	0.33	5.17	0.79	0.31	0.52	**1.62**	-0.01777
Digitaria ciliaris	106	6	6.32	1.12	17.67	0.79	1.05	1.79	**3.63**	-0.04784
Digitaria sanguinalis	8	2	2.11	0.08	4	0.26	0.08	0.41	**0.75**	-0.00566
Dioscorea alata	8	3	3.16	0.08	2.67	0.39	0.08	0.27	**0.74**	-0.00566
Dioscorea bulbifera	3	2	2.11	0.03	1.5	0.26	0.03	0.15	**0.44**	-0.00241
Drymaria diandra	1174	52	54.74	12.36	22.58	6.82	11.64	2.29	**20.75**	-0.25021
Dryopteris filix-mas	9	2	2.11	0.09	4.5	0.26	0.08	0.46	**0.8**	-0.00626
Duchesnea indica	8	2	2.11	0.08	4	0.26	0.08	0.41	**0.75**	-0.00566
Elatostema alsinoides	40	1	1.05	0.42	40	0.13	0.4	4.06	**4.59**	-0.02191
Elatostema hookerianum	9	1	1.05	0.09	9	0.13	0.08	0.91	**1.12**	-0.00626
Eragrostis nigra	228	4	4.21	2.4	57	0.52	2.26	5.79	**8.57**	-0.0856
Eragrostis tenella	581	12	12.63	6.12	48.42	1.57	5.76	4.92	**12.25**	-0.16431
Eragrostis unioloides	377	7	7.37	3.97	53.86	0.92	3.74	5.47	**10.13**	-0.12277
Fimbristylis dichotoma	157	5	5.26	1.65	31.4	0.65	1.55	3.19	**5.39**	-0.06475
Galinsoga parviflora	29	5	5.26	0.31	5.8	0.65	0.29	0.59	**1.53**	-0.01681
Gamochaeta pensylvanicum	18	1	1.05	0.19	18	0.13	0.18	1.83	**2.14**	-0.01128
Globba racemosa	1	1	1.05	0.01	1	0.13	0.01	0.1	**0.24**	-0.00091
Guizotia abyssinica	24	3	3.16	0.25	8	0.39	0.24	0.81	**1.44**	-0.01436
Hydrocotyle himalaica	19	3	3.16	0.2	6.33	0.39	0.19	0.64	**1.22**	-0.01181
Hypoestes sanguonolenta	16	3	3.16	0.17	5.33	0.39	0.16	0.54	**1.09**	-0.01022
Hypoestes triflora	17	1	1.05	0.18	17	0.13	0.17	1.73	**2.03**	-0.01075
Ichnocarpus frutescens	3	2	2.11	0.03	1.5	0.26	0.03	0.15	**0.44**	-0.00241
Impatiens balsamina	9	5	5.26	0.09	1.8	0.65	0.08	0.18	**0.91**	-0.00626
Imperata cylindrica	101	5	5.26	1.06	20.2	0.65	1	2.05	**3.7**	-0.04607
Jasminum dispermum	4	2	2.11	0.04	2	0.26	0.04	0.2	**0.5**	-0.0031
Kyllinga brevifolia	39	3	3.16	0.41	13	0.39	0.39	1.32	**2.1**	-0.02146
Lantana camara	1	1	1.05	0.01	1	0.13	0.01	0.1	**0.24**	-0.00091
Lepidagathis incurva	21	5	5.26	0.22	4.2	0.65	0.21	0.43	**1.29**	-0.01284
Leucas indica	4	2	2.11	0.04	2	0.26	0.04	0.2	**0.5**	-0.0031
Lobelia nummularia	2	1	1.05	0.02	2	0.13	0.02	0.2	**0.35**	-0.00169
Lygodium salicifolium	2	2	2.11	0.02	1	0.26	0.02	0.1	**0.38**	-0.00169
Melia azedarach	1	1	1.05	0.01	1	0.13	0.01	0.1	**0.24**	-0.00091
Mikania micrantha	22	11	11.58	0.23	2	1.44	0.22	0.2	**1.86**	-0.01336
Mitracarpus verticillatus	21	2	2.11	0.22	10.5	0.26	0.21	1.07	**1.54**	-0.01284
Morus australis	1	1	1.05	0.01	1	0.13	0.01	0.1	**0.24**	-0.00091
Murdannia nudiflora	26	4	4.21	0.27	6.5	0.52	0.25	0.66	**1.43**	-0.01535
Natsiatum herpeticum	2	1	1.05	0.02	2	0.13	0.02	0.2	**0.35**	-0.00169

Nephrolepis cordifolia	33	6	6.32	0.35	5.5	0.79	0.33	0.56	**1.68**	-0.01871
Neyraudia arundinacea var. zollingeri	2	1	1.05	0.02	2	0.13	0.02	0.2	**0.35**	-0.00169
Oplismenus burmanii	752	24	25.26	7.92	31.33	3.14	7.46	3.18	**13.78**	-0.19345
Oplismenus compositus	584	28	29.47	6.15	20.86	3.67	5.79	2.12	**11.58**	-0.16486
Oxalis corniculata	417	20	21.05	4.39	20.85	2.62	4.13	2.12	**8.87**	-0.13163
Oxalis corymbosa	13	2	2.11	0.14	6.5	0.26	0.13	0.66	**1.05**	-0.00857
Paspalum conjugatum	2	1	1.05	0.02	2	0.13	0.02	0.2	**0.35**	-0.00169
Peperomia pellucida	70	8	8.42	0.74	8.75	1.05	0.7	0.89	**2.64**	-0.03447
Pericampylus glaucus	4	4	4.21	0.04	1	0.52	0.04	0.1	**0.66**	-0.0031
Peristrophe speciosa	13	3	3.16	0.14	4.33	0.39	0.13	0.44	**0.96**	-0.00857
Persicaria chinensis	74	13	13.68	0.78	5.69	1.7	0.73	0.58	**3.01**	-0.03603
Persicaria hydropiper	7	1	1.05	0.07	7	0.13	0.07	0.71	**0.91**	-0.00504
Persicaria microcephala	470	47	49.47	4.95	10	6.16	4.66	1.02	**11.84**	-0.14279
Persicaria posumbu	20	1	1.05	0.21	20	0.13	0.2	2.03	**2.36**	-0.01233
Persicaria runcinata	32	3	3.16	0.34	10.67	0.39	0.32	1.08	**1.79**	-0.01824
Phaulopsis imbricata	19	11	11.58	0.2	1.73	1.44	0.19	0.18	**1.81**	-0.01181
Pityrogramma calomelanos	1	1	1.05	0.01	1	0.13	0.01	0.1	**0.24**	-0.00091
Polystichum lentum	**21**	**4**	**4.21**	**0.22**	**5.25**	0.52	0.21	0.53	**1.26**	-0.01284
Pouzolzia hirta	41	7	7.37	0.43	5.86	0.92	0.4	0.59	**1.91**	-0.02236
Pteris biaurita	5	2	2.11	0.05	2.5	0.26	0.05	0.25	**0.56**	-0.00377
Pupalia lappacea	286	30	31.58	3.01	9.53	3.93	2.83	0.97	**7.73**	-0.10096
Remusatia pumila	4	1	1.05	0.04	4	0.13	0.04	0.41	**0.58**	-0.0031
Rhaphidophora hookeri	2	1	1.05	0.02	2	0.13	0.02	0.2	**0.35**	-0.00169
Rhopalephora scaberrima	7	2	2.11	0.07	3.5	0.26	0.07	0.36	**0.69**	-0.00504
Richardia scabra	1	1	1.05	0.01	1	0.13	0.01	0.1	**0.24**	-0.00091
Rungia pectinata	6	4	4.21	0.06	1.5	0.52	0.06	0.15	**0.73**	-0.00441
Saccharum spontaneum	11	1	1.05	0.12	11	0.13	0.11	1.12	**1.36**	-0.00743
Sacciolepis indica	7	1	1.05	0.07	7	0.13	0.07	0.71	**0.91**	-0.00504
Selaginella biformis	11	3	3.16	0.12	3.67	0.39	0.11	0.37	**0.87**	-0.00743
Selaginella bisulcata	20	2	2.11	0.21	10	0.26	0.2	1.02	**1.48**	-0.01233
Setaria palmifolia	267	38	40	2.81	7.03	4.98	2.65	0.71	**8.34**	-0.09607
Setaria plicata	68	10	10.53	0.72	6.8	1.31	0.68	0.69	**2.68**	-0.03368
Setaria pumila	104	6	6.32	1.09	17.33	0.79	1.03	1.76	**3.58**	-0.04713
Sida acuta	1	1	1.05	0.01	1	0.13	0.01	0.1	**0.24**	-0.00091
Sporobolus fertilis	10	2	2.11	0.11	5	0.26	0.1	0.51	**0.87**	-0.00685
Stephania glabra	7	4	4.21	0.07	1.75	0.52	0.07	0.18	**0.77**	-0.00504
Strobilanthes divaricata	22	5	5.26	0.23	4.4	0.65	0.22	0.45	**1.32**	-0.01336
Synedrella nodiflora	45	9	9.47	0.47	5	1.18	0.44	0.51	**2.13**	-0.02413
Tectaria coadunata	21	9	9.47	0.22	2.33	1.18	0.21	0.24	**1.63**	-0.01284
Thysanolaena latifolia	8	1	1.05	0.08	8	0.13	0.08	0.81	**1.02**	-0.00566

Torenia violacea	2	1	1.05	0.02	2	0.13	0.02	0.2	**0.35**	-0.00169
Unidentified 1	2	1	1.05	0.02	2	0.13	0.02	0.2	**0.35**	-0.00169
Unidentified 2	11	3	3.16	0.12	3.67	0.39	0.11	0.37	**0.87**	-0.00743
Unidentified 3	7	2	2.11	0.07	3.5	0.26	0.07	0.36	**0.69**	-0.00504
Urena lobata	2	2	2.11	0.02	1	0.26	0.02	0.1	**0.38**	-0.00169
Urochloa ramosa	16	2	2.11	0.17	8	0.26	0.16	0.81	**1.23**	-0.01022
Viola pilosa	12	3	3.16	0.13	4	0.39	0.12	0.41	**0.92**	-0.00801
Youngia japonica	11	4	4.21	0.12	2.75	0.52	0.11	0.28	**0.91**	-0.00743
Zephyranthes carinata	1	1	1.05	0.01	1	0.13	0.01	0.1	**0.24**	-0.00091
TOTAL:	10096	763	**803.18**	**106.22**	**984.94**					**-3.35**

Table 7.44: Top Ten IVI scoring species of plants in the whole year's vegetation of Makaibari Tea Estate

Species	RF	RD	RA	IVI
Borreria alata	6.16	14.16	3.09	**23.41**
Drymaria diandra	6.82	11.64	2.29	**20.75**
Oplismenus burmanii	3.14	7.46	3.18	**13.78**
Ageratum houstonianum	4.06	6.61	2.18	**12.85**
Eragrostis tenella	1.57	5.76	4.92	**12.25**
Persicaria microcephala	6.16	4.66	1.02	**11.84**
Oplismenus compositus	3.67	5.79	2.12	**11.58**
Bulbostylis densa	1.05	4.16	5.33	**10.54**
Eragrostis unioloides	0.92	3.74	5.47	**10.13**
Oxalis corniculata	2.62	4.13	2.12	**8.87**

Species Diversity [Shannon-Weiner Index] for this Tea Garden has been determined to -3.35. This is a quite moderate value of diversity. Such a value was under expectation because the habitate is highly disturbed one at the same time extreme dominance of few species only. However, this is a biogarden and chemical pesticides and fertilizers are not under use for the last few years.

Species Richness has been determined through **Menhinick's Index** and the obtained value is **1.135**.

7.4.2 Soom Tea Estate

I. Survey in the Winter: A total of 62 quadrates have been studied and the analysis of the recorded data has been presented in Table 7.45. As much as 80 species of plants has been recorded through the process. As for any other vegetation, the population size for different species varies greatly. The total number of 4942 individuals has been recorded from Soom Tea Estate of which *Stellaria uliginosa* (478 from 7 quadrates), *Drymaria diandra* (440 from 17 quadrates), *Ageratum conyzoides* (320 from 23 quadrates), *Oxalis corniculata* (262 from 9 quadrates) *Lecanthus peduncularis* (203 from 4 quadrates) etc. are well represented species. The first species (*Stellaria uliginosa*), with its large number of recorded individuals found growing in only seven quadrates has the highest IVI score (18.13). *Drymaria diandra* recorded from 17 quadrates occupied the 2nd position with its IVI score of 16.27. The only gregarious and/or high-biomass plant recorded there is *Ageratum conyzoides* appeared 3rd with the IVI score of 14.46. None of the five high IVI-scored species (Table 7.46) from the winter vegetation of Soom Tea Estate were recorded from 50% or more quadrates. Of these the highest RF of 6.67 has been scored by *Ageratum conyzoides* for its presence in 23 quadrates. On the other hand, as much as 26 species has been recorded from one quadrate only.

However, all the five species recorded in Table 7.46 are annuals, two (*Stellaria uliginosa* and *Lecanthus peduncularis*) are cold loving plants of temperate region; *Drymaria diandra* prefers to grow in sub-tropical to temperate climate and the remaining two (*Ageratum conyzoides* and *Oxalis corniculata*) are cosmopolitan plants. *Lecanthus peduncularis* of Urticaceae is a prostrate succulent herb produce very interesting coenanthium inflorescence on long peduncle.

Table 7.45: Analysis of winter quadrate sample data from Soom Tea Estate

Name of Plants	NI	NQ	F	D	A	RF	RD	RA	IVI
Ageratum conyzoides	320	23	37.1	5.16	13.91	6.67	6.48	1.31	**14.46**
Aconogonon molle	7	1	1.61	0.11	7	0.29	0.14	0.66	**1.09**
Ageratum houstonianum	72	6	9.68	1.16	12	1.74	1.46	1.13	**4.33**
Ajuga macrosperma	69	8	12.9	1.11	8.63	2.32	1.39	0.81	**4.52**
Artemisia indica	12	1	1.61	0.19	12	0.29	0.24	1.13	**1.66**
Athyrium oxyphyllum.	12	3	4.84	0.19	4	0.87	0.24	0.38	**1.49**
Axonopus compressus	88	2	3.23	1.42	44	0.58	1.78	4.14	**6.5**
Bidens pilosa	21	4	6.45	0.34	5.25	1.16	0.43	0.49	**2.08**
Borreria alata	57	3	4.84	0.92	19	0.87	1.15	1.79	**3.81**
Cardamine hirsuta	47	4	6.45	0.76	11.75	1.16	0.95	1.11	**3.22**
Casearia graveolens	1	1	1.61	0.02	1	0.29	0.03	0.09	**0.41**
Chamabainia cuspidata	17	1	1.61	0.27	17	0.29	0.34	1.6	**2.23**
Chromolaena odoratum	17	2	3.23	0.27	8.5	0.58	0.34	0.8	**1.72**
Commelina paludosa	66	7	11.29	1.06	9.43	2.03	1.33	0.89	**4.25**
Conyza canadensis	2	2	3.23	0.03	1	0.58	0.04	0.09	**0.71**
Crassocephalum crepidioides	37	11	17.74	0.6	3.36	3.19	0.75	0.32	**4.26**
Crotalaria cytisoides	6	3	4.84	0.1	2	0.87	0.13	0.19	**1.19**
Cyanthillium cinereum	7	1	1.61	0.11	7	0.29	0.14	0.66	**1.09**

Cymbopogon nardus	3	1	1.61	0.05	3	0.29	0.06	0.28	**0.63**
Dichrocephala integrifolia	**162**	20	32.26	2.61	8.1	5.8	3.28	0.76	**9.84**
Dicliptera bupleuroides	88	9	14.52	1.42	9.78	2.61	1.78	0.92	**5.31**
Dicranopteris linearis	10	1	1.61	0.16	10	0.29	0.2	0.94	**1.43**
Digitaria ciliaris	23	1	1.61	0.37	23	0.29	0.46	2.16	**2.91**
Digitaria sanguinalis	37	2	3.23	0.6	18.5	0.58	0.75	1.74	**3.07**
Diplazium frondosum	3	1	1.61	0.05	3	0.29	0.06	0.28	**0.63**
Drymaria diandra	440	17	27.42	7.1	25.88	4.93	8.91	2.44	**16.28**
Drymaria villosa	221	6	9.68	3.56	36.83	1.74	4.47	3.47	**9.68**
Eleusine indica	68	2	3.23	1.1	34	0.58	1.38	3.2	**5.16**
Emilia sonchifolia	4	1	1.61	0.06	4	0.29	0.08	0.38	**0.75**
Eragrostis tenella	15	1	1.61	0.24	15	0.29	0.3	1.41	**2**
Galinsoga parviflora	117	12	19.35	1.89	9.75	3.48	2.37	0.92	**6.77**
Gamochaeta pensylvanicum	75	13	20.97	1.21	5.77	3.77	1.52	0.54	**5.83**
Grass (unidentified)	170	3	4.84	2.74	56.67	0.87	3.44	5.33	**9.64**
Hydrocotyle himalaica	9	1	1.61	0.15	9	0.29	0.19	0.85	**1.33**
Hypoestes triflora	104	10	16.13	1.68	10.4	2.9	2.11	0.98	**5.99**
Lecanthus peduncularis	203	4	6.45	3.27	50.75	1.16	4.1	4.78	**10.04**
Lindenbergia grandiflora	36	5	8.06	0.58	7.2	1.45	0.73	0.68	**2.86**
Lindenbergia indica	20	4	6.45	0.32	5	1.16	0.4	0.47	**2.03**
Lobelia nummularia	123	6	9.68	1.98	20.5	1.74	2.48	1.93	**6.15**
Lycopodium cerretum	2	1	1.61	0.03	2	0.29	0.04	0.19	**0.52**
Lysimachia alternifolia	7	1	1.61	0.11	7	0.29	0.14	0.66	**1.09**
Mazus pumilus	8	1	1.61	0.13	8	0.29	0.16	0.75	**1.2**
Mazus surculosus	2	1	1.61	0.03	2	0.29	0.04	0.19	**0.52**
Nephrolepis cordifolia	40	6	9.68	0.65	6.67	1.74	0.82	0.63	**3.19**
Oplismenus burmanii	19	2	3.23	0.31	9.5	0.58	0.39	0.89	**1.86**
Oplismenus compositus	102	6	9.68	1.65	17	1.74	2.07	1.6	**5.41**
Oxalis corniculata	262	9	14.52	4.23	29.11	2.61	5.31	2.74	**10.66**
Oxalis corniculata var. villosa	110	5	8.06	1.77	22	1.45	2.22	2.07	**5.74**
Oxalis corymbosa	19	2	3.23	0.31	9.5	0.58	0.39	0.89	**1.86**
Oxyspora paniculata	3	1	1.61	0.05	3	0.29	0.06	0.28	**0.63**
Paspalum conjugatum	66	2	3.23	1.06	33	0.58	1.33	3.11	**5.02**
Peristrophe speciosa	17	1	1.61	0.27	17	0.29	0.34	1.6	**2.23**
Persicaria chinensis	63	9	14.52	1.02	7	2.61	1.28	0.66	**4.55**
Persicaria hydropiper	141	9	14.52	2.27	15.67	2.61	2.85	1.47	**6.93**
Persicaria nepalensis	15	1	1.61	0.24	15	0.29	0.3	1.41	**2**
Persicaria posumbu	2	1	1.61	0.03	2	0.29	0.04	0.19	**0.52**
Persicaria runcinata	108	8	12.9	1.74	13.5	2.32	2.18	1.27	**5.77**
Pilea symmeria	89	7	11.29	1.44	12.71	2.03	1.81	1.2	**5.04**
Pilea umbrosa	9	2	3.23	0.15	4.5	0.58	0.19	0.42	**1.19**
Polystichum lentum	5	2	3.23	0.08	2.5	0.58	0.1	0.24	**0.92**
Pouzolzia hirta	56	5	8.06	0.9	11.2	1.45	1.13	1.05	**3.63**
Primula melacoides	7	1	1.61	0.11	7	0.29	0.14	0.66	**1.09**
Pseudognaphalium affine	59	3	4.84	0.95	19.67	0.87	1.19	1.85	**3.91**
Pteris biaurita	44	8	12.9	0.71	5.5	2.32	0.89	0.52	**3.73**
Pupalia lappacea	5	1	1.61	0.08	5	0.29	0.1	0.47	**0.86**

Rubia manjith	3	1	1.61	0.05	3	0.29	0.06	0.28	**0.63**
Rungia pectinata	33	3	4.84	0.53	11	0.87	0.67	1.04	**2.58**
Sacciolepis indica	5	1	1.61	0.08	5	0.29	0.1	0.47	**0.86**
Schoenoplectus juncoides	10	3	4.84	0.16	3.33	0.87	0.2	0.31	**1.38**
Selaginella biformis	96	8	12.9	1.55	12	2.32	1.95	1.13	**5.4**
Selaginella bisulcata	26	3	4.84	0.42	8.67	0.87	0.53	0.82	**2.22**
Setaria palmifolia	44	5	8.06	0.71	8.8	1.45	0.89	0.83	**3.17**
Spilanthes acmella	34	3	4.84	0.55	11.33	0.87	0.69	1.07	**2.63**
Stellaria media	27	1	1.61	0.44	27	0.29	0.55	2.54	**3.38**
Stellaria patens	85	2	3.23	1.37	42.5	0.58	1.72	4	**6.3**
Stellaria uliginosa	478	7	11.29	7.71	68.29	2.03	9.67	6.43	**18.13**
Strobilanthes divaricata	24	3	4.84	0.39	8	0.87	0.49	0.75	**2.11**
Tectaria coadunata	12	2	3.23	0.19	6	0.58	0.24	0.56	**1.38**
Viola pilosa	5	1	1.61	0.08	5	0.29	0.1	0.47	**0.86**
Youngia japonica	11	4	6.45	0.18	2.75	1.16	0.23	0.26	**1.65**
TOTAL:	**4942**	**345**	**556.43**	**79.69**	**1062.7**				

Table 7.46: Top Five IVI scoring species of plants in the winter vegetation of Soom Tea Estate

Species	RF	RD	RA	IVI
Stellaria uliginosa	2.03	9.67	6.43	18.13
Drymaria diandra	4.93	8.9	2.44	16.27
Ageratum conyzoides	6.67	6.48	1.31	14.46
Oxalis corniculata	2.61	5.3	2.74	10.65
Lecanthus peduncularis	1.16	4.11	4.78	10.05

II. Survey in the Pre-Monsoon Period: A total of 45 quadrates have been studied and the analysis of the recorded data has been presented in Table 7.47. As much as 58 species of plants has been recorded through the process during this dry period. Like any other vegetation, the population size for different species varies greatly. A total number of 3476 individuals has been recorded through the quadrate samples of which *Drymaria diandra* (645 from 19 quadrates), *Persicaria nepalensis* (254 from 16 quadrates), *Oplismenus compositus* (188 from 4 quadrates), *Digitaria sanguinalis* (185 from 4 quadrates), *Galinsoga parviflora* (168 from 14 quadrates) etc. are well represented species. *Drymaria diandra* has been emerged as most important species (IVI : 31.88) in the vegetation due to its extremely high population structure as well as very wide distribution. *Persicaria nepalensis* is a small annual herb recorded from 16 quadrates with its IVI score of 16.83 is now recognised as the next important species. There are two grasses in the list of five important plants (Table 7.48) which are quite small and produce little biomass. Like winter vegetation, in pre-monsoon vegetation too not a single species has been recorded from 50% or more quadrates.

It is also interesting to note that all the five plants recorded in Table 7.48 are all annuals and none of them is gregarious, so does not produce good amount of biomass. So, the weed vegetation in pre-monsoon period appears quite sparse and low and, thereby, affects the crop much less. The frequency distribution for most of the species is quite low but the total recorded population is high and that is possible only if the floristic diversity remain much high.

Table 7.47: Analysis of pre-monsoon quadrate sample data from Soom Tea Estate

Name of Plants	NI	NQ	F	D	A	RF	RD	RA	IVI
Achyranthes bidentata	2	1	2.22	0.04	2	0.46	0.05	0.27	**0.78**
Ageratina adenophora	5	1	2.22	0.11	5	0.46	0.14	0.67	**1.27**
Ageratum conyzoides	42	7	15.56	0.93	6	3.24	1.2	0.8	**5.24**
Ageratum houstonianum	7	1	2.22	0.16	7	0.46	0.21	0.93	**1.6**
Bidens pilosa	12	5	11.11	0.27	2.4	2.31	0.35	0.32	**2.98**
Blumea hieracifolia	9	1	2.22	0.2	9	0.46	0.26	1.2	**1.92**
Boehmeria rugulosa	2	1	2.22	0.04	2	0.46	0.05	0.27	**0.78**
Borreria alata	173	11	24.44	3.84	15.73	5.09	4.97	2.1	**12.16**
Centella asiatica	25	1	2.22	0.56	25	0.46	0.73	3.33	**4.52**
Commelina paludosa	109	10	22.22	2.42	10.9	4.63	3.13	1.45	**9.21**
Conyza canadensis	10	1	2.22	0.22	10	0.46	0.28	1.33	**2.07**
Crassocephalum crepidioides	9	2	4.44	0.2	4.5	0.93	0.26	0.6	**1.79**
Crotalaria cytisoides	2	2	4.44	0.04	1	0.93	0.05	0.13	**1.11**
Cyanthillium cinereum	5	1	2.22	0.11	5	0.46	0.14	0.67	**1.27**
Cynodon dactylon	130	3	6.67	2.89	43.33	1.39	3.74	5.77	**10.9**
Cyperus cyperoides	36	7	15.56	0.8	5.14	3.24	1.04	0.68	**4.96**
Dichrocephala integrifolia	24	5	11.11	0.53	4.8	2.31	0.69	0.64	**3.64**
Dicliptera bupleuroides	8	1	2.22	0.18	8	0.46	0.23	1.07	**1.76**
Digitaria ciliaris	124	5	11.11	2.76	24.8	2.31	3.57	3.3	**9.18**
Digitaria sanguinalis	185	4	8.89	4.11	46.25	1.85	5.32	6.16	**13.33**
Drymaria diandra	645	19	42.22	14.33	33.95	8.8	18.56	4.52	**31.88**
Drymaria villosa	71	2	4.44	1.58	35.5	0.93	2.05	4.73	**7.71**
Eleusine indica	35	1	2.22	0.78	35	0.46	1.01	4.66	**6.13**
Emilia sonchifolia	6	1	2.22	0.13	6	0.46	0.17	0.8	**1.43**
Eragrostis nigra	27	1	2.22	0.6	27	0.46	0.78	3.6	**4.84**
Eragrostis tenella	5	1	2.22	0.11	5	0.46	0.14	0.67	**1.27**
Galinsoga parviflora	168	14	31.11	3.73	12	6.48	4.83	1.6	**12.91**
Grass-unidentified 1	92	3	6.67	2.04	30.67	1.39	2.64	4.09	**8.12**
Grass-unidentified 2	61	3	6.67	1.36	20.33	1.39	1.76	2.71	**5.86**
Gynura nepalensis	6	1	2.22	0.13	6	0.46	0.17	0.8	**1.43**
Hypericum japonicum	12	3	6.67	0.27	4	1.39	0.35	0.53	**2.27**
Hypoestes triflora	8	1	2.22	0.18	8	0.46	0.23	1.07	**1.76**
Isachne albens	5	1	2.22	0.11	5	0.46	0.14	0.67	**1.27**
Kyllinga brevifolia	17	3	6.67	0.38	5.67	1.39	0.49	0.76	**2.64**
Kyllinga nemoralis	93	5	11.11	2.07	18.6	2.31	2.68	2.48	**7.47**
Lindernia ciliata	9	2	4.44	0.2	4.5	0.93	0.26	0.6	**1.79**
Lobelia nummularia	172	6	13.33	3.82	28.67	2.78	4.95	3.82	**11.55**

Lysimachia alternifolia	27	4	8.89	0.6	6.75	1.85	0.78	0.9	**3.53**
Microlepia strigosa	11	2	4.44	0.24	5.5	0.93	0.31	0.73	**1.97**
Oplismenus compositus	188	4	8.89	4.18	47	1.85	5.41	6.26	**13.52**
Oxalis corniculata var. villosa	165	6	13.33	3.67	27.5	2.78	4.75	3.66	**11.19**
Peristrophe speciosa	11	1	2.22	0.24	11	0.46	0.31	1.47	**2.24**
Persicaria hydropiper	195	10	22.22	4.33	19.5	4.63	5.61	2.6	**12.84**
Persicaria nepalensis	254	16	35.56	5.64	15.88	7.41	7.3	2.12	**16.83**
Persicaria runcinata	87	9	20	1.93	9.67	4.17	2.5	1.29	**7.96**
Pilea sp	9	2	4.44	0.2	4.5	0.93	0.26	0.6	**1.79**
Pilea symmeria	13	2	4.44	0.29	6.5	0.93	0.38	0.87	**2.18**
Plantago erosa	7	3	6.67	0.16	2.33	1.39	0.21	0.31	**1.91**
Poa annua	24	2	4.44	0.53	12	0.93	0.69	1.6	**3.22**
Polygonum sp.	24	3	6.67	0.53	8	1.39	0.69	1.07	**3.15**
Pteris semipinnata	3	1	2.22	0.07	3	0.46	0.09	0.4	**0.95**
Pouzolzia hirta	23	2	4.44	0.51	11.5	0.93	0.66	1.53	**3.12**
Selaginella biformis	9	1	2.22	0.2	9	0.46	0.26	1.2	**1.92**
Selaginella bisulcata	12	2	4.44	0.27	6	0.93	0.35	0.8	**2.08**
Setaria palmifolia	10	2	4.44	0.22	5	0.93	0.28	0.67	**1.88**
Spilanthes acmella	6	1	2.22	0.13	6	0.46	0.17	0.8	**1.43**
Torenia violacea	46	5	11.11	1.02	9.2	2.31	1.32	1.23	**4.86**
Youngia japonica	1	1	2.22	0.02	1	0.46	0.03	0.13	**0.62**
TOTAL:	**3476**	**216**	**479.92**	**77.21**	**750.57**				

Table 7.48: Top Five IVI scoring species of plants in the pre-monsoon vegetation of Soom Tea Estate

Species	RF	RD	RA	IVI
Drymaria diandra	8.8	18.56	4.52	**31.88**
Persicaria nepalensis	7.41	7.3	2.12	**16.83**
Oplismenus compositus	1.85	5.41	6.26	**13.52**
Digitaria sanguinalis	1.85	5.32	6.16	**13.33**
Galinsoga parviflora	6.48	4.83	1.6	**12.91**

III. Survey in the Post-Monsoon Period: A total of 20 quadrates have been studied and the analysis of the recorded data has been presented in Table 7.49. And, a good number of 56 species of plants has been recorded through the process. As for any other vegetation, the population size for different species varies greatly in this garden too. The total number of 2340 individuals has been recorded that expresses a picture of moderate occurrence of weeds in the vegetation even during post-monsoon period. *Drymaria diandra* with its IVI score of 43.79 [RF = 10.93, RD = 26.45, RA = 6.41] appeared as the most important weed of Soom Tea Estate during post-monsoon period. *Drymaria villosa* with the IVI score of 18.02 [RF = 5.46, RD = 8.46, RA = 4.1] stands in the second position. *Borreria ocymoides* [IVI : 17.11] that grows during monsoon and continue to survive until the arrival of winter, occupied the 3rd position. Only one grass, Cynodon dactylon [IVI : 14.27] became the 5th important plant of the garden in post-monsoon weed flora [Table 7.50].

Drymaria diandra is behaving like a gregarious species in this vegetation with its 100 % Frequency, i.e. it was recorded in all the 20 quadrates during monsoon period. Two other species, *Drymaria villosa* and *Lecanthus peduncularis* were recorded from 50 % of the quadrates. So, the distribution pattern is little broader during this climatic period.

Out of the five high IVI scorer plants, four are annuals and only *Cynodon dactylon* is the only Chaemiphytic perennial plant. Also, all these five species are native to the local flora.

Table 7.49: Analysis of post-monsoon quadrate sample data from Soom Tea Estate

Name of Plants	NI	NQ	F	D	A	RF	RD	RA	IVI
Ageratum conyzoides	97	11	55	4.85	8.82	6.01	4.15	1.83	**11.99**
Ageratina adenophora	2	1	5	0.1	2	0.55	0.09	0.41	**1.05**
Ajuga macrosperma	14	2	10	0.7	7	1.09	0.6	1.45	**3.14**
Anaphalis contorta	17	1	5	0.85	17	0.55	0.73	3.52	**4.8**
Athyrium oxyphyllum.	2	2	10	0.1	1	1.09	0.09	0.21	**1.39**
Bidens pilosa	1	1	5	0.05	1	0.55	0.04	0.21	**0.8**
Boehmeria rugulosa	12	2	10	0.6	6	1.09	0.51	1.24	**2.84**
Borreria alata	18	5	25	0.9	3.6	2.73	0.77	0.75	**4.25**
Borreria ocymoides	179	6	30	8.95	29.83	3.28	7.65	6.18	**17.11**
Centella asiatica	2	1	5	0.1	2	0.55	0.09	0.41	**1.05**
Commelina suffruticosa	1	1	5	0.05	1	0.55	0.04	0.21	**0.8**
Crassocephalum crepidioides	3	1	5	0.15	3	0.55	0.13	0.62	**1.3**
Cynodon dactylon	113	3	15	5.65	37.67	1.64	4.83	7.8	**14.27**
Dichrocephala integrifolia	2	2	10	0.1	1	1.09	0.09	0.21	**1.39**
Dicliptera bupleuroides	5	2	10	0.25	2.5	1.09	0.21	0.52	**1.82**
Digitaria ciliaris	80	3	15	4	26.67	1.64	3.42	5.52	**10.58**
Digitaria sanguinalis	18	2	10	0.9	9	1.09	0.77	1.86	**3.72**
Drymaria diandra	619	20	100	30.95	30.95	10.93	26.45	6.41	**43.79**
Drymaria villosa	198	10	50	9.9	19.8	5.46	8.46	4.1	**18.02**
Eleusine indica	24	1	5	1.2	24	0.55	1.03	4.97	**6.55**
Galinsoga parviflora	7	1	5	0.35	7	0.55	0.3	1.45	**2.3**
Pogonantherum crinitum	1	1	5	0.05	1	0.55	0.04	0.21	**0.8**
Hydrocotyle himalaica	11	3	15	0.55	3.67	1.64	0.47	0.76	**2.87**
Hydrocotyle nepalensis	1	1	5	0.05	1	0.55	0.04	0.21	**0.8**
Hypericum japonicum	6	1	5	0.3	6	0.55	0.26	1.24	**2.05**
Hypoestes sanguonolenta	5	1	5	0.25	5	0.55	0.21	1.04	**1.8**
Kyllinga brevifolia	6	1	5	0.3	6	0.55	0.26	1.24	**2.05**
Lecanthus peduncularis	170	10	50	8.5	17	5.46	7.26	3.52	**16.24**
Lindenbergia indica	24	3	15	1.2	8	1.64	1.03	1.66	**4.33**

Lindernia ciliata	5	1	5	0.25	5	0.55	0.21	1.04	**1.8**
Lobelia nummularia	122	11	55	6.1	11.09	6.01	5.21	2.3	**13.52**
Briggsia kurzii	3	2	10	0.15	1.5	1.09	0.13	0.31	**1.53**
Mazus pumilus	11	1	5	0.55	11	0.55	0.47	2.28	**3.3**
Mikania micrantha	2	1	5	0.1	2	0.55	0.09	0.41	**1.05**
Nephrolepis cordifolia	7	4	20	0.35	1.75	2.19	0.3	0.36	**2.85**
Oplismenus burmanii	66	2	10	3.3	33	1.09	2.82	6.83	**10.74**
Oplismenus compositus	13	1	5	0.65	13	0.55	0.56	2.69	**3.8**
Oxalis corniculata	34	6	30	1.7	5.67	3.28	1.45	1.17	**5.9**
Oxalis corniculata var. villosa	74	7	35	3.7	10.57	3.83	3.16	2.19	**9.18**
Persicaria capitata	1	1	5	0.05	1	0.55	0.04	0.21	**0.8**
Persicaria chinensis	1	1	5	0.05	1	0.55	0.04	0.21	**0.8**
Persicaria hydropiper	69	5	25	3.45	13.8	2.73	2.95	2.86	**8.54**
Persicaria nepalensis	14	2	10	0.7	7	1.09	0.6	1.45	**3.14**
Persicaria runcinata	108	8	40	5.4	13.5	4.37	4.62	2.79	**11.78**
Plantago erosa	1	1	5	0.05	1	0.55	0.04	0.21	**0.8**
Pouzolzia hirta	10	2	10	0.5	5	1.09	0.43	1.04	**2.56**
Pseudognaphalium affine	2	2	10	0.1	1	1.09	0.09	0.21	**1.39**
Rungia pectinata	15	3	15	0.75	5	1.64	0.64	1.04	**3.32**
Selaginella biformis	26	5	25	1.3	5.2	2.73	1.11	1.08	**4.92**
Selaginella bisulcata	8	3	15	0.4	2.67	1.64	0.34	0.55	**2.53**
Setaria palmifolia	1	1	5	0.05	1	0.55	0.04	0.21	**0.8**
Stellaria patens	43	2	10	2.15	21.5	1.09	1.84	4.45	**7.38**
Stellaria uliginosa	20	3	15	1	6.67	1.64	0.85	1.38	**3.87**
Viola diffusa	22	3	15	1.1	7.33	1.64	0.94	1.52	**4.1**
Viola pilosa	5	2	10	0.25	2.5	1.09	0.21	0.52	**1.82**
Youngia japonica	19	4	20	0.95	4.75	2.19	0.81	0.98	**3.98**
TOTAL:	**2340**	**183**	**915**	**117**	**483.01**				

Table 7.50: Top Five IVI scoring species of plants in the post-monsoon vegetation of Soom Tea Estate

Species	RF	RD	RA	IVI
Drymaria diandra	10.93	26.45	6.41	**43.79**
Drymaria villosa	5.46	8.46	4.1	**18.02**
Borreria ocymoides	3.28	7.65	6.18	**17.11**
Lecanthus peduncularis	5.46	7.26	3.52	**16.24**
Cynodon dactylon	1.64	4.83	7.8	**14.27**

IV: The Annual Picture: While bringing data from all three seasons under a single head, i.e. data from a total of 127 quadrates that will produce the annual structure for the weedy vegetation in Soom Tea Estate. This has been presented in Table 7.51. It shows that 113 species of weeds with a total of 10758 individuals growing in the garden as recorded through 127 quadrate samplings. Maximum number of individuals has been recorded for *Drymaria diandra* (1704 from 56 quadrates) and this is followed by *Ageratum conyzoides* (459 from 41 quadrates), *Stellaria* *uliginosa* (498 from 10 quadrates), *Drymaria villosa* (490 from 18 quadrates), *Lobelia nummularia* (417 from 23 quadrates), *Persicaria hydropiper* (405 from 24 quadrates), *Lecanthus peduncularis* (373 from 14 quadrates), *Galinsoga parviflora* (292 from 27 quadrates), *Oxalis corniculata var. villosa* (349 from 18 quadrates), *Persicaria runcinata* (303 from 25 quadrates) etc. have been recorded with quite high population structure. Of these *Drymaria diandra* (IVI : 22.74) has been appeared as the most important species in this garden. This species was also determined as most important species in pre-monsoon and post-monsoon seasons and 2nd in winter season vegetation. Interestingly, the second position is occupied by *Ageratum conyzoides* (IVI : 10.64) that was determined as important weed only once in winter at the 3rd position probably due to its nearly equal presence in the vegetation round the year. Though the recorded population of *Galinsoga parviflora* in Soom Tea Estate is not much but its high RA value made it one important species of weed.

It is also important to note that none of the recorded 113 species in Soom Tea Estate has been recorded from 50 % or more quadrate samples. The highest Frequency/ Relative Frequency was noted for *Drymaria diandra* that was growing in 56 (i.e. 44.09 %) quadrates. This was followed by Ageratum conyzoides, which was recorded from 41 quadrates. Drymaria villosa is a very weed of post-monsoon – early winter period in Darjiling Hills, but it prefers to grow in open places. That is why a comparatively poor population for the species has been met with. *Oxalis corniculata* is one cospopolitan species that grows in abundance not only in the normal open or semi-open vegetation but also in the Tea Gardens as it was appeared in the discussion made so far in this chapter. But, in Soom Tea Estate, a variety of the species *O. corniculata* var. *villosa* has been recorded with quite considerable population structure.

Table 7.52 presented ten most important weeds of Soom Tea Estate. Interestingly, all these ten plants are annuals and are Therophytic. All these plants are native to the local flora. At the high altitude cold areas *Ageratum conyzoides* does not behave as gregarious plant grows like small herbs. So, none of these ten plants are gregarious and the weedy vegetation is of low height only except that the branches of *Drymaria diandra* sometimes ramble upon the Tea bushes and forms an open net-work.

Table 7.51: Analysis of annual quadrate sample data from Soom Tea Estate

Name of Plants	NI	NQ	F	D	A	RF	RD	RA	IVI	SD
Achyranthes bidentata	2	1	0.79	0.02	2	0.13	0.02	0.16	**0.31**	-0.001597
Aconogonon molle	7	1	0.79	0.06	7	0.13	0.07	0.54	**0.74**	-0.0047744

Ageratina adenophora	7	2	1.57	0.06	3.5	0.27	0.07	0.27	**0.61**	-0.0047744
Ageratum conyzoides	459	41	32.28	3.61	11.2	5.51	4.26	0.87	**10.64**	-0.1345835
Ageratum houstonianum	79	7	5.51	0.62	11.29	0.94	0.73	0.88	**2.55**	-0.036085
Ajuga macrosperma	83	10	7.87	0.65	8.3	1.34	0.77	0.64	**2.75**	-0.037531
Anaphalis contorta	17	1	0.79	0.13	17	0.13	0.15	1.32	**1.6**	-0.0101927
Artemisia indica	12	1	0.79	0.09	12	0.13	0.11	0.93	**1.17**	-0.0075834
Athyrium oxyphyllum.	14	5	3.94	0.11	2.8	0.67	0.13	0.22	**1.02**	-0.0393134
Axonopus compressus	88	2	1.57	0.69	44	0.27	0.81	3.41	**4.49**	-0.0181948
Bidens pilosa	34	10	7.87	0.27	3.4	1.34	0.32	0.26	**1.92**	-0.0059282
Blumea hieracifolia	9	1	0.79	0.07	9	0.13	0.08	0.7	**0.91**	-0.0086467
Boehmeria rugulosa	14	3	2.36	0.11	4.67	0.4	0.13	0.36	**0.89**	-0.0869078
Borreria alata	248	19	14.96	1.95	13.05	2.55	2.3	1.01	**5.86**	-0.0681528
Borreria ocymoides	179	6	4.72	1.41	29.83	0.81	1.66	2.31	**4.78**	-0.023737
Cardamine hirsuta	47	4	3.15	0.37	11.75	0.54	0.44	0.91	**1.89**	-0.0008629
Casearia graveolens	1	1	0.79	0.01	1	0.13	0.01	0.08	**0.22**	-0.0150274
Centella asiatica	27	2	1.57	0.21	13.5	0.27	0.25	1.05	**1.57**	-0.0101927
Chamabainia cuspidata	17	1	0.79	0.13	17	0.13	0.15	1.32	**1.6**	-0.0101927
Chromolaena odoratum	17	2	1.57	0.13	8.5	0.27	0.15	0.66	**1.08**	-0.0669974
Commelina paludosa	175	17	13.39	1.38	10.29	2.29	1.63	0.8	**4.72**	-0.0008629
Commelina suffruticosa	1	1	0.79	0.01	1	0.13	0.01	0.08	**0.22**	-0.0075834
Conyza canadensis	12	3	2.36	0.09	4	0.4	0.11	0.31	**0.82**	-0.0245573
Crassocephalum crepidioides	49	14	11.02	0.39	3.5	1.88	0.46	0.27	**2.61**	-0.0053571
Crotalaria cytisoides	8	5	3.94	0.06	1.6	0.67	0.07	0.12	**0.86**	-0.0075834
Cyanthillium cinereum	12	2	1.57	0.09	6	0.27	0.11	0.47	**0.85**	-0.0022824
Cymbopogon nardus	3	1	0.79	0.02	3	0.13	0.02	0.23	**0.38**	-0.0856157
Cynodon dactylon	243	6	4.72	1.91	40.5	0.81	2.26	3.14	**6.21**	-0.0190738
Cyperus cyperoides	36	7	5.51	0.28	5.14	0.94	0.33	0.4	**1.67**	-0.006489
Schonoplectus juncoides	10	3	2.36	0.08	3.33	0.4	0.09	0.26	**0.75**	-0.0707222
Dichrocephala integrifolia	188	27	21.26	1.48	6.96	3.63	1.75	0.54	**5.92**	-0.0438275
Dicliptera bupleuroides	101	12	9.45	0.8	8.42	1.61	0.94	0.65	**3.2**	-0.006489
Dicranopteris linearis	10	1	0.79	0.08	10	0.13	0.09	0.78	**1**	-0.0814156
Digitaria ciliaris	227	9	7.09	1.79	25.22	1.21	2.11	1.96	**5.28**	-0.0848358
Digitaria sanguinalis	240	8	6.3	1.89	30	1.08	2.23	2.33	**5.64**	-0.0022824
Diplazium frondosum	3	1	0.79	0.02	3	0.13	0.02	0.23	**0.38**	-0.2918676
Drymaria diandra	1704	56	44.09	13.42	30.43	7.53	15.85	2.36	**25.74**	-0.1406962
Drymaria villosa	490	18	14.17	3.86	27.22	2.42	4.56	2.11	**9.09**	-0.0524057
Eleusine indica	127	4	3.15	1	31.75	0.54	1.18	2.46	**4.18**	-0.006489
Emilia sonchifolia	10	2	1.57	0.08	5	0.27	0.09	0.39	**0.75**	-0.0150274
Eragrostis nigra	27	1	0.79	0.21	27	0.13	0.25	2.09	**2.47**	-0.0116893
Eragrostis tenella	20	2	1.57	0.16	10	0.27	0.19	0.78	**1.24**	-0.0086467
Galinsoga parviflora	292	27	21.26	2.3	10.81	3.63	2.72	0.84	**7.19**	-0.0978939
Gamochaeta pensylvanicum	75	13	10.24	0.59	5.77	1.75	0.7	0.45	**2.9**	-0.0346202
Briggsia kurzii	3	2	1.57	0.02	1.5	0.27	0.02	0.12	**0.41**	-0.0022824
Grass (unidentified)	170	3	2.36	1.34	56.67	0.4	1.58	4.39	**6.37**	-0.0655413
Pogonantherum	1	1	0.79	0.01	1	0.13	0.01	0.08	**0.22**	-0.0008629

crinitum										
Grass-unidentified 1	92	3	2.36	0.72	30.67	0.4	0.85	2.38	**3.63**	-0.0407203
Grass-unidentified 2	61	3	2.36	0.48	20.33	0.4	0.57	1.58	**2.55**	-0.0293293
Gynura nepalensis	6	1	0.79	0.05	6	0.13	0.06	0.47	**0.66**	-0.0041783
Hydrocotyle himalaica	20	4	3.15	0.16	5	0.54	0.19	0.39	**1.12**	-0.0116893
Hydrocotyle nepalensis	1	1	0.79	0.01	1	0.13	0.01	0.08	**0.22**	-0.0008629
Hypericum japonicum	18	4	3.15	0.14	4.5	0.54	0.17	0.35	**1.06**	-0.0106967
Hypoestes sanguinolenta	5	1	0.79	0.04	5	0.13	0.05	0.39	**0.57**	-0.0475246
Hypoestes triflora	112	11	8.66	0.88	10.18	1.48	1.04	0.79	**3.31**	-0.0035666
Isachne albens	5	1	0.79	0.04	5	0.13	0.05	0.39	**0.57**	-0.0131439
Kyllinga brevifolia	23	4	3.15	0.18	5.75	0.54	0.21	0.45	**1.2**	-0.0410694
Kyllinga nemoralis	93	5	3.94	0.73	18.6	0.67	0.86	1.44	**2.97**	-0.1165608
Lecanthus peduncularis	373	14	11.02	2.94	26.64	1.88	3.47	2.07	**7.42**	-0.0190738
Lindenbergia grandiflora	36	5	3.94	0.28	7.2	0.67	0.33	0.56	**1.56**	-0.0224917
Lindenbergia indica	44	7	5.51	0.35	6.29	0.94	0.41	0.49	**1.84**	-0.0086467
Lindernia ciliata	14	3	2.36	0.11	4.67	0.4	0.13	0.36	**0.89**	-0.1259884
Lobelia nummularia	417	23	18.11	3.28	18.13	3.09	3.87	1.41	**8.37**	-0.001597
Lycopodium cerretum	2	1	0.79	0.02	2	0.13	0.02	0.16	**0.31**	-0.0181948
Lysimachia alternifolia	34	5	3.94	0.27	6.8	0.67	0.32	0.53	**1.52**	-0.0111954
Mazus pumilus	19	2	1.57	0.15	9.5	0.27	0.18	0.74	**1.19**	-0.001597
Mazus surculosus	2	1	0.79	0.02	2	0.13	0.02	0.16	**0.31**	-0.0070404
Microlepia strigosa	11	2	1.57	0.09	5.5	0.27	0.11	0.43	**0.81**	-0.001597
Mikania micrantha	2	1	0.79	0.02	2	0.13	0.02	0.16	**0.31**	-0.023737
Nephrolepis cordifolia	47	10	7.87	0.37	4.7	1.34	0.44	0.36	**2.14**	-0.0382473
Oplismenus burmanii	85	4	3.15	0.67	21.25	0.54	0.79	1.65	**2.98**	-0.1005401
Oplismenus compositus	303	11	8.66	2.39	27.55	1.48	2.82	2.14	**6.44**	-0.0988605
Oxalis corniculata	296	15	11.81	2.33	19.73	2.02	2.75	1.53	**6.3**	-0.1112185
Oxalis corniculata var. villosa	349	18	14.17	2.75	19.39	2.42	3.25	1.5	**7.17**	-0.0111954
Oxalis corymbosa	19	2	1.57	0.15	9.5	0.27	0.18	0.74	**1.19**	-0.0022824
Oxyspora paniculata	3	1	0.79	0.02	3	0.13	0.02	0.23	**0.38**	-0.03125
Paspalum conjugatum	66	2	1.57	0.52	33	0.27	0.61	2.56	**3.44**	-0.0154893
Peristrophe speciosa	28	2	1.57	0.22	14	0.27	0.26	1.09	**1.62**	-0.0008629
Persicaria capitata	1	1	0.79	0.01	1	0.13	0.01	0.08	**0.22**	-0.0304861
Persicaria chinensis	64	10	7.87	0.5	6.4	1.34	0.59	0.5	**2.43**	-0.1234621
Persicaria hydropiper	405	24	18.9	3.19	16.88	3.23	3.77	1.31	**8.31**	-0.0957001
Persicaria nepalensis	283	19	14.96	2.23	14.89	2.55	2.63	1.15	**6.33**	-0.001597
Persicaria posumbu	2	1	0.79	0.02	2	0.13	0.02	0.16	**0.31**	-0.1005401
Persicaria runcinata	303	25	19.69	2.39	12.12	3.36	2.82	0.94	**7.12**	-0.0059282
Pilea sp	9	2	1.57	0.07	4.5	0.27	0.08	0.35	**0.7**	-0.0441681
Pilea symmeria	102	9	7.09	0.8	11.33	1.21	0.94	0.88	**3.03**	-0.0059282
Pilea umbrosa	9	2	1.57	0.07	4.5	0.27	0.08	0.35	**0.7**	-0.0053571
Plantago erosa	8	4	3.15	0.06	2	0.54	0.07	0.16	**0.77**	-0.0136204
Poa annua	24	2	1.57	0.19	12	0.27	0.22	0.93	**1.42**	-0.0136204
Polygonum sp.	24	3	2.36	0.19	8	0.4	0.22	0.62	**1.24**	-0.0022824
Pteris semipinnata	3	1	0.79	0.02	3	0.13	0.02	0.23	**0.38**	-0.0035666
Polystichum lentum	5	2	1.57	0.04	2.5	0.27	0.05	0.19	**0.51**	-0.0396667

Pouzolzia hirta	89	9	7.09	0.7	9.89	1.21	0.83	0.77	**2.81**	-0.0047744
Primula melacoides?	7	1	0.79	0.06	7	0.13	0.07	0.54	**0.74**	-0.0293293
Pseudognaphalium affine	61	5	3.94	0.48	12.2	0.67	0.57	0.95	**2.19**	-0.0224917
Pteris biaurita	44	8	6.3	0.35	5.5	1.08	0.41	0.43	**1.92**	-0.0035666
Pupalia lappacea	5	1	0.79	0.04	5	0.13	0.05	0.39	**0.57**	-0.0022824
Rubia manjith	3	1	0.79	0.02	3	0.13	0.02	0.23	**0.38**	-0.0241481
Rungia pectinata	48	6	4.72	0.38	8	0.81	0.45	0.62	**1.88**	-0.0035666
Sacciolepis indica	5	1	0.79	0.04	5	0.13	0.05	0.39	**0.57**	-0.0536787
Selaginella biformis	131	14	11.02	1.03	9.36	1.88	1.22	0.73	**3.83**	-0.023324
Selaginella bisulcata	46	8	6.3	0.36	5.75	1.08	0.43	0.45	**1.96**	-0.0269738
Setaria palmifolia	55	8	6.3	0.43	6.88	1.08	0.51	0.53	**2.12**	-0.0208014
Spilanthes acmella	40	4	3.15	0.31	10	0.54	0.37	0.78	**1.69**	-0.0150274
Stellaria media	27	1	0.79	0.21	27	0.13	0.25	2.09	**2.47**	-0.052725
Stellaria patens	128	4	3.15	1.01	32	0.54	1.19	2.48	**4.21**	-0.1422436
Stellaria uliginosa	498	10	7.87	3.92	49.8	1.34	4.63	3.86	**9.83**	-0.0136204
Strobilanthes divaricata	24	3	2.36	0.19	8	0.4	0.22	0.62	**1.24**	-0.0035666
Tectaria coadunata	12	2	1.57	0.09	6	0.27	0.11	0.47	**0.85**	-0.0075834
Torenia violacea	46	5	3.94	0.36	9.2	0.67	0.43	0.71	**1.81**	-0.023324
Viola diffusa	22	3	2.36	0.17	7.33	0.4	0.2	0.57	**1.17**	-0.0126633
Viola pilosa	10	3	2.36	0.08	3.33	0.4	0.09	0.26	**0.75**	-0.006489
Youngia japonica	31	9	7.09	0.24	3.44	1.21	0.28	0.27	**1.76**	-0.0168555
TOTAL:	10758	744	**585.78**	**84.69**	**1289.58**					**-3.73**

Table 7.52: Top Ten IVI scoring species of plants in the annual vegetation of Soom Tea Estate

Species	RF	RD	RA	IVI
Drymaria diandra	7.53	15.85	2.36	**25.74**
Ageratum conyzoides	5.51	4.26	0.87	**10.64**
Stellaria uliginosa	1.34	4.63	3.86	**9.83**
Drymaria villosa	2.42	4.56	2.11	**9.09**
Lobelia nummularia	3.09	3.87	1.41	**8.37**
Persicaria hydropiper	3.23	3.77	1.31	**8.31**
Lecanthus peduncularis	1.88	3.47	2.07	**7.42**
Galinsoga parviflora	3.63	2.72	0.84	**7.19**
Oxalis corniculata var. *villosa*	2.42	3.25	1.5	**7.17**
Persicaria runcinata	3.36	2.82	0.94	**7.12**

Species Diversity [Shannon-Weiner Index] for this Tea Garden has been determined to -3.73. This is a quite moderate value of diversity. Such a value was under expectation because the habitate is highly disturbed one at the same time extreme dominance of few species only. This

Species Richness has been determined through **Menhinick's Index** and the obtained value is **1.089**.

7.4.3 Tamsong Tea Estate

I. Survey in the Winter: A total of 14 quadrates have been studied and the analysis of the recorded data has been presented in Table 7.53. A good number of 40 species of plants has been recorded through the process. As for any other vegetation, the population size for different species varies greatly. The total number of 1652 individuals has been recorded from Tamsong Tea Estate of which *Oxalis corniculata* (430 from 10 quadrates), *Gamochaeta pensylvanicum* (252 from 10 quadrates), *Oplismenus compositus* (250 from 11 quadrates), *Oplismenus burmanii* (169 from 8 quadrates) *Drymaria diandra* (135 from 9 quadrates) etc. are well represented species. The first species (*Oxalis corniculata*), with its large number of recorded individuals found growing in ten quadrates has the highest IVI score (48.39). *Gamochaeta pensylvanicum* also recorded from 10 quadrates occupied the 2nd position with its IVI score of 31.64. There is no gregariously growing or high-biomass producer plant recorded as important weed in the garden in winter. One interesting fact is that all the five recognised high IVI scorers were recorded from more than 50 % quadrates. So, it is expected that these plants will be available almost in every sectors of the garden.

Table 7.53: Analysis of winter quadrate sample data from Tamsong Tea Estate

Name of Plants	NI	NQ	F	D	A	RF	RD	RA	IVI
Ageratum conyzoides	4	1	7.14	0.29	4	0.79	0.25	1.34	**2.38**
Ajuga macrosperma	9	3	21.43	0.64	3	2.38	0.54	1.01	**3.93**
Artemisia indica	2	2	14.29	0.14	1	1.59	0.12	0.34	**2.05**
Bidens pilosa	30	3	21.43	2.14	10	2.38	1.81	3.35	**7.54**
Boehmeria rugulosa	1	1	7.14	0.07	1	0.79	0.06	0.34	**1.19**
Centella asiatica	3	1	7.14	0.21	3	0.79	0.18	1.01	**1.98**
Commelina paludosa	14	4	28.57	1	3.5	3.17	0.85	1.17	**5.19**
Commelina suffruticosa	14	2	14.29	1	7	1.59	0.85	2.35	**4.79**
Crassocephalum crepidioides	2	2	14.29	0.14	1	1.59	0.12	0.34	**2.05**
Cyanthillium cinereum	1	1	7.14	0.07	1	0.79	0.06	0.34	**1.19**
Dichrocephala integrifolia	9	3	21.43	0.64	3	2.38	0.54	1.01	**3.93**
Dicliptera bupleuroides	16	2	14.29	1.14	8	1.59	0.97	2.68	**5.24**
Digitaria sanguinalis	3	1	7.14	0.21	3	0.79	0.18	1.01	**1.98**
Drymaria diandra	135	9	64.29	9.64	15	7.14	8.17	5.03	**20.34**
Drymaria villosa	31	2	14.29	2.21	15.5	1.59	1.87	5.19	**8.65**
Emilia sonchifolia	3	1	7.14	0.21	3	0.79	0.18	1.01	**1.98**
Galinsoga parviflora	8	2	14.29	0.57	4	1.59	0.48	1.34	**3.41**
Gamochaeta pensylvanicum	252	10	71.43	18	25.2	7.94	15.26	8.44	**31.64**
Gynura nepalensis	1	1	7.14	0.07	1	0.79	0.06	0.34	**1.19**
Hydrocotyle himalaica	5	1	7.14	0.36	5	0.79	0.31	1.68	**2.78**
Lobelia nummularia	74	6	42.86	5.29	12.33	4.76	4.48	4.13	**13.37**
Nasturtium officinale	2	1	7.14	0.14	2	0.79	0.12	0.67	**1.58**

Nephrolepis cordifolia	1	1	7.14	0.07	1	0.79	0.06	0.34	**1.19**
Oplismenus burmanii	169	8	57.14	12.07	21.13	6.35	10.23	7.08	**23.66**
Oplismenus compositus	250	11	78.57	17.86	22.73	8.73	15.14	7.61	**31.48**
Oxalis corniculata	430	10	71.43	30.71	43	7.94	26.04	14.41	**48.39**
Oxalis latifolia	5	1	7.14	0.36	5	0.79	0.31	1.68	**2.78**
Paspalum conjugatum	2	1	7.14	0.14	2	0.79	0.12	0.67	**1.58**
Peristrophe speciosa	26	7	50	1.86	3.71	5.56	1.58	1.24	**8.38**
Persicaria chinensis	2	1	7.14	0.14	2	0.79	0.12	0.67	**1.58**
Persicaria hydropiper	6	2	14.29	0.43	3	1.59	0.36	1.01	**2.96**
Persicaria nepalensis	11	2	14.29	0.79	5.5	1.59	0.67	1.84	**4.1**
Persicaria runcinata	37	1	7.14	2.64	37	0.79	2.24	12.4	**15.43**
Pilea symmeria	6	2	14.29	0.43	3	1.59	0.36	1.01	**2.96**
Pteris biaurita	1	1	7.14	0.07	1	0.79	0.06	0.34	**1.19**
Pupalia lappacea	29	6	42.86	2.07	4.83	4.76	1.75	1.62	**8.13**
Setaria palmifolia	3	2	14.29	0.21	1.5	1.59	0.18	0.5	**2.27**
Setaria plicata	3	1	7.14	0.21	3	0.79	0.18	1.01	**1.98**
Tectaria coadunata	2	1	7.14	0.14	2	0.79	0.12	0.67	**1.58**
Youngia japonica	50	9	64.29	3.57	5.56	7.14	3.03	1.86	**12.03**
TOTAL:	**1652**	**126**	**900.01**	**117.95**	**298.49**				

However, all the five species recorded in Table 7.54 are annuals and at least three species (*Oxalis corniculata, Gamochaeta pensylvanicum* & *Oplismenus compositus*) are nearly cosmopolitan in distribution. *Oplismens burmanii* is also one widely distributed plant. *Drymaria diandra* generally grows in sub-tropical and temperate climate. Again, in this list there are two grasses, both of which are from the same genus.

Table 7.54: Top Five IVI scoring species of plants in the winter vegetation of Tamsong Tea Estate

Species	RF	RD	RA	IVI
Oxalis corniculata	7.94	26.04	14.41	**48.39**
Gamochaeta pensylvanicum	7.94	15.26	8.44	**31.64**
Oplismenus compositus	8.73	15.14	7.61	**31.48**
Oplismenus burmanii	6.35	10.23	7.08	**23.66**
Drymaria diandra	7.14	8.17	5.03	**20.34**

II. Survey in the Pre-Monsoon Period: A total of 31 quadrates have been studied and the analysis of the recorded data has been presented in Table 7.55. As much as 57 species of plants has been recorded through the process during this dry period. Like any other vegetation, the population size for different species varies greatly. A total number of 3560 individuals has been recorded through the quadrate samples of which *Drymaria diandra* (739 from 20 quadrates), *Oplismenus burmanii* (737 from 22 quadrates), *Oplismenus compositus* (382 from 13 quadrates), *Ageratum conyzoides* (303 from 19 quadrates), *Oxalis corniculata* (238 from 10 quadrates) etc. are well represented species. *Drymaria diandra* has been emerged as most important species (IVI : 36.13) in the vegetation due to its extremely high population structure as well as very wide distribution (RF : 8.66 %). *Oplismenus burmanii* is a common semi-erect grass and has scored nearly equal IVI of 36.11 and with 7.87 % RF. Another species of the same genus, *Oplismenus compositus* and *Ageratum conyzoides* are also recorded with quite high RF values 5.12 % and 7.48 %, respectively. There are two grasses (both of the genus *Oplismenus*) in the list of five important plants (Table 7.56) which are quite small and produce little biomass. In fact, except *Ageratum conyzoides* no other plant of this list is known to produce bushy high biomass producing plant. Unlike winter vegetation, in pre-monsoon vegetation only three species (*Ageratum conyzoides, Drymaria diandra & Oplismenus burmanii*) have been recorded from 50% or more quadrates.

It is also interesting to note that all the five plants recorded in Table 7.56 are annuals and none of them is gregarious, so does not produce good amount of biomass. So, the weed vegetation in pre-monsoon period appears quite sparse and low and, thereby, affects the crop much less.

Table 7.55: Analysis of pre-monsoon quadrate sample data from Tamsong Tea Estate

Name of Plants	NI	NQ	F	D	A	RF	RD	RA	IVI
Ageratum conyzoides	303	19	61.29	9.77	15.95	7.48	8.3	3.45	**19.23**
Ajuga macrosperma	23	5	16.13	0.74	4.6	1.97	0.63	1	**3.6**
Artemisia indica	2	1	3.23	0.06	2	0.39	0.05	0.43	**0.87**
Athyrium oxyphyllum.	59	11	35.48	1.9	5.36	4.33	1.61	1.16	**7.1**
Bidens pilosa	43	9	29.03	1.39	4.78	3.54	1.18	1.03	**5.75**
Boehmeria platyphylla var. *scabrella*	10	2	6.45	0.32	5	0.79	0.27	1.08	**2.14**
Boehmeria rugulosa	14	2	6.45	0.45	7	0.79	0.38	1.51	**2.68**
Borreria alata	124	11	35.48	4	11.27	4.33	3.4	2.44	**10.17**
Flueggea virosa	63	6	19.35	2.03	10.5	2.36	1.72	2.27	**6.35**
Carex sp	3	1	3.23	0.1	3	0.39	0.08	0.65	**1.12**
Centella asiatica	4	1	3.23	0.13	4	0.39	0.11	0.87	**1.37**
Commelina suffruticosa	11	2	6.45	0.35	5.5	0.79	0.3	1.19	**2.28**
Crassocephalum crepidioides	11	5	16.13	0.35	2.2	1.97	0.3	0.48	**2.75**
Cynodon dactylon	46	3	9.68	1.48	15.33	1.18	1.26	3.32	**5.76**
Cyperus cyperoides	14	5	16.13	0.45	2.8	1.97	0.38	0.61	**2.96**
Dichrocephala integrifolia	12	4	12.9	0.39	3	1.57	0.33	0.65	**2.55**
Digitaria ciliaris	42	3	9.68	1.35	14	1.18	1.15	3.03	**5.36**
Digitaria sanguinalis	48	4	12.9	1.55	12	1.57	1.32	2.6	**5.49**

Dioscorea bulbifera	1	1	3.23	0.03	1	0.39	0.03	0.22	**0.64**
Dioscorea pentaphylla	1	1	3.23	0.03	1	0.39	0.03	0.22	**0.64**
Drymaria diandra	739	20	64.52	23.84	36.95	7.87	20.26	8	**36.13**
Drymaria villosa	119	5	16.13	3.84	23.8	1.97	3.26	5.15	**10.38**
Duchesnea indica	8	2	6.45	0.26	4	0.79	0.22	0.87	**1.88**
Equisetum debile	2	1	3.23	0.06	2	0.39	0.05	0.43	**0.87**
Eragrostis tenella	69	7	22.58	2.23	9.86	2.76	1.89	2.13	**6.78**
Erigeron karvinskianus	5	1	3.23	0.16	5	0.39	0.14	1.08	**1.61**
Galinsoga parviflora	47	3	9.68	1.52	15.67	1.18	1.29	3.39	**5.86**
Gamochaeta pensylvanicum	5	2	6.45	0.16	2.5	0.79	0.14	0.54	**1.47**
Hydrocotyle himalaica	22	4	12.9	0.71	5.5	1.57	0.6	1.19	**3.36**
Hypoestes sanguinolenta	15	3	9.68	0.48	5	1.18	0.41	1.08	**2.67**
Impatiens discolor	3	1	3.23	0.1	3	0.39	0.08	0.65	**1.12**
Imperata cylindrica	8	1	3.23	0.26	8	0.39	0.22	1.73	**2.34**
Kyllinga brevifolia	27	3	9.68	0.87	9	1.18	0.74	1.95	**3.87**
Lantana camara	4	2	6.45	0.13	2	0.79	0.11	0.43	**1.33**
Murdannia nudiflora	10	2	6.45	0.32	5	0.79	0.27	1.08	**2.14**
Nephrolepis cordifolia	4	1	3.23	0.13	4	0.39	0.11	0.87	**1.37**
Oplismenus burmanii	737	22	70.97	23.77	33.5	8.66	20.2	7.25	**36.11**
Oplismenus compositus	382	13	41.94	12.32	29.38	5.12	10.47	6.36	**21.95**
Oxalis corniculata	238	10	32.26	7.68	23.8	3.94	6.53	5.15	**15.62**
Peperomia pellucida	36	2	6.45	1.16	18	0.79	0.99	3.9	**5.68**
Pericampylus glaucus	1	1	3.23	0.03	1	0.39	0.03	0.22	**0.64**
Persicaria chinensis	4	2	6.45	0.13	2	0.79	0.11	0.43	**1.33**
Persicaria hydropiper	22	6	19.35	0.71	3.67	2.36	0.6	0.79	**3.75**
Persicaria runcinata	75	9	29.03	2.42	8.33	3.54	2.06	1.8	**7.4**
Pouzolzia hirta	13	2	6.45	0.42	6.5	0.79	0.36	1.41	**2.56**
Pteris biaurita	2	2	6.45	0.06	1	0.79	0.05	0.22	**1.06**
Pupalia lappacea	10	2	6.45	0.32	5	0.79	0.27	1.08	**2.14**
Rubia manjith	1	1	3.23	0.03	1	0.39	0.03	0.22	**0.64**
Selaginella biformis	9	3	9.68	0.29	3	1.18	0.25	0.65	**2.08**
Selaginella bisulcata	11	4	12.9	0.35	2.75	1.57	0.3	0.6	**2.47**
Setaria palmifolia	27	2	6.45	0.87	13.5	0.79	0.74	2.92	**4.45**
Setaria pumila	19	3	9.68	0.61	6.33	1.18	0.52	1.37	**3.07**
Strobilanthes divaricata	2	1	3.23	0.06	2	0.39	0.05	0.43	**0.87**
Synedrella nodiflora	112	5	16.13	3.61	22.4	1.97	3.07	4.85	**9.89**
Tectaria coadunata	20	7	22.58	0.65	2.86	2.76	0.55	0.62	**3.93**
Tripsacum laxum	1	1	3.23	0.03	1	0.39	0.03	0.22	**0.64**
Viola pilosa	7	2	6.45	0.23	3.5	0.79	0.2	0.76	**1.75**
TOTAL:	**3650**	**254**	**819.39**	**117.69**	**462.09**				

Table 7.56: Top Five IVI scoring species of plants in the pre-monsoon vegetation of Tamsong Tea Estate

Species	RF	RD	RA	IVI
Drymaria diandra	7.87	20.26	8.00	**36.13**
Oplismenus burmanii	8.66	20.2	7.25	**36.11**

Oplismenus compositus	5.12	10.47	6.36	**21.95**
Ageratum conyzoides	7.48	8.3	3.45	**19.23**
Oxalis corniculata	3.94	6.53	5.15	**15.62**

III. Survey in the Post-Monsoon Period: A total of 20 quadrates have been studied and the analysis of the recorded data has been presented in Table 7.57. And, a good number of 60 species of plants has been recorded through the process. As for any other vegetation, the population size for different species varies greatly in this garden too. The total number of 2709 individuals has been recorded that expresses a picture of moderate occurrence of weeds in the vegetation even during post-monsoon period. *Drymaria diandra* with its IVI score of 35.61 [RF = 6.84, RD = 21.45, RA = 7.32] appeared as the most important weed of Tamsong Tea Estate during post-monsoon period. *Drymaria villosa* with the IVI score of 28.72 [RF = 3.68, RD = 15.32, RA = 9.72] stands in the second position. *Ageratum conyzoides* [IVI : 14.13] that grows during monsoon and continue to survive until the arrival of winter, occupied the 3rd position. Only one grass, *Oplismenus compositus* [IVI : 12.73] became the 4th important plant of the garden in post-monsoon weed flora [Table 7.58].

As it was found in Soom Tea Estate, in Tamsong also *Drymaria diandra* is behaving like a gregarious species in with its 65 % Frequency, i.e. it was recorded in 13 of the rotal 20 quadrates during post-monsoon period. Two other species, *Ageratum conyzoides* and *Borreria alata* were recorded from over 50 % of the quadrates (55 % & 65 % respectively). So, the distribution pattern is little broader during this climatic period.

Table 7.57: Analysis of post-monsoon quadrate sample data from Tamsong Tea Estate

Name of Plants	NI	NQ	F	D	A	RF	RD	RA	IVI
Ageratum conyzoides	161	11	55	8.05	14.64	5.79	5.94	2.4	**14.13**
Ageratum houstonianum	47	4	20	2.35	11.75	2.11	1.73	1.93	**5.77**
Ajuga macrosperma	53	6	30	2.65	8.83	3.16	1.96	1.45	**6.57**
Artemisia indica	6	2	10	0.3	3	1.05	0.22	0.49	**1.76**
Athyrium oxyphyllum.	9	2	10	0.45	4.5	1.05	0.33	0.74	**2.12**
Athyrium pectinatum	4	1	5	0.2	4	0.53	0.15	0.66	**1.34**
Bidens pilosa	17	5	25	0.85	3.4	2.63	0.63	0.56	**3.82**
Boehmeria platyphylla	43	2	10	2.15	21.5	1.05	1.59	3.52	**6.16**
Boehmeria rugulosa	33	4	20	1.65	8.25	2.11	1.22	1.35	**4.68**
Borreria alata	117	13	65	5.85	9	6.84	4.32	1.47	**12.63**
Cardamine hirsuta	6	1	5	0.3	6	0.53	0.22	0.98	**1.73**
Centella asiatica	13	2	10	0.65	6.5	1.05	0.48	1.07	**2.6**
Chloris dolichostachya	19	1	5	0.95	19	0.53	0.7	3.11	**4.34**

Commelina suffruticosa	1	1	5	0.05	1	0.53	0.04	0.16	**0.73**
Crassocephalum crepidioides	1	1	5	0.05	1	0.53	0.04	0.16	**0.73**
Dichrocephala integrifolia	2	1	5	0.1	2	0.53	0.07	0.33	**0.93**
Dicliptera bupleuroides	30	5	25	1.5	6	2.63	1.11	0.98	**4.72**
Digitaria ciliaris	126	6	30	6.3	21	3.16	4.65	3.44	**11.25**
Digitaria sanguinalis	9	1	5	0.45	9	0.53	0.33	1.47	**2.33**
Drymaria diandra	581	13	65	29.05	44.69	6.84	21.45	7.32	**35.61**
Drymaria villosa	415	7	35	20.75	59.29	3.68	15.32	9.72	**28.72**
Duchesnea indica	7	2	10	0.35	3.5	1.05	0.26	0.57	**1.88**
Eleusine indica	1	1	5	0.05	1	0.53	0.04	0.16	**0.73**
Equisetum debile	15	3	15	0.75	5	1.58	0.55	0.82	**2.95**
Equisetum diffusum	22	1	5	1.1	22	0.53	0.81	3.61	**4.95**
Eragrostis nigra	40	2	10	2	20	1.05	1.48	3.28	**5.81**
Eragrostis tenella	6	1	5	0.3	6	0.53	0.22	0.98	**1.73**
Galinsoga parviflora	37	2	10	1.85	18.5	1.05	1.37	3.03	**5.45**
Hedyotis scandens	3	2	10	0.15	1.5	1.05	0.11	0.25	**1.41**
Hydrocotyle himalaica	16	4	20	0.8	4	2.11	0.59	0.66	**3.36**
Imperata cylindrica	35	1	5	1.75	35	0.53	1.29	5.74	**7.56**
Kyllinga brevifolia	14	3	15	0.7	4.67	1.58	0.52	0.77	**2.87**
Kyllinga nemoralis	4	1	5	0.2	4	0.53	0.15	0.66	**1.34**
Lindenbergia grandiflora	1	1	5	0.05	1	0.53	0.04	0.16	**0.73**
Lindenbergia indica	13	2	10	0.65	6.5	1.05	0.48	1.07	**2.6**
Lindernia ciliata	89	7	35	4.45	12.71	3.68	3.29	2.08	**9.05**
Lindernia crustacea	9	1	5	0.45	9	0.53	0.33	1.47	**2.33**
Lobelia nummularia	46	6	30	2.3	7.67	3.16	1.7	1.26	**6.12**
Mazus pumilus	6	2	10	0.3	3	1.05	0.22	0.49	**1.76**
Oenanthe javanica	2	1	5	0.1	2	0.53	0.07	0.33	**0.93**
Oplismenus burmanii	80	4	20	4	20	2.11	2.95	3.28	**8.34**
Oplismenus compositus	150	7	35	7.5	21.43	3.68	5.54	3.51	**12.73**
Oxalis corniculata	120	7	35	6	17.14	3.68	4.43	2.81	**10.92**
Oxalis corymbosa	5	3	15	0.25	1.67	1.58	0.18	0.27	**2.03**
Paspalidium flavidum	13	1	5	0.65	13	0.53	0.48	2.13	**3.14**
Persicaria hydropiper	69	3	15	3.45	23	1.58	2.55	3.77	**7.9**
Persicaria nepalensis	2	1	5	0.1	2	0.53	0.07	0.33	**0.93**
Persicaria runcinata	47	4	20	2.35	11.75	2.11	1.73	1.93	**5.77**
Pouzolzia hirta	35	6	30	1.75	5.83	3.16	1.29	0.96	**5.41**
Pupalia lappacea	20	3	15	1	6.67	1.58	0.74	1.09	**3.41**
Rungia pectinata	2	1	5	0.1	2	0.53	0.07	0.33	**0.93**
Selaginella biformis	22	4	20	1.1	5.5	2.11	0.81	0.9	**3.82**
Selaginella bisulcata	21	2	10	1.05	10.5	1.05	0.78	1.72	**3.55**
Setaria palmifolia	6	2	10	0.3	3	1.05	0.22	0.49	**1.76**
Strobilanthes divaricata	28	3	15	1.4	9.33	1.58	1.03	1.53	**4.14**
Synedrella nodiflora	9	1	5	0.45	9	0.53	0.33	1.47	**2.33**
Tectaria coadunata	2	2	10	0.1	1	1.05	0.07	0.16	**1.28**
Torenia violacea	2	1	5	0.1	2	0.53	0.07	0.33	**0.93**
Viola diffusa	6	2	10	0.3	3	1.05	0.22	0.49	**1.76**
Viola pilosa	11	1	5	0.55	11	0.53	0.41	1.8	**2.74**

TOTAL:	2709	190	950	135.45	610.22				

All the five high IVI scorer plants are annuals and only one is a grass (*Oplismenus compositus*). Though not regarded as serious, but both the species of *Drymaria* are very important weeds in Tamsong Tea Estate. However, the overall picture in this garden is quite good and weeds create comparatively less problem to the garden management. This garden does not use any chemical herbicide as a part of its agronomic practice.

Table 7.58: Top Five IVI scoring species of plants in the post-monsoon vegetation of Tamsong Tea Estate

Species	RF	RD	RA	IVI
Drymaria diandra	6.84	21.45	7.32	35.61
Drymaria villosa	3.68	15.32	9.72	28.72
Ageratum conyzoides	5.79	5.94	2.4	14.13
Oplismenus compositus	3.68	5.54	3.51	12.73
Borreria alata	6.84	4.32	1.47	12.63

IV: The Annual Picture: While bringing data from all three seasons under a single head, i.e. data from a total of 65 quadrates that has produced the annual structure for the weedy vegetation in Soom Tea Estate. This has been presented in Table 7.59. It shows that 92 species of weeds with a total of 8011 individuals growing in the garden as recorded through 65 quadrate samplings. Maximum number of individuals has been recorded for *Drymaria diandra* (1455 from 42 quadrates) and this is followed by *Oplismenus burmanii* (986 from 34 quadrates), *Oplismenus compositus* (782 from 31 quadrates), *Oxalis corniculata* (788 from 27 quadrates), *Drymaria villosa* (565 from 14 quadrates), *Ageratum conyzoides* (468 from 31 quadrates), *Borreria alata* (241 from 24 quadrates), *Gamochaeta pensylvanicum* (257 from 12 quadrates), *Digitaria ciliaris* (168 from 9 quadrates), *Persicaria runcinata (*159 from 14 quadrates) etc. have been recorded with quite high population structure. Of these *Drymaria diandra* (IVI : 30.25) has been appeared as the most important species in this garden. This species was also determined as most important species in post-monsoon, 2nd in pre-monsoon and 5th in winter season vegetation. The second position is occupied by *Oplismenus burmanii* (IVI : 22.22) that was once determined as most important weed in pre-monsoon and 4th in winter.

It is also important to note that only two of the recorded 92 species in Tamsong Tea Estate has been recorded from 50 % or more quadrate samples. The highest Frequency/ Relative Frequency was noted for *Drymaria diandra* that was growing in 42 (i.e. F : 64.62 %) quadrates.

This was followed by *Oplismenus burmanii*, which was recorded from 34 quadrates. *Oplismenus compositus* is a cosmopolitan grass and forms dense clothing in open and semi-open vegetation. *Drymaria villosa* is a very common weed of post-monsoon – early winter period in Darjiling Hills, but it prefers to grow in open places. That is why a comparatively poor population for the species has been met with. *Oxalis corniculata* is one cosmopolitan species that grows in abundance not only in the normal open or semi-open vegetation but also in the Tea Gardens as it was appeared in the discussion made so far in this chapter. *Ageratum conyzoides* and *Borreria alata*

Out of the ten highly important species of Tamsong Tea Estate (Table 7.60) only *Digitaria ciliaris* (IVI : 6.22) and *Persicaria runcinata* (IVI : 6.00) were not recognised as important weeds in seasonal vegetation. Again, all these ten plants are annuals and are Therophytic. All these plants are native to the local flora. At the high altitude cold areas *Ageratum conyzoides* does not behave as gregarious plant grows like small herbs. So, none of these ten plants are gregarious and the weedy vegetation is of low height only except that the branches of *Drymaria diandra* sometimes ramble upon the Tea bushes and forms an open net-work

Table 7.59: Analysis of annual quadrate sample data from Tamsong Tea Estate

Name of Plants	NI	NQ	F	D	A	RF	RD	RA	IVI	SD
Ageratum conyzoides	468	31	47.69	7.2	15.1	5.44	5.84	2.06	**13.34**	-0.1659179
Ageratum houstonianum	47	4	6.15	0.72	11.75	0.7	0.58	1.6	**2.88**	-0.0301468
Ajuga macrosperma	85	14	21.54	1.31	6.07	2.46	1.06	0.83	**4.35**	-0.0482341
Artemisia indica	10	5	7.69	0.15	2	0.88	0.12	0.27	**1.27**	-0.008346
Athyrium oxyphyllum.	68	13	20	1.05	5.23	2.28	0.85	0.71	**3.84**	-0.0037959
Athyrium pectinatum	4	1	1.54	0.06	4	0.18	0.05	0.55	**0.78**	-0.0504292
Bidens pilosa	90	17	26.15	1.38	5.29	2.98	1.12	0.72	**4.82**	-0.008346
Boehmeria macrophylla	43	2	3.08	0.66	21.5	0.35	0.54	2.93	**3.82**	-0.0280585
Boehmeria platyphylla var. *scabrella*	10	2	3.08	0.15	5	0.35	0.12	0.68	**1.15**	-0.0306621
Boehmeria rugulosa	48	7	10.77	0.74	6.86	1.23	0.6	0.94	**2.77**	-0.1054063
Borreria alata	241	24	36.92	3.71	10.04	4.21	3.01	1.37	**8.59**	-0.0381054
Cardamine hirsuta	6	1	1.54	0.09	6	0.18	0.07	0.82	**1.07**	-0.0053902
Carex sp	3	1	1.54	0.05	3	0.18	0.04	0.41	**0.63**	-0.0029547
Centella asiatica	20	4	6.15	0.31	5	0.7	0.25	0.68	**1.63**	-0.0149615
Chloris dolichostachya	19	1	1.54	0.29	19	0.18	0.24	2.59	**3.01**	-0.0143351
Commelina paludosa	14	4	6.15	0.22	3.5	0.7	0.18	0.48	**1.36**	-0.0110964
Commelina suffruticosa	26	5	7.69	0.4	5.2	0.88	0.32	0.71	**1.91**	-0.0185985
Crassocephalum crepidioides	14	8	12.31	0.22	1.75	1.4	0.18	0.24	**1.82**	-0.0110964

Cyanthillium cinereum	1	1	1.54	0.02	1	0.18	0.02	0.14	**0.34**	-0.001122
Cynodon dactylon	46	3	4.62	0.71	15.33	0.53	0.58	2.09	**3.2**	-0.0296289
Cyperus cyperoides	14	5	7.69	0.22	2.8	0.88	0.18	0.38	**1.44**	-0.0110964
Dichrocephala integrifolia	23	8	12.31	0.35	2.88	1.4	0.28	0.39	**2.07**	-0.0168045
Dicliptera bupleuroides	46	7	10.77	0.71	6.57	1.23	0.58	0.9	**2.71**	-0.0296289
Digitaria ciliaris	168	9	13.85	2.58	18.67	1.58	2.09	2.55	**6.22**	-0.0810453
Digitaria sanguinalis	60	6	9.23	0.92	10	1.05	0.75	1.36	**3.16**	-0.0366563
Dioscorea bulbifera	1	1	1.54	0.02	1	0.18	0.02	0.14	**0.34**	-0.001122
Dioscorea pentaphylla	1	1	1.54	0.02	1	0.18	0.02	0.14	**0.34**	-0.001122
Drymaria diandra	1455	42	64.62	22.38	34.64	7.37	18.15	4.73	**30.25**	-0.3098181
Drymaria villosa	565	14	21.54	8.69	40.36	2.46	7.05	5.51	**15.02**	-0.1870223
Duchesnea indica	15	4	6.15	0.23	3.75	0.7	0.19	0.51	**1.4**	-0.0117598
Eleusine indica	1	1	1.54	0.02	1	0.18	0.02	0.14	**0.34**	-0.001122
Emilia sonchifolia	3	1	1.54	0.05	3	0.18	0.04	0.41	**0.63**	-0.0029547
Equisetum debile	17	4	6.15	0.26	4.25	0.7	0.21	0.58	**1.49**	-0.0130622
Equisetum diffusum	22	1	1.54	0.34	22	0.18	0.28	3	**3.46**	-0.0161959
Eragrostis nigra	40	2	3.08	0.62	20	0.35	0.5	2.73	**3.58**	-0.0264621
Eragrostis tenella	75	8	12.31	1.15	9.38	1.4	0.93	1.28	**3.61**	-0.0437313
Erigeron karvinskianus	5	1	1.54	0.08	5	0.18	0.06	0.68	**0.92**	-0.0046056
Flueggea virosa	63	6	9.23	0.97	10.5	1.05	0.79	1.43	**3.27**	-0.0404814
Galinsoga parviflora	92	7	10.77	1.42	13.14	1.23	1.15	1.79	**4.17**	-0.0512975
Gamochaeta pensylvanicum	257	12	18.46	3.95	21.42	2.1	3.2	2.92	**8.22**	-0.110342
Gynura nepalensis	1	1	1.54	0.02	1	0.18	0.02	0.14	**0.34**	-0.001122
Hedyotis scandens	3	2	3.08	0.05	1.5	0.35	0.04	0.2	**0.59**	-0.0029547
Hydrocotyle himalaica	43	9	13.85	0.66	4.78	1.58	0.54	0.65	**2.77**	-0.0280585
Hypoestes sanguinolenta	15	3	4.62	0.23	5	0.53	0.19	0.68	**1.4**	-0.0029547
Impatiens discolor	3	1	1.54	0.05	3	0.18	0.04	0.41	**0.63**	-0.0280585
Imperata cylindrica	43	2	3.08	0.66	21.5	0.35	0.54	2.93	**3.82**	-0.0269972
Kyllinga brevifolia	41	6	9.23	0.63	6.83	1.05	0.51	0.93	**2.49**	-0.0037959
Kyllinga nemoralis	4	1	1.54	0.06	4	0.18	0.05	0.55	**0.78**	-0.0037959
Lantana camara	4	2	3.08	0.06	2	0.35	0.05	0.27	**0.67**	-0.001122
Lindenbergia grandiflora	1	1	1.54	0.02	1	0.18	0.02	0.14	**0.34**	-0.0104241
Lindenbergia indica	13	2	3.08	0.2	6.5	0.35	0.16	0.89	**1.4**	-0.049993
Lindernia ciliata	89	7	10.77	1.37	12.71	1.23	1.11	1.73	**4.07**	-0.0076298
Lindernia crustacea	9	1	1.54	0.14	9	0.18	0.11	1.23	**1.52**	-0.0629297
Lobelia nummularia	120	12	18.46	1.85	10	2.1	1.5	1.36	**4.96**	-0.0053902
Mazus pumilus	6	2	3.08	0.09	3	0.35	0.07	0.41	**0.83**	-0.008346
Murdannia nudiflora	10	2	3.08	0.15	5	0.35	0.12	0.68	**1.15**	-0.002071
Nasturtium officinale	2	1	1.54	0.03	2	0.18	0.02	0.27	**0.47**	-0.0046056
Nephrolepis cordifolia	5	2	3.08	0.08	2.5	0.35	0.06	0.34	**0.75**	-0.002071
Oenanthe javanica	2	1	1.54	0.03	2	0.18	0.02	0.27	**0.47**	-0.2578437
Oplismenus burmanii	986	34	52.31	15.17	29	5.96	12.3	3.96	**22.22**	-0.2271242
Oplismenus compositus	782	31	47.69	12.03	25.23	5.44	9.76	3.44	**18.64**	-0.228115
Oxalis corniculata	788	27	41.54	12.12	29.19	4.74	9.83	3.98	**18.55**	-0.0046056

Oxalis corymbosa	5	3	4.62	0.08	1.67	0.53	0.06	0.23	**0.82**	-0.0046056
Oxalis latifolia	5	1	1.54	0.08	5	0.18	0.06	0.68	**0.92**	-0.0104241
Paspalidium flavidum	13	1	1.54	0.2	13	0.18	0.16	1.77	**2.11**	-0.002071
Paspalum conjugatum	2	1	1.54	0.03	2	0.18	0.02	0.27	**0.47**	-0.0242893
Peperomia pellucida	36	2	3.08	0.55	18	0.35	0.45	2.46	**3.26**	-0.001122
Pericampylus glaucus	1	1	1.54	0.02	1	0.18	0.02	0.14	**0.34**	-0.0185985
Peristrophe speciosa	26	7	10.77	0.4	3.71	1.23	0.32	0.51	**2.06**	-0.0053902
Persicaria chinensis	6	3	4.62	0.09	2	0.53	0.07	0.27	**0.87**	-0.0534446
Persicaria hydropiper	97	11	16.92	1.49	8.82	1.93	1.21	1.2	**4.34**	-0.0104241
Persicaria nepalensis	13	3	4.62	0.2	4.33	0.53	0.16	0.59	**1.28**	-0.0777964
Persicaria runcinata	159	14	21.54	2.45	11.36	2.46	1.99	1.55	**6.00**	-0.0053902
Pilea symmeria	6	2	3.08	0.09	3	0.35	0.07	0.41	**0.83**	-0.0306621
Pouzolzia hirta	48	8	12.31	0.74	6	1.4	0.6	0.82	**2.82**	-0.0029547
Pteris biaurita	3	3	4.62	0.05	1	0.53	0.04	0.14	**0.71**	-0.0361691
Pupalia lappacea	59	11	16.92	0.91	5.36	1.93	0.74	0.73	**3.4**	-0.001122
Rubia manjith	1	1	1.54	0.02	1	0.18	0.02	0.14	**0.34**	-0.002071
Rungia pectinata	2	1	1.54	0.03	2	0.18	0.02	0.27	**0.47**	-0.0214945
Selaginella biformis	31	7	10.77	0.48	4.43	1.23	0.39	0.6	**2.22**	-0.022061
Selaginella bisulcata	32	6	9.23	0.49	5.33	1.05	0.4	0.73	**2.18**	-0.0242893
Setaria palmifolia	36	6	9.23	0.55	6	1.05	0.45	0.82	**2.32**	-0.0029547
Setaria plicata	3	1	1.54	0.05	3	0.18	0.04	0.41	**0.63**	-0.0143351
Setaria pumila	19	3	4.62	0.29	6.33	0.53	0.24	0.86	**1.63**	-0.0209239
Strobilanthes divaricata	30	4	6.15	0.46	7.5	0.7	0.37	1.02	**2.09**	-0.0117598
Synedrella nodiflora	121	6	9.23	1.86	20.17	1.05	1.51	2.75	**5.31**	-0.0633287
Tectaria coadunata	24	10	15.38	0.37	2.4	1.75	0.3	0.33	**2.38**	-0.0174076
Torenia violacea	2	1	1.54	0.03	2	0.18	0.02	0.27	**0.47**	-0.002071
Tripsacum laxum	1	1	1.54	0.02	1	0.18	0.02	0.14	**0.34**	-0.001122
Viola diffusa	6	2	3.08	0.09	3	0.35	0.07	0.41	**0.83**	-0.0053902
Viola pilosa	18	3	4.62	0.28	6	0.53	0.23	0.82	**1.58**	-0.0137021
Youngia japonica	50	9	13.85	0.77	5.56	1.58	0.62	0.76	**2.96**	-0.0316849
TOTAL:	**8011**	**570**	**877**	**123.3**	**732.7**					**-3.13**

Table 7.60: Top Ten IVI scoring species of plants in the annual vegetation of Tamsong Tea Estate

Species	RF	RD	RA	IVI
Drymaria diandra	7.37	18.15	4.73	**30.25**
Oplismenus burmanii	5.96	12.3	3.96	**22.22**
Oplismenus compositus	5.44	9.76	3.44	**18.64**
Oxalis corniculata	4.74	9.83	3.98	**18.55**
Drymaria villosa	2.46	7.05	5.51	**15.02**
Ageratum conyzoides	5.44	5.84	2.06	**13.34**
Borreria alata	4.21	3.01	1.37	**8.59**
Gamochaeta pensylvanicum	2.1	3.2	2.92	**8.22**
Digitaria ciliaris	1.58	2.09	2.55	**6.22**
Persicaria runcinata	2.46	1.99	1.55	**6.00**

Species Diversity [Shannon-Weiner Index] for this Tea Garden has been determined to -3.13. This is a quite moderate value of diversity. Such a value was under expectation because the habitate is highly disturbed one at the same time extreme dominance of few species only. This is also maintained as a biogarden for the last few years.

Species Richness has been determined through **Menhinick's Index** and the obtained value is **1.028**.

7.4.4 Overall Weed Picture of Darjiling Hill Tea Gardens

Three Tea Gardens from Darjiling Hills has been studied to understand the weeds and their social behaviour in association with the Tea bushes. The results of the survey have been discussed above at the garden level for different seasons and for the round the year. Now, the results of all these four gardens compiled together to get a wholistic annual picture and that has been presented in Table 7.61.

In the selected t Tea Gardens altogether 287 quadrates have been studied at random and in different seasons. During the process altogether 28863 individuals have been counted representing 187 species of macrophytes (Pteridophytes and Angiosperms) covering 136 genera. At the family level these are representing 11 Pteridophytic, 33 Dicotyledonous and 8 Monocotyledonous families. Taxonimic distribution of recorded plants has been presented in Table 7.62.

Table 7.61: Analysis with the whole year quadrate sample data from three Tea Gardens in Hills of Darjiling.

Name of plants			NI	NQ	RF	RD	RA	IVI	SD
Achyranthes bidentata	S	1	2	1	0.05	0.01	0.11	0.17	-0.00066
Aconogonon molle	S	1	7	1	0.05	0.02	0.39	0.46	-0.00202
Ageratina adenophora	MS	2	11	5	0.24	0.04	0.12	0.4	-0.003
Ageratum conyzoides	MST	3	1025	83	4	3.55	0.69	8.24	-0.11853
Ageratum houstonianum	MST	3	793	42	2.02	2.75	1.06	5.83	-0.09875
Ajuga macrosperma	ST	2	168	24	1.16	0.58	0.39	2.13	-0.02995
Anaphalis contorta	S	1	17	1	0.05	0.06	0.96	1.07	-0.00438
Artemisia indica	ST	2	22	6	0.29	0.08	0.21	0.58	-0.00547
Athyrium oxyphyllum.	MST	3	132	30	1.44	0.46	0.25	2.15	-0.02464
Athyrium pectinatum	T	1	4	1	0.05	0.01	0.22	0.28	-0.00123
Axonopus compressus	MS	2	111	10	0.48	0.38	0.62	1.48	-0.02138
Bambusa sp	M	1	14	2	0.1	0.05	0.39	0.54	-0.0037
Bidens pilosa	MST	3	154	38	1.83	0.53	0.23	2.59	-0.02792

Blumea hieracifolia	S	1	9	1	0.05	0.03	0.51	0.59	-0.00252
Boehmeria	M	1	5	1	0.05	0.02	0.28	0.35	-0.00276
Boehmeria platyphylla var. *scabrella*	T	1	10	2	0.1	0.03	0.28	0.41	-0.0097
Boehmeria macrophylla	T	1	43	2	0.1	0.15	1.21	1.46	-0.0015
Boehmeria rugulosa	ST	2	62	10	0.48	0.21	0.35	1.04	-0.0132
Borreria alata	MST	3	1918	90	4.33	6.64	1.2	12.17	-0.18016
Borreria ocymoides	MS	2	196	9	0.43	0.68	1.22	2.33	-0.0339
Breynia retusa	M	1	2	1	0.05	0.01	0.11	0.17	-0.00066
Briggsia kurzii	S	1	3	2	0.1	0.01	0.08	0.19	-0.00095
Bulbostylis densa			420	8	0.39	1.46	2.95	4.8	-0.06155
Cardamine hirsute	ST	2	53	5	0.24	0.18	0.6	1.02	-0.01157
Carex sp.	MT	2	7	2	0.1	0.02	0.2	0.32	-0.00202
Casearia graveolens	S	1	1	1	0.05	0	0.06	0.11	-0.00036
Centella asiatica	MST	3	62	8	0.39	0.21	0.44	1.04	-0.0132
Chamabainia cuspidata	S	1	17	1	0.05	0.06	0.96	1.07	-0.00438
Chloris dolichostachya	T	1	19	1	0.05	0.07	1.07	1.19	-0.00482
Chromolaena odoratum	MS	2	31	12	0.58	0.11	0.15	0.84	-0.00734
Commelina diffusa	M	1	25	5	0.24	0.09	0.28	0.61	-0.00611
Commelina paludosa	MST	3	215	27	1.3	0.74	0.45	2.49	-0.0365
Commelina suffruticosa	MST	3	147	25	1.2	0.51	0.33	2.04	-0.02689
Conyza Canadensis	S	1	12	3	0.14	0.04	0.22	0.4	-0.00324
Crassocephalum crepidioides	MST	3	104	37	1.78	0.36	0.16	2.3	-0.02027
Crotalaria cytisoides	S	1	8	5	0.24	0.03	0.09	0.36	-0.00227
Cyanotis vaga	M	1	62	5	0.24	0.21	0.7	1.15	-0.0132
Cyanthillium cinereum	MST	3	29	10	0.48	0.1	0.16	0.74	-0.00694
Cymbopogon nardus	S	1	3	1	0.05	0.01	0.17	0.23	-0.00095
Cynodon dactylon	MST	3	304	10	0.48	1.05	1.71	3.24	-0.04795
Cyperus compressus	M	1	123	11	0.53	0.43	0.63	1.59	-0.02326
Cyperus cyperoides	MST	3	151	29	1.4	0.52	0.29	2.21	-0.02748
Cyperus pilosus	M	1	2	1	0.05	0.01	0.11	0.17	-0.00066
Desmodium triflorum	M	1	3	2	0.1	0.01	0.08	0.19	-0.00095
Dichrocephala integrifolia	MST	3	275	45	2.17	0.95	0.34	3.46	-0.04434
Dicliptera bupleuroides	MST	3	179	25	1.2	0.62	0.4	2.22	-0.03152
Dicranopteris linearis	MS	2	41	7	0.34	0.14	0.33	0.81	-0.00931
Digitaria ciliaris	MST	3	501	24	1.16	1.74	1.17	4.07	-0.07036
Digitaria sanguinalis	MST	3	308	16	0.77	1.07	1.08	2.92	-0.04845
Dioscorea alata	M	1	8	3	0.14	0.03	0.15	0.32	-0.00227
Dioscorea bulbifera	MT	2	4	3	0.14	0.01	0.07	0.22	-0.00123
Dioscorea pentaphylla	T	1	1	1	0.05	0	0.06	0.11	-0.00036
Diplazium frondosum	S	1	3	1	0.05	0.01	0.17	0.23	-0.00095
Drymaria diandra	MST	3	4333	150	7.22	15.01	1.62	23.85	-0.28467
Drymaria villosa	ST	2	1055	32	1.54	3.65	1.85	7.04	-0.12095
Dryopteris filix-mas	M	1	9	2	0.1	0.03	0.25	0.38	-0.00252
Duchesnea indica	MT	2	23	6	0.29	0.08	0.22	0.59	-0.00569
Elatostema alsinoides	M	1	40	1	0.05	0.14	2.25	2.44	-0.00912
Elatostema hookerianum	M	1	9	1	0.05	0.03	0.51	0.59	-0.00252

Eleusine indica	ST	2	128	5	0.24	0.44	1.44	2.12	-0.02403
Emilia sonchifolia	ST	2	13	3	0.14	0.05	0.24	0.43	-0.00347
Equisetum debile	T	1	17	4	0.19	0.06	0.24	0.49	-0.00438
Equisetum diffusum	T	1	22	1	0.05	0.08	1.24	1.37	-0.00547
Eragrostis nigra	MST	3	295	7	0.34	1.02	2.37	3.73	-0.04684
Eragrostis tenella	MST	3	676	22	1.06	2.34	1.73	5.13	-0.01832
Eragrostis unioloides	M	1	377	7	0.34	1.31	3.03	4.68	-0.08792
Erigeron karvinskianus	T	1	5	1	0.05	0.02	0.28	0.35	-0.05666
Fimbristylis dichotoma	M	1	157	5	0.24	0.54	1.77	2.55	-0.0015
Flueggea virosa	T	1	63	6	0.29	0.22	0.59	1.1	-0.02836
Galinsoga parviflora	MST	3	413	39	1.88	1.43	0.6	3.91	-0.01337
Gamochaeta pensylvanicum	MST	3	350	26	1.25	1.21	0.76	3.22	-0.06077
Globba racemosa	M	1	1	1	0.05	0	0.06	0.11	-0.0535
Grass-unidentified	S	1	170	3	0.14	0.59	3.19	3.92	-0.00036
Grass-unidentified 1	S	1	92	3	0.14	0.32	1.72	2.18	-0.03024
Grass-unidentified 2	S	1	61	3	0.14	0.21	1.14	1.49	-0.0059
Guizotia abyssinica	M	1	24	3	0.14	0.08	0.45	0.67	-0.00202
Gynura nepalensis	ST	2	7	2	0.1	0.02	0.2	0.32	-0.00095
Hedyotis scandens	T	1	3	2	0.1	0.01	0.08	0.19	-0.01666
Hydrocotyle himalaica	MST	3	82	16	0.77	0.28	0.29	1.34	-0.00036
Hydrocotyle nepalensis	S	1	1	1	0.05	0	0.06	0.11	-0.0046
Hypericum japonicum	S	1	18	4	0.19	0.06	0.25	0.5	-0.00834
Hypoestes sanguinolenta	MST	3	36	7	0.34	0.12	0.29	0.75	-0.02418
Hypoestes triflora	MS	2	129	12	0.58	0.45	0.6	1.63	-0.00095
Ichnocarpus frutescens	M	1	3	2	0.1	0.01	0.08	0.19	-0.00095
Impatiens balsamina	M	1	9	5	0.24	0.03	0.1	0.37	-0.00252
Impatiens discolour	T	1	3	1	0.05	0.01	0.17	0.23	-0.02644
Imperata cylindrical	MT	2	144	7	0.34	0.5	1.16	2	-0.0015
Isachne albens	S	1	5	1	0.05	0.02	0.28	0.35	-0.00123
Jasminum dispermum	M	1	4	2	0.1	0.01	0.11	0.22	-0.02011
Kyllinga brevifolia	MST	3	103	13	0.63	0.36	0.45	1.44	-0.01914
Kyllinga nemoralis	ST	2	97	6	0.29	0.34	0.91	1.54	-0.0015
Lantana camara	MT	2	5	3	0.14	0.02	0.09	0.25	-0.0562
Lecanthus peduncularis	S	1	373	14	0.67	1.29	1.5	3.46	-0.00526
Lepidagathis incurve	M	1	21	5	0.24	0.07	0.24	0.55	-0.00123
Leucas indica	M	1	4	2	0.1	0.01	0.11	0.22	-0.00854
Lindenbergia grandiflora	ST	2	37	6	0.29	0.13	0.35	0.77	-0.0123
Lindenbergia indica	ST	2	57	9	0.43	0.2	0.36	0.99	-0.02011
Lindernia ciliate	ST	2	103	10	0.48	0.36	0.58	1.42	-0.00252
Lindernia crustacean	T	1	9	1	0.05	0.03	0.51	0.59	-0.07433
Lobelia nummularia	MST	3	539	36	1.73	1.87	0.84	4.44	-0.00066
Lycopodium clavatum	S	1	2	1	0.05	0.01	0.11	0.17	-0.00066
Lygodium salicifolium	M	1	2	2	0.1	0.01	0.06	0.17	-0.00794
Lysimachia alternifolia	S	1	34	5	0.24	0.12	0.38	0.74	-0.00611
Mazus pumilus	ST	2	25	4	0.19	0.09	0.35	0.63	-0.00066
Mazus surculosus	S	1	2	1	0.05	0.01	0.11	0.17	-0.00036
Melia azedarach	M	1	1	1	0.05	0	0.06	0.11	-0.003

Microlepia strigosa	S	1	11	2	0.1	0.04	0.31	0.45	-0.0059
Mikania micrantha	MS	2	24	12	0.58	0.08	0.11	0.77	-0.00526
Mitracarpus verticillatus	M	1	21	2	0.1	0.07	0.59	0.76	-0.00036
Morus australis	M	1	1	1	0.05	0	0.06	0.11	-0.00834
Murdannia nudiflora	MT	2	36	6	0.29	0.12	0.34	0.75	-0.00066
Nasturtium officinale	T	1	2	1	0.05	0.01	0.11	0.17	-0.00066
Natsiatum herpeticum	M	1	2	1	0.05	0.01	0.11	0.17	-0.01716
Nephrolepis cordifolia	MST	3	85	18	0.87	0.29	0.27	1.43	-0.00066
Neyraudia arundinacea var. zollingeri	M	1	2	1	0.05	0.01	0.11	0.17	-0.00066
Oenanthe javanica	T	1	2	1	0.05	0.01	0.11	0.17	-0.17445
Oplismenus burmanii	MST	3	1823	62	2.99	6.32	1.65	10.96	-0.16481
Oplismenus compositus	MST	3	1669	70	3.37	5.78	1.34	10.49	-0.15374
Oxalis corniculata	MST	3	1501	62	2.99	5.2	1.36	9.55	-0.05338
Oxalis corniculata var. villosa	S	1	349	18	0.87	1.21	1.09	3.17	-0.00854
Oxalis corymbosa	MST	3	37	7	0.34	0.13	0.3	0.77	-0.0015
Oxalis latifolia	T	1	5	1	0.05	0.02	0.28	0.35	-0.00095
Oxyspora paniculata	S	1	3	1	0.05	0.01	0.17	0.23	-0.00347
Paspalidium flavidum	T	1	13	1	0.05	0.05	0.73	0.83	-0.0146
Paspalum conjugatum	MST	3	70	4	0.19	0.24	0.98	1.41	-0.02059
Peperomia pellucida	MT	2	106	10	0.48	0.37	0.6	1.45	-0.0015
Pericampylus glaucus	MT	2	5	5	0.24	0.02	0.06	0.32	-0.01408
Peristrophe speciosa	MST	3	67	12	0.58	0.23	0.31	1.12	-0.00036
Persicaria capitata	S	1	1	1	0.05	0	0.06	0.11	-0.02644
Persicaria chinensis	MST	3	144	26	1.25	0.5	0.31	2.06	-0.0712
Persicaria hydropiper	MST	3	509	36	1.73	1.76	0.8	4.29	-0.06705
Persicaria microcephala	M	1	470	47	2.26	1.63	0.56	4.45	-0.04697
Persicaria nepalensis	ST	2	296	22	1.06	1.03	0.76	2.85	-0.00547
Persicaria posumbu	MS	2	22	2	0.1	0.08	0.62	0.8	-0.06962
Persicaria runcinata	MST	3	494	42	2.02	1.71	0.66	4.39	-0.00482
Phaulopsis imbricata	M	1	19	11	0.53	0.07	0.1	0.7	-0.00252
Pilea sp	S	1	9	2	0.1	0.03	0.25	0.38	-0.02091
Pilea symmeria	ST	2	108	11	0.53	0.37	0.55	1.45	-0.00252
Pilea umbrosa	S	1	9	2	0.1	0.03	0.25	0.38	-0.00036
Pityrogramma calomelanos	M	1	1	1	0.05	0	0.06	0.11	-0.00227
Plantago erosa	S	1	8	4	0.19	0.03	0.11	0.33	-0.0059
Poa annua	S	1	24	2	0.1	0.08	0.67	0.85	-0.00036
Pogonantherum crinitum	S	1	1	1	0.05	0	0.06	0.11	-0.0059
Polygonum sp.	S	1	24	3	0.14	0.08	0.45	0.67	-0.00095
Pteris semipinnata	S	1	3	1	0.05	0.01	0.17	0.23	-0.00632
Polystichum lentum	MS	2	26	6	0.29	0.09	0.24	0.62	-0.03138
Pouzolzia hirta	MST	3	178	24	1.16	0.62	0.42	2.2	-0.00202
Primula melacoides	S	1	7	1	0.05	0.02	0.39	0.46	-0.01302
Pseudognaphalium affine	S	1	61	5	0.24	0.21	0.69	1.14	-0.01138
Pteris biaurita	MST	3	52	13	0.63	0.18	0.22	1.03	-0.0535
Pupalia lappacea	MST	3	350	42	2.02	1.21	0.47	3.7	-0.00123

Remusatia pumila	M	1	4	1	0.05	0.01	0.22	0.28	-0.00066
Rhaphidophora hookeri	M	1	2	1	0.05	0.01	0.11	0.17	-0.00202
Rhopalephora scaberrima	M	1	7	2	0.1	0.02	0.2	0.32	-0.00036
Richardia scabra	M	1	1	1	0.05	0	0.06	0.11	-0.00123
Rubia manjith	ST	2	4	2	0.1	0.01	0.11	0.22	-0.01212
Rungia pectinata	MST	3	56	11	0.53	0.19	0.29	1.01	-0.003
Saccharum spontaneum	M	1	11	1	0.05	0.04	0.62	0.71	-0.00324
Sacciolepis indica	MS	2	12	2	0.1	0.04	0.34	0.48	-0.00276
Schoenoplectus juncoides	S	1	10	3	0.14	0.03	0.19	0.36	-0.03067
Selaginella biformis	MST	3	173	24	1.16	0.6	0.41	2.17	-0.0193
Selaginella bisulcata	MST	3	98	16	0.77	0.34	0.34	1.45	-0.01302
Setaria palmifolia	MST	3	358	52	2.5	1.24	0.39	4.13	-0.05445
Setaria plicata	MT	2	71	11	0.53	0.25	0.36	1.14	-0.01478
Setaria pumila	MT	2	123	9	0.43	0.43	0.77	1.63	-0.02326
Sida acuta	M	1	1	1	0.05	0	0.06	0.11	-0.00036
Spilanthes acmella	S	1	40	4	0.19	0.14	0.56	0.89	-0.00912
Sporobolus fertilis	M	1	10	2	0.1	0.03	0.28	0.41	-0.00276
Stellaria media	S	1	27	1	0.05	0.09	1.52	1.66	-0.00652
Stellaria patens	S	1	128	4	0.19	0.44	1.8	2.43	-0.02403
Stellaria uliginosa	S	1	498	10	0.48	1.73	2.8	5.01	-0.07004
Stephania glabra	M	1	7	4	0.19	0.02	0.1	0.31	-0.00202
Strobilanthes divaricata	MST	3	76	12	0.58	0.26	0.36	1.2	-0.01564
Synedrella nodiflora	MT	2	166	15	0.72	0.58	0.62	1.92	-0.02967
Tectaria coadunata	MST	3	57	21	1.01	0.2	0.15	1.36	-0.0123
Thysanolaena latifolia	M	1	8	1	0.05	0.03	0.45	0.53	-0.00227
Torenia violacea	MST	3	50	7	0.34	0.17	0.4	0.91	-0.01101
Tripsacum laxum	T	1	1	1	0.05	0	0.06	0.11	-0.00036
Unidentified	M	1	11	3	0.14	0.04	0.21	0.39	-0.003
Unidentified	M	1	7	2	0.1	0.02	0.2	0.32	-0.00202
Unidentified	M	1	2	1	0.05	0.01	0.11	0.17	-0.00066
Urena lobata	M	1	2	2	0.1	0.01	0.06	0.17	-0.00066
Urochloa ramose	M	1	16	2	0.1	0.06	0.45	0.61	-0.00416
Viola diffusa	ST	2	28	5	0.24	0.1	0.31	0.65	-0.00673
Viola pilosa	MST	3	40	9	0.43	0.14	0.25	0.82	-0.00912
Youngia japonica	MST	3	92	22	1.06	0.32	0.24	1.62	-0.01832
Zephyranthes carinata	M	1	1	1	0.05	0	0.06	0.11	-0.00036
TOTAL:			28863	2077					**- 3.83**

Table 7.62 presents ten high IVI scored plants or in other words, most important weeds of Terai Tea Gardens. So, *Borreria alata* is the most important plant that has scored highest for IVI of 36.43 with highest values of RF (24.1%), RD (7.49%) and RA (4.89%). The second position is occupied by *Ageratum conyzoides* with the IVI score of 17.81 [RF: 9.77%; RD: 5.13%; RA: 2.9%]. Two species each for *Borreria* and *Ageratum* found place within this list of ten most important weeds. Species like *Borreria alata*, *Borreria ocymoides*, *Ageratum conyzides* and *Ageratum haustonianum* high biomass producing plants. These are considerably tall, much branched, very fast groing plants of quite broad ecological amplitude. On the other hand, *Oxalis corniculata*, *Desmodium triflorum*, *Digitaria ciliaris* and *Gamochaeta pensylvanicum* are very

small plants, occupy much less space and produce very low amount of biomass. Among these ten plants there is only one perennial plant that is a very rigid and troublesome grass, *Imperata cylindrica*. All the selected gardens of Terai use good amount of Herbicides regularly. Under such condition, only therophytic plants can survive in the habitat if they become successful in producing mature seeds during the period between two successive applications of herbicides. However, all these plants are abundant in the natural vegetation outside the plantations and seeds from those places can easily enter into the plantation areas. However, Imperata cylindrica is a geophytic herb and herbicide can not destroy its stem or apical buds. But, its population remain controlled by the shady environment in the garden floor and the very high amount of vegetal cover by dominant broad-leaved dicotylenous plants.

Table 7.62: Ten most important weeds in the Tea Gardens of Darjiling Hills.

Species	RF	RD	RA	IVI
Drymaria diandra	7.22	15.01	1.62	**23.85**
Borreria alata	4.33	6.64	1.2	**12.17**
Oplismenus burmanii	2.99	6.32	1.65	**10.96**
Oplismenus compositus	3.37	5.78	1.34	**10.49**
Oxalis corniculata	2.99	5.2	1.36	**9.55**
Ageratum conyzoides	4.00	3.55	0.69	**8.24**
Drymaria villosa	1.54	3.65	1.85	**7.04**
Ageratum houstonianum	2.02	2.75	1.06	**5.83**
Eragrostis tenella	1.06	2.34	1.73	**5.13**
Stellaria uliginosa	0.48	1.73	2.8	**5.01**

Table 7.63: Taxonomic distribution of plants in the Tea Gardens of Darjiling Hills as recorded through quadrate samplings.

TAXA	Numerical Representation		
	Species	Genus	Family
Pteridophytes	18	14	11
Dicotyledons	112	86	33
Monocotyledons	54	39	08
TOTAL:	**184**	**139**	**52**

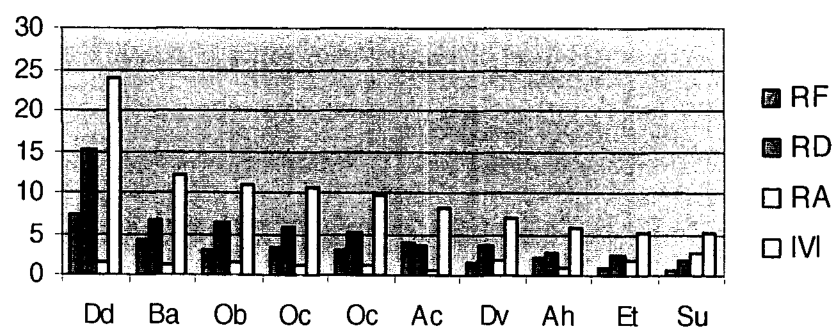
Table 7.64: Ten dominant families among the weeds of Tea Gardens in Darjiling Hills.

Sl. Nos.	Families	No. of Genera	No. of Species
1.	Poaceae	25	32
2.	Asteraceae	22	23
3.	Urticaceae	6	12
4.	Cyperaceae	5	9
5.	Polygonaceae	3	9
6.	Acanthaceae	7	8
7.	Scrophulariaceae	4	7
8.	Rubiaceae	5	6

9.	Commelinaceae	4	6
10.	Caryophyllaceae	2	5

When considering the dominant families, **Poaceae** appeared to be the largest with the record of 32 species under 25 genera. It is followed by **Asteraceae** with 23 species covering 22 genera, **Urticaceae** 12 species (6 genera), **Cyperaceae** 9 species (5 genera) etc. are dominant families. Polygonaceae is also represented by 9 species but covering 3 genera only. Urticaceae, Polygonaceae, Commelinaceae and Caryophyllaceae were not within the top-ten families in Tarai gardens [Table 7.64]. At the same time, number of species and genera in the families are also more. After these there are two families with 4 species each and one family with 3 species; 11 families with 2 species each and remaining 16 families are represented with single species only. This is one direct indication about the wide diversity in the weed flora of Terai Tea Gardens.

Fig. 7.2: Most Dominant Weeds in Hill Tea Gardens



[Dd = *Drymaria diandra*; Ba= *Borreria alata*; Ob= *Oplismenus burmanii*; Oc= *Oplismenus compositus*; Oc= *Oxalis corniculata*; Ac= *Ageratum conyzoides*; Dv= *Drymaria villosa*; Ah= *Ageratum houstonianum*; Et= *Eragrostis tenella*; Su= *Stellaria uliginosa*]

Out of the recorded recorded 139 genera *Persicaria* appeared to be the largest with 7 species; 5 genera (Boehmeria, *Cyperus, Eragrostis, Oxalis* and *Setaria*) 5 species each; 4 genera (Commelina, Dioscorea, Pilea and Stellaria) with three species each and 17 genera (*Ageratum, Borreria, Digitaria, Kyllinga, Oplismenus, Hypoestes, Hydrocotyle, Impatiens, Drymaria, Athyrium, Equisetum, Selaginella, Lindenbergia, Lindernia, Mazus, Elatostema* and *Viola*) with two species each. And, naturally, all the other 109 genera recorded from these gardens are represented by single species only.

7.4.4.1 Diversity Indices: Two indices have been determined to understand the diversity and the similarity of vegetation in Hill Tea Gardens.

I. Species Diversity [Shannon-Weiner Index] for the Terai Tea Gardens as a whole has been determined to **-3.83**. This is a moderate value of diversity. Such a value was under expectation because the habitate is highly disturbed one. However, the worst situation has been observed in Tamsong Tea Estate with its index value **-3.13** and the condition is comparatively better in Soom Tea Estae where the value is **-3.73**.

II. Species Richness for the Hill Tea Garden habitat has been determined through **Menhinick's Index** and the obtained value is **1.101**. The value is quite low for this region. That can be realised easily from the fact that only some selected herbaceous plants can grow in any Tea Garden habitat due to a large number of factors making the habitat unsuitable for the survival of numerous species of local plants. Among the Hill Tea Gardens the highest species richness is in Makaibari Tea Estate (1.135), which is followed by Soom Tea Estate (1.089) and the least is in Tamsong Tea Estate (1.028).

III. Similarity Index: Many mathematical formulations are available for the determination of Similarity Index between two pieces of vegetation of which Sorensen's (1968) method has been adopted in the present study.

(A) For Similarity Index between *Makaibari Tea Estate* and *Soom Tea Estate*:

$$S = \frac{2C}{a + b} \quad \text{or, } (2\text{x } 57) / (114 + 113) = 114 / 227 = 0.502$$

Where; S: index value

C: number of species common to both sites [57 species]

a: number o species in site 'a' [Makaibari Tea Estate: 114 species]

b: number of species in site 'b' [Soom Tea Estate: 113 species]

The value of S is just at 0.5. So, the similarity between the two weed floras at Makaibari Tea Estate and Soom Tea Estate is just satisfactory.

(B) For Similarity Index between *Makaibari Tea Estate* and *Tamsong Tea Estate*:

Here C = 58, a = 114 and b = 92.

So, (2 x 58) / (114 + 92) = 116 / 206 = 0.563

The value of S is more than 0.5 and less than one. So, the similarity between the two weed flora *Makaibari Tea Estate* and *Tamsong Tea Estate* is good.

(C) For Similarity Index between *Soom Tea Estate* and *Tamsong Tea Estate*:

Here C = 64, a = 113 and b = 92.
So, (2 x 64) / (113 + 92) = 128 / 205 = 0.624

The value of S is more than 0.5 and less than one. So, the similarity between the two weed flora *Soom Tea Estate* and *Tamsong Tea Estate* is quite good. All three of these gardens located in the hills. Makaibari is covering mostly the sub-tropical area.

Soom and Tamsong Tea Gardens have covered subtropical and temperate regions of Darjiling Hiils. So, it is expected that there will be good level of similarities among the weed floras of these three important Tea Estates of the area.

7.5 Holistic Phytosociological Picture of Weeds of Tea in Terai and Hills of Darjiling

Four Tea Gardens from Terai and three from Darjiling Hills have been studied to understand the weeds and their social behaviour in association with the Tea bushes in Darjiling Tea Plantations. The results of the survey have been discussed above at the garden level for different seasons and for the round the year and also at Regional level (i.e. Terai or Hill). Now, the results of all these seven gardens compiled together to get a wholistic annual picture and that has been presented in Table 7.65.

In the selected Tea Gardens altogether 548 quadrates has been studied at random and in different seasons. During the process altogether 54717 individuals have been counted representing 258 species of macrophytes (Pteridophytes and Angiosperms) covering 178 genera. At the family level these are representing 13 Pteridophytic, 48 Dicotyledonous and 9 Monocotyledonous families. Taxonimic distribution of recorded plants has been presented in Table 7.67.

Table 7.65: Analysis with the whole year quadrate sample data from the Tea Gardens in Terai and Hills of Darjiling.

Species	Families		NG	GF	NI	NQ	F	D	A	RF	RD	RA	IVI	SD
Achyranthes bidentata	Amaranthaceae	S	1	14.29	2	1	0.18	0	2	0.023	0	0.103	0.126	-0.000374126
Aconogonon molle	Polygonaceae	S	1	14.29	7	1	0.18	0.01	7	0.023	0.01	0.359	0.392	-0.001148847
Ageratina adenophora	Asteraceae	MkS	2	28.57	11	5	0.91	0.02	2.2	0.119	0.02	0.113	0.252	-0.001714281
Ageratum conyzoides	Asteraceae	G H K M Mk S T	7	100	3552	192	35.04	6.48	18.5	4.568	6.488	0.949	12.005	-0.177751753
Ageratum houstonianum	Asteraceae	G H K M Mk S T	7	100	1862	104	18.98	3.4	17.9	2.474	3.404	0.919	6.797	-0.1152026
Ajuga macrosperma	Lamiaceae	ST	2	28.57	168	24	4.38	0.31	7	0.571	0.31	0.359	1.24	-0.017794768
Albizia chinensis	Mimosaceae	H	1	14.29	2	2	0.36	0	1	0.047	0	0.051	0.098	-0.000374126
Aleuritopteris albomarginata	Pteridaceae	H K	2	28.57	13	5	0.91	0.02	2.6	0.119	0.02	0.133	0.272	-0.001986198
Amaranthus spinosus	Amaranthaceae	K	1	14.29	4	1	0.18	0.01	4	0.023	0.01	0.205	0.238	-0.000697477
Amaranthus viridis	Amaranthaceae	K	1	14.29	1	1	0.18	0	1	0.023	0	0.051	0.074	-0.000199756
Anaphalis contorta	Asteraceae	S	1	14.29	17	1	0.18	0.03	17	0.023	0.03	0.872	0.925	-0.00251382
Argemone mexicana	Papaveraceae	G	1	14.29	6	2	0.36	0.01	3	0.047	0.01	0.154	0.211	-0.001001664
Artemisia indica	Asteraceae	ST	2	28.57	22	6	1.09	0.04	3.67	0.142	0.04	0.188	0.37	-0.003149303
Athyrium oxyphyllum	Athyriaceae	H K Mk S T	5	71.43	145	35	6.39	0.26	4.14	0.833	0.26	0.212	1.305	-0.015749532
Athyrium pectinatum	Athyriaceae	T	1	14.29	4	1	0.18	0.01	4	0.023	0.01	0.205	0.238	-0.000697477
Axonopus compressus	Poaceae	G H K M Mk S	6	85.71	502	85	15.51	0.92	5.91	2.022	0.921	0.303	3.246	-0.04310933
Bambusa sp	Poaceae	M Mk	2	28.57	16	3	0.55	0.03	5.33	0.072	0.03	0.274	0.376	-0.002383712
Bidens pilosa	Asteraceae	Mk S T	3	42.86	154	38	6.93	0.28	4.05	0.903	0.28	0.208	1.391	-0.004124108
Blumea hieracifolia	Asteraceae	S	1	14.29	9	1	0.18	0.02	9	0.023	0.02	0.462	0.505	-0.001435668
Blumea lacera	Asteraceae	H	1	14.29	6	2	0.36	0.01	3	0.047	0.01	0.154	0.211	-0.001001664
Boehmeria platyphylla var. scabrella	Urticaceae	T	1	14.29	10	2	0.36	0.02	5	0.047	0.02	0.257	0.324	-0.001575892
Boehmeria macrophylla	Urticaceae	T	1	14.29	43	2	0.36	0.08	21.5	0.047	0.08	1.103	1.23	-0.005627734
Boehmeria polystachya	Urticaceae	Mk	1	14.29	5	1	0.18	0.01	5	0.023	0.01	0.257	0.29	-0.000851414
Boehmeria rugulosa	Urticaceae	ST	2	28.57	62	10	1.82	0.11	6.2	0.237	0.11	0.318	0.665	-0.007698923

Boerhavia coccinea	Nyctaginaceae	G	1	14.29	4	2	0.36	0.01	2	0.047	0.01	0.103	0.16	-0.000697477
Borreria alata	Rubiaceae	G H K M Mk S T	7	100	8137	249	45.44	14.85	32.68	5.923	14.869	1.677	22.469	-0.283679222
Borreria ocymoides	Rubiaceae	G H K M Mk S	6	85.71	2035	120	21.9	3.71	16.96	2.855	3.715	0.87	7.44	-0.122595202
Breynia retusa	Euphorbiaceae	Mk	1	14.29	2	1	0.18	0	2	0.023	0	0.103	0.126	-0.000374126
Briggsia kurzii	Gesneriaceae	S	1	14.29	3	2	0.36	0.01	1.5	0.047	0.01	0.077	0.134	-0.000538913
Bulbostylis densa	Cyperaceae	Mk	1	14.29	420	8	1.46	0.77	52.5	0.19	0.771	2.694	3.655	-0.037439304
Cardamine hirsuta	Brassicaceae	G H S T	2	28.57	87	9	1.64	0.16	9.67	0.214	0.16	0.496	0.87	-0.010263583
Carex sp.	Cyperaceae	Mk T	2	28.57	7	2	0.36	0.01	3.5	0.047	0.01	0.18	0.237	-0.001148847
Casearia graveolens	Flacourtiaceae	S	1	14.29	1	1	0.18	0	1	0.023	0	0.051	0.074	-0.000199756
Centella asiatica	Apiaceae	H K M Mk S T	6	85.71	82	17	3.1	0.15	4.82	0.404	0.15	0.247	0.801	-0.009762604
Chamabainia cuspidata	Urticaceae	S	1	14.29	17	1	0.18	0.03	17	0.023	0.03	0.872	0.925	-0.00251382
Chloris dolichostachya	Poaceae	M T	2	28.57	57	3	0.55	0.1	19	0.072	0.1	0.975	1.147	-0.007165812
Chromolaena odoratum	Asteraceae	M Mk S	3	42.86	32	13	2.37	0.06	2.46	0.309	0.06	0.126	0.495	-0.004361228
Chrysopogon aciculatus	Poaceae	H	1	14.29	4	1	0.18	0.01	4	0.023	0.01	0.205	0.238	-0.000697477
Cleome rutidosperma	Cleomaceae	G K M	3	42.86	42	13	2.37	0.08	3.23	0.309	0.08	0.166	0.555	-0.005514955
Clerodendrum viscosum	Verbenaceae	G K	2	28.57	33	5	0.91	0.06	6.6	0.119	0.06	0.339	0.518	-0.00447892
Coix lachryma-jobi	Poaceae	H	1	14.29	4	1	0.18	0.01	4	0.023	0.01	0.205	0.238	-0.000697477
Commelina diffusa	Commelinaceae	Mk	1	14.29	25	5	0.91	0.05	5	0.119	0.05	0.257	0.426	-0.003520228
Commelina paludosa	Commelinaceae	Mk S T	3	42.86	215	27	4.93	0.39	7.96	0.643	0.391	0.409	1.443	-0.021801837
Commelina suffruticosa	Commelinaceae	H Mk S T	4	57.14	156	26	4.74	0.28	6	0.618	0.28	0.308	1.206	-0.016735427
Conyza canadensis	Asteraceae	H K M S	4	57.14	21	7	1.28	0.04	3	0.167	0.04	0.154	0.361	-0.003024043
Crassocephalum crepidioides	Asteraceae	H K M Mk S T	6	85.71	371	88	16.06	0.68	4.22	2.094	0.681	0.217	2.992	-0.033914214
Crinum amoenum	Amaryllidaceae	G	1	14.29	10	2	0.36	0.02	5	0.047	0.02	0.257	0.324	-0.001575892
Crotalaria cytisoides	Fabaceae	H K M S	4	57.14	17	9	1.64	0.03	1.89	0.214	0.03	0.097	0.341	-0.00251382
Crotalaria pallida	Fabaceae	G H M	3	42.86	15	6	1.09	0.03	2.5	0.142	0.03	0.128	0.3	-0.002252458
Cuscuta reflexa	Cuscutaceae	G	1	14.29	1	1	0.18	0	1	0.023	0	0.051	0.074	-0.000199756
Cyanotis vaga	Commelinaceae	Mk	1	14.29	62	5	0.91	0.11	12.4	0.119	0.11	0.636	0.865	-0.007698923
Cyanthillium cinereum	Asteraceae	G H K M Mk S T	4	57.14	47	20	3.65	0.09	2.35	0.476	0.09	0.121	0.687	-0.006074686
Cymbopogon nardus	Poaceae	H S	2	28.57	4	2	0.36	0.01	2	0.047	0.01	0.103	0.16	-0.000697477

Cynodon dactylon	Poaceae	G H K M Mk S T	7	100	760	69	12.59	1.39	11.01	1.641	1.392	0.565	3.598	-0.059493119
Cyperus compressus	Cyperaceae	G H K M Mk	5	71.43	278	25	4.56	0.51	11.12	0.594	0.511	0.571	1.676	-0.026881978
Cyperus cyperoides	Cyperaceae	G K M Mk S T	6	85.71	159	35	6.39	0.29	4.54	0.833	0.29	0.233	1.356	-0.017001798
Cyperus iria	Cyperaceae	H M	2	28.57	54	7	1.28	0.1	7.71	0.167	0.1	0.396	0.663	-0.006842131
Cyperus niveus	Cyperaceae	H	1	14.29	15	2	0.36	0.03	7.5	0.047	0.03	0.385	0.462	-0.002252458
Cyperus pilosus	Cyperaceae	Mk	1	14.29	2	1	0.18	0	2	0.023	0	0.103	0.126	-0.000374126
Cyperus pseudokyllingioides	Cyperaceae	H K M	3	42.86	484	27	4.93	0.88	17.93	0.643	0.881	0.92	2.444	-0.041887229
Desmodium laxiflorum	Fabaceae	H K	2	28.57	3	2	0.36	0.01	1.5	0.047	0.01	0.077	0.134	-0.000538913
Desmodium laxum	Fabaceae	H	1	14.29	15	3	0.55	0.03	5	0.072	0.03	0.257	0.359	-0.002252458
Desmodium triflorum	Fabaceae	G H K M Mk	5	71.43	1503	102	18.61	2.74	14.74	2.426	2.744	0.756	5.926	-0.098886551
Dichrocephala integrifolia	Asteraceae	Mk S T	3	42.86	275	45	8.21	0.5	6.11	1.07	0.501	0.314	1.885	-0.026646526
Dicliptera bupleuroides	Acanthaceae	Mk S T	3	42.86	179	25	4.56	0.33	7.16	0.594	0.33	0.367	1.291	-0.018752003
Dicranopteris linearis	Gleicheniaceae	H Mk S	3	42.86	42	8	1.46	0.08	5.25	0.19	0.08	0.269	0.539	-0.005514955
Digitaria ciliaris	Poaceae	G H K M Mk S T	7	100	1532	113	20.62	2.8	13.56	2.688	2.804	0.696	6.188	-0.100258374
Digitaria sanguinalis	Poaceae	H K M Mk S T	6	85.71	354	22	4.01	0.65	16.09	0.523	0.651	0.826	2	-0.032664271
Dioscorea alata	Dioscoreaceae	G Mk	2	28.57	9	4	0.73	0.02	2.25	0.095	0.02	0.115	0.23	-0.001435668
Dioscorea bulbifera	Dioscoreaceae	Mk T	2	28.57	4	3	0.55	0.01	1.33	0.072	0.01	0.068	0.15	-0.000697477
Dioscorea pentaphylla	Dioscoreaceae	R	1	14.29	1	1	0.18	0	1	0.023	0	0.051	0.074	-0.000199756
Diplazium esculentum	Athyriaceae	G H K M S	5	71.43	130	34	6.2	0.24	3.82	0.808	0.24	0.196	1.244	-0.01438024
Diplazium frondosum	Athyriaceae	S	1	14.29	3	1	0.18	0.01	3	0.023	0.01	0.154	0.187	-0.000538913
Drymaria diandra	Caryophyllaceae	G Mk S T	4	57.14	4351	152	27.74	7.94	28.63	3.616	7.95	1.469	13.035	-0.201569247
Drymaria villosa	Caryophyllaceae	S T	2	28.57	1055	32	5.84	1.93	32.97	0.761	1.933	1.692	4.386	-0.076249243
Dryopteris filix-mas	Dryopteridaceae	G H K M Mk	5	71.43	134	31	5.66	0.24	4.32	0.738	0.24	0.222	1.2	-0.014748342
Duchesnea indica	Rosaceae	Mk T	2	28.57	23	6	1.09	0.04	3.83	0.142	0.04	0.197	0.379	-0.00327373
Ehretia serrata	Ehretiaceae	H K M	3	42.86	6	5	0.91	0.01	1.2	0.119	0.01	0.062	0.191	-0.001001664
Elatostemma alsinoides	Urticaceae	Mk	1	14.29	40	1	0.18	0.07	40	0.023	0.07	2.053	2.146	-0.005288078
Elatostemma hookerianum	Urticaceae	Mk	1	14.29	9	1	0.18	0.02	9	0.023	0.02	0.462	0.505	-0.001435668
Eleusine indica	Poaceae	G H K M	6	85.71	226	31	5.66	0.41	7.29	0.738	0.411	0.374	1.523	-0.022710769

		S T												
Emilia sonchifolia	Asteraceae	G H K M S T	6	85.71	305	42	7.66	0.56	7.26	0.999	0.561	0.373	1.933	-0.028975096
Equisetum debile	Equisetaceae	T	1	14.29	17	4	0.73	0.03	4.25	0.095	0.03	0.218	0.343	-0.00251382
Equisetum diffusum	Equisetaceae	T	1	14.29	22	1	0.18	0.04	22	0.023	0.04	1.129	1.192	-0.003149303
Eragrostis gangetica	Poaceae	K M	5	71.43	12	6	1.09	0.02	2	0.142	0.02	0.103	0.265	-0.001851004
Eragrostis nigra	Poaceae	Mk S T	0	0	295	7	1.28	0.54	42.14	0.167	0.541	2.163	2.871	-0.028205188
Eragrostis sp.	Poaceae	S	1	14.29	92	3	0.55	0.17	30.67	0.072	0.17	1.574	1.816	-0.010759297
Eragrostis tenella	Poaceae	H K M Mk S T	6	85.71	719	28	5.11	1.31	25.68	0.666	1.312	1.318	3.296	-0.057013828
Eragrostis unioloides	Poaceae	K M Mk	3	42.86	534	43	7.85	0.97	12.42	1.023	0.971	0.637	2.631	-0.045253026
Erigeron karvinskianus	Asteraceae	T	1	14.29	5	1	0.18	0.01	5	0.023	0.01	0.257	0.29	-0.000851414
Euphorbia hirta	Euphorbiaceae	G H M	3	42.86	34	7	1.28	0.06	4.86	0.167	0.06	0.249	0.476	-0.004596057
Evolvulus alsinoides	Convolvulaceae	H	1	14.29	7	1	0.18	0.01	7	0.023	0.01	0.359	0.392	-0.001148847
Fimbristylis dichotoma	Cyperaceae	H K M Mk	4	57.14	549	39	7.12	1	14.08	0.928	1.001	0.723	2.652	-0.04624566
Flueggea virosa	Euphorbiaceae	T	1	14.29	63	6	1.09	0.11	10.5	0.142	0.11	0.539	0.791	-0.00780464
Galinsoga parviflora	Asteraceae	Mk S T	3	42.86	413	39	7.12	0.75	10.59	0.928	0.751	0.543	2.222	-0.036942432
Gamochaeta pensylvanicum	Asteraceae	G H K Mk ST	6	85.71	1405	66	12.04	2.56	21.29	1.57	2.563	1.093	5.226	-0.09417371
Globba racemosa	Zingiberaceae	Mk	1	14.29	1	1	0.18	0	1	0.023	0	0.051	0.074	-0.000199756
Grass-unidentified	Poaceae	S	1	14.29	170	3	0.55	0.31	56.67	0.072	0.31	2.908	3.29	-0.017969767
Guizotia abyssinica	Asteraceae	Mk	1	14.29	24	3	0.55	0.04	8	0.072	0.04	0.411	0.523	-0.003397361
Gynura nepalensis	Asteraceae	S T	2	28.57	7	2	0.36	0.01	3.5	0.047	0.01	0.18	0.237	-0.001148847
Hedyotis scandens	Rubiaceae	G K T	3	42.86	11	7	1.28	0.02	1.57	0.167	0.02	0.081	0.268	-0.001714281
Hydrocotyle himalaica	Apiaceae	Mk S T	3	42.86	82	16	2.92	0.15	5.13	0.381	0.15	0.263	0.794	-0.009762604
Hydrocotyle nepalensis	Apiaceae	S	1	14.29	1	1	0.18	0	1	0.023	0	0.051	0.074	-0.000199756
Hydrocotyle sibthorpioides	Apiaceae	G H K M	4	57.14	85	15	2.74	0.16	5.67	0.357	0.16	0.291	0.808	-0.01006384
Hypericum japonicum	Hypericaceae	K S	2	28.57	35	7	1.28	0.06	5	0.167	0.06	0.257	0.484	-0.004712656
Hypoestes sanguinolenta	Acanthaceae	Mk S T	3	42.86	36	7	1.28	0.07	5.14	0.167	0.07	0.264	0.501	-0.004828731
Hypoestes triflora	Acanthaceae	Mk S	2	28.57	129	12	2.19	0.24	10.75	0.285	0.24	0.552	1.077	-0.014287865
Ichnocarpus frutescens	Apocynaceae	Mk	1	14.29	3	2	0.36	0.01	1.5	0.047	0.01	0.077	0.134	-0.000538913
Impatiens balsamina	Balsaminaceae	Mk	1	14.29	9	5	0.91	0.02	1.8	0.119	0.02	0.092	0.231	-0.001435668
Impatiens discolor	Balsaminaceae	T	1	14.29	3	1	0.18	0.01	3	0.023	0.01	0.154	0.187	-0.000538913

Imperata cylindrica	Poaceae	G K M Mk T	5	71.43	844	36	6.57	1.54	23.44	0.856	1.542	1.203	3.601	-0.064448341
Indigofera tasmanii	Fabaceae	G	1	14.29	1	1	0.18	0	1	0.023	0	0.051	0.074	-0.000199756
Isachne albens	Poaceae	S	1	14.29	5	1	0.18	0.01	5	0.023	0.01	0.257	0.29	-0.000851414
Ixeris polycephala	Asteraceae	G H K	3	42.86	49	17	3.1	0.09	2.88	0.404	0.09	0.148	0.642	-0.006295789
Jasminum dispermum	Oleaceae	Mk	1	14.29	4	2	0.36	0.01	2	0.047	0.01	0.103	0.16	-0.000697477
Juncus bufonius	Juncaceae	G	1	14.29	12	1	0.18	0.02	12	0.023	0.02	0.616	0.659	-0.001851004
Kyllinga brevifolia	Cyperaceae	G H K M Mk S T	7	100	197	30	5.47	0.36	6.57	0.713	0.36	0.337	1.41	-0.020292
Kyllinga nemoralis	Cyperaceae	G H K M S T	6	85.71	130	15	2.74	0.24	8.67	0.357	0.24	0.445	1.042	-0.01438024
Lantana camara	Verbenaceae	Mk T	2	28.57	5	3	0.55	0.01	1.67	0.072	0.01	0.086	0.168	-0.000851414
Lecanthus peduncularis	Urticaceae	S	1	14.29	373	14	2.55	0.68	26.64	0.332	0.681	1.367	2.38	-0.034060316
Lepidagathis incurva	Acanthaceae	Mk	1	14.29	21	5	0.91	0.04	4.2	0.119	0.04	0.216	0.375	-0.003024043
Leucas indica	Lamiaceae	G H K M Mk	5	71.43	125	34	6.2	0.23	3.68	0.808	0.23	0.189	1.227	-0.013916935
Lindenbergia grandiflora	Scrophulariaceae	S T	2	28.57	37	6	1.09	0.07	6.17	0.142	0.07	0.317	0.529	-0.004944297
Lindenbergia indica	Scrophulariaceae	G S T	3	42.86	63	11	2.01	0.11	5.73	0.262	0.11	0.294	0.666	-0.00780464
Lindernia ciliata	Scrophulariaceae	K S T	3	42.86	119	15	2.74	0.22	7.93	0.357	0.22	0.407	0.984	-0.01335612
Lindernia crustacea	Scrophulariaceae	G H K M T	5	71.43	489	47	8.58	0.89	10.4	1.118	0.891	0.534	2.543	-0.042227912
Lindernia pyxidaria	Scrophulariaceae	G H K M	4	57.14	58	7	1.28	0.11	8.29	0.167	0.11	0.425	0.702	-0.007273055
Lobelia nummularia	Lobeliaceae	Mk S T	3	42.86	539	36	6.57	0.98	14.97	0.856	0.981	0.768	2.605	-0.045584751
Ludwigia perennis	Onagraceae	M	1	14.29	4	2	0.36	0.01	2	0.047	0.01	0,103	0.16	-0.000697477
Luffa aegyptiaca	Cucurbitaceae	H	1	14.29	1	1	0.18	0	1	0.023	0	0.051	0.074	-0.000199756
Lycopodium cerretum	Lycopodiaceae	S	1	14.29	2	1	0.18	0	2	0.023	0	0.103	0.126	-0.000374126
Lygodium microphyllum	Lygodiaceae	G	1	14.29	1	1	0.18	0	1	0.023	0	0.051	0.074	-0.000199756
Lygodium salicifolium	Lygodiaceae	G	2	28.57	5	4	0.73	0.01	1.25	0.095	0.01	0.064	0.169	-0.000851414
Lysimachia alternifolia	Primulaceae	S	1	14.29	34	5	0.91	0.06	6.8	0.119	0.06	0.349	0.528	-0.004596057
Mazus pumilus	Scrophulariaceae	G H K S T	5	71.43	151	24	4.38	0.28	6.29	0.571	0.28	0.323	1.174	-0.016289117
Mazus surculosus	Scrophulariaceae	S	1	14.29	2	1	0.18	0	2	0.023	0	0.103	0.126	-0.000374126
Mecardonia procumbens	Scrophulariaceae	G H K	3	42.86	98	13	2.37	0.18	7.54	0.309	0.18	0.387	0.876	-0.011347605
Melastoma malabathricum	Melastomataceae	K	1	14.29	1	1	0.18	0	1	0.023	0	0.051	0.074	-0.000199756
Melia azadarach	Meliaceae	Mk	1	14.29	1	1	0.18	0	1	0.023	0	0.051	0.074	-0.000199756

Melochia corchorifolia	Sterculiaceae	G K	2	28.57	3	3	0.55	0.01	1	0.072	0.01	0.051	0.133	-0.000538913
Merremia hirta	Convolvulaceae	K M	2	28.57	2	2	0.36	0	1	0.047	0	0.051	0.098	-0.000374126
Microlepia strigosa	Dennstaedtiaceae	S	1	14.29	11	2	0.36	0.02	5.5	0.047	0.02	0.282	0.349	-0.001714281
Mikania micrantha	Asteraceae	G H K M Mk S	6	85.71	47	23	4.2	0.09	2.04	0.548	0.09	0.105	0.743	-0.006074686
Mimosa pudica	Mimosaceae	G H K	3	42.86	15	9	1.64	0.03	1.67	0.214	0.03	0.086	0.33	-0.002252458
Mitracarpus verticillatus	Rubiaceae	G H K M Mk	5	71.43	836	73	13.32	1.53	11.45	1.736	1.532	0.588	3.856	-0.063983263
Morus australis	Moraceae	Mk	1	14.29	1	1	0.18	0	1	0.023	0	0.051	0.074	-0.000199756
Mukia maderaspatana	Cucurbitaceae	G	1	14.29	8	2	0.36	0.01	4	0.047	0.01	0.205	0.262	-0.001293405
Murdannia nudiflora	Commelinaceae	G K M Mk T	5	71.43	53	13	2.37	0.1	4.08	0.309	0.1	0.209	0.618	-0.006733567
Murraya koenigii	Rutaceae	G H	2	28.57	2	2	0.36	0	1	0.047	0	0.051	0.098	-0.000374126
Nasturtium officinale	Brassicaceae	T	1	14.29	2	1	0.18	0	2	0.023	0	0.103	0.126	-0.000374126
Natsiatum herpeticum	Icacinaceae	H Mk	2	28.57	3	2	0.36	0.01	1.5	0.047	0.01	0.077	0.134	-0.000538913
Neanotis hirsuta	Rubiaceae	G	1	14.29	14	2	0.36	0.03	7	0.047	0.03	0.359	0.436	-0.002119983
Nelsonia canescens	Acanthaceae	G	1	14.29	7	2	0.36	0.01	3.5	0.047	0.01	0.18	0.237	-0.001148847
Neolamarckia cadamba	Rubiaceae	K	1	14.29	3	1	0.18	0.01	3	0.023	0.01	0.154	0.187	-0.000538913
Nephrolepis cordifolia	Nephrolepidaceae	Mk S T	3	42.86	85	18	3.28	0.16	4.72	0.428	0.16	0.242	0.83	-0.01006384
Neyraudia arundinacea var. zollingeri	Poaceae	Mk	1	14.29	2	1	0.18	0	2	0.023	0	0.103	0.126	-0.000374126
Oenanthe javanica	Apiaceae	T	1	14.29	2	1	0.18	0	2	0.023	0	0.103	0.126	-0.000374126
Oldenlandia corymbosa	Rubiaceae	G H K M	4	57.14	401	47	8.58	0.73	8.53	1.118	0.731	0.438	2.287	-0.036085576
Oldenlandia diffusa	Rubiaceae	H K M	3	42.86	119	20	3.65	0.22	5.95	0.476	0.22	0.305	1.001	-0.01335612
Oplismenus burmanii	Poaceae	H Mk S T	4	57.14	1834	63	11.5	3.35	29.11	1.499	3.354	1.494	6.347	-0.11397912
Oplismenus compositus	Poaceae	G H K Mk S T	6	85.71	1817	90	16.42	3.32	20.19	2.14	3.324	1.036	6.5	-0.11323248
Oxalis corniculata	Oxalidaceae	G H K M Mk S T	7	100	2990	175	31.93	5.46	17.09	4.162	5.467	0.877	10.506	-0.159058756
Oxalis corniculata var. villosa	Oxalidaceae	S	1	14.29	349	18	3.28	0.64	19.39	0.428	0.641	0.995	2.064	-0.032293826
Oxalis corymbosa	Oxalidaceae	G H K Mk S T	6	85.71	84	19	3.47	0.15	4.42	0.452	0.15	0.227	0.829	-0.009963647
Oxalis latifolia	Oxalidaceae	T	1	14.29	5	1	0.18	0.01	5	0.023	0.01	0.257	0.29	-0.000851414
Oxyspora paniculata	Melastomataceae	S	1	14.29	3	1	0.18	0.01	3	0.023	0.01	0.154	0.187	-0.000538913
Paspalidium flavidum	Poaceae	T	1	14.29	13	1	0.18	0.02	13	0.023	0.02	0.667	0.71	-0.001986198

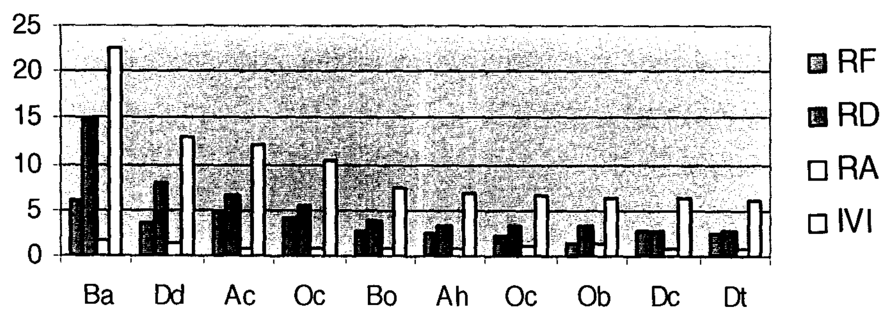
Paspalum conjugatum	Poaceae	G K M Mk S T	6	85.71	235	30	5.47	0.43	7.83	0.713	0.431	0.402	1.546	-0.023447124
Paspalum scrobiculatum	Poaceae	G H K M	4	57.14	579	58	10.58	1.06	9.98	1.379	1.061	0.512	2.952	-0.048208611
Peperomia pellucida	Piperaceae	H K Mk T	2	28.57	138	18	3.28	0.25	7.67	0.428	0.25	0.394	1.072	-0.015114256
Pericampylus glaucus	Menispermaceae	G H Mk T	4	57.14	8	8	1.46	0.01	1	0.19	0.01	0.051	0.251	-0.001293405
Peristrophe speciosa	Acanthaceae	Mk S T	3	42.86	67	12	2.19	0.12	5.58	0.285	0.12	0.286	0.691	-0.008224643
Persicaria capitata	Polygonaceae	S	1	14.29	1	1	0.18	0	1	0.023	0	0.051	0.074	-0.000199756
Persicaria chinensis	Polygonaceae	Mk S T	3	42.86	144	26	4.74	0.26	5.54	0.618	0.26	0.284	1.162	-0.015659165
Persicaria hydropiper	Polygonaceae	G H Mk S T	5	71.43	519	39	7.12	0.95	13.31	0.928	0.951	0.683	2.562	-0.044252674
Persicaria microcephala	Polygonaceae	Mk	1	14.29	470	47	8.58	0.86	10	1.118	0.861	0.513	2.492	-0.040928253
Persicaria nepalensis	Polygonaceae	S T	2	28.57	296	22	4.01	0.54	13.45	0.523	0.541	0.69	1.754	-0.028282455
Persicaria posumbu	Polygonaceae	Mk S	2	28.57	22	2	0.36	0.04	11	0.047	0.04	0.565	0.652	-0.003149303
Persicaria runcinata	Polygonaceae	Mk S T	3	42.86	494	42	7.66	0.9	11.76	0.999	0.901	0.604	2.504	-0.042567659
Phaulopsis imbricata	Acanthaceae	G Mk	1	14.29	32	13	2.37	0.06	2.46	0.309	0.06	0.126	0.495	-0.004361228
Phyllanthus reticulatus	Euphorbiaceae	H	1	14.29	2	1	0.18	0	2	0.023	0	0.103	0.126	-0.000374126
Phyllanthus urinaria	Euphorbiaceae	G K M	3	42.86	49	20	3.65	0.09	2.45	0.476	0.09	0.126	0.692	-0.006295789
Physalis divaricata	Solanaceae	G	1	14.29	1	1	0.18	0	1	0.023	0	0.051	0.074	-0.000199756
Pilea sp	Urticaceae	S	1	14.29	9	2	0.36	0.02	4.5	0.047	0.02	0.231	0.298	-0.001435668
Pilea symmeria	Urticaceae	S T	2	28.57	108	11	2.01	0.2	9.82	0.262	0.2	0.504	0.966	-0.012313352
Pilea umbrosa	Urticaceae	S	1	14.29	9	2	0.36	0.02	4.5	0.047	0.02	0.231	0.298	-0.001435668
Piper longum	Piperaceae	G	1	14.29	5	1	0.18	0.01	5	0.023	0.01	0.257	0.29	-0.000851414
Pityrogramma calomelanos	Hemionitidaceae	G Mk	1	14.29	11	4	0.73	0.02	2.75	0.095	0.02	0.141	0.256	-0.001714281
Plantago erosa	Plantaginaceae	S	1	14.29	8	4	0.73	0.01	2	0.095	0.01	0.103	0.208	-0.001293405
Poa annua	Poaceae	S	1	14.29	24	2	0.36	0.04	12	0.047	0.04	0.616	0.703	-0.003397361
Pogonantherum crinitum	Poaceae	S	1	14.29	1	1	0.18	0	1	0.023	0	0.051	0.074	-0.000199756
Polygonum plebeium	Polygonaceae	K	1	14.29	84	3	0.55	0.15	28	0.072	0.15	1.437	1.659	-0.009963647
Polygonum sp.	Polygonaceae	S	1	14.29	24	3	0.55	0.04	8	0.072	0.04	0.411	0.523	-0.003397361
Polypodiastrum argutum	Polypodiaceae	S	1	14.29	3	1	0.18	0.01	3	0.023	0.01	0.154	0.187	-0.000538913
Polystichum lentum	Dryopteridaceae	Mk	2	28.57	26	6	1.09	0.05	4.33	0.142	0.05	0.222	0.414	-0.003642363
Portulaca oleracea	Portulacaceae	H K	2	28.57	9	2	0.36	0.02	4.5	0.047	0.02	0.231	0.298	-0.001435668
Pothos scandens	Araceae	H	1	14.29	4	2	0.36	0.01	2	0.047	0.01	0.103	0.16	-0.000697477

Pouzolzia hirta	Urticaceae	Mk S T	3	42.86	178	24	4.38	0.32	7.42	0.571	0.32	0.381	1.272	-0.018665505
Pouzolzia zeylanica	Urticaceae	G H K M	4	57.14	109	18	3.28	0.2	6.06	0.428	0.2	0.311	0.939	-0.012408967
Primula melacoides	Primulaceae	S	1	14.29	7	1	0.18	0.01	7	0.023	0.01	0.359	0.392	-0.001148847
Pseudognaphalium affine	Asteraceae	G H K S	4	57.14	93	12	2.19	0.17	7.75	0.285	0.17	0.398	0.853	-0.010857834
Pteris biaurita	Pteridaceae	G Mk S T	4	57.14	54	14	2.55	0.1	3.86	0.332	0.1	0.198	0.63	-0.006842131
Pueraria phaseoloides	Fabaceae	K	1	14.29	2	1	0.18	0	2	0.023	0	0.103	0.126	-0.000374126
Pupalia lappacea	Amaranthaceae	G Mk S T	4	57.14	358	45	8.21	0.65	7.96	1.07	0.651	0.409	2.13	-0.032959694
Remusatia pumila	Araceae	Mk	1	14.29	4	1	0.18	0.01	4	0.023	0.01	0.205	0.238	-0.000697477
Rhaphidophora hookeri	Araceae	Mk	1	14.29	2	1	0.18	0	2	0.023	0	0.103	0.126	-0.000374126
Rhopalephora scaberrima	Commelinaceae	Mk	1	14.29	7	2	0.36	0.01	3.5	0.047	0.01	0.18	0.237	-0.001148847
Rhynchospora rubra	Cyperaceae	K M	3	42.86	11	3	0.55	0.02	3.67	0.072	0.02	0.188	0.28	-0.001714281
Richardia scabra	Rubiaceae	Mk	1	14.29	1	1	0.18	0	1	0.023	0	0.051	0.074	-0.000199756
Rubia manjith	Rubiaceae	S T	2	28.57	4	2	0.36	0.01	2	0.047	0.01	0.103	0.16	-0.000697477
Rungia pectinata	Acanthaceae	G H K M Mk S T	7	100	95	23	4.2	0.17	4.13	0.548	0.17	0.212	0.93	-0.011054318
Saccharum spontaneum	Poaceae	H K M Mk	4	57.14	306	35	6.39	0.56	8.74	0.833	0.561	0.449	1.843	-0.029051754
Sacciolepis indica	Poaceae	Mk S	2	28.57	12	2	0.36	0.02	6	0.047	0.02	0.308	0.375	-0.001851004
Schoenoplectus juncoides	Cyperaceae	S	1	14.29	10	3	0.55	0.02	3.33	0.072	0.02	0.171	0.263	-0.001575892
Scoparia dulcis	Scrophulariaceae	G H K M	4	57.14	52	16	2.92	0.09	3.25	0.381	0.09	0.167	0.638	-0.006624658
Seedlings (Leguminous)	Fabaceae	G H K	3	42.86	11	4	0.73	0.02	2.75	0.095	0.02	0.141	0.256	-0.001714281
Seedlings (unidentified)	???	H	1	14.29	1	1	0.18	0	1	0.023	0	0.051	0.074	-0.000199756
Selaginella biformis	Selaginellaceae	Mk S T	3	42.86	173	24	4.38	0.32	7.21	0.571	0.32	0.37	1.261	-0.01823146
Selaginella bisulcata	Selaginellaceae	Mk S T	3	42.86	98	16	2.92	0.18	6.13	0.381	0.18	0.315	0.876	-0.011347605
Selaginella monospora	Selaginellaceae	G H K M	4	57.14	160	15	2.74	0.29	10.67	0.357	0.29	0.548	1.195	-0.017090357
Setaria glauca	Poaceae	S	1	14.29	61	3	0.55	0.11	20.33	0.072	0.11	1.043	1.225	-0.007592912
Setaria palmifolia	Poaceae	H M Mk S T	5	71.43	369	56	10.22	0.67	6.59	1.332	0.671	0.338	2.341	-0.033767915
Setaria plicata	Poaceae	G Mk T	3	42.86	76	13	2.37	0.14	5.85	0.309	0.14	0.3	0.749	-0.009154023
Setaria pumila	Poaceae	Mk T	2	28.57	123	9	1.64	0.22	13.67	0.214	0.22	0.702	1.136	-0.013730596
Sida acuta	Malvaceae	Mk	1	14.29	1	1	0.18	0	1	0.023	0	0.051	0.074	-0.000199756
Smilax zeylanica	Smilacaceae	H	1	14.29	1	1	0.18	0	1	0.023	0	0.051	0.074	-0.000199756
Solanum aculeatissimum	Solanaceae	G	1	14.29	5	3	0.55	0.01	1.67	0.072	0.01	0.086	0.168	-0.000851414
Solanum nigrum	Solanaceae	G H M	3	42.86	21	9	1.64	0.04	2.33	0.214	0.04	0.12	0.374	-0.003024043

Sonchus asper	Asteraceae	G H	2	28.57	11	2	0.36	0.02	5.5	0.047	0.02	0.282	0.349	-0.001714281
Spilanthes acmella	Asteraceae	S	1	14.29	40	4	0.73	0.07	10	0.095	0.07	0.513	0.678	-0.005288078
Sporobolus fertilis	Poaceae	Mk	1	14.29	10	2	0.36	0.02	5	0.047	0.02	0.257	0.324	-0.001575892
Stellaria media	Caryophyllaceae	K S	2	28.57	74	3	0.55	0.14	24.67	0.072	0.14	1.266	1.478	-0.008949268
Stellaria patens	Caryophyllaceae	S	1	14.29	128	4	0.73	0.23	32	0.095	0.23	1.642	1.967	-0.014195349
Stellaria uliginosa	Caryophyllaceae	S	1	14.29	498	10	1.82	0.91	49.8	0.237	0.911	2.556	3.704	-0.042838789
Stephania glabra	Menispermaceae	Mk	1	14.29	7	4	0.73	0.01	1.75	0.095	0.01	0.09	0.195	-0.001148847
Stephania japonica	Menispermaceae	H	1	14.29	2	1	0.18	0	2	0.023	0	0.103	0.126	-0.000374126
Strobilanthes divaricata	Acanthaceae	Mk S T	3	42.86	76	12	2.19	0.14	6.33	0.285	0.14	0.325	0.75	-0.009154023
Synedrella nodiflora	Asteraceae	Mk T	2	28.57	166	15	2.74	0.3	11.07	0.357	0.3	0.568	1.225	-0.017619332
Tectaria coadunata	Tectariaceae	Mk S T	3	42.86	57	21	3.83	0.1	2.71	0.499	0.1	0.139	0.738	-0.007165812
Tephrosia candida	Fabaceae	M	1	14.29	20	2	0.36	0.04	10	0.047	0.04	0.513	0.6	-0.002897911
Thysanolaena latifolia	Poaceae	Mk	1	14.29	8	1	0.18	0.01	8	0.023	0.01	0.411	0.444	-0.001293405
Torenia violacea	Scrophulariaceae	H K Mk S T	5	71.43	69	13	2.37	0.13	5.31	0.309	0.13	0.273	0.712	-0.008432987
Trema orientalis	Ulmaceae	K M	2	28.57	6	4	0.73	0.01	1.5	0.095	0.01	0.077	0.182	-0.001001664
Trichosanthes lepiniana	Cucurbitaceae	H	1	14.29	1	1	0.18	0	1	0.023	0	0.051	0.074	-0.000199756
Tripsacum laxum	Poaceae	T	1	14.29	1	1	0.18	0	1	0.023	0	0.051	0.074	-0.000199756
Triumfetta rhomboidea	Tiliaceae	H	1	14.29	1	1	0.18	0	1	0.023	0	0.051	0.074	-0.000199756
Typhonium trilobatum	Araceae	G	1	14.29	15	3	0.55	0.03	5	0.072	0.03	0.257	0.359	-0.002252458
Typhonium diversifolium	Araceae	G	1	14.29	21	2	0.36	0.04	10.5	0.047	0.04	0.539	0.626	-0.003024043
Unidentified	????	Mk	1	14.29	11	3	0.55	0.02	3.67	0.072	0.02	0.188	0.28	-0.001714281
Unidentified	????	Mk	1	14.29	7	2	0.36	0.01	3.5	0.047	0.01	0.18	0.237	-0.001148847
Unidentified	????	Mk	1	14.29	2	1	0.18	0	2	0.023	0	0.103	0.126	-0.000374126
Urena lobata	Malvaceae	Mk	1	14.29	2	2	0.36	0	1	0.047	0	0.051	0.098	-0.000374126
Urochloa ramosa	Poaceae	M Mk	2	28.57	48	10	1.82	0.09	4.8	0.237	0.09	0.246	0.573	-0.006185428
Viola diffusa	Violaceae	S T	2	28.57	28	5	0.91	0.05	5.6	0.119	0.05	0.287	0.456	-0.003884545
Viola pilosa	Violaceae	Mk S T	3	42.86	40	9	1.64	0.07	4.44	0.214	0.07	0.228	0.512	-0.005288078
Youngia japonica	Asteraceae	G H K Mk S T	6	85.71	263	62	11.31	0.48	4.24	1.474	0.481	0.218	2.173	-0.025698658
Zephyranthes carinata	Amaryllidaceae	Mk	1	14.29	1	1	0.18	0	1	0.023	0	0.051	0.074	-0.000199756
			619		54730	4206	**767.12**	**99.87**	**1948.52**					**-3.877**

Table 7.67 presented the numerical reprtentation of different ranks of taxa recorded through quadrate sampling in two different regions and also of the overall condition.Analysis of data reveal that weed flora is much rich in hill gardens. The reason may be that at two gardens, Makaibari and Tamsong are spreading over wide altitudinal range. So, the lower stretches of these gardens are facing quite warm climate and the upper reaches facing subtropical temperate climate. That means the selection of weeds took place here from much wider stock of potential weeds in the surrounding vegetation. A closer look in the floras of terai and hill gardens shows that while distribution of only 73 species are restricted to Terai gardens and as much as 113 species are restricted to Hill gardens. And, another 72 species has been recorded from both Terai and Hill gardens.

Fig. 7.3: Dominant Weeds of Terai and Hills of Darjiling



[Ba= *Borreria alata*; Dd = *Drymaria diandra*; Ac= *Ageratum conyzoides*; Oc= *Oxalis corniculata*; Bo= *Borreria ocymoides*; Ah= *Ageratum houstonianum*; Oc= *Oplismenus compositus*; Ob= *Oplismenus burmanii*; Dc= *Digitaria ciliaris*; Dt= *Desmodium triflorum*]

Again, out of the 258 species only 8 [*Ageratum conyzoides, A. houstonianum, Borreria alata, Cynodon dactylon, Digitaria ciliaris, Kyllinga brevifolia, Oxalis corniculata & Rungia pectinata*] are growing in all the 7 gardens. Another 16 species [*Axonopus compressus, Borreria ocymoides, Centella asiatica, Crassocephalum crepidoides, Cyperus cyperoides, Digitaria sanguinolenta, Eleusine indica, Emilia sonchifolia, Eragrostis tenella, Gamochaeta pensylvanicum, Kyllinga nemoralis, Mikenia micrantha, Oplismenus compositus, Oxalis corymbosa, Paspalum conyjoides & Youngia japonica*] recorded to grow in 6 gardens. The number of species recorded from 5 gardens is 15 [*Cyperus compressus, Desmodium triflorum, Diplazium esculentum, Dryopteris filix-mas, Eragrostic gangetica, Imperata cylindrica, Leucas indica, Lindernia crustacea, Mazus pumilus, Murdania nudiflora, Persicaria hydropiper, Setaria* *palmifolia & Torrenia violacea*]. In addition, 19 species are recorded in 4 gardens, 36 species in 3 gardens, 44 species in 2 gardens and 121 species in 1 garden.

Table 7.66 presents ten high IVI scored plants or in other words, most important weeds of Terai Tea Gardens. So, *Borreria alata* is the most important plant that has scored highest for IVI of 22.469 with highest values of RF (4.923%), RD (14.869%) and RA (1.677%). The second position is occupied by *Drymeria diandra* with the IVI score of 13.035 [RF: 3.616%; RD: 7.95%; RA: 1.469%]. Two species each of three genera namely *Borreria, Ageratum* and *Oplismenus* found place within this list of ten most important weeds of Darjiling Tea Gardens. That means, these 10 species are representing only 7 genera. Species like *Borreria alata, Borreria ocymoides, Ageratum conyzides* and *Ageratum houstonianum* high biomass producing plants. These are considerably tall, much branched, very fast groing plants of quite broad ecological amplitude. On the other hand, *Oxalis corniculata, Desmodium triflorum, Digitaria ciliaris* and *Drymeria diandra* are very small plants, occupy much less space and produce very low amount of biomass. All these ten plants are annual herbs. As has already been discussed, all the selected Terai gardens use good amount of Herbicides regularly. Under such condition, only therophytic plants can survive in the habitat if they become successful in producing mature seeds during the period between two successive applications of herbicides. However, all these plants are abundant in the natural vegetation outside the plantations and seeds from those places can easily enter into the plantation areas.

When compared the dominant species of weeds within Terai, Darjiling Hills and the entire area [Table 7.69] *Borreria alata* scored highest IVI in Terai and for the entire area and second position in Hill Gsrdens. *Drymaria diandra* has been determined as second with overall score and it was recorded as most important weed in Hill Tea Gardens. It also occupied second position when considered the entire area as a whole. The third position has been occupied by *Ageratum conyzoides* which was in second position in Terai gardens, sixth in Hill gadens and was in third position for the entire area. With the overall score other species placed position in top-ten are sequentially *Oxalis corniculata, Borreria ocymoides, Ageratum houstonianum, Digitaria ciliaris, Oplismenus compositus, Oplismenus burmanii* and *Desmodium triflorum.*

Table 7.66: Ten most important weeds in the Tea Gardens of Terai and Darjiling Hills.

Species	RF	RD	RA	IVI
Borreria alata	5.923	14.869	1.677	22.469
Drymaria diandra	3.616	7.95	1.469	13.035

Ageratum conyzoides	4.568	6.488	0.949	12.005
Oxalis corniculata	4.162	5.467	0.877	10.506
Borreria ocymoides	2.855	3.715	0.87	7.44
Ageratum houstonianum	2.474	3.404	0.919	6.797
Oplismenus compositus	2.14	3.324	1.036	6.5
Oplismenus burmanii	1.499	3.354	1.494	6.347
Digitaria ciliaris	2.688	2.804	0.696	6.188
Desmodium triflorum	2.426	2.744	0.756	5.926

Table 7.67: Taxonomic distribution of plants in the Tea Gardens of Terai, Darjiling Hills and for the entire area (All) as recorded through quadrate samplings.

TAXA	Numerical Representation								
	Species			Genus			Family		
	Terai	Hill	All	Terai	Hill	All	Terai	Hill	All
Pteridophytes	09	18	22	07	14	16	06	11	13
Dicotyledons	89	112	164	77	86	123	35	33	48
Monocotyledons	40	54	68	28	39	39	08	08	09
Undetermined	--	03	04	--	--	--	--	--	--
TOTAL:	**138**	**187**	**258**	**112**	**139**	**178**	**49**	**52**	**70**

Table 7.68 presented ten dominant families of weeds in Tea Gardens of Terai and Hills of Darjiling. Poaceae has appeared as champion weed-producer with its recorded 36 species (from 27 genera) and that is followed by Asteraceae [26 species, 24 genera], Cyperaceae [13 species, 7 genera], Urticaceae [13 species, 6 genera], etc. Out of these ten families monocotyledons contributed 55 species and Dicotylens contributed 87 species, i.e. a total of 142 species (55.04 %) out of 258 recorded species from these 7 gardens under study.

Table 7.68: Ten dominant families among the weeds of Tea Gardens in Terai and Darjiling Hills.

Sl. Nos.	Families	No. of Genera	No. of Species
1.	Poaceae	27	36
2.	Asteraceae	24	26
3.	Cyperaceae	7	13
4.	Urticaceae	6	13
5.	Rubiaceae	8	10
6.	Scrophulariaceae	6	10
7.	Polygonaceae	3	10
8.	Acanthaceae	8	9
9.	Fabaceae	5	9
10.	Commelinaceae	4	6

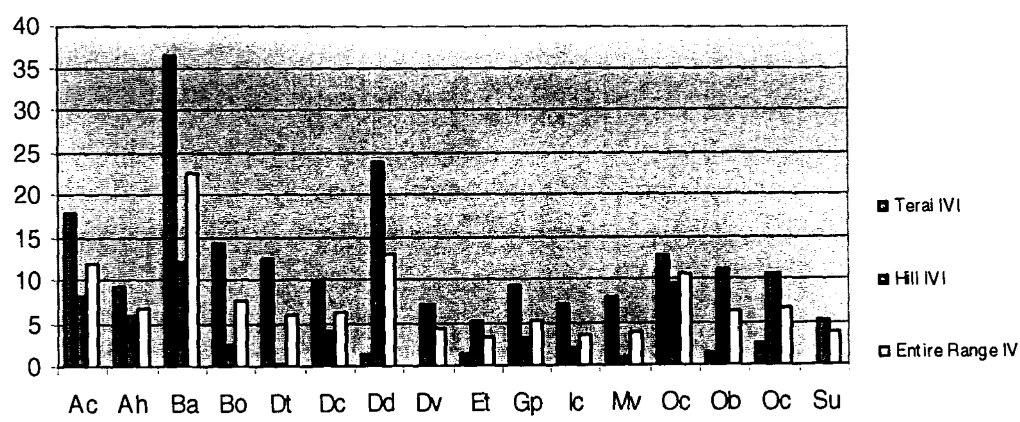
Again, a comparison of the dominant weed-producing families [Table 7.70] of the rergions under study and to that of the entire region shows that the first and second positions are always occupied by Poaceae and Asteraceae respectively. Other families found position among the top-ten in all places are Acanthaceae, Cyperaceae, Rubiaceae and Scrophulariaceae. Seven families [Amaranthaceae, Araceae, Caryophyllaceae, Cucurbitaceae, Euphorbiaceae, Pteridaceae

& Solanaceae] were recorded in top-ten either in Terai or in Hill gardens. At the same time, four more gardens [Commelinaceae, Fabaceae, Polygonaceae & Urticaceae] were recorded in top-ten either for Terai or for Hills and also for the entire area under study. - - Both, Poaceae and Asteraceae are well-known weed-producers. They are quite dominant in natural vegetations too. Acanthaceae, Commelinaceae, Cyperaceae, Fabaceae, Polygonaceae, Rubiaceae, Scrophulariaceae and Urticaceae are also dominating families in local flora both in Terai and on hills.

Table 7.69: Phytosociological status of different species of weeds in Tea Gardens of Terai, Hills of Darjiling and the entire range.

pecies	IVI & Relave Position Important Weeds in Gardens of							
	Terai		Hills		Entire Range		Overall Score	
	IVI	Position	IVI	Position	IVI	Position	IVI	Position
Ageratum conyjoides	17.81	2	8.24	6	12.005	3	37.908	3
Ageratum houstonianum	9.21	8	5.83	8	6.797	6	21.761	6
Borreria alata	36.43	1	12.17	2	22.469	1	70.903	1
Borreria ocymoides	14.41	3	2.33	-	7.44	5	24.089	5
Desmodium triflorum	12.39	5	0.19	-	5.926	10	18.428	10
Digitaria ciliaris	9.63	6	4.07	-	6.188	9	19.799	7
Drymaria diandra	1.29	-	23.85	1	13.035	2	38.075	2
Drymaria villosa	- -	-	7.04	7	4.386	-	11.422	- -
Eragrostis tenella	1.35	-	5.13	9	3.296	-	9.768	- -
Gamochaeta pensylvanicum	9.26	7	3.22	-	5.226	-	17.664	- -
Imperata cylindrica	7.09	10	2.00	-	3.601	-	12.676	- -
Mitracarpus verticillatus	7.93	9	0.76	-	3.856	-	12.489	
Oxalis corniculata	12.73	4	9.55	5	10.506	4	32.651	4
Oplismenus burmanii	1.47	-	10.96	3	6.347	8	18.746	9
Oplismenus compositus	2.44	-	10.49	4	6.5	7	19.369	8
Stellaria uliginosa	- -	-	5.01	10	3.704	-	8.736	- -

Fig. 7.4: Most Dominant Weeds in Tea Gardens in Darjiling Distrist



[Ac= *Ageratum conyzoides*; Ah= *Ageratum houstonianum*; Ba= *Borreria alata*; Bo= Borreria ocymoides; Dt= Desmodium triflorum; Dc= Digitaria ciliaris; Dd = *Drymaria diandra*; Dv= *Drymaria villosa*; Et= *Eragrostis tenella*; Gp= *Gamochaeta pensylvanicum*; Ic= Imperata cylindrical; Mv= Mitracarpus *verticillatus;* Oc= *Oxalis corniculata*; Ob= *Oplismenus burmanii*; Oc= *Oplismenus compositus*; Su= *Stellaria uliginosa*]

Out of the recorded recorded 178 genera *Persicaria* appeared to be the largest with 7 species. It is followerd by *Cyperus* with 6 species and *Eragrostic* with 5 species. Three genera namely *Boehmeria, Oxalis* and *Setaria* are contributing four species each, while eight genera [*Commelina, Desmodium, Dioscorea, Hydrocotyle, Lindernia, Pilea, Selaginella* and *Stellaria*] have contributed three species each. And, lastly 139 genera are recorded through quadrate sampling only with one species each.

Fig. 7.5: Taxonomic Distribution of Tea Garden Weeds [through quadrate sampling]

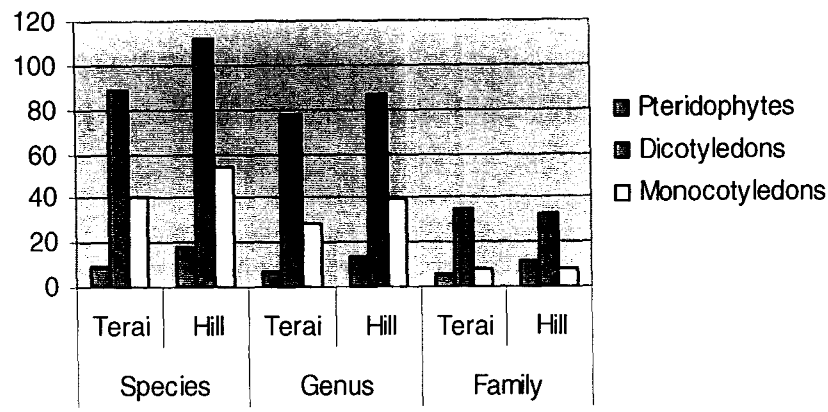


Table 7.70. Numerical distribution of dominant plant families in Tea Gardens of Terai, Hills of Darjiling and for the entire range.

Families	Genera			Species					
	Terai	Hills	All	Terai		Hills		All	
				No.	Rank	No.	Rank	No.	Rank
Acanthaceae	3	7	8	3	7	8	6	9	8
Amaranthaceae	2	-	-	3	8	-	-	-	-
Araceae	2	-	-	3	8	-	-	-	-
Asteraceae	13	22	24	14	2	23	2	26	2
Caryophyllaceae	-	2	-	-	-	5	10	-	-
Commelinaceae	-	4	4	-	-	6	9	6	10
Cucurbitaceae	3	-	-	3	7	-	-	-	-
Cyperaceae	4	5	7	9	4	9	4	13	3
Euphorbiaceae	2	-	-	3	8	-	-	-	-
Fabaceae	5	-	5	9	3	-	-	9	9
Poaceae	16	25	27	22	1	32	1	36	1
Polygonaceae	-	3	3	-	-	9	5	10	7
Pteridaceae	2	-	-	3	8	-	-	-	-
Rubiaceae	6	5	8	8	5	6	8	10	5
Scrophulariaceae	6	4	6	8	6	7	7	10	6
Solanaceae	2	-	-	3	8	-	-	-	-
Urticaceae	-	6	6	-	-	12	3	13	4

7.5.1 Similarity Index: Many mathematical formulations are available for the determination of Similarity Index between two pieces of vegetation of which Sorensen's (1968) method has been adopted in the present study.

$$S = \frac{2C}{a + b} \quad \text{or, } (2 \times 72) / (138 + 187) = 144 / 325 = 0.443$$

Where; S: index value

C: number of species common to both sites [72 species]

a: number o species in site 'a' [Tea Gardens in Terai: 138 species]

b: number of species in site 'b' [Tea Gardens in Hills: 187 species]

The value of S is less than 0.5. So, the similarity between the two weed flora in the Tea Gardens in tropical Terai and the Tea Gardens in subtropical and temperate regions of Darjiling Hills do not bear many similarities. It was under expectations that the floras are different and that has been proved through this mathematical formulation.

7.5.2 Species Diversity [Shannon-Weiner Index] for the Tea Gardens of Terai and hills of Darjiling District as a whole has been determined to -3.877. This is a moderate value of diversity. Such a value was under expectation because the habitate is highly disturbed one. However, the diversity status is comparatively better in hill gardens where the Index value is -3.83. Again, considering the Tea Gardens as unit vegetation, the worst situation has been observed in Matigara Tea Estate with its index value -2.73. For the hill gardens the lowest diversity status has been determined as -3.13 in Tamsong Tea Estate. On the other hand, the highest Index value has been determined in Soom Tea Estate and that is followed by Makaibari Tea Estate [SD = -3.35].

7.5.3. Species Richness for the all the Tea Gardens in Darjiling area, covering both Terai and Hills has been determined through **Menhinick's Index** and the obtained value is **1.1**. The value is quite low for this region specially when the region's background flora is considered. Even within this situation, Species Richness in Terai Tea Garden habitat is much richer than the hilly part of the district. Though the Index value of 1.863 is nothing for this region's biodiversity rich natural habitat even then it is 0.7 higher than the Index value for hill Tea Garden habitat.

On overall observation for the entire region under study, the weed flora of Mohorgong & Gulma is the richest and the Tamsong Tea Estate is the Poorest.

It is now clear that the effects of regular cleaning of weeds in Tea Garden exert many deleterious effects on the floristic diversity and richness of the habitat. Whatever may be the method of cleaning, spraying weedicides or manual by sickling, the effects are always adverse.

7.6. Conclusion

The Tea Garden habitats are not suitable for the growth of most of the local species of plants. Therophytes are over dominating the flora. Few phanerophytes recorded from Tea Gardens are actually musked by the Tea bushes and they never develop to their normal habit. Shade loving plants (sciophytes) and the early seed-producers are more successful plants. Plant families with broader ecological amplitude or tolerance like Poaceae, Asteraceae, Cyperaceae etc are dominating in the vegetation. Determined Values of *Shannon-Weiner Index* and *Menhinick's Index* exposed the poor status of this type of habitat, which has actually replaced very large patches of an extremely rich flora (Das 1995, 2004) of Darjiling Hills.

CHAPTER 8

PHENOLOGY

8.1 Introduction

The relations between climate and periodic biological phenomena constitute the science of Phenology (Lieth 1974). The continuous change in climatic parameters creates seasonal fluctuation in vegetation. This is due to the differential response of plants towards water, humidity, solar radiation/ sunlight and heat which get modified by vegetation itself.

Phenological observations and calendars were used in agriculture thousands of years ago in China and Rome. The term **phenology** was first proposed by the Belgian Botanist Charles Morren in 1853, but the father of the modern plant phenology and the phonological observation networks is the Swedish Botanist Carolus Linnaeus (or Carl von Linné). In his *Philosophia Botanica*, Linnaeus (1751) outlined methods for compiling annual plant calendars of leaf opening, flowering, fruiting and leaf-fall, together with climatological observations "so as to show how areas differ". Linnaeus' simple statement on the purpose of phenology is valid even today, although the potential uses of phenology have expanded considerably. The detailed information on the history of phenology and phonological observations is given by Ihne (1884), Abbe (1905), Schnelle (1955), Caprio (1966), Wang (1967), Hopp (1974) and Lieth (1974).

Phenological information on different floristic elements of a given area helps to understand the nature of vegetation in a much better way. Phenology is intimately related to the prevailing climatic conditions of a place. It is interesting to observe how different species react to different phases of climatic cycle of places within their range of distribution and to know how plants of different habit groups, e.g. annual and perennial herbs, shrubs, climbers etc. pass through different seasons of the year and complete their life cycles.

Pattern of phenology varies greatly even within same habit groups or similar type of vegetation. This indicates differences in response by different species to any given set-up of environment. Therefore, an understanding of phenology of a species expresses the gradual changes of its phonological conditions round the year.

Studies on various aspects of different species and vegetation have been conducted in different corners of the world by a number of workers including Harper (1906), Sorenson (1941), Jackson (1966), Janzen (1967), Taylor (1969, 1974), Croat (1975), Putz (1979), Stranghetti & Ranga (1997).

In India, though the scope and need of this type of work is extremely high, only very little and isolated works have been done so far. Gupta (1986) has worked on the phenological progression of high altitude grasses of Garwal Himalaya. Besides, Sundriyal *et al* (1987) and Sundriyal (1990) also studied the phenological development of some high altitude species in Garwal Himalaya. Kaul & Raina (1980) in Srinagar, Booj & Ramakrishnan (1981) and Shukla & Ramakrishnan (1982) in North East India and Ralhan *et al* (1985) in Kumaun studied the phenology of woody plants, especially of trees. Sivaraj & Krisnamurthy (1989) have studied flowering phenology in the vegetation of Shervaroys in South India. Besides, Panda *et al* (1992) have studied the flowering calender of angiosperms in Sambalpur District, Orissa in Eastern India.

Eastern Himalaya is endowed with richness and representativeness in biodiversity. About 40 % of the Himalayan floristic elements are endemic to the region, particularly to the eastern flank. Darjiling is located almost in the middle part of Eastern Himalaya. Though different parts of Eastern Himalaya were floristically explored by some stalwarts in Botany including Hooker (1872), Biswas (1966), Hara (1966, 1971), Hara *et al* (1978, 1982), Ohashi (1975), Grierson & Long (1983, 1984, 1987, 1991, 1999, 2001), Noltie (1994, 2000), Pearce & Cribb (2002) but phenological studies in Sub-Himalayan herblands in Darjiling area are very scarce. Das & Chanda (1987) have worked on the flowering calender of the angiospermic flora of Darjiling Hills, but their study contained mainly high altitude species growing between 1500 to 2300 m. And, there is almost no data available on the phenological behaviour of the plants of the herblands in Terai, Duars and foot-hills of Darjiling Himalaya.

Herbaceous flora is the most sensitive group of plants which are generally worst sufferer by any type of interference within the vegetation of an area. So, before framing up any strategy for the conservation of this vulnerable group, their natural habitats are to be preserved with top most priority. But, the plant habitats in this part of the country are extremely disturbed due to innumerable anthropogenic activities. Establishment of Tea Gardens is one such glaring example.

During recent survey of weeds in seven Tea Gardens in Terai and in Darjiling Hills phenological studies on 220 of such species were carried out, consecutively for about 3 years i.e. from July 2002 to May 2004. The present chapter deals with the data collected from such studies. Following phenologic observations were recorded during the survey:

1. Period of seedling appearance or new flashes
2. Flowering period
3. Fruit ripening & seed dispersal period
4. Period of death or resting

In addition, mode of pollination of these 220 species of plants also has been recorded. Only three broad modes of pollination have been recognized for this purpose those are (i) Anemophilous, (ii) Entomophilous & (iii) Amphiphilous.

Appearance of a seedling on germination of a seed or the sprouting of the underground bulbs, tubers, rhizomes etc or the production of leaf-flushes after breaking a dormant/ resting period has been considered as the start of a new phonological cycle. As winter is the most stressfull season in this part of the country that is why great majority of the local species tend to take rest or remain dormant during the witer months. Officially winter starts here from mid-November and continued upto the end of February. However, the hill areas remain much cool even upto the end of March. That is a phonological cycle starts from germination and ends with its rest.

Also, the habit and biological spectrum of those weedy species were studied for better understanding of their life cycle. Because life-forms reflect the major features of the climate in a given area and the biological spectrum is regarded as an indicator of the prevailing environment and the occurrence of similar biological spectrum in different regions reflect the local climatic conditions.

However, the detailed methodology followed for this work has been described under the Chapter-5 (Materials & Methods).

8.2 Results and Discussion

Habit, life form and phenology of Tea Garden weeds of Terai and Darjiling Hills were observed consecutively for about 3-years. A total of 257 species of plants were recorded from the relevant area and the phenology of 220 of these species has been studied in detail. During investigation different phenological parameters including seedling appearance, flowering, fruit marurity and seed dispersal and death and/or resting periods of different species were taken into consideration.

The phenology of almost all the species studied for the purpose showed nearly a similar pattern of response to the local climatic conditions. The climatic data presented here are for the years 1995 to 2000 [Tables-1.1a – c] for Hill Sub-Divisions and for the years 1997 to 2005 [Tables 1.1d] for Terai (Chapter-1). Rainfall and relative humidity are generally remaining high throughout this region. Temperature in this region usually does not exceed beyond 35 °C. The climate of study sites and other parts of the region is conducive with heavy rainfall and high humidity for the growth and propagation of plants. The monsoon season commence from mid June and extends till October. Highest average rainfall was recorded in the month of July. Winter was conspicuously dry with minimum rainfall during November to March. The minimum average rainfall was recorded in the month of December.

Habit groups, life forms and phenological calender of different species are presented in Table-8.1.

Table 8.1: Phenology, Life-Forms, Habit Groups and modes of pollination for the weed flora of the Tea Gardens in Terai and in the Hills of Darjiling.

[*ABBREVIATIONS USED*: **(I) GARDENS: G** = Gulma & Mohargong T.E.; **H** = Hansqua T.E.; **K** = Kamalpur T.E.; **M** = Matigara T.E.; **Mk** = Makaibari T.E.; **S** = Soom T.E.; **T** = Tamsong T.E.; **(II) LIFE FORMS: P**= Phanerophyte, **Ch** = Chamaephyte, **H** = Hemicryptophyte, **C** = Cryptophyte, **T** = Therophyte; **(III) HABIT GROUPS: HA** = Annual Herb; **HP** = Perennial Herb; **HG** = Geophytic Herb; **US** = Undershrub; **S** = Shrub; **Sf** = Suffrutescent Plant; **T** = Tree; **TS** = Small Tree; **SP** = Stem Parasite; **CA** = Annual Climber; **SC** = Shrubby Climber; **CG** = Geophytic Climber; **CE** = Epiphytic Climber; **CSf** = Suffrutescent Climber; **(IV) POLLINATION: A** = Anemophilous; **E** = Entomophilous; **A/E** = Amphiphilous]

Plants	Gardens	Life Forms	Habit	appearance	Flowering	Fruiting	Death/ rest	Pollination
Achyranthes bidentata	S	T	HA	May – Jul	Aug - Feb	Sep-Mar	Jan - Mar	A
Aconogonon molle	S	P	S	Apr - May	Jun - Nov	Aug - Jan	Dec- Mar	E

Ageratina adenophora	MkS	T	HA	Apr – Jun	Jan - Jun	Mar - Sep	Sep - Nov	E
Ageratum conyzoides	G H K M MkST	T	HA	Jan – Dec	Jan - Dec	Jan - Dec	Nov - Jun	E
Ageratum houstonianum	G H K M MkST	T	HA	Sep – Jan	Feb - Aug	Apr - Oct	Apr - Jun	E
Ajuga macrosperma	ST	T	HA	May – Jul	Jan - Dec	Jan - Dec	Feb - May	E
Albizia chinensis	H	P	T	Apr - May	Jul - Aug	Jan - Feb	Jan - Mar	A
Amaranthus spinosus	K	T	HA	Apr - Aug	May-Nov	Jun - Jan	Dec - Feb	A
Amaranthus viridis	K	T	HA	Apr – Oct	Apr - Sep	May- Dec	Feb - Mar	A
Anaphalis contorta	S	H	HP	Mar - Apr	Aug- Nov	Oct - Feb	Dec - Mar	A
Argemone mexicana	G	T	HA	Sep – Oct	Jan - Mar	Mar- May	Apr - Jun	E
Artemisia indica	ST	H	HP	Apr - May	Aug - Oct	Oct - Dec	Nov - Apr	A
Axonopus compressus	G H K M Mk S	Ch	HP	Jan – Dec	Jul - Dec	Aug - Feb	Jan - Mar	A
Bidens pilosa	Mk S T	T	HA	Mar - Sep	May - Jan	Aug- Apr	Nov - Apr	E
Blumea hieracifolia	S	T	HA	May - Jun	Sep - Mar	Nov-May	May - Jun	E
Blumea lacera	H	T	HA	May - Jun	Feb- May	Mar - Jun	May - Jun	E
Boehmeria platyphylla var. *scabrella*	T	P	S	Mar - May	Aug - Oct	Oct - Feb	NRq	A
Boehmeria macrophylla	T	P	S	Mar - May	Sep - Oct	Oct - Feb	NRq	A
Boehmeria polystachya	Mk	P	US	Mar - May	Sep - Oct	Oct - Feb	NRq	A
Boehmeria rugulosa	ST	P	US	Apr - May	Sep - Dec	Oct - Feb	NRq	A
Boerhavia coccinea	G	Ch	Sf	Mar – Jun	Apr - Aug	May- Oct	Dec - Mar	E
Borreria alata	G H K M Mk S T	T	HA	Feb – Jul	Jul - Oct	Sep - Jan	Jan - Mar	E
Borreria ocymoides	G H K M Mk S	T	HA	May – Jul	Jun - Nov	Jul - Jan	Jan - Mar	E
Breynia retusa	Mk	P	US	Mar - Apr	May - Jun	Jul - Aug	NRq	A
Briggsia kurzii	S	T	HA	May – Jul	Jun - Oct	Oct - Nov	NRq	E
Bulbostylis densa	Mk	T	HA	May - Jun	Jun - Sep	Jul - Nov	Nov - Apr	A
Cardamine hirsuta	G H S T	T	HA	Sep - Nov	Oct - Apr	Dec - Jun	May - Oct	E
Casearia graveolens	S	P	S	Mar - Apr	Mar- May	Jul - Aug	Dec - Apr	E
Centella asiatica	H K M Mk S T	Ch	HP	Feb - May	Feb- May	Apr - Sep	NRq	A
Chamabainia cuspidata	S	Ch	HP	Mar - Apr	May- Sep	Jul - Dec	Nov - Mar	A
Chloris dolichostachya	M T	T	HA	Jun – Jul	Oct - Nov	Nov - Jan	Jan - Mar	A
Chromolaena odoratum	M Mk S	H	Sf	Mar - Apr	Sep - Dec	Nov - Feb	Dec - May	E
Chrysopogon aciculatus	H	Ch	HP	Feb - Mar	Apr - Dec	May- Feb	NRq	A
Cleome rutidosperma	G K M	T	HA	Apr – Jun	Jan - Dec	Jan - Dec	Jan - Mar	E
Clerodendrum viscosum	G K	H	Sf	Mar - Apr	Jan - Feb	Feb - Apr	Jan - Mar	E
Coix lachryma-jobi	H	T	HA	Feb – Jul	Apr - Dec	Jun - Feb	Jan - May	A
Commelina diffusa	Mk	Ch	HP	Apr - May	Apr - Oct	May- Dec	Jan - Mar	E
Commelina paludosa	Mk S T	Ch	HP	Mar - Apr	May-Nov	NR	Jan - Mar	E
Commelina suffruticosa	H Mk S T	H	HP	Mar - May	Jun - Oct	Aug- Dec	Nov - Mar	E
Conyza canadensis	H K M S	T	HA	May - Aug	Jan - Dec	Jan - Dec	Jan - Dec	A/E
Crassocephalum crepidioides	H K M Mk S T	T	HA	May - Sep	Apr - Dec	Jun - Feb	Jan - Dec	E
Crinum amoenum	G	C	HP	Apr - May	Apr - Jun	Jun - Jul	Nov - May	E
Crotalaria cytisoides	H K M S	T	HA	May - Jun	Apr - Nov	Jun - Feb	Jan - Apr	E
Crotalaria pallida	G H M	T	HA	Jun – Aug	Jun - Nov	Sep - Mar	Jan - May	E
Cuscuta reflexa	G	T	SP	May - Jun	Feb - Oct	Apr - Dec	NR	E

Cyanotis vaga	Mk	T	HA	Jul – Sep	Jun - Oct	Jul - Dec	Jun - Sep	E
Cyanthillium cinereum	G H K M Mk S T	T	HA	May - Aug	Jan - Dec	Jan - Dec	Jan - Dec	E
Cymbopogon nardus	H S	H	HP	Apr - May	Sep - Oct	Nov - Jan	Jan - Apr	A
Cynodon dactylon	G H K M Mk S T	Ch	HP	Apr – Jun	Mar - Sep	Apr- Nov	NRq	A
Cyperus compressus	G H K M Mk	T	HA	May – Jul	May - Oct	Jun - Nov	Nov - Apr	A
Cyperus cyperoides	G K M Mk S T	T	HA	Apr - Jun	Apr - Sep	Jun - Nov	Nov - Mar	A
Cyperus iria	H M	T	HA	May – Jul	May- Sep	Jun - Oct	Oct - Apr	A
Cyperus niveus	H	T	HA	Apr – Jun	May -Sep	Jun- Nov	Aug- Jan	A
Cyperus pilosus	Mk	T	HA	May – Jul	Jun - Oct	Aug- Nov	Nov - Apr	A
Cyperus pseudokyllingioides	H K M	T	HA	May - Jun	Jun - Dec	Jul - Feb	Jan - Apr	A
Desmodium laxiflorum	H K	Ch	HP	Mar - May	May- Sep	Jul - Nov	Dec - Mar	E
Desmodium laxum	H	Ch	HP	Mar - May	May- Sep	Jun - Nov	Nov - Mar	E
Desmodium triflorum	G H K M Mk	T	HA	Apr - May	Apr - Oct	Jun - Nov	Oct - Apr	E
Dichrocephala integrifolia	Mk S T	T	HA	Mar – Jun	Apr - Oct	Apr - Dec	Nov - Feb	A/E
Dicliptera bupleuroides	Mk S T	T	HA	Mar – Jul	Sep- May	Nov - Jul	Sep - Mar	E
Digitaria ciliaris	G H K M Mk S T	T	HA	Apr – Jul	Apr- Oct	May-Nov	Nov - Mar	A
Digitaria sanguinalis	H K M Mk S T	T	HA	May – Jul	Jun - Sep	Jul - Oct	Oct - Apr	A
Dioscorea alata	G Mk	C	CG	Apr – Jun	Aug - Sep	Oct - Jan	Nov - Apr	A
Drymaria diandra	G Mk S T	Ch	HP	May - Jun	Sep - Apr	Oct- May	NRq	A
Drymaria villosa	S T	T	HA	Nov – Jan	May - Oct	Jun - Dec	Oct - Dec	A
Duchesnea indica	Mk T	T	HA	Oct - Dec	Feb - Sep	Mar- Nov	Sep - Oct	E
Ehretia serrata	H K M	P	T	May - Jun	Mar - Apr	Jun - Jul	NRq	E
Elatostema alsinoides	Mk	T	HA	Apr - May	May - Jul	Jun - Sep	Nov - Apr	A
Elatostema hookerianum	Mk	Ch	HP	May - Jun	Jun - Sep	Jun - Aug	Nov - May	A
Eleusine indica	G H K M S T	T	HA	Mar - May	May- Dec	Jun - Jan	Jan - Mar	A
Emilia sonchifolia	G H K M S T	T	HA	Jan - Dec	Jan - Dec	Jan - Dec	Jan - Dec	E
Eragrostis gangetica	K M	T	HA	Aug - Oct	Sep - Jan	Oct - Mar	Mar - Aug	A
Eragrostis nigra	Mk S T	T	HA	Jun - Aug	May - Oct	Jun - Dec	Dec - Jun	A
Eragrostis tenella	H K M Mk S T	T	HA	Jun - Sep	Apr - Oct	May-Nov	Nov - Jun	A
Eragrostis unioloides	K M Mk	T	HA	Jun - Sep	Feb - Dec	Mar - Jan	Feb - Jun	A
Erigeron karvinskianus	T	Ch	HP	Mar - Apr	Jan - Dec	Jan - Dec	NRq	E
Euphorbia hirta	G H M	T	HA	Mar - Sep	Jan - Dec	Jan - Dec	Jan - Dec	A
Evolvulus alsinoides	H	T	HA	Mar - Jul	Jan - Dec	Jan - Dec	Jan - Dec	E
Fimbristylis dichotoma	H K M Mk	T	HA	May - Jun	Mar - Oct	Apr - Dec	Nov - May	A
Flueggea virosa	T	P	US	Mar - Apr	Apr- May	Jul - Aug	NRq	A
Galinsoga parviflora	Mk S T	T	HA	Apr - Aug	Apr - Dec	Apr - Jan	Jan - Apr	E
Gamochaeta pensylvanicum	G H K Mk ST	T	HA	Jun - Oct	Feb - Jun	Mar- Aug	Aug - May	A/E
Globba racemosa	Mk	C	HG	May - Jun	May-Aug	Jun - Sep	Sep - May	E
Guizotia abyssinica	Mk	T	HA	Oct - Dec	Nov - Apr	Dec- May	May - Oct	E
Gynura nepalensis	S T	T	HA	Jun - Jul	Mar- June	May-Aug	Sep - May	E
Hedyotis scandens	G K T	Ch	CS	Apr - May	May-Nov	Jul - Jan	Feb - Apr	E

Hydrocotyle himalaica	Mk S T	Ch	HP	Apr - May	Apr - Oct	Jun - Dec	Dec - Mar	A
Hydrocotyle nepalensis	S	Ch	HP	May - Jun	Aug- Dec	Sep - Jan	Dec - Apr	A
Hydrocotyle sibthorpioides	G H K M	T	HA	Jul - Oct	Sep - Feb	Oct - Mar	Mar - Jul	A
Hypericum japonicum	K S	T	HA	Jan - Dec	Jan - Dec	Jan - Dec	Jan - Dec	E
Hypoestes sanguinolenta	Mk S T	P	US	May - Aug	Sep - Apr	Nov-May	NRq	E
Hypoestes triflora	Mk S	T	HA	May - Jun	Aug- Nov	Sep - Dec	Dec - Apr	E
Ichnocarpus frutescens	Mk	P	CS	Apri - May	Aug - Oct	Oct - Jan	NRq	E
Impatiens balsamina	Mk	T	HA	Apr - May	Jun - Sep	Jun - Oct	Nov - Mar	E
Impatiens discolor	T	T	HA	May - Jun	Jun - Sep	Jun - Oct	Oct - Apr	E
Imperata cylindrica	G K M Mk T	H	HP	Mar - May	Oct - Apr	Nov-May	NRq	A
Isachne albens	S	T	HA	Jun - Aug	Sep - Feb	Oct - Mar	Mar - May	A
Ixeris polycephala	G H K	T	HA	Jun - Jul	Aug - Apr	Aug-May	May - Jun	E
Jasminum dispermum	Mk	P	CS	May - Jun	Apr- May	May - Jun	NRq	E
Juncus bufonius	G	T	HA	Jun - Aug	Jun - Sep	Jul - Oct	Oct - May	A
Kyllinga brevifolia	G H K M Mk S T	T	HA	May - Jun	Mar - Oct	Apr- Nov	Nov - Apr	A
Kyllinga nemoralis	G H K M S T	T	HA	May - Jun	Apr - Sep	May- Oct	Oct - Apr	A
Lantana camara	Mk T	P	S	Apr - May	May-Nov	Jul - Feb	Feb - Mar	E
Lecanthus peduncularis	S	Ch	HP	May - Jun	Aug - Oct	Sep - Dec	Dec - Apr	A
Lepidagathis incurva	Mk	T	HA	Jun - Jul	Oct - Apr	Dec - Jun	Oct - May	E
Leucas indica	G H K M Mk	T	HA	Jan - Dec	Jan - Dec	Jan - Dec	Jan - Dec	E
Lindenbergia grandiflora	S T	H	Sf	May - Jun	Aug - Apr	Oct- May	Dec - Apr	E
Lindenbergia indica	G S T	T	HA	May - Aug	Feb - Oct	Apr - Dec	Nov - Apr	E
Lindernia ciliata	K S T	T	HA	Apr - Sep	Jul - Oct	Jul - Nov	Nov - Mar	E
Lindernia crustacea	G H K M T	T	HA	Apr - Sep	Jul - Oct	Jul - Nov	Nov - Mar	E
Lindernia pyxidaria	G H K M	T	HA	May - Jul	Jul - Sep	Jul - Sep	Oct - Apr	E
Lobelia nummularia	Mk S T	T	HA	Jun	Feb - Oct	Apr - Dec	Nov - May	E
Ludwigia perennis	M	T	HA	Jun - Aug	Sep - Jan	Nov- Mar	Mar - May	E
Luffa aegyptiaca	H	T	HA	May - Jul	Aug- Dec	Jan - Mar	Feb - Apr	E
Lysimachia alternifolia	S	T	HA	May - Jun	Aug - Sep	Sep - Oct	Oct - Apr	E
Mazus pumilus	G H K S T	T	HA	May - Dec	May - Oct	Jun - Nov	Dec - Apr	E
Mazus surculosus	S	T	HA	May - Jul	May- Sep	Jun - Nov	Dec - Apr	E
Mecardonia procumbens	G H K	T	HA	Mar - Aug	Apr - Sep	May- Oct	Oct - Mar	E
Melastoma malabathricum	K	P	US	Mar - Apr	Sep- May	Oct - Jul	Dec - Feb	E
Melia azadarach	Mk	P	T	Apr - May	Apr- May	Jun - Jul	NRq	E
Melochia corchorifolia	G K	T	HA	Apr - Jun	May-Nov	Jul - Jan	Jan - Mar	E
Merremia hirta	K M	T	CA	May - Jun	Sep - Nov	Oct - Jan	Jan - Apr	E
Mikania micrantha	G H K M Mk S	Ch	CS	Feb - Mar	Aug - Feb	Sep - Mar	Jan - Mar	A/E
Mimosa pudica	G H K	T	HA	Apr - Jun	May- Dec	Jul - Jan	Feb - Mar	A
Mitracarpus verticillatus	G H K M Mk	T	HA	Mar - Jun	Jun - Oct	Jul - Dec	Dec - Feb	E
Morus australis	Mk	P	TS	Apr - May	Mar - Apr	May - Jun	Dec - Mar	A
Mukia maderaspatana	G	T	CA	May - Jun	Aug - Oct	Sep - Dec	Dec - Apr	E
Murdannia nudiflora	G K M Mk T	T	HA	Apr - Jul	Mar- Nov	Apr- Nov	Nov - Mar	E
Murraya koenigii	G H	P	S	Apr - May	Feb - Apr	Apr- May	Dec - Mar	E

Nasturtium officinale	T	T	HA	Apr	Jun - Aug	NR	Dec - Mar	E
Natsiatum herpeticum	H Mk	P	CS	May - Jun	Nov- Dec	Feb - Mar	Jan - Apr	A
Neanotis hirsuta	G	T	HA	May - Jun	Jun - Sep	Jul - Nov	Nov - Apr	E
Nelsonia canescens	G	Ch	HP	Apr - May	Feb - Apr	Apr - Jun	Jan - Mar	E
Neolamarckia cadamba	K	P	T	Apr - May	May- Sep	Sep - Nov	Jan - Mar	E
Neyraudia arundinacea var. zollingeri	Mk	T	HA	Sep - Oct	Oct - Apr	Nov- Apr	Apr - Aug	A
Oenanthe javanica	T	T	HA	May - Jun	Mar - Apr	May - Jun	Jun - Apr	E
Oldenlandia corymbosa	G H K M	T	HA	Mar - Oct	Jan - Dec	Jan - Dec	Oct - Mar	E
Oldenlandia diffusa	H K M	T	HA	May - Jul	Apr - Nov	Jun - Jan	Jan - Apr	E
Oplismenus burmanii	H Mk S T	T	HA	Apr - Jun	Jan - Oct	Feb - Nov	Dec - Mar	A
Oplismenus compositus	G H K Mk S T	T	HA	Apr - Jun	Aug- Dec	Sep - Jan	Dec - Mar	A
Oxalis corniculata	G H K M Mk S T	T	HA	Mar - Nov	Jan - Dec	Jan - Dec	Dec - Feb	E
Oxalis corniculata var. villosa	S	T	HA	Apr - Jun	May - Oct	Jun - Nov	Nov - Mar	E
Oxalis corymbosa	G H K Mk S T	C	HP	Mar - May	Feb - Oct	NR	Dec - Feb	E
Oxalis latifolia	T	C	HP	Mar - May	Apr - Sep	NR	Nov - Feb	E
Oxyspora paniculata	S	Ch	S	Apr - May	Jul - Oct	Sep - Dec	NRq	E
Paspalidium flavidum	T	T	HA	Jun - Jul	Aug- Dec	Apr - Sep	Oct - May	A
Paspalum conjugatum	G K M Mk S T	T	HA	Jun - Jul	Aug- Dec	Sep - Jan	Jan - May	A
Paspalum scrobiculatum	G H K M	T	HA	Jun - Jul	Apr- Oct	May-Nov	Dec - May	A
Peperomia pellucida	H K Mk T	T	HA	Feb - Oct	Jan - Dec	Jan - Dec	Nov - Jan	A
Pericampylus glaucus	G H Mk T	C	CG	Apr - May	Apr- May	Jul - Sep	Nov - Mar	A
Peristrophe speciosa	Mk S T	T	HA	May - Jul	Oct - Dec	Dec - Jan	Feb - Apr	E
Persicaria capitata	S	Ch	HP	Mar - May	May- Sep	Jun - Nov	Nov - Feb	E
Persicaria chinensis	Mk S T	Ch	US	Feb - Apr	Apr - Nov	Jun - Jan	Dec - Jan	E
Persicaria hydropiper	G H Mk S T	T	HA	Jun - Jul	Jul - Oct	Jul - Nov	Oct - May	A/E
Persicaria microcephala	Mk	T	HA	Mar - Jun	May- Dec	Jun - Jan	Dec - Feb	E
Persicaria nepalensis	S T	T	HA	Apr - Jun	May-Nov	May- Dec	Dec - Mar	E
Persicaria posumbu	Mk S	T	HA	Mar - Apr	Apr - Dec	Apr - Dec	Nov - Feb	E
Persicaria runcinata	Mk S T	T	HA	Apr - Jun	May- Dec	May - Jan	Dec - Mar	A/E
Phaulopsis imbricata	G Mk	T	HA	May - Jun	Oct - Feb	Dec- Mar	Feb - Apr	E
Phyllanthus reticulatus	H	P	S	Apr - May	Apr - Jun	Jun - Aug	NRq	A
Phyllanthus urinaria	G K M	T	HA	May - Aug	Apr - Sep	May-Nov	Nov - Apr	A
Physalis divaricata	G	T	HA	May - Jul	May-Nov	Aug - Jan	Dec - Apr	E
Pilea sp	S	T	HA	May - Jul	Jun - Sep	Jul - Oct	Nov - Apr	A
Pilea symmeria	S T	T	HA	May - Jun	Jun - Sep	Jul - Oct	Nov - Apr	A
Pilea umbrosa	S	Ch	HP	May - Jun	Jun - Sep	Jul - Oct	Nov - Apr	A
Piper longum	G	Ch	HP	May - Jun	May- Sep	Jul - Oct	Dec - Apr	A
Plantago erosa	S	T	HA	Feb - May	Mar - Oct	May- Dec	Nov - Feb	A
Poa annua	S	T	HA	Jun - Aug	Feb - Sep	Apr - Dec	Jan - May	A
Pogonantherum crinitum	S	T	HA	Apr - Jun	Jul - Dec	Sep - Jan	Jan - Mar	A
Polygonum plebeium	K	T	HA	Aug - Nov	Nov - Apr	Nov- Apr	May - Aug	A/E
Portulaca oleracea	H K	T	HA	May - Sep	Jan - Dec	Jan - Dec	Oct - Apr	E
Pothos scandens	H	Ch	CE	May - Jul	Dec - Apr	May - Jun	NRq	E

Pouzolzia hirta	Mk S T	Ch	HP	Mar - May	Jun - Sep	Jul - Oct	Oct - Mar	A
Pouzolzia zeylanica	G H K M	T	HA	May - Jun	Jun - Nov	Jul - Jan	Nov - Apr	A
Primula melacoides	S	T	HA	Apr - Jun	Sep - Dec	Nov - Jan	Jan - Mar	E
Pseudognaphalium affine	G H K S	T	HA	Sep - Dec	Mar - Dec	Apr - Jan	Dec - Aug	A/E
Pueraria phaseoloides	K	H	CSf	May - Jun	Sep - Nov	Nov - Jan	Dec - Apr	E
Pupalia lappacea	G Mk S T	T	HA	May - Jun	Sep - Feb	Nov- Apr	Dec - Apr	A
Remusatia pumila	Mk	C	HP	Jun - Jul	May - Jul	Jul - Aug	Oct - May	E
Rhaphidophora hookeri	Mk	Ch	CE	Apr - May	Mar - Jul	Dec - Jan	NRq	A/E
Rhopalephora scaberrima	Mk	H	HP	May - Jun	Aug - Oct	Aug - Oct	Oct - Apr	A/E
Rhynchospora rubra	K M	T	HA	May - Jun	Jul - Sep	Sep - Oct	Oct - Apr	A
Richardia scabra	Mk	T	HA	Apr - May	Jul - Oct	Aug- Nov	Dec - Apr	E
Rubia manjith	S T	T	CA	May - Jun	Jul - Oct	Sep- Dec	Dec - Apr	E
Rungia pectinata	G H K M Mk S T	T	HA	Apr - Jun	Nov - Apr	Dec- May	Jan - Mar	E
Saccharum spontaneum	H K M Mk	H	HP	Mar - Apr	Dec - Jan	Dec - Feb	Jan - Feb	A
Sacciolepis indica	Mk S	T	HA	May - Jul	Jul - Oct	Jul - Nov	Oct - May	A
Scoparia dulcis	G H K M	Ch	Sf	Mar - Apr	Apr - Jan	May- Feb	Jan - Mar	E
Setaria glauca	S	T	HA	Apr - Jul	Aug - Oct	Sep - Dec	Nov - Mar	A
Setaria palmifolia	H M Mk S T	T	HA	May - Jul	May- Dec	Jun - Jan	Dec - Apr	A
Setaria plicata	G Mk T	T	HA	May - Jul	May- Feb	Jun - Feb	Jan - Apr	A
Setaria pumila	Mk T	T	HA	Mar - Jul	May- Feb	Jun - Feb	Jan - Feb	A
Sida acuta	Mk	T	HA	May - Jun	Oct - Jan	Dec- Mar	Jan - Apr	E
Smilax zeylanica	H	P	CS	Apr - May	Mar -May	Dec	Dec - Mar	A
Solanum aculeatissimum	G	T	HA	Apr - May	Apr - Oct	Aug - Jan	Jan - Mar	E
Solanum nigrum	G H M	T	HA	Mar - Sep	May - Jan	Jun - Jan	Dec - Mar	E
Sonchus asper	G H	T	HA	May - Jul	Jun - Dec	Jun - Jan	Jan - Apr	E
Spilanthes acmella	S	Ch	HP	Apr - May	Jan - Dec	Jan - Dec	Dec - Mar	E
Sporobolus fertilis	Mk	H	HP	Mar - Apr	Sep - Dec	Nov - Feb	Jan - Mar	A
Stellaria media	K S	T	HA	May - Aug	Jul - Oct	Aug- Nov	Dec - Apr	A
Stellaria patens	S	T	HA	May - Jul	Jul - Oct	Aug- Nov	Dec - Apr	A
Stellaria uliginosa	S	T	HA	May - Jul	Jul - Nov	Aug - Jan	Dec - Apr	A
Stephania glabra	Mk	C	CG	Apr - May	May - Jun	Jul - Sep	Dec - Mar	A
Stephania japonica	H	C	CG	Apr - May	May - Jun	Jul - Sep	Nov - Mar	A
Strobilanthes divaricata	Mk S T	Ch	US	Mar - Apr	Jul - Nov	Sep - Jan	Jan - Apr	E
Synedrella nodiflora	Mk T	T	HA	May - Jul	Jul - Feb	Aug- Mar	Jan - Apr	E
Tephrosia candida	M	P	S	Apr - May	Sep - Nov	Jan - Feb	NRq	E
Thysanolaena latifolia	Mk	H	US	Mar - May	Oct - Apr	Nov-May	NRq	A
Torenia violacea	H K Mk S T	T	HA	Apr - May	May- Sep	Jul - Oct	Nov - Mar	E
Trema orientalis	K M	P	TS	Apr - May	Apr - Jun	Jul - Aug	Jan - Mar	A
Trichosanthes lepiniana	H	C	CG	Mar - May	Apr- May	Jul - Aug	Nov - Mar	E
Triumfetta rhomboidea	H	T	HA	May - Jun	Aug- Dec	Sep - Jan	Dec - Apr	E
Typhonium trilobatum	G	C	HG	May - Jun	Jun - Jul	NR	Nov - Apr	E
Typhonium diversifolium	G	C	HG	May - Jun	Jun - Jul	NR	Nov - Apr	E
Urena lobata	Mk	T	HA	May - Jun	Aug - Jan	Oct - Mar	Jan - Apr	E
Urochloa ramosa	M Mk	T	HA	Jun - Jul	May- Sep	Jun - Oct	Oct - May	A
Viola diffusa	S T	T	HA	Mar - Jun	May- Sep	Jun - Oct	Oct - Mar	E

Viola pilosa	Mk S T	Ch	HP	Feb - May	Feb - Sep	Mar - Oct	Nov - Feb	E
Youngia japonica	G H K Mk S T	T	HA	Jan - Dec	Jan - Dec	Jan - Dec	NRq	E
Zephyranthes carinata	Mk	C	HG	Apr - May	Apr - Aug	Jun - Sep	Dec - Mar	E

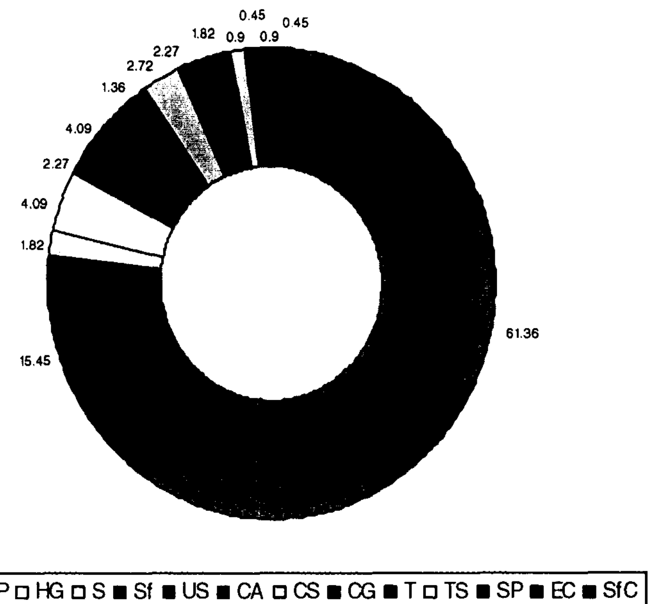
8.2.1 Habit Groups

As for the habit groups of the plants in the calendar, there are 135 annual herbs (61.36 %), 34 perennial herbs (15.45 %), 9 shrubs, 9 undershrubs, 14 different types of climbers, 6 tree-seedlings, etc have been recorded from these Tea Gardens as has been presented in Table 8.2.

Table 8.2: Distribution of Habit Groups among the Tea Garden weeds in Terai and in the hills of Darjiling.

Habit Groups	**No. of Species**	**%**
Annual Herbs (**HA**)	135	61.36
Perennial Herbs (**HP**)	34	15.45
Geophytic Herbs (**HG**)	4	1.82
Shrubs (**S**)	9	4.09
Suffrutescent plant (**Sf**)	5	2.27
Undershrubs (**US**)	9	4.09
Annual Climbers (**CA**)	3	1.36
Shruby Climbers (**CS**)	6	2.72
Geophytic Clembers (**CG**)	5	2.27
Trees (**T**)	4	1.82
Small Trees (**TS**)	2	0.90
Stem Parasite (**SP**)	1	0.45
Epiphytic Climber (**EC**)	2	0.90
Suffrutescent Climber (**SfC**)	1	0.45
	220	

Fig. 8.1: Habit Groups of Tea Garden Weeds [through quadrate sampling]



The excessive dominance of Annual Herbs with 61.36% of the plants under study is certainly at per with the habitat conditions. For promoting the growth of tea-bushes either weedy-plant are regularly killed with the application of herbicidal chemicals or those are cleaned manually by sickling. Weed flora of Terai gardens is mostly constituted of Annual Herbs as they use chemical herbicides quite often. On the other hand, the selected hill gardens generally do not use any such chemicals. The 6 species of trees recorded are all in their seedling state of life cycle.

8.2.2 Life Forms

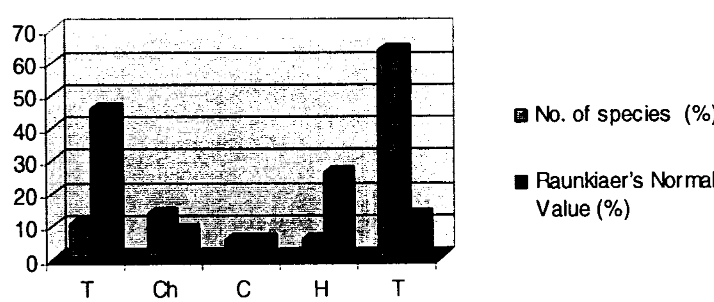
Out of the studied 220 species (Table- 8.1 & Fig.- 4.1), there are 140 Therophytes, 30 Chamaephytes, 13 Hemicryptophytes, 24 Phanerophytes and 13 Cryptophytes. The percentage contributions of the different life forms are in the descending order of Therophytes (63.64 %), Chamaephytes (13.64 %), Phanerophytes (10.91 %), Cryptophytes (5.91 %) and Hemicryptophytes (5.91 %). The highest percentage of the biological spectrum of these Tea Gardens was contributed by Therophytes, while Cryptophytes and Hemicryptophytes are the lowest. Since the spectrum showed almost a complete dominance of Therophytes and Chamaephytes together (77.28 %), the flora may be called Thero-Chamaephytic. Also, keeping apart the Phanerophytes, 89.01 % weedy plants in these gardens are small plants and pass away the unfavourable season keeping their perennating organs on or inside or very close to the soil surface.

Table 8.3: Distribution of Life Form classes among the Tea Garden weeds in Terai and in the hills of Darjiling.

Life Forms	**No. of species**	**%**	**Raunkiaer's Normal Value (%)**
Phenerophytes (T)	24	10.91	46.00
Chamaephytes (Ch)	30	13.64	9.00
Cryptophytes (C)	13	5.91	6.00
Hemicryptophytes (H)	13	5.91	26.00
Therophytes (T)	140	63.64	13.00
TOTAL:	**220**		

It is difficult to believe that garden care-takers will permit weedy unwanted plants to grow freely inside their plantations. The Phanerophytes recorded here are surviving there in semihidden with the tea bushes.

Fig. 8.2: Life Form Classes of Tea Garden Weeds [through quadrate sampling]



The biological spectrum of the flora in the present study can be compared with the normal biologicl spectrum of Raunkiaer (1934). The highest percentage to the biological spectrum of the present flora was contributed by Therophytes (63.64 %) which was found to be nearly five times to that of in the Raunkiaer's normal spectrum (i.e. 13.00 %). Chamaephytes constituted the second largest group with its 13.64 % representation as against 9.26 % in the normal spectrum. Phanerophytes the third largest group is represented with 10.91 % species only against 46.00 %. Cryptophytes were 5.91 % as against 6.00 % in the normal spectrum and Hemicryptophytes were also with 5.91 % aginst their normal value o 26.0 % as in the Raunkiaer's normal biological spectrum.

Certainly, the higher percentage of Therophytes in the present study is attributed to the excessive anthropogenic interferences in the vegetation. According to Cain (1950) overgrazing or many other types of biotic interferences tends to increase the percentage of Therophytes through the resultant introduction and spread of the small weedy plants. Regular weeding operations in Tea Gardens also prohibit the growth of Phanerophytes.

8.2.3 Phenology of the Tea Garden Weeds

8.2.3.1 Seedling Appearance/ Awakening after Rest

In this investigation, it was observed that majority of the species broke their dormancy between March and August, i.e. their seedlings or new shoots (after rest) appeared during this period. The seedlings and/or new shoots of annuals and perennials started emerging from ground in the month of March, when 54 species (24.55 %) were observed in seedling stage. The peak period of seedling or new shoot appearance was May when 167 species (75.91 %) showed their juvenile stage. For most of the species, seedling and/or new shoot appearance period is extended from 2 to 3 months, while remaining species had a longer period. 37 species produced their seedlings or new shoots between May and June. Moreover, 36 species produced their seedlings or new shoot between April and May. It was then sharply reduced to 19 between March and April and then 15 between June and July. May is the most important month when highest number of species broke their dormancy.

On the other hand, apart from the 7 species germinating round the year (i.e. Jan – Dec), only two other species [*Ageratum houstonianum* (Sep – Jan) and *Drymaria villosa* (Nov – Jan)] found to produce seedling in January. And, not a single species has been recorded to initiate dormancy breaking during this month. The situation is same for the month of December. During February, however, nine species initiated dormancy breaking. - - This observation is quite at per with the local environmental conditions. The ambient temperature starts decreasing from the later part of September and that become quite cold at mid-November. This cold spell continued upto the middle of February when after day temperature starts increasing very slowly. If the amount of precipitation is considered, a dry period from October to March/ April makes the soil dry rendering it unsuitable for the germination of seeds.

Most of the species establish themselves from seedlings. Some species, however, propagate vegetatively from rhizomes, root stocks or other perennating organs. The vernal season begins with the rise in temperature from middle of April and continues upto the second week of June. Rainfall and temparature are the main limiting factors for breaking the dormancy of the plants of the vegetations in this area. However, rain starts from the middlie or end of April. Some plants then start to germinate and the number steadily increases upto July.

4.2.3.2 Vegetative Growth

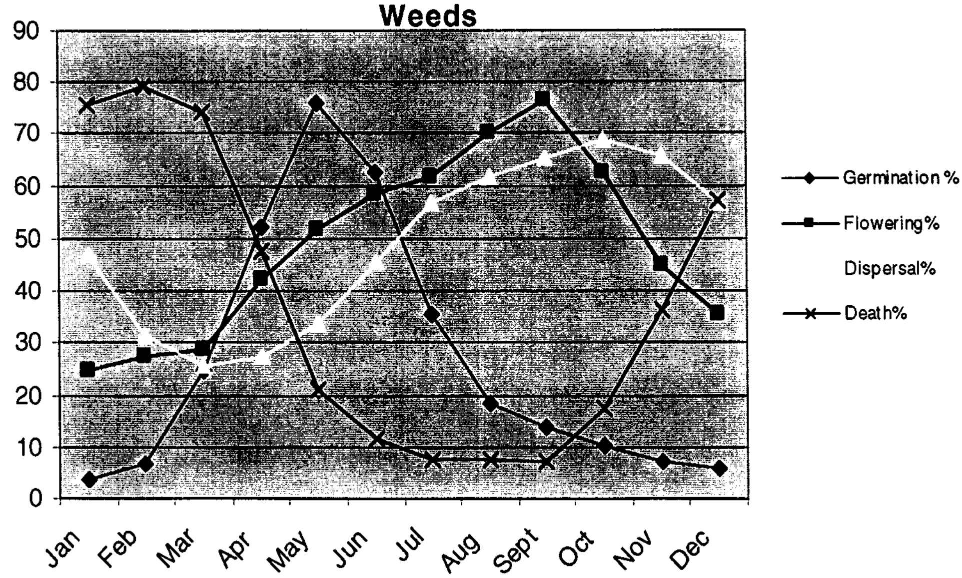
Seedling appearance is soon followed by the vegetative growth. Vegetative growth of most of the species was observed between April and September, with a peak during May and June, when nearly 200 species of plants grew vegetatively. The perennial grasses such as *Cymbopogon pendulus, Imperata cylindrica, Paspalum scrobiculatum, Saccharum spontaneum, Sporobolus indicus* and most of the forbs sprouted from the rhizome / root-stocks / tubers / bulbs etc. followed by vigorous growth. Sprouting and vegetative growth was very fast during May and June. However, the whole vegetation remains lush green during the months of May and August.

Vegetative growth is very soon interrupted with the initiation of flowering. Tea Garden haitat face quite high degree of stress and competition. So, naturally, most of the species will try to produce seeds or propagules as early as possible. Thousands of individuals of numerous recorded species found to start flowering at the 3 – 5 leaf stage. For a successful weed this must be an advantageous character. However, for a particular species, early seedlings represent longer vegetative growth.

Table 8.4: Distribution of Phenological Phases among the Tea Garden weeds in Terai and in the hills of Darjiling.

Months	Phenological Phases							
	Germination/ Awakening		Flowering		Fruit ripening & Dispersal		Death/Rest	
	No.	%	No.	%	No.	%	No.	%
January	8	3.64	54	24.55	**103**	**46.82**	**166**	**75.45**
February	15	6.82	60	27.27	69	31.36	**174**	**79.09**
March	54	24.55	63	28.64	56	25.45	**163**	**74.09**
April	**115**	**52.27**	**93**	**42.27**	60	27.27	**105**	**47.73**
May	**167**	**75.91**	**114**	**51.82**	74	33.64	47	21.36
June	**138**	**62.73**	**129**	**58.64**	**100**	**45.45**	26	11.82
July	78	35.45	**136**	**61.82**	**125**	**56.82**	17	7.73
August	41	18.64	**154**	**70.00**	**136**	**61.82**	17	7.73
Sepiember	31	14.09	**168**	**76.36**	**144**	**65.45**	16	7.27
October	23	10.45	**138**	**62.73**	**151**	**68.64**	39	17.73
November	16	7.27	**99**	**45.00**	**145**	**65.91**	80	36.36
December	13	5.91	78	35.45	**125**	**56.82**	**126**	**57.27**

Fig. 8.3: Distribution of Phenophases of Tea Garden Weeds



4.2.3.3 Flowering Calendar:

During the present investigation it was seen that most of the species flourish during the period of heavy rainfall and gradually starts flowering. Maximum number of species starts opening their flowering buds in late July or early August. Most of these plants generally continue to flower upto winter. Moreover, at least 17 species viz. *Ageratum conyzoides, Ajuga macrosperma, Cleome rutidosperma, Conyza Canadensis, Cyanthillium cinereum, Emilia sonchifolia, Erigeron karvinskianus, Euphorbia hirta, Evolvulus alsinoides, Hypericum japonicum, Leucas indica, Oldenlandia corymbosa, Oxalis corniculata, Peperomia pellucida, Portulaca oleracea, Spilanthus acmella* and *Youngia japonicva* flowered more or less round the year with a considerably reduced number during the winter, and the rate of flowering was not same in different months.

A close scrutinee to the Flowering Calendar of Tea Garden weeds that only very few plants flower during winter months. Less than 40 % species remain in flower during December to March. As much as 168 (76.36 %) species has been recorded to flower during the month of September [Table 8.4]. It is followed by August [154 or 70 %], October [138 or 62.73 %] and July [136 or 61.82 %]. - - Two things are very clear from this observation. (1) Many species starts flowering with the proper increase of temperature during April – May and that continued upto August, and (2) another set of species initiate flowering when the ambient temperature starts falling in the later part of September.

It is also interesting to note that the flowering period of majority of the species is more than three months long. As it was discussed earlier, all seeds of a species do not germinate within a short period but that takes months to complete the appearance phase. The individuals appeared first generally initiate flowering early, followed by individuals appearing later. However, apart from few plants, most of the species completes flowering during the period April to November. Due to the long duration of flowering period, plants at different phenophases are available at a given time in the habitat.

So, some species started flowering only with a decrease in day temperature (i.e. mid-September-November); some are winter flowering species e.g. *Cardamine hirsuta, Clerodendrum viscosum, Lepidagathis incurve, Natsiatum herpeticum, Phaulopsis imbricate, Polygonum plebejum, Saccarum spontaneum* etc. started to flower either almost immediately, or later during November to February. Also, there were some species which started to flower only with a rise in temperature after winter (March to May). These plants, however, flowered for a longer period and generally continued through the monsoon upto the winter.

There are some variations in the flowering periods of the widely distributed plants. Quite a good number of species has been recorded from both Terai and Hill gardens. In the Flowering Calendar presented in Table 8.1, the entire period of flowering has been covered as that was similarly treated by Das & Chanda (1987). However, flowering early or flowering late for a species is controlled by its adaptation. If a species prefer to flower with the increase of ambient temperature, then that will flower late in Hill gardens. On the other hand, if a species prefer to flower with the decrease of ambient temperature, then that will flower early in Hill gardens.

8.2.3.3.A. Pollination Types

As has already been mentioned, only two major types of pollination has been considered during the present survey though no plant has been noted here to follow any specialized mode of pollination. Das & Chanda (1987) has recognized the occurrence of much higher degree of Entomophilous plants in Darjiling Hills. This selection is, probably, due to the prevalence of high atmospheric humidity, high and widely distributed rainfall, formation of dense fog etc. as air borne pollens fails to fly and reach to the destination under such environmental conditions. Even under such situation, the presence of 41.36 % Anemophilous weeds is quite interesting. Terai gardens can ofcourse host a good number of such plants. [Table 8.5]

Ten plants have been marked as Amphiphilous as they take the help both the pollinating agents, i.e. by insects as well as by air.

Table 8.5: Distribution of Pollination types among the Tea Garden weeds in Terai and in the hills of Darjiling.

Type of Pollination	No. of species	%
Anemophilous (A)	91	41.36
Entomophilous (E)	119	54.09
Amphiphilous (A/E)	10	4.55
TOTAL:	**220**	

8.2.3.4 Fruit Ripening and Seed Dispersal

Unlike most of the commonly available plants, in case of herbaceous species flowering and fruiting are a simultaneous process, as the majority of them needs to complete their life cycle within a short span of time. Also, in majority of the herbaceous species fruit set occurs simultaneously with the ripening of fruits. Like flowering period, the knowledge about fruiting period, specially the period of it's ripening and seed dispersal is very important. Plants with a broad flowering period also produce fruits, as expected, over a broad period. If an entire fruiting period is presented in a calender then a part of it will also overlap entire or a good portion of the flowering period in most of the herbaceous plants. Results of the present investigation revealed that (Table 8.1) most of the species selected the post monsoon period for their fruit ripening and also for dispersal. During this period (August to November) more than 175 species showed at the peak of their fruiting. However, most of these species generally continued this phenophase upto post winter period. Moreover, 17 species showed fruit ripening and seed-dispersal round the year. Names of those 17 plants have been discussed under the Flowering Calendar. If a short-living herbaceous plant flowers round the year, it is quite natural that they will ripen their fruits and seeds also round the year. Like the width of fruiting period of these species the flowering period was also nearly equally wide. But these plants with very wide flowering period do not produce fruits in equal proportion (flower : fruit-set ratio) in all parts of its range of flowering. The amount of flower production and fruit-set can not be equal in all the seasons though they are flowering throughout the year or over a broad period. In most of the species, seed dispersal occurred within, 4-6 weeks time after fruiting. And, they select the winter period for their seed dispersal. This dispersal period is more important in annuals because that is the last stage in their compact life-cycle after which they die.

However, the highest number of 153 species of plants has been recorded in this phenophase during October. It is then closely followed by November (147) and September (146). March is the month when the least number (56) plants are passing through this phase. Ripening and dispersal of fruits and seeds are completed by most of these herbaceous weeds of Tea Gardens during the month of January. Only very few species continued the process after this. So, February to May is the lean period for this phenophase when less than 40% of the test plants are performing this function [Table 8.4].

8.2.3.5 Death or Rest

Majority of the annual herbs chracteristically complete their life cycles with no resting period between seed-ripening and germination. They have a clear-cut death-phase and the individuals of a species die after the completion of their fruit ripening and/or seed dispersal. On the other hand, perennials, like wise develop continuously, environment permitting, but most of them undergo a period of rest in which active growth and flowering are ceased even though the environment continues to be favourable. However, like annuals, most of the perennials prefer to enter their rest phase during a period when the environment becomes quite hostile for their normal survival. In this part of the country winter is the most difficult season for normal survival. In this investigation too, it has been observed that almost all the species were turning dry during the middle of December as a result of the onset of severe winter-climatic conditions. Sharp decline in ambient temperature and low soil moisture content prevent plant growth. Death or resting phase of most of the annual species showing peaks during the month of January. However, there are some winter loving plants too. Those germinate during August to November and continue their growth and development during the chilling winter months. Some of these plants include *Ageratina adenophora, Ageratum houstonianum, Argemone mexicana, Blumea lacera, Drymaria villosa, Gamochaeta pensylvanicum, Ixeris polycephala, Phaulopsis imbricata*, etc.

The death process for herbaceous plants generally initiate in October and with the quick fall of ambient temperature more and more species join the sprocess. So, when we find only 39 plants in this phenophase during October, it becomes more than double (80 species) in

November. In December 129 species are in the process and it go on increasing to 170 in January and 178 in February. By this time many species completes this phenophase and that is reflected in the reduced number of 167 species in March.

8.3 CONCLUSION

The phenology of 220 species of angiospermic plants presented in this chapter has exposed some interesting features like:

1. Germination and/or awakening of most of the plants take place during March to June, that is after the adversities of winter months are over
2. Vegetative phage for annuals is quite short and majority of them pass over to flowering phase within 3 – 6 weeks
3. Majority of these plants prefer to remain in flowering phase during monsoon that may be extending from mid-June to late September
4. However a good number of plants initiate flowering quite early during April – May
5. Fruiting period is quite overlapping with the flowering period, though the ripening starts within 4 – 6 weeks after fruit-setting in most of these annuals
6. These plants complete fruit and seed dispersal at the time of fruit-ripening or immediately after it.
7. Most of these plants die or enter the resting period during November to January.

From the scrutinee of the phenophases of the plants under study another important phenomenon become aparant. Due to the contiguity of land and vegetation upward and downward migration of species is a continuous process in this area. That means when tropical plants are gradually being adopted to grow in comparatively cooler environment, temperated plants are also trying to clibing down the hills and getting adopted to grow in comparatively warmer climate. So, now temperate lants like *Stellaria media, Stellaria alsine, Drymaria diandra, Drymaria villosa, Lindenbergia grandiflora* etc are also growing in Terai as short living winter herbs. The phonological behavior of such plants gets modified when they are growing in a place with different environmental conditions.

The Tea Garden weeds are mostly Therophytes or annual herbs and most of them are local species. Even if the plants are killed in using chemical herbicides, seeds from nearby vegetations enter the gardens within a short period and re-establish a rich weed flora.

CHAPTER 9

Reproductive Potential of Weeds

9.1 Introduction

"Weed" is a great problem in any cultivated field and Tea Gardens are not in exception. In fact, most of these plants are coming from the local vegetation. Weeds cause loss of crop production (Thakur 1954) sometimes to the extent of nearly 90% of expectation. These plants create or modify the habitat in such a manner which does not favour the proper growth of crop plants by utilizing space and nutrients for their own growth. Like all other crops, Tea Gardens also greatly affected by weeds and causing qualitative and quantitative loss of the crop (Mustafee 1981, 1998).

Life of the individual plant is limited in duration; it has developed certain mechanisms by which it can reproduce itself in order to continue the perpetuation of the species and also to multiply in number to create a larger population structure. The mechanism of propagation of weeds are numerous and a full understanding of their various aspects is essential if one is to cope with a specific weed problem and to strike at one of the most vital aspects of weed growth – the spread into new habitat (King 1966). The primary survival mechanisms of weeds are seeds, rhizomes, stolons, roots, tubers, buds, bulbs, bulblets etc. Seed production is the method by which weeds are most widely disseminated. Thus seed production, seed dissemination, dormancy and ability of seeds and propagules to resist any detrimental effects of the environment are the major adaptations for survival of weeds.

The crop field weeds adapted to grow in a habitat with frequent disturbances in the soil mainly due to different agronomic practices. Annuals are, therefore, the prevailing life forms among the weeds. These are mainly therophytes, i.e. they reproduce by seeds. Most of the weeds are herbaceous and success of a weed is greatly depending on its ability for viable seed production. To control those weeds, it is therefore very important to know the reproductive potentiality of these weeds, which mainly include the health and number of seeds, seed weight, viability, germination, mode of dispersal etc. The reproductive capacity, which are certainly genetically controlled, are very much species specific and is of considerable ecological interest. Reproductive capacity also has bearing on the dispersal of seeds.

9.1.1 What is a Seed?

A seed has been defined as a "matured integumented ovule" but a slightly more elaborate definition describes the seed as "a reproductive unit formed from a fertilized ovule, consisting of an embryo, food store and protective coat". Weeds produce large number of seeds, which have greater viability than crop seeds. A single individual of a weed species commonly produces a very large number of seeds, tens and hundreds of thousands and these seeds easily escape detection when scattered on or within the soil, making their presence known only as and when they germinate and become seedlings of plants. Seed germination is accomplished if the seed passes through three stages viz. imbibation of water, activation of the metabolic processes leading to mobilization and translocation of nutrient reserves as well as synthesis of new structural and enzymatic constituents and the growth of embryo. Blocking any of these three stages resulted in the dormancy of seeds.

In angiosperms the adaptive significance of seeds is associated with the reproductive efficiency and successful establishment of seedlings in nature (Stebbeins, 1971). Due to the above fact, the resources available to a plant during development are divided between seed production and other ends so that the allocation of seeds is itself partitioned between numbers and size (Harper, 1970). The high seed number and small seed size confers an increased chance for dispersal. Accordingly, some seeds will land in a spot that is favorable for seed germination and seedling establishment. Larger seed numbers enhances the chances that some seeds will find a 'safe site' (Harper, 1965). So, it is necessary to gather some knowledge about the number of seeds produced by a plant and also the seed weight, to understand its reproductive potential. Though many of these seeds are consumed, destroyed or wasted in nature in various ways, but both seed weight and seed number contributes to the establishment of a weed species. The actual number varies with the species and environmental conditions. The number of seeds produced per plant is related apparently to the total weight of the seeds produced and the lighter and smaller the seeds the more seeds are produced per plant. Production of abundant and small seeds is a common adaptation that ensures a high probability of dispersal and re-infestation. Annual and biennial weeds depend on seed production as the means of propagation and survival while perennial weeds are less dependent on this mechanism and the persistence of annual and biennial weeds depend mainly on their ability to re-infest the soil. In cultivated fields annual weeds also arise from seeds lying buried in the soil, a legacy of preceding weed flora in the same piece of land. Cultivated land becomes a reservoir for vast number of viable weed seeds ranging in numbers from a few million to well over 100 million per acre. The first infestation of most perennial species begins largely with seeds. A single plant of an annual weed can produce enough seeds in one season to cover an entire area of one acre with this species in the next year. Many weeds can produce large number of viable seeds even after having cut off soon after flowering. A few weeds may produce seeds through apomixes and weeds like fern and fern allies reproduce by spores. If the production of seeds can be controlled, many species eventually can be eliminated from the crop fields. In widely distributed plant population of the cosmopolitan species, the adaptational features are sometimes correlated with specific environmental characters and the plants occurring under those specific conditions differ in shape, size, colour, growth habit, reproductive behavior and vigor etc. from the other plants of the same species growing in nature (Misra, 1974).

9.2 Previous Works

Weed related literature contains numerous references to seed size, seed shape, seed morphology, seed weight, seed germination, seed output as well as reproductive capacity. Stone (1914) listed the weed seed contents in crop seed samples. Korsmo (1930) provided considerable information on the weight and number of seed per plant. Stevens (1932, 1957) presented valuable data on the seed production of common weeds & economic plants with special reference to the selection of specimens & clearing of seed material according to a definite plan. Hofslen (1954) reported that in extreme cases seed output/hectare might exceed one million. Salisbury (1942) noted that high seed production is the characteristic feature of a species that is associated with the colonisation of weeds in a new habitat, such as woodland clearings, mud of shallow lakes and ponds etc. The average seed output of as many as 32 species studied showed 2,27,000 seeds per plant

Black (1956, 1959) pointed out the influence and variation in seed size. Baker (1972) presented the seed weight in relation to environmental conditions. Harper (1970) presented valuable information on the shapes and sizes of seeds. Holm *et al* (1977) also counted the seeds of many weed species. In India, Tadulingam & Venkatnarayana (1932) described the seed morphology of several South Indian weeds. Datta *et al* (1970) and Ghosh & Datta (1975) described the seed morphology of some species of *Corchorus*. Maity & Banerjee (1976) described the exomorphic seed structure but they did not provide any information of seed out put per plant. But, Datta & Banerjee (1976) recorded the weight of 1000 seeds and total seed number for 140 weeds prevailing in rice fields of West Bengal. They also compared the seed production of three common species with those published by Pammel & King (1910), Ottawa Laboratory (1929), Korsmo (1930) and Stevens (1932, 1957). Datta *et al* (1980) recorded the weight of 1000 seeds as well as total number of seeds produced by a plant for 66 Indian weeds. Paria & Sahoo (1981) reported the reproductive capacity of certain weed species growing in the vicinity of Calcutta. Islam (1996) worked on the shapes, sizes and weights of seeds as well as the average seed output of common weeds of North - East India. Acharya (1998) recorded the weights of 1000 seeds as well as total number of seeds produced by a plant for 130 rice field weeds of Malda district. Laloo (2003) determined the germination percentage, average seed output and finally the reproductive capacity of some common and dominant weed species of Meghalaya.

9.3 The Present Work

There was no other available previous work on the reproductive potential of weeds of Darjiling District. Present dissertation is an attempt to know the vegetation properly, and reproductive potentiality of some common Tea Garden weeds of this region. Present work may add little but important and essential knowledge on the weeds of Darjiling District. This will be also helpful in realizing the influence of habitat factors on the reproductive potential of different weeds, if such a comparison is made in future.

9.4 Results & Discussion:

During the study of "Reproductive Potential" five aspects of angiospermic Tea Garden weeds of the Darjiling District has been taken into consideration. These are (a) number of seeds per fruit, (b) number of seeds per plant, (c) weight of 1000 seeds, (d) germination percentage and (e) Reproductive capacity.

A total of 80 species has been selected from tea gardens of Terai region only and worked out for this purpose. In case of germination, all set-ups were done in laboratory conditions under diffused light for a short period of ten days only. Though, it is true that weed-seeds can remain dormant in soil for months together even under favorable environmental conditions. All the observations have been presented below in Tables 9.1 and 9.2.

Table 9.1: Seed Size Index, Shape Index and Seed Weight of common Tea weeds of Terai and Hills of Darjiling. [In Asteraceae the number of cypsela has been considered as number of seeds]

Sl. No.	Name of plants	Family	Length (mm)	Breadth (mm)	Size index	Shape index	Weight of seeds (g)	
							1 seed	1000 seeds
1	*Acalypha indica*	Euphorbiaceae	1	0.8	0.8	1.25	0.000109	0.109
2	*Acmella paniculata*	Asteraceae	2	1	2	2	0.000133	0.133
3	*Ageratum conyzoides*	Asteraceae	3	0.25	0.75	12	0.000099	0.099
4	*Ageratum houstonianum*	Asteraceae	3.5	0.3	1.05	11.67	0.001964	1.964
5	*Amaranthus spinosus*	Amaranthaceae	1	1	1	1	0.000215	0.215
6	*Amaranthus viridis*	Amaranthaceae	1	1	1	1	0.000261	0.261

7	*Anisomeles indica*	Lamiaceae	2	1.5	3	1.33	0.00138	1.38
8	*Bidens pilosa*	Asteraceae	9	0.5	4.5	18	0.001354	1.354
9	*Blumea lacera*	Asteraceae	2.5	0.2	0.5	12.5	0.000039	0.039
10	*Borreria alata*	Rubiaceae	3	1.5	4.5	2	0.002949	2.949
11	*Borreria ocymoides*	Rubiaceae	1	0.3	0.3	3.33	0.000086	0.086
12	*Cassia occidentalis*	Caesalpinaceae	6	3	18	2	0.015809	15.809
13	*Cassia tora*	Caesalpinaceae	4	3.5	14	1.14	0.020457	20.457
14	*Centella asiatica*	Apiaceae	3	2	6	1.5	0.000575	0.575
15	*Chromolaena odoratum*	Asteraceae	10	0.5	5	20	0.000283	0.283
16	*Chrysopogon aciculatus*	Poaceae	2.5	0.2	0.5	12.5	0.000572	0.572
17	*Cleome rutidosperma*	Capparaceae	1.9	1.5	2.85	1.27	0.000907	0.907
18	*Clerodendrum viscosum*	Verbenaceae	7	6	42	1.17	0.047199	47.199
19	*Conyza canadensis*	Asteraceae	1.5	0.25	0.38	6	0.00004	0.04
20	*Crassocephalum crepidioides*	Asteraceae	11	6	66	1.83	0.000303	0.303
21	*Crotalaria pallida*	Fabaceae s.s.	3	2	6	1.5	0.010762	10.762
22	*Croton bonplandianus*	Euphorbiaceae	4.5	2.1	9.45	2.14	0.007083	7.083
23	*Cyanthillium cinereum*	Asteraceae	6	0.5	3	12	0.00014	0.14
24	*Cynoglossum lanceolatum*	Boraginaceae	2	2	4	1	0.001059	1.059
25	*Cyperus compressus*	Cyperaceae	1	0.5	0.5	2	0.000126	0.126
26	*Cyperus cyperoides*	Cyperaceae	1	1	1	1	0.00012	0.12
27	*Cyperus tenuispica*	Cyperaceae	0.4	0.3	0.12	1.33	0.000048	0.048
28	*Drymaria diandra*	Caryophyllaceae	0.9	0.6	0.54	1.5	0.000203	0.203
29	*Eclipta prostrata*	Asteraceae	2	1	2	2	0.000288	0.288
30	*Elephantopus scaber*	Asteraceae	4.4	0.6	2.64	7.33	0.000587	0.587
31	*Emilia sonchifolia*	Asteraceae	8.5	0.5	4.25	17	0.000304	0.304
32	*Eragrostis tenella*	Poaceae	0.5	0.3	0.15	1.67	0.00002	0.02
33	*Euphorbia hirta*	Euphorbiaceae	0.5	0.5	0.25	1	0.000057	0.057
34	*Euphorbia orbiculata*	Euphorbiaceae	1	0.5	0.5	2	0.000332	0.332
35	*Fimbristylis dichotoma*	Cyperaceae	0.5	0.5	0.25	1	0.000049	0.049
36	*Gamochaeta pensylvanicum*	Asteraceae	0.4	0.1	0.04	4	0.000007	0.007
37	*Glinus lotoides*	Molluginaceae	0.2	0.1	0.02	2	0.000007	0.007
38	*Glinus oppositifolius*	Molluginaceae	0.2	0.2	0.04	1	0.000022	0.022
39	*Heliotropium indicum*	Boraginaceae	1.5	1	1.5	1.5	0.001682	1.682
40	*Hydrocotyle sibthorpioides*	Apiaceae	1	0.8	0.8	1.25	0.000146	0.146
41	*Hypericum japonicum*	Hypericaceae	0.4	0.1	0.04	4	0.000006	0.006
42	*Hyptis suaveolens*	Lamiaceae	3.1	2.2	6.82	1.41	0.004013	4.013
43	*Ipomoea quamoclit*	Convolvulaceae	6	3	18	2	0.0124	12.4
44	*Kyllinga nemoralis*	Cyperaceae	1.25	0.75	0.94	1.67	0.000147	0.147
45	*Leucas indica*	Lamiaceae	3	1	3	3	0.001218	1.218
46	*Lindernia crustacea*	Scrophulariaceae	0.2	0.2	0.04	1	0.00025	0.25
47	*Ludwigia perennis*	Onagraceae	0.5	0.5	0.25	1	0.00002	0.02
48	*Mazus pumilus*	Scrophulariaceae	0.3	0.2	0.06	1.5	0.00008	0.08
49	*Melastoma malabathricum*	Melastomataceae	0.5	0.5	0.25	1	0.000004	0.004
50	*Melochia corchorifolia*	Sterculiaceae	2.3	1.8	4.14	1.28	0.004443	4.443
51	*Mitracarpus verticillatus*	Rubiaceae	0.9	0.5	0.45	1.8	0.000134	0.134

52	*Oldenlandia corymbosa*	Rubiaceae	0.25	0.25	0.06	1	0.000013	0.013
53	*Oldenlandia diffusa*	Rubiaceae	0.25	0.25	0.06	1	0.00002	0.02
54	*Osbeckia nepalensis*	Melastomataceae	0.75	0.5	0.375	1.5	0.000025	0.025
55	*Oxalis corniculata*	Oxalidaceae	1.2	1	1.2	1.2	0.000608	0.608
56	*Paspalum scrobiculatum*	Poaceae	2	1.5	3	1.33	0.000778	0.778
57	*Peperomia pellucida*	Piperaceae	0.5	0.5	0.25	1	0.000114	0.114
58	*Persicaria orientalis*	Polygonaceae	2	2	4	1	0.002875	2.875
59	*Phaulopsis imbricata*	Acanthaceae	2	1.9	3.8	1.05	0.000577	0.577
60	*Phyllanthus urinaria*	Euphorbiaceae	1.25	0.75	0.94	1.67	0.000296	0.296
61	*Plantago erosa*	Plantaginaceae	1	0.7	0.7	1.43	0.000132	0.132
62	*Polycarpon prostratum*	Caryophyllaceae	0.5	0.5	0.25	1	0.000032	0.032
63	*Polygonum plebeium*	Polygonaceae	1.2	1	1.2	1.2	0.000392	0.392
64	*Pouzolzia zeylanica*	Urticaceae	1.2	0.8	0.96	1.5	0.000264	0.264
65	*Pseudognaphalium affine*	Asteraceae	0.3	0.1	0.03	3	0.0028	2.8
66	*Pupalia lappacea*	Amaranthaceae	2.5	1	2.5	2.5	0.002349	2.349
67	*Richardia scabra*	Rubiaceae	2.5	1.8	4.5	1.39	0.001109	1.109
68	*Scoparia dulcis*	Scrophulariaceae	0.2	0.25	0.05	0.8	0.00001	0.01
69	*Setaria pumila*	Poaceae	1	0.5	0.5	2	0.000148	0.148
70	*Sida acuta*	Malvaceae	2	1.9	3.8	1.05	0.002144	2.144
71	*Solanum aculeatissimum*	Solanaceae	2.9	2	5.8	1.45	0.002983	2.983
72	*Solanum nigrum*	Solanaceae	1.8	1	1.8	1.8	0.00056	0.56
73	*Solanum torvum*	Solanaceae	3	2	6	1.5	0.00167	1.67
74	*Stellaria media*	Caryophyllaceae	1	0.8	0.8	1.25	0.000205	0.205
75	*Synedrella nodiflora*	Asteraceae	7	1	7	7	0.000747	0.747
76	*Tephrosia candida*	Fabaceae s.s.	5	4.2	21	1.19	0.00942	9.42
77	*Tridax procumbens*	Asteraceae	7	1	7	7	0.000683	0.683
78	*Triumfetta rhomboidea*	Tiliaceae	4	4	16	1	0.00507	5.07
79	*Urena lobata*	Malvaceae	3.5	2.5	8.75	1.4	0.01294	12.94
80	*Youngia japonica*	Asteraceae	6	0.5	3	12	0.000083	0.083

Table 9.2: Seed Out-put of some common Tea weeds of Terai and Hills of Darjiling. [In Asteraceae the number of cypsela has been considered as number of seeds].

Sl. No.	Name of plants	Seed Output			Reproductive capacity			
		Fruit or capitula / plant	Seeds / Fruit	Seed Output	Germination %	Viable %	Non-viable %	RC Value
1	*Acalypha indica*	177	3	531	*	*	*	*
2	*Acmella paniculata*	124	166	20584	7	7	93	1440.88
3	*Ageratum conyzoides*	155	97	15035	7	7	93	1052.45
4	*Ageratum houstonianum*	380	89	33820	24	24	76	8116.8
5	*Amaranthus spinosus*	2580	1	2580	6	6	94	154.8
6	*Amaranthus viridis*	1841	1	1841	1	1	99	18.41
7	*Anisomeles indica*	119	4	476	*	*	*	*

8	*Bidens pilosa*	85	53	4505	32	32	68	1441.6
9	*Blumea lacera*	374	233	87142	*	*	*	*
10	*Borreria alata*	339	2	678	29	29	71	196.62
11	*Borreria ocymoides*	375	2	750	*	*	*	*
12	*Cassia occidentalis*	63	38	2394	70	70	30	1675.8
13	*Cassia tora*	214	50	10700	93	93	7	9951
14	*Centella asiatica*	39	2	78	*	*	*	*
15	*Chromolaena odoratum*	133	37	4921	13	13	87	639.73
16	*Chrysopogon aciculatus*	76	1	76	80	80	20	60.8
17	*Cleome rutidosperma*	43	51	2193	1	1	99	21.93
18	*Clerodendrum viscosum*	84	3	252	*	*	*	*
19	*Conyza canadensis*	7378	120	885360	8	8	92	70828.8
20	*Crassocephalum crepidioides*	63	170	10710	16	16	84	1713.6
21	*Crotalaria pallida*	278	47	13066	30	30	70	3919.8
22	*Croton bonplandianus*	875	3	2625	*	*	*	*
23	*Cyanthillium cinereum*	330	24	7920	59	59	41	4672.8
24	*Cynoglossum lanceolatum*	3523	4	14092	*	*	*	*
25	*Cyperus compressus*	10388	1	10388	*	*	*	*
26	*Cyperus cyperoides*	13566	1	13566	*	*	*	*
27	*Cyperus tenuispica*	149	1	149	*	*	*	*
28	*Drymaria diandra*	349	6	2094	12	12	88	251.28
29	*Eclipta prostrata*	42	99	4158	34	34	66	1413.72
30	*Elephantopus scaber*	5	68	340	12	12	88	40.8
31	*Emilia sonchifolia*	172	43	7396	59	59	41	4363.64
32	*Eragrostis tenella*	2044	1	2044	*	*	*	*
33	*Euphorbia hirta*	283	3	849	1	1	99	8.49
34	*Euphorbia orbiculata*	231	3	693	*	*	*	*
35	*Fimbristylis dichotoma*	232	1	232	*	*	*	*
36	*Gamochaeta pensylvanicum*	68	72	4896	8	8	92	391.68
37	*Glinus lotoides*	311	58	18038	*	*	*	*
38	*Glinus oppositifolius*	47	77	3619	*	*	*	*
39	*Heliotropium indicum*	836	4	3344	*	*	*	*
40	*Hydrocotyle sibthorpioides*	2369	2	4738	*	*	*	*
41	*Hypericum japonicum*	10	221	2210	*	*	*	*
42	*Hyptis suaveolens*	1145	2	2290	98	98	2	2244.2
43	*Ipomoea quamoclit*	666	4	2664	12	12	88	319.68
44	*Kyllinga nemoralis*	4864	1	4864	5	5	95	243.2
45	*Leucas indica*	1025	4	4100	*	*	*	*
46	*Lindernia crustacea*	61	130	7930	*	*	*	*
47	*Ludwigia perennis*	288	1520	437760	*	*	*	*
48	*Mazus pumilus*	55	217	11935	*	*	*	*
49	*Melastoma malabathricum*	102	997	101694	14	14	86	14237.16
50	*Melochia corchorifolia*	34	5	170	80	80	20	136

51	*Mitracarpus verticillatus*	2439	2	4878	3	3	97	146.34
52	*Oldenlandia corymbosa*	134	59	7906	3	3	97	237.18
53	*Oldenlandia diffusa*	82	76	6232	3	3	97	186.96
54	*Osbeckia nepalensis*	244	580	141520	72	72	28	101894.4
55	*Oxalis corniculata*	31	43	1333	*	*	*	*
56	*Paspalum scrobiculatum*	710	1	710	1	1	99	7.1
57	*Peperomia pellucida*	2600	1	2600	*	*	*	*
58	*Persicaria orientalis*	4557	1	4557	1	1	99	45.57
59	*Phaulopsis imbricata*	233	4	932	64	64	36	596.48
60	*Phyllanthus urinaria*	1720	6	10320	*	*	*	*
61	*Plantago erosa*	1511	17	25687	1	1	99	256.87
62	*Polycarpon prostratum*	101	13	1313	*	*	*	*
63	*Polygonum plebeium*	1150	1	1150	*	*	*	*
64	*Pouzolzia zeylanica*	425	1	425	42	42	58	178.5
65	*Pseudognaphalium affine*	121	105	12705	7	7	93	889.35
66	*Pupalia lappacea*	13192	1	13192	97	97	3	12796.24
67	*Richardia scabra*	350	3	1050	*	*	*	*
68	*Scoparia dulcis*	658	223	146734	8	8	92	11738.72
69	*Setaria pumila*	141	1	141	48	48	52	67.68
70	*Sida acuta*	113	4	452	8	8	92	36.16
71	*Solanum aculeatissimum*	34	337	11458	*	*	*	*
72	*Solanum nigrum*	290	54	15660	4	4	96	626.4
73	*Solanum torvum*	7	225	1575	*	*	*	*
74	*Stellaria media*	267	18	4806	8	8	92	384.48
75	*Synedrella nodiflora*	185	18	3330	50	50	50	1665
76	*Tephrosia candida*	289	10	2890	62	62	38	1791.8
77	*Tridax procumbens*	20	44	880	36	36	64	316.8
78	*Triumfetta rhomboidea*	127	1	127	8	8	92	10.16
79	*Urena lobata*	38	5	190	20	20	80	38
80	*Youngia japonica*	156	23	3588	8	8	92	287.04

9.4.1 Species-wise Observation

As Dicotylodonous plants are dominating in the weed flora, a larger number of 71 species of this group has been tested with only nine species of monocots. The findings on fruit and seed output, germination percentage and reproductive capacity of the selected weed species have been summarized in Tables 9.1 & 9.2 and has been described below in detail:

I. DICOTS:

***Acalypha indica* L.:** The average number of fruits produced by an individual of this species is 177, and 3 seeds in one fruit. So the average seed-output is 531. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Acmella paniculata* (DC.) Jansen:** The average number of fruits produced by an individual of this species is 124, and 166 seeds in one fruit. This brought the average seed-output of the species to 20584. In the absence of light, germination started from the 5th day and made a steady progress up to 10th day. On the 10th day, 7% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 1440.88 per plant.

***Ageratum conyzoides* L.:** The average number of capitula produced by an individual of this species is 155, and 97 cypsela in one capitulum. This brought the average seed-output of the species to 15035. In the absence of light, germination started from the 5th day and made a steady progress up to 10th day. On the 10th day, 7% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 1052.45 per plant.

***Ageratum houstonianum* Milller:** The average number of capitula produced by an individual of this species is 380, and 89 cypsela in one capitulum. This brought the average seed-output of the species to 33820. In the absence of light, germination started from the 4th day and made a steady progress up to 10th day. On the 10th day, 24% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 8116.8 per plant.

***Amaranthus spinosus* L.:** The average number of fruits produced by an individual of this species is 2580, and 1 seed in one fruit. This brought the average seed-output of the species to 2580. In the absence of light, germination started from the 3rd day and made a steady progress up to 10th day. On the 10th day, 6% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 154.8 per plant.

***Amaranthus viridis* L.:** The average number of fruits produced by an individual of this species is 1841, and 1 seed in one fruit. This brought the average seed-output of the species to1841. In the absence of light, germination started from the 10th day and made a steady progress up to 10th day. On the 10th day, 1% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 18.41 per plant.

***Anisomeles indica* (L.) O.Kuntze:** The average number of fruits produced by an individual of this species is 119, and 4 seeds in one fruit. This brought the average seed-output of the species to 476. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Bidens pilosa* L.:** The average number of capitula produced by an individual of this species is 85, and 53 cypsela in one capitulum. This brought the average seed-output of the species to 4505. In the absence of light, germination started from the 3rd day and made a steady progress up to 10th day. On the 10th day, 32% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 1441.6. per plant.

***Blumea lacera* (Burm.f.) DC.:** The average number of capitula produced by an individual of this species is 374, and 233 cypsela in one capitulum. This brought the average seed-output of the species to 87142. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Borreria alata* (Aubl.) DC.:** The average number of fruits produced by an individual of this species is 339, and 2 seeds in one fruit. This brought the average seed-output of the species to 678. In the absence of light, germination started from the 4th day and made a steady progress up to 10th day. On the 10th day, 29% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 196.62 per plant.

***Borreria ocymoides* (Burm.f.) DC.**: The average number of fruits produced by an individual of this species is 375, and 2 seeds in one fruit. This brought the average seed-output of the species to 750. In the absence of light, no germination was observed. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Cassia occidentalis* L.**: The average number of fruits produced by an individual of this species is 63, and 38 seeds in one fruit. This brought the average seed-output of the species to 2394. In the absence of light, germination started from the 3rd day and made a steady progress up to 10th day. On the 10th day, 70% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 1675.8 per plant.

***Cassia tora* L.**: The average number of fruits produced by an individual of this species is 214, and 50 seeds in one fruit. This brought the average seed-output of the species to10700. In the absence of light, germination started from the 2nd day and made a steady progress up to 10th day. On the 10th day, 93% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 9951 per plant.

***Centella asiatica* (L.) Urban:** The average number of fruits produced by an individual of this species is 39, and 2 seeds in one fruit. This brought the average seed-output of the species to 78. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Chromolaena odoratum* (L.) King& Robinson:** The average number of capitula produced by an individual of this species is 133, and 37 cypsela in one capitulum. This brought the average seed-output of the species to 4921. In the absence of light, germination started from the 5th day and made a steady progress up to 10th day. On the 10th day, 13% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 639.73 per plant.

***Cleome rutidosperma* DC.:** The average number of fruits produced by an individual of this species is 43, and 51 seeds in one fruit. This brought the average seed-output of the species to 2193. In the absence of light, germination started from the 7th day and made a steady progress up to 10th day. On the 10th day, 1% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 21.93 per plant.

***Clerodendrum viscosum* Ventenat:** The average number of fruits produced by an individual of this species is 84, and 3 seeds in one fruit. This brought the average seed-output of the species to 252. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Conyza canadensis* (L.) Cronquist:** The average number of capitula produced by an individual of this species is 7378, and 120 seeds in one fruit. This brought the average seed-output of the species to 885360. In the absence of light, germination started from the 4th day and made a steady progress up to 10th day. On the 10th day, 8% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 70828.8 per plant.

***Crassocephalum crepidioides* (Bentham) S. Moore:** The average number of capitula produced by an individual of this species is 63, and 170 cypsela in one capitulum. This brought the average seed-output of the species to 10710. In the absence of light, germination started from the 5th day and made a steady progress up to 10th day. On the 10th day, 16 % germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 1713.6 per plant.

***Crotalaria pallida* Aiton:** The average number of fruits produced by an individual of this species is 278, and 47 seeds in one fruit. This brought the average seed-output of the species to13066. In the absence of light, germination started from the 3rd day and made a steady progress up to 10^{th} day. On the 10^{th} day, 30% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 3919.8 per plant.

***Croton bonplandianus* Baillon:** The average number of fruits produced by an individual of this species is 875, and 3 seeds in one fruit. This brought the average seed-output of the species to 2625. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Cyanthillium cinereum* (L.) Robinson:** The average number of capitula produced by an individual of this species is 330, and 24 cypsela in one capitulum. This brought the average seed-output of the species to 7920. In the absence of light, germination started from the 4^{th} day and made a steady progress up to 10^{th} day. On the 10^{th} day, 59% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 4672.8 per plant.

***Cynoglossum lanceolatum* Forsskal:** The average number of fruits produced by an individual of this species is 3523, and 4 seeds in one fruit.. This brought the average seed-output of the species to 14092. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Drymaria diandra* (Blume) Duke:** The average number of fruits produced by an individual of this species is 349, and 6 seeds in one fruit. This brought the average seed-output of the species to 2094. In the absence of light, germination started from the 6^{th} day and made a steady progress up to 10^{th} day. On the 10^{th} day, 12% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 251.28 per plant.

***Eclipta prostrata* (L.) L.:** The average number of capitula produced by an individual of this species is 42, and 99 cypsela in one capitulum. This brought the average seed-output of the species to 4158. In the absence of light, germination started from the 6th day and made a steady progress up to 10th day. On the 10th day, 34% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 1413.72per plant.

***Elephantopus scaber* L.**: The average number of capitula produced by an individual of this species is 5, while the number of seeds in one fruit was 68. This brought the average seed-output of the species to 340. In the absence of light, germination started from the 3rd day and made a steady progress up to 10th day. On the 10th day, 12% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 40.8 per plant.

***Emilia sonchifolia* (L.) DC.**: The average number of capitula produced by an individual of this species is 172, and 43 cypsela in one capitulum. This brought the average seed-output of the species to 7396. In the absence of light, germination started from the 5th day and made a steady progress up to 10th day. On the 10th day, 59% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 4363.64 per plant.

***Eragrostis tenella* (L.) P. Beauvois ex Roemer & Schultes.**: The average number of fruits produced by an individual of this species is 2044, and 1 seed in one fruit This brought the average seed-output of the species to 2044. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Euphorbia hirta* L.**: The average number of fruits produced by an individual of this species is 283, and 3 seeds in one fruit.. This brought the average seed-output of the species to 849. In the absence of light, germination started from the 4th day and made a steady progress up to 10th day. On the 10th day, 1% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 8.49 per plant.

***Euphorbia orbiculata* H. B. K.:** The average number of fruits produced by an individual of this species is 231, and 3 seeds in one fruit.. This brought the average seed-output of the species to 693. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Gamochaeta pensylvanicum* (Willdenow) Cabrera:** The average number of capitula produced by an individual of this species is 68, and 72 seeds in one fruit. This brought the average seed-output of the species to 4896. In the absence of light, germination started from the 5th day and made a steady progress up to 10th day. On the 10th day, 8% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 391.68 per plant.

***Glinus lotoides* L.:** The average number of fruits produced by an individual of this species is 311, and 58 seeds in one fruit. This brought the average seed-output of the species to 18038. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Glinus oppositifolius* (L.) A. DC.:** The average number of fruits produced by an individual of this species is 47, and 77 seeds in one fruit. This brought the average seed-output of the species to 3619. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Heliotropium indicum* L.:** The average number of fruits produced by an individual of this species is 836, and 4 seeds in one fruit. This brought the average seed-output of the species to 3344. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Hydrocotyle sibthorpioides* Lam.:** The average number of fruits produced by an individual of this species is 2369, and 2 seeds in one fruit. This brought the average seed-output of the species to 4738. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Hypericum japonicum* Murray:** The average number of fruits produced by an individual of this species is 10, and 221 seeds in one fruit. This brought the average seed-output of the species to 2210. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Hyptis suaveolens* (L.) Poiteau.:** The average number of fruits produced by an individual of this species is 1145, and 2 seeds in one fruit. This brought the average seed-output of the species to 2290. In the absence of light, germination started from the 2nd day and made a steady progress up to 10th day. On the 10th day, 98% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 2244.2 per plant.

***Ipomoea quamoclit* L.:** The average number of fruits produced by an individual of this species is 666, and 4 seeds in one fruit. This brought the average seed-output of the species to 2664. In the absence of light, germination started from the 1st day and made a steady progress up to 10th day. On the 10th day, 12% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 319.68 per plant.

***Leucas indica* (L.) R. Br. ex Vatke:** The average number of fruits produced by an individual of this species is 1025, and 4 seeds in one fruit. This brought the average seed-output of the species to 4100. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Lindernia crustacea* (L.) Mueller:** The average number of fruits produced by an individual of this species is 61, and 130 seeds in one fruit. This brought the average seed-output of the species to 7930. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Ludwigia perennis* L.:** The average number of fruits produced by an individual of this species is 288, and 1520 seeds in one fruit. This brought the average seed-output of the species to 437760. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

Mazus pumilus **(Burman f.) van Steenis:** The average number of fruits produced by an individual of this species is 55, and 217 seeds in one fruit. This brought the average seed-output of the species to 11935. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

Melastoma malabathricum **L.:** The average number of fruits produced by an individual of this species is 102, and 997 seeds in one fruit. This brought the average seed-output of the species to 101694. In the absence of light, germination started from the 5^{th} day and made a steady progress up to 10^{th} day. On the 10^{th} day, 14% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, 14237.16 was per plant.

Melochia corchorifolia **L.:** The average number of fruits produced by an individual of this species is 34, and 5 seeds in one fruit. This brought the average seed-output of the species to 170. In the absence of light, germination started from the 7^{th} day and made a steady progress up to 10^{th} day. On the 10^{th} day, 80% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 136 per plant.

Mitracarpus verticillatus **(Schum. et Thonn.) Vatke:** The average number of fruits produced by an individual of this species is 2439, and 2 seeds in one fruit. This brought the average seed-output of the species to 4878. In the absence of light, germination started from the 9^{th} day and made a steady progress up to 10^{th} day. On the 10^{th} day, 3% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 146.34 per plant.

Oldenlandia corymbosa **L.:** The average number of fruits produced by an individual of this species is 134, and 59 seeds in one fruit. This brought the average seed-output of the species to 7906. In the absence of light, germination started from the 2nd day and made a steady progress up to 10th day. On the 10th day, 3% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 237.18 per plant.

Oldenlandia diffusa **(Willdenow) Roxburgh:** The average number of fruits produced by an individual of this species is 82, and 76 seeds in one fruit. This brought the average seed-output of the species to 6232. In the absence of light, germination started from the 2nd day and made a steady progress up to 10th day. On the 10th day, 3% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 186.96 per plant.

Osbeckia nepalensis **Hooker:** The average number of fruits produced by an individual of this species is 244, and 580 seeds in one fruit. This brought the average seed-output of the species to 141520. In the absence of light, germination started from the 2nd day and made a steady progress up to 10th day. On the 10th day, 72% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 101894.4 per plant.

Oxalis corniculata **L.:** The average number of fruits produced by an individual of this species is 31, and 43 seeds in one fruit. This brought the average seed-output of the species to 1333. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

Peperomia pellucida **(L.) Kunth:** The average number of fruits produced by an individual of this species is 2600, and 1 seed in one fruit. This brought the average seed-output of the species to 2600. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

Persicaria orientalis **(L.) Spach:** The average number of fruits produced by an individual of this species is 4557, and 1 seed in one fruit. This brought the average seed-output of the species to 4557. In the absence of light, germination started from the 5^{th} day and made a steady progress up to 10^{th} day. On the 10^{th} day, 1% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 45.57 per plant.

Phaulopsis imbricata **(Forsskal) Sweet:** The average number of fruits produced by an individual of this species is 233, and 4 seeds in one fruit. This brought the average seed-output of the species to 932. In the absence of light, germination started from the 3^{rd} day and made a steady progress up to 10^{th} day. On the 10^{th} day, 64% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 596.48 per plant.

Phyllanthus urinaria **L.:** The average number of fruits produced by an individual of this species is 1720 and 6 seeds in one fruit. This brought the average seed-output of the species to 10320. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

Plantago erosa **Wallich:** The average number of fruits produced by an individual of this species is 1511 and 17 seeds in one fruit. This brought the average seed-output of the species to 25687. In the absence of light, germination started from the 8^{th} day and made a steady progress up to 10^{th} day. On the 10^{th} day, 1% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 256.87per plant.

Polycarpon prostratum **(Forsskal) Ascherson:** The average number of fruits produced by an individual of this species is 101 and 13 seeds in one fruit. This brought the average seed-output of the species to 1313. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

Polygonum plebeium R. Brown: The average number of fruits produced by an individual of this species is 1150 and 1 seed in one fruit. This brought the average seed-output of the species to 1150. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

Pouzolzia zeylanica (L.) Bennett: The average number of fruits produced by an individual of this species is 425 and 1 seed in one fruit. This brought the average seed-output of the species to 425. In the absence of light, germination started from the 5th day and made a steady progress up to 10th day. On the 10th day, 42% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 178.5 per plant.

Pseudognaphalium affine (D. Don) Anderberg: The average number of capitula produced by an individual of this species is 121 and 105 seeds in one fruit. This brought the average seed-output of the species to 12705. In the absence of light, germination started from the 5th day and made a steady progress up to 10th day. On the 10th day, 7% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 889.35 per plant.

Pupalia lappacea (L.) Juss.: The average number of fruits produced by an individual of this species is 13192 and 1 seed in one fruit. This brought the average seed-output of the species to 13192. In the absence of light, germination started from the 2nd day and made a steady progress up to 10th day. On the 10th day, 97% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 12796.24 per plant.

Richardia scabra L.: The average number of fruits produced by an individual of this species is 350 and 3 seeds in one fruit. This brought the average seed-output of the species to 1050. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Scoparia dulcis* L.:** The average number of fruits produced by an individual of this species is 658 and 223 seeds in one fruit. This brought the average seed-output of the species to 146734. In the absence of light, germination started from the 4th day and made a steady progress up to 10th day. On the 10th day, 8% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 11738.72 per plant.

***Sida acuta* Burm.f.:** The average number of fruits produced by an individual of this species is 113 and 4 seeds in one fruit. This brought the average seed-output of the species to 452. In the absence of light, germination started from the 2nd day and made a steady progress up to 10th day. On the 10th day, 8% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 36.16 per plant.

***Solanum aculeatissimum* Jacquin:** The average number of fruits produced by an individual of this species is 34 and 337 seeds in one fruit. This brought the average seed-output of the species to 11458. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Solanum nigrum* L.:** The average number of fruits produced by an individual of this species is 290 and 54 seeds in one fruit. This brought the average seed-output of the species to 15660. In the absence of light, germination started from the 3rd day and made a steady progress up to 10th day. On the 10th day, 4% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 626.4 per plant.

***Solanum torvum* Swartz:** The average number of fruits produced by an individual of this species is 7 and 224 seeds in one fruit. This brought the average seed-output of the species to 1575. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Stellaria media* (L.) Villars.**: The average number of fruits produced by an individual of this species is 267 and 18 seeds in one fruit. This brought the average seed-output of the species to 4806. In the absence of light, germination started from the 4^{th} day and made a steady progress up to 10^{th} day. On the 10^{th} day, 8% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 384.48 per plant.

***Synedrella nodiflora* (L.) Gaertner.**: The average number of capitula produced by an individual of this species is 185 and 18 cypsela in one capitulum This brought the average seed-output of the species to 3330. In the absence of light, germination started from the 2^{nd} day and made a steady progress up to 10^{th} day. On the 10^{th} day, 50% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 1665 per plant.

***Tephrosia candida* DC.**: The average number of fruits produced by an individual of this species is 289 and 10 seeds in one fruit. This brought the average seed-output of the species to 2890. In the absence of light, germination started from the 2^{nd} day and made a steady progress in rapid rate up to 10^{th} day. On the 10^{th} day, 62% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 1791.8 per plant.

***Tridax procumbens* L.**: The average number of capitula produced by an individual of this species is 20 and 44 seeds in one fruit. This brought the average seed-output of the species to 880. In the absence of light, germination started from the 5^{th} day and made a steady progress up to 10^{th} day. On the 10^{th} day, 36% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 316.8 per plant.

***Triumfetta rhomboidea* Jacq.**: The average number of fruits produced by an individual of this species is 127 and 1 seed in one fruit. This brought the average seed-output of the species to 127. In the absence of light, germination started from the 1^{st} day and made a steady progress in rapid rate up to 10th day. On the 10th day, 8% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 10.16 per plant.

***Urena lobata* L.:** The average number of fruits produced by an individual of this species is 38 and 5 seeds in one fruit. This brought the average seed-output of the species to 190. In the absence of light, germination started from the 2nd day and made a steady progress in rapid rate up to 10th day. On the 10th day, 20% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 38 per plant.

***Youngia japonica* (L.) DC.:** The average number of capitula produced by an individual of this species is 156 and 23 cypsela in one capitulum. This brought the average seed-output of the species to 3588. In the absence of light, germination started from the 4th day and made a steady progress up to 10th day. On the 10th day, 8% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 287.04 per plant.

II. MONOCOTS:

***Chrysopogon aciculatus* (Retzius) Trinius:** The average number of fruits produced by an individual of this species is 76, and 1 seed in one fruit. This brought the average seed-output of the species to 76. In the absence of light, germination started from the 3rd day and made a steady progress up to 10th day. On the 10th day, 80% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 60.8 per plant.

***Cyperus compressus* L.:** The average number of fruits produced by an individual of this species is 10388, and 1 seed in one fruit. This brought the average seed-output of the species to10388. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.


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PLATE XII: Seeds or propagules of some Tea Garden weeds:

1. *Borreria alata*
2. *Mitracarpus verticillatus*
3. *Oxalis corniculata*
4. *Hyptis suaveolens*
5. *Synedrella nodiflora*
6. *Chromolaena odoratum*
7. *Sida acuta*
8. *Bidens pilosa*
9. *Cassia occidentalis*
10. *Cleome rutidosperma*
11. *Vernonia cinerea*
12. *Ageratum conyzoides*


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PLATE XIII: Seeds or propagules of some Tea Garden weeds:

13. *Leucas indica*
14. *Eclipta prostrate*
15. *Croton bonplandianum*
16. *Ageratum houstonianum*
17. *Cynoglossum lanceolatum*
18. *Elephantopus scaber*
19. *Heliotropium indicum*
20. *Blumea lacera*
21. *Phaulopsis imbricata*
22. *Solanum myriacanthum*
23. *Tridax procumbens*
24. *Polygonum plebeium*

***Cyperus cyperoides* (Retzius) O.Kuntze:** The average number of fruits produced by an individual of this species is 13566, and 1 seed in one fruit. This brought the average seed-output of the species to13566. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Cyperus tenuispica* Steudel:** The average number of fruits produced by an individual of this species is 149, and 1 seed in one fruit. This brought the average seed-output of the species to 149. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Fimbristylis dichotoma* (L.) Vahl:** The average number of fruits produced by an individual of this species is 232, and 1 seed in one fruit. This brought the average seed-output of the species to 232. No germination was observed under *in vitro* condition. Therefore, it was not possible to calculate the Reproductive Capacity for this species.

***Kyllinga nemoralis* (J. R. & G. Forster) Dandy ex Hutchinson & Dalziel:** The average number of fruits produced by an individual of this species is 4864, and 1 seed in one fruit. This brought the average seed-output of the species to 4864. In the absence of light, germination started from the 10^{th} day and made a steady progress up to 10^{th} day. On the 10^{th} day, 5% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 243.2 per plant.

***Paspalum scrobiculatum* L.:** The average number of fruits produced by an individual of this species is 710, and 1 seed in one fruit. This brought the average seed-output of the species to 710. In the absence of light, germination started from the 8^{th} day and made a steady progress up to 10^{th} day. On the 10^{th} day, 1% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 7.1 per plant.

***Setaria pumila* (Poiret) Roemer & Schultes:** The average number of fruits produced by an individual of this species is 141 and 1 seed in one fruit. This brought the average seed-output of the species to 141. In the absence of light, germination started from the 5th day and made a steady progress up to 10th day. On the 10th day, 48% germination was observed. The reproductive capacity, after taking into account the germination percentage and average seed-output of the species, was 67.68 per plant.

9.4.2 Estimation of Seeds per Fruit

After determining the average number of seeds a fruit produces by the 71 species of dicotyledonous plants, it is found that the highest number of 1520 seeds is produced by *Ludwigia perennis* (Onagraceae). It is then followed by *Melastoma malabathricum* (997), *Osbeckia nepalensis* (580) *Solanum aculeatissimum* (337), *Solanum torvum* (225), *Scoparia dulcis* (223), *Hypericum japonicum* (221), *Mazus pumilus* (217), *Lindernia crustacea* (130), *Glinus oppositifolius* (77) etc. Among the first ten dicotyledonous weedy species with higher number of seeds per fruit, highest seed producer belongs to Onagraceae, two from Melastomataceae and Solanaceae; three belongs to Scrophulariaceae and one each of Hypericaceae and Molluginaceae. There have been 46 (64.79%) species of weeds, which bear more than 1 seeds per fruit, and only 25 (35.21%) species produce 1-seeded fruits. This last category of plants is belonging to the families Amaranthaceae, Asteraceae, Piperaceae, Polygonaceae, Tiliaceae and Urticaceae.

On the other hand, all the monocotyledonous weeds under study produce only 1 seed per fruit. These plants are belonging to Poaceae and Cyperaceae only.

9.4.3 Seeds per Plant

In case of dicotyledonous weeds, highest number of seeds per plant has been recorded in *Conyza canadensis* (885360) of Asteraceae. It is followed by *Ludwigia perennis* (437760), *Scoparia dulcis* (146734), *Osbeckia nepalensis* (141520), *Melastoma malabathricum* (101694), *Blumea lacera* (87142), *Ageratum houstonianum* (33820), *Plantago erosa* (25687), *Acmella paniculata* (20584), *Glinus lotoides* (18038) etc.

Among the first ten dicotyledonous weed species of higher number of seeds per plant, four belongs to Asteraceae, two of Melastomataceae, one each of Onagraceae, Scrophulariaceae, Plantaginaceae and Molluginaceae. Lowest number of seed produced per plant has been observed in *Centella asiatica* (78) under Apiaceae and other plant which contain less than 300 seeds per plant include *Triumfetta rhomboidea* (127), *Melochia corchorifolia* (170), *Urena lobata* (190), *Clerodendrum viscosum* (252) etc.

In monocotyledonous weeds highest number of seeds per plant has observed in *Cyperus cyperoides* (13566) followed by *Cyperus compressus* (10388), *Kyllinga nemoralis* (4864), *Eragrostis tenella* (2044), *Paspalum scrobiculatum* (710) etc. Among these five high seed producer monocotyledonous weeds three belongs to Cyperaceae and two belongs to Poaceae. Lowest seed production has been observed in *Chrysopogon aciculatus* (76) of Poaceae. Other plants those produce less than 300 seeds per plant, include *Fimbristylis dichotoma* (232), Cyperus *tenuispica* (149), *Setaria pumila* (141) and *Chrysopogon aciculatus* (76) etc.

9.4.4 Seed Weight

Seeds of dicotyledonous weeds show higher seed-weight than the monocotyledonous ones. Here the seed-weight has been presented as 1000 seed's weight in gram. Top-ten high seed-weight plants are *Clerodendrum viscosum* (47.199 g), *Cassia tora* (20.457gm), *Cassia occidentalis* (15.809 g), *Urena lobata* (12.94 g), *Ipomoea quamoclit* (12.4 g), *Crotalaria pallida* (10.762 g), *Tephrosia candida* (9.42 g), *Croton bonplandianus* (7.083 g), *Triumfetta rhomboidea* (5.07 g) and *Melochia corchorifolia* (4.443 g). Among these the topper belongs to Verbenaceae, 2 are of Caesalpinaceae and Fabaceae s.s. and 1 each of Malvaceae, Convolvulaceae, Euphorbiaceae, Tiliaceae and Sterculiaceae.

Among Dicotyledons, *Melastoma malabathricum* bears lightest seed-weight of 0.004 g only for 1000 seeds. Other dicotyledonous weeds, which have seed weight less than 0.100 g are *Ageratum conyzoides* (0.099 g), *Borreria ocymoides* (0.086 g), *Youngia japonica* (0.083 g), *Mazus pumilus* (0.08 g), *Euphorbia hirta* (0.057 g), *Conyza* *canadensis* (0.04 g), *Blumea lacera* (0.039 g), *Polycarpon prostratum* (0.032 g), *Osbeckia nepalensis* (0.025 g), *Glinus oppositifolius* (0.022 g), *Ludwigia perennis* (0.02 g), *Oldenlandia diffusa* (0.02 g), *Oldenlandia corymbosa* (0.013 g), *Scoparia dulcis* (0.01 g), *Gamochaeta pensylvanicum* (0.007 g), *Glinus lotoides* (0.007 g), *Hypericum japonicum* (0.006 g), *Melastoma malabathricum* (0.004 g) etc.

All the monocotyledonous weeds bear seed-weight less than 1.000 g for 1000 seeds. Among them highest seed weight has been observed in *Paspalum scrobiculatum* (0.778 g) and that is followed by *Chrysopogon aciculatus* (0.572gm), *Setaria pumila* (0.148gm), *Kyllinga nemoralis* (0.147gm), *Cyperus compressus* (0.126 g) etc. Among these top five species with high seed weight, three belongs to Poaceae. 4 and 2 species are of Cyperaceae. Lowest seed weight among monocotyledonous weeds has been observed in *Eragrostis tenella* (0.02 g) of Poaceae.

9.4.5 Germination Percentage

Out of the 71 species of dicotyledonous weeds ubder study, highest germination percentage has been observed in *Hyptis suaveolens* (98%) of Lamiaceae and that is followed by *Pupalia lappacea* (97%), *Cassia tora* (93%), *Melochia corchorifolia* (80%), *Osbeckia nepalensis* (72%), *Cassia occidentalis* (70%), *Phaulopsis imbricata* (64%), *Tephrosia candida* (62%), *Cyanthillium cinereum* (59%), *Emilia sonchifolia* (59%), *Synedrella nodiflora* (50%) etc.

Lowest germination percentage of 1% among the dicotyledonous weeds under study has been observed in five species like *Amaranthus viridis, Cleome rutidosperma, Euphorbia hirta, Persicaria orientalis,* and *Plantago erosa*. Species like *Mitracarpus verticillatus*, *Oldenlandia corymbosa* and *Oldenlandia diffusa* showed only 3% germination, *Solanum nigrum* showed only 4% germination, *Amaranthus spinosus* showed only 6% germination, *Acmella paniculata, Ageratum conyzoides* and *Pseudognaphalium affine* showed only 7% germination, *Conyza canadensis*, *Gamochaeta pensylvanicum*, *Scoparia dulcis*, *Sida acuta*, *Stellaria media*, *Triumfetta rhomboidea*, and *Youngia japonica* showed only 8% germination. Whereas 26 species of dicotyledonous weeds showed complete dormancy within the time frame of this *in vitro* experimental set-up.

In case of monocotyledonous weeds highest percentage of germination has been observed in *Chrysopogon aciculatus* (80%) and *Setaria pumila* (48%). Both the species belongs to Poaceae. Lowest percentage of germination observed in *Paspalum scrobiculatum* (only 1%) of Poaceae and *Kyllinga nemoralis* (only 5%) of Cyperaceae. Whereas all other species like *Cyperus compressus, Cyperus cyperoides, Cyperus tenuispica, Eragrostis tenella* and *Fimbristylis dichotoma* showed complete dormancy within the time frame of this *in vitro* experimental set-up.

9.4.6 Reproductive Capacity (RC)

In case of dicotyledonous weeds, highest reproductive capacity has been observed in *Osbeckia nepalensis* (101894.4) belonging to Melastomataceae, which is followed by *Conyza canadensis* (70828.8), *Melastoma malabathricum* (14237.16), *Pupalia lappacea* (12796.24), *Scoparia dulcis* (11738.72), *Cassia tora* (9951), *Ageratum houstonianum* (8116.8), *Cyanthillium cinereum* (4672.8), *Emilia sonchifolia* (4363.64) and *Crotalaria pallida* (3919.8) etc. Of the high reproductive capacity holding species, four belongs to Asteraceae, two of Melastomataceae and one each of Amaranthaceae, Scrophulariaceae, Caesalpinaceae and Fabaceae (s.s.).

On the other hand, lowest Reproductive Capacity has been observed in *Euphorbia hirta* only 8.49 of Euphorbiaceae and that is followed by *Triumfetta rhomboidea* 10.16, *Amaranthus viridis* 18.41, *Cleome rutidosperma* 21.93, *Sida acuta* 36.16, *Urena lobata* 38, *Elephantopus scaber* 40.8, *Persicaria orientalis* 45.57 etc. Whereas 26 species of dicotyledonous weeds has not been shown the reproductive capacity value due to their complete dormancy during the *in vitro* experiment.

In the case of Monocotyledonous weeds the highest value of Reproductive Capacity has been shown by *Kyllinga nemoralis* (243.2) of Cyperaceae, which is followed by *Setaria pumila* 67.68 and *Chrysopogon aciculatus* 60.8 (both of Poaceae).

On the other hand, the lowest RC value has been shown by *Paspalum scrobiculatum* (7.1), which is also belonging to Poaceae. The RC of all other plants under Cyperaceae like *Cyperus compressus, Cyperus cyperoides, Cyperus tenuispica* and *Fimbristylis dichotoma* and *Eragrostis tenella* of Poaceae was not determined as their seeds were not germinated in the *in vitro* experimental conditions.

9.4.7 Reproductive Potential (RP) of Successful Families

From the stand point of Reproductive Potentiality, the presently discussed weed flora Terai Tea Gardens showed Poaceae as the most successful family. Asteraceae occupied the second position and Cyperaceae and Fabaceae (s.s.) jointly occupy the 3rd position. Rubiaceae and Scrophulariaceae jointly occupy the 4th position and Amaranthaceae and Euphorbiaceae occupy 5th position jointly.

In Poaceae the range of seed production per plant varies from 76 to 2044 and their 1000 seed-weight ranged between 0.02 – 0.778 g. In Asteraceae, seed per plant ranges from 340 to 885360 and 1000 seed-weight ranges between 0.007 – 2.8g. The values of seed output and 1000 seed-weight of these important families has been presented in Table 9.3.

Table 9.3: Five high RP Angiospermic families with their seed output and 1000 seeds weight.

Families	Seed output	1000 seeds-weight in g	RP value
Poaceae	76 – 2044	0.02 – 0.778	7.1 – 67.68
Asteraceae	340 – 885360	0.007 – 2.8g	40.8 – 70828.8
Cyperaceae	149 – 13566	0.048 – 0.147	243.2
Fabaceae s.s.	2890 – 13066	9.42 - 10.762	1791.8 – 3919.8
Rubiaceae	678 – 7906	0.013 - 2.949	146.34 – 237.18
Scrophulariaceae	7930 – 146734	0.01 - 0.25	11738.72
Amaranthaceae	1841 – 13192	0.215 - 2.349	18.41 – 12796.24
Euphorbiaceae	531 – 10320	0.057 - 7.083	8.49

So among the recorded weeds of five most successful families, only 26.67% (i.e.12 species) bear less than 1000 seeds per plant and 73.33% (i.e. 33 species) bear more than 1000 seeds per plant. On the other hand only 20% (i.e. 9 species) shows seed weight more than 1.0g per 1000 seeds and 80% (i.e. 36 species) shows seed weight less than 1.0g per 1000 seeds.

There is positive correlation between seed weight and seed number generally exists within different members in a particular family. This finding is getting its support from Dutta & Banerjee (1976). Holzner & Numata (1982) commented that one must be aware that due to the high plasticity of weeds, seed number may vary from none to some hundreds of thousands or even millions per plant within one species. In the context of seed weight, there also exist some variations. Stevens (1932) pointed out that the differences are due to the selection and cleaning of seeds. However, the paucity of data on seed number and seed weight may be due to the following facts (a) selection of the plant (b) competition during growth (c) nature of collection (i.e. either from the crop field or outside) (d) cleaning of seeds (e) proper drying etc.

The successful families of the present flora viz. Poaceae and Cyperaceae also support Salisbury's (1956) view who states that some of the most successful species are those which exhibit a large seed out put and possesses also a means of vegetative propagation. This later method provide the equivalent of a large food supply in the seed but over a much longer period and thus permits tolerance of greater and more prolonged competition by the vegetatively produced off-springs. The ability to propagate both by seeds as well as vegetatively is an advantage to the plant and that must be one of the reasons behind the success of the species as a weed. Grasses and sedges have the capacity to produce large number of seeds as well as they propagate vegetatively and that is why they generally dominate the weed floras.

Though majority of the species of Asteraceae does not reproduce vegetatively but they have some other specials features to become successful weeds, which include (a) majority are anemochore species i.e. send their seeds away from the mother plant by air (b) seeds are furnished with special devices such as pappus which increase the ability to disperse by air to a new habitat (c) rosette growth to occupy a certain amount of space (e.g. *Blumea lacera*) (d) some exotic species dispersed by man with his traffic and transport systems to a new habitat etc.

Other families including Fabaceae s.s., Rubiaceae, Scrophulariaceae, Amaranthaceae and Euphorbiaceae also produce large number of small seeds and consist mainly of clitochore species i.e. the species shed their seeds around the mother plant and relay on dispersal in time rather than in space. They do not have any sophisticated dispersed devices because man himself is by far the most important agent for dispersal of crop field weed seeds with his livestock, transport devices, agriculture machinery, irrigation systems and so on or sometimes they are able to disperse their seeds by any special means to a few meters. So, the seedlings are threatened by intraspecific competition.

But the weeds overcome this situation with their (a) prolong germination time and (b) only a small portion of seed germinate at a time and even this portion does not germinate at the very same time. These weeds also have the ability to continuous seed production for as long as the growing condition permit and wide amplitude of modification plasticity and adaptability (Ehrendorfer, 1965) enabling the population to survive and produce seeds in a wide range of ecological conditions. On the other hand the weed species which bear small number of large seeds also get good opportunity of establishment because large seeds carry much food for the seedling and make it as independent as possible from the supply of nutrients and light from the environment and also enhance the seedling growth during the time of establishment.

In Poaceae, except *Eragrostis tenella,* which shows complete dormancy in an *in vitro* experiment with a pre-determined duration, whereas others exhibit 1 – 80 % germination and reproductive potentiality ranges from 7.1 to 67.68. In Asteraceae, except *Blumea lacera,* which shows complete dormancy in an *in vitro* experiment with a pre-determined duration, germination % ranges between 7 to 59 % whereas RP ranges from 40.8 to 70828.8. In Cyperaceae, except *Kyllinga nemoralis,* all other species those show complete dormancy in an *in vitro* experiment with a pre-determined duration, which exhibit only 5% germination and only 243.2 RP. In Fabaceae s.s., germination % ranges between 30 – 62 % and RP shows 1791.8 - 3919.8. In Rubiaceae, two species viz.

Borreria ocymoides and *Richardia scabra* did not germinate and remained dormant in an *in vitro* experiment with a pre-determined duration. But in other cases germination percentage ranges between 3 – 29% whereas RP ranges from 146.34 to 237.18. In Scrophulariaceae, only *Scoparia dulcis* shows 8 % germination and 11738.72 RP whereas all other species did not exhibit RP due to their complete dormancy. In Amaranthaceae, all species germinated and shows germination percentage from 1% upto 97% and RP exhibit from 18.41 to 12796.24. In Euphorbiaceae, except *Euphorbia hirta,* all other species are dormant in an *in vitro* experiment with a pre-determined duration and *Euphorbia hirta* shows very less germination (i.e. only 1%) and off course very less RP, which is only 8.49.

So among the recorded weeds of five most successful families, 31.11% (i.e.14 species) are fully dormant with in vitro germination experiment with pre-determined duration under laboratory conditions and 55.55 % (i.e. 25 species) shows less than 50 % germination and 33.33 % (i.e.15 species) exhibit less than 500 value for RP.

CHAPTER 10

EFFECT OF HERBICIDES

10.1 Introduction

Weeds are a nuisance in the tea plantation of North Bengal and have been found to inflict a considerable amount of crop loss. Blatchley (1992) has designated weeds as "a plant out of place or growing where it is not wanted". George (1916) defined a weed as "a plant growing where it is desired that something else shall grow". Nelson (1946) has defined weeds as "those plants for which man has found no use and which in their evolution has developed such power of aggression, persistence or reproduction, as to make them a menace to the best development of crop". According to Muenscher (1946), "weeds are those plants with harmful or objectionable habits or characteristics, which grow where they are not wanted, usually in places where it is desired that something else should grow". Robbins *et al* (1942) termed weeds as "unwanted, non-useful, often prolific and persistence, interfere with agricultural operations, increase labour, add to costs and reduce yields". Dutta *et al* (2002) have described weeds as "plants out of place in agricultural field or any vegetation". They have reported that weeds are highly competitive in nature, depriving the crop plants their due share of water, space, nutrients, sunlight etc. Weeds are adaptable to adverse climatic conditions and their reproductive system being far superior, easily outgrow crop plants if not controlled in time.

10.2 Aims and Objectives

i) To study the weed flora in the selected area
ii) To study the population dynamics of each species
iii) To identify the major (dominating) weeds of the area
iv) To determine the bio mass of weeds under each treatment
v) To evaluate the effect of selected herbicides on the individual species of weeds
vi) To study the adverse effect of weeds on the productivity of tea crop

10.3 Methods Adopted

The experiment was conducted on 5 years old bushes in North Bengal University campus Tea Garden that has been leased out to Hurdeodass & Co. Ltd. (Owner of Matigara Tea Estate) [26°42'50.0" N latitude & 88°22'14.2" E longitude; 130 metres above MSL]

The trial was laid out in Randomized Block Design, R.B.D.). There were five replications and 20 plots. Average plot size was 10 m^2 consisting of average 130 plants in each plot. Spacing of tea plants were 105 cm x 60 cm planted in staggered single hedge style. Weed population per plot (species wise) on quadrates (1m x 1m size) was counted after 7 days,14 days and 21days from the date of spray of herbicides from randomly selected points in pre monsoon and post monsoon seasons in 2004. Dry weight of collected weeds was recorded (species wise) in two different seasons. Yield of green leaf (tea) was recorded at weekly interval in pre monsoon and post monsoon seasons (three rounds after each spray).

10.4 Herbicides Used

Following herbicides were used in different treatments with doses and dilutions as mentioned for each:

2, 4 – D (ANKAMINE) (a.i. 22.5%): 350 ml in 200 liters of water (1.75 ml/litre).

Glyphosate (ROUND UP) (a.i. 41%): 1000 ml in 200 liters of water (5 ml/litre).

Paraquat (GRAMOXONE) (a.i. 24%): 500 ml in 200 liters of water (2.5 ml/litre).

Doses were fixed as per the recommendations of Tea Research Association (Tocklai Experimental Station) as suggested in *The Planter's Handbook*, 1996 (Barbora 1996).

10.4.1 Properties of the Herbicides under Use

2,4 – D (2,4 – Dichlorophenoxy acetic acid): Post emergence, systemic, selective herbicide.

Glyphosate (N- Phosphonomethyl) Glycine: Post emergence, systemic, non-selective herbicide

Paraquat (1-1$'$-dimethyl-4, 4$'$-bipyridylium): Post emergence, contact herbicide.

Table 10.1 showed some common features of selected herbicides

Table 10.1: Some common features of herbicides.

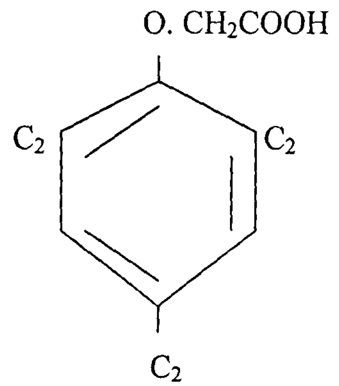
Name of herbicides	Solubility in water	Melting point	Toxicity
2,4 – D	6.2 x 10^2 mg/l	140.5^0 c	***
Glyphosate	1.2 x 10^5 mg/l	230^0 c	**

Paraquat	5×10^5 mg/l	---	***

Toxicity based on Oral LD_{50} for male rats:
**** < 50 mg/kg
*** 51 – 500 mg/kg
** 501 – 5000 mg/kg
* > 5000 mg/kg

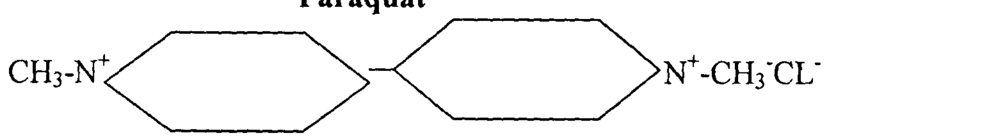
Chemical structures of the herbicides under use are as follows:

2, 4 - D



Glyphosate
$(OH)_2P(O)CH_2NHCH_2COOH$

Paraquat



10.4.2 Mode of Action

2, 4 – D: It is a post emergence, translocated, selective hormone herbicide. It is readily absorbed by roots and leaves, then move down to the phloem along with carbohydrates manufactured by leaves. Spray of 2,4 – D stops cell division and induces swelling of the cells. Rate of photosynthesis is reduced and absorption of water and soil nutrients and food transportation is disrupted. Due to varied rate of cell division and cell enlargement, twisting and curvature of leaves & stems occur.

Glyphosate: It is a broad spectrum post emergence, translocated herbicide, rapidly absorbed by the foliage and translocated to the underground roots and storage organs in sufficient quantities to kill the plant. The efficacy of glyphosate is related to the depletion of soluble sugar and starch content in the rhizome, which gives complete result by checking shoot regeneration.

Paraquat: Contact non-selective herbicide. Although absorbed by the foliage and green tissue it may or may not be translocated to different parts depending on light, temperature and humidity. It acts rapidly in light. Movement of Paraquat is mainly through xylem. Paraquat kills tissue by formation of H_2O_2 by oxidation process and series of chain reactions.

10.5 Sprayers Used:

For spraying of the herbicides, ASPEE BAK PAK SRP 19 hand operated sprayers with TCR triggers and WFN 40 nozzles were used. Pressure was 0.70 kg per square centimeter, spray angle 40^0 and discharge rate 470 ml of spray fluid per minute.

10.6 Statistical Analysis

Critical Difference (C.D.) or Least Significant Difference (L.S.D.), Co-efficient of Variance (C.V.) and Correlation Coefficient were calculated using the methods referred by Panse & Sukhatme (1989) while in case of regression, the method referred by Gupta & Kapoor (1986) was used. For Weed Control Efficiency methods of Mani *et al* 1973 was followed.

10.7 Weather Data

Monthly mean of maximum temperature, minimum temperature and rainfall (Table 10.2) were obtained from Bagdogra Air field (Indian Air Force)

Table 10.2: Weather condition during the year of study (2004)- Monthly mean

Months of year	**Temperature**			**RAINFAL L(mm)**
	MAX	MIN	MEAN (°C)	
JAN	25.2	6.6	15.9	27.5
FEB	27.8	12.2	20.0	31.0
MAR	27.6	14.1	20.9	35.0
APR	33.7	18.2	26.0	120.0
MAY	33.9	22.8	28.4	547.5
JUN	31.5	23.9	27.2	740.0
JUL	30.5	24.6	27.6	979.0
AUG	31.9	25.2	28.6	625.5
SEP	29.9	23.4	26.7	1063.0
OCT	30.2	19.3	24.8	220.0
NOV	27.7	12.9	20.3	37.0
DEC	26.2	10.8	12.5	8.0
Total precipitation:				**4433.5**

Highest monthly mean of maximum temperature was recorded in August while lowest in January. Highest monthly mean of Minimum temperature was recoded in August and lowest in January. Rainfall was highest in September while lowest in December.

10.8 Results

The work has been done during premonsoon and postmonsoon seasons. Data has been processed separately to understand the situation when the total climatic set-up remain completely different.

10.8.1 Premonsoon Studies

All the species of weeds were collected from all the plots, using a quadrate of 1 x 1m. During the premonsoon season, following weeds were found in the plots (Table 10.3).

Table 10.3: Weeds found in quadrate samples after different treatments during Premonsoon Season

Sl. No.	Name of weed	Control	Gramoxone	2,4 - D	Round up
1	*Ageratum conyzoides*	+	+	+	-
2	*Axonopus compressus*	+	-	+	+
3	*Borreria alata*	+	+	+	+
4	*Borreria ocymoides*	+	+	-	+
5	*Centella asiatica*	+	-	-	+
6	*Chromolaena odoratum*	-	-	+	-
7	*Cleome rutidosperma*	+	-	-	-
8	*Conyza canadensis*	+	-	-	-
9	*Crassocephalum crepidioides*	+	+	+	+
10	*Crotalaria pallida*	+	-	-	-
11	*Cyanthillium cinereum*	+	+	-	-
12	*Cynodon dactylon*	+	+	+	-
13	*Cyperus compressus*	+	-	+	+
14	*Cyperus iria*	+	-	-	-
15	*Desmodium triflorum*	+	+	+	+
16	*Digitaria ciliaris*	+	+	+	+
17	*Digitaria sanguinalis*	+	-	+	-
18	*Ehretia serrata*	-	+	-	-
19	*Eleusine indica*	-	+	-	-
20	*Emilia sonchifolia*	+	+	-	+
21	*Eragrostis tenella*	+	-	+	-
22	*Eragrostis unioloides*	+	+	+	+
23	*Fimbristylis dichotoma*	+	-	+	+
24	*Hydrocotyle sibthorpioides*	+	-	-	-
25	*Kyllinga nemoralis*	+	-	-	+
26	*Leucas indica*	+	+	+	+
27	*Lindernia crustacea*	+	+	+	-

28	*Lindernia pyxidaria*	-	+	-	-
29	*Mikania micrantha*	+	-	-	-
30	*Mitracarpus verticillatus*	+	+	+	+
31	*Murdannia nudiflora*	+	-	-	-
32	*Oldenlandia corymbosa*	+	+	+	+
33	*Oxalis corniculata*	+	+	+	-
34	*Paspalum conjugatum*	+	-	-	-
35	*Paspalum scrobiculatum*	+	+	+	+
36	*Phyllanthus urinaria*	+	+	+	+
37	*Pouzolzia zeylanica*	+	+	-	-
38	*Rhynchospora rubra*	+	-	-	-
39	*Saccharum spontaneum*	+	+	+	-
40	*Scoparia dulcis*	+	-	-	+
41	*Solanum nigrum*	+	-	-	-
42	*Tephrosia candida*	-	-	-	+

+ indicates presence of weeds and (-) indicates no existence

Among all the weeds collected, 15 species dominating were taken into consideration. Data presented on Table 10.4 indicates the status of control under different treatments.

Table 10.4: Population of major weeds per quadrate (1 x 1m) of pre-monsoon season.

Name of weed	Paraquat (Gramoxone)	2,4-D (Ankamine)	Glyphosate (Round up)	Untreated Control	S. E.	C.D. at 5% level	S. D.	C.V. (%)
Ageratum conyzoides	2.39	4.4	0	14.60	1.89	5.82	6.97	32.59
Axonopus compressus	0	0.6	0.2	0.33	0.23	0.72	0.49	43.21
Borreria alata	27.01	51.33	14.94	88.27	13.39	41.27	36.83	20.29
Crassocephalum crepidioides	2.41	4.67	0.93	4.8	1.32	4.07	3.09	24.12
Cyperus compressus	0	0.66	0.07	0.93	0.31	0.96	0.8	48.25
Desmodium triflorum	3.07	3.2	0.2	5.53	1.28	3.94	3.06	25.5
Digitaria ciliaris	2.07	5.93	0.2	7.27	1.38	4.25	3.96	25.6
Emilia sonchifolia	1.07	0	2.67	9.33	1.55	4.77	4.79	36.65
Eragrostis unioloides	0.33	1.73	0.53	1.87	0.54	1.66	1.35	30.63
Leucas indica	0.8	0.2	0.13	3.86	1.29	3.97	2.96	59.22
Mitracarpus verticillatus	5.73	2.37	13.01	19.07	2.67	8.24	8.42	20.98
Oxalis corniculata	0.33	2.53	0	5.33	0.59	1.81	2.52	30.72
Paspalum scrobiculatum	2.8	4.27	1.07	8.87	1.5	4.62	4.17	24.51
Phyllanthus urinaria	0.27	0.33	0.07	1.33	0.3	0.92	0.78	39
Saccharum spontaneum	0.07	0.13	0	0.4	0.19	0.59	0.39	65
TOTAL	**48.35**	**82.35**	**34.02**	**171.79**	**28.43**	**87.61**	**80.58**	**526.27**

[S.E. = Standard Error, C.D. = Critical Difference, S.D. = Standard Deviation, C.V. = Coefficient of variation]

Weeds of all species were collected and dried in an oven. Status of bio mass under different treatments is presented on Table10.5.

Table 10.5: Average biomass of major weeds per quadrate (1 x 1m) of pre-monsoon season.

Name of weed	Paraquat (Gramoxone)	2,4-D (Ankamine)	Glyphosate (Round up)	Untreated Control	S. E.	C.D. at 5% level	S. D.	C.V. (%)
Ageratum conyzoides	0.84	2.33	0	25.4	3.69	11.37	13.1	45.85
Axonopus compressus	0	5.07	2.2	3.47	2.26	6.97	4.6	42.86
Borreria alata	70.37	81.27	15.23	271.2	20.41	62.89	106.25	24.25
Crassocephalum crepidioides	5.19	15.87	0.63	18.03	4.91	15.12	11.82	29.76
Cyperus compressus	0	1.34	0.054	1.45	0.68	2.09	1.63	57.39
Desmodium triflorum	6.04	7.66	0.01	9.6	1.8	5.56	4.91	21.06
Digitaria ciliaris	21.8	104.13	0.47	171.53	34.38	105.94	98.44	33.04
Emilia sonchifolia	0.6	0	3.47	16.42	1.69	5.21	7.48	36.51
Eragrostis unioloides	9.67	34.07	7.93	67.2	21.89	67.46	55.82	46.96
Leucas indica	0.73	0.67	0.33	9.02	1.56	4.82	4.83	44.91
Mitracarpus verticillatus	7.9	3.46	20.23	31.33	5.35	16.5	14.8	23.52
Oxalis corniculata	0.43	4.31	0	15.5	1.96	6.04	7.37	36.43
Paspalum scrobiculatum	67.87	156.8	3.87	291.67	53.88	166.04	163.56	31.44
Phyllanthus urinaria	0.13	0.09	0.02	1.61	0.29	0.89	0.87	47.08
Saccharum spontaneum	0.33	0.34	0	1.6	0.69	2.14	1.45	63.76
TOTAL	191.9	417.41	54.444	935.03	155.44	479.04	496.93	584.82

[S.E. = Standard Error,C.D. = Critical Difference,S.D. = Standard Deviation, C.V. = Coefficient of variation]

Individual treatments were taken for Phytosociological study as depicted on tables furnished below (Table 10.6):

10.8.1. A. Phytosociological Observation after Paraquat Treatment

Not all the plants died after herbicide treatment and at the same time new weed population occupy the vacated area very soon. Table 10.6 presented the result after processing the phytosociological data collected from the field.

Table 10.6: Phytosociological parameters for different weeds in Paraquat (Gramoxone) treated plots during pre-monsoon season.

Sl. No.	Name of weeds	NI	NQ	F	D	A	RF	RD	RA	IVI	BM (gm)
1	*Ageratum conyzoides*	36	3	20	2.4	12	3.41	3.66	6.53	13.6	0.03
2	*Borreria alata*	405	13	86.67	27	31.15	14.77	41.15	16.96	72.88	0.26
3	*Borreria ocymoides*	33	2	13.33	2.2	16.5	2.27	3.35	8.98	14.6	0.05
4	*Crassocephalum crepidioides*	36	8	53.33	2.4	4.5	9.09	3.66	2.45	15.2	0.22
5	*Cyanthillium cinereum*	3	1	6.67	0.2	3	1.14	0.3	1.63	3.07	0.02

6	*Cynodon dactylon*	1	1	6.67	0.07	1	1.14	0.11	0.54	1.79	0.4
7	*Desmodium triflorum*	46	8	53.33	3.07	5.75	9.09	4.68	3.13	16.9	0.2
8	*Digitaria ciliaris*	32	6	40	2.13	5.33	6.82	3.25	2.9	12.97	1.02
9	*Ehretia serrata*	1	1	6.67	0.07	1	1.14	0.11	0.54	1.79	0.05
10	*Eleusine indica*	3	2	13.33	0.2	1.5	2.27	0.3	0.82	3.39	1.03
11	*Emilia sonchifolia*	16	1	6.67	1.07	16	1.14	1.63	8.71	11.48	0.06
12	*Eragrostis unioloides*	6	3	20	0.4	2	3.41	0.61	1.09	5.11	2.4
13	*Leucas indica*	12	1	6.67	0.8	12	1.14	1.22	6.53	8.89	0.09
14	*Lindernia crustacea*	148	7	46.67	9.87	21.14	7.95	15.04	11.51	34.5	0.05
15	*Lindernia pyxidaria*	13	1	6.67	0.87	13	1.14	1.33	7.08	9.55	0.15
16	*Mitracarpus verticillatus*	86	10	66.67	5.73	8.6	11.36	8.73	4.68	24.77	0.14
17	*Oldenlandia corymbosa*	52	3	20	3.47	17.33	3.41	5.29	9.44	18.14	0.03
18	*Oxalis corniculata*	5	3	20	0.33	1.67	3.41	0.5	0.91	4.82	0.13
19	*Paspalum scrobiculatum*	42	10	66.67	2.8	4.2	11.36	4.27	2.29	17.92	2.42
20	*Phyllanthus urinaria*	4	2	13.33	0.27	2	2.27	0.41	1.09	3.77	0.05
21	*Pouzolzia zeylanica*	3	1	6.67	0.2	3	1.14	0.3	1.63	3.07	0.17
22	*Saccharum spontaneum*	1	1	6.67	0.07	1	1.14	0.11	0.54	1.79	0.5

Table 10.7: Ten high IVI scoring weeds in Paraquat (Gramoxone) treated plots.

Name of weeds	RF	RD	RA	IVI
Borreria alata	14.77	41.15	16.96	72.88
Lindernia crustacea	7.95	15.04	11.51	34.5
Mitracarpus verticillatus	11.36	8.73	4.68	24.77
Oldenlandia corymbosa	3.41	5.29	9.44	18.14
Paspalum scrobiculatum	11.36	4.27	2.29	17.92
Desmodium triflorum	9.09	4.68	3.13	16.9
Crassocephalum crepidioides	9.09	3.66	2.45	15.2
Borreria ocymoides	2.27	3.35	8.98	14.6
Ageratum conyzoides	3.41	3.66	6.53	13.6
Digitaria ciliaris	6.82	3.25	2.9	12.97

Table 10.8: Ten high biomass producing weeds in Paraquat (Gramoxone) treated plots.

Name of weeds	Biomass gm	
Paspalum scrobiculatum	2.42	1
Eragrostis unioloides	2.4	2

Eleusine indica	1.03	3
Digitaria ciliaris	1.02	4
Saccharum spontaneum	0.5	5
Cynodon dactylon	0.4	6
Borreria alata	0.26	7
Crassocephalum crepidioides	0.22	8
Desmodium triflorum	0.2	9
Pouzolzia zeylanica	0.17	10

During pre-monsoon season, it can be seen from Table10.6 that in the plots treated with Paraquat (Gramoxone) *Borreria alata* registered highest population however data presented in Table 10.8 suggests that biomass was highest in *Paspalum scrobiculatum.*

10.8.1. B. Phytosociological Observation after 2,4 – D (Ankamine) Treatment

Not all the plants died after herbicide treatment and at the same time new weed population occupy the vacated area very soon. Table 10.9 presented the result after processing the phytosociological data collected from the field.

Table 10.9: Phytosociological parameters for different weeds in 2,4 – D (Ankamine) treated plots during pre-monsoon season.

Sl. No.	Name of weeds	NI	NQ	F	D	A	RF	RD	RA	IVI	BM (gm)
1	*Ageratum conyzoides*	70	6	40	4.67	11.67	5.04	3.79	4.54	13.37	0.05
2	*Axonopus compressus*	11	4	26.67	0.73	2.75	3.36	0.59	1.07	5.02	2.29
3	*Borreria alata*	770	8	53.33	51.33	96.25	6.72	41.65	37.42	85.79	0.16
4	*Chromolaena odoratum*	1	1	6.67	0.07	1	0.84	0.06	0.39	1.29	0.5
5	*Crassocephalum crepidioides*	80	8	53.33	5.33	10	6.72	4.32	3.89	14.93	0.3
6	*Cynodon dactylon*	18	6	40	1.2	3	5.04	0.97	1.17	7.18	0.58
7	*Cyperus compressus*	19	4	26.67	1.27	4.75	3.36	1.03	1.85	6.24	0.24
8	*Desmodium triflorum*	83	10	66.67	5.53	8.3	8.4	4.49	3.23	16.12	0.17
9	*Digitaria ciliaris*	198	10	66.67	13.2	19.8	8.4	10.71	7.7	26.81	0.79
10	*Digitaria sanguinalis*	66	4	26.67	4.4	16.5	3.36	3.57	6.41	13.34	0.69
11	*Eragrostis tenella*	26	3	20	1.73	8.67	2.52	1.4	3.37	7.29	0.27
12	*Eragrostis unioloides*	58	9	60	3.87	6.44	7.56	3.14	2.5	13.2	1.98
13	*Fimbristylis dichotoma*	217	9	60	14.47	24.11	7.56	11.74	9.37	28.67	0.07
14	*Leucas indica*	3	2	13.33	0.2	1.5	1.68	0.16	0.58	2.42	0.33
15	*Lindernia crustacea*	14	2	13.33	0.93	7	1.68	0.75	2.72	5.15	0.05
16	*Mitracarpus verticillatus*	35	4	26.67	2.33	8.75	3.36	1.89	3.4	8.65	0.15
17	*Oldenlandia corymbosa*	2	1	6.67	0.13	2	0.84	0.11	0.78	1.73	0.03
18	*Oxalis corniculata*	80	10	66.67	5.33	8	8.4	4.32	3.11	15.83	0.29
19	*Paspalum scrobiculatum*	64	10	66.67	4.27	6.4	8.4	3.46	2.49	14.35	3.68
20	*Phyllanthus urinaria*	20	6	40	1.33	3.33	5.04	1.08	1.29	7.41	0.12
21	*Saccharum spontaneum*	14	2	13.33	0.93	7	1.68	0.75	2.72	5.15	2.17

Table 10.10: Ten high IVI scoring weeds in 2,4 – D (Ankamine) treated plots.

Name of weeds	RF	RD	RA	IVI	
Borreria alata	6.72	41.65	37.42	85.79	1
Fimbristylis dichotoma	7.56	11.74	9.37	28.67	2
Digitaria ciliaris	8.4	10.71	7.7	26.81	3
Desmodium triflorum	8.4	4.49	3.23	16.12	4
Oxalis corniculata	8.4	4.32	3.11	15.83	5
Crassocephalum crepidioides	6.72	4.32	3.89	14.93	6
Paspalum scrobiculatum	8.4	3.46	2.49	14.35	7
Ageratum conyzoides	5.04	3.79	4.54	13.37	8
Digitaria sanguinalis	3.36	3.57	6.41	13.34	9
Eragrostis unioloides	7.56	3.14	2.5	13.2	10

Table 10.11: Ten high biomass producing weeds in 2,4 – D (Ankamine) treated plots.

Name of weeds	Biomass gm	
Paspalum scrobiculatum	3.68	1
Axonopus compressus	2.29	2
Saccharum spontaneum	2.17	3
Eragrostis unioloides	1.98	4
Digitaria ciliaris	0.79	5
Digitaria sanguinalis	0.69	6
Cynodon dactylon	0.58	7
Chromolaena odoratum	0.5	8
Leucas indica	0.33	9
Crassocephalum crepidioides	0.3	10

In the 2,4 – D (Ankamine) treated plots *Borreria alata* registered highest population (Table 10.9). As for as biomass is concerned higher rate was observed with *Paspalum scrobiculatum, Axonopus compressus, Saccharum spontaneum* etc. (Table 10.11)

10.8.1. C. Phytosociological Observation after Glyphosate Treatment

Not all the plants died after herbicide treatment and at the same time new weed population occupy the vacated area very soon. Table 10.12 presented the result after processing the phytosociological data collected from the field.

Table 10.12: Phytosociological parameters for different weeds in Glyphosate (Round up) treated plots during pre-monsoon season.

Sl. No.	*Name of weeds*	NI	NQ	F	D	A	RF	RD	RA	IVI	BM (gm)
1	*Axonopus compressus*	2	1	6.67	0.13	2	1.76	0.31	1.56	3.63	1.65
2	*Borreria alata*	224	11	73.33	14.93	20.36	19.3	35.27	15.88	70.45	0.1
3	*Borreria ocymoides*	55	3	20	3.67	18.33	5.26	8.67	14.29	28.22	0.04
4	*Centella asiatica*	7	2	13.33	0.47	3.5	3.51	1.11	2.73	7.35	0.36
5	*Crassocephalum crepidioides*	14	3	20	0.93	4.67	5.26	2.2	3.64	11.1	0.07
6	*Cyperus compressus*	1	1	6.67	0.07	1	1.76	0.17	0.78	2.71	0.08
7	*Desmodium triflorum*	3	1	6.67	0.2	3	1.76	0.47	2.34	4.57	0.01
8	*Digitaria ciliaris*	3	1	6.67	0.2	3	1.76	0.47	2.34	4.57	0.23
9	*Emilia sonchifolia*	41	5	33.33	2.73	8.2	8.77	6.45	6.39	21.61	0.13
10	*Eragrostis unioloides*	9	2	13.33	0.6	4.5	3.51	1.42	3.51	8.44	1.33
11	*Fimbristylis dichotoma*	14	2	13.33	0.93	7	3.51	2.2	5.46	11.17	0.06
12	*Kyllinga nemoralis*	7	1	6.67	0.47	7	1.76	1.11	5.46	8.33	0.01
13	*Leucas indica*	2	1	6.67	0.13	2	1.76	0.31	1.56	3.63	0.25
14	*Mitracarpus verticillatus*	195	13	86.67	13	15	22.81	30.71	11.7	65.22	0.16
15	*Oldenlandia corymbosa*	10	2	13.33	0.67	5	3.51	1.58	3.9	8.99	0.02
16	*Paspalum scrobiculatum*	16	2	13.33	1.07	8	3.51	2.53	6.24	12.28	0.36
17	*Phyllanthus urinaria*	1	1	6.67	0.07	1	1.76	0.17	0.78	2.71	0.03
18	*Scoparia dulcis*	5	3	20	0.33	1.67	5.26	0.78	1.3	7.34	0.67
19	*Tephrosia candida*	26	2	13.33	1.73	13	3.51	4.09	10.14	17.74	0.08

Table 10.13: Ten high IVI scoring weeds in Glyphosate (Round up) treated plots.

Name of weeds	RF	RD	RA	IVI	
Borreria alata	19.3	35.27	15.88	70.45	1
Mitracarpus verticillatus	22.81	30.71	11.7	65.22	2
Borreria ocymoides	5.26	8.67	14.29	28.22	3
Emilia sonchifolia	8.77	6.45	6.39	21.61	4
Tephrosia candida	3.51	4.09	10.14	17.74	5
Paspalum scrobiculatum	3.51	2.53	6.24	12.28	6
Fimbristylis dichotoma	3.51	2.2	5.46	11.17	7
Crassocephalum crepidioides	5.26	2.2	3.64	11.1	8
Oldenlandia corymbosa	3.51	1.58	3.9	8.99	9
Eragrostis unioloides	3.51	1.42	3.51	8.44	10

Table 10.14: Ten high biomass producing weeds in Glyphosate (Round up) treated plots.

Name of weeds	Biomass gm	
Axonopus compressus	1.65	1
Eragrostis unioloides	1.33	2
Scoparia dulcis	0.67	3
Paspalum scrobiculatum	0.37	4
Centella asiatica	0.36	5
Leucas indica	0.25	6
Digitaria ciliaris	0.23	7
Mitracarpus verticillatus	0.16	8
Emilia sonchifolia	0.13	9
Borreria alata	0.1	10

In the plots treated with Glyphosate (Round up), *Borreria alata, Mitracarpus verticillatus* and *Borreria ocymoides* recorded high population. This conforms to the findings of Rao & Rahman (1978). *Axonopus compressus* recorded highest biomass in Glyphosate (Round up) treated plots (Table 10.14).

10.8.1. D. Phytosociological Observation in Control areas

As no herbicide was used so there was no death of any plant, which indicates that there was creation of no vacant spaces allowing other or newly grown plants to occupy the area. However, the result of processing of phytosociological data has been presented in Table 10.15.

Table 10.15: Phytosociological parameters for different weeds in Untreated Control plots during pre-monsoon season.

Sl. No .	Name of weeds	NI	NQ	F	D	A	RF	RD	RA	IVI	BM (gm)
1	*Ageratum conyzoides*	220	10	66.67	14.67	22	5.24	7.01	5.57	17.82	0.17
2	*Axonopus compressus*	5	2	13.33	0.33	2.5	1.05	0.16	0.63	1.84	1.04
3	*Borreria alata*	132 4	15	100	88.27	88.27	7.85	42.2	22.35	72.4	0.31
4	*Borreria ocymoides*	123	4	26.67	8.2	30.75	2.09	3.92	7.78	13.79	0.06
5	*Centella asiatica*	3	1	6.67	0.2	3	0.52	0.1	0.76	1.38	0.17
6	*Cleome rutidosperma*	1	1	6.67	0.07	1	0.52	0.03	0.25	0.8	1
7	*Conyza canadensis*	1	1	6.67	0.07	1	0.52	0.03	0.25	0.8	0.5
8	*Crassocephalum crepidioides*	71	10	66.67	4.73	7.1	5.24	2.26	1.8	9.3	0.38
9	*Crotalaria pallida*	2	1	6.67	0.13	2	0.52	0.06	0.51	1.09	1.05

10	*Cyanthillium cinereum*	1	1	6.67	0.07	1	0.52	0.03	0.25	0.8	3
11	*Cynodon dactylon*	1	1	6.67	0.07	1	0.52	0.03	0.25	0.8	0.03
12	*Cyperus compressus*	14	5	33.33	0.93	2.8	2.62	0.44	0.71	3.77	0.16
13	*Cyperus iria*	7	2	13.33	0.47	3.5	1.05	0.22	0.89	2.16	0.46
14	*Desmodium triflorum*	47	13	86.67	3.13	3.62	6.81	1.5	0.92	9.23	0.24
15	*Digitaria ciliaris*	109	9	60	7.27	12.11	4.71	3.48	3.07	11.26	2.36
16	*Digitaria sanguinalis*	75	5	33.33	5	15	2.62	2.39	3.8	8.81	0.74
17	*Emilia sonchifolia*	140	13	86.67	9.33	10.77	6.81	4.46	2.73	14	0.18
18	*Eragrostis tenella*	1	1	6.67	0.07	1	0.52	0.03	0.25	0.8	0.04
19	*Eragrostis unioloides*	27	9	60	1.8	3	4.71	0.86	0.76	6.33	3.74
20	*Fimbristylis dichotoma*	84	5	33.33	5.6	16.8	2.62	2.68	4.25	9.55	0.11
21	*Hydrocotyle sibthorpioides*	3	1	6.67	0.2	3	0.52	0.1	0.76	1.38	3.03
22	*Kyllinga nemoralis*	7	2	13.33	0.47	3.5	1.05	0.22	0.89	2.16	1.5
23	*Leucas indica*	**58**	**11**	**73.33**	**3.87**	**5.27**	**5.76**	**1.85**	**1.33**	**8.94**	**0.23**
24	*Lindernia crustacea*	166	9	60	11.07	18.44	4.71	5.29	4.67	14.67	0.06
25	*Mikania micrantha*	3	3	20	0.2	1	1.57	0.1	0.25	1.92	0.71
26	*Mitracarpus verticillatus*	285	13	86.67	19	21.92	6.81	9.08	5.55	21.44	0.16
27	*Murdannia nudiflora*	6	2	13.33	0.4	3	1.05	0.19	0.76	2	0.1
28	*Oldenlandia corymbosa*	41	7	46.67	2.73	5.86	3.67	1.31	1.48	6.46	0.1
29	*Oxalis corniculata*	83	8	53.33	5.53	10.38	4.19	2.64	2.63	9.46	0.11
30	*Paspalum conjugatum*	12	1	6.67	0.8	12	0.52	0.38	3.04	3.94	0.83
31	*Paspalum scrobiculatum*	133	14	93.33	8.87	9.5	7.33	4.24	2.41	13.98	3.29
32	*Phyllanthus urinaria*	5	4	26.67	0.33	1.25	2.09	0.16	0.32	2.57	0.03
33	*Pouzolzia zeylanica*	64	1	6.67	4.27	64	0.52	2.04	16.2	18.76	0.38
34	*Rhynchospora rubra*	1	1	6.67	0.07	1	0.52	0.03	0.25	0.8	0.03
35	*Saccharum spontaneum*	2	1	6.67	0.13	2	0.52	0.06	0.51	1.09	0.25
36	*Scoparia dulcis*	11	3	20	0.73	3.67	1.57	0.35	0.93	2.85	0.76
37	*Solanum nigrum*	1	1	6.67	0.07	1	0.52	0.03	0.25	0.8	3.2

Table 10.16: Ten high IVI scoring weeds in Untreated Control plots.

Name of weeds	RF	RD	RA	IVI	
Borreria alata	7.85	42.2	22.35	72.4	1
Mitracarpus verticillatus	6.81	9.08	5.55	21.44	2
Pouzolzia zeylanica	0.52	2.04	16.2	18.76	3
Ageratum conyzoides	5.24	7.01	5.57	17.82	4
Lindernia crustacea	4.71	5.29	4.67	14.67	5
Emilia sonchifolia	6.81	4.46	2.73	14	6
Paspalum scrobiculatum	7.33	4.24	2.41	13.98	7
Borreria ocymoides	2.09	3.92	7.78	13.79	8
Digitaria ciliaris	4.71	3.48	3.07	11.26	9
Fimbristylis dichotoma	2.62	2.68	4.25	9.55	10

Table 10.17: Ten high biomass producing weeds in Untreated Control plots.

Name of weeds	Biomass gm	
Eragrostis unioloides	3.74	1
Paspalum scrobiculatum	3.29	2
Solanum nigrum	3.2	3
Hydrocotyle sibthorpioides	3.03	4
Cyanthillium cinereum	3	5
Digitaria ciliaris	2.36	6
Kyllinga nemoralis	1.5	7
Crotalaria pallida	1.05	8
Axonopus compressus	1.04	9
Cleome rutidosperma	1	10

Under normal condition i.e. without spray of any chemicals, *Borreria alata* have shown high percentage of coverage. While *Eragrostis unioloides*, *Paspalum scrobiculatum* was shown to have highest biomass production.

10.8.2 Postmonsoon Studies

Like premonsoon vegetation, for post monsoon season also similar studies has been conducted and the results are presented below in the similar fashion.

Table 10.18: Weeds found in quadrate samples after different treatments during Postmonsoon Season.

Sl. No.	Name of weed	Control	Gramoxone	2,4 - D	Round up
1	*Ageratum conyzoides*	+	-	+	-
2	*Axonopus compressus*	+	-	+	+
3	*Borreria alata*	+	+	+	+
4	*Borreria ocymoides*	+	+	+	+
5	*Centella asiatica*	+	-	-	-
6	*Crassocephalum crepidioides*	+	+	+	-
7	*Crotalaria pallida*	+	-	-	-
8	*Cyanthillium cinereum*	+	-	-	+
9	*Cynodon dactylon*	+	-	+	-
10	*Cyperus compressus*	+	-	+	+
11	*Cyperus iria*	-	-	+	-
12	*Cyperus pseudokyllingioides*	-	-	+	+
13	*Desmodium triflorum*	+	+	+	+
14	*Digitaria ciliaris*	+	+	+	+
15	*Dryopteris filix-mas*	-	+	-	-

16	*Eleusine indica*	-	-	+	-
17	*Emilia sonchifolia*	+	-	+	+
18	*Eragrostis unioloides*	+	-	+	-
19	*Euphorbia hirta*	+	-	-	-
20	*Fimbristylis dichotoma*	-	+	-	-
21	*Imperata cylindrica*	+	-	+	+
22	*Kyllinga nemoralis*	+	-	+	+
23	*Leucas indica*	+	-	+	+
24	*Lindernia crustacea*	+	+	-	-
25	*Ludwigia perennis*	-	-	+	-
26	*Mitracarpus verticillatus*	+	-	+	+
27	*Murdannia nudiflora*	+	-	-	-
28	*Oldenlandia corymbosa*	+	+	+	+
29	*Oxalis corniculata*	+	-	+	-
30	*Paspalum scrobiculatum*	+	+	+	+
31	*Phyllanthus urinaria*	+	-	-	-
32	*Pouzolzia zeylanica*	+	-	-	-
33	*Rungia pectinata*	-	-	-	+
34	*Saccharum spontaneum*	+	+	+	+
35	*Solanum nigrum*	+	-	-	-
36	*Trema orientalis*	+	-	-	-
37	*Urochloa ramosa*	+	-	+	+

+ indicates presence of weeds and (-) indicates no existence

Table 10.19: Population of major weeds per quadrate (1m X 1m) of post-monsoon season.

Name of weed	Paraquat (Gramoxone)	2,4-D (Ankamine)	Glyphosate (Round up)	Untreated Control	S. E.	C.D. at 5% level	S. D.	C.V. (%)
Ageratum conyzoides	0	4.2	0	25.8	3.53	10.87	13.04	43.47
Axonopus compressus	0	2.13	1.33	3.67	0.69	2.14	2.05	28.74
Borreria alata	1.27	21.4	10.6	53.07	2.86	8.8	20.24	23.44
Crassocephalum crepidioides	0.27	0.87	0	0.93	0.11	0.35	0.44	21.29
Cyperus compressus	0	0.33	0.33	1.47	0.26	0.81	0.81	37.97
Desmodium triflorum	4.47	10.47	2.6	14.2	2.65	8.17	8.42	26.53
Digitaria ciliaris	0.4	0.33	0.07	2.47	0.45	1.39	1.38	42.24
Emilia sonchifolia	0	0.6	0.27	4.07	0.48	1.48	1.94	39.32
Eragrostis unioloides	0	0.07	0	0.6	0.08	0.24	0.29	43.5
Leucas indica	0	0.27	0.2	1.27	0.18	0.54	0.6	34.62
Mitracarpus verticillatus	0	0.07	0.2	2.73	0.34	1.05	1.33	44.33
Oxalis corniculata	0	0.13	0	0.93	0.65	2	0.73	68.44

Paspalum scrobiculatum	0.33	0.87	0.67	2.2	0.38	1.18	0.98	24.1
Phyllanthus urinaria	0	0	0	0.4	0.08	0.24	0.24	60
Saccharum spontaneum	1.53	2.67	2	8.4	1.44	4.45	4.42	30.27
TOTAL	8.27	44.41	18.27	122.21	14.18	43.71	56.91	568.26

S.E. = Standard Error,C.D. = Critical Difference,S.D. = Standard Deviation, C.V. = Coefficient of variation

Table 10.20: Average biomass of major weeds per quadrate (1m X 1m) of post-monsoon season.

Name of weed	Paraquat (Gramoxone)	2,4-D (Ankamine)	Glyphosate (Round up)	Untreated Control	S. E.	C.D. at 5% level	S. D.	C.V. (%)
Ageratum conyzoides	0	15	0	150.94	23.62	72.78	80.22	48.34
Axonopus compressus	0	6.13	3.60	14.20	2.63	8.11	7.95	33.22
Borreria alata	3.53	123.93	72.4	276.13	23.85	73.5	113.85	23.92
Crassocephalum crepidioides	2.13	2.57	0	9.93	1.29	3.97	4.83	33
Cyperus compressus	0	0.4	0.6	1.82	0.38	1.18	1.1	38.98
Desmodium triflorum	4.4	12.64	3.1	21.37	4.44	13.68	12.9	31.08
Digitaria ciliaris	0.67	0.84	0.36	9.47	2.31	7.13	6.03	53.2
Emilia sonchifolia	0	1.49	0.67	6.34	1.28	3.94	3.58	42.13
Eragrostis unioloides	0	0.36	0	2.93	0.51	1.57	1.57	47.69
Leucas indica	0	3.07	1.73	23	3.94	12.14	12.02	43.24
Mitracarpus verticillatus	0	0.1	1.13	13.03	1.97	6.08	6.69	46.89
Oxalis corniculata	0	0.07	0	0.8	0.26	0.81	0.64	73.9
Paspalum scrobiculatum	1.07	3.74	4.2	21.67	2.3	7.08	9.45	30.81
Phyllanthus urinaria	0	0	0	0.25	0.05	0.15	0.15	60.98
Saccharum spontaneum	6	25.87	9	58.67	13.55	41.75	38.55	38.73
TOTAL	**17.8**	**196.21**	**96.79**	**610.55**	**82.38**	**253.87**	**299.53**	**646.11**

S.E. = Standard Error,C.D. = Critical Difference,S.D. = Standard Deviation,C.V. = Coefficient of variation

10.8.2. A. Phytosociological Observation after Paraquat Treatment

Not all the plants died after herbicide treatment and at the same time new weed population occupy the vacated area very soon. Table 10.21 presented the result after processing the phytosociological data collected from the field.

Table 10.21: Phytosociological parameters for different weeds in Paraquat (Gramoxone) treated plots during post-monsoon season.

Sl. No.	Name of weeds	NI	NQ	F	D	A	RF	RD	RA	IVI	BM (gm)
1	*Borreria alata*	16	7	70	1.6	2.29	17.5	7.05	4.35	28.9	0.29
2	*Borreria ocymoides*	73	6	60	7.3	12.17	15	32.16	23.11	70.27	0.14
3	*Crassocephalum crepidioides*	6	3	30	0.6	2	7.5	2.64	3.8	13.94	1.1
4	*Desmodium triflorum*	58	7	70	5.8	8.29	17.5	25.55	15.74	58.79	0.09
5	*Digitaria ciliaris*	6	1	10	0.6	6	2.5	2.64	11.39	16.53	0.17
6	*Dryopteris filix-mas*	2	2	20	0.2	1	5	0.88	1.9	7.78	0.98
7	*Fimbristylis dichotoma*	4	1	10	0.4	4	2.5	1.76	7.59	11.85	0.08
8	*Lindernia crustacea*	2	1	10	0.2	2	2.5	0.88	3.8	7.18	0.15
9	*Oldenlandia corymbosa*	34	8	80	3.4	4.25	20	14.98	8.07	43.05	0.19
10	*Paspalum scrobiculatum*	3	1	10	0.3	3	2.5	1.32	5.7	9.52	0.3
11	*Saccharum spontaneum*	23	3	30	2.3	7.67	7.5	10.13	14.56	32.19	0.39

Table 10.22: Ten high IVI scoring weeds in Paraquat (Gramoxone) treated plots.

Name of weeds	RF	RD	RA	IVI	
Borreria ocymoides	15	32.16	23.11	70.27	1
Desmodium triflorum	17.5	25.55	15.74	58.79	2
Oldenlandia corymbosa	20	14.98	8.07	43.05	3
Saccharum spontaneum	7.5	10.13	14.56	32.19	4
Borreria alata	17.5	7.05	4.35	28.9	5
Digitaria ciliaris	2.5	2.64	11.39	16.53	6
Crassocephalum crepidioides	7.5	2.64	3.8	13.94	7
Fimbristylis dichotoma	2.5	1.76	7.59	11.85	8
Paspalum scrobiculatum	2.5	1.32	5.7	9.52	9
Dryopteris filix-mas	5	0.88	1.9	7.78	10

Table10.23: Ten high biomass producing weeds in Paraquat (Gramoxone) treated plots.

Name of weeds	Biomass gm	
Crassocephalum crepidioides	1.1	1
Dryopteris filix-mas	0.98	2
Saccharum spontaneum	0.39	3
Paspalum scrobiculatum	0.3	4
Borreria alata	0.29	5
Oldenlandia corymbosa	0.19	6
Digitaria ciliaris	0.17	7
Lindernia crustacea	0.15	8
Borreria ocymoides	0.14	9
Desmodium triflorum	0.09	10

In post-monsoon season, it can be seen from Table 10.21 that in the plots treated with Paraquat (Gramoxone) *Borreria ocymoides* registered highest population however data presented in Table 10.23 suggests that biomass was highest in *Crassocephalum crepidioides.* Percentage of broad-leaved weeds was found to be more than grasses and sedges.

10.8.2. B. Phytosociological Observation after 2,4 – D (Ankamine) Treatment

Not all the plants died after herbicide treatment and at the same time new weed population occupy the vacated area very soon. Table 10.24 presented the result after processing the phytosociological data collected from the field.

Table 10.24: Phytosociological parameters for different weeds in 2,4 – D (Ankamine) treated plots during post-monsoon season.

Sl. No.	Name of weeds	NI	NQ	F	D	A	RF	RD	*RA*	IVI	BM (gm)
1	*Ageratum conyzoides*	106	4	40	10.6	26.5	5.06	7.99	10.65	23.7	0.55
2	*Axonopus compressus*	32	7	70	3.2	4.57	8.86	2.41	1.84	13.11	0.3
3	*Borreria alata*	353	8	80	35.3	44.13	10.13	26.62	17.74	54.49	0.75
4	*Borreria ocymoides*	296	7	70	29.6	42.29	8.86	22.32	17	48.18	0.22
5	*Crassocephalum crepidioides*	7	3	30	0.7	2.33	3.8	0.53	0.94	5.27	0.31
6	*Cynodon dactylon*	3	1	10	0.3	3	1.27	0.23	1.21	2.71	0.3
7	*Cyperus compressus*	9	1	10	0.9	9	1.27	0.68	3.62	5.57	0.1
8	*Cyperus iria*	4	1	10	0.4	4	1.27	0.3	1.61	3.18	0.05
9	*Cyperus pseudokyllingioides*	8	4	40	0.8	2	5.06	0.6	0.8	6.46	0.15
10	*Desmodium triflorum*	128	7	70	12.8	18.29	8.86	9.65	7.35	25.86	0.13
11	*Digitaria ciliaris*	18	2	20	1.8	9	2.53	1.36	3.62	7.51	0.49
12	*Eleusine indica*	1	1	10	0.1	1	1.27	0.08	0.4	1.75	0.5
13	*Emilia sonchifolia*	8	2	20	0.8	4	2.53	0.6	1.61	4.74	0.25
14	*Eragrostis unioloides*	1	1	10	0.1	1	1.27	0.08	0.4	1.75	0.4
15	*Imperata cylindrica*	20	2	20	2	10	2.53	1.51	4.02	8.06	0.46
16	*Kyllinga nemoralis*	3	2	20	0.3	1.5	2.53	0.23	0.6	3.36	0.4
17	*Leucas indica*	4	2	20	0.4	2	2.53	0.3	0.8	3.63	1.88
18	*Ludwigia perennis*	3	1	10	0.3	3	1.27	0.23	1.21	2.71	0.3
19	*Mitracarpus verticillatus*	25	3	30	2.5	8.33	3.8	1.89	3.35	9.04	0.52
20	*Oldenlandia corymbosa*	176	7	70	17.6	25.14	8.86	13.27	10.11	32.24	0.15
21	*Oxalis corniculata*	2	1	10	0.2	2	1.27	0.15	0.8	2.22	0.05
22	*Paspalum scrobiculatum*	14	4	40	1.4	3.5	5.06	1.06	1.41	7.53	0.46
23	*Saccharum spontaneum*	91	6	60	9.1	15.17	7.59	6.86	6.1	20.55	0.78
24	*Urochloa ramosa*	14	2	20	1.4	7	2.53	1.06	2.81	6.4	0.6

Table 10.25: Ten high IVI scoring weeds in 2,4 – D (Ankamine) treated plots.

Name of weeds	RF	RD	RA	IVI	
Borreria alata	10.13	26.62	17.74	54.49	1
Borreria ocymoides	8.86	22.32	17	48.18	2
Oldenlandia corymbosa	8.86	13.27	10.11	32.24	3
Desmodium triflorum	8.86	9.65	7.35	25.86	4
Ageratum conyzoides	5.06	7.99	10.65	23.7	5
Saccharum spontaneum	7.59	6.86	6.1	20.55	6
Axonopus compressus	8.86	2.41	1.84	13.11	7
Mitracarpus verticillatus	3.8	1.89	3.35	9.04	8
Imperata cylindrica	2.53	1.51	4.02	8.06	9
Paspalum scrobiculatum	5.06	1.06	1.41	7.53	10

Table 10.26: Ten high biomass producing weeds in 2,4 – D (Ankamine) treated plots.

Name of weeds	Biomass gm	
Leucas indica	1.88	1
Saccharum spontaneum	0.78	2
Borreria alata	0.75	3
Urochloa ramosa	0.6	4
Ageratum conyzoides	0.55	5
Mitracarpus verticillatus	0.52	6
Eleusine indica	0.5	7
Digitaria ciliaris	0.49	8
Paspalum scrobiculatum	0.46	9
Imperata cylindrica	0.45	10

In the 2,4 – D (Ankamine) treated plots *Borreria alata* and *Borreria ocymoides* registered high population (Table). As for as biomass is concerned higher rate was observed with *Leucas indica, Saccharum spontaneum, Borreria alata* etc. (Table)

10.8.2. C. Phytosociological Observation after Glyphosate Treatment

Not all the plants died after herbicide treatment and at the same time new weed population occupy the vacated area very soon. Table 10.27 presented the result after processing the phytosociological data collected from the field.

Table 10.27: Phytosociological parameters for different weeds in Glyphosate (Round up) treated plots during post-monsoon season.

Sl. No	Name of weeds	NI	NQ	F	D	A	RF	RD	RA	IVI	BM (gm)

.											
1	*Axonopus compressus*	11	4	40	1.1	2.75	8	2.12	2.12	12.24	0.3
2	*Borreria alata*	153	10	100	15.3	15.3	20	29.54	11.79	61.33	0.69
3	*Borreria ocymoides*	164	8	80	16.4	20.5	16	31.66	15.8	63.46	0.29
4	*Cyanthillium cinereum*	5	1	10	0.5	5	2	0.97	3.85	6.82	0.18
5	*Cyperus compressus*	7	1	10	0.7	7	2	1.35	5.4	8.75	0.16
6	*Cyperus pseudokyllingioides*	12	1	10	1.2	12	2	2.32	9.25	13.57	0.1
7	*Desmodium triflorum*	62	4	40	6.2	15.5	8	11.97	11.95	31.92	0.08
8	*Digitaria ciliaris*	10	1	10	1	10	2	1.93	7.71	11.64	0.23
9	*Emilia sonchifolia*	2	1	10	0.2	2	2	0.39	1.54	3.93	0.25
10	*Imperata cylindrica*	13	1	10	1.3	13	2	2.51	10.02	14.53	0.27
11	*Kyllinga nemoralis*	2	1	10	0.2	2	2	0.39	1.54	3.93	0.2
12	*Leucas indica*	4	1	10	0.4	4	2	0.77	3.08	5.85	0.75
13	*Mitracarpus verticillatus*	1	1	10	0.1	1	2	0.19	0.77	2.96	0.5
14	*Oldenlandia corymbosa*	6	3	30	0.6	2	6	1.16	1.54	8.7	0.1
15	*Paspalum scrobiculatum*	22	6	60	2.2	3.67	12	4.25	2.83	19.08	0.74
16	*Rungia pectinata*	1	1	10	0.1	1	2	0.19	0.77	2.96	1.5
17	*Saccharum spontaneum*	40	4	40	4	10	8	7.72	7.71	23.43	0.42
18	*Urochloa ramosa*	3	1	10	0.3	3	2	0.58	2.31	4.89	1.67

Table 10.28: Ten high IVI scoring weeds in Glyphosate (Round up) treated plots.

Name of weeds	RF	RD	RA	IVI	
Borreria ocymoides	16	31.66	15.8	63.46	1
Borreria alata	20	29.54	11.79	61.33	2
Desmodium triflorum	8	11.97	11.95	31.92	3
Saccharum spontaneum	8	7.72	7.71	23.43	4
Paspalum scrobiculatum	12	4.25	2.83	19.08	5
Imperata cylindrica	2	2.51	10.02	14.53	6
Cyperus pseudokyllingioides	2	2.32	9.25	13.57	7
Axonopus compressus	8	2.12	2.12	12.24	8
Digitaria ciliaris	2	1.93	7.71	11.64	9
Cyperus compressus	2	1.35	5.4	8.75	10

Table 10.29: Ten high biomass producing weeds in Glyphosate (Round up) treated plots.

Name of weeds	Biomass gm	
Urochloa ramosa	1.67	1
Rungia pectinata	1.5	2
Leucas indica	0.75	3
Paspalum scrobiculatum	0.74	4

Borreria alata	0.69	5
Mitracarpus verticillatus	0.5	6
Saccharum spontaneum	0.42	7
Axonopus compressus	0.3	8
Borreria ocymoides	0.29	9
Imperata cylindrica	0.27	10

In the plots treated with Glyphosate (Round up), *Borreria ocymoides* and *Borreria alata* recorded high population. This conforms to the findings of Rao and Rahman (1978). *Urochloa ramosa* recorded highest biomass in Glyphosate (Round up) treated plots (Table 10.29).

10.8.2. D. Phytosociological Observation in Control areas

As no herbicide was used so there was no death of any plant, which indicates that there was creation of no vacant spaces allowing other or newly grown plants to occupy the area. However, the result of processing of phytosociological data has been presented in Table 10.30.

Table 10.30: Phytosociological parameters for different weeds in Untreated Control plots during post-monsoon season.

Sl. No.	Name of weeds	NI	NQ	F	D	A	RF	RD	RA	IVI	BM (gm)
1	*Ageratum conyzoides*	316	6	60	31.6	52.67	5.61	16.51	18.39	40.51	0.54
2	*Axonopus compressus*	38	6	60	3.8	6.33	5.61	1.99	2.21	9.81	0.42
3	*Borreria alata*	663	10	100	66.3	66.3	9.35	34.64	23.15	67.14	0.53
4	*Borreria ocymoides*	321	9	90	32.1	35.67	8.41	16.77	12.45	37.63	0.25
5	*Centella asiatica*	1	1	10	0.1	1	0.93	0.05	0.35	1.33	0.05
6	*Crassocephalum crepidioides*	8	5	50	0.8	1.6	4.67	0.42	0.56	5.65	1.21
7	*Crotalaria pallida*	1	1	10	0.1	1	0.93	0.05	0.35	1.33	0.1
8	*Cyanthillium cinereum*	1	1	10	0.1	1	0.93	0.05	0.35	1.33	0.05
9	*Cynodon dactylon*	47	6	60	4.7	7.83	5.61	2.46	2.73	10.8	0.05
10	*Cyperus compressus*	7	3	30	0.7	2.33	2.8	0.37	0.81	3.98	0.11
11	*Desmodium triflorum*	200	9	90	20	22.22	8.41	10.45	7.76	26.62	0.16
12	*Digitaria ciliaris*	7	2	20	0.7	3.5	1.87	0.37	1.22	3.46	0.31
13	*Emilia sonchifolia*	49	6	60	4.9	8.17	5.61	2.56	2.85	11.02	0.15
14	*Eragrostis unioloides*	5	3	30	0.5	1.67	2.8	0.26	0.58	3.64	0.48
15	*Euphorbia hirta*	7	2	20	0.7	3.5	1.87	0.37	1.22	3.46	0.26
16	*Imperata cylindrica*	8	2	20	0.8	4	1.87	0.42	1.4	3.69	0.34
17	*Kyllinga nemoralis*	18	4	40	1.8	4.5	3.74	0.94	1.57	6.25	0.24
18	*Leucas indica*	6	1	10	0.6	6	0.93	0.31	2.09	3.33	2.5
19	*Lindernia crustacea*	2	1	10	0.2	2	0.93	0.1	0.7	1.73	0.05
20	*Mitracarpus verticillatus*	12	3	30	1.2	4	2.8	0.63	1.4	4.83	0.11
21	*Murdannia nudiflora*	3	2	20	0.3	1.5	1.87	0.16	0.52	2.55	0.1
22	*Oldenlandia corymbosa*	118	7	70	11.8	16.86	6.54	6.17	5.89	18.6	0.07

3	*Oxalis corniculata*	5	1	10	0.5	5	0.93	0.26	1.75	2.94	0.08
4	*Paspalum scrobiculatum*	6	2	20	0.6	3	1.87	0.31	1.05	3.23	1.48
5	*Phyllanthus urinaria*	3	2	20	0.3	1.5	1.87	0.16	0.52	2.55	0.05
6	*Pouzolzia zeylanica*	10	1	10	1	10	0.93	0.52	3.49	4.94	0.2
7	*Saccharum spontaneum*	39	5	50	3.9	7.8	4.67	2.04	2.72	9.43	0.65
8	*Solanum nigrum*	1	1	10	0.1	1	0.93	0.05	0.35	1.33	0.4
9	*Trema orientalis*	3	2	20	0.3	1.5	1.87	0.16	0.52	2.55	0.18
0	*Urochloa ramosa*	9	3	30	0.9	3	2.8	0.47	1.05	4.32	0.86

Table 10.31: Ten high IVI scoring weeds in Untreated Control plots.

Name of weeds	RF	RD	RA	IVI	
Borreria alata	9.35	34.64	23.15	67.14	1
Ageratum conyzoides	5.61	16.51	18.39	40.51	2
Borreria ocymoides	8.41	16.77	12.45	37.63	3
Desmodium triflorum	8.41	10.45	7.76	26.62	4
Oldenlandia corymbosa	6.54	6.17	5.89	18.6	5
Emilia sonchifolia	5.61	2.56	2.85	11.02	6
Cynodon dactylon	5.61	2.46	2.73	10.8	7
Axonopus compressus	5.61	1.99	2.21	9.81	8
Saccharum spontaneum	4.67	2.04	2.72	9.43	9
Kyllinga nemoralis	3.74	0.94	1.57	6.25	10

Table 10.32: Ten high biomass producing weeds in Untreated Control plots.

Name of weeds	Biomass gm	
Leucas indica	2.5	1
Paspalum scrobiculatum	1.48	2
Crassocephalum crepidioides	1.21	3
Urochloa ramosa	0.86	4
Saccharum spontaneum	0.65	5
Ageratum conyzoides	0.54	6
Borreria alata	0.53	7
Eragrostis unioloides	0.48	8
Axonopus compressus	0.42	9
Solanum nigrum	0.4	10

Under normal condition i.e. without spray of any chemicals, *Borreria alata, Ageratum conyzoides, Borreria ocymoides* have shown high percentage of coverage. While *Leucas indica* was shown to have highest biomass production.

10.8.3 Effect on yield

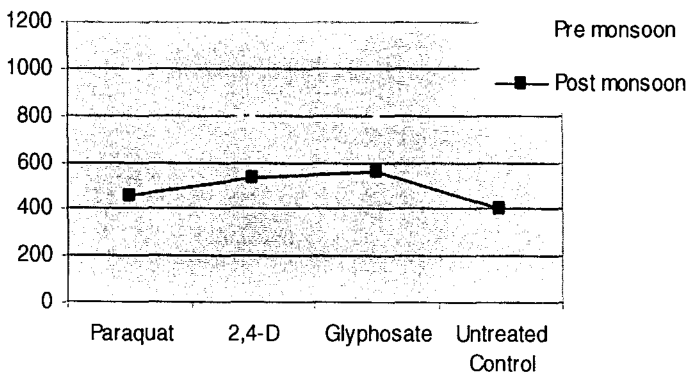
Weeds interfere with the yield of the crop. It is expected that if there is more weed the yield will be less and if weeds are removed then there should have increase in yield. So, the yield was recorded in the form of plucked green leaf and the result has been presented in Table 10.33 below.

Table 10.33: Yield of green tea (kg/ha) in Matigara Tea Estate under different treatment conditions (Total 6 rounds)

Season	Paraquat (Gramoxone)	2,4-D (Ankamine)	Glyphosate (Round up)	Untreated Control	S.E.	C.D. at 5% level	S.D.	C.V. (%)
Pre monsoon	**976.4**	**779.56**	**775.62**	**721.92**	**11.65**	**35.89**	**35.44**	**5.45**
Post monsoon	**455.12**	**532.35**	**560.4**	**402.62**	**14.22**	**43.82**	**33.58**	**8.61**

S.E. = Standard Error, C.D. = Critical Difference, S.D. = Standard Deviation, C.V. = Coefficient of variation

Fig. 10.1: Yield of green Tea (kg/ha) in different treatments



Yield data presented on Table transpires that the plots treated with Glyphosate had given highest yield followed by 2,4 – D and Paraquat. Untreated control registered lowest yield. Yield with Glyphosate treated was significantly higher than Paraquat and untreated control out not with 2,4 – D. All the three herbicides treatments yielded significantly higher than that of untreated control. This supplements the findings of all the weed scientists mentioned below:

10.8.4 Weed Control Efficiency

All methods adopted for any work can not be exactly equally effective. And, weed is a heterogeneous group of plants and all plants can not response in the exactly similar fashion. That means the efficiency of different weed killer chemicals vary. This is expressed as the Weed Control Efficiency of a herbicide.

10.8.4.A. In Premonsoon Treatments

The result has been presented in two tables. The first one, Table 10.34 presented result based on population structure of weed seven days after the treatment and, the second one is based on recorded dry matter (Table 10.35) produced after drying the living plants available on the eighth day after treatment.

Table 10.34: Weed Control Efficiency (WCE) on the basis of weed population of Pre monsoon Season

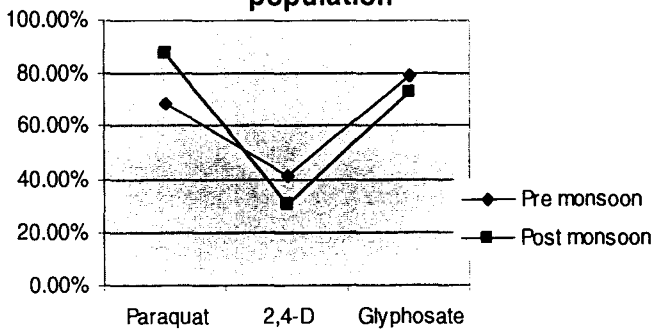
Paraquat (Gramoxone)	68.63%
2,4 – D (Ankamine)	41.06%
Glyphosate (Round up)	79.76%

Table 10.35: Weed Control Efficiency (WCE) on the basis of weed dry matter of Pre monsoon Season

Paraquat (Gramoxone	80.37%
2,4 – D (Ankamine)	45.63%
Glyphosate (Round up)	94.01%

In both type of computation, Glyphosphate has been determined as the most efficient herbicide used in this area. This is followed by Paraquat and for 2,4 – D the efiiciency is below 50% in both the cases.

Fig. 10.2: WCE on the basis of weed population



10.8.4.B. In Postmonsoon Treatments

The result has been presented in two tables. The first one, Table 10.36 presented result based on population structure of weed seven days after the treatment and, the second one is based on recorded dry matter (Table 10.35) produced after drying the living plants available on the eighth day after treatment.

Table 10.37: Weed Control Efficiency (WCE) on the basis of weed population of Post monsoon Season

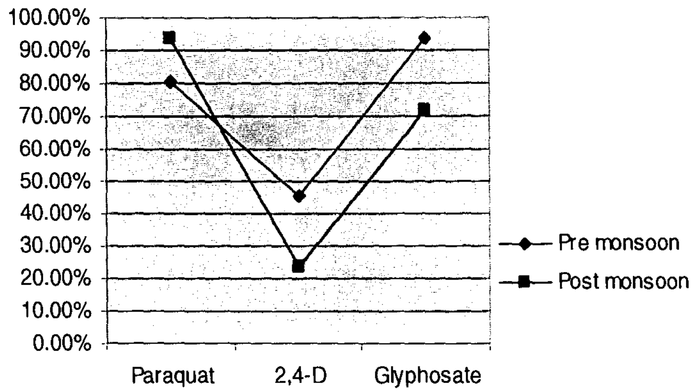
Paraquat (Gramoxone)	88.14%
2,4 – D (Ankamine)	30.72%

Glyphosate (Round up)	72.94%

Table 10.37: Weed Control Efficiency (WCE) on the basis of weed dry matter of Post monsoon Season

Paraquat (Gramoxone	93.79%
2,4 – D (Ankamine)	23.65%
Glyphosate (Round up)	71.63%

Fig. 10.3: WCE on the basis of weed dry matter



The result is little different during this postmonsoon period. Here, Paraquat has been determined as the most efficient weed killer and is immediately followed by Glyphosphate. The efficiency of 2,4 – D is much less during this postmonsoon period.

So, both Paraquat and Glyphosate were found to be quite effective in controlling weeds in the treated tea gardens of Terai-Duars area. 2,4-D was not found to be effective for this zone.

10.9 Discussion

Singh (2005) has reported that the crop loss due to weed is 10 – 15 %. Chakravartee *et al* (1998) also reported 10 – 15 % crop loss and also mentioned that it can take up to 252 kg of soil Nitrogen per hectare annually in young tea. They have reported that weed control in tea by using herbicides has been found to be advantageous with a cost benefit ratio of 1: 10 or more. Ordish (1952) has reported that loss caused by weeds may range from 10 – 40 %. Venkataramani (1970) opined that traditional method of weed control by manual scraping, digging or pulling of weeds is neither efficient nor economical today. It has been reported that out of total annual loss of agricultural produce from various parts of India – weeds accounted for 45 %, insects – 30 %, diseases – 20 % and other pests 5 % (Rao 1983). In many instances loss due to weeds has been estimated to as high as 70 – 80 % (Islam 1996). Eden (1947) found that the uncontrolled weed growth removed half as much as Nitrogen as that removed by tea at its most productive period, an equal amount of Phosphate and twice the amount of Potash. He observed that grasses are more severe competitors for Nitrogen than broad-leaved weeds. Glover (1952) reported that in Assam, the soil Nitrate content in the topsoil under a thick cover of *Imperata cylindrica* was about 0.1 ppm compared to 5 – 10 ppm in clean soil. Cramer (1967) estimated the worldwide tea crop lost due to weeds is approximately 10 – 15 %. Manual control of weeds does not serve the purpose. In East Africa, it was observed that non-removal of only 1 % of the existing roots of *Digitaria scalarum* lead to 30 % reinfestation of the area in only eight weeks (Fleming 1958). Dutta (1961) found sickling to be quite inefficient in controlling total weeds. Dutta (1965) had listed *Setaria palmifolia, Imperata cylindrica, Arundinella bengalensis* and *Sacharum spontaneum* as the most serious monocot weeds and *Mikania micrantha* and *Borreria hispida* as the most troublesome dicotyledonous weeds in tea. Darter (1968) and Newing (1971) found that certain weeds like *Senecio, Borreria, Commelina* and *Polygonum* were resistant to paraquat.

As per the Planters' Handbook published by Tea Research Association (Barbora 1996), 2,4-D is able to control all dicot (broad leaved) weeds except *Borreria ,Eupatorium* etc. According to him, paraquat and glyphosate are able to control monocot weeds very effectively. Sharma & Venkataram (1982) considered *Cynodon dactylon, Imperata cylindrica, Panicum repens, Axonopus compressus , Paspalum conjugatum* as the most troublesome weeds in tea. They have mentioned that when grassy weed flora are controlled, species like *Ageratum conyziodes, Bidens biternata, Borreria ocymoides, Drymaria diandra, Oxalis corniculata, Oxalis latifolia, Polygonum repens* increase their population. They observed that weeds like *Borreria latifolia, Commelina, Crassocephalum crepidiodes, Galinsoga parviflora, Mimosa pudica, Sida rhombifolia, Spilanthes acmella, Polygonum chinensis* etc are some of the more common and widely distributed deep rooted broad leaves weeds.

Rao & Rahman (1978) had observed that glyphosate @ 2-3 litres per hectare had a good control on monocot weeds and *Polygonum* sp, but it was not effective against *Borreria*. However, Rahman *et al* (1975) in an experiment conducted at Borbhetta in 1972 found that *Borreria* could be controlled fully by glyphosate @ 6 litres per hectare, but it was not fully effective against *Commelina benghalensis*. But, Kabir *et al* (1991) have reported that both *Borreria* and *Commelina* could be controlled at lower doses also. Rahman (1977) has opined that a number of problematic weeds have appeared as a result of the use of herbicides e.g. *Oxalis, Paspalum* and *Polygonum*. Kabir *et al* (1991) found glyphosate to be the most effective herbicide against most of the weeds of tea. Kabir & Ghosh-Hajra (1993) also observed that glyphosate was able to control most of the tea garden weeds. Basu (1972) had reported that 2,4-D is not effective against grasses. In a long-term experiment, it was found that minimum soil disturbances due to spry of herbicide resulted in 12 % yield increase (Dey 1972), Trapaidze & Narwaniya (1971) observed that the top 10 cm soil in the herbicide treated plots had 1% -3 % more soil moisture than in the untreated plots.

The present work has significantly contributed to the methods of weed control in Tea Gardens of Terai and Duars. Chemicals need to work under the influences of local environment and the genetic make up of the assemblages of taxonomically very widely diversified wild plants. The use of 2,4 – D can be avoided in this area and stress may be given on Paraquat and Glyphosate.

However, the presently increasing awareness against the use of chemicals in agriculture and horticulture prompted many gardens to stop using herbicides and even the chemical fertilizers. This is a healthy trend and, may be, in near future we shall be able to develop proper local methodology in controlling weeds of our valuable plantations

CHAPTER 11

ALLELOPATHIC EFFECTS OF WEEDS ON TEA SEED GERMINATION

One needs his own space for survival. Equally, plants need to have their own space, too. The environment, shared by all, contains limited resources and less-than-ideal growth conditions. All living things have strategies to thrive in this intense struggle for life. There are not a lot of clear winners or losers, but many survivors. Man or other animals can walk away or shut the door in front of the invaders, but plants can not do the same to save their space for survival as they can't walk or run away. Plants have a different way of acquiring or protecting their own space. They use **Allelopathy**, which means, **"Power"**

11.1 WHAT IS ALLELOPATHY?

Allelopathy is a chemical process that a plant uses to keep other plants from growing too close to it.

The term "*Allelopathy*" is from Greek meaning "to suffer from each other." The word derived from two separate words: *allelon* which means 'of each other', and *pathos* which means, 'to suffer'. Allelopathy has traditionally been considered only the negative chemical warfare or chemical inhibition of one species by another. Modern researches suggest that allelopathic effects can be of both positive and negative, depending upon the doses and organisms involved.

Allelopathy denotes that body of scientific knowledge which concerns the production of specific biomolecules by one plant, mostly secondary metabolites, that can induce suffering in, or give benefit to, another plant. This concept suggests that biomolecules (specifically termed as '*allelochemicals*') produced by a plant escape into the environment and subsequently influence the growth and development of other neighbouring plants.

Allelopathic chemicals can be present in any part of the plant like leaves, flowers, roots, fruits or stems. They can also be found in the surrounding soil. Target species are affected by these toxins in many different ways. The toxic chemicals may inhibit shoot/ root growth, they may inhibit nutrient uptake, or they may attack a naturally occurring symbiotic relationship thereby destroying the plant's usable source of a nutrient.

In 1996, *International Allelopathic Society* broadened its definition that allelopathy refers to any process involving secondary metabolites produced by plants, microorganisms, viruses and fungi that influence the growth and development of Agricultural and Biological Systems.

Different types of plants grow at a place forming an association. But in such association different species of plants are not completely harmless to other species. Even in cultivated fields, weeds of different nature grow among the crop plants and plants growing along the boundaries of the crop fields also having some effects on cultivation. It has been observed that the residual parts of many species of plants exude some chemicals which inhibit or promote the growth of associated plants. Any direct or indirect inhibitory or stimulatory effect of one plant (including microorganisms) on another through the production of chemical compounds that escape into the environment has been defined as *Allelopathy* by Rice (1984).

11.2 History

Theophrastus (ca. 300 B.C.), a student and successor to Aristotle, wrote about allelopathic reactions in his botanical works. He has been referred as the "father of Botany", and wrote how chickpea "exhausts" the soil and destroys weeds.

In 1 C.E., Gaius Plinius Secundus, a roman scholar and naturalist, wrote about how chick pea and barley "scorch up" corn land. He also mentioned that Walnut trees are toxic to other plants.

In 1832, Augustin Pyramus de Candolle, a botanist and naturalist, suggested that chemicals released by the crop caused soil sickness.

In 1907 – 1909, two researchers, Schreiner and Reed investigated leading to the isolation of a number of phytotoxic chemicals from plants and soils.

The term 'Allelopathy' was first coined by Prof. Hans Molisch, a German Plant Physiologist in 1937 who referred it as biochemical interactions between all types of plants including microorganisms. With this terminology, he covered both harmful and beneficial reciprocal biochemical interactions. Molisch's definition has been invariably followed by most of the investigators in Asia and Europe.

Thereafter, worldwide, a lot of allelopathic research was conducted in various fields of Agricultural and Biological Sciences.

Allelopathic effects of weeds on different crops/ crop varieties were reported by Tukey (1969), Whittaker (1971), Alsaadawi & Rice (1982a), Tripathi *et al* (1984), Rice (1984) and Pellisier (1993). Tukey (1970) stated that the most physiological and biochemical processes of plants have been reported to be adversely affected by the allelochemicals on addition to the soil or growth medium in the form of ground leaf litter, leaf leachates or extracts of plants and plant parts. Khailov (1974) mentioned that the effect of any given compound might be 'inhibitory' or 'stimulatory' which, in tern, depends on the concentration of the compounds in the surrounding medium. Del Moral & Cates (1971) defined allelopathy as the inhibitor of germination, growth and metabolism of one plant due to the release of organic chemicals by another. According to Putnam & Duke (1978), allelopathy may be a habitat factor in enhancing dominance by certain weeds in a variety of agro-ecosystems. Harper (1977) proposed the blanket term '*interference*', comprising all chances in the environment, brought about by the proximity of the individuals and also includes 'the production of toxins'. Salisbury (1957) certainly indicated the presence of allelopathic reaction when he mentioned that anything that prevents a seed from sprouting and discourages a species from thriving must have a powerful influence on the composition of the plant community.

According to Rice (1984), Theophrastus (Ca 300 BC) observed and described similar inhibitory effects of crop plants on other crops over 2000 years ago. Later on, no scientific research was done to verify such observations until early part of the twentieth century. Since the turn of the century allelopathic research has been mainly restricted on well documented over the past few decades particularly in relation to its significance in both natural and agro-ecosystems [Rakhteenko *et al.*, 1973; Rice, 1976, 1979; Putnam & Duke, 1978; Rieeta 1981 and Bhowmik & Doll, 1982]. In agricultural ecosystems there are many agrestals whose allelopathic influences also have been proved in the laboratory [Giimmer & Beyer, 1960; Martin & Rademacher, 1960 and Welbank, 1960; Grodzinskiy, 1965].

The ecological significance of allelopathic influence has been pointed out by Whittaker & Feeney (1971), Datta & Sinha Roy (1974), Chatterji (1975) and Lodhi (1975a). Muller (1966, 1969, 1970, 1974) demonstrated the significance of allelopathy in relation to environmental complex and threw light on the allelopathic mechanism for a dominant vegetation. In forestry, the importance of allelopathic research on herbaceous or woody seed plants, ferns as well as mycorrhizae and other microorganisms can be ascertained. Moreover, allelopathy has also been implicated in many fields of plant sciences.

Rice (1984) mentioned the effects of weed interference of crop yields, effect of crop plants on other crop plants and effect of crop plants on weeds. In the field of forestry the importance of the studies of an allelopathic effect of woody seed plants or herbaceous angiosperms, ferns, as well as micorrhizae and other microorganisms can be realized. Allelopathy has also been implicated in case of plant pathology. In the last three decades, allelopathic research has been mainly carried out in the United States in general and

California and Oklahoma in particular. Both these states belong to the semi-arid climatic zone, there being very little or no information from the humid or sub-humid region, though the latter areas are covered with luxuriant vegetation and offered an excellent aspect for plant ecologists to do their work (Chou, 1977).

At present, considerable information are available on the role of allelopathy in cultivated and natural ecosystems. This phenomenon was studied in the last few decades in an extensive and critical way by a large number of workers in different parts of the world including Bonner & Galston (1944), Bonner(1950), Evenari (1961), Muller (1965, 1969), Rice (1967, 1972, 1976), Groner (1974, 1975), Newman & Rovira (1975), Al-Naib & Al-Mousawi (1976), Gliessman (1976, 1978), Lodhi (1976, 1978), Ballester *et al.* (1977), Newman & Miller (1977), Weaver & Klarich (1977). Fisher *et al.* (1978), Bell & Klikoff (1979), Lodhi & Killingbeck (1980), Stachon & Zimdahi (1980), Lovett & Jackson (1980), Younger *et al.* (1980), Lovett & Duffield (1981), Jobidon & Thibault (1982).

In India Datta & Sinha-Roy (1973, 1974, 1975, 1983), Sarma (1974a, 1974b), Datta & Chakraborty (1975, 1978, 1982a, 1982b), Pandya (1975, 1976, 1977), Murthy & Ravindra (1975), Murthy & Nagodra (1977), Ashraf & Sen (1978), Datta & Chatterjee (1980a, 1980b, 1980c), Datta & Bandyopadhyay (1981, 1989), Datta & Ghosh (1982, 1987, 1988), Datta & Dasmahapatra (1984, 1988), Gautam & Bishnoi (1990), Sundaramoorthy & Kalra (1991), Acharia & Sinha (1992), Agarwal & Anand (1992), Kohli & Batish (1994), Prasad (1995), Kalita & Dey (1998), Acharyya (1998), Kalita (1999), Sinha & Deo (1999), Kadir (2001), Agarwal *et al.* (2002), Goyal & Singh (2003), and Lama (2004) demonstrated allelopathic influences of some weedy species of plants of natural and cultivated vegetations.

11.3 Are all plants Allelopathic?

All the plants are not allelopathic. Some, though exhibit these allelopathic tendencies, may actually be displaying aggressive competition of a non-chemical form. Much of the controversy surrounding allelopathy is in trying to distinguish the type of competition being displayed. In general, if it is of a chemical nature, then the plant is considered allelopathic.

11.4 How Does Allelopathy Work?

Allelopathy is a chemical process that a plant uses to keep other plants out of its space. There are four general ways by means of which toxic metabolites get out of plants, these are weathering, leaching, exudation and volatilization (Tukey, 1969; Datta & Sinha Roy, 1974; Datta & Chatterjee, 1980a).

- Plants release chemicals that affect other plant's growth from their roots into the ground. The plants trying to grow near the allelopathic plant absorb those chemicals from the soil and are unable to live.
- Some plants release chemicals from their roots that will slow down or stop the process of photosynthesis of others. The chemicals actually change the amount of chlorophyll the plant produces. This affects the amount of food the plant can make. If a plant can't make food, naturally, it will die.
- Sometimes plants release chemicals in the form of gasses. These gasses are released through the small pores in the plant's leaves. Other plants absorb the gas and are stunted or die.

11.5 Nature's Impact:

Competition is used by both plants and animals to assure a place in nature. Plants will compete for sunlight, water, nutrients etc. and like animals, for territory. Competition, like parasitism, disease and predation, influences distribution and amount of organisms in an ecosystem. The interactions of ecosystems define an environment. When organisms compete with one another, they create the potential for resource limitations and possible extinctions. Allelopathy is a form of chemical competition. The allelopathic plant is competing through 'interference' chemicals and prevents other plants from using the available resources and thus influence the evolution and distribution of other species. One might say that allelopathic plants control the environments in which they live.

As for example, some pine trees are allelopathic. When their needles fall onto the ground and decompose, those release some acids or produce acid during decomposition, which goes into the soil. The soil absorbs acid from the decomposing needles. This acid doesn't hurt the pine tree, but discourages or kills other plants growing near it. This acid in the soil keeps unwanted plants from growing near the pine tree. Some other plants are also known to use allelopathic weapon to assure their space in nature.

Chemical signals are very common in many organisms. Both plants and animals use odours and scents as communication mechanisms. For example, in the animal kingdom insects use chemical signals as sex attractants, trail markers, and alarm calls. Among plants, many of the angiosperms (flowering plants) use strong floral scents to attract potential pollinators. And some organisms (both plants and animals) use airborne chemical compounds to discourage the presence of other organisms. Scientists use the term allelopathy to refer the biochemical interactions between different plants. The term usually implies that one plant produces one or more chemicals that have an inhibitory effect on nearby plants, but allelopathy may also include stimulatory effects.

Allelopathy is understood to mean the influence exerted by vegetable products (fruits) on other plants or plants of the same species through the gases they give off, such as carbon dioxide (CO_2), ethylene (ethane, C_2H_4) and aromatic substances, which reach their peak in particular at the climacteric (= time of maximum respiration). Due to this reason the fruit and vegetable species are not stored together. On the other hand, allelopathy may be used to advantage in ripening warehouses to bring about ripening at the desired time by exposure to ethylene.

There is convincing evidence that allelopathic interactions between plants play a crucial role in natural as well as in manipulated ecosystems:

1. The credit for a specific vegetation pattern has mostly been given to the competition. However, in recent times evidence is accumulating that all types of plants, viz. herbs, shrubs and trees, allelopathically affect the patterning of vegetation, largely in their immediate vicinity.
2. One of the most worked out aspects of allelopathy in manipulated ecosystems is the role of allelopathy in agriculture. In this, the effects of weeds on crops, crops on

weeds and crops on crops have been invariably emphasized. In addition, the possibility of using allelochemicals as growth regulators and natural pesticides (number of them are either commercially available or in the process of large-scale manufacture) promotes sustainable agriculture.

3. Allelopathic interactions have been demonstrated to play a crucial role in natural as well as man-made forests. Such interactions are pivotal in determining the composition of the vegetation growing as under-storey and in understanding the forest regeneration problems. Results obtained so far have shown that almost all types of plants (viz. angiosperms, gymnosperms, lower plants like ferns and micro-organisms, including mycorrhizae) present in forests indulge in allelopathic interactions.
4. Some of the recent findings have demonstrated that tree-crop interactions may have significant bearings on the total productivity of an agroforestry system (simultaneously or sequentially combined production of crops and forest plants). Therefore, it seems essential that the allelopathic compatibility of crops with trees should be checked before being introduced to an agroforestry system.

The above-quoted examples are some of the major aspects of allelopathic interactions in natural and manipulated ecosystems. Scientists study allelopathy and use their research to find natural, healthier herbicides and pesticides to stunt or kill specific unwanted plants and insects, but not to kill our desired plants.

In the next Millennium, worldwide there will be increase in demand for better quality food and in large quantity due to increased human population. Therefore, for sustainability of Agriculture, we need to minimize the use of presently marketed pesticides (like weedicides, insecticides, nematicides, fungicides) in crop production through the use of allelopathic strategies for pest management. The present pesticides used for control of agricultural pests have caused many problems, viz., development of resistance in organisms, environmental pollution, toxicity related health hazards in humans and livestock. Studies have shown a great potential of allelochemicals in pest- control, thereby, these may minimize or eliminate the use of present day pesticides.

Besides, allelopathy has many applications in agroecosystems and thus provides basis to Sustainable Agriculture. Therefore, it becomes a priority area of multidisciplinary research in developed countries and currently research is being conducted in most of the countries. To provide clean environment to our future generations, to avoid health hazards in human and livestock and for sustainability of agriculture, adoption of allelopathic strategies in farming is essential.

No allelopathic study on tea caused by weed residue has been undertaken earlier by any worker. Therefore the present investigation was carried out to determine the presence of any allelopathic effect of the associate plants of Tea, on its seeds germination and on the early growth of seedlings.

Taking all the above aspects in mind, the present work is restricted only on the effects of leachets and extracts of aerial parts of six commonly associated weed species to test their probable allelopathic effects upon a certified cultivar of TEA (TS $_{520}$). All these weeds are dicotyledonous *viz. Drymaria villosa* , *Galinsoga parviflora, Persicaria runcinata* were selected from the high altitude tea gardens and other three *viz. Ageratum conyzoides, Borreria latifolia* and *Mikania micrantha* were selected from the Tea Gardens of Terai-Duars regions.

In the present investigation, the effect of derived concentrations (i.e. 1:2.5, 1:5, 1:10 and 1:20) of leachets and extracts individually of aerial parts of test plants i.e. stem, leaves and inflorescence have been studied. For each desired concentration of leachets or extracts and for control (i.e. with distilled water) two replicates each with 10 seeds of tea and 25 ml of solution has been used.

Observations analyzed on the percentage of seed germination, percentage of inhibition or stimulation of germination, percentage of non-viability, percentile of viability, mean root length, mean shoot length, mean seedling length, percentage of inhibition or stimulation of root, shoot and seedling length, shoot vigour index, root vigour index, seedling vigour index and shoot: root ratio of seedling under different treatments. The Materials and methods used for this work have been detailed in Chapter-5.

11.6 Results and Discussion: Effects of Leachates

In this investigation leachates of six associated species of *Camellia sinensis* namely, *Ageratum conyzoides* L., *Borreria latifolia* (Aublet) Schumann, *Drymaria villosa* Chamisso et Schlechtendal, *Galinsoga parviflora* Cavanilles, *Mikania micrantha* Kunth, *Persicaria runcinata* (D. Don) H. Gross were tested for their allelopathic effects on the germination of seeds and seedling growth of *Camellia sinensis* and the results of those experiments are presented below.

11.6.1 Effects of Leachates of *Ageratum conyzoides* L. on Seed Germination and Seedling Growth of *Camellia sinensis* (L.) O. Kuntze

Table-11.1 and Plate-**XIV** exhibit the effect of leachates of aerial parts of *Ageratum conyzoides* on seed germination and seedling growth of *Camellia sinensis.* Results reveal that higher concentration leachates of 1:2.5 and 1:5 dilutions exhibited 15.96 % and 15.96 % inhibition on seed germination (71.43 %) as against control (85 %), whereas with the dilution of leachates at 1:10 and 1:20 the percentage of germination was increased to 85.71 and 100 respectively showed 0.84 % and 17.65 % stimulation on seed germination. The Leachates concentration of 1:20 showed no effect on seed germination in comparison with control. Increase in concentration of the leachates (i.e. 1:20, 1:10, 1:5 and 1:2.5) led to decline of the percentile of viability (100.00, 85.71, 71.43 and 71.43 respectively). In this investigation it was observed that the highest concentration of leachates of 1:2.5 showed delayed germination and it took 7 days to germinate the first seed. Afterwards with the decreasing concentration (1:5, 1:10 and 1:20) it was first and took 4 days to germinate the first seed. While in control the first seed germinated after 4 days.

The seedling growth of *Camellia sinensis* was affected variably in different concentrations of Leachates of *Ageratum conyzoides.* Maximum shoot length was recorded at 1:10 concentration of leachate (1.28 cm). The higher concentration of leachates i.e. 1:2.5 and 1:5; and lowest dilution of leachets 1: 20 caused 39.62, 19.81 and 15.09 % inhibition in shoot length, respectively when compared to control. But the diluted leachate at 1:10 level showed stimulatory effect caused 20.75 % stimulation in shoot length as against the control.

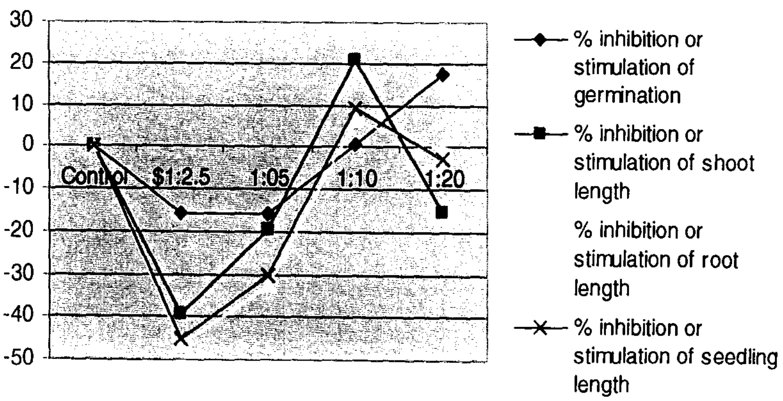
Table 11.1. Effect of leachates of aerial parts of *Ageratum conyzoides* L. on seed germination and seedling growth of *Camellia sinensis* (L.) O. Kuntze

PARAMETERS	CONCENTRATION OF SOLUTIONS				
	Control	1:2.5	1:5	1:10	1:20
Germination percentage	85.00	71.43	71.43	85.71	100
Germination % inhibition or stimulation	00.00	- 15.96	- 15.96	+0.84	+ 17.65
Percentile of viability	85.00	71.43	71.43	85.71	100
Nonviable Percentage	15.00	28.57	28.57	14.29	00.00
Mean shoot length (cm) per seedling	1.06	0.64	0.85	1.28	0.9
Percentage of inhibition or stimulation of shoot length	00.00	- 39.62	- 19.81	+ 20.75	- 15.09
Mean root length (cm) per seedling	4.74	2.53	3.2	5.05	4.73
Percentage of inhibition or stimulation of root length	00.00	- 46.62	- 32.49	+ 6.54	- 0.21
Mean total length (cm) per seedling	5.8	3.17	4.05	6.33	5.63
Percentage of inhibition or stimulation of seedling length	00.00	- 45.34	- 30.17	+ 9.14	- 2.93
Shoot vigour index	90.1	45.72	60.72	109.71	90.0
Root vigour index	402.9	180.72	228.58	432.84	473.0
Seedling vigour index	493.0	226.44	289.3	542.55	563.0
Shoot / Root ratio	0.22	0.25	0.27	0.25	0.19

+ / - Signs indicates stimulatory / inhibitory effect of Leachates.

On the other hand, the leachates of *Ageratum conyzoides* showed strong inhibitory effect on root growth of *Camellia sinensis* at the higher concentration i.e. 1:2.5 and 1:5 exhibited 46.62 and 32.49 % inhibition in root length, respectively, as compared to control. Although with the dilution of leachates the inhibitory effect in root length was decreased. At the lower concentration of leachates i.e. 1:10 showed slight 6.54 % stimulation and whereas 1:20 dilution level exhibited least 0.21 % inhibition in root length as compared to control, respectively. In spite of that root hairs were seen at 1:5 concentration and lateral roots were also developed at lower concentrations of 1:10. In control there was no development of root hairs or the initiation lateral roots.

Fig. 11.1: Effect of leachates of *Ageratum conyzoides*



Moreover, compared to the control (5.8 cm), the total length of seedling of *Camellia sinensis* was appreciably smaller in all concentrations of leatchates except 1:10 dilution. At the concentrations of 1:2.5, 1:5 and 1:20 levels exhibited 45.34, 30.17 and 2.93 % inhibition whereas lower dilution 1:10 caused 9.14 % stimulation of seedling length.

In this study it was seen that the shoot vigour index was more at concentration of 1:10 but seedling vigour index and root vigour index were more in all diluted concentrations of Leachates (1:10 and 1:20) in comparison with the control. With 1:2.5, 1:5 and 1:10 dilutions the shoot: root ratio of seedling was higher (0.25, 0.27 and 0.25, respectively) than that of the control (0.22) indicating more inhibition of root growth as compared to that of shoot.

11.6.2 Effects of Leachates of *Borreria alata* (Aublet) chumann on Seed Germination and Seedling Growth of *Camellia sinensis* (L.) O. Kuntze

Table-11.2 and Plate XIV exhibits the effects of leachates of aerial parts of *Borreria alata* on seed germination and seedling growth of *Camellia sinensis*. Results revealed that leachates at the concentration of 1:2.5 exhibited 32.78 % strong inhibition on seed germination (57.14 %) as against control (85 %), whereas with the dilution of leachates at 1:5, 1:10 and 1:20 the percentage of germination was increased to 71.43, 71.43 and 85.71, respectively. At the concentration of 1:5, 1:10 exhibited the same inhibition rate i.e. 15.96%. But, the lowest concentration 1:20 showed least stimulatory effect and caused 0.84 % stimulation on seed germination in comparison with control. Increase in concentration of the leachates (i.e. 1:20, 1:10, 1:5 and 1:2.5) led to decline of the percentile of viability (100.00, 83.34, 83.34 and 66.67 respectively). The highest concentration of leachates of 1:2.5 showed delayed germination and it took 11 days to germinate the first seed. Afterwards with the decreasing concentration (1:5, 1:10 and 1:20) it was fast and took only 4 days to germinate the first seed. While in control the first seed germinated after 4 days. Development of root hairs was seen at 1:2.5 and 1:5 concentrations, but lateral root initiation was prohibited. Whereas in control there was no initiation of root hairs or lateral roots.

The leachates of *Borreria alata* showed strong inhibitory effect on shoot growth of *Camellia sinensis*. Maximum shoot length was recorded at 1:20 concentration of leachate (1.17 cm) and thereafter it started declining with increasing concentrations. The higher concentration of leachates i.e. 1:2.5, 1:5 and 1:10 showed strong inhibitory effect on shoot growth of *Camellia sinensis*. Although with the dilution of leachates the inhibitory effect in shoot length was decreased (48.11, 43.40 and 36.79 % inhibition) as compared to control. But the diluted leachates at 1:20 level showed stimulatory effect that caused 10.38 % stimulation in shoot length as against control. On the other hand, the leachates of *Borreria alata* showed variable effect on root growth of *Camellia sinensis* in different concentrations. At the concentrations of leachates of 1:2.5 and 1:10 showed inhibitory effect on root growth, resulting (13.50 and 2.32 % inhibition) as compared to control, respectively. Whereas with the dilution of leachates at 1:5 and 1:20 showed stimulatory effect that caused 0.21 and 8.23 % stimulation in root elongation as against the control. The seedling growth of *Camellia sinensis* was affected variably in different concentrations of leachate of *Borreria alata*. Moreover, as compared to the control (5.8 cm), the total length of seedling of *Camellia sinensis* was smaller in higher concentrations of leatchates of 1:2.5, 1:5 and 1:10 (i.e. 4.65, 5.35, and 5.3 cm). But the diluted leachates at 1:20 level showed stimulatory effect caused 8.62 % stimulation in seedling length as against control.

Table 11.2. Effect of leachates of aerial parts of *Borreria alata* (Aublet) Schumann on seed germination and seedling growth of *Camellia sinensis* (L.) O. Kuntze

PARAMETERS	CONCENTRATION OF SOLUTIONS				
	Control	1:2.5	1:5	1:10	1:20
Germination percentage	85.0	51.14	71.43	71.43	85.71
Germination % inhibition or stimulation	00.00	- 31.78	- 15.96	- 15.96	+ 0.84
Percentile of viability	99.17	66.67	83.34	83.34	100.0
Nonviable Percentage	15.0	42.86	28.57	28.57	14.29
Mean shoot length (cm) per seedling	1.06	0.55	0.6	0.67	1.17
Percentage of inhibition or stimulation of shoot length	00.00	- 48.1	- 43.4	- 36.79	+ 10.38
Mean root length (cm) per seedling	4.74	4.10	4.75	4.63	5.13
Percentage of inhibition or stimulation of root length	00.00	- 13.5	+ 0.21	- 2.32	+ 8.23
Mean total length (cm) per seedling	5.8	4.65	5.35	5.3	6.3
Percentage of inhibition or stimulation of seedling length	00.00	- 19.83	- 7.76	- 8.62	+ 8.62
Shoot vigour index	90.1	31.43	42.86	47.86	100.28
Root vigour index	402.9	234.27	339.29	330.72	439.69
Seedling vigour index	493.0	265.7	382.15	378.58	539.97
Shoot / Root ratio	0.22	0.13	0.13	0.14	0.23

+ / - Signs indicates stimulatory / inhibitory effect of Leachates.

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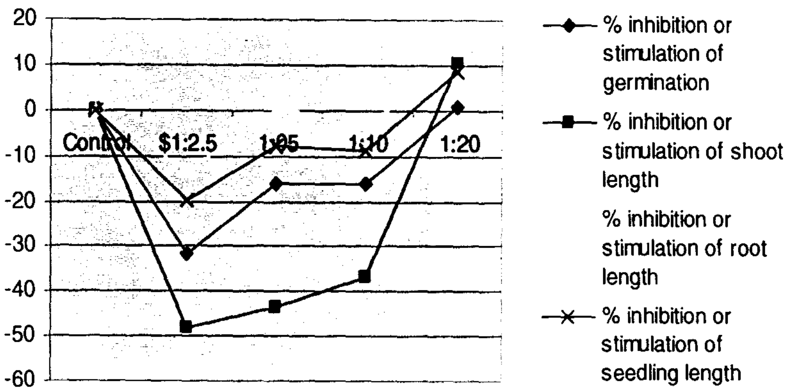
Fig. 11.2: Effect of leachates of *Borreria alata*



In this study it was seen that the shoot vigour index, root vigour index, and seedling vigour index were less at higher concentrations of leachets of 1:2.5, 1:5, 1:10 level. But at 1:20 concentration of leachates shoot vigour index, root vigour index, and seedling vigour index were more in comparison to the control. The shoot: root ratio followed a similar pattern of response. The shoot: root ratio of seedlings was slightly affected (0.13, 0.13, and 0.14) at all the higher concentrations of Leachates in comparison to control (0.22). But in lowest concentration of 1:20 it was increased (0.23) indicating more inhibition of shoot length than that of root length.

11.6.3 Effects of Leachates of *Drymaria villosa* Chamisso et Schlechtendal on Seed Germination and Seedling Growth of *Camellia sinensis* (L.) O. Kuntze

Table-11.3 exhibit the effect of leachates of aerial parts of *Drymaria cordata* on seed germination and seedling growth of *Camellia sinensis*. Results reveal that leachates at the concentration of 1:2.5 and 1:10 exhibited 15.96 % and 15.96 % caused 71.43 % inhibition on seed germination as against 85 % in control; whereas at the concentrations 1:5 and 1:20 exhibited the same percentage of germination was increased to 85.71. At the lowest concentration of 1:5 and 1:20 showed least stimulatory effect and caused only 0.84 % stimulation on seed-germination when compares to the control. Increase in concentration of the leachates (i.e. 1:20, 1:10, 1:5 and 1:2.5) led to decline of the percentile of viability (100.00, 83.34, 100.00 and 83.34 respectively). All the concentrations of leachates except 1:20 level took 4 days to germinate the first seed. Diluted concentration of leachets 1:20 showed delayed germination and took 7 days to germinate the first seed. While in control the first seed germinated after 4 days. In spite of that lateral roots were also developed at the lower concentration (1:10). Whereas in control there was no initiation of root hairs or lateral roots.

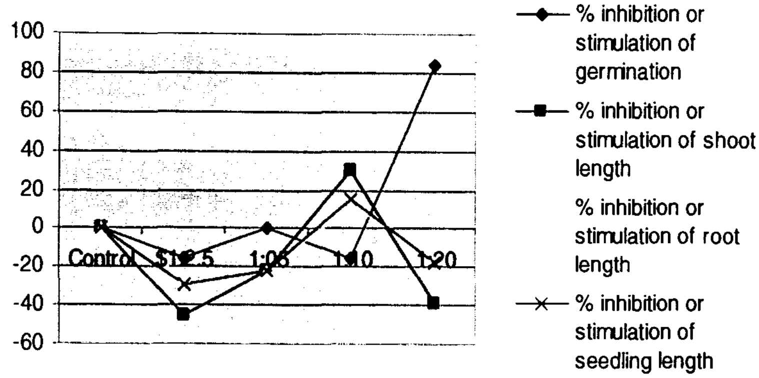
Table 11.3. Effect of leachates of aerial parts of *Drymaria villosa* Chamisso et Schlechtendal on seed germination and seedling growth of *Camellia sinensis* (L.) O. Kuntze

PARAMETERS	CONCENTRATION OF SOLUTIONS				
	Control	1:2.5	1:5	1:10	1:20
Germination percentage	85.0	71.43	85.71	71.43	85.71
Germination % inhibition or stimulation	00.00	- 15.96	+ 0.84	- 15.96	+ 84.0
Percentile of viability	99.17	83.34	100	83.34	100
Nonviable Percentage	15.0	28.57	14.29	28.57	14.29
Mean shoot length (cm) per seedling	1.06	0.58	0.83	1.38	0.65
Percentage of inhibition or stimulation of shoot length	00.00	- 45.28	- 21.70	+30.19	- 38.68
Mean root length (cm) per seedling	4.74	3.55	3.68	5.3	4.12
Percentage of inhibition or stimulation of root length	00.00	- 25.11	- 22.36	+ 11.81	- 13.08
Mean total length (cm) per seedling	5.8	4.13	4.51	6.68	4.77
Percentage of inhibition or stimulation of seedling length	00.00	- 28.79	- 22.24	+ 15.17	- 17.76
Shoot vigour index	90.1	41.43	71.14	98.57	55.71
Root vigour index	402.9	253.58	315.41	378.58	353.13
Seedling vigour index	493.0	295.01	386.55	477.15	408.84
Shoot / Root ratio	0.22	0.16	0.23	0.26	0.16

+ / - Signs indicates stimulatory / inhibitory effect of Leachates.

The leachates of *Drymaria cordata* showed strong inhibitory effect on shoot growth of *Camellia sinensis.* Maximum shoot length was recorded at 1:10 concentration of leachate (1.38 cm) and thereafter it started declining with the increase of concentrations. All the concentration of leachates showed strong inhibitory effect on shoot growth except the 1:10 concentration. Although with the dilution of leachates the inhibitory effect in shoot length was decreased and caused (45.28, 21.70 and 38.68 % inhibition) as compared to control, respectively. But the diluted leachates at 1:10 level showed more stimulatory effect caused 30.19 % stimulation in shoot length as against control. On the other hand, the leachates of *Drymaria cordata* showed variable effect on root growth of *Camellia sinensis* in different concentrations. At the concentrations of leachates of 1:2.5, 1:5 and 1:20 showed inhibitory effect on root growth of *Camellia sinensis,* resulting 25.11, 22.36 and 13.08 % inhibition, as compared to control, respectively. Whereas with the dilution of leachates at 1:10 showed 11.81% stimulation in root length as against the control.

Fig. 11.3: Effect of leachates of *Drymaria villosa*

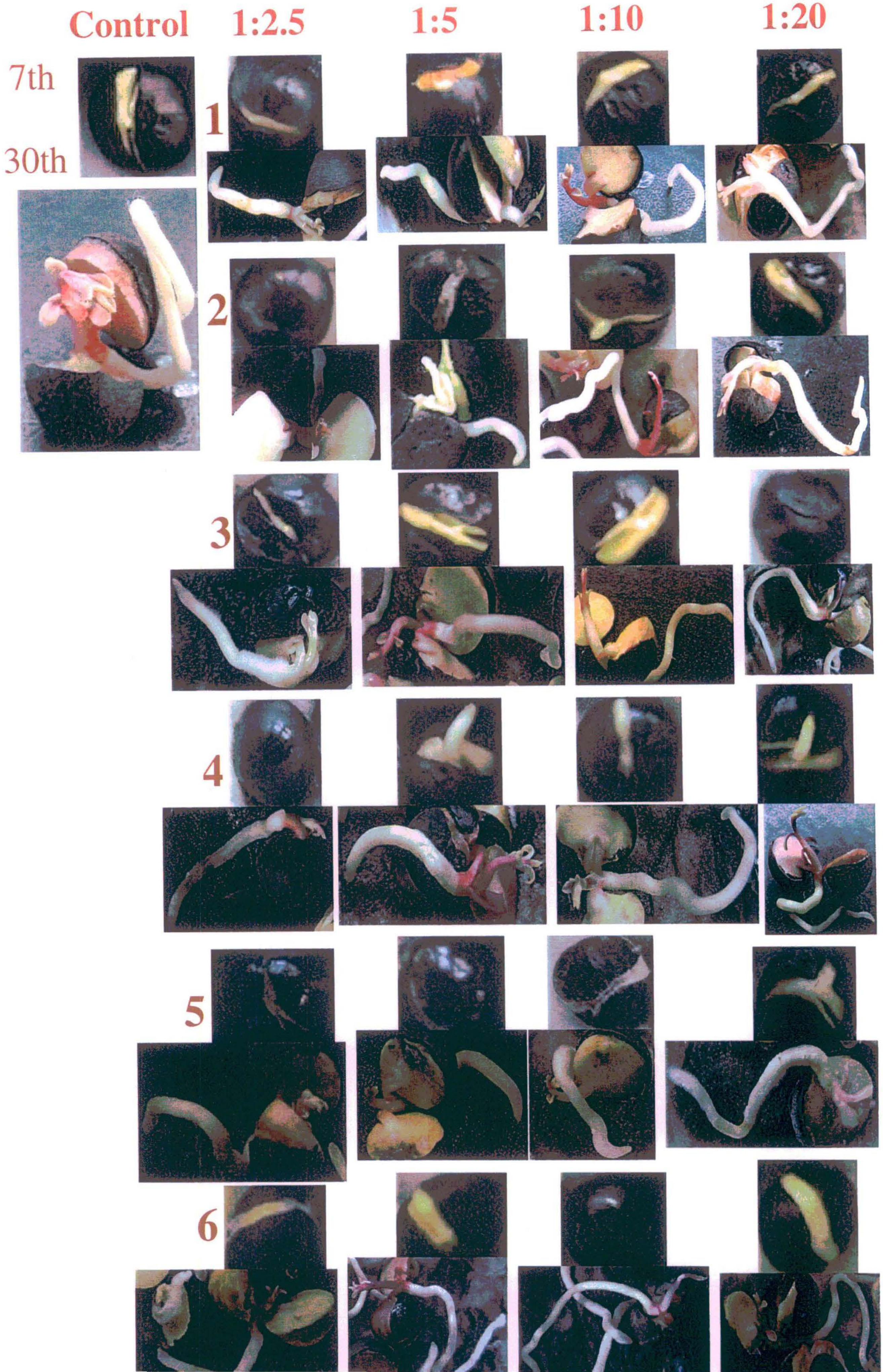


The seedling growth of *Camellia sinensis* was affected variably in different concentrations of leachates of *Drymaria cordata*. Moreover, as compared to the control (5.8 cm), the total length of seedling was smaller in all the concentrations of leatchates except in 1:10. At the concentrations 1:2.5, 1:5 and 1:20 showed 28.79, 22.24 and 17.76 % inhibition as compared to control, respectively. But the diluted leachates at 1:10 level showed stimulatory effect and caused 15.17 % stimulation in seedling growth as against control.

In this study it was seen that the shoot vigour index was more at the 1:10 dilution only and less in other concentrations but seedling vigour index and root vigour index were less in all the concentrations of leachates in comparison to the control. The shoot: root ratio of seedlings was slightly affected (0.16) at 1:2.5 and 1: 20 concentrations of leachates respectively in comparison to control (0.22). But in concentrations of 1: 5 and 1:10 it was increased (0.23 and 0.26) indicating more stimulation of shoot elongation than that of root elongation.

11.6.4 Effects of Leachates of *Galinsoga parviflora* Cavanilles on Seed Germination and Seedling Growth of *Camellia sinensis* (L.) O. Kuntze

Data on seed germination and seedling growth of *Camellia sinensis* in response to leachate treatments of aerial parts of *Galinsoga parviflora* have been recorded in Table-11.4. During this investigation it was observed that treatment with highest concentration of leachates (1:2.5) showed only inhibitory effects on seed germination, achieved 71.43 % of seed germination resulted in 15.96 % inhibition as compared to control (85 %). Thereafter, germination percentage increased linearly with decreasing concentration of leachates reaching a maximum of 100.00 % with the



Control
1:2.5
1:5
1:10
1:20
7th
30th
1
2
3
4
5
6

dilutions of 1:10 and 1:20 levels. In spite of that, application of 1:5, 1:10 and 1:20 levels caused 0.84, 17.65 and 17.65 % stimulation in seed germination, respectively, as against control. Moreover all the concentration of Leachates took same time to initiate the germination i.e. 4 days to germinate the first seed. While in control also the first seed was germinated after 4 days. In addition to that root hairs were developed at the lowest concentration of 1:20 only and prohibited lateral roots initiation. Whereas in control there was no initiation of root hairs or lateral roots.

The growth of seedlings was also noticed to be influenced under different concentration of leachates (Plate-**XIV'**). The seedling length was progressively decreased by increasing concentration of leachates and the decrease reached a maximum (2.58 cm) in 1:2.5 level of concentration and showed vigorous inhibition (50.86 %) as against control (5.8 cm). But the diluted leachates at 1:10 and 1:20 levels showed 5 and 14.83 % stimulation in seedling elongation as against the control.

Leachate treatments tremendously retarded the growth of shoot at 1:2.5, 1:5 and 1:10 levels caused 79.25, 10.38, and 0.94 % inhibition in shoot length as compared to control, respectively. Whereas, the rate of shoot growth was slightly increased at 1:20 level of dilution. The 1:20 dilution of leachate showed least stimulatory effect that caused 15.09 % stimulation in shoot length as against the control. Although with the further dilution of leachates the inhibitory effect in root length was decreased. At higher concentration of 1:2.5 and 1: 5 level showed 44.51 and 27.22 % inhibition as compared to control, respectively. But the diluted leachates at 1:10 and 1:20 level showed stimulatory effect causing 6.33 and 14.77 % stimulation in root length as against control.

Table 11.4. Effect of leachates of aerial parts of *Galinsoga parviflora* Cavanilles on seed germination and seedling growth of *Camellia sinensis* (L.) O. Kuntze

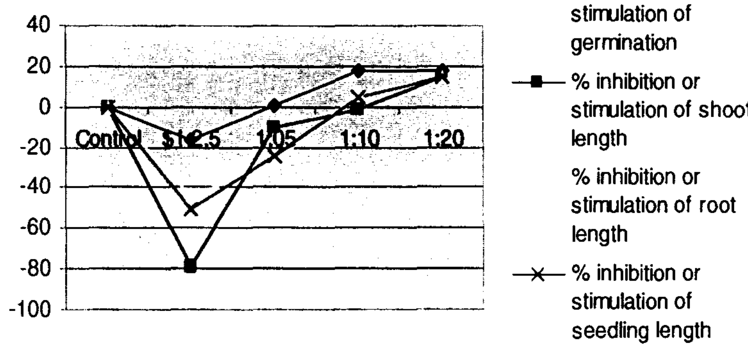
PARAMETERS	**CONCENTRATION OF SOLUTIONS**				
	Control	**1:2.5**	**1:5**	**1:10**	**1:20**
Germination percentage	85.0	71.43	85.71	100.0	100.0
Germination % inhibition or stimulation	00.00	- 15.96	+ 0.84	+ 17.65	+ 17.65
Percentile of viability	85.0	71.43	85.71	100.0	100.0
Nonviable Percentage	15.0	28.57	14.29	00.00	00.00
Mean shoot length (cm) per seedling	1.06	0.22	0.95	1.05	1.22
Percentage of inhibition or stimulation of shoot length	00.00	- 79.25	- 10.38	- 0.94	+ 15.09
Mean root length (cm) per seedling	4.74	2.63	3.45	5.04	5.44
Percentage of inhibition or stimulation of root length	00.00	- 44.51	- 27.22	+ 6.33	14.77
Mean total length (cm) per seedling	5.8	2.85	4.4	6.09	6.66

Percentage of inhibition or stimulation of seedling length	00.00	- 50.86	- 24.14	+ 5.0	+ 14.83
Shoot vigour index	90.1	15.71	81.42	105.0	122.0
Root vigour index	402.9	187.86	295.7	504.0	544.0
Seedling vigour index	493.0	203.57	377.12	609.0	666.0
Shoot / Root ratio	0.22	0.08	0.28	0.21	0.22

+ / - Signs indicates stimulatory / inhibitory effect of Leachates.

In spite of that seedling vigour index, shoot vigour index and root vigour index were lower in higher concentration of Leachates and higher in all diluted leachets as compared to control.

Fig. 11.4: Effect of leachates of *Galinsoga parviflora*



In the present investigation it was observed that the shoot: root ratio of seedling was higher (0.28) at the concentrations of 1:5 only, over the control (0.22), which indicated more inhibition of growth of root system of seedlings. Besides, under the concentration of 1:2.5, 1:10 and 1:20 the shoot: root ratios were 0.08, 0.21, and 0.22 respectively.

11.6.5 Effects of Leachates of *Mikania micrantha* Kunth on Seed Germination and Seedling Growth of *Camellia sinensis* (L.) O. Kuntze

Results of treatments with the leachates of aerial parts of *Mikania micrantha* on different parameters of germination and seedling growth of *Camellia sinensis* are given in Table - 11.5. From the perusal of the results, it is apparent that there was deleterious effect on the percentage of germination in all dilutions of leachates which exhibited firm and inhibitory toxic effect. At the concentration of 1:2.5, 1:5 and 1:10 levels of Leachates exhibited 66.39, 32.78 and 15.96 % inhibition on seed germination (28.57, 57.14 and 71.43 % respectively) as against control (85 %). Although at lower concentrations of 1:20 germination exhibited very low (0.84 %) stimulatory effect as compare to control. However, the effect of leachates of *Mikania micrantha* on seed germination of *Camellia sinensis* was inhibitory. All the concentration of Leachates, except 1: 5 dilution, took 4 days to germinate the first seed. Whereas at concentration of leachets 1: 5 showed delayed germination and it took 11 days to germinate the first seed. While in control the first seed germinated after 4 days. In spite of that root hairs were also developed at lower concentrations of 1:10 and prohibited lateral roots initiation. Whereas in control there was no initiation of root hairs or lateral roots.

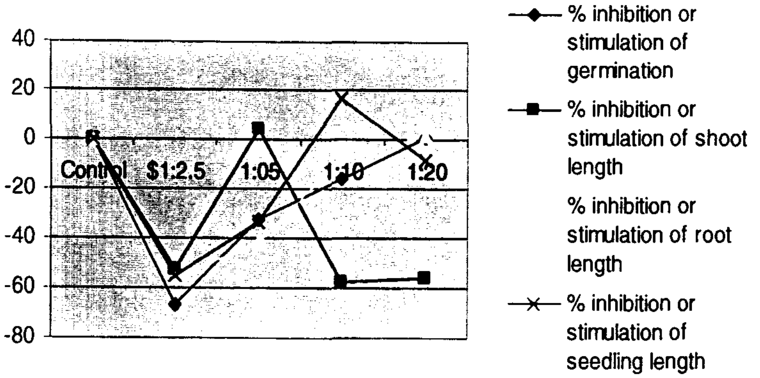
In this investigation it was seen that there was detrimental effect on the growth of seedling of *Camellia sinensis* with the leachates of *Mikania micrantha* in all concentrations. The seedling growth increased linearly with decreasing concentration of Leachates. At concentrations of 1:2.5, 1:5, 1:10 and 1:20 seedling growth was highly hindered and caused 55.17, 33.10, 16.38 and 8.62 % inhibition in seedling length, respectively, as compared with the control.

Table 11.5. Effect of leachates of aerial parts of *Mikania micrantha* Kunth on seed germination and seedling growth of *Camellia sinensis* (L.) O. Kuntze

PARAMETERS	CONCENTRATION OF SOLUTIONS				
	Control	1:2.5	1:5	1:10	1:20
Germination percentage	85.0	28.57	57.14	71.43	85.71
Germination % inhibition or stimulation	00.00	- 66.39	- 32.78	- 15.96	+ 0.84
Percentile of viability	99.17	33.33	66.67	83.34	100.0
Nonviable Percentage	15.0	71.43	42.86	28.57	14.29
Mean shoot length (cm) per seedling	1.06	0.5	1.1	0.45	0.47
Percentage of inhibition or stimulation of shoot length	00.00	- 52.83	+ 3.77	- 57.55	- 55.66
Mean root length (cm) per seedling	4.74	2.1	2.78	4.4	4.83
Percentage of inhibition or stimulation of root length	00.00	- 55.7	- 41.35	- 7.17	+ 1.90
Mean total length (cm) per seedling	5.8	2.6	3.88	4.85	5.3
Percentage of inhibition or stimulation of seedling length	00.00	- 55.17	- 33.10	16.38	- 8.62
Shoot vigour index	90.1	14.29	62.85	32.14	40.28
Root vigour index	402.9	60.0	158.85	314.29	413.98
Seedling vigour index	493.0	74.29	221.7	346.43	454.26
Shoot / Root ratio	0.22	0.24	0.4	0.10	0.10

+ / - Signs indicates stimulatory / inhibitory effect of Leachates.

Fig. 11.5: Effect of leachates of *Mikania micrantha*



Shoot vigour index, root vigour index and seedling vigour index were also low in viable concentrations. Only in diluted concentration (1:20) showed slightly higher root vigour index as compare to control. Besides, the shoot: root ratio of seedling was observed that the shoot: root ratio of seedling was higher (0.40) at the concentrations of 1:5 only over the control (0.22), which indicated more inhibition of growth of root system of seedlings. Besides, under the concentration of 1:2.5, 1:10 and 1:20 the shoot: root ratios were 0.24, 0.10 and 0.10 respectively.

11.6.6 Effects of Leachates of *Persicaria runcinata* (D. Don) H. Gross on Seed Germination and Seedling Growth of *Camellia sinensis* (L.) O. Kuntze OF *Camellia sinensis* (L.) O. Kuntze

Effects of different concentration of leachates of whole plant of *Polygonum runcinatum* on seed germination and seedling growth of *Camellia sinensis* are shown in Table-11.6 and Plate-XIV From the perusal of the data it is evident that highest concentration of leachates of 1:2.5 exhibited slight stimulatory effect (0.84 %) on germination percentage (85.71%) as against 85 % in control. Interestingly, at the concentration of leachates of 1: 5 exhibited inhibitory effect (15.96 %) on germination percentage (71.43) as against 85 % with control. Subsequently, diluted leachates of 1:10 and 1:20 improved the germination percentage to 85.71 and 85.71 respectively and showed least stimulatory effect (0.84 %) as compared to control. All the concentration of Leachates except 1: 10 took 4 days to germinate the first seed. Whereas 1: 10 concentration of leachets showed delayed germination and took 7 days to germinate the first seed.

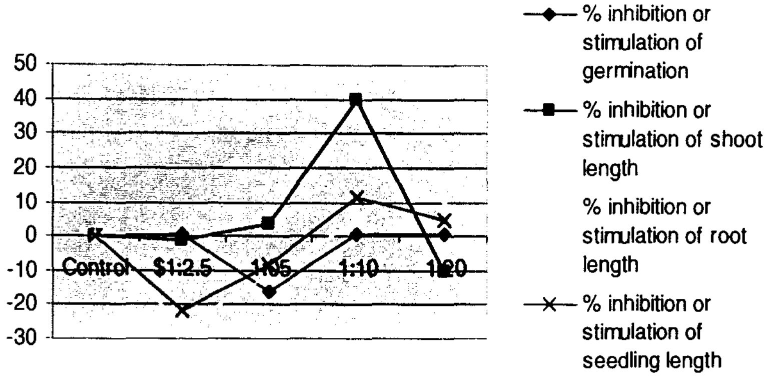
Seedling growth was also varied greatly under the influence of different concentrations of Leachates. Treatments with the dilutions of 1:5, 1:10 levels manifested 3.77 and 39.62 % more elongation of shoot length, respectively, over the control. Though the highest concentration of leachates (1:2.5) and lowest concentration of leachates (1:20) exhibited 0.94 and 10.38 % inhibition in shoot elongation. Moreover, it was observed that the tendency of root growth did not follow the similar trend as the shoot. It was usually inhibited at higher concentrations of 1:2.5 and 1:5 and was retarded through 26.16 and 11.39 % inhibition, respectively. But only at the lower 1:10 and 1:20 concentration showed 5.06 and 8.23 % stimulation, respectively in root elongation. There was also inhibition of root hair or lateral root initiation. The growth of seedlings was appeared to be promoted at the diluted concentration of Leachates. dilutions 1:10 and 1:20 showed 11.38 and 4.83 % stimulation respectively and at the higher concentration of Leachates (1:2.5 and 1:5) there was 21.55 and 8.62 % inhibition respectively over the control.

Table 11.6. Effect of leachates of aerial parts of *Persicaria runcinata* (D. Don) H. Gross on seed germination and seedling growth of *Camellia sinensis* (L.) O. Kuntze

PARAMETERS	CONCENTRATION OF SOLUTIONS				
	Control	1:2.5	1:5	1:10	1:20
Germination percentage	85.0	85.71	71.43	85.71	85.71
Germination % inhibition or stimulation	00.00	+ 0.84	- 15.96	+ 0.84	+0.84
Percentile of viability	99.17	100.0	83.34	100.0	100.0
Nonviable Percentage	15.0	14.29	28.57	14.29	14.29
Mean shoot length (cm) per seedling	1.06	1.05	1.1	1.48	0.95
Percentage of inhibition or stimulation of shoot length	00.00	- 0.94	+ 3.77	+ 39.62	- 10.38
Mean root length (cm) per seedling	4.74	3.5	4.2	4.98	5.13
Percentage of inhibition or stimulation of root length	00.00	- 26.16	- 11.39	+ 5.06	+ 8.23
Mean total length (cm) per seedling	5.8	4.55	5.3	6.46	6.08
Percentage of inhibition or stimulation of seedling length	00.00	- 21.55	- 8.62	+ 11.38	+ 4.83
Shoot vigour index	90.1	90.0	78.57	126.85	81.42
Root vigour index	402.9	299.99	300.01	426.84	439.69
Seedling vigour index	493.0	389.99	378.58	553.69	521.11
Shoot / Root ratio	0.22	0.3	0.26	0.3	0.19

+ / - Signs indicates stimulatory / inhibitory effect of Leachates.

Fig. 11.6: Effect of leachates of *Persicaria runcinata*



In the present investigation it was observed that the seedling vigour index and root vigour index were lower at concentrations of 1:2.5 and 1:5 but they were higher with 1:10 and 1:20 dilutions. Although the shoot vigour index was higher only at lowest concentration (1:10), but it was definitely lower with all other concentrations as against control. With 1:2.5, 1:5 and 1:10 dilutions the shoot: root ratio of seedling was higher (0.30, 0.26 and 0.30, respectively) than that of control (0.22) indicating more inhibition of root growth as compared to that of shoot.

11.7 RESULTS AND DISCUSSIONS: EFFECT OF EXTRACTS

In the present study extracts of six commonly associated species *viz. Ageratum conyzoides* L., ***Borreria alata* (Aublet) Schumann,** *Drymaria villosa* Chamisso et Schlechtendal, *Galinsoga parviflora* Cavanilles, *Mikania micrantha* Kunth, and *Persicaria runcinata* (D. Don) H. Gross were tested for their allelopathic effects on seed germination and seedling growth of *Camellia sinensis* (L.) O. Kuntze and the results of which are discussed below.

11.7.1 Effect of extracts of *Ageratum conyzoides* L. on Seed Germination and Seedling Growth of *Camellia sinensis* (L.) O. Kuntze

The effects of extracts of aerial parts of *Ageratum conyzoides* on different parameters of seed germination and seedling growth of *Camellia sinensis* are presented in Table 11.7.

Results reveal that the process of seed germination was observed to be affected by the treatment with the extract. The germination percentage showed decline along with the increase of concentration of extract solutions. Higher concentration of extract of 1:2.5 showed more inhibitory effect (32.78 %) on the percentage of germination as well as the percentile of viability. On the other hand, extracts of 1:5, 1:10 dilutions also exhibited inhibitory effect and caused 15.96 % and 15.96 % decline on seed germination and 1:20 dilution exhibited least stimulatory effect of 0.84 % as against 85.0 % with control. In this investigation it was observed that all the concentration of extracts took same time to germinate the first seed i.e. at the 5th day of sowing as same as control in which too first seed was germinated on the 4th day.

The effect of extracts on the growth of seedlings revealed that all shoot, root and seedling length was considerably inhibited in almost all concentrations. Only the root length and seedling length were slightly stimulated (12.24 and 9.83 % respectively) over the control at 1:20 dilution of the extract. Whereas shoot, root and seedling length showed decline along with the increase of concentration of extracts. Application of highest concentration (1:2.5) caused strong toxic effects in all the cases like shoot, root and seedling length of 33.96%, 42.19%, and 40.69 % respectively as against control. However, root hairs were seen in all the concentrations of extract but lateral roots were initiated only at lower concentrations of 1:20 level. Whereas in control there was no initiation of root hairs or lateral roots.

Although seedilng vigour index, root vigour index and shoot vigour index were lower in all the concentrations of extracts except at 1:20 where root vigour index and seeding vigour index were more as compared to control. In this investigation it was observed that the shoot: root ratio of seedling in different concentration of extracts did not show any major dissimilarity. Although with the 1:2.5 dilution, the occurrences of higher shoot: root ratio 0.26 over the control (0.22) indicated more inhibition of root growth than that of the shoot.

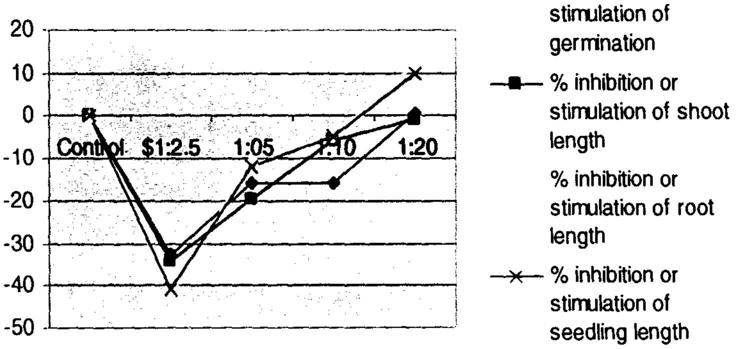
Table 11.7. Effect of extracts of aerial parts of *Ageratum conyzoides* L. on seed germination and seedling growth of *Camellia sinensis* (L.) O. Kuntze

PARAMETERS	CONCENTRATION OF SOLUTIONS				
	Control	1:2.5	1:5	1:10	1:20
Germination percentage	85.0	57.14	71.43	71.43	85.71
Germination % inhibition or stimulation	00.00	- 32.78	- 15.96	- 15.96	+ 0.84
Percentile of viability	99.17	66.67	83.34	83.34	100.0
Nonviable Percentage	15.0	42.86	28.57	28.57	14.29
Mean shoot length (cm) per seedling	1.06	0.70	0.85	1.00	1.05
Percentage of inhibition or stimulation of shoot length	00.00	- 33.96	- 19.81	- 5.66	- 0.94
Mean root length (cm) per seedling	4.74	2.74	4.27	4.53	5.32
Percentage of inhibition or stimulation of root length	00.00	- 42.19	- 9.92	- 4.43	+ 12.24
Mean total length (cm) per seedling	5.8	3.44	5.12	5.53	6.37
Percentage of inhibition or stimulation of seedling length	00.00	- 40.69	- 11.72	- 4.66	+ 9.83
Shoot vigour index	90.1	40	60.72	71.43	90
Root vigour index	402.9	156.56	305.01	323.58	455.98

Seedling vigour index	493.0	196.56	365.73	395.01	545.98
Shoot / Root ratio	0.22	0.26	0.20	0.22	0.20

+ / - Signs indicates stimulatory / inhibitory effect of extracts.

Fig. 11.7: Effect of extracts of *Ageratum conyzoides*



11.7.2 Effect of extracts of *Borreria latifolia* (Aublet) Schumann on Seed Germination and Seedling Growth of *Camellia sinensis* (L.) O. Kuntze

Effects of extracts of different concentration of aerial parts of *Borreria alata* on the germination of seeds and seedling growth of *Camellia sinensis* is shown in Table 11.8. In the present investigation it was observed that extracts of *Borreria alata* showed much inhibitory effect on seed germination and seedling growth of *Camellia sinensis*.

The germination percentage showed decline along with the increase of concentration of extract solutions. Higher concentration of extract at 1:2.5 showed more inhibitory effect (32.78 %) on the percentage of germination as well as on the percentile of viability. On the other hand, dilutions of 1:5, 1:10 and 1:20 exhibited same inhibitory effects on seed germination and caused 15.96 %, 15.96 % and 15.96 % decline as against 85.0 % with control, respectively. In this investigation it was observed that all the concentration of extracts took same time to germinate the first seed i.e. 4 days as it was also in the control, except at the dilution of 1:10 which was much delayed and took 7 days to germinate the first seed.

The effects of extracts on the growth of seedlings revealed that both shoot, root and seedling elongation was considerably inhibited in almost all concentrations. Only the growth of root and seedling were stimulated (20.25 % and 14.31 % respectively) at 1:20 dilution of the extract over the control. Application of highest concentration (1:2.5) showed vigorous toxic effects on shoot, root and seedling growth i.e. 52.83%, 55.06% and 54.66 % decline as against the control. However, no lateral roots were initiated. Only root hairs were seen at lower 1:10 concentrations. Whereas in control there was no initiation of root hairs or lateral roots.

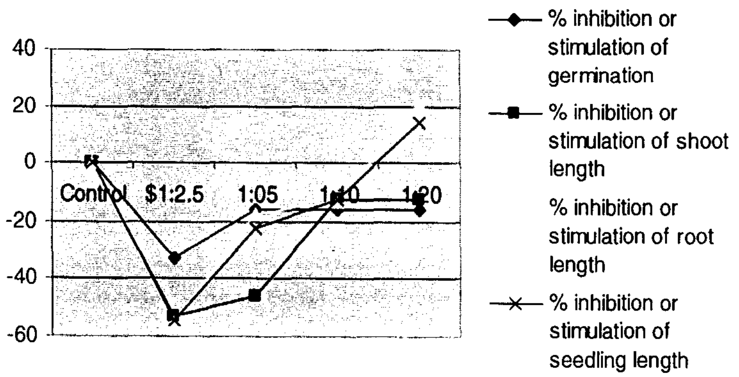
However, seeding vigour index, shoot vigour index and root vigour index were lower in almost all the concentrations of extracts over the control. But root vigour index were slightly more at the lower concentrations of 1:20 as compared to control. Though shoot: root ratio of seedling was influenced in all concentration of extracts and never showed any major dissimilarity. Highest shoot: root ratio of seedling was found at the concentration of 1:2.5 and 1:10 and those caused 0.23 over the control (0.22), indicating slight inhibition of root growth in comparison to shoot growth.

Table 11.8. Effect of extracts of aerial parts of *Borreria latifolia* (Aublet) Schumann on seed germination and seedling growth of *Camellia sinensis* (L.) O. Kuntze

PARAMETERS	CONCENTRATION OF SOLUTIONS				
	Control	**1:2.5**	**1:5**	**1:10**	**1:20**
Germination percentage	85.0	57.14	71.43	71.43	71.43
Germination % inhibition or stimulation	00.00	- 32.78	- 15.96	- 15.96	- 15.96
Percentile of viability	100.0	67.22	84.04	84.04	84.04
Nonviable Percentage	15.0	42.86	28.57	28.57	28.57
Mean shoot length (cm) per seedling	1.06	0.50	0.57	0.93	0.93
Percentage of inhibition or stimulation of shoot length	00.00	- 52.83	- 46.23	- 12.26	- 12.26
Mean root length (cm) per seedling	4.74	2.13	3.93	4.13	5.70
Percentage of inhibition or stimulation of root length	00.00	- 55.06	- 17.09	- 12.87	+ 20.25
Mean total length (cm) per seedling	5.8	2.63	4.5	5.06	6.63
Percentage of inhibition or stimulation of seedling length	00.00	- 54.66	- 22.41	- 12.76	+ 14.31
Shoot vigour index	90.1	28.57	40.72	66.43	66.43
Root vigour index	402.9	121.71	280.72	295.01	407.15
Seedling vigour index	493.0	150.28	321.44	361.44	473.58
Shoot / Root ratio	0.22	0.23	0.15	0.23	0.16

+ / - Signs indicates stimulatory / inhibitory effect of extracts.

Fig. 11.8: Effect of extracts of *Borreria alata*



11.7.3 Effect of extracts of *Drymaria villosa* Chamisso *et* Schlechtendal on Seed Germination and Seedling Growth of *Camellia sinensis* (L.) O. Kuntze

Table 11.9 presents the effects of extracts of whole plants of *Drymaria villosa* on seed germination and seedling growth of *Camellia sinensis*. Results revealed that extracts at different concentrations reduced the germination percentage in comparison to control.

In this investigation reciprocal relationship between reduction of germination percentage and extract concentration was observed. The application of 1:2.5, 1:5 and 1:10 dilutions caused 32.78 %, 15.96 % and 15.96 % inhibition in seed germination, respectively. Whereas in lowest concentration of extract of 1:20 exhibited least stimulation 0.84 % in seed germination as against 85.0 with control, respectively. It was noticed that only highest concentration of extracts of 1:2.5 showed delayed germination, which germinated the first seed at 8th day after sowing. While with all the lower concentration of extracts took same time to germinate the first seed i.e. after 4 days as it is in control.

Results of the effects of extracts on seedling growth also showed similar effects as in case of germination. The length of root, shoot and seedlings reduced inversely under the influence of different dilutions of extract. Growth of root and shoot showed inhibitory effects in almost all the concentrations of extract except at lower dilution of 1:20 level where shoot growth showed stimulatory effect of 13.21 % over the control. Treatments with extract solutions, namely, 1:2.5, 1:5 and 1:10 resulted in 25.34 %, 19.66 % and 9.83 % decline whereas in diluted concentration of extract of 1:20 showed least 2.24 % stimulation in seedling length over the control, respectively. However, there was no initiation of root hairs or lateral roots in control. But lateral root initiation was found at a later stage only in 1:5 dilution.

Seedling vigour index, root vigour index and shoot vigour index were lower in all concentrations of extract except at the lowest dilution (1:20), where all these three are little higher than control. However, all the concentrations of extract shoot: root ratio of seedling was slightly influenced. Highest shoot: root ratio of seedling was found in lowest concentration of (1:20) caused 0.25 over the control (0.22) which indicates the inhibition of root growth in comparison to shoot growth.

Table 11.9. Effect of extracts of aerial parts of *Drymaria villosa* Chamisso et Schlechtendal on seed germination and seedling growth of *Camellia sinensis* (L.) O. Kuntze

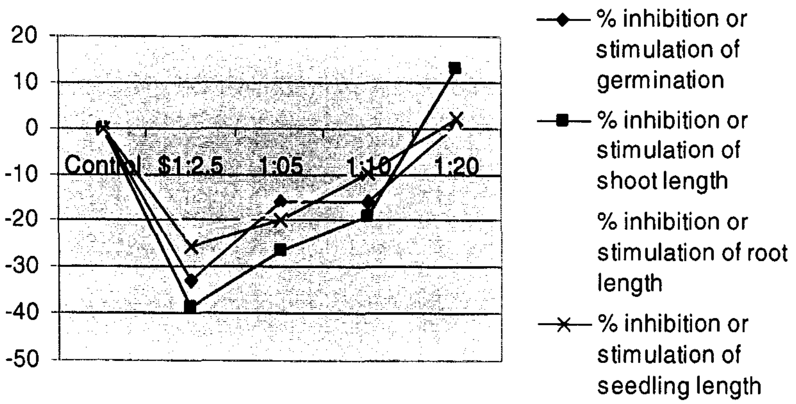
PARAMETERS	CONCENTRATION OF SOLUTIONS				
	Control	1:2.5	1:5	1:10	1:20
Germination percentage	85.0	57.14	71.43	71.43	85.71
Germination % inhibition or stimulation	00.00	- 32.78	- 15.96	- 15.96	+ 0.84


7th
30th
1
2
3
4
5
6

Percentile of viability	99.17	66.67	83.34	83.34	100
Nonviable Percentage	15.0	42.86	28.57	28.57	14.29
Mean shoot length (cm) per seedling	1.06	0.65	0.78	0.86	1.2
Percentage of inhibition or stimulation of shoot length	00.00	- 38.68	- 26.42	- 18.87	+ 13.21
Mean root length (cm) per seedling	4.74	3.68	3.88	4.37	4.73
Percentage of inhibition or stimulation of root length	00.00	- 22.36	- 18.14	- 7.81	- 0.21
Mean total length (cm) per seedling	5.8	4.33	4.66	5.23	5.93
Percentage of inhibition or stimulation of seedling length	00.00	- 25.34	- 19.66	- 9.83	+ 2.24
Shoot vigour index	90.1	37.14	55.72	61.43	102.85
Root vigour index	402.9	210.28	277.15	312.15	405.41
Seedling vigour index	493.0	247.42	332.87	373.58	508.26
Shoot / Root ratio	0.22	0.18	0.20	0.20	0.25

+ / - Signs indicates stimulatory / inhibitory effect of extracts.

Fig. 11.9: Effect of extracts of *Drymaria villosa*



11.7.4 Effect of extracts of *Galinsoga parviflora* Cavanilles on Seed Germination and Seedling Growth of *Camellia sinensis* (L.) O. Kuntze

Different parameters of seed germination and seedling growth of *Camellia sinensis* under the influence of extracts from aerial parts of *Galinsoga parviflora* are recorded in Table - 11.10.

Results reveal that the process of seed germination has been affected by the treatment of the extract. The higher concentrations of 1:2.5 and 1:5 resulted 15.96 % and 15.96 % decline in seed germination over the control (85.0 %). Besides diluted extracts of 1:10 and 1:20 caused least 0.84 % and 0.84 % stimulation in seed germination in comparison to control, which led to the increase of the percentile of viability (83.34 %, 83.34 %, 100 % and 100 % respectively) along with the increase in dilution. Moreover, in all the concentration of extracts time required for germination was same i.e. 4 days to germinate the first seed except at the lower dilution of 1:20 that showed delayed germination where first seed germinated after 7 days. In control the first seed germinated after 4 days.

The length of seedling and root appeared to be promoted with the lower concentration of extracts at 1:20 level. It was observed that there was 6.72 % and 8.44% stimulation in the elongation of seedling and root at 1:20 dilution of the extract over the control. On the other hand, the 1:2.5, 1:5 and 1:10 levels of dilution showed inhibition in the elongation of seedling and root. Highest inhibition in seedling and root elongation was found in the highest concentration (1:2.5) of extracts 34.48 and 49.37 %, respectively. The shoot growth was stimulated more in almost all the concentrations i.e. 1:2.5, 1:5 and 1:10 levels of dilution and exhibited 32.08 %, 32.08 % and 13.21 % stimulation, respectively except at 1:20 dilution level which showed the least inhibitory effect of 0.94 % as compared to control. So, totally opposite responses in the growth of shoot and root were shown in different concentrations of extracts. Moreover, formation of root hairs and the initiation of lateral roots were inhibited in this treatment.

Seedling and root vigour indices were higher at the dilution of 1:20 and lower at 1:2.5, 1:5 and 1:10 levels. However, shoot vigour index was higher in all the higher concentrations of extracts and for the lower concentration only 1:20 dilution exhibited similar shoot vigour index in comparison with the control. In this investigation it was observed that shoot: root ratio of seedlings was much influenced. At the lower level of concentration namely, 1:5, 1:10 and 1:20 shoot: root ratio of seedlings were 0.34, 0.28 and 0.20, respectively, caused better growth of shoot. But in the highest concentration (1:2.5) this ratio was increased (0.58) indicating more inhibition of root growth than shoot.

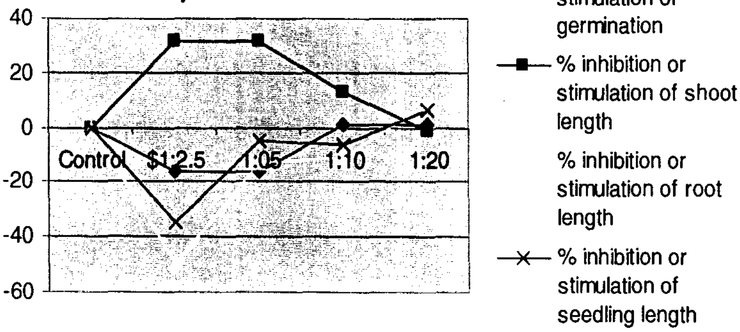
Table 11.10. Effect of extracts of aerial parts of *Galinsoga parviflora* Cavanilles on seed germination and seedling growth of *Camellia sinensis* (L.) O. Kuntze

PARAMETERS	CONCENTRATION OF SOLUTIONS				
	Control	**1:2.5**	**1:5**	**1:10**	**1:20**
Germination percentage	85.0	71.43	71.43	85.71	85.71
Germination % inhibition or stimulation	00.00	- 15.96	- 15.96	+ 0.84	+ 0.84
Percentile of viability	99.17	83.34	83.34	100	100
Nonviable Percentage	15.0	28.57	28.57	14.29	14.29
Mean shoot length (cm) per seedling	1.06	1.4	1.4	1.2	1.05
Percentage of inhibition or stimulation of shoot length	00.00	+32.08	+32.08	+ 13.21	- 0.94
Mean root length (cm) per seedling	4.74	2.4	4.12	4.22	5.14
Percentage of inhibition or stimulation of root length	00.00	- 49.37	- 13.08	- 10.97	+ 8.44
Mean total length (cm) per seedling	5.8	3.8	5.52	5.42	6.19
Percentage of inhibition or stimulation of seedling length	00.00	- 34.48	- 4.83	- 6.55	+ 6.72

Shoot vigour index	90.1	100.0	100.0	102.85	90.0
Root vigour index	402.9	171.43	294.29	361.70	440.55
Seedling vigour index	493.0	271.43	394.29	464.55	530.55
Shoot / Root ratio	0.22	0.58	0.34	0.28	0.20

+ / - Signs indicates stimulatory / inhibitory effect of extracts.

Fig. 11.10: Effect of extracts of *Galinsoga parviflora*



11.7.5 Effect of extracts of *Mikania micrantha* Kunth on Seed Germination and Seedling Growth of *Camellia sinensis* (L.) O. Kuntze

Effects of the extracts of whole plant of *Mikania micrantha* on different parameters of seed germination and seedling growth of *Camellia sinensis* are presented in Table - 11.11.

Both, germination and early growth of seedling were affected adversely by the effect of this dominating associate of tea. At the beginning, germination percentage decreased linearly against the increase of concentration of extracts. It was minimum (57.14 %) with the highest concentration (1:2.5) of extracts and showed 32.78 % inhibitory effect over control. Moreover, extract concentrations of 1:5 and 1:10 caused 32.78 % and 15.96 % decline and 1:20 dilution showed 0.84 % stimulation in seed germination, as against the control (85.0). When in 1: 2.5 dilution of extract 12 days was required for the germination of the first seed, it took only 5 days, like control, in other.

As it was in case of germination, the effect of extracts on early growth of seedlings was also quite prominent. With extracts treatment the growth of shoot, root and seedling were inhibited adversely and were always less than that of the control except in 1:20 dilution, where shoot and seedling growth enhanced to 20.75 % and 1.38 %. Treatments with extracts dilutions, namely, 1:2.5, 1:5, and 1:10 caused 15.09 %, 62.26 % and 1.89 % inhibition of shoot elongation and 77.22 %, 56.75 %, 29.75 % and 2.95 % inhibition in root elongation, respectively, over the control. It is clear that toxic effects on the growth of roots of new born seedlings were tremendous than that of shoot growth in different concentrations of extracts. Highest degree of inhibition (65.86%) of seedling growth was resulted in highest concentration 1:2.5 over the control. There was no initiation of lateral roots except at 1:5 dilution where only root hairs were seen.

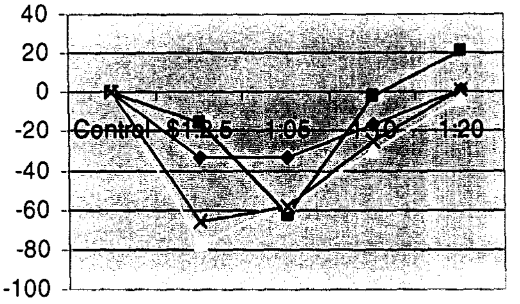
Moreover, the seedling vigour index, root vigour index and shoot vigour index, were always lower in all concentration of extracts, except at the 1:20 dilution where shoot and seedling vigour indices were little higher than that of control. In this investigation it was observed that the shoot: root ratio of seedling was affected considerably in different concentrations. Although with the 1:2.5 dilution, the occurrence of higher shoots: roots ratio (0.83) indicated more injurious and/or toxic inhibition of root growth than that of the shoot as compared to control (0.22).

Table 11.11. Effect of extracts of aerial parts of *Mikania micrantha* Kunth on seed germination and seedling growth of *Camellia sinensis* (L.) O. Kuntze

PARAMETERS	CONCENTRATION OF SOLUTIONS				
	Control	1:2.5	1:5	1:10	1:20
Germination percentage	85.0	57.14	57.14	71.43	85.71
Germination % inhibition or stimulation	00.00	- 32.78	-32.78	-15.96	+ 0.84
Percentile of viability	99.17	66.67	66.67	83.34	100
Nonviable Percentage	15.0	42.86	42.86	28.57	14.29
Mean shoot length (cm) per seedling	1.06	0.9	0.4	1.04	1.28
Percentage of inhibition or stimulation of shoot length	00.00	- 15.09	- 62.26	-1.89	+ 20.75
Mean root length (cm) per seedling	4.74	1.08	2.05	3.33	4.60
Percentage of inhibition or stimulation of root length	00.00	- 77.22	- 56.75	- 29.75	- 2.95
Mean total length (cm) per seedling	5.8	1.98	2.45	4.37	5.88
Percentage of inhibition or stimulation of seedling length	00.00	- 65.86	- 57.76	- 24.66	+ 1.38
Shoot vigour index	90.1	51.43	22.86	74.29	109.71
Root vigour index	402.9	61.71	117.14	237.86	394.27
Seedling vigour index	493.0	113.14	140	312.15	503.98
Shoot / Root ratio	0.22	0.83	0.20	0.31	0.28

+ / - Signs indicates stimulatory / inhibitory effect of extracts.

Fig. 11.11: Effect of extracts of *Mikania micrantha*



11.7.6 Effect of extracts of *Persicaria runcinata* (D. Don) H. Gross on Seed Germination and Seedling Growth of *Camellia sinensis* (L.) O. Kuntze

Different parameters of seed germination and seedling growth under the influence of extracts of aerial parts of *Persicaria runcinata* on *Camellia sinensis* have been presented in Table - 11.12.

In the present investigation it was found that the increase of the concentration of the extracts led to decrease in the percentage of germination as well as percentile of viability. The application of 1:2.5 and 1:5 dilutions of extracts caused 15.96 % and 15.96 % inhibition in seed germination respectively over the control, expressing clear decline of the percentile of viability. Moreover, lower concentrations of extracts i.e. 1:10 and 1:20 dilutions appeared to have 0.84 % and 17.65 % stimulatory effect in seed germination than that of the control (85.0 %). All the concentration of extracts except 1: 20 levels showed delayed germination and took 7 days to germinate the first seed. However, at 1: 20 concentration of extract showed first seed germination on the 4th day.

The seedling growth was adversely affected in different concentrations of extracts. Roots of seedlings were more affected than that of shoots and only lateral root was initiated at the lower 1:20 level of dilution. However, control did not show any root hairs and lateral roots initiation within this period. Application of different concentrations of extracts, namely, 1:2.5, 1:5 and 1:20 caused 19.81 %, 15.09 % and 5.66 % inhibition whereas 1:10 dilution showed 22.64 % stimulation in shoot length. In case of root length, 1:2.5, 1:5 and 1:10 caused 40.93, 31.86 and 19.83 % reduction, when 1:20 dilution showed little stimulatory effect of 0.84 % in root elongation as compared to the control. Moreover, growth of seedlings was inhibited in all the concentration of extract. Highest inhibition of seedling growth resulted in strong concentration at 1:2.5 levels was 37.07 % as compared to control.

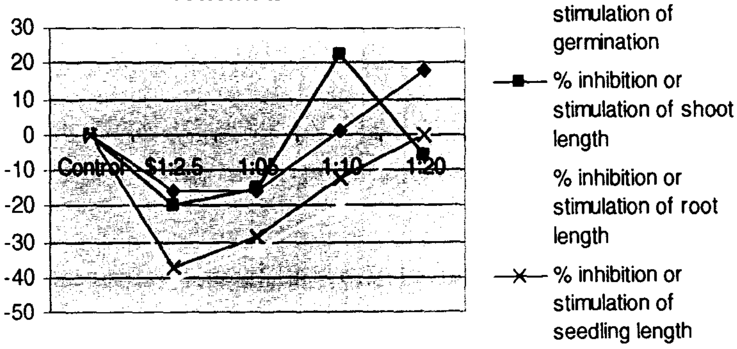
Shoot, root and seedling vigour indices were lower in almost all concentrations of diluted extracts except at the lower concentration of 1:20. In the present study it was also observed that the shoot: root ratios of seedlings were higher (0.30, 0.28 and 0.34) in 1:2.5, 1:5 and 1:10 concentrations respectively except the lower concentration of 1:20 that showed little less i.e. 0.21 than that of the control (0.22) causing more inhibition of the root growth than to the shoot.

Table 11.12. Effect of extracts of aerial parts of *Persicaria runcinata* (D. Don) H. Gross on seed germination and seedling growth of *Camellia sinensis* (L.) O. Kuntze

PARAMETERS	CONCENTRATION OF SOLUTIONS				
	Control	1:2.5	1:5	1:10	1:20
Germination percentage	85.0	71.43	71.43	85.71	100
Germination % inhibition or stimulation	00.00	- 15.96	- 15.96	+ 0.84	+ 17.65
Percentile of viability	85	71.43	71.43	85.71	100
Nonviable Percentage	15.0	28.57	28.57	14.29	00.00
Mean shoot length (cm) per seedling	1.06	0.85	0.9	1.3	1.00
Percentage of inhibition or stimulation of shoot length	00.00	-19.81	- 15.09	+ 22.64	- 5.66
Mean root length (cm) per seedling	4.74	2.8	3.23	3.8	4.78
Percentage of inhibition or stimulation of root length	00.00	- 40.93	- 31.86	- 19.83	+ 0.84
Mean total length (cm) per seedling	5.8	3.65	4.13	5.1	5.78
Percentage of inhibition or stimulation of seedling length	00.00	- 37.07	- 28.79	- 12.07	- 0.34
Shoot vigour index	90.1	60.72	64.29	111.42	100.0
Root vigour index	402.9	200.0	230.72	325.70	478.0
Seedling vigour index	493.0	260.72	295.01	437.12	578.0
Shoot / Root ratio	0.22	0.30	0.28	0.34	0.21

+ / - Signs indicates stimulatory / inhibitory effect of extracts.

Fig. 11.12: Effect of extracts of *Persicaria runcinata*



11.8 CONCLUSION

Results reveal that allelopathic experiments with the leachates and extracts of six dominant weed species on the germination and early seedling growth of tea (*Camellia sinensis*) are quite interesting which need further studies. Almost in all the cases of leachates and extracts at highest concentration (1:2.5) showed no promotory effect instead, high to complete inhibitory effects on the germination of seeds and subsequent seedling growth of *Camellia sinensis*. However, interestingly, it was noted that in case of *Persicaria runcinata* the highest concentration (1:2.5) of leachate showed slightly stimulatory effects on seed germination. However the leachates or extracts of all the test species had no major effect on seed germination. But, eirt allelopathic effects were noticed in seedling elongation, specially on the root elongation.

It is also noteworthy that in all the cases of leachates or extracts at lower *Camellia sinensis*. These data reflect that inhibitory or stimulatory effect of a given plant leachate or extract effects differentially under different concentrations. This agrees with the views of Rice (1984) who stated ".... apparently most, if not all, organic compounds that are inhibitory to the same process in very small concentrations" and also supports the views of Molisch (1937) who referred allelopathy as biochemical interactions detrimental as well as beneficial between all types of plants. The result suggests that the growth inhibitory compounds due to auto-toxic principles contained in the plant tissue are concentration rate dependent. At lower concentrations, with some species, these compounds did not inhibit the germination or seedling growth or rather tended to stimulate, whereas at higher concentrations they inhibited the germination and seedling growth of *Camellia sinensis*.

The observation showed that *Mikania micrantha* was a highly toxic plant, which strongly inhibited not only the germination of seeds but also the seedling growth of *Camellia sinensis* in both leachates and extracts under use. It indicates the presence of potent germination and growth-retarding factors of allelopathic implication for *Camellia sinensis* in the commonly associated species. So an intensive study of the plant communities in relation to *Mikania micrantha* might be of great practical value for understanding the allelochemic interactions between the plant associations.

However the results of the use of leachates or extracts of *Borreria alata* and *Ageratum conyzoides* individually showed the inhibitory effects to the germination as well as seedling growth of *Camellia sinensis* at higher concentrations. Interestingly, its allelopathic effect was noticed much in seedling elongation, specially on the elongation of root mainly in extract solution. It may be inferred that these plants not only compete with *Camellia sinensis* but also interact quite effectively to some extent by retarding its post-germination aspects due to their allelopathic potentialities. This type of differential behavior of delayed emergence and the inhibition of seedling growth in different species of plants has been reported by different authors. In this respect, Klein & Schusta (1930) have reported high content of a water-soluble alkaloid that have found fatal in high concentration.

Similarly, at lower concentrations of *Ageratum conyzoides, Borreria alata, Galinsoga parviflora, Drymaria villosa* and *Persicaria runcinata* stimulated seedling growth of *Camellia sinensis* but none of them at highest concentration showed any promotory effect. This is in conformity with the observation made by Chatterji (1975) where aqueous extracts of *Crotalaria medicagenea* in lower concentration stimulated the growth of hypocotyl and radicle of the seedling of *Calligonum polygonoides* while the highest concentration was inhibitory.

Furthermore, all the lower dilutions of leachate and extract of *Galinsoga parviflora* showed stimulatory effect on seed germination and seedling growth and interestingly shoot length was much stimulated in higher concentrations of extract.

Finally, it was observed that in almost all the cases biochemical interactions are to be inhibitory than stimulatory between weeds and crop plant like TEA and moreover the rate of inhibition of extract solutions were more than respective leachate solutions. It suggests that some compounds of plants do not leach out and / or the compounds in the test solutions are higher in extracts than in the leachates. Since the effects of leachates or extracts were variable with the variation of concentration of solutions, the compounds responsible for inhibition or stimulation are supposed to be water soluble in nature. It is likely that these compounds leach out from the plants during the season or during decomposition of residues and then get absorbed into the soil. Thereafter the moisture in the soil dilutes the released compounds to cause auto-toxicity in field conditions. Schreiner & Reed (1908) reported that all the allelopathics are water-soluble compounds, mostly phenolic in nature. Phenolic compounds may be in effective, inhibitory or stimulatory in their biological activities (Kefeli & Kadyrov 1971).

From the above findings it is concluded that in an intermixed community of weed and crop plants (TEA), the more aggressive species usually dominates and this aggressiveness is associated with favorable contrasting growth habits and above these factors, there are some weeds which supplement aggressiveness by the release of growth inhibiting substances or allelochemicals, get released into the soil as root exudates or leachates of their dead and decaying vegetative matter or both, are inhibitory or stimulatory to seed germination, growth and development of seedlings of *Camellia sinensis.* Thereby reducing or eliminating the competitiveness of crop plants as well as of other weed species.

It has also been observed by several workers that, crops too have allelopathic effects on weeds and such growth inhibitory phytotoxic compounds might act as natural herbicides (Bell & Koeppe, 1972). Though a considerable amount of information related to allelopathy has accumulated in scientific literature, its significance to agriculture and particularly, to weed science is yet to be fully recognized to evaluate its effective use.

CHAPTER 12

Useful and Poisonous Tea Weeds

Man living as far back as in *vedic* period realized that no plant is useless. The plant once regarded as one useless weed, proved to be a wonder species in many times in the history of science. Even then it is important to recognize the plants those we need to use to satisfy our immediate needs and/or the usefulness of those plants already known to us. On the other hand, there are many plants, the poisonous actions of which cause our concern.

All the plants growing in Tea Gardens as weeds can not be useless. Ethnobotanically useful plants of this flora will be discussed in the next chapter. The present section of the dissertation will deal with the useful and poisonous plants in general.

12.1 Useful Plants

In fact, quite a large number of weeds and other plants growing in Tea Garden areas are useful in different ways. But only some commonly useful plants has been presented here (Table 12.1). A good number of references are available on the useful plants in India, which include Biswas & Chopra (1956), Chopra *et al* (1956), Krishna & Das (1983), Bhujel *et al* (1984 a,c), Das & Chanda (1990) and Pal (1999).

Table 12.1: Useful plants growing in Tea Gardens in Darjiling Hills and Terai.

[***Abbreviations used***: G = Gungaram T.E., H = Hansqua T.E., K = Kamalpur T.E., M = Matigara T.E., Mo = Mohurgong & Gulma T.E., Mk = Makaibari T.E., S = Soom T.E., T = Tamsong T.E.]

Sl. No.	Name of plants	Common name	Gardens where recorded	Useful Parts	Uses
1	*Acacia catechu* [Mimosaceae]	Khair	G, H, M	Gum	Commercial, medicinal

2	*Aconogonum molle [Polygonaceae]*	Thotne	S, T	Young stem	Edible
3	*Adiantum capillus-veneris* [Adiantaceae]	Fern	G, H, K, M, Mo, Mk, S, T	Whole plant	Ornamental
4	*Adiantum philippense* [Adiantaceae]	Fern	G, H, K, M, Mo, Mk, S, T	Whole plant	Ornamental
5.	*Aegle marmelos [*Rutaceae]	Bael, Bel	G, H, K, M, Mo	Ripe Fr	Raw
6	*Albizia lebbeck [Mimosaceae]*	Sirish	G, H, K, M, Mo	Trunk	Timber
7	*Alnus nepalensis* [Betulaceae]	Utis	S, T	Trunk	Timber
8	*Alocasia macrorrhiza* [Araceae]	Man-kachu	G, H, Mo	Stem	Edible
9	*Alstonia scholaris* [Apocynaceae]	Chhatian	G, H, K, M	Bark, whole plant	Medicinal, Ornamental
10	*Andrographis paniculata* [Acanthaceae]	Kalomegh	G, H, Mo	Whole plant	Medicinal
11	*Angiopteris crassipes* [Marattiaceae]		Mo, Mk	Root-stock, root	Medicinal, Perfumery
12	*Annona reticulata [*Annonaceae]	Nona	G, H, K, M, Mo	Ripe fruit, leaves	Edible, medicinal, fodder
13	*Annona squamosa* [Annonaceae]	Ata	G, H, K, M, Mo	Ripe fruits, leaves	Edible, medicinal, fodder
14	*Areca catechu* [Arecaceae]	Supari, Gua	H, K, Mt	Fruits	Commercial, medicinal
15	*Artemisia indica* [Asteraceae]	Nak-nisinda	Mk, S, T	Leaf, shoot	Medicinal, repellent, religious
16	*Artocarpus heterophyllus* [Moraceae]	Kathar, Kanthal	G, H, K, M, Mo	Lf, Fr, Sd	Edible
17	*Asplenium filix-femina* [Aspleniaceae]		G, H, K, M, Mo, Mk, S, T	Rhizome	Medicinal, ornamental
18	*Averrhoa carambola* [Averrhoaceae]	Kamranga	H, K	Fruit	Edible
19	*Bauhinia purpurea* [Caesalpiniaceae]	Tanki	G, H, K, M, Mo, Mk, S, T	Grown plant	Ornamental, edible
20	*Betula alnoides* [Betulaceae]	Sour	S, T	Trunk	Timber
21	*Blechnum orientale* [Blechnaceae]		G, H, K, M, Mo, Mk, S, T	Rhizome	Edible, Medicinal
22	*Blumea lacera [Asteraceae]*		G, H, K, M, Mo,	Leaf	Medicinal, aromatic oil
23	*Boehmeria hamiltoniana [Urticaceae]*		Mk, S, T	Leaf	Fodder
24	*Boerhavia coccinea [Nyctaginaceae]*	Punarnova	G, H, M, Mo	Whole plant	Medicinal, edible
25	*Bombax ceiba* [Bombacaceae]	Simal	G, H, K, M, Mo	Gum, Fl	Commercial, floss
26	*Brassica campestris* [Brassicaceae]	Sarisa	G, H, K, M, Mo, Mk, S, T	Lf, Sd	Edible

27	*Brassica juncea* [Brassicaceae]	Rye saag	G, H, K, M, Mo	Yng Sht	Edible
28	*Cajanus cajan* [Fabaceae]	Arhar	G, H, K, M, Mo	Sd	Edible
29	*Caesampelos periera [Menispermaceae]*		G, H, Mo	Root-stock	Medicinal
30	*Camellia sinensis* [Theaceae]	Chia, Chha	G, H, K, M, Mo	Fl, Lf	Beverage
31	*Cannabis sativa* [Cannabaceae]	Ganja, Vang	G, H, K, M, Mo, Mk, S, T	Leaf, flower	Narcotic, medicinal
32	*Cassia fistula* [Caesalpiniaceae]	Sonalu, badarlathi	G, H, K, M, Mo, Mk, S, T	Rt, Lf, bud, Fr pulp	Ornamental, medicinal
33	*Catharanthus roseus* [Apocynaceae]	Nayantara	G, H, K, M, Mo	Lf, Fl	Ornamental, medicinal
34	*Centella asiatica [Apiaceae]*	Thankuni	G, H, K, M, Mo, Mk, S, T	Leaf	Edible, Medicinal
35	*Ceratopteris thalictroides* [Parkeriaceae]		G, H	Fronds	Edible, Medicinal
36	*Chenopodium album* [Chenopodiaceae]	Bhatua saag	G, H, K, M, Mo	Yng Sht	Edible
37	*Cinnamomum tamala* [Lauraceae]	Tejpat	G, H, K, M, Mo, Mk, S, T	Lf	Spice
38	*Clerodendrum indicum [Verbenaceae]*	Vant	G, H, K, M, Mo	Grown plant	Ornamental, medicinal
39	*Colocasia esculenta* [Araceae]	Kachu	G, H, K, M, Mo	Rhizome, petiole	Edible
40	*Crinum amoenum* [Amaryllidaceae]		K, M, Mo	Grown plant	Ornamental
41	*Cryptomeria japonica* [Taxodiaceae]	Dhupi	S, T	Trunk	Timber
42	*Curcuma longa* [Zingiberaceae]	Haldi	G, H, K, M, Mo, Mk, S, T	Rhz	Spice
43	*Cymbopogon nardus* [Poaceae]	Citronella ghash	G, H, K, M, Mo	Lf	Aromatic oil
44	*Cynodon dactylon [Poaceae]*	Durba ghash	G, H, K, M, Mo, Mk	Shoot	Worship, ornamental, fodder
45	*Dicranopteris linearis* [Gleicheniaceae]		G, H, K, M, Mo, Mk, S, T	Rhizome, Fronds	Medicinal, basketry
46	*Dioscorea bulbifera [Dioscoreaceae]*	Chupri alu, Bontarul	G, H, K, M, Mo, Mk, S, T	Root-stock	Edible
47	*Diplazium esculentum* [Athyriaceae]	Dhenki Saag	G, H, K, M, Mo	Young frond	Green vegetable
48	*Drymeria diandra [Caryophyllaceae]*	Abijalo	G, H, K, M, Mo, Mk, S, T	Shoot	Medicinal
49	*Dryopteris filix-mas* [Dryopteridaceae]		G, H, K, M, Mo,	Young frond, root	Edible, Medicinal

			Mk, S, T		
50	*Eryngium foetidum* [Apiaceae]	Bilati Dhania	G, H, K, M, Mo, Mk, S, T	Lf	Spice
51	*Euphorbia hirta [Euphorbiaceae]*	Pushi dudh	G, H, K, M	Shoot	Medicinal
52	*Ficus hispida* [Moraceae]	Dumur	H, K, Mo	Figs	Edible
53	*Girardinia diversifolia* [Urticaceae]	Vangre Sishnu	Mk, S, T	Stem	Bow-string, fibre
54	*Glinus oppositifolius* [Molluginaceae]	Gima	G, H, K, M, Mo	Shoot	Edible
55	*Gmelina arborea* [Verbenaceae]	Gamar	G, H, K, M, Mo	Trunk	Timber
56	*Holarrhena pubescens* [Apocynaceae]	Khirra	G, H, K, M, Mo, Mk, S, T	Bk	Medicinal
57	*Imperata cylindrica* [Poaceae]	Kush, Thatch	G, H, K, M, Mo, Mk	Leaf	Rope, thatch
58	*Ipomoea batatas* [Convolvulaceae]	Misti Alu, Ranga Alu	G, H, K, M, Mo, Mk, S, T	Tubers, Yng Tg	Edible
59	*Ipomoea quamoclit [Convolvulaceae]*	Labanga Lata	M, Mo, Mk	Grown plant	Ornamental
60	*Jatropha curcas* [Euphorbiaceae]	Swet Bharenda	G, H, K, M	Seeds, grown plant	Oil, hedge
61	*Justicia adhatoda [Acanthaceae]*	Basak	G, H, M, Mo, Mk	Leaf, whole plant	Medicinal, hedge
62	*Lycopersicon esculentum* [Solanaceae]	Tomatom, Tomator	G, H, K, M, Mo	Lf, Fr	Edible
63	*Lycopodiella cernua* [Lycopodiaceae]		M, Mo, Mk, S, T	Shoot	Medicinal
64	*Lycopodium pseudoclavatum* [Lycopodiaceae]		S, T	Spore, Shoot	Science experiment, Medicinal
65	*Lygodium microphyllum* [Lygodiaceae]		G, H, K, M, Mk	Root-stock	Medicinal
66	*Lygodium salicifolium* [Lygodiaceae]		G, H, K, M, Mk	Root-stock	Medicinal
67	*Magnolia campbellii* [Magnoliaceae]	Chanp	S, T	Trunk	Timber, ornamental
68	*Mallotus philippensis [Euphorbiaceae]*	Sindure	G, M, Mo, Mk	Seeds	Dye, fodder
69	*Mangifera indica* [Anacardiaceae]	Aam	G, H, K, M, Mo	Ripe/ green Fr	Edible; fodder
70	*Manihot esculenta* [Euphorbiaceae]	Simul-tarul	G, H, K, M, Mo, Mk, S, T	Tuberous Rt	Edible
71	*Maranta arundinacea* [Marantaceae]	Arrowroot	G, H, K, M, Mo, Mk, S, T	Rhz	Edible, ornamental, medicinal
72	*Melia azadirach [Meliaceae]*	Ghora Neem	G, H, K, M, Mo, Mk	Grown plant	Ornamental, biomass
73	*Mentha piperata* [Lamiaceae]	Pudina	G, H, K, M, Mo,	WP, Lf	Edible

			Mk, S, T		
74	*Mesua ferrea* [Clusiaceae]	Nageswar, Nagkesor	G, H, K, M, Mo	Whole plant	Timber, medicinal, ornamental
75	*Michelia champaca* [Magnoliaceae]	Chanp	G, H, K, M, Mo, Mk, S, T	Whole plant	Timber, medicinal, ornamental
76	*Michelia doltsopa* [Magnoliaceae]	Rani Chanp	G, H, K, M, Mo, Mk, S, T	Trunk	Timber
77	*Momordica charantia* [Cucurbitaceae]	Karela	G, H, K, M, Mo	Lf, Fr	Edible
78	*Momordica dioica* [Cucurbitaceae]	Chetheli	G, H, K, M, Mo	Leafy Tg, Fr	Edible
79	*Moringa oleifera* [Moringaceae]	Sagna	G, H, K, M, Mo	Lf, Fl, Fr	Edible
80	*Morus alba* [Moraceae]	Tunt	G, H, K, M, Mo	Ripe Fr	Edible
81	*Mucuna pruriens [Fabaceae]*	Aalkusi	G, H, K, M	Seed	Medicinal
82	*Murraya koenigii* [Rutaceae]	Karipata	G, H, K, Mo, Mk,T	Leaf	Aromatic for food
83	*Murraya paniculata* [Rutaceae]	Kamini	G, H, K, M, Mo	Whole plant	Ornamental, medicinal
84	*Musa bulbisiana* [Musaceae]	Kala	G, H, K, M, Mo, Mk, S, T	Green & ripe Fr	Edible
85	*Nasturtium officinale [Brassicaceae]*	Simraya	Mk, S, T	Young Shoot	Edible
86	*Neolamarckia cadamba* [Rubiaceae]	Kadam	G, H, K, M, Mo	Trunk, Ripe fruits	Timber, edible
87	*Nephrolepis auriculata* [Nephrolepidaceae]		Mk, S, T	Whole plant, root-tuber	Ornamental, edible, medicinal
88	*Nyctanthes arbor-tristis* [Verbenaceae]	Sefali	G, H, K, M, Mo, Mk, S, T	Whole plant	Ornamental, medicinal
89	*Oryza sativa* [Poaceae]	Chaule, Chawor	G, H, K, M, Mo	Grains, straw	Edible, fodder, insulator, oil
90	*Pedilanthus tithymeloides* [Euphorbiaceae]	Rangchita, Belati-sij	G, H, K, M, Mo, Mk, S, T	Whole plant	Ornamental, medicinal
91	*Paederia foetida [Rubiaceae]*	Gandal	G, H, Mo, Mk, S	Leaf	Edible, Medicinal
92	*Phoebe attenuata [Lauraceae]*		Mk, T	Trunk	Timber
93	*Phyllanthus amarus [Euphorbiaceae]*		G, H, K, M	Whole plant	Medicinal
94	*Phyllanthus emblica* [Euphorbiaceae]	Amloki	G, H, K, Mo, Mk	Fruits	Medicinal, edible
95	*Pinus roxburghii* [Pinaceae]	Pine	Mk, S, T	Trunk	Timber, resin
96	*Piper betle* [Piperaceae]	Paan	G, H, K, M, Mo, Mk, S, T	Leaf	Edible, medicinal
97	*Piper longum* [Piperaceae]	Pipla	G, H, K, M, Mo, Mk, S, T	Infructe-scens	Spice, medicinal

98	*Piper mullesua [Piperaceae]*	Jangli Paan	G, H, Mo, Mk	Fruits	Medicinal
99	*Piper nigrum* [Piperaceae]	Gol marich	G, H, K, M, Mo, Mk, S, T	Fr	Spice, medicinal
100	*Piper peepuloides* [Piperaceae]	Rukh pipla	G, H, K, M, Mo, Mk, S, T	Ripe Fr	Spice, medicinal
101	*Pityrograma calomelanos* [Hemionytidaceae]		G, H, K, M, Mo, Mk, S, T	Fronds, Rhizome	Medicinal
102	*Plumbago zeylanica* [Plumbaginaceae]	Chetoar, Chitawar, Chita	G, H, K, M, Mo	Whole plant	Ornamental, medicinal
103	*Pongamia pinnata* [Fabaceae]	Karanj	G, H, K, M, Mo	Rt, Bk, Sd, oil	Medicinal
104	*Prunus cerasoides* [Rosaceae]		S, T	Grown tree	Ornamental, walking stick
105	*Psidium guajava* [Myrtaceae]	Ambak, Amrud	G, H, K, M, Mo	Fr	Edible
106	*Pteridium aquilinum* [Pteridiaceae]		G, H, K, M, Mo, Mk, S, T	Rhizome	Edible, Medicinal
107	*Punica granatum* [Punicaceae]	Dalim, Bedana	G, H, K, M, Mo, Mk, S, T	Rt, fruit	Edible, medicinal
108	*Rauvolfia serpentina* [Apocynaceae]	Sarpagandha, Nagbeli	G, H, K, M, Mo	Rt	Medicinal
109	*Ricinus communis [Euphorbiaceae]*	Rehrhi	G, H, K, M, Mk, T	Seeds, inflorescence	Oil, edible
110	*Rubia mantith [Rubiaceae]*	Manjistha, Majito	Mk, S, T	Root, stem	Dye, medicinal
111	*Rubus ellipticus [Rosaceae]*		Mk, S, T	Fruits	Edible
112	*Saccharum officinarum* [Poaceae]	Ikh, Ukhu	G, H, K, M, Mo	St	Edible
113	*Saccharum officinarum* [Poaceae]	Ikh, Ukhu	G, H, K, M, Mo	St	Commercial, edible, medicinal
114	*Saraca asoca* [Caesalpiniaceae]	Ashoke	G, H, K, M, Mo, Mk, S, T	Whole plant	Ornamental, medicinal
115	*Schima wallichii* [Theaceae]	Chilaune	Mk, S, T	Trunk	Timber, Fuel
116	*Scoparia dulcis* [Scrophulariaceae]	Petberela	G, H, K, M, Mo	Leaf	Medicinal
117	*Selaginella bisulcata* [Selaginellaceae]		G, H, K, M, Mo, Mk, S, T	Grown plant	Ornamental
118	*Setaria palmifolia [Poaceae]*		G, H, K, M, Mo, Mk, S, T	Whole plant	Fodder
119	*Shorea robusta* [Dipterocarpaceae]	Sal	G, H, K, M, Mo, Mk, S, T	Whole plant	Timber, cottage industry, medicinal
120	*Sida acuta [Mavaceae]*	Berela	G, H, K, M, Mo	Root, whole plant	Medicinal, broom

121	*Sida rhombifolia [Mavaceae]*		G, H, K, M	Stem	Fibre
122	*Smilax ovalifolia* [Smilacaceae]	Kukurdaini, Kumarika	H, K, M, Mk	Root	Medicinal
123	*Solanum torvum [Solanaceae]*	Pako Saag	G, H, K, M	Fruits	Medicinal
124	*Syzygium cumini* [Myrtaceae]	Jamuna	G, H, K, M, Mo, Mk, S, T	Bk, Fr, Sd	Edible, medicinal
125	*Tamarindus indica* [Caesalpiniaceae]	Tentul	G, H, K, M, Mo, Mk, S, T	Lf, Fr	Edible, medicinal
126	*Trichosanthes dioica* [Cucurbitaceae]	Patuka, Patal	G, H, K, M, Mo, Mk, S, T	Lf, Fr	Edible
127	*Tectaria coadunata* [Tectariaceae]		G, H, M, Mo, Mk	Fronds	Edible, Medicinal
128	*Tectona grandis* [Verbenaceae]	Segun	G, H, K, M, Mo, Mk, S, T	Whole plant	Timber, medicinal
129	*Terminalia chebula [Combretaceae]*	Haritaki, Harrah	G, H	Fruits	Medicinal, mastigatory
130	*Terminalia myriocarpa [Combretaceae]*	Panisaj	H, K, Mo	Trunk	Timber
131	*Thysanolena latifolia [Poaceae]*	Jhrhu	Mo, Mk, S, T	Leaf	Fodder
132	*Tsuga dumosa* [Pinaceae]		S	Trunk	Timber, ornamental
133	*Typhonium trilobatum [Araceae]*	Kharkon	G, H, K, M	Leaf	Edible
134	*Urena lobata [Malvaceae]*		G, H, M, Mk	Stem	Fibre
135	*Urtica dioica [Urticaceae]*	Sishnu	Mk, S, T	Young Shoot	Edible
136	*Vitex negundo [Verbenaceae]*	Nishinda	G, H, M	Leaf	Medicinal
137	*Zingiber officinalis* [Zingiberaceae]	Ada	G, H, K, M, Mo, Mk, S, T	Rhz	Spice, medicinal

12.2 Poisonous Plants

A plant may be poisonous through the activities of its different parts. Leaf/ stem/ underground parts/ hairs/ flowers/ fruits/ seeds/ latex etc. A poisonous plant may also be a desirable plants as the poisonous chemical ingradients might be useful in medicine. There are few publications on the poisonous plants in India, which include Atkinson , Biswas & Chopra (1956), Chopra *et al* (1965), Bhujel *et al* (1984b), and Basu (1990). In addition, a beautiful guide book by Lucia Woodward (1985) also has been consulted for the purpose. Table 12.2 presented a list of poisonous plants recorded from the Tea Garden areas in hills and Terai of Darjiling.

Table 12.2: Poisonous plants growing in Tea Gardens in Darjiling Hills and Terai.

[*Abbreviations used*: G = Gungaram T.E., H = Hansqua T.E., K = Kamalpur T.E., M = Matigara T.E., Mo = Mohurgong & Gulma T.E., Mk = Makaibari T.E., S = Soom T.E., T = Tamsong T.E.]

Sl. No.	Name of plants	Common name	Gardens where recorded	Parts	Symptoms
01	*Alstonia scholaris* [Apocynaceae]	Chhatiwan	G, H, K, M, Mo, Mk, S, T	Latex, pollen	Toxic, highly allergic
2.	*Arisaema* spp. [Araceae]	Saap Phul	S, T	Whole plant	Severe irritation and vomiting if consumed.
3.	*Artemisia dubia* [Asteraceae]	Titepati	Mk, S, T	Leaves & young shoots	Fish poison
4.	*Calotropis gigantea* [Asclepiadaceae]	Aank	G, H, K, Mo	Latex	Harmful on eyes
5.	*Cannabis sativa* [Cannabaceae]	Ganja, Vang	G, H, K, M, Mo, Mk, S, T	Flowers & Leaves	Euphoria and elation, then heightened senses, hallucinations, depression & comatose sleep. Die in overdose.
6.	*Cuscuta reflexa* [Cuscutaceae]	Swarnlata		Branches	Unbearable pain in the upper abdomen in consumed.
7.	*Datura stramonium* [Solanaceae]	Sweto Dhutra	G, H, K, M, Mo, Mk, S, T	Leaves, Fruits & Seeds	Unquenchable thirst, vomiting, enlarged pupils, delirium, jumbled speech, nervous twitches and convulsions; death in overdose.
8.	*Datura suaveolens* [Solanaceae]	Ghantiphul, Sanaiphool	G, H, K, M, Mo, Mk, S, T	Leaves, Fruits & Seeds	Unquenchable thirst, vomiting, enlarged pupils, delirium, jumbled speech, nervous twitches and convulsions; death in overdose. Poisonous to pigs.
9.	*Dendrocnide sinuata* [Urticaceae]	Moringe	G, H, K, M, Mo, Mk, S, T	Whole plant	Stings of hairs very painful; pollens also very irritating
10.	*Equisetum diffusum* [Equisetaceae]	Horsetail	G, H, K, M, Mo, Mk, S, T	Whole plant	Dangerous to horses and cattle; causes loss of condition, fast & weak heartbeat and unsteady.
11.	*Euphorbia royleana* [Euphorbiaceae]	Shionni	G, H, K, M, Mo, Mk, S, T	Milky latex	Damage eyes externally
12.	*Girardinia diversifolia* [Urticaceae]	Vangre Sishnu	G, H, K, M, Mo, Mk, S, T	Whole plant	Extremely high irritation on touch and consumption of fresh leaves.
13.	*Hydrangea macrophylla* [Saxifragaceae]	Hydrangea	G, H, K, M, Mo, Mk, S, T	Flowers, Leaves	Gastroenteritis with pain, nausea, diarrhea.
14.	*Hedyotis scandens* [Rubiaceae]	Bakhri lahara	G, H, K, M, Mo,	Whole plant	Fish poison

			Mk, S, T		
15.	*Holarrhena pubescens* [Apocynaceae]	Khirra	G, H, K, M, Mo, Mk, S, T	Young shoot	Fish poison
16.	Jatropha curcas [Euphorbiaceae]	Hattikane	G, H, K, M, Mo, Mk, S, T	Seeds (many)	Severe collapse
17	*Ipomoea purpurea* [Convolvulaceae]	Morning Glory	G, H, K, M, Mo, Mk, S, T	Seeds	Unpredictable psychological disturbances, including heightened perception of vision, smell and hearing, can cause permanent damage to brain and death.
18.	*Lantana camara* [Verbenaceae]	Lantana, Bon Tulsi	G, H, K, M, Mo, Mk, S, T	Fruits	Gastrointestinal pain, diarrhea, weakness, circulatory failure.
20.	*Laportea interrupta* [Urticaceae]	Bichuti	G, H, K, M, Mo, Mk, S, T	Whole plant	Extremely high irritation on touch
21.	*Laportea terminalis* [Urticaceae]	Patle Sishnu, Gharia sishnu	G, H, K, M, Mo, Mk, S, T	Whole plant	Extremely high irritation on touch and consumption of fresh leaves.
22.	*Lyonia ovalifolia* [Ericaceae]		G, H, K, M, Mo, Mk, S, T	Leaves	Deadly poisonous to cattle
23.	*Maesa chisia* [Myrsinaceae]	Bilaune	G, H, K, M, Mo, Mk, S, T	Sticks from branches	Believed that cows and goats hit with the stick they will deteriorate slowly and die. Local people avoid its shadow for this reason.
24.	*Manihot esculenta* [Euphorbiaceae]	Simal tarul	G, H, K, M, Mo, Mk, S, T	Roots & root bark	Poisonous if taken raw
25.	*Mikenia micrantha* [Asteraceae]	Goal-lata	G, H, K, M, Mo, Mk, S, T	Leaves	Fish-poison
26.	*Mirabilis jalapa* [Nyctaginaceae]	Sandhyamani, Four-o'clock	G, H, K, M, Mo, Mk, S, T	Seeds & Roots	Irritates skin and mucous membrane. Gastrointestinal upsets, diarrhea.
27	*Momordica charantia* [Cucurbitaceae]	Uchchha	G, H, K, M, Mo, Mk, S, T	Fruit & Seeds	Vomiting, diarrhea.
28.	*Mucuna macrocarpa* [Fabaceae]		G, H, K, M, Mo, Mk, S, T	Hairs on calyx	Irritation on skin and mucous membrane.
29.	*Mucuna pruriens* [Fabaceae]	Aalkusi	G, H, K, M, Mo, Mk, S, T	Hairs on fruits & calyx	Severe irritation on skin and mucous membrane.
30.	*Neolamarckia cadamba* [Rubiaceae]	Kadam	G, H, K, M, Mo, Mk, S, T	Fruit	poisonous
31.	*Parthenium hysterophorus* [Asteraceae]	Parthenium	M	All aerial parts	Severe allergy, dermatitis, internal bleeding
32.	*Persicaria hydropiper*	Kusurpota,	G, H, K,	Leaves	Food and fish poisoning

	[Polygonaceae]	Sukurpota	M, Mo, Mk, S, T		
33	*Plumeria rubra* [Apocynaceae]	Rukh chuwa	G, H, K, M, Mo, Mk, S, T	Latex	Poison to eyes
34	*Poinsettia pulcherrima* [Euphorbiaceae]	Poinsettia, Lalpata	G, H, K, M, Mo, Mk, S, T	Flowers & Leaves	Sap causes blistering of skin, ingestion leads to vomiting, diarrhea, delirium.
35	*Pteridium aquilinum* [Pteridiaceae]	Bracken	G, H, K, M, Mo, Mk, S, T	All parts & Rhizome	Horses and cattle are particularly vulnerable; well known fish poison
36	*Ricinus communis* [Euphorbiaceae]	Rehri, Castor Bean	G, H, K, M, Mo, Mk, S, T	Whole plant & Seeds	Cause extremely serious allergic reactions; seeds laxative but fatal; burning of mouth and throat; diarrhea, abdominal pain, cramps, weakness, damage to liver and kidneys, hemorrhages.
37	*Rhus chinensis* [Anacardiaceae]	Bhakimlo	G, H, K, M, Mo, Mk, S, T	Whole plant	Acrid juice cause severe irruption (blisters) on skin
38	*Rhus succedanea* [Anacardiaceae]	Rani Bhalayo	G, H, K, M, Mo, Mk, S, T	Whole plant	Acrid juice cause severe irruption on skin; quite harmful
39	*Sambucus nigra* [Sambucaceae]	Elder	G, H, K, M, Mo, Mk, S, T	Leaves, Roots, Fruits, Bark	Violent purgation; nausea from raw berries; fresh leaves and berries irritate skin.
40	*Schima wallichii* [Theaceae]	Chilaune	G, H, K, M, Mo, Mk, S, T	Peeled bark	Itching effect on contact with skin
41	*Solanum myriacanthum* [Solanaceae]	Jangli Begun	G, H, K, M, Mo, Mk, S, T	Seeds	Extremely poisonous due to high solasodin content
42	*Solanum nigrum* [Solanaceae]	Pako saag	G, H, K, M, Mo, Mk, S, T	Whole plant, Fruits	Gastric pain, constipation or diarrhea; weakness, drowsiness and paralysis
43	*Taxus baccata* [Taxaceae]	Dhyengre salla	G, H, K, M, Mo, Mk, S, T	Leaves	Poisonous to live-stocks
44	*Tragia involucrata* [Euphorbiaceae]	Jal Bichuti	G, H, K, M, Mo, Mk, S, T	Whole plant	Extremely high irritation on touch
45	*Trichosanthes lepiniana* [Cucurbitaceae]	Indreni	G, H, K, M, Mo, Mk, S, T	Fruits, seeds	Nausea, vomiting, abdominal pain diarrhea
46	*Typhonium trilobatum* [Araceae]	Kharkon	G, H, K, M, Mo, Mk, S, T	Rhizome	Severe irritation of mouth, throat & stomach
47	*Urtica dioica* [Urticaceae]	Sishnu	G, H, K, M, Mo, Mk, S, T	Whole plant	Extremely high irritation on touch and consumption of fresh leaves.
48	*Urtica parviflora* [Urticaceae]	Sishnu	G, H, K, M, Mo, Mk, S, T	Whole plant	Extremely high irritation on touch and consumption of fresh leaves.

49	*Zanthoxylum acanthopodium* [Rutaceae]	Bokay timbur	G, H, K, M, Mo, Mk, S, T	Fruits	Poisonous to pigs, intoxicate fish. Excess intake leads to breathing trouble in man.
50	*Zanthoxylum nitidium* [Rutaceae]	Parpare timbur	G, H, K, M, Mo, Mk, S, T	Fruits	Poisonous to pigs

12.3 Discussion

As much as 137 plants has been recorded here as useful plants and 50 species as poisonous plants. These plants are either growing as weeds inside the bushes or in open leftover spaces within the garden territory. In addition, garden employees grow different types of vegetables, ornamentals etc in front of their residences. Hill people are very much garden loving and almost every house, small or big, grow some ornamental plants. These plants are under cultural condition and have not been incorporated in the list of useful plants.

However, the selected plants are mostly wild and are belonging to different habit groups. Uses of these plants are also very much diverse, and quite a few of those are regularly marketed like *Aconogonum molle, Albizia lebbeck, Alnus nepalensis, Alocasia macrorrhiza, Alstonia scholaris, Angiopteris crassipes, Boerhavia coccinea, Caesampelos periera, Cannabis sativa, Centella asiatica, Colocasia esculenta, Dioscorea bulbifera, Diplazium esculentum, Phyllanthus emblica, Glinus oppositifolius, Gmelina arborea, Imperata cylindrica, Jatropha curcas, Justicia adhatoda, Nasturtium officinale, Ricinus communis, Rubia monjith, Terminalia chebula, Terminalia myriocarpa, Thysanolena latifolia, Typhonium trilobatum*, etc. In addition, there are many other plants those are either occasionally marketed or are sold in very low quantity. Majority of these plants are still now out of cultivation and are regularly procured from the natural habitat. If proper cultural methods can be developed many of the plants can be regular sources of income for many poor people. Again, there are some other plants those are not regularly marketed or never put into the sale but can be exploited with little care. Popularization of the uses of these plants and little research and development activities can improve the economic viability for cultivation and regular marketing of many of these plants.

Plants considered as poisonous in this account are also quite useful in other senses. Many of these plants are of multipurpose use.

CHAPTER 13

ETHNOBOTANY OF TEA GARDEN WORKERS

13.1 Introduction

The association of man with plants is an age-old process. Also the relationship between man and environment in general has never been static and is changing continuously. But this is not the case with tribal/ aboriginal communities the world over. The life, culture and traditions of these communities have remained almost undisturbed and static for hundreds of years and often it is said that they are the living archaeological museums of ancient traditions and cultural heritage of a nation.

The Indian subcontinent is inhabited by over 53 million tribal people belonging to over 550 such communities [like *Santal, Munda, Oraon, Naga, Mompa, Karbis, Saora, Sarasia, Irulus, Chenchus, Kharia, Baigas, Bando* etc. with some degenerated communities like *Ongae, Great Andamanies, Jarawa, Sentinelese, Shompen, Toda, Toto, Asur, Birhore, Lodha* etc.] that come under 227 linguistic groups (Rao 1996). They inhabit varied geographic and climatic zones of the country and are living in complete harmony with the nature. Tribals constitute about 7.7 % of India's total population and utilize about 10,000 plant species for healthcare, food and other material requirements (Jain 1991; Pushpangadan 1994). They can utilize the resources without disturbing the delicate balance of the ecosystem. Tribal people thus mostly remained as stable societies and are unaffected by the social, cultural, material and economic evolutions that are taking place in the civilized societies. But this peaceful coexistence of the tribal-society has been violently shaken in the recent past by the interference in their habitats by so called civilized outsiders. India is very rich for its 16 agro-climatic zones and its old heritage of ancient civilization with old and obsolete literatures like Vedas, Quaran, Puran, Sanhitas, Neghuntus, Nidans, Epics (Ramayana, Mahabharata), archaeological remains and sacred groves and is a virgin field for ethnobotanical studies in various aspects to get first hand information on inter-disciplinary and intra-disciplinary subjects. However, the subject is newer to science in India; multidisciplinary in nature and unique in many ways.

The tribal people, when they are living very close to nature they have acquired and accumulated the knowledge about the use of plants growing around them. Many of these plants are not known to the outside world. After proper scrutiny this rich knowledge could benefit the mankind in many ways. The inroads of civilization are presently posing problems and imminent danger as well, for this rich and varied expertise and it is likely that this will be lost to humanity for all time to come. The habitats where the tribal lived and the environment in which the folklore evolved on the uses of wild plants are fast disappearing due to interference of outside world. Similarly with the advancement of civilization, human life became more and more complicated and consequently the plants around human beings have been put more to use in various ways (Seitel 2001).

People in the pre-historic times used plants quite intuitively for the fulfillments of basic needs. Such as food, clothing, shelter, tools and even for the cure of many of their bodily disorders. The medicinal plants played a very important role from times immemorial among the illiterates to highly civilized men and women in the folklores, superstitions, traditions, various rituals, witchcraft and chanting of mantras connected with healing of diseases, and also repelling the influence of evil spirits. This man-plant relationship can be classified into two groups viz. (a) abstract and (b) concrete. The abstract relationship includes faith in good and bad power of plants, taboos, sacred plants, worship and folklore. On the other hand, the concrete relationship includes mainly the material use such as food, medicines, house building, agricultural implements and operations, other domestic uses etc (Jain 2004).

13.2 Definitions

The term **ethnobotany** was first coined by Harshberger (1885) one of the pioneers of American economic botany. Robbins *et al* (1916) gave the broad definition of the area of ethnobotany that includes investigation and evaluation of the knowledge of all phases of life amongst the primitive societies and the effects of the plant environment upon life, customs, beliefs and history of the tribal people. Jones (1941) gave a concise definition of ethnobotany as the study of interrelationship of primitive men and plants. According to Jones (1941), ethnobotany is "the study of the relationship which exists between people of primitive societies and their plant environment". According to Keng (1974) "the science of ethnobotany is concerned with the relationship between man and vegetation as well as the influence, man has had on the vegetation". Ethnobotany has been defined as a multidisciplinary study involving the relationship between plant and the aboriginal people, some knowledge of anthropology of the region and a fair familiarity with the flora and vegetation of the area (Rao 1981). Its importance has been realized chiefly in respect of the varied economic uses of the plants among the primitive human societies. It brings to light numerous little known or unknown uses of plants, some of which have potential for wider usage (Rao 1981). In comparison to economic botany, ethnobotany is not only limited up to accumulation of information from a particular locality or group of people but also includes the transfer of authentic information from one sector to the other with critical scientific as well as economic evaluation for wider application (Bhattarai 1991). Wickens (1993) distinguished ethnobotany from economic botany by considering ethnobotany as "the study of useful plants prior to their commercial exploitation and eventual domestication".

The word "*Ethno*" in English came from Greek word "*ethnokos,*" meaning the human race and "botany," or plant science. Thus, ethnobotany can be defined as the relationship of plant life with human beings.

13.3 History of Ethnobotanical Studies

The history of use of plants in medicine can be traced back to pre-Rigvedic times. The preparation and use of medicines from plants have been mentioned in the 'Rigveda', the earliest scripture and the oldest repository of human knowledge (4500 – 1600 BC). The Vedic Aryans were familiar with about 100 medicinal plants. Later, in '*Ayurveda*', a part of '*Atharvaveda*', various uses of plants including the medicinal properties are given. This was followed by contributions like '*Charak Samhita*' (1000 – 800 BC. '*Sushruta Samhita*' (800 – 700 BC) and Vagbhatta's '*Ashtanga Hridaya*'. Later on, a number of books on Ayurveda and medicinal plants were written by erudite scholars like Bhikshu, Patanjali, Nagarju, Chakradatta, Bangasen (500 – 100 BC). '*Vriksha Ayurveda*' by Parashara gives detailed characteristics of vegetable drugs including habitat, soil for growth, season of collection, duration of efficacy and method of storage (Mitra & Jain 1991).

The earliest organized worker on this aspect was Francisco Hernandry (1570 – 1575) who studied the flora and fauna of Mexico in relation to man (De 1968). The compilation of Indian medicinal plants started in the early century. Sir William Jones's '*Catalogue of Medicinal Plants*' (1799), Fleming's '*Catalogue of Medicinal Plants*' (1810), Ainslie's '*Materia Medica of Hindoosthan*' (1813), Roxburgh's '*Flora Indica*' (1820 – 1832) and Royle's '*An essay on the antiquity of Hindu medicine*' (1837) dealt mainly with plants and drugs of established indigenous systems of Indian medicine 'O' Shaughnessy's. *The Bengal Dispensatory*' (1811) is the first book dealing exclusively with the properties and uses of medicinal plants.

Irvine (1847), Strachey (1852) and Boissier (1867) contributed significantly in the study of indigenous drugs of India in '*Pharmacopoeia of India*'; Waring (1868) has given a new dimension to the studies of medicinal plants. Modeeen's *Supplement to Pharmacopoeia of India* (1869) and Fleckiger and Hanbury's (1870) *Pharmacographia* added new information. Dutta's *Materia Medica of the Hindus* (1877), Dymock's '*Vegetable Materia Medica of Western India*' (1883) and contributions of Khori (1887) and Dey (1896) are valuable contributions related to medicinal plant products. Waring

(1897) contributed to the folk medicine through his '*Bazar Medicine and Common Medicinal Plants of India*'.

The **Siddha** system of medicine is considered as a branch of **Ayurveda** with advancement in respect of a few selected medicinal plants and was evolved by Sadhus (sages) in South India. The **Unani** system of medicine is supposed to be a contemporary of Siddha type of medicinal system developed by Muslim physicians during the Mohammedans rule. The allopathic medicine originated in Europe and became dominant in India with the establishment of British Empire.

Barrow (1990) worked on the ethnobotany of Coanhilla, Spruce (1908) worked on tribes of Andes and Amazon regarding the knowledge of using rubber plants. Safford (1915 – 1917) studied narcotic and stimulant plants of Haiti and Aztec region. In North America, considerable amount of work was done among the Red Indians. In South America, some work was done in Peru. The major contributions of Schultes (1941, 1956, 1960, 1963, 1967, 1987 a.b. 1988, 1990, 1992, 1993, 1996), who is considered as Father of modern Ethnobotany, include its various aspects like wild edibles, narcotic drugs, psychoactive plants, hallucinogens eic. The other specialized branches of ethnobotany are archaeo-ethnobotany, ethno-agriculture, ethno-ecology, ethnopharmacology, etc.

The remarkable progress of Hindu medicine from Vedic to the period of Tantras and Siddhas declined with the invasions of Greeks, Scythians, Huns, Moghuls and Europeans. However, with the establishment of British rule in India, there was further intermingling and also introduction of some new medicinal plants. Organised study and research in ethnobotany with emphasis on tribal medicine and culture are of recent origin. Ethnobotanical explorations with special reference to tribal/ folklore medicine were carried out by a number of investigators round the world.

In India much works on Ethnobotany have been accumulated and researches in the field are gaining momentum which is evident from the literature pilings up at rapid rate. Fuch (1908) studied the Korkus of Vindhya Hills; Guha (1930) studied Garo tribe from Assam region, while Dastur (1951) contributed to the medicinal plants of India and Pakistan. Elwin (1955) worked on the religious aspects of Indian tribes. Gupta (1960) enumerated 101 useful and medicinal plants of Nainital in Kumaon Himalaya, Jain

(1963a,b) studied Madia tribe from Bastar region of Madhya Pradesh. The contributions of Jain and his co-workers (1965, 1967, 1971, 1987) worked on plants used for various purposes. Dr. S.K. Jain, former Director of Botanical Survey of India, is also credited for the establishment of the *Society of Ethnobotanists* and its official journal ***Ethnobotany***.

Janardhanan (1963) enumerated the medicinal plants of *Khed taluka* of Pune district and provided information regarding their use and mode of administration. Contributions of Gupta (1963) on Chotanagpur plateau; Jain and Tarafder (1963) on native plant remedies for snakebite among the tribal people of central India etc. are noteworthy contributions. The wild food plants used by tribes like Madia, Halba, Gond were noted by Jain (1964). Dhar *et al* (1968-88) screened Indian medicinal plants for antimicrobial activity. Preliminary screening of 202 plant species for alkaloids, saponins and steroids was done by Maiti (1968). Kapoor *et al* (1969) surveyed Indian medicinal plants for various secondary metabolites. Malhotra & Moorthy (1973) recorded useful and medicinal plants from Chandrapur district. Das & Mandal (2002) and Das et al (2006) enumerated the Medicinal Plants of Darjiling area.

Venkatram *et al* (1975) reported the identity and therapeutic claims of 'Sanjeevinee' with miraculous panaceal properties and sold in certain parts of Karnataka and Maharashtra. Vartak & Datar (1975) enumerated wild edibles of Karnala Bird Sanctuary. Gadgil & Vartak (1976) studied the sacred grooves of Western Ghats, Dan *et al* (1978) did phytochemical screening of plants from Indian Botanic Garden, Brahmam & Saxena (1978) conducted survey of plants from Orissa for tannins, saponins, flavonoids and alkaloids. Tiwari *et al* (1978, 1980) contributed on the primitive tribes of Eastern Ghats and their medicinal folk lore. Similarly, Bedi (1978) worked on Ratanmahal Hills of Gujarat, the area predominantly inhabited by Bhils. Kumar *et al* (1980) supplemented information on Garo tribe of Meghalaya and Maheshwari *et al* (1980) on Tharus of Uttar Pradesh. Joshi *et al* (1980) studied the ethnobotany of Gujarat with reference to folk medicine used by Dang tribe. Daniel (1980) analysed 150 plants of Gujarat forests for alkaloids, saponins and tannins. He has also screened 200 and more plants for the presence of economically important natural products.

Singh & Pande (1980) reported plants used by tribes of Eastern Rajasthan, Pal (1980) collected plants used in veterinary medicine by the tribes of Bihar, Orissa and West Bengal. Kamble & Pradhan (1980) collected medicinal plants used by the Korku tribe in Akola district of Maharashtra state. Sharma & Kulkarni (1980) studied sacred grooves of Kolhapur district. Thakre (1980, 1983), studied the common medicinal plants against bacteria. Ramchandran & Nair (1981) reported the traditional uses of 138 species belonging to 199 genera and 52 families by the *Irulas* of Tamil Nadu. Vartak & Gadgil (1981) studied sacred grooves along Western Maharashtra and Goa. Tripathi & Rastogi (1981) have illustrated the effects of flavonoids in biology and medicine and recommended the flavonoids isolated from seeds of *Rhamnus infectoria* for use in ophthalmology. Shah *et al* (1981) enumerated the ethnobotanical notes on 133 plants belonging to 54 families from Saurashtra in Gujarat. Kamboj and Dhawan (1982) reported antifertility and abortifacient herbal drugs used by primitive societies of India. Shah *et al* (1983) recorded medicinal plants from Dahanu forest region of Maharashtra state. Tarafder (1983a, 1984a) listed plants used by tribal people for antifertility, abortion and conception. Bhargava (1983) studied different tribes of Andaman and Nicobar Islands. Sen *et al* (1983) have done ethnobotanical study of Kuchla (*Strychnos nux-vomica)* and Gunjatkar & Vartak (1983) studied fish tail plam (*Caryota urens*). Jain & Puri (1984) explored the ethnobotanical properties of 100 plants of Jausar-Bawar hills of Uttar Pradesh. Hemadri & Rao (1984) described 17 plants exclusively used in the treatment of jaundice by the tribal people of Dandakaranya. Yoganarsimhan *et al* (1984) described 210 plant species belonging to 79 families of Andaman and Nicobar Islands. Pushpangadan & Atal (1984) described ethnomedico-botanical investigation of 79 species used by tribal people of Western Ghats in Kerala. Sharma & Malhotra (1984) studied some tribal areas of Maharashtra state. Rai & Bhujel (2002) studied the ethnobotany in Darjiling Hills region. Rai *et al* (1998) studied the ethnobotany in the fringe areas of Darjiling and Sikkim and has reported a large number of plants of wide range of uses among different groups of tribes. Jana & Chouhan (1999, 2000), Sinha & Chauhan (1997), Hajra & Chakraborty (1981), Dash & Chauhan (2002) among others have studied the ethnobotany of Sikkim.

Nilegaonkar *et al* (1985) analysed 13 species of wild edibles used by tribal people of Pune and Ahmadnagar districts and found that the protein value of wild leafy vegetables are higher than that of conventional leafy vegetables. Atique *et al* (1985) did ethnobotanical study of cluster fig (*Ficus racemosa*). Shah and Gopal (1985) studied Bhil, Gharasia and Dubla tribes of North Gujarat. Sharma and Vyas (1985) reported the medicinal importance of ferns used by the tribes of Rajashtan. Lal *et al* (1985) described ethnobotanical uses of lichens. Ramashankar and Khare (1986) studied phytochemistry of *Adiantum coudatum* and *Cheilanthus farinosa* and revealed the presence of alkaloids, steroids and flavonoids in those. Irawati *et al* (1986) cultured corms of *Amorphophallus companulatus* on Murashige and Skoog's medium. Saxena and Vyas (1986), tested seeds of *Nigella sativa, Argemone mexicana, Brassica juncea* and other ethnomedicinal plants for their antimicrobial activities against human pathogenic fungi. Jain *et al,* (1987) described the method of oil extraction from moul (*Bassia latifolia*) seeds.

13.3 Ethnobotanical Studies in India

The history to development of ethnobiology is as old as human civilization. The scientific evaluation of the subject is very recent and with application of the knowledge of social anthropology, ecology, pharmacology, archaeology and a few other disciplines, the scope of the subject has widened greatly. The history of ethnobotanical study in India is about four centuries old when Garcia da Orta (1563) published his *Oscoloquis* giving an account of the indigenous plants of India, but without using the term ethnobotany. Organized ethnobotanical work in India started with the publications by Janaki Ammal (1956) and Jain (1963). These investigations formed the foundations of modern ethnobotany and also prompted a large number of research workers from different parts of the country. The *'All India Coordinated Research Project of Ethnobiology"* involving several centres viz. Botanical Survey of India, National Botanical Research Institute, Regional Research Laboratories and some Universities launched in 1980s by the Ministry of Environment and Forests, Government of India, acted as a booster for many young workers to initiate ethnobiological researches in the country. Traditional medicinal plants are the main focus in these studies. As has already been mentioned that there are about 53 million tribal people belonging to over 550 tribal communities are living in India (Rao

1996). Only limited number of tribes has retained their original culture. The increase in the population level in tribal communities, their migration to other places in search of food, welfare schemes for the tribal communities floated by State and Central Government and impact of civilization, etc. have all collectively changed the lifestyle and age-old culture of the tribal people in several parts of the country. The cumulative effect of these activities is detrimental where the culture of the aboriginals and invaluable knowledge of medicinal and other useful plants are threatened. In order to protect ethnobiology, the traditional cultures and also the forests and other types of vegetation which nourishes the culture should be conserved.

All systems of traditional Indian medicine had their roots, in one way or the other, in folk medicines and household remedies. Whereas, some those earliest remedies and prescriptions became widespread and were subjected to certain refinements, revisions and improvements through practices by trained medicine men and thus got incorporated in organized system of medicine. But a major bulk of old medicines remained endemic to certain regions or people in the country. Due to lack of communication of intermingling and breeding of ideas and varying ways of life, many of these earlier remedies survived only by words from generation to generation. These are being practiced particularly in remote rural areas and tribal societies. The lack or absence of acculturation has in many instances, helped in preservation of this knowledge almost in original form (Jain 1981). Approximately 85% of the rural population of India depends upon wild verities of plants for the treatment of various diseases they are suffering. But unfortunately, due to rapid spread of the facilities of civilization and acculturation tribal environment, cultures, their faith and belief are rapidly changing with a downward trend. The indiscriminate exploitation and destruction of forest, spread of harmful chemicals, introduction of alien species and over exploitation of natural resources, a number of taxa have already been disappeared and others are awaiting a similar fate, even before we became aware of their existence. It is therefore, important to preserve the oral folklore on plants and plant resources before it is lost.

13.4 Importance of Studying Ethnobotany

Ethnobotany represents best avenues for screening new economic plants for food, medicine, etc. as well as for gene pool source for the development of agricultural and medicinal crops. For this purpose, a close collaboration is required among agriculturist, phytochemists, pharmacologists, nutritionists and ethnobotanists. This will not only lead to the discovery of new economic plants but also result in better understanding the relationship between primitive societies and modern science. However, the significance of Ethnobotany is multifaceted and multi-dimensional in nature. The following may be included under its coverage (Goel 2006):

(a) Man-plant interaction in human society.
(b) Historical understanding based on existing human culture.
(c) Genetic pool for resistant crops and for development of hybrid plant species.
(d) Scientific investigation of herbal practices exists among different ethnic communities and tribal groups to discover new medicinal plant species, new area of knowledge, treatment, therapies and drug development.
(e) Development of traditional technologies with scientific imputes for the benefit of artisan classes and for sustainable utilization of natural resources.

13.5 Sacred Groves

Tribal people have their own way of conservation. They are aware of the importance and level of their dependence on forests. Sometimes patches of forests are preserved on religious ground and are referred as *Devrai* or *Dev Rahati* or *Gram Than* or *Jaherthan,* etc. (i.e. sacred groves). These sacred groves remain free from human interferences due to religious beliefs or in the name of God! There are over 230 such groves found in Maharashtra (Gadgil & Vartak 1981). A sacred grove is a patch of vegetation associated with some deity. These are protected through the grace of deity. Thus, removal of any plant material (even a piece of dead wood) or killing any animal from sacred grove is a sin. Tribal people believe that breaking the law may result in serious illness or even to death (Gadgil & Vartak 1973, 1974, 1975, 1981; Gadgil & Chandran 1992; Godbole 1996; Dash & Chouhan 2002).

13.6 Drugs from Ethnic Formulations

In Indian premier institutions like the Central Drug Research Institute (CDRI), Central Institute of Medical and Aromatic Plants (CIMAP), Regional Research Laboratory, Jammu (RRL) and Tropical Botanic Garden and Research Institute (TBGRI) are working on medicinal plants. These institutions are engaged in gathering the information from different tribal pockets in India. They are evaluating the efficacy of drugs by photochemical and biological testing. Recently TBGRI is equipped with cryobank facility where medicinal plants are cryopreserved. The medicinal plant conservation park (MPCP) is also being developed at TBGRI, where about 450 medicinal plants are being conserved (TBGRI News 1995).

Remedies in traditional medicine consist of formula prepared from various natural substances, animals and vegetables. The vegetable remedies account for about 90% of these. Great importance is attached to the proper preparation of all herbal drugs, which are considered ineffective unless pre-treated in a prescribed manner. These herbal remedies are either swallowed, rubbed into scarification, poured into wounds, boiled and inhaled as fumes, splashed on to eyes, smoked in pipes or snuffed as snuff.

This system of medicine which is the only easy and accessible health care system for most of the population in rural areas needs to be evaluated scientifically, given due recognition and developed so as to improve its efficacy and safety. The chemical constituents of most of the herbs used by traditional healers are still unknown. It is, therefore, of paramount importance to know the chemical components of every reported herb and to make permanent records of the knowledge from the 'medicine men' before they all pass away. India has a vast reservoir of nearly 400,000 practitioners of *Ayurveda, Siddha, Unani* etc. whose services could not be adequately utilized in the health care delivery systems. The proper use of medicinal plants is a necessity and not a luxury. The use of medicinal plants in traditional medicines finds its natural expression and further development in primary health care. In China for example medicinal plants are an integral part of the formal health system and are utilized in about 40% of cases at the primary care level. It is often claimed and widely believed that remedies of natural origin are harmless and carry no risk to the consumer.

Drugs are derived from a number of sources in a number of ways. As it is already mentioned that the earliest drugs were plant extracts followed by pure natural compounds of known structures. This then followed the domination of completely synthetic chemical drugs. But, in recent years people are becoming conscious of the increased potency and harmful effects of synthetic drugs. Disillusioned with synthetic western medicine, more and more people are now realizing that natural medicine is better and we are now trying to return to the fold of traditional herbal systems. The World Health Organization (WHO) also admitted that it will not be possible or even desirable to replace this herbal medicine with western techniques, which leads to a revival of interest in wild medicinal plants. This 'green wave' (Tyler 1986) is likely to gain momentum in the years to come. The immense possibilities of these systems in achieving the proclaimed goal of "Health for all by 2000 AD" as enshrined in the Alma-Ata declaration are now being realized by the international community. They are now groomed as sources of alternative medicine, even though it is difficult to find agreement as to how these systems being synonymous with local medicine based on local resources, can best be utilized on a global basis (Farnsworth 1984).

Secondary metabolites produced by spermatophytes are commercially used as biologically active compound. It is estimated that only 5 – 15% of world's existing species have been surveyed for biological active compounds so far. It is because of limited financial and technical resources available, the developing countries of the world do not have a clear picture of the biodiversity and the richness of their natural resources. This is alarming in view of the current rate of extinction of tropical forests which contains most of the world's plant species. If the current trend of destruction of tropical forest habitats continues at its present rate, phytochemists may have only a few decades remaining to survey the chemical constituents of a large part of the plant kingdom for potentially useful compounds. This prompted interest in the tropical forest, where biological diversity is at the highest and indigenous population have a unique knowledge about the plant and its medicinal properties.

In the deluge of modernism, valuable and time-tested ethnobiological knowledge connected with agriculture, folk-medicine, etc. is fast disappearing. Although there are many examples of such information forming the source of modern medicine, technique etc. such knowledge provided by natives is generally ignored. As a result this rich and useful source of information has almost died up. Before this is completely lost to civilization, efforts to record such information and to preserve the gene pool should be taken up on an emergency basis (Manilal 1992).

The best recent example is the novel information provided by ***Kani*** tribe from Agastyamalai hills in Western Ghats, Kerala pertaining to antifatigue properties from the fruits of *Tricopus zeylanicus* ssp. *travancoricus* ('Aryogyapacha') lead to the development of an anti-fatigue drug named as ***Jeevani*** at Tropical Botanic Garden and Research Institute (TBGRI), Thiruvananthapuram (Kerala). Kanis chew these tiny fruits as instant source of energy and anti-fatigue agent when they climb hilly slopes carrying heavy head-loads. Laboratory tests confirmed its immuno-enhancing properties. Intake of fruits relieves fatigue, protects liver and boosts the immune system of body (Pushpangadan 2002; Pushpangadan *et al* 1997).

13.7 The Present Work

In view of these considerations and increasing necessity and importance of ethnobotanical research for human welfare, the present study in two Tea Gardens of Terai of West Bengal has been taken up. A considerable proportion of Tea Garden workers are tribal people in general, Santhals and Oraons in particular and this offers excellent scope for ethnobotanical investigations in the area. The aims of the present investigation include:

1. Collection of baseline qualitative data through focused botanical exploration. This includes documentation, preservation and vouchering of ethnobotanically useful plant specimens.
2. To prepare inventories on the varied plants used by different tribal communities for various purposes related to their social and survival strategies.
3. Focus attention on importance of proper conservation of biological diversity.

4. To understand the people's way of conserving biodiversity; etc.

The result of the survey can be classified into: (i) Wild Edible Plants; (ii) *Jhārā* preparation; (iii) Fodder Plants; (iv) Medicinal & Aromatic Plants; (v) Dye Yielding Plants; (vi) Religious Plants; etc.

13.8 Wild Edible Plants

Before learning the techniques of cultivation man was completely dependent on wild plants for their vegetable food. The trend is still continuing. People living in urban areas also like some wild plants in their maily menu. It is needless to narrate again the living standard of Tea Garden workers and certainly they will look for wild edible plants of their locality. For this purpose they may move outside the Tea Garden area where much more species of wild plants are growing in abundance. Table 13.1 recorded such plants used by Tea Garden workers in Terai and Table 13.2 for gardens in Darjiling hill region.

Table 13.1: List of plants used as food by Tea garden workers in Terai Region of Darjiling in West Bengal.

[***Abbreviations used***: G = Gungaram T.E., H = Hansqua T.E., K = Kamalpur T.E., M = Matigara T.E., Mo = Mohurgong & Gulma T.E., NK = Not Known, Bk = Bark, Brw = Brewing, Fl = Flower, Fr = Fruit, Infl = Inflorescence, Lf = Leaf, Rt = Root, Rhz = Rhizome, Sd = Seed, Sht = Shoot, St = Stem, Tg = Twig, Wd = Wood, WP = Whole Plant, Yng = Young]

Sl. No.	Plants [Families]	Local Name	Gardens where recorded	Parts Used	Mode of use
01	*Acmella calva* [Asteraceae]	Jangjurbi	G, H, K, M, Mo	Yng Tg	Green vegetable
02	*Adenanthera pavonina* [Mimosaceae]	Reti	G, H, K, M, Mo	Frt	Vegetable
03	*Aegle marmelos [*Rutaceae]	Bael, Bel	G, H, K, M, Mo	Ripe Fr	Raw
04	*Alocasia macrorrhiza [*Araceae]	Mankachhu	G, H, K, M, Mo	Lf, St	Vegetable
05	*Alternanthera paronichioides* [Amaranthaceae]	Sanchi	G, H, K, M, Mo	Sht	Green vegetable
06	*Alternanthera sessilis* [Amaranthaceae]	Gudru saag, Nunia saag	G, H, K, M, Mo	Yng Sht	Green vegetable
07	*Amaranthus lividus* [Amaranthaceae]	Lal bhaji	G, H, K, M, Mo	Yng Sht	Green vegetable
08	*Amaranthus spinosus* [Amaranthaceae]	Kata bhaji	G, H, K, M, Mo	Yng Sht	Green vegetable
09	*Amaranthus viridis* [Amaranthaceae]	Khudi bhaji	G, H, K, M, Mo	Yng Sht	Green vegetable

	[Commelinaceae]		M, Mo		
37	*Costus speciosus* [Zingiberaceae]	Kemuk, Betlawre	G, H, K, M, Mo	Yng Lf	Green vegetable
38	*Crotalaria juncea* [Fabaceae]	Sanaiful	G, H, K, M, Mo	Yng Sht	Green vegetable
39	*Cyanthillium cinereum* [Asteraceae]	Chhepra, Jurbula	G, H, K, M, Mo	Semi-tuberous Rt	Brewing
40	*Deeringia amaranthoides* [Amaranthaceae]	Chhonra-chhunri saag	G, H, K, M, Mo	Yng Sht	Green vegetable
41	*Dillenia indica* [Dilleniaceae]	Chalta	G, H, K, M, Mo	Persistent calyx	Vegetable
42	*Dioscorea alata* [Dioscoreaceae]	Arukanda, Nappakanda, Gethikanda, Toral	G, H, K, M, Mo	Rhz	Vegetable
43	*Dioscorea bulbifera* [Dioscoreaceae]	Bantarul	G, H, K, M, Mo	Rhz	Vegetable
44	*Diplazium esculentum* [Athyriaceae]	Dhenki saag, Kukri saag	G, H, K, M, Mo	Yng frond	Green vegetable
45	*Dryopteris filix-mas* [Dryopteridaceae]		G, H, K, M, Mo	Yng frond	Green vegetable
46	*Enydra fluctuans* [Asteraceae]	Hinche saag	G, H, K, M, Mo	Yng Sht	Green vegetable
47	*Ficus hispida* [Moraceae]	Dumur, Koksa	G, H, K, M, Mo	Lf, Fr	Green vegetable
48	*Glinus oppositifolius* [Caryophyllaceae]	Gima saag, Deila saag	G, H, K, M, Mo	WP	Green vegetable
49	*Hygrophila auriculata* [Acanthaceae]	Kulekhara	G, H, K, M, Mo	Yng Sht	Green vegetable
50	*Ipomoea aquatica* [Convolvulaceae]	Kalmi saag	G, H, K, M, Mo	Yng Sht	Green vegetable
51	*Lantana camara* [Verbenaceae]	Kuttush, Putush kata	G, H, K, M, Mo	Fr, Bk	Raw
52	*Leucas indica* [Lamiaceae]	Guma saag	G, H, K, M, Mo	Fl, Sht	Green vegetable
53	*Luffa aegyptiaca* [Cucurbitaceae]	Gomra, Dhundhul	G, H, K, M, Mo	Leafy Tg, Fr	Vegetable
54	*Malva verticillata* [Malvaceae]	Laffa saag	G, H, K, M, Mo	Sht	Green vegetable
55	*Marsilea minuta* [Marsileaceae]	Susni	G, H, K, M, Mo	Lf	Green vegetable
56	*Melastoma malabathricum* [Melastomataceae]	Datrangi	G, H, K, M, Mo	Ripe Fr	Raw
57	*Melochia corchorifolia* [Sterculiaceae]		G, H, K, M, Mo	Yng Sht	Green vegetable
58	*Mentha arvensis* [Lamiaceae]	Pudina	G, H, K, M, Mo	WP, Lf	Aromatic food additive
59	*Mimusops elangi* [Sapotaceae]	Bakul	G, H, K, M, Mo	Ripe Fr	Raw
60	*Momordica dioica*	Chetheli,	G, H, K,	Green Fr	Fruit vegetable

10	*Ammania baccifera* [Lythraceae]	Amber	G, H, K, M, Mo	Lf	Green vegetable
11	*Amorphophallus paeoniifolius* [Araceae]	Bon-Oll	G, H, K, M, Mo	Tuber, Lf	Green vegetable
12	*Annona reticulata* [Annonaceae]	Nona	G, H, K, M, Mo	Ripe Fr	Raw
13	*Annona squamosa* [Annonaceae]	Ata	G, H, K, M, Mo	Ripe Fr	Raw
14	*Artocarpus lacucha* [Moraceae]	Dahua, Dewa, Borhar	G, H, K, M, Mo	Ripe Fr	Raw
15	*Artocarpus heterophyllus* [Moraceae]	Kathar, Kanthal	G, H, K, M, Mo	Lf, Fr, Sd	Brewing, Fruit vegetable
16	*Azadirachta indica* [Meliaceae]	Neem	G, H, K, M, Mo	Lf, Fr, Bk	Bitter vegetable
17	*Bacopa monierii* [Scrophulariaceae]	Brahmi	G, H, K, M, Mo	Yng Sht	Green vegetable
18	*Bauhinia purpurea* [Caesalpiniaceae]	Kochnar, Koirala	G, H, K, M, Mo	Fl bud	Vegetable
19	*Bauhinia variegata* [Caesalpiniaceae]	Tanki	G, H, K, M, Mo	Fl bud	Vegetable
20	*Boerhavia coccinea* [Nyctaginaceae]	Khapra saag	G, H, K, M, Mo	WP	Vegetable
21	*Brassica campestris* [Brassicaceae]	Sarisa	G, H, K, M, Mo	Lf, Sd	Green vegetable, condiment
22	*Brassica juncea* [Brassicaceae]	Rye saag	G, H, K, M, Mo	Yng Sht	Vegetable
23	*Cajanus cajan* [Fabaceae]	Arhar	G, H, K, M, Mo	Sd	Fd
24	*Camellia sinensis* [Theaceae]	Chia, Chha	G, H, K, M, Mo	Fl, Lf	Cooked. Beverage
25	*Cassia occidentalis* [Caesalpiniaceae]	Tapray, Kalkasunda	G, H, K, M, Mo	Lf	Green vegetable
26	*Cassia tora* [Caesalpiniaceae]	Chhoto chakar	G, H, K, M, Mo	Lf	Green vegetable
27	*Catunaregam longispina* [Rubiaceae]	Maidalu, Kankra Jat	G, H, K, M, Mo	Lf	Green vegetable
28	*Centella asiatica* [Apiaceae]	Beng saag	G, H, K, M, Mo	WP	Green vegetable
29	*Chenopodium album* [Chenopodiaceae]	Bhatua saag	G, H, K, M, Mo	Yng Sht	Green vegetable
30	*Citrus medica* [Rutaceae]	Nimbu	G, H, K, M, Mo	Fr	Raw
31	*Citrus grandis* [Rutaceae]	Bimbira	G, H, K, M, Mo	Fr	Raw
32	*Clerodendrum viscosum* [Verbenaceae]	Ghato, Vhauti	G, H, K, M, Mo	Yng Lf	Brewing, vegetable
33	*Coccinia grandis* [Cucurbitaceae]	Janglikundr, Telakuch	G, H, K, M, Mo	Leafy Tg, Fr,	Green vegetable, Brewing
34	*Coix lachryma-jobi* [Poaceae]	Ghanrey mala	G, H, K, M, Mo	Mature grains	Like wheat
35	*Colocasia esculenta* [Araceae]	Kalo kachhu	G, H, K, M, Mo	Lf, Rhz	Green vegetable
36	*Commelina benghalensis*	Kana saag	G, H, K,	Yng Sht	Green vegetable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	[Cucurbitaceae]	Ban karela	M, Mo		
61	*Mussaenda roxburghii* [Rubiaceae]	Katmatiya, Dhobi Kat	G, H, K, M, Mo	Yng Sht	Brewing, Green vegetable
62	*Neolamarckia cadamba* [Rubiaceae]	Kadam	G, H, K, M, Mo	Ripe Fr	Raw
63	*Oldenlandia corymbosa* [Rubiaceae]	Atisar, Khetpapra	G, H, K, M, Mo	WP	Green vegetable
64	*Oldenlandia diffusa* [Rubiaceae]	Atisar	G, H, K, M, Mo	WP	Green vegetable
65	*Oroxylum indicum* [Bignoniaceae]	Totola, Taloyar, Dakdewa	G, H, K, M, Mo	Bk	Brewing
66	*Oxalis corniculata* [Oxalidaceae]	Khatta saag, Amruli saag, Amarching ari	G, H, K, M, Mo	WP	Green vegetable
67	*Oxalis corymbosa* [Oxalidaceae]	Pani kandi	G, H, K, M, Mo	Bulb	Vegetable
68	*Paederia foetida* [Rubiaceae]	Padrilarang, Gandha-bhadali	G, H, K, M, Mo	Lf	Green vegetable
69	*Persicaria hydropiper* [Polygonaceae]	Kusurpota, Sukurpota	G, H, K, M, Mo	Lf	Green vegetable
70	*Plumbago zeylanica* [Plumbaginaceae]	Chetoar, Chitawar	G, H, K, M, Mo	Leafy Tg	Brewing
71	*Polygonum plebeium* [Polygonaceae]	Chimti saag	G, H, K, M, Mo	WP	Green vegetable
72	*Portulaca oleracea* [Portulacaceae]	NK	G, H, K, M, Mo	WP	Green vegetable
73	*Pteridium aquilium* [Pteridiaceae]		G, H, K, M, Mo	Yng frond	Green vegetable
74	*Rauvolfia serpentina* [Apocynaceae]	Nagbeli	G, H, K, M, Mo	Bk of Rt, Rt	Brewing
75	*Scoparia dulcis* [Scrophulariaceae]	Atibala, Mitha, Jangli Dhania, Ghuma, Darchetowar	G, H, K, M, Mo	Leafy Tg	Brewing
76	*Sesbania grandiflora* [Fabaceae]	Bagphul, Bokphul	G, H, K, M, Mo	Fl	Vegetable
77	*Sesbania sesban* [Fabaceae]	Jayanti	G, H, K, M, Mo	Leafy Tg	Green vegetable
78	*Solanum nigrum* [Solanaceae]	Pako saag	G, H, K, M, Mo	Yng Tg, ripe Fr	Green vegetable; raw by children
79	***Solanum torvum*** [Solanaceae]	Goth Begun, Pako saag	G, H, K, M, Mo	Yng Fr	Fruit vegetable
80	*Stephania glabra* [Menispermaceae]	Inderparhi, Parhi, Karaiya	G, H, K, M, Mo	Rt Tuber	Brewing

81	*Stephania japonica* [Menispermaceae]	Inderparhi, Parhi, Karaiya	G, H, K, M, Mo	Rt Tuber	Brewing
82	*Trichosanthes lepiniana* [Cucurbitaceae]	Kowa tumbil	G, H, K, M, Mo	Yng Fr	Fruit vegetable
83	*Wattakaka volubilis* [Asclepiadaceae]	Chhit larang	G, H, K, M, Mo	St Bk	Brw
84	*Wedelia montana* [Asteraceae]	Bhringaraj	G, H, K, M, Mo	Leafy Tg	Green vegetable
85	*Zizyphus mauritiana* [Rhamnaceae]	Baer, Kul	G, H, K, M, Mo	Fr	Raw

Table 13.2: List of plants used as food by Tea garden workers in Darjiling Hills of West Bengal.

[***Abbreviations used***: Mk = Makaibari T.E., S = Soom T.E., T = Tamsong T.E., NK = Not Known Bk = Bark, Brw = Brewing, Fl = Flower, Fr = Fruit, Infl = Inflorescence, Lf = Leaf, Rt = Root, Rhz = Rhizome, Sd = Seed, Sht = Shoot, St = Stem, Tg = Twig, Wd = Wood, WP = Whole Plant, Yng = Young]

Sl. No.	Plants [Families]	Local Name	Gardens where recorded	Parts Used	Mode of use
01	*Acacia catechu* [Mimosaceae]	Khayer	Mk, S, T	Dryed resin (Khayer)	Chewing with betel leaf
02	*Aconogonum molle* [Polygonaceae]	Thotne	Mk, S, T	Soft St	Raw & cooked
03	*Actinidia strigosa* [Actinidiaceae]		Mk, S, T	Fr	Raw; brewing
04	*Ambroma augusta* [Sterculiaceae]	Sano kapasi	Mk, S, T	Sd	Edible
05	*Antidesma acidum* [Euphorbiaceae]	Archal	Mk, S, T	Lf, green & ripe Fr	Cooked or raw
06	*Ardisia solanacea* [Myrsinaceae]	Damai phal	Mk, S, T	Ripe Fr	Raw
07	*Artocarpus heterophyllus* [Moraceae]	Rukh katahar, Kathal	Mk, S, T	Fr, Sd	Cooked, raw
08	*Bauhinia purpurea* [Caesalpiniaceae]	Taki	Mk, S, T	Yng Sht, bud, Fl	Cooked as vegetable
09	*Bauhinia variegate* [Caesalpiniaceae]	Koiralo	Mk, S, T	Yng Sht, bud, Fl	Cooked as vegetable
10	*Berginia ciliata* [Saxifragaceae]	Pakhan bet	Mk, S, T	Fl	Pickles
11	*Brassica juncea* [Brassicaceae]	Rayo saag	Mk, S, T	Tender Lf & Sht	Green vegetable, ***Gundruk*** (a fermented food) from dried and mature leaves
12	*Calamus erectus* [Arecaceae]	Bet	Mk, S, T	Ripe Fr	Raw
13	*Canna edulis* [Cannaceae]	Phul tarul	Mk, S, T	Rhz	Cooked
14	*Cardamine hirsute* [Brassicaceae]		Mk, S, T	Sht	Green vegetable
15	*Carica papaya* [Caricaceae]	Mewa	Mk, S, T	Yng & ripe Fr	Coockes & raw
16	*Chenopodium album*	Bhatua saag	Mk, S, T	Sht	Green vegetable

	[Chenopodiaceae]				
17	*Cinnamomum bejolghota* [Lauraceae]	Bhale sinkowli	Mk, S, T	Bk of St & Rt	Flavouring spices
18	*Cinnamomum tamala* [Lauraceae]	Tejpatta	Mk, S, T	Bk, Lf	Flavouring spices
19	*Citrus aurntium* [Rutaceae]	Suntala	Mk, S, T	Ripe Fr	Raw
20	*Citrus maxima* [Rutaceae]	Sankatra	Mk, S, T		Raw
21	*Choerospondias axillaria* [Anacardiaceae]	Lapsi	Mk, S, T	Ripe & green Fr	Raw, pickles
22	Coriandrum sativum [Apiaceae]	Dhaniya	Mk, S, T	Lf, Infl, Fr	Salads, sauces and pickles and spice
23	*Costus speciosus* [Zingiberaceae]	Bet lauree	Mk, S, T	Rhz	Cooked
24	*Deeringia amaranthoides* [Amaranthaceae]	Bakri sag	Mk, S, T	Yng Lf, Sht	Green vegetable
25	*Dillenia indica* [Dilleniaceae]	Panchphal, Mechiaphal	Mk, S, T	Pseudocarp	Cooked
26	*Dioscorea belophylla* [Dioscoreaceae]	Ghita torul	Mk, S, T	Yam	Cooked
27	*Dioscorea pentaphylla* [Dioscoreaceae]	Rani bhyagur	Mk, S, T	Yam	Cooked
28	*Diplazium esculentum* [Athyriaceae]	Ningro	Mk, S, T	Young fronds	Green vegetable
29	*Elaeocarpus lancaefolius* [Elaeocarpaceae]	Bhadrasey	Mk, S, T	Fr	Raw
30	*Emblica officinale* [Euphorbiaceae]	Amloki	Mk, S, T	Fr	Raw
31	*Eryngium foetidum* [Apiaceae]	Bhote dhania	Mk, S, T	Lf	Flavouring spices, salads, sauces
32	*Fagopyrum debotrys* [Polygonacea]	Fapar	Mk, S, T	Sht	Green vegtable
33	*Ficus benghalensis* [Moraceae]	Bor	Mk, S, T	Ripe fig	Raw
34	*Ficus benjamina* [Moraceae]	Kabra	Mk, S, T	Yng Sht, Lf bud	Cooked & raw
35	*Heracleum nepalense* [Apiaceae]	Chimping	Mk, S, T	Fr	Pickles, aromatic spice
36	*Houttuynia cordata* [Saururaceae]	Gandey jhar	Mk, S, T	Yng Sht	Green vegetable
37	*Litsea cubeba* [Lauraceae]	Siltimbur	Mk, S, T	Fr	Raw, pickles
38	*Luffa aegyptiaca* [Cucurbitaceae]	Ghiroula, Dhundal	Mk, S, T	Immature Fr	Fruit vegetable
39	*Manihot esculenta* [Euphorbiaceae]	Simal tarul, Tapioca	Mk, S, T	Tuberous Rt	Sauces, pickles, morcha for brewing. Sometimes staple diet
40	*Morus australis* [Moraceae]	Sano kimbu	Mk, S, T	Ripe Fr	Raw
41	*Mucuna pruriens* [Fabaceae]	Hiunde simi	Mk, S, T	Sd	Substitute of dal (pulses)
42	*Musa balbisiana* [Musaceae]	Ban-kera	Mk, S, T	Infl, green & ripe Fr, stem inside Lf sheaths	Vegetable; ripe fruits taken raw
43	*Nasturtium officinale* [Brassicaceae]	Simrayo	Mk, S, T	Sht	Green vegetable
44	*Oroxylum indicum*	Totala	Mk, S, T	Fl	Vegetable

	[Bignoniaceae]				
45	*Ostodes paniculata* [Euphorbiaceae]	Bepari	Mk, S, T	Lf	Roti Prepared in leaves add special flavour and taste during different festivals in Nepalese
46	*Oxalis corniculata* [Oxalidaceae]	Chariamilo	Mk, S, T	WP	Green vegetable (sour)
47	*Pandanus nepalensis* [Pandanaceae]	NK	Mk, S, T	Ripe Fr	Raw
48	*Passiflora edulis* [Passifloraceae]	Garendal	Mk, S, T	Ripe Fr	Raw
49	*Persicaria chinensis* [Polygonaceae]			Yng Sht	Raw
50	*Phlogacanthus thyrsiformis* [Acanthaceae]	Rambasak, Chuwa	Mk, S, T	Young infl	Vegetable
51	*Piper chava* [Piperaceae]	Chava paan	Mk, S, T	Lf	Mastigatory
52	*Prunus cerasoides* [Rosaceae]	Painyun	Mk, S, T	Ripe Fr	Raw
53	*Psidium guajava* [Myrtaceae]	Ambak	Mk, S, T	Ripe Fr	Raw
54	*Punica granatum* [Punicaceae]	Darim, Anar	Mk, S, T	Ripe Fr	Raw
55	*Raphanus sativus* [Brassicaceae]	Mula	Mk, S, T	Fresh root tuber, Lf	Vegetable. ***Sinki*** a traditional fermented food prepared from matured dry leaves and dried root tuber
56	*Rumex nepalensis* [Polygonaceae]	Halhale	Mk, S, T	Lf	Green vegetable
57	*Stellaria media* [Caryophyllaceae]		Mk, S, T	Sht	Green vegetable
58	*Terminalia bellirica* [Combretaceae]	Barra	Mk, S, T	Fr kernel, cotyledons	Raw
59	*Terminalia chebula* [Combretaceae]	Harra	Mk, S, T	Fr kernel	Raw
60	*Tetradium fraxinifolium* [Rutaceae]	Khanakpa	Mk, S, T	Fr	Pickles
61	*Toddalia asiatica* [Rutaceae]	Singane kanra	Mk, S, T	Ripe Fr	Raw
62	*Trichosanthes lepiniana* [Cucurbitaceae]	Indraynee, Indrenee	Mk, S, T	Sd	Roasted
63	*Urtica ardens* [Urticaceae]	Sisnu, Ghariya sisnu	Mk, S, T	Yng infl	Cooked
64	*Urtica dioca* [Urticaceae]	Patle sisnu	Mk, S, T	Yng infl	Cooked
65	*Urtica parviflora* [Urticaceae]	Sisnu	Mk, S, T	Yng infl	Cooked
66	*Zanthoxylum nitidium* [Rutaceae]	Parpare Timbur	Mk, S, T	Fr	Raw, pickles, sauces
67	*Zanthoxylum oxyphyllum* [Rutaceae]	Bhainsi Timbur	Mk, S, T	Fr	Raw, pickles, sauces
68	*Zingiber officinalis* [Zingiberaceae]	Aduwa	Mk, S, T	Rhz	Sauces, pickles, spices, flavouring agen
69	*Zizyphus mauritiana* [Rhamnaceae]	Baer	Mk, S, T	Fr	Raw, pickles

The present survey recorded the use of 85 species of plants as food by the Tea Garden workers in five Tea Estates. Of these only four are pteridophytes (covering four genera and families), and seven are monocots (covering three families). 74 species of dicotyledons are represented by 39 families. - - In hill Tea Gardens comperatively lesser number of 69 species has been recorded to eat by Tea Garden workers. These include only one species of fern, eight species of monocotyledons and the remaining 60 species are dicotyledonous. At the family level, there are one pteridophytic, five monocotyledonous and 31 dicotyledonous taxa.

Morphological diversity among the edible parts of the recorded plants is also quite interesting. Almost all normal morphological organs are edible, starting from root, passing through stem, leaf, inflorescence, flower, fruit and seed and a number of modified organs.

Man's hunger did not spare even the poisonous plants. Seeds of *Trichosanthes lepiniana* are poisonous, but there are speciea preparations for this also. Quite a good number of neetle species are available [*Girardinia diversifolia, Laportea interrupta, Laportea terminalis, Urtica ardens, Urtica dioica, Urtica parviflora* etc] and, interestingly, most of these are edible.

For habit groups, all types like tree, shrub, climber, annual and perennial herbs, epiphytes etc are in this list.

They make some special preparation also. Common fermented foods like *Sinki* and *Gundruk* using locally available plants and use those during period of scarecity. Brewing cereals for alcoholic drinks they need to prepare '*morcha*' or '*Rani Dabai*', the starter mixtures, for which also they are having definite prescription of plants. The method of preparation of *Jhara* or *Harhia* has also been studied in detain and has been presented here within this chapter.

13.9 *Jhârâ* Preparation by Oraon Community (Ghosh & Das 2004)

13.9.1 What is *Jhārā*?

'***Jhārā***' or '***Hārhiā***' – the rice beer is extremely popular among the tribal people especially in the eastern states of India. Santhals, Oraons, Mundas and similar other groups of people living over wide areas in India, mainly in difficult country terrains. These tough but poor-people generally live in forest villages and maintain a large number of traditional cultural practices. After whole day's struggle for the collection of livelihood they need some entertainment at night and for that their basic requirement is an alcoholic drink. So, they drink rice beer in good amount and start enjoying with their traditional musical instruments, songs and dances. It is also consumed during all of their festivals, marriages and other ceremonies regularly (Roy 1947). The rice beer is called as ***'Jhārā'*** by Oraons and ***'Hārhiā'*** by Santhals.

It is almost impossible to determine when these tribal people started preparing rice beer but certainly it is a good improvisation of natural and direct fermentation of boiled rice when kept for a few hours soaked in water. The main point of modification is the addition of a specially formulated starter mixture in the boiled rice.

13.9.2 The Survey Area

The survey was made during 2003 – 2004 mainly among the Oraons and Santhals working in tea gardens in Darjiling Terai. Workers mainly from two Tea Gardens were selected for the purpose (i) *Gungaram Tea Estate* and (ii) *Hansqua Tea Estate*. Both the gardens are situated in the slightly undulating land of Darjiling-Terai and with a very good size of tribal work-force. For the present work, quite a few visits have been made to these two Tea Gardens and developed nice rapport with them using contact persons.

13.9.3 Stages in *Jhārā* Preparation

While ***Hārhiā*** is consumed by almost all of them, including children, it is prepared in a good proportion of the tribal families in Terai and Duars. However, only a few people produce it for sale. During the basic interaction with these people about the method of brewing *'Jhārā'* or *'Hārhiā'*, a good number of questions come to the mind including (i) nature of the basic ingredients and modifiers, (iii) actual method of preparation, (iv) method of storage, (v) related social rites, and certainly (vi) the underlying science behind the method. The rice beer is called as ***'Jhārā'*** by Oraons and ***'Hārhiā'*** by Santhals. The starter preparation in the form of flat white tablets is known as ***Rānu Dābāi*** among the tribals in Terai-Duars and is sold openly in local markets.

The entire process of the survey can be divided into three parts: (i) survey for the identification of basic ingredients among a large section of tribal Tea Garden workers, (ii) observing the method of preparation of starter mixture and (iii) filling of the fermenter and diluting the fermented product.

I. **Identification of Ingredients:** A good number of people from the Oraon and Santhal communities engaged in the preparation and marketing of *Rānu Dābāi* and/or *Hārhiā* were interviewed quite informally. They were also asked to spot the useful plants in field and the recorded informations include (i) vernacular name, (ii) useful part, (iii) purpose of use and (iv) the amount used. Collected voucher specimens will be deposited in the NBU-Herbarium.

II. **Method of Preparation:** The Tigga family in Hansqua Tea Estate, Mr. Subodh Tigga and his wife Mrs. Jhario Tigga are known to produce best quality *Rānu Dābāi* in the area. They agreed to prepare it in front of us. The entire process of its preparation has been recorded and photographed on 18th January 2004 at their residence.

Other people provided valuable information include Mr. Sudarsan Kumar Tirki, Anna Kujur, Solani Kujur, Johan Kujur (Oraons), Surya Sauriya, Jyoti Kumari Ekka, Mashi Prakash Ekka (Santhals), Dildhare Baraik (Baraik), and others.

13.9.4 Useful plants and their parts

The number of plants used in the process varies considerably from person to person. All the recorded plants have been presented here. Interestingly, while the Tigga family accepted that all these plants can be used but they use only some of these. Apart from this, all other information found to be almost same with all the resource persons.

1. ***Oryza sativa*** L. [Poaceae; vern. *Chaule, Chawor*]: the machine dehusked raw rice grains are preferred to produce the main bulk of the starter mixture; rarely parboiled grains are also used; paddy straw is used as insulator [*Chandrâ et AP Das* 0555].
2. ***Coccinia grandis*** (L.) Voigt [Cucurbitaceae; vern. *Jangli Kundri*]: the elongated and constricted tuberous roots are very important constituent; its use develops sweetness [*Chandrâ et AP Das* 0035].
3. ***Vernonia cinerea*** (L.) Lessing [Asteraceae; vern. *Chhepra, Jurbula*]: the whole plant including its fleshy and semi-tuberous roots is used; it also produces sweetness [*Chandrâ et AP Das* 0010].
4. ***Clerodendrum viscosum*** Ventenat [Verbenaceae; vern. *Ghato*]: terminal young and soft leaves are used; it produces a bitter taste [*Chandrâ et AP Das* 0006].
5. ***Plumbago zeylanica*** L. [Plumbaginaceae; vern. *Chetoar, Chitawar*]: leafy branches are used; it is a process enhancer [*Chandrâ et AP Das* 0100].
6. ***Stephania japonica*** (Thunberg) Miers [Menispermaceae; vern. *Inderparhi, Parhi, Karaiya*]: root or tuberous root; as preservative if intended to store for a longer period [*Chandrâ et AP Das* 0145].
7. ***Stephania glabra*** (Roxburgh) Miers [Menispermaceae; vern. *Inderparhi, Parhi, Karaiya*]: same as *S. japonica* [*Chandrâ et AP Das* 0380].
8. ***Oroxylum indicum*** (L.) Bentham ex Kurz [Bignoniaceae; vent. *Totola, Taloyar, Dakdewa*]: bark; adds a bitter taste [*Chandrâ et AP Das* 0107].
9. ***Mussaenda roxburghii*** Hook.f. [Rubiaceae; vern. *Katmatiya*]: roots; develops sweetness and yellowish tint in the liquor [*Chandrâ et AP Das* 0265].
10. ***Scoparia dulcis*** L. [Scrophulariaceae; vern. *Barier, Mitha, Jangli Dhamia, Ghuma, Dar-chetowar*]: leafy twigs; to improve the sweetness [*Chandrâ et AP Das* 069].
11. ***Rauvolfia serpentina*** (L.) Bentham ex Kurz [Apocynaceae; vern. *Nagbeli*]: bark of roots; develops a bitter taste [*Chandrâ et AP Das* 0556].
12. ***Artocarpus heterophyllus*** Lamarck [Moraceae; vern. *Kathar, Kanthal*]: leaves; improves sweetness and produce a yellowish tint in the liquor [*Chandrâ et AP Das* 0303].
13. ***Wattakaka volubilis*** (L.f.) Stapf (= *Dregea volubilis* (L.f.) Bentham ex Hook.f.) [Asclepiadaceae: vern. *Chhit Larang*]: bark of stem; develops a bitter taste [*Chandrâ et AP Das* 0264].

In addition, few old *Rānu Dābāi* tablets are also added to the preparation.

Out of the recorded thirteen species of plants five [i.e. *Oryza sativa, Coccinia grandis, Plumbago zeylanica, Vernonia cinerea* and *Clerodendrum viscosum*] are must for the preparation of a good quality of starter mixture. Powdered grains (*gundā*) of *Oryza sativa form* the medium and bulk of the product. If the roots of *Rauvolfia serpentina* is available in sufficient quantity then it will replace *Coccinia grandis.*

However, sometimes, in emergency they use only the bark of *Wattakaka volubilis*. This plant is rare but most of the other plants are easily available in the locality.

Except the above mentioned five plants, the uses of other plants depend on the likings of the users and availability. These plants are taste or colour or smell enhancers. Use of a species of *Stephania* improves the storage quality of *Rānu Dābāi*. But, its use is very rare as the rate of consumption is very high and only few people are expert in good quality starter production.

Instead of measuring the weight of any plant materials they use an arbitrary amount which they have learnt from their experience. Again, the proportion of different plants varies according to the preferences of the manufacturer.

During demonstration the Tigga family started with 10 kg of rice. The weight of other four plants used by them are (i) roots of *Coccinia grandis*: c. 500 g; (ii) tips of *Clerodendrum viscosum*: c. 300 g; (iii) whole plant of *Vernonia cinerea*: c. 350 g and (iv) twigs of *Plumbago zeylanica* c. 250 g. Tiggas generally do not use other plants. But, the enquiry revealed that c. 300 g of *Rauvolfia serpentina* roots can replace *Coccinia grandis* roots. And, the remaining other plants are used in much less quantity i.e. 50 – 100 g only for 10 kg of rice. About 1 kg of the bark of *Wattakaka volubilis* is used if *Rānu Dābāi* made only with this plant.

13.9.5 The Method of Collection

1. ***Rice Grain:*** As most of these Tea Garden workers do not have land for paddy cultivation, they purchase low-priced raw-rice (rarely parboiled) from the market. It may not be of good quality but need to be free from insect infestation.

2. ***Plants:*** Oraons and Santhals collect these plants fresh from their surrounding locality. Generally, they do not use dried or preserved plants. Only the bark of *Wattakaka volubilis* is sometimes stored after drying. After collection, plants or plant parts are washed properly and spread under open sun for some time to remove the surface water. Except the dried bark of *Wattakaka volubilis*, other plants are not available in the market and except *Plumbago zeylanica* and *Rauvolfia serpentina* which are sometimes grown in their premises, all others are collected from the wild.

13.9.6 Preparation of *Rānu Dābāi*

Six distinct stages can be recognized in the process:

i. ***Washing of Rice and Storing of Wash-water:*** After cleaning the rice grains on a '*Soop*', (a flat traditional utensil generally made of sliced bamboo) it is now taken in a vessel (made of clay/ metal/ PVC) for washing. Clean water (from dug-well/ tube-well) is poured in it, stirred and decanted. The decanted wash-water is preserved in a bucket for future use.

ii. ***Mixing and Grinding:*** It is done with a traditional wooden husking machine called '*Dhiki*'. At first all freshly collected plant materials (i.e. except rice grains) are chopped and grounded properly and taken out on a '*Soop*'. Rice grains are then put in the pit of


1
2
6
4
5
3

PLATE XVIII:Ethnobotany: *Hariâ/ Jharâ* preparation:

1. All ingredients (except rice) assembled on a *Soop* (note the presence of chili & charcoal)
2. Drying *Ranu Dabai* under Sun after incubation
3. *Ranu Dabai* on sale in the market
4. Fermentation of rice is over (liquid visible on one side of the container is the *Hariâ*.
5. *Hariâ* is for sale
6. Oraons enjoying after consuming *Jharâ*.

Dhiki and when partially powdered a few (3 – 4 large tablets for 10 kg of rice) old *Rānu Dābāi* tablets are added. And after some time the plant paste is also added to it and allowed to mix properly. When the rice grains are properly powdered and mixed with plant paste, it is then taken out on a sieve (*Chakni*) and the coarse part is returned to the *Dhiki*. After completing the sieving, woody and fibrous materials are rejected.

iii. *Tablet Preparation:* The powdered material (*gūndā*) is now taken in a large vessel (*Dikchi*) and made into paste using the previously stored rice wash-water. The paste become slightly greenish-white and emits the smell of mixed herbage.

Clean gunny-bags are then spread on the floor under shade or inside the rooms. There is no dice for preparing the tablets but are completely hand-made. The standard size is 4.5 – 7 cm in diameter, which is arranged in rows on the gunny where these are kept for 40 – 60 minutes. Here the tablets loose some amount of water and become little tough. Some people produce very small tablets of around 1.5 – 2 cm in diameter or rarely some giant tablets of 14 – 15 cm in diameter.

iv. *Incubation:* It is done inside a large basket (*Dhakiya*) made of sliced bamboo. Clean and dry straw is spread on the bottom of the basket and some tablets are kept on it. These are then covered with straw and another layer of tablets are kept on it. The process is repeated until the basket is full. And then, a larger amount of straw is added at the top. The entire set is now covered with polythene sheet and/or gunny and stored in a dark and warm place. Depending on the ambient temperature, the incubation period varies from 2 – 3 days in warm season and 4 – 6 days in winter. The inside temperature will rise considerably (*bukhar*) and the set will start emitting pungent *Hārhiā*-like smell. During this a layer of cottony mycelia will develop on the tablets. The fungal mycelia may produce a mat of black sporangia in damp weather or if stored for a slightly longer period.

v. *Drying*: Now, the tablets will be taken out of the basket and will be kept in single layer on large sized circular flat bamboo basket called '*dāgrā*' and get dried under the sun for 7 – 8 days. Now the *Rānu Dābāi* is ready for storing and for use.
The average size and weight of these dry tablets are presented in Table 1.

Table 13.3. Average size and dry weight of marketed *Rānu Dābāi* in Terai of Darjiling.

Average diameter in cm	**Average thickness in cm**	**Average weights in g**
14.5	0.8	112.79
6.00	0.65	24.28
1.5	1.5	1.67

vi. *Storing*: Dried *Rānu Dābāi* is kept in small bamboo baskets and stored in a dry place. These can be stored upto one year.

13.9.7 Preparation of *Jhārā*

It is not necessary that only the starter mixture (*Rānu Dābāi*) manufacturers will prepare *Jhārā* or *Hārhiā*. Other people purchase these tablets and produce *Jhārā* for domestic consumption and/or for sale. The process is having following steps:

i. *Boiling of rice*: generally low priced raw rice grains are taken, washed properly and boiled in water so that it need not to be decanted when the grains will be very soft.

ii. *Adding Starter Mixture*: it is generally done in a metallic or earthen container (the fermenter) with a wide bottom to facilitate the proper spreading of the boiled rice. *Rānu Dābāi,* at the rate of one large-sized (or 6 – 8 small) tablet per kilogram of rice is taken, powdered on a clean surface and then mix the same with the cooked rice on a *Soop*. After proper mixing it is then transferred to the fermenter. A little amount of water is also added to this mixture.

iii. *Incubation*: the lid for the fermenter is placed properly and the entire set is covered to keep it warm. The total incubation period varies from 3 – 5 days depending on the ambient temperature. When the fermented stock will produce a strong alcoholic smell then it is ready for use.

iv. *Diluting the Fermented Stock*: The fermented stock is then diluted with drinking water at the rate of 5 litre per kilogram of rice.

And, now the *Jhārā* or *Hārhiā* is ready for consumption.

13.9.8 The Safety Rites

Though the practice of only one rite has been observed during the entire process but they maintain it very seriously. They always keep '*one or few dry chillies and a piece of charcoal*' on the raw materials and on products of different steps of the entire process. They believe that it will keep all the evil forces away which may damage the product or deteriorate its quality.

13.10 Fodder Plants

Man domesticated many animals in their own interest. They keep herbivores like cows, buffelows, horses, donkeys, goats, sheeps, pigs, elephants, etc along with themselves in their own habitat. For maintaining these animals they need a good amount of fodder which they need to collect mostly from the nearby vegetation. Also, they grow some plants like Ficus hookeriana, *Artocarpus heterophyllus, Artocarpus lacucha, Brassaiopsi hainla, Sauraja nepalensis,* etc. near their houses or settlements. It is very difficult to record all the fodder plants available in the area as majority of the plants are browsed by one or the other herbivorous animal. The present record is from the fresh stock of collected fodder from the natural habitat and in consultation with the persons engaged in the collection of fodder. They

Table 13.4: List of plants used as fodder by Tea garden workers in Darjiling Hills and Terai in West Bengal.

[*Abbreviations used*: G = Gungaram T.E., H = Hansqua T.E., K = Kamalpur T.E., M = Matigara T.E., Mo = Mohurgong & Gulma T.E., Mk = Makaibari T.E., S = Soom T.E., T = Tamsong T.E., NK = Not Known]

Sl. No.	Plants	Local Name	T.E. where recorded	Edible plant parts
01.	*Acmella calva* [Asteraceae]	Kalijhar	G, H, Mo, Mk, T	Whole plant for pigs
02.	*Aconogonum molle* [Polygonaceae]	Thotney	Mk, S, T	Shoot
03.	*Alstonia scholaris* [Apocynaceae]	Chhatiwan	G, H, K, Mo, Mk	Leaves for pigs
04.	*Alternanthera sessilis* [Amaranthaceae]	Gudru saag, Nunia saag	G, H, K, M	Shoot
05.	*Amaranthus viridis* [Amaranthaceae]	Khudi bhaji	G, H, K	Shoot
06.	*Annona reticulata* [Annonaceae]	Nona	G, H, M, Mo	Leaves
07	*Annona squamosa* [Annonaceae]	Ata	G, H, K, M, Mo	Leaves
08.	*Artocarpus heterophyllus* [Moraceae]	Kathar, Kanthal	G, H, M, Mo, Mk	Leaves
09.	*Artocarpus lacucha* [Moraceae]	Dahua, Dewa	G, Mo, Mk	Leaves
10.	*Axonopus compressus* [Poaceae]	Chepti	G, H, K, M, Mo, Mk, S, T	Entire shoot
11.	*Bambusa spp.* [Poaceae]	Bansh	G, H, K, M, Mo, Mk, S, T	Leaves
12.	*Bauhinia purpurea* [Caesalpiniaceae]	Kochnar, Taki	G, H, K, M, Mo, Mk	Leaves
13.	*Bauhinia variegata* [Caesalpiniaceae]	Koiralo	G, H, K, Mo, Mk, T	Leafy shoot
14.	*Bidens pilosa* [Asteraceae]	Kuro	G, H, Mo, Mk, S, T	Whole plants for pigs
15.	*Bischofia javanica* [Bischofiaceae]	Kainjal	G, H, K	Fruits by monkeys
16.	*Boehmeria macrophylla* [Urticaceae]	Kamli	Mk, S, T	Leaves
17.	*Boehmeria rugulosa* [Urticaceae]	Daar	G, Mo, Mk, T	Foliage
18.	*Brassaiopsi hainla* [Araliaceae]		Mk, S, T	Foliage
19.	*Canna edulis* [Cannaceae]	Phul tarul	G, H, K, M, Mo, Mk, S, T	Whole plant
20.	*Coix lachryma-jobi* [Poaceae]	Ghanrey mala	H, K, M, Mo, Mk, S	Whole plant
21.	*Commelina benghalensis* [Commelinaceae]	Kanchira, Kana sag	G, H, K, Mk	Whole plant

22.	*Cynodon dactylon* [Poaceae]	Dubo, Dubba	G, H, K, M, Mo, Mk, S, T	Whole plant
23.	*Dillenia indica* [Dilleniaceae]	Panchphal, Mechiaphal	G, H, K, Mo, Mk	Foliage
24.	*Dillenia pentagyna* [Dilleniaceae]	Tantari	G, H, K, Mo, Mk	Leaves
25.	*Dioscorea alata* [Dioscoreaceae]	Arukanda, Nappakanda, Gethikanda, Torul	G, H, K, Mk, S	Rhizome
26.	*Ehretia acuminata* [Ehretiaceae]	NK	G, H, K, M,	Leaves; Fruits by monkeys
27.	*Eleusine indica* [Poaceae]	Nun-marua, Suyarmerewa	G, H, K, M, Mk	Whole plant
28.	*Equisetum debile* [Equisetaceae]		G, , Mo, Mk, S, T	Whole plant
29.	*Ficus benghalensis* [Moraceae]	Bar, Bot	G, H, K, M, Mo, Mk	Leaves
30.	*Ficus benjamina* [Moraceae]	Kabra	G, H, K, Mo, Mk	Foliage
31.	*Ficus hispida* [Moraceae]	Dumur, Khasray	G, H, Mo, Mk, T	Leaves
32.	*Ficus hookeriana* [Moraceae]	NK	Mk, S, T	Leaves
33.	*Ficus neriifolia* [Moraceae]	Dudhilo	Mk, S, T	Leaves
34.	*Ficus religiosa* [Moraceae]	Pipal	G, H, Mk	Leaves
35.	*Girardinia diversifolia* [Urticaceae]	Vangre Sishnu	Mk, S, T	Leaves after boiling
36.	*Imperata cylindrica* [Poaceae]	Siru	G, H, K, M, Mo, Mk, S, T	Leaves
37.	*Litsea glutinosa* [Lauraceae]	Meda, Kawala	H, K, Mo, Mk	Leaves
38.	*Mangifera indica* [Anacardiaceae]	Aam	G, H, K, M, Mo, Mk	Leaves
39.	*Mikania micrantha* [Asteraceae]	Mikenia, Badmash larang	G, H, K, M, Mo, Mk, S, T	Whole plant
40.	*Murraya paniculata* [Rutaceae]	Bajradanthi	G, H, K, Mk	Foliage
41	*Morus macroura* [Moraceae]	Kimbu, Bola	Mk, S	Leaves
42	*Musa bulbisiana* [Musaceae]	Kera, Kela	G, H, K, M, Mo, Mk, S, T	Leaves, pseudostem
43	*Oroxylum indicum* [Bignoniaceae]	Totala	G, H, K, M, Mo, Mk, S, T	Foliage
44	*Oryza sativa* [Poaceae]	Chaule, Chawor	G, H, K, M, Mo, Mk, S, T	Grains, straw
45	*Persicaria chinensis* [Polygonaceae]	NK	G, H, Mo, Mk, S, T	Whole plant
46	*Rumex nepalensis* [Polygonaceae]	Halhalay	Mk, S, T	Leaves, inflorescence
47	*Sauraja nepalensis* [Saurajaceae]	Gagun	Mo, Mk, S, T	Leaves
48	*Setaria palmifolia* [Poaceae]	Bashpata, Dhotisara	G, H, K, Mo, Mk, S, T	Whole plant
49	*Streblus asper* [Moraceae]	Kakshi	G, H, K	Leaves for goates

50	*Syzygium cumini* [Myrtaceae]	Jamuna	G, H, K	Leaves
51	*Tetradium fraxinifolium* [Rutaceae]	Khanakpa	Mk, S, T	Leaves
52	*Thysanolaena latifolia* [Poaceae]	Phul jharu, Amliso	G, H, K, Mo, Mk	Whole plant
53	*Tinospora cordifolia* [Menispermaceae]	Gurjo lahara	G, H, K	Succulent stem, improves lactation
54	*Trema orientalis* [Ulmaceae]	Khas-khasia	G, H, K, Mk	Leaves
55	*Trifolium repens* [Fabaceae]	NK	Mk, S, T	Whole plant
56	*Urtica dioica* [Urticaceae]	Sishnu	Mk, S, T	Leaves after boiling
57	*Urtica parviflora* [Urticaceae]	Sishnu	Mk, S, T	Leaves after boiling

Through this exercise, as much as 57 species of plants has been recorded which were represented by 46 genera, one pteridophytic family, four monocotyledonous families and 22 dicotyledonous families. These include plants of almost all habit groups and wide variety of morphological organs of plants. These include some poisonous plants like species of *Girardinia, Urtica* etc. Neetles are boiled with water and common salt before serving those to the cattles. These plants are actually very good fodders and increase milk output. Some naturalized exotic plants like *Axonopus compressus, Trifolium repens, Annona reticulate, Annona squoamosa, Canna edulis, Mikania scandens* etc are good fodders and local people regularly collect first two of these plants specially for the lactating cows.

13.11 Medicinal & Aromatic Plants

From the Ethnobotanical survey among the workers in eight Tea Gardens of the region a large number of Medicinal and Aromatic Plants has been recorded. Table 13.5 recorded the information from five Terai gardens [*Gungaram Tea Estate, Hansqua Tea Estate, Kamalpur Tea Estate, Matigara Tea Estate* and *Mohugong & Gulma Tea Estate*] and Table 13.6 recorded information from hills Tea Gardens [*Makaibari Tea Estate, Soom Tea Estate* and *Tamsong Tea Estate*].

Table 13.5: Medicinal & aromatic plants used by the workers in Terai Tea Gardens in Darjiling.

[***Abbreviations used***: G = Gungaram T.E., H = Hansqua T.E., K = Kamalpur T.E., M = Matigara T.E., Mo = Mohurgong & Gulma T.E., Bk = Bark, Fl = Flower, Fr = Fruit, Lf = Leaf, Rt = Root, Rhz = Rhizome, Sd = Seed, Sht = Shoot, St = Stem, Tg = Twig, WP = Whole Plant, Yng = Young]

Sl. No.	Plants [Families]	Local Name	T.E. where recorded	Parts Used	Purpose of use
01.	*Acacia catechu* [Mimosaceae]	Khair	G, H, K, M, Mo	Bk, Rt	Leucorrhoea, chest pain, menstrual complaints, diarrhea, gonorrhoea, bronchitis, facilitate child

					birth, astringent, toothache, dysentery, mouth sores, asthma
02.	*Achyranthes aspera* [Amaranthaceae]	Chitchithii	G, H, K, M, Mo	Lf,Rt, Sd	Bites of poisonous insects, wasps, bees; diarrhea, haemorrhiods, cough, abortion; Bleeding piles
03.	*Achyranthes bidentata* [Amaranthaceae]	Chitchithii	G, H, K, M, Mo	Rt	Abortion
04.	*Acmella calva* [Asteraceae]	Jangjurbi, Jurbula, Jariphul	G, H, K, M, Mo	Whole plant, Capitula	Dysentery, scabies, throat infection, purgative, tongue paralysis; toothache
05.	*Acorus calamus* [Acoraceae]	Boch, Bojo, Ghorbaj	G, H, K, M, Mo	Rz	Respiratory troubles, antipyretic, fever; increases memory,
06.	*Adiantum capellusveneris* [Adiantaceae]	Unew	G, H, K, M, Mo	Lf	Strangury, dysentery, blood, diseases, ulcers, erysipelas, epileptic fits. Treating irregular menstruation
07.	*Aegle marmelos* [Rutaceae]	Bael, Bel	G, H, K, M, Mo	Lf, Fr	Digestive disorders, astringent, dysentery, diarrhea, eye trouble, cholera, fever, gastric trouble, constipation, diabetes, abdominal pain, urinary trouble, heart palpitation, opthalmia, piles, restorative, laxative
08.	*Ageratum conyzoides* [Asteraceae]	Ilamay jhar, Dochunti	G, H, K, M, Mo	Lf	Diarrhoea , dysentery, intestinal colic with flatulence; rheumatism, fever; leaves &salt to prevent tetanus, leprosy & other cutaneous disease; eye lotion, antilithic; cuts , wounds, sores; prevent stone formation
09.	*Ageratum houstonianum* [Asteraceae]	Bhusuri pata	G, H, K, M, Mo	Lf	Etching problem in rainy season, fever and cought
10.	*Albizia lebbek* [Mimosaceae]	NK	G, H, K, M, Mo	Sd, Bk	Diarrhea, dysentery, eye complaints, piles, gonorrhoea, ulcer
11.	*Albizia odoratissima* [Mimosaceae]	NK	G, H, K, M, Mo	Bk	Intermittent fever
12.	*Aloe barbadensis* [Liliaceae]	Ghiukumari	G, H, K, M, Mo	Lf	Dyspepsia, piles, eczema, dysentery, constipation, diarrhea, brain tonic, menstrual suppressions
13.	*Alstonia scholaris* [Apocynaceae]	Chhatim, Chhatiwan	G, H, K, M, Mo	Ltx, Wd, Bk	Fever, malaria, ulcers, diarrhea, sinusitis, leprosy, strengthens teeth; tumours, rheumatic pains, sores, toothach, ear drop; rheumatism, wounds;

					snake & scropion bites, febrifuge in treating malaria,ulcers; pain during pregnency & clearing blood, bodyache, worms, indigestion, appetizer
14.	*Alternanthera peronichioides* [Amaranthaceae]	Sanchi	G, H, K, M, Mo	Sht	Fever, galactagogue
15.	*Ammannia baccifera* [Lythraceae]	Amber	G, H, K, M, Mo	Lf	Rheumatic pain, fevers, skin diseases, appetizer, laxative, stomachic, blood problems, aphrodisiac, strangury
16.	*Amorphophallus paeoniifolius* [Araceae]	Ban-ol	G, H, K, M, Mo	Rhz, Lf	Appetizer
17.	*Ananus comosus* [Bromeliaceae]	Anaras, Bhui Kathar	G, H, K, M, Mo	Fr, Lf	Menstruation, urinary & digestive problems, worms, nervous exhaustion
19.	*Andrographis paniculata* [Acanthaceae]	Kalomegh	G, H, K, M, Mo	Lf	Dysentery, dyspepsia, bronchitis, diabetes, itches, influenza, liver trouble, jaundice, piles, deworming, constipation, fever
20.	*Anona reticulata* [Annonaceae]	Nona	G, H, K, M, Mo	Bk, Lf, Fr	Blood complaints, fever, dysentery, tonic and maturant
21.	*Annona squamosa* [Annonaceae]	Ata	G, H, K, M, Mo	Lf, ripe Fr	Drastic purgative, tumours, dysentery, depression, spinal disease, boils
22.	*Argemone mexicana* [Papaveraceae]	Siyalkanta	G, H, K, M, Mo	Rt, Sd, latex	skin diseases, piles, emetic, laxative, expectorant, warts, demulcent, cough, asthma, eczema, itching, antiviral, anthelmintic, tumours, cancer
23.	*Artemisia indica* [Asteraceae]	Titepati	G, H, K, M, Mo	Lf	Ulcers, inflamations, intestinalworms, lack of apetite, leprosy, fever
14.	*Artocarpus lacucha* [Moraceae]	Dahua, Dewa, Borhar	G, H, K, M, Mo	Latex	Pneumonia in children, worm, dysentery, externally on mumps
25.	*Averrhoa carambola* [Averrhoaceae]	Kamranga	G, H, K, M, Mo	Fr	Jaundice
26.	*Azadirachta indica* [Asteraceae]	Neem	G, H, K, M, Mo	Lf, Fr, Bk, oil	Vomiting, Burning sensation, fever, opthalmia, skin disease, leprosy, piles, joundice, blood suger, cough, asthma, toothache, ulcers, urinary diseases
27.	*Bacopa monnieri* [Scrophulariaceae]	Brahmi	G, H, K, M, Mo	Leafy Tg	Brain tonic, nervine tonic, asthma, tonsil, epilepsy, hoarseness, improves memory
28.	*Bambusa* sp. [Poaceae]	Bans	G, H, K, M, Mo	water inside	Nocturnal bed wet and nocturia

				stem	
29.	*Bauhinia purpurea* [Caesalpiniaceae]	Koirala	G, H, K, M, Mo	Bk	Astringent, smallpox, rheumatism, dropsy, bone fracture, stomachic
30.	*Bauhinia variegata* [Caesalpiniaceae]	Tanki	G, H, K, M, Mo	Lf, Bk	Piles, dysentery, leprosy, indigestion, ulcer, obesity, syphilis, tumours, constipation, depurative, vulenerary, antiinflammatory
31.	*Biophytum sensitivum* [Oxalidaceae]	Rani Lajjabati	G, H, K, M, Mo	WP	Urinary calculi, snake bite,asthma, wounds, hyperdipsia in bilious fever, gonorrhoea
32.	*Bischofia javanica* [Euphorbiaceae]	Kainjal	G, H, K, M, Mo	Bk	Antipyretic
33.	*Boerhavia coccinea* [Nyctaginaceae]	Punarnava	G, H, K, M, Mo	WP, Rt	Decoration of plant is beneficial in oedema, dropsy. Root in Jaundice, ascities
34.	*Bombax ceiba* [Bombacaceae]	Simal	G, H, K, M, Mo	Gum, Fl	Aphrodisiac, cholera, stimulant, nerve tonic, haemorrhage, asthma, leprosy, digestive disorder, anemia, chickenpox, leucorea
35.	*Bridelia retusa* [Euphorbiaceae]	Gayo	G, H, K, M, Mo	Lf, Rt	Diarrhoea, gargle, astringent, rheumatism
36.	*Cajanus cajan* [Fabaceae]	Arhar	G, H, K, M, Mo	Sd, Lf	Nutritious; jaundice
37.	*Callicarpa arborea* [Verbenaceae]	Gwelo	G, H, K, M, Mo	Bk, St	Skin diseases, gastric complaints, fever, masticatory, scorpion bite, pneumonia
38.	*Calotropis gigantea* [Asclepiadaceae]	Akoyan, Akunda, Aank	G, H, K, M, Mo	Ltx, Lf, Rt	Cardiac asthma, headache
39.	*Camellia sinensis* [Theaceae]	Chia, Chha	G, H, K, M, Mo	Lf, Rt	Food poisoning, vomiting, eyesores, conjunctivitis, sun burns; mumps
40.	*Cannabis sativa* [Cannabaceae]	Bhengri, Bhang	G, H, K, M, Mo	Lf, Fl	Sedative; Veterinary problems
41.	*Cardamine hirsuta* [Brassicaceae]	Baurai	G, H, K, M, Mo	WP	Cough & cold
42.	*Cassia alata* [Caesalpiniaceae]	Thuletapre, Baro chakar	G, H, K, M, Mo	Sd, Lf	Wounds, cuts, itching problems, arthritis and other pains
43.	*Cassia fistula* [Caesalpiniaceae]	Sonalu, badarlathi	G, H, K, M, Mo	Rt, Lf, bud, Fr pulp	Strong purgative, skin diseases, leprosy, jaundice, tuberculous, syphilis, abdominal pain, high blood pressure, epilepsy, constipation of TB patient , asthma, antifertility, antiseptic

44.	*Cassia occidentalis* [Caesalpiniaceae]	Tapray, Kalkasunda	G, H, K, M, Mo	Rt, Lf	Ringworm, scorpion sting, elephantiasis; aphrodisiac, hiccough, alesecteric, asthma, eyesore, typhoid, haematuria, rheumatism, hemoglobin disorder, hysteria, diuretic, inflammation of rectum; purgative, skin diseases, antiperiodic
45.	*Cassia sophera* [Caesalpiniaceae]	Tapray, Chhoto Kalkasunda	G, H, K, M, Mo	Lf, St, Fl	A substitute of *Cassia occidentalis*
46.	*Cassia tora* [Caesalpiniaceae]	Chhoto chakar, Chakra sag	G, H, K, M, Mo	Lf	Dried leaf powder used in soup to reduce body pain
47.	*Catharanthus roseus* [Apocynaceae]	Nayantara	G, H, K, M, Mo	Lf, Fl	Leukemia, diabetes
48.	*Centella asiatica* [Apiaceae]	Thankuni, Beng saag	G, H, K, M, Mo	Lf, WP	Indigestion, dysentery, fever, stomach trouble, fatigue, bloodless, ulcer of mouth, weakness, loss of memory, cough, leprosy, excessive sweats, jaundice, constipation
49.	*Chenopodium album* [Chenopodiaceae]	Bhatua saag	G, H, K, M, Mo	Yng Sht	Dysentery, amaenia, parasites, Hook worm & Round Worm
50.	*Chenopodium ambrosoides* [Chenopodiaceae]	Chandan beto	G, H, K, M, Mo	WP	Parasites - hook worm, round worm
51.	*Chromolaena odoratum* [Asteraceae]	Assamia	G, H, K, M, Mo	Lf	Cough
52.	*Cinnamomum tamala* [Lauraceae]	Tejpata	G, H, K, M, Mo	Bk, Lf	Gonorrhoea, diarrhoea, cough
53.	*Cissus quadrangularis* [Vitaceae]	Harjore	G, H, K, M, Mo	St	Bowel complaints, wounds, burns, scurvy, asthma, fracture of bone, dysentery
54.	*Citrus medica* [Rutaceae]	Nimbu, lebu, bimbira	G, H, K, M, Mo	Rt, Fr	anthelmintic, diarrhoea, dysentery, stomach problems; boiled fruit juice for cattle food poisoning
55.	*Cleome rutidosperma* [Cleomaceae]	Torel	G, H, K, M, Mo	WP	Jaundice, blood purifier
56.	*Clerodendrum indicum* [Verbenaceae]	Brahmajasti	G, H, K, M, Mo	Lf, Rt	Asthma, cold, cough, worm, remittent fever, veneral disease, rheumatism
57.	*Clerodendrum viscosum* [Verbenaceae]	Ghato, Vhauti	G, H, K, M, Mo	Lf, Rt, Fr	Worms, fever, colic pain, aphrodisiac, antipyretic, burning sensation, biliousness, anthelmintic, , foul odour,leucoderma blood diseases; dysentery; hasten suppuration of boils & abscesses; cough and

					cold, contraceptic; skin diseases, itching; veternery problems
58.	*Clitoria ternatea* [Fabaceae]	Aparajita	G, H, K, M, Mo	Sd	Brain tonic
59.	*Coix lachryma-jobi* [Poaceae]	Ghanrey mala	G, H, K, M, Mo	Rt	Anthelmintic, wormifuge
60.	*Colocasia esculenta* [Araceae]	Kalo kachhu	G, H, K, M, Mo	Lf	Cough, wounds
61.	*Commelina benghalensis* [Commelinaceae]	Kanchira, Kana saag	G, H, K, M, Mo	WP	leprosy, dropsy, rheumatic pain, ringworm, eczema; Juice is an antidote to snake bite
62.	*Costus speciosus* [Costaceae]	Kemuk	G, H, K, M, Mo	Rz	Cough, cold, fever, skin diseases
63.	*Crassocephalum crepidioides* [Asteraceae]		G, H, K, M, Mo	Lf	Cuts and wounds
64.	*Crotalaria retusa* [Fabaceae]	Atasi	G, H, K, M, Mo	WP	Astringent, digestive, expectorant, febrifuge, dyspepsia, leprosy
65.	*Curculigo orchioides* [Hypoxidaceae]	Kalo musali, Talmuli	G, H, K, M, Mo	WP	Aphrodisiac, appetizer, diseases of blood, bronchitis, indigestion, diarrhoea, gonorrhea, joint pains, jaundice, asthma
66.	*Curcuma amada* [Zingiberaceae]	Amada, Jangli hardi	G, H, K, M, Mo	Rz	Digestion trouble, diabetes, asthma, ulcer on panis, sprains, bronchitis, cought
67.	*Curcuma aromatica / caesia* [Zingiberaceae]	Bon hardi, Kalo Haldi	G, H, K, M, Mo	Rz	Aromatic, carminative, stimulant, rheumatic pain, sprains, anemia, weakness
68.	*Curcuma longa* [Zingiberaceae]	Hardi	G, H, K, M, Mo	Rz	Stomachic, antiperiodic, antirheumatic, antiseptic, carminative, authalmintic
69.	*Curcuma zedoaria* [Zingiberaceae]	Pila hardi	G, H, K, M, Mo	Rz	Food poisoning, jaundice, blood purifier, dropsy, skin diseases
70.	*Cuscuta reflexa* [Cuscutaceae]	Banda larong, Amar lata, Swarnalata	G, H, K, M, Mo	WP	Skin diseases, jaundice, diabetes
71.	*Cymbopogon nardus* [Poaceae]	Citronella ghash	G, H, K, M, Mo	Lf	Leprosy, insecticidal
72.	*Cynodon dactylon* [Poaceae]	Dubo, Dubba	G, H, K, M, Mo	Leafy Sht	Leucorrhoea, wounds, cuts, leprosy, fever, dysentery, vomiting, skin diseases, bodyache
73.	*Cyperus rotundus* [Cyperaceae]	Mutha	G, H, K, M, Mo	Rt stock	Dysentery, wounds, epilepsy, loss of appetites, weight loss, from digestive troubles in new born babies, gas, colic, gripes, diarrhea, constipation, intestinal worms
74.	*Dalbergia sissoo* [Fabaceae]	Sishu	G, H, K,	Lf, Sd	Gonorrhoea, dysentery,

			M, Mo		skin disease, leprosy
75.	*Datura metel* [Solanaceae]	Dhutura	G, H, K, M, Mo	Sd, Lf, Rt	Diarrhea, antipyretic, sores, antiseptic, insanity, cuts, wounds
76.	*Datura stramonium* [Solanaceae]	Dhutura	G, H, K, M, Mo	Sd, Lf	Pain, fever, dog's bite, worms, dysentery, asthma
77.	*Desmodium triflorum* [Fabaceae]	Kodalia	G, H, K, M, Mo	Lf	Wounds, abscesses, indolent sores and itch, cough in children
78.	*Dillenia indica* [Dilleniaceae]	Panchphal, Chalta		Fr	Dyspepsia, bronchitis, expectorant, arthritis, laxative, appetizer
79.	*Dioscorea alata* [Dioscoreaceae]	Arukanda, Gethikanda, Toral	G, H, K, M, Mo	Rz	Medicinal
80.	*Dioscorea deltoidea* [Dioscoreaceae]	Githa lahara, Tarul, Ban tarul, Kukkur tarul, nappakanda	H	Rt tuber	Birth control, fever, improving sex hormone, rheumatism, rheumatic fevers, arthritis, eye & ear troubles, breast cancer, monopause problems, uterine bleeding; anemia during pregnancy
81.	*Dioscorea pentaphylla* [Dioscoreaceae]	Bhegur	G, H, K, M, Mo	Rz	Gastric disorders, pains, contraceptive, allergic fevers. Veterinary problems
82.	*Drymaria cordata* ssp. *diandra* [Caryophyllaceae]	Abijalo	G, H, K, M, Mo	WP	Nasal congestion
83.	*Eclipta prostrata* [Asteraceae]	Keshut	G, H, K, M, Mo	Leafy Tg, Rt	Jaundice, fever, skin diseases, asthma,bronchitis, hair colour, black spots on face
84.	*Elephantopus scaber* [Asteraceae]	Gajalata	G, H, K, M, Mo	Rt , Lf, Fl	Diarrhoea, bronchitis
85.	*Eleusine indica* [Poaceae]	Nunmarua, Suyarmerewa	G, H, K, M, Mo	WP	Stomachache; Veterinary problems
86.	*Emblica officinalis* [Euphorbiaceae]	Amloki, Aonla, Amala	H, K, M, G	Fr	Fever, vomiting, acidity, leucorrhoea, diabetes, bronchitis, asthma, anemia, constipation, dropsy, liver problem, dysentery, piles, headache, inflamation, urinary discharge
87.	*Enydra fluctuans* [Asteraceae]	Hinche saag	G, H, K, M, Mo	Yng Sht	Med
88.	*Equisetum debile* [Equisetaceae]	NK	G, H, K, M, Mo	Under-ground St	Vet
89.	*Equisetum diffusum* [Equisetaceae]	Kurkury jhar	G, H, K, M, Mo	Leafy Sht	Urinary trouble, yellow fever, coolant in gonorrhoea, bedwets in children
90.	*Erythrina stricta* [Fabaceae]	Phaledo, Madar	G, H, K, M, Mo	Yng Lf	Injury like twisting of limbs in cattle

91.	*Euphorbia hirta* [Euphorbiaceae]	NK	G, H, K, M, Mo	WP	Dysentery, colic pain; destroy warts; chronic bronchial affection, chiefly in children, worms, asthma, often in gonorrhoea
92.	*Euphorbia royleana* [Euphorbiaceae]	Sheonri, Sulu	G, H, K, M, Mo	St	Cathartic, anthelmintic, weakness
93.	*Euphorbia tirucalii* [Euphorbiaceae]	NK		St	Parasites, hook worm, round worm
94.	*Ficus benghalensis* [Moraceae]	Bar, Bot	G, H, K, M, Mo	Ltx	Latex used for male disease
95.	*Ficus hispida* [Moraceae]	Khasrey	G, H, K, M, Mo	Bk, Fr	Purgative, emetic galactagogue, facilitate calf-laying, ulcer
96.	*Ficus religiosa* [Moraceae]	Pipla	G, H, K, M, Mo	Bk	Sores, burns
97.	*Gmelina arborea* [Verbenaceae]	Gamari	G, H, K, M, Mo	Rt, Lf, Bk, Fl	Antiseptic, bone fracture, blood purifier, cholera, diarrhea, dyspepsia, dropsy, rheumatism, syphilis, small pox, cough, indigestion, seminal weakness
98.	*Hedyotis scandens* [Rubiaceae]	Bohri / Pinase lahara	G, H, K, M, Mo	Lf, Rt	Eye disease / troubles following childbirth; sprain, jaundice, tape worm
99.	*Heliotropium indicum* [Boraginaceae]	Hatisunr	G, H, K, M, Mo	Lf	Fever, ulcer, local inflammations,eye diseases, blood purifier
100	*Holarrhena pubescens* [Apocynaceae]	Khirra	G, H, K, M, Mo	Bk	Dysentery
101	*Hydrocotyle sibthorpioides* [Apiaceae]	Chhoto Beng Saag	G, H, K, M, Mo	WP	Med
102	*Hygrophila auriculata* [Acanthaceae]	Kulekhara	G, H, K, M, Mo	Yng Sht	Urinary affections, dropsy; diarrhoea, aphrodisiac, dropsy, gonorrhoea; emulcent, refrigerant, tonic, jaundice, urinary infections, anemia
103	*Hypericum japonicum* [Hypericaceae]	Simay jhar	G, H, K, M, Mo	WP	Used externally on inflammation
104	*Ichnocarpus frutescens* [Apocynaceae]	Dudhi lahara, Shyanulata	G, H, K, M, Mo	Rt, St, Lf	Cooling, aphrodisiac, thurst, vomiting, fevers, bilious; atropy, bleeding gums, convulsions, measles, night blindness
105	*Imperata cylindrica* [Poaceae]	Siru	G, H, K, M, Mo	Rhz	Med
106	*Ipomoea aquatica* [Convolvulaceae]	Kalmi saag	G, H, K, M, Mo	Yng Sht	Insomnia
107	*Ipomoea batatas* [Convolvulaceae]	Misti Alu, Ranga Alu	G, H, K, M, Mo	Lf, tuber, Rt	Scorpion sting, laxative
108	*Jasminum sambac* [Oleaceae]	Chameli	G, H, K, M, Mo	Lf, Fl	Med

109	*Jatropha curcas* [Euphorbiaceae]	Arendi	G, H, K, M, Mo	Fr, Sd	Oil in arthritis, chronic dysentery, fistula, urinary discharges, anaemia, purgative, skin diseases
110	*Justicia adhatoda* [Acanthaceae]	Baksa, Paksa pata	G, H, K, M, Mo	Lf, Sht with Fl	Bronchitis, cooling & purifier of blood, cold, cough, asthma, piles, diarrhea, dysentery, pox, ophthalmia, TB, acidity, indigestion, worm, heart disease
111	*Justicia gendarussa* [Acanthaceae]	Jagatmadan	G, H, K, M, Mo	WP	Haemostasis, blood dysentery, facial paralysis, internal haemorrhages, emetic, febrifuge
112	*Kalanchoe pinnata* [Crassulaceae]	Patharkuchi	G, H, K, M, Mo	Lf	Diabetes, cold, cough, stomach trouble, insect bites, diarrhea, vomiting, dysentery, inflammation
113	Lagerstroemia reginae [Lythraceae]	Jarul	G, H, K, M, Mo	Rt,Bk, Sd	Astringent, purgative, narcotic
114	*Lannea coromandelica* [Anacardiaceae]	Dabdabey, Ludhhi, Jiya	G, H, K, M, Mo	Bk	Dysentry, diarrhea, sores, swellings, chlorela, hydrocil, stomachache
115	*Lantana camara* [Verbenaceae]	Kuttush, Putush kata	G, H, K, M, Mo	Fr, Bk	Ulcerous wounds
116	*Leucas indica* [Lamiaceae]	Guma saag, Dandakalas	G, H, K, M, Mo	Fl, Sht	Stomach problems, cuts, snake bites, cold, rheumatism, headache, old sores
117	*Litsea glutinosa* [Lauraceae]	Meda, Kawala	G, H, K, M, Mo	Lf, Bk	Bone fracture
118	*Macaranga indica* [Euphorbiaceae]	Malata	G, H, K, M, Mo	Latex	Wounds
119	*Mallotus philippensis* [Euphorbiaceae]	Sindurey	G, H, K, M, Mo	Rt, Fr, Sd	Anthelmintic, carminative, appetizer, rheumatism, dysentery, boils, tonic, skin disease, constipation, ulcer
120	*Malvaviscus arboreus* [Malvaceae]	Jaba ful, Lanka-jaba	G, H, K, M, Mo	Bud	Male disease
121	*Mangifera indica* [Anacardiaceae]	Aam	G, H, K, M, Mo	Bk, Sd	Diarrhea, dysentery, haemorrhage
122	*Maranta arundinacea* [Marantaceae]	Arrowroot	G, H, K, M, Mo	Rhz	Astringent, refrigerant, tonic, aphrodisiac, dysentery, bronchitis, main ingredients in biscuits, cakes, puddings jellies and face powder
123	Marsilea minuta [Marsileaceae]	Susni	G, H, K, M, Mo	Lf	Brain tonic
124	*Mazus japonica* [Scrophulariaceae]	Atisar	G, H, K, M, Mo	WP	Cholera
125	*Melastoma malabathricum* [Melastomataceae]	Datrangi	G, H, K, M, Mo	Yng Sht, Bk, Rt	Pneumonia, children's fever, wounds, skin diseases

126	*Mentha arvensis & M. piperata* [Lamiaceae]	Pudina	G, H, K, M, Mo	WP	Indigestion, vomiting, diabetes, cold, cough, stomach trouble, stimulant, deodorant, antiseptic, carminative
127	*Mesua ferrea* [Clusiaceae]	Nageswar, Nagkesor	G, H, K, M, Mo	Fr, Fl, Sd, oil	Hiccough, halitosis, leprosy, dermatopathy, pruritus, haemoptysis, cephalagia; vitiated condition of skin disease; male & female sexual diseases
128	*Michelia champaca* [Magnoliaceae]	Chanp	G, H, K, M, Mo	Bk, Rt, Fl	Antifertility, inflammation, cholera, asthma, bronchitis, menstrual complaints, dysentery, fever,astringent, menorrhoea, mucus, sores, ulcers, boils, stimulant
129	*Mimosa pudica* [Mimosaceae]	Bohari jhar, Lajwanti	G, H, K, M, Mo	WP, Lf, Rt	Dysentery, "Kapha", biliousness, leprosy, dysentery, vaginal and uterine complaints, inflammation, burning sensation, fatigue, asthma, leucoderma, blood disease, iron deficiency, toothache
130	*Mimusops elangi* [Sapotaceae]	Bakul	G, H, K, M, Mo	Bk, Fl	Strangury, disease of gum & teeth, blood diseases, Symptom strong fever, headache, pain in the neck, spermatorrhoea
131	*Mirabilis jalapa* [Nyctaginaceae]	Jahajuhin, Krishna kali, Sandha-maloti	G, H, K, M, Mo	Lf, Rt	Strong purgative; stomachache, urticaria, aphradisiac
132	*Momordica charantia* [Cucurbitaceae]	Karela, uchhe	G, H, K, M, Mo	Unripe & ripe Fr, Lf	Diabetes, biliousness, blood diseases, anemia, strongly purgative, ulcers, colitis, appetizer, induces menstruation, antipyretic, liver problems,aphordisiac, anthelmintic
133	*Momordica dioica* [Cucurbitaceae]	Chetheli, Ban karela	G, H, K, M, Mo	Rt, Fr, Lf	Bleeding piles, high fever, snake bite, scorpion sting, antiseptic, blood diseases, asthma, ulcers, leprosy, bronchitis, heart troubles, urinary discharges, hiccup, aphordisiac, anthelmintic piles
134	*Morinda angustifolia* [Rubiaceae]	Hardi kat	G, H, K, M, Mo	Rt	Pruritus of toes, menstruation problems
135	*Moringa oleifera* [Moringaceae]	Sagna	G, H, K, M, Mo	Lf, Rt, Fl, Fr	Small pox
136	*Morus alba* [Moraceae]	Tunt	G, H, K,	Bk, Lf,	Throat sore, fever, heart,

			M, Mo	Fr	spleen, arthritis
137	*Mucuna pruriens* [Fabaceae]	Alkusi, Kewach	G, H, K, M, Mo	Pods, Sd, Rt	Anthelmintic, leucorrhoea, paralysis, nerve tonic, diuretic, urinary troubles, dropsy
138	*Murraya koenigii* [Rutaceae]	Karipata	G, H, K, M, Mo	Rt, Lf, Fr	Dysentery, eruptions, vomiting, kidney pain, & as an astringent
139	*Musa bulbisiana* [Musaceae]	Kera, Kela	G, H, K, M, Mo	Rz	A piece of root tagged on big fingure of foot for fast delivery
140	*Mussaenda roxburghii* [Rubiaceae]	Katmatiya, Dhobi Kat	G, H, K, M, Mo	Rt, Yng Sht	Jaundice. Veterinary problems
141	*Neolamarckia cadamba* [Rubiaceae]	Kadam	G, H, K, M, Mo	Bk	Cholera, fever, dysentery, skin diseases, oral diseases, snake bite
142	*Nyctanthes arbor-tristis* [Verbenaceae]	Sefali	G, H, K, M, Mo	Bk, Lf, Sd	Fever, rheumatism, malaria fever, worm expectorant, bilious fever, scurfy affection of the scalp, cough, leaves edible to cure stomach problems
143	*Ocimum tenuiflorum* [Lamiaceae]	Tulsi	G, H, K, M, Mo	Lf	Dysentery, dyspepsia, urinary disorder, cold & cough, demulcent, antibacterial, malarial fever
144	*Oldenlandia corymbosa* [Rubiaceae]	Atisar, Khetpapra	G, H, K, M, Mo	WP	Cough, blood purification
145	*Oldenlandia diffusa* [Rubiaceae]	Atisar	G, H, K, M, Mo	WP	Cough, blood purification
146	*Opuntia dillenii* [Cactaceae]	Nagphana, Fanimansa	G, H, K, M, Mo	Fr, Lf	Gonorrhoea, whooping cough, expectorant, cough, purgative, opthalmatic,
147	*Oroxylum indicum* [Bignoniaceae]	Totola, Taloyar, Dakdewa	G, H, K, M, Mo	Rt, Sd, Bk, Fr	Fever, dysentery, diarrhea, epilepsy, miscarriage, piles, jaundice, smallpox, dyspepsia, rheumatism, vermifuge, cholera, astringent, dropsy, anti-inflammatory, wounds, rheumatoid arthritis
148	*Paederia foetida* [Rubiaceae]	Padrilarang, Gandha-bhadali	G, H, K, M, Mo	Lf, Rt, WP	Dysentery, piles; stomach problem, piles, fever, liver troubles
149	*Peperomia pellucida* [Piperaceae]	Luchipata	G, H, K, M, Mo	WP	Scorpion bites
150	*Percompylus glaucus* [Menispermaceae]	Pipalpati	G, H, K, M, Mo	Rt	Antidote to bites of poisonous snakes
151	*Persicaria chinensis* [Polygonaceae]	NK	G, H, K, M, Mo	Lf, Yng Sht	Med
152	*Phyla nodiflora* [Verbenaceae]	Bhuiokra	G, H, K, M, Mo	WP	Cuts and insects bites
153	*Phyllanthus amarus* [Euphorbiaceae]	Bhui amla	G, H, K, M, Mo	WP	Gastropathy, dropsy, diarrhoea, dysentery, fever, scabies, ulcers, wounds,

					jaundice
154	*Phyllanthus simplex* [Euphorbiaceae]	Bhui amla	G, H, K, M, Mo	WP	Mammary abscess, itch, sleepless children, gonorrhoea, hiccough, urinary trouble, asthma
155	*Phyllanthus urinaria* [Euphorbiaceae]	Bhui amla	G, H, K, M, Mo	WP	Gastropathy, dropsy, diarrhoea, dysentery, fever, scabies, ulcers, wounds, jaundice
156	*Piper longum* [Piperaceae]	Pipla	G, H, K, M, Mo	Rt, Fr	Fever, skin diseases, cold , cough, abortion, piles, sore throat, arthritis
157	*Plumbago zeylanica* [Plumbaginaceae]	Chetoar, Chitawar, Chita	G, H, K, M, Mo	Leafy Tg	Fever, piles, laxative, indigation, gastic ulcer, dysentery, cold, cough, bronchitis. Aerial part raped with cotton and tagged in neck of hydrocil patient
158	*Premna bengalensis* [Verbenaceae]	Baro sinduwer, Gineri	G, H, K, M, Mo	Leafy Tg	Removing insects of poultry birds
159	*Premna mucronata* [Verbenaceae]	Gineri	G, H, K, M, Mo	Bk, Fr	Eczema, throat pain, boils, febrifuge
160	*Premna obtusifolia* [Verbenaceae]	Gineri	G, H, K, M, Mo	Bk, Lf	Diuretic, dropsy, boils. Colic pain of cattle
161	*Psidium guajava* [Myrtaceae]	Amrud, Peyara	G, H, K, M, Mo	Yng Lf	Gum and teeth problems, pyorrhea
162	*Pupalia lappacea* [Amaranthaceae]	Chirchithii	G, H, K, M, Mo	Rt	Med
163	*Rauvolfia sarpentina* [Apocynaceae]	Sarpagandha Nagbeli	G, H, K, M, Mo	Rt	High blood pressure, fever
164	*Ricinus communis* [Euphorbiaceae]	Rehri, Arandi	G, H, K, M, Mo	Rt, Sd, Lf, oil	Dysentery, neuralgia, colic, night blindness, opthalmia, earache, small breast, less menstruation, less urine, burn, wound, leucoderma, headache, bone fracture, body pain
165	*Rumex trisetifer* [Polygonaceae]	NK	G, H, K, M, Mo	Lf, Yng Sht	Med
166	*Saccharum officinarum* [Poaceae]	Ikh, Ukhu	G, H, K, M, Mo	Cane	Burning during urination, diabetes; timely expultion of placenta in cow
167	*Sansevieria trifasciata* [Dracaenaceae]	Sarpahara	G, H, K, M, Mo	Rhz	Piles
168	*Scoparia dulcis* [Scrophulariaceae]	Atibala,Barier, Jangli Dhania, Ghuma, Chini-michhiri	G, H, K, M, Mo	Leafy Tg, Rt	Renal diseases, jaundice, antidiabetic, cough, cuts, bronchitis, fever, headache, toothache, kidney troubles, burning sensation,
169	*Sesbania grandiflora* [Fabaceae]	Bagphul	G, H, K, M, Mo	Rt, Bk, Lf, Fl, Fr	Anthelmintic, febrifuge, nyctalopia, cephalalgia, astringent, anaemia

170	*Sida acuta* [Malvaceae]	Bareiri, Balujhar, Berala	G, H, K, M, Mo	Rt	Fever, urinery discharge& digestion problem
171	*Sida cordifolia* [Malvaceae]	Bala, Swet berela	G, H, K, M, Mo	WP, Lf, Rt	Inflammation of muscular & skeletal systems, rheumatoid arthritis, osteoarthritis, dental pain, back ache
172	*Sida rhombifolia* [Malvaceae]	Bariari, Golpata, Pitberela	G, H, K, M, Mo	St, Lf	Sores, rheumatism, fever, haemopthysis, leucoderma, menorrhagia, boils, cough, cold, aphomia
173	*Smilax zeylanica* [Smilacaceae]	Kukurdaini, Kumarilata, Kumarika	G, H, K, M, Mo	Rt	Blood purification, dysentery, bronchitis
174	*Solanum indicum* [Solanaceae]	Brihati	G, H, K, M, Mo	Rt, Lf, Fr	Fever, cold, cough, asthma, epithalmia, improves taste & appetite
175	*Solanum nigrum* [Solanaceae]	Pakosag, Kakmachi	G, H, K, M, Mo	WP, Lf, Fl, Fr	Diuretic, laxative, sedative, antiseptic, antidysentric, expectorant, antipyretic
176	*Solanum torvum* [Solanaceae]	Goth begun	G, H, K, M, Mo	WP, Lf, Fr	Digestive, diuretic, liver enlargement, haemostatic
177	*Stephania glabra* [Menispermace]	Inderparhi, Parhi, Karaiya, Panhelo tamarke	G, H, K, M, Mo	**Rt tuber**	Hernia. Pot made of root tuber as a pot of drinking water of poultry will keep them free from epidemic diseases
178	*Stephania hernandiifolia* [Menispermaceae]	Nimukha	G, H, K, M, Mo	Lf, Fr, Sd	Skin diseases, malarial fever. Veterinary problems
179	*Streblus asper* [Moraceae]	Saorah	G, H, K, M, Mo	Lf	Skin ailments
180	*Tagetes patula* [Asteraceae]	Shaey patri	G, H, K, M, Mo	Lf, Fl,	Children's fever, tonsilitis, mouth sores, dysentery
181	*Tamarindus indica* [Caesalpiniaceae]	Tentul	G, H, K, M, Mo	Lf, Fr, Sd	Bleeding piles, pox, painful anuria, swelling for kidney problems, diabetes
182	*Terminalia arjuna* [Combretaceae]	Arjun	G, H, K, M, Mo	Bk, Lf	Diabetes, dysentery, pneumonia, leprosy, neuralgia, wounds
183	*Terminalia bellirica* [Combretaceae]	Barra, Bahera	G, H, K, M, Mo	Fr, Sd	Cough, bronchitis,diabetes, gastric problems, liver problems, asthma, leprosy, purgative, piles, muscular pain, catarrh, opthalmia, leucoderma, inflamation
184	*Terminalia chebula* [Combretaceae]	Harra, Haritaki	G, H, K, M, Mo	Fr, Sd	Bronchitis, cold, eczema, constipation, dysentery, measles, sores, pneumonia, stomach complaints, spleen problem, piles, skin disease, aphonia, opthalmia
185	*Tetrameles nudiflora* [Datiscaceae]	Mayna	G, H, K, M, Mo	Bk, Fr	Asthma, cough, rheumatic pain

186	*Thysanolaena latifolia* [Poaceae]	Phul jharu, Amliso	G, H, K, M, Mo	Rt	Mumps, brils, abscesses
187	*Tinospora cordifolia* [Menispermaceae]	Gurjo, Gulancha	G, H, K, M, Mo	Sht	Dyspepsia, fever, urinary diseases, dysentery, gaut, ulcers, jaundice, leprosy, stomach troubles
189	*Toona ciliata* [Meliaceae]	Toon	G, H, K, M, Mo	Bk, Lf	Fever, gastric troubles, dysentery, antiseptic
190	*Trema orientalis* [Ulmaceae]	Khaskhasia	G, H, K, M, Mo	Bk, Lf	Limb pain
191	*Trewia nudiflora* [Euphorbiaceae]	Pithali	G, H, K, M, Mo	Rt	Bile problems, rheumatism, swelling
192	*Trichosanthes dioca* [Cucurbitaceae]	Patuka, Patal	G, H, K, M, Mo	Lf, Fr	Liver tonic
193	*Trichosanthes lepiniana* [Cucurbitaceae]	Kowa tumbil	G, H, K, M, Mo	Rt, Yng Fr	Fever, abortion
194	*Urena lobata* [Malvaceae]	Ban okra	G, H, K, M, Mo	Rt, St, Fl	Expectorant, throat sore, aphthosis, diuretic
195	*Vallaris solanacea* [Apocynaceae]	Harmali	G, H, K, M, Mo	Rt, Bk, letex	Sinus, ulcer due to fracture, sores, purgative, astringent
196	*Vetiveria zizanioides* [Poaceae]	Khaskhas	G, H, K, M, Mo	Rt, Lf	Stimulant, diaphoretic, stomachic, cooling, bitter astringent, blood diseases
197	*Vitex negundo* [Verbenaceae]	Sinduwer, Nisinda	G, H, K, M, Mo	Leafy Tg	Sciatica, asthma, fever, refreshment after delivery for baby & mother, eye inflammation, arthritis, leucoderma, bronchitis
198	*Wedelia montana* [Asteraceae]	Bhringaraj	G, H, K, M, Mo	Lf, WP	Hair growth in girls
199	*Youngia japonica* [Asteraceae]	NK	G, H, K, M, Mo	Sht	Fever and burning urination in children
200	*Zingiber officinalis* [Zingiberaceae]	Ada, Adua	G, H, K, M, Mo	Rhz	Cold, cough, fever, small pox, kidney troubles, hiccough, chronic dysentery
201	*Zizyphus mauritiana* [Rhamnaceae]	Baer, Kul	G, H, K, M, Mo	Lf, Bk, Fr	Conjunctivitis, dysentery

Table 13.6: Medicinal & aromatic plants used by the workers in Darjiling Hill Tea Gardens.

[***Abbreviations used***: Mk = Makaibari T.E., S = Soom T.E., T = Tamsong T.E., NK = Not Known, Bk = Bark, Fl = Flower, Infl = Inflorescence, Fr = Fruit, Lf = Leaf, Ltx = Latex, Rt = Root, Rhz = Rhizome, Sd = Seed, Sht = Shoot, St = Stem, Tg = Twig, Wd = Wood, WP = Whole Plant, Yng = Young]

Sl. No.	Plants [Families]	Local Name	Gardens	Parts Used	Purpose of use
1	*Acacia catechu* [Mimosaceae]	Khayer	Mk	Dryed resin	Bodyache, chronic body pain, fracture
2	*Achyranthes aspera* [Amaranthaceae]	Apang	Mk	Rt, WP	Toothache, snake bite, hydrophobia, hysteria, diuretic, purgative, diarrhoea, dysentery, piles, rheumatism
3	*Achyranthes bidentata* [Amaranthaceae]	Ankhlay Kuro	S, T	Lf	Rheumatism

4	*Acmella calva* [Asteraceae]	Kalijhar	Mk,S,T	Fresh Fl	Tonsillitis, mouth sores, toothache
5	*Aconogonum molle* [Polygonaceae]	Thotnay	S, T	Sht	Antidote
6	*Acorus calamus* [Acoraceae]	Bojo	Mk	Rt, Rhz	Dehydration; cough & cold, vomiting, flautulens, asthma, stomachache, skin diseases, prevents malaria. Sores & wounds of cattle and goats
7	*Adhatoda vasica* [Acanthaceae]	Basak	S	Lf	Cough & cold
8	*Adiantum capillus-veneris* [Adiantaceae]	Unew	Mk, S	Lf	Irregular menstruation; insects in chiken
9	*Ageratina adenophora [*Asteraceae]	Kalo Bonmara	Mk, S, T	Lf, Sht	Bleeding, cuts and wounds as antiseptic and blood clotting agent. Steam bath from aerial parts in case of jaundice, antedot
10	*Ageratum conyzoides* [Asteraceae]	Ilamay-jhar	Mk	Lf, Rt	Cuts & wounds, antiseptic, and blood clotting agent, styptic, antititanous, gall bladder stone
11	*Ageratum houstonianum* [Asteraceae]	Ilamay-jhar	Mk,S,T	Lf, Rt	Cuts and wounds as antiseptic, and blood clotting agent.
12	*Ajuga macrosperma* [Lamiaceae]		S,T	Yng Sht	Liver complaints, loss of appetite
13	*Aloe barbadensis* [Liliaceaea]	Ghur kumari	Mk	Lf	Wounds, burnings, carminative, digestic
14	*Aloe vera* [Liliaceae]	Ghew kumari	Mk	Lf	Burns & inflammation
15	*Alstonia scholaris* [Apocynaceae]	Chhatiyan	S, T	Rt, Bk, latex	Leprosy, skin diseases, ulcers, dysentery, malerial fever, snake bite, toothache, anthelmintic, vermifuge, stimulant after child birth, laxative, appetizer, astringent, antiperiodic, stimulates child birth. Bark as tonic for goats & pigs.
16	*Ambroma augusta* [Sterculiaceae]	Sano Kapasi	Mk,S	Rt, Lf	Menstrual disorders, snake bites
17	*Amomum subulatum* [Zingiberaceae]	Alaichi	Mk,S,T	Rt, Sd	Fever, stimulant, stomachic, aphrodisiac, gonorrhea patients. Asthma, bronchitis, piles; Kidney throat, urinery bladder and rectum disorder, carminative, diuretic, stimulant
18	*Ampelocissus barbata* [Vitaceae]	Jarila lahara	S, T	St	Sores & wounds, pneumonia, cataract. releiving cattle from ticks, mites, and other parasitic infections
19	*Andrographis paniculata* [Acanthaceae]	Kalmegh	Mk	Rt, Lf	Stomachic and blood purifier
20	*Annanus comosus* [Bromeliaceae]	Anaros	Mk	Fr	Yellow fever; improves appetite, digestion, reduce excessive gastric acid

21	*Antidesma acidum* [Euphorbiaceae]	Archal	Mk, S	St Bk, Lf, Sht	Pneumonia, sores, bruises, pruritus in toes, hydrosil, dysentery, diarrhoea
22	*Artemisia dubia* [Asteraceae]	Titepate	S, T	Lf, Sht	Giddiness, sinusitis, nausea, asthma, stomach troubles, loss of appetite, menstrual disorders, antihelmintic
23	*Artemisia vulgaris* [Asteraceae]	Titepate	Mk, S, T	Lf, Sht	Nasal Bleeding, congestion, blood vomiting, dysentery, urinary troubles, convulsions, hysteria, asthma, epilepsy, depression, measles, vermifuge, skin diseases, ulcers, antiseptic, febrifuge,
24	*Asparagus racemosus* [Asparagaceae]	Kurilo	Mk	Rt	Diabetes & tuberculosis
25	Astilbe rivularis [Saxifragaceae]	Buro okhati, Bansuari	T	Rhz	Tonsillitis, mouth sores, dysentery & diarrhoea
26	*Azadirachta indica* [Meliaceae]	Neem	Mk, S, T	Lf, Bk, Yng Sht	Ulcers, inflamations, eye troubles, intestinalworms, leprosy, fever, toxic manifestations, lack of apetite, sores & wounds etc
27	*Bauhinia purpurea* [Caesalpiniaceae]	Taki	Mk, T	St Bk	Dysentery
28	*Bauhinia variegata* [Caesalpiniaceae]	Koiralo	Mk	Fl, Bk, Rt	Blood dysentery, alterative, skin diseases, cough, bleeding piles, dyspepsia, flautulence, antidote to snake poison
29	*Begonia palmata* [Begoniaceae]	Mangar kajey	Mk	Lf	Antifungal, dysentery and diarrhea, an abortifacient
30	*Begonia picta* [Begoniaceae]	Mangar kanje	Mk, S, T		Piles, juvenile dysentery
31	*Berginia ciliata* [Saxifragaceae]	Pakhonbet	S, T	WP	Cough & cold, astringent, diuretic, aphrodisiac, body and joint pain, tonic, fever, boils, and ophthalmia
32	*Blumea balsamifera* [Asteraceae]	Gai tiharey	Mk	Lf, Rt	Skin parasites
33	*Boehmeria rugulosa* [Urticaceae]	Daar	Mk,	Juice of St Bk	Snake bites
34	*Bombax ceiba* [Bombacaceae]	Simal	Mk, S, T	Gum, Yng Sht	Dysentery, aphrodisiac, stimulant, gonorrhoea, piles, tonic in male impotency, diarrhoea. Tender part of plant as fodder for dysentery and diarrhoea to cattle
35	*Brassaiopsis hainla* [Araliaceae]	Kalo chuletro	Mk	Fl	Cough
36	*Brassica juncea* [Brassicaceae]	Rayo sag	Mk, S, T	Lf	Diarrhea, body pain, weakness
37	*Buddleja asiatica* [Buddlejaceae]	Bhimsen pati	S	Lf	Skin diseases. Prevents mite infestation of poultry birds
38	*Cajanus cajan* [Fabaceae]	Rahori dal	Mk	Fr	Yellow fever

39	*Caladium hortulanum* [Araceae]	Bet gera	Mk	Rt tuber	Deworming of man
40	*Calamus tenuis* [Arecaceae]	Bet	S	St	Liver ailments
41	*Callicarpa arborea* [Verbenaceae]	Bhati Guielo	Mk	Bk, Sht	Fever, carminative, heart & skin diseases, pneumonia, fever
42	*Calotropis gigantea* [Asclepiadaceae]	Akanda, Aak, Aank	Mk, S	Rt, latex	Analgesic, twisted ankle, bone dislocations. Fracture in cattle
43	*Camellia sinensis* [Theaceae]	Chia	Mk	Lf	Infection in GI tract, astringent, digestive, nerve-tonic, fever, insect stings, swellings, sunburns
44	*Canarium strictum* **Burseraceae**	Gokul dhup	Mk	Gum	Cough & diarrhoea of goats
45	*Cannabis sativa* [Cannabaceae]	Gnaja, Vang	Mk, S, T	Lf	Sedative, narcotic, stimulant, stomachic, antispasmodic, astringent, delirient, diuretic, hypnotic, catarrh, flatulence, haemorrhage, hydrophobia, dysentry; Digestion problems and pneumonia in cattle
46	*Capsicum frutescens* [Solanaceae]	Dallay Khursani	Mk, S, T	Fr	Gastric problems, tuberculosis, stimulant, tonic, carminative, muscle spasm, antiseptic, increases blood flow to the skin
47	*Cardamine hirsuta* [Brassicaceae]	Simraya	S, T	Sht	Jaundice, Low Blood Pressure
48	*Carica papaya* [Caricaceae]	Mewa	Mk	Fr, Sd	Jaundice, acidity, intestinal worms, liver disorders
49	*Cassia fistula* [Caesalpiniaceae]	Raj briksha	Mk	Fr, Sd, Fr pulp	Vomiting, diarrhea, pneumonia; pulp is a strong purgative
50	*Cassia occidentalis* [Caesalpiniaceae]	Thule-tapre	Mk, S, T	Lf, Rt, Sd	Cuts & wounds, diarrhoea, dysentery, cough, headache, purgative, antiperiodic, skin diseases, ringworm
51	*Cassis sophera* [Caesalpiniaceae]		S, T	**Rt, Lf, Fr**	Blood dysentery
52	*Catharanthus roseus* [Apocynaceae]	Nayantara	S, T	Rt, Fl, Lf	Diabetes, high blood pressure, anxiety, blood dysentery, ulcers, cough, cancer, menorrhagia, leukaemia.
53	*Centella asiatica* [Apiaceae]	Barma butty, Ghora tapray	S, T	Sd	Fever, asthma, bronchitis, leprosy, tonsilitis, diuretic, alterative tonic, dysentry, diarrhoea, mouth sores, cacaract
54	*Chenopodium album* [Chenopodiaceae]	Bethu Sak	Mk	Lf	Stomachache
55	*Chenopodium ambrosoides* [Chenopodiaceae]	NK	Mk, T	Sht	Tonic, antispasmodic, nervous breakdown
56	*Chromolaena odorata* [Asteraceae]	Banmara	Mk, T	Lf	Cuts & injuries as antiseptic & blood clotting agent
57	*Cinnamomum sp.* [Lauraceae]	Sin-kauli	Mk	Bk, Lf	Rheumatism, diarrhoea; digestion problem in cattle

58	*Cinnamomum tamala* [Lauraceae]	Tejpatta	Mk	Bk, Lf	Rheumatism, colic, diarrhea, gonorrhea; suppression of lochia after child birth
59	*Cissampelos pariera* [Menispermaceae]	Batul patey	Mk	Rt, Lf	Piles, pain, cough, disrrhoea, dyspepsia, erruptions, dyspepsia, inflamations, enlarged spleen, kidney & heart troubles, snake bites
60	*Cissus quadrangularis* [Vitaceae]	Harjora	S, T	Lf	Piles, ulcers, constipation for bone fracture
61	*Citrus aurntium* [Rutaceae]	Kali jyamir, Suntala	Mk, S, T	Fr	Dysentery, diarrhoea, anaemia; tonic for pregnant mother
62	*Citrus medica* [Rutaceae]	Nimbu, Bimbira	Mk	Fr	Indigestion, vomiting, diarrhoea, antiscorbutic
63	*Citrus maxima* [Rutaceae]	Sankatra	Mk, T	Ripe Fr	Diarrhea
64	*Clematis buchananiana* [Ranunculaceae]	Pinasay Lahara	Mk	Rt, Lf	Headache, sinusitis, stomachache
65	*Clerodendrum serretum* [Verbenaceae]	Andekhi	Mk	Rt	Dysentery
66	*Clerodendrum viscosum* [Verbenaceae]	Bhant	S, T	Lf, Bk	Leucoderma, thirst, Burning sensation, skin diseases
67	*Clinopodium umbrosum* [Lamiaceae]		S, T	Fresh Lf	Burns
68	*Coffea arabica* [Rubiaceae]	Coffee	Mk	Beans	Heart functioning, stimulent, digestive, diuretic, headache, migrane, dierrhoea
69	*Colebrookea oppositifolia* [Lamiaceae]	Dhusrey	Mk	Rt, Lf	Pneumonia. To cattle for poor vision or blindness
70	*Coriandrum sativum* [Apiaceae]	Dhaniya	Mk, T	WP, Fr	Urinal troubles, body ache, cold
71	*Costus speciosus* [Costaceae]	Betlowre	S, T	Lf, Rt, St	Liver ailments, stomachache, UTI, VD, astringent, purgative, stimulant, burning urination, jaundice, juvenile diabetes
72	*Croton bonplandianus* [Euphorbiaceae]		Mk	Yng Sht	Bone fracture, cuts & wounds
73	*Curculigo capitulata* [Hypoxidaceae]	Dhoti sara	Mk, S, T	Bulb	Gastritis, stomach colic, pain, burns, cuts & wounds
74	*Curcuma aromatica* [Zingiberaceae]	Ban Haledo	Mk, S, T	Lf, Rhz	Apetiser, stomachache, diabetes, indigestion, yellow fever, anti-inflamatory, antiacterial, antioxidant, digestion
75	*Curcuma longa* [Zingiberaceae]	Hardi, Haldi	Mk, S, T	Rhz, Rt	Apetiser, leucoderma, blood diseases, cuts, urinary discharges, fever, dropsy. Paste in poultry fowl and cattle
76	*Cymbopogon citratus* [Poaceae]	Timburey jhar	Mk, S, T	Lf	Stomach, blood & skin problems, cramping pain, flautulence, leprosy, ringworm

77	*Cymbopogon nardus* [Poaceae]	Citronella	S, T	Lf	Leprosy, insecticidal
78	*Cynodon dactylon* [Poaceae]	Durba, Duo	Mk, S, T	Sht	Leprosy, dysentery, fever, vomiting, skin diseases, epilepsy, liver cirrhosis, indigestion, burning urination, piles, body swelling
79	*Datura fastuosa* [Solanaceae]	Dhatura	S, T	Sds, Lf	Pain, fever
80	*Datura metel* [Solanaceae]	Dhutura	Mk,S,T	Lf, Sd, Rt	Dog bite, neuralgia, rheumatic, swellings, sciatica, lumbago, insanity, fever, skin diseases, antiseptic
81	*Datura stramonium* [Solanaceae]	Seto Dhutura	Mk	Sd	insanity, fever, skin diseases, antiseptic, narcotic, sedative
82	*Datura suaveolens* [Solanaceae]	Dhatura, Ghantiful, Sanaiful	S, T	Sds, Lf	Pain, fever, arthritis, gout, other muscular pains
83	*Deeringia amaranthoides* [Amaranthaceae]	Bakri sag	Mk	Lf, Rt	Medicinal
84	*Dicliptera bupleuroides* [Acanthaceae]	NK	Mk,S,T	Fresh Lf	Snake bite
85	*Dillenia indica* [Dilleniaceae]	Panchfal, Mechiafal	Mk	Fr	Gastritis, fever, diarrhoea, urinary problems, colic pain. Indigestion, dysentery & fever in cattle
86	*Dioscorea belophylla* [Dioscoreaceae]	Ghita torul	Mk	Rhz	Medicinal
87	*Dioscorea bulbifera* [Dioscoreaceae]	Githa lahara	Mk	Rt stock	Cough of cattle, ulcers
88	*Dioscorea deltoidea* [Dioscoreaceae]	Bhagur	Mk	Rt stock	Fever of cattle, kills lice, contraceptive
89	*Dioscorea floribunda* [Dioscoreaceae]	Goltarul	Mk,T		Fever, contraceptive
90	*Dioscorea pentaphylla* [Dioscoreaceae]	Rani bhyagur, Bontarul	Mk	Rt stock	Stomach problems, fever, swellings, contraceptive, anthelmintic
91	*Dioscorea prazeri* [Dioscoreaceae]	Bontarul	S, T	Rt stock	Fever, stomach trouble, contraceptive
92	*Diplazium esculentum* [Athyriaceae]	Ningro	Mk	Yng fronds	Constipation
93	*Drymaria diandra* [Caryophyllaceae]	Abijalo	Mk, S, T	Sht	Diptheria, nasal congestion, dog-bite, snake bit, hay fever, hay asthma, pneumonia, headache, conjunctivitis, throat pain
94	*Drymaria villosa* [Caryophyllaceae]	Abijalo	Mk,S,T		Fresh aerial parts tightened in a clean cotton cloth and heated for few minutes and strong fume inhaled to cure sinusitis, fever, cold, throat troubles, antiperiodic, cough, internal haemorrhage, dysentery

95	*Elettaria cardamomum* [Zingiberaceae]	Elachi	S, T	Sd	Asthma, bronchitis, piles; kidney, throat, urinary bladder & rectum disorders
96	*Elsholtzia blanda* [Lamiaceae]	Mirryjhar	S, T	WP	Allergy
97	*Emblica officinale* [Euphorbiaceae]	Amlaki	Mk, S, T	Fr, St	Piles, anaemia, eye inflamation, urinary discharge, diarrhoea, fever, cold, dyspepsia, haemorrhage, irritation of bladder
98	*Entada rheedii* [Fabaceae]	Pangra	Mk	Bk, Sd	Mumps, fracture in cattle, skin diseases, hair wash, pain after delivery, glandular swelling
99	*Equisetum debile* [Equisetaceae]	Kurkure jhar	Mk	Rt stock	Weakness, loss of appetite, anemia, urinary troubles, mouth sores, cuts, diabetes, gonorrhoea, stomach upset, urinary infection. Urinary problems to horses,
100	*Equisetum diffusum* [Equisetaceae]	Kurkury jhar	Mk, S, T	Sht	Urinary trouble, yellow fever, coolant in gonorrhoea, bedwets in children
101	*Erycibe paniculata* [Convolvulaceae]	Bhui champa	S, T	Lf	Accidental dislocation of bones
102	*Erythrina arborescence* [Fabaceae]	Faledo	Mk	Lf	Infected wounds of cattle; falling hairs of pigs
103	*Euphorbia pulcherrima* [Euphorbiaceae]	Lalupate, Ratopate	Mk	Latex	Pain in burnt area
104	*Euphorbia royleana* [Euphorbiaceae]	Shionni	Mk	Latex	Toothache, skin warts, food poisoining
105	*Evodia fraxinifolia* [Rutaceae]	Khanakpa	Mk, S, T	Fr	Gastric problems, typhoid
106	*Ficus benghalensis* [Moraceae]	Bor	Mk	Latex	Stomachich, gastritis, other stomach troubles
107	*Ficus religiosa* [Moraceae]	Pipol, Aswath	Mk	Bk	Vomiting, leucorrhoea, female sterility, cuts and wounds
108	*Girardinia diversifolia* [Urticaceae]	Vangre Sishnu	Mk, S, T	Yng sht, Rt, Infl	Hligh Blood Pressure, bone fracture, joint dislocation, diabetes
109	*Gmelina arborea* [Verbenaceae]	Khamari, Gamari	Mk	Bk	Food poisoning, jaundice
110	*Gonostegia hirta* [Urticaceae]	Chiplay	Mk, S, T	Rt	Bone fracture & dislocation
111	*Hedychium spicatum* [Zingiberaceae]	Sara	Mk	Rhz, Rt	Stomach & liver troubles, burnt wounds, vomiting, diarrhoea, asthma, dysentery, headache, hair fall, rheumatism, snake bite
112	*Hedyotis scandens* [Rubiaceae]	Bakhra lahara	S, T	Rt	Vomiting, stomachache, gastritis, food poisoning, abortifacient
113	*Heliotropium indicum* [Boraginaceae]	Hatisura	S, T	Lf	Fever, ulcers, inflamation
114	*Hemiphragma heterophylla* [Scrophulariaceae]		S, T	Ripe Fr	Cough & cold

115	*Heracleum nepalense* [Apiaceae]	Chimping	S, T	Fr	typhoid, nausea, vomiting
116	*Heracleum wallichii* [Apiaceae]	Chimping	Mk, S, T	Fl, Fr, Rt	Fever, stomachache, swelling of hands & legs, diarrhoea
117	*Holarrhena pubescens* [Apocynaceae]	Khirra	Mk	St Bk	Piles, ulcers, intestinal worms
118	*Houttuynia cordata* [Saururaceae]	Gandey jhar	S, T	Lf, Sht	Anemia & tuberculosis
119	*Hydrocotyle himalaica* [Apiaceae]	Thankuni	S, T	Lf	Stomach problems
120	*Hypericum petulum* [Hypericaceae]	Urilo	S, T	Sd	Dog bites, urinary troubles, food poisoning, stimulant, wounds. Urinary troubles to cattle.
121	*Imperata cylindrica* [Poaceae]	Siru	Mk	Lf, Rhz	Parasites in stomach, kidney problems, anthelmintic, wormifuge. Young shoot given to mother cow to smooth expulsion of placenta
122	*Justicia adhatoda* [Acanthaceae]	Asuro	Mk, S	St, Bk, Lf	Gastritis, high blood pressure, diabetes, asthma, cough, fever, vomiting, gonorrhoea, leprosy
123	Jatropha curcas [Euphorbiaceae]	Hatikane	Mk	Plant extract	Cuts, wounds, burns, bad breathing, pyorrhoea. Seeds strong purgative, cause nausea, vomiting, burning in stomach
124	*Kaemferia rotunda* [Zingiberaceae]	Bhui champa	Mk	Rhz, WP	Accidental dislocation of bones, fracture, wounds, swellings, mumps, dropsy, gout, stomachic, rheumatism, in gastric troubles, remove blood clots, tumour, leucoderma
125	*Kalanchoe pinnata* [Crassulaceae]	Pathar kuchi	S, T	Lf	Diarrhoea, vomoting
126	*Lantana camara* [Verbenaceae]	Kaligare	Mk	Bk	Ulcerous wounds
127	*Laportea terminalis* [Urticaceae]	Patley Sishnu, Gharia sishnu	Mk, S, T	Yng sht	High Blood Pressure, bone fracture, joint dislocation, swelling, pneumonia, heart troubles
128	*Leucas indica* [Lamiaceae]	Danda kalas	S, T	Lf	Snake bites, apetiser
129	*Lindenbergia grandiflora* [Scrophulariaceae]		Mk	Fl	Cuts and wounds
130	*Litsea citrata* [Lauraceae]	Sil Timbur	Mk	Bk, Fr, Sd	Stomachache for gas, skin diseases, dimulcent, diuretic, rheumatism
131	*Litsea cubeba* [Lauraceae]	Siltimbur	T	Fr	Cholera, indigestion, stomach colic; vermifuge, food poisoning, stomach disorders
132	*Lobelia nummularia* [Lobeliaceae]	Lanka sanay	Mk, S	Arrial parts	Pneumonia & fever for children; dysentery, tonsillitis, externally on snakebite
133	*Luffa aegyptiaca* [Cucurbitaceae]	Ghiroula, Dhundal	Mk	Fr	Diarrhoea of cattle

134	*Lycopodium pseudoclavatum* [Lycopodiaceae]	Nagbelli	Mk, S, T	Sht, Lf	Pain, indigestion
135	*Lycopodium pseudoclavatum* [Lycopodiaceae]	Nagbeli	S, T	Spores,	Diuretic, demulcent, anti septic, rheumatism, pulmonary disorders, kidney pain, uterus problems, dyspepsia, pain, hemorrhage after childbirth, emetic for children, scorbutic affections, indigestion
136	*Lyonia ovalifolia* [Ericaceae]	Ongeri	Mk	Rt	Children's prolonged fever
137	*Maesa chisia* [Myrsinaceae]	Bilaune	S, T	St Bk	Gastritis
138	*Mahonia nepaulensis* [Berberidaceae]	Chutro, Keshari	S, T	Bk	Eye pain, jaundice, fever, flatulence, blood purification, haemorrhage in piles, dysentery, urinary troubles, diuretic
139	*Malvaviscus arboreus* [Malvaceae]	Jabakusum	Mk	Nectar, Fl	Diabetes, sores, wounds on nose, ear, naval
140	*Melastoma malabathricum* [Melastomataceae]	Lajjaboti	S, T	Lf	Cough & cold
141	*Melissa parviflora* [Lamiaceae]	Gandhay jhar	S, T	WP	Brain tonic, antedote
142	*Mentha piperata* [Lamiaceae]	Padina	Mk, S, T	WP	Vomiting, stomachache, indigestion
143	*Mimosa himalayana* [Mimosaceae]	Arari kanra	Mk, T	Rt	Boils to discharge the pus
144	*Mimosa pudica* [Mimosaceae]	Bohari jhar, Lajjaboti	Mk, S, T	Rt, Lf	Iron deficiency, piles, urinary troubles, blood dysentery, toothache, anthelmintic
145	*Molineria gracilis* [Hypoxidaceae]	Dhoti sara	S, T	Rt, Fr, Fl	Asthma, piles, jaundice
146	*Morinda angustifolia* [Rubiaceae]	Haledo	S, T	Rt	Stomach problems
147	*Moringa oleifera* [Moringaceae]	Sajana	Mk	Lf, Fl	hiccough, vomiting, influenza, eye diseases, diuretic, cholagogue, stimulent
148	*Murraya paniculata* [Rutaceae]	Bajra-danthi	Mk	St	Toothbrush, pyorrhea. Toothpick useful in toothache
149	*Morus australis* [Moraceae]	Sano kimbu	Mk, S, T	Rt	Anthelmintic, astringent, cooling, vermifuge, purgative, laxative, allays thirst and removes fever, throat inflammation, thickening of vocal cords, hoarse voice
150	*Morus macroura* [Moraceae]	Bon Kimbu	Mk	Lf	Antiseptic
151	*Mucuna pruriens* [Fabaceae]	Hiunde simi	S, T	Fl, Lf	Inflammation, burns, skin diseases
152	*Musa bulbisiana* [Musaceae]	Kera	S, T	Lf, Rt, Fl, Yng Fr	Cough & cold, ear diseases, bronchitis, astringent, diarrhoea, improves appetite
153	*Mussaenda macrophylla* [Rubiaceae]	Sitalu, Dhobini phool	Mk, T	Rt	Juvenile jaundice, burning urination

154	*Mussaenda roxburghii* [Rubiaceae]	Sitalu, Dhobini kath	Mk	Rt	Jaundice, burning urination
155	*Mussaenda treutleri* [Rubiaceae]	Sitalu, Dhobini kath	Mk, S	Rt	Jaundice, burning urination, common cough & cold
156	*Nasturtium officinale* [Brassicaceae]	Simrayo	Mk, S, T	Lf	Cough & cold, high blood pressure, tuberculosis, fever, bodyache, headache
157	*Neolamarckia cadamba* [Rubiaceae]	Kadam	Mk	Fr, St Bk	Wounds, diarrhoea
158	*Nephrolepis cordifolia* [Nephrolepidaceae]	Paniamla	S, T	Rt tuber	Diabetes, yellow fever, burning urination
159	*Nyctanthes arbortristis* [Verbenaceae]	Rudilo	Mk	Lf, Bk	Lice cleaning; expectorant, alterative, intermitant fever, rheumatism, loss of apetite etc.
160	*Ocimum tenuiflorum* [Lamiaceae]	Kalo Tulsi	Mk, S, T	Lf	Cough & cold, expectorant, diaphoretic, antiperiodic, bronchitis, antifungal, genito-urinary system, influenza, asthma, bronchitis, fever, stomach colic of children, tonsillitis, mouth ulcers
161	*Oroxylum indicum* [Bignoniaceae]	Totola	Mk, S, T	Bk, Fl, Fr, Sd	Diabetes, carminative, laxative; piles, bronchitis, disrrhoea, dysentry, rheumatism, jaundice, food poisoning; mouth ulcers, tonsillitis, pneumonia
162	*Osbeckia nepalensis* [Melastomataceae]	Angeri	Mk, T	Yng Lf, Sht	pneumonia, fever, cold
163	*Oxalis corniculata* [Oxalidaceae]	Chari amilo	S, T	WP	Eye pain, ophthalmic infections, cooling agents, febrifuge, stomachic, intoxication, appetizer, dysentery, prolapsis of rectum, boils, diarrhoea
164	*Paederia foetida* [Rubiaceae]	Padee/ Biri Lahara	Mk, S, T	Rt, Lf	Piles, fever; stomach & liver troubles, heart troubles and abnormal palpitation
165	*Perilla frutescens* [Lamiaceae]	Silong	Mk	Lf	Children's pox,seafood poisoning
166	*Persicaria chinensis* [Polygonaceae]	Ratnowlo	Mk, S, T	Lf, Sht	Insect sting and sting of nettle plants.
167	Persicaria microcephala [Polygonaceae]	Ratnowlo	S, T	Lf, Sht	Insect and wasps sting
168	*Phlogacanthus thyrsiflorus* [Acanthaceae]	Rambasak , Chua	Mk	Bk, Lf	Piles, liver cirrhosis, bronchial, antiseptic, whooping cough, menorrhagia
169	Physalis peruviana [Solanaceae]	Phak phake	Mk, S, T	Lf	Fever, pneumonia, cold for children, urinary troubles
170	*Pinus roxburghii* [Pinaceae]	Salla dhup, chirpine	S, T	Wood resin	Asthma, bronchitis, gonorrhoea
171	*Piper longum* [Piperaceae]	Pipul, Pipla,	S, T	Lf, Rt, Fr	Headache, common cold and prolong cough, asthma, hiccough,

		Jangli pipul			digestive, rheumatism, asthma, cough, abdominal enlargements, fever, leprosy, gonorrhea, piles, spleen, skin diseases
172	*Piper peepuloides* [Piperaceae]	Rukh pipla	S, T	Ripe Fr	common cold and cough
173	*Plantago erosa* [Plantaginaceae]	Jibre jhar	S, T	WP	Antiseptic, amoebic & bacillary dysentery; cuts and bruises; tonsillitis
174	*Plumeria rubra* [Apocynaceae]	Rukh chuwa	Mk	Latex	Food poisoning
175	*Plumbago zeylanica* [Plumbaginaceae]	Chita, Sweto Chitu	Mk, S, T	Rt, Lf, St	Dysentery, piles, bronchitis, loss of apetite, boils, diarrhoea, piles; food poisoning, gastritis, stomach pain, scabies, eczema
176	*Pouzolzia zeylanica* [Urticaceae]	Chiplay	Mk	Rt	Bone fracture, joint dislocation, sprain
177	*Premna integrifolia* [Verbenaceae]	Ginari	Mk	Lf	Insecticide for chicken
178	*Prunus cerasoides* [Rosaceae]	Paiyun	S, T	Fr, St Bk	Stone, abortion; bodyache, chronic body pain of old people, bone fracture, joint dislocation
179	*Psidum guajava* [Myrtaceae]	Ambok	Mk	St Bk	Blood dysentery, diarrhoea, dysentery, anemia, bleeding teeth
180	*Punica granatum* [Punicaceae]	Darim, Anar	Mk	Bk, Fr	Dysentry, cooling and refrigerent, used in diarrhoea
181	*Pupalia atropurpurea* [Amaranthaceae]	Ulta kuro	Mk	Rt	Pneumonia
182	*Raphanus sativus* [Brassicaceae]	Mula	Mk, S, T	Rt tuber	Digestive, acidic stomach. Crushed seeds mixed with animal feed in indigestion and fermented root for food poisoning
183	*Rhododendron arboreum* [Ericaceae]	Lali Gurus	S, T	Fl	Dysentery, diarrhoea, dysentery, fish bone stuck in throat, bodyache, cold
184	*Rhus chinensis* [Anacardiaceae]	Bhakimlo	S, T	Ripe Fr	Diarrhoea, dysentery
185	*Rubia manjith* [Rubiaceae]	Majito	S, T	WP	Externally on scorpion sting and insect bites
186	*Rubus calycinus* [Rosaceae]	Bhui ainselu, Bin ainselu	T	Rt	Tonsillitis
187	*Rubus ellipticus* [Rosaceae]	Ainselu, Bhotay kanra	Mk, S, T	Yng Sht, Rt	Colic pain, tonsillitis, diarrhoea, dysentery
188	*Rubus lineatus* [Rosaceae]	Ghampe ainselu	T	Rt	Food poisoning and stomach pain
189	*Rumex nepalensis* [Polygonaceae]	Halhalay	S, T	Rt	Diarrhoea, stomch colic, skin diseases
190	*Rauvolfia serpentina* [Apocynaceae]	Sarpagand ha	S, T	Rt	High Blood Pressure, mental retardation, depression, tonic, narcotic, antidote for snake bite, insect stings. insomnia, nervous

					breakdown, violent insanity
191	*Rhus semialata* [Anacardiaceae]	Bhoki omilo	Mk	Lf, Bk	Immunisation. Deworming of cattle
192	*Rosa brunonii* [Rosaceae]	Boisey kara	Mk	Sht	Fracture in cattles
193	*Saccharum officinarum* [Poaceae]	Uku	Mk	St	Yellow fever
194	*Sapindus mukorossi* [Sapindaceae]	Ritha	Mk	Fr	Pneumonia
195	*Schima wallichii* [Theaceae]	Chilaune	Mk, S, T	St Bk, Fr	Stomach colic, gastritis, blood dysentery, softening cracked heel and sole; insect and scorpion sting; bark irritant and vermicide and used for gonorrhoea
196	*Scoparia dulcis* /Scrophulariaceae]	Patberela	S	Sht, Lf	Cough & cold, toothache; piles, diabetes
197	*Senesio scandens* [Asteraceae]	Pailey Lahara	Mk	Lf	Yellow fever
198	*Shorea robusta* [Dipterocarpaceae]	Sakhuwa	Mk	Resin	Diarrhoea, astringent, detergent, dysentery
199	*Sida acuta* [Malvaceae]	Khareto	Mk, T	St, Yng Sht	To discharge pus from boils, bone fracture
200	*Sida cordifolia* [Malvaceae]	Khoreto	Mk	Lf	Wounds which suppurate
201	*Skimmia arborescens* [Rutaceae]	Jamaray juwa	Mk	Fl	Diabetes
202	*Smilax ovalifolia* [Smilacaceae]	Kukurdain i, Datiwan	Mk	Lf, Rt	Apetizer, VD, rheumatic pain, gout, epilepsy, seminal weakness, tooth brush in pyorrhoea
203	*Solanum indicum* [Solanaceae]	Behi	Mk	Fr	Stomach problems, astringent, carminative, digestive, asthma, bronchitis, flautulance, heart trouble, toothache, vomiting
204	*Solanum nigrum* [Solanaceae]		Mk	Lf, Fr	Muscle pain, laxative, alterative, diuretic, vomiting, urinary discharge, hydrophobia
205	*Solanum torvum* [Solanaceae]	Ban bihi	Mk	Fr, Sd	Checking bleeding after delivary, jaundice, liver disorders
206	*Spinacea oleracea* [Chenopodiaceae]	Palangi Sak	Mk	WP	Cooling, antibacterial, UTI
207	*Spondius pinnata* [Anacardiaceae]	Amru, Amara	Mk	Bk, Fr, Lf	Piles, rheumatism, sore-throat, burning sensation, dysentery, earache, cough & cold
208	*Stephania hernandifolia* [Menispermaceae]	Tamarkey	Mk	Fr, Rt	Diabetes, astringent for fever, diarrhoea, urinary diseases, dyspepsia
209	*Stephania japonica* [Menispermaceae]	Inderparhi , Parhi, Karaiya, Tamarke	Mk, S, T	Rt tuber	Stomach pain, diabetes, diarrhoea, bodyache, fever, urinary diseases, boils, septic inflammatory parts. Tuberous root as pot of drinking water for poultry keep them free from epidemic diseases. Ulcer and diarrhea in cattle

210	*Sterculia villosa* [Sterculiaceae]	Odal	MK	Gum, Rt	Amoebiosis, bone dislocation, fractures, throat infection, joint pains, stomach disorders
212	*Tagetes patula* [Asteraceae]	Saipatri phul	Mk, S, T	Lf, Fl	Fever, Pneumonia, ulcers, eye diseases, antiseptic in tonsilitis
213	*Taxus baccata* [Taxaceae]	Dhangre Salla	Mk	Aril, Lf, Bk	Carminative, expectorant, stomachic & tonic, ; asthma, bronchitis, epilepsy
214	*Tectaria coaduanata* [Tectariaceae]	Kali Oonew, Kaliningr o	Mk.S,T	Root-stock	Dysentery, cuts and wounds
215	*Terminalia alata* [Combretaceae]	Pakasaj	Mk.	WP	Anaemia, cholera, dysentery, fever, haematuria, sores, wounds, stomacheic
216	*Terminalia bellirica* [Combretaceae]	Bahera, Barra	S	Ripe Fr	Indigestion, tonsillitis and cough
217	*Terminalia chebula* [Combretaceae]	Harrha	Mk	Fr, Sd	Cough, apathy, asthma, bile trouble, bleeding, gum-ulcer, blood pressure, carious teeth, diarrhoea, enlarged spleen, flautulence, cardiac diseses, piles
218	*Terminalia myriocarpa* [Combretaceae]	Panisaj	Mk, S	St Bk	Substitute of tea for bodyache, fatigue
219	*Tetradium fraxinifolium* [Rutaceae]	Khanakpa	S,T	Fr, Lf	Gastritis, stomach colic, hepatic disorders, cholera, diarrhoea, vomiting. Stomach problems in cattle.
220	*Thysanolena latifolia* /Poaceae]	Amliso, Kuchho	S	Yng Sht, Rt	Mumps, brils, abscesses, tonsillitis,
221	*Tinospora cordifolia* [Menispermaceae]	Gurjo lahara	S	St	Stomach problems, burning urination, diabetes, other urinary troubles, menstruation problems, febrifuge, gonorrhoea, rheumatic pain, kill and clean out harmful insects of skin and ears
222	*Toona ciliata* [Meliaceae]	Tooni	Mk	Bk	Astringent, ulcers, chronic dysentery
223	*Trichosanthes lepiniana* [Cucurbitaceae]	Indraynee, Indrenee	Mk,S	Fr placen ta	Diabetes
224	*Trifolium repens* [Fabaceae]	Tinpate jhar	S	WP	Diabetes
225	*Urena lobata* [Malvaceae]	Bheray kuro, Kuray pat	Mk,S,T	Sd	Dog bites
226	*Urtica ardens* [Urticaceae]	Sishnu, Ghariya sishnu	Mk,S,T	Yng Sht, Infl	High blood pressure, piles
227	*Urtica dioica* [Urticaceae]	Patle Sishnu	S	Yng Sht, Infl,	High Blood Pressure, minor fracture, gout, heart diseases, swellings

				Rt	
228	*Urtica parviflora* [Urticaceae]	Sishnu	S,T	Yng Sht, Infl, Rt	High blood pressure, bone fracture, joint dislocation, sprain, tonic and clearing agent after childbirth
229	*Urtica mairei* [Urticaceae]	Sishnu	S	Rt, Lf	Fracture, High Blood Pressure
230	*Vibernum erubescens* [Caprifoliaceae]		T	Ripe Fr	Cough & cold
231	*Vitex negundo* [Verbenaceae]	Simali	S	Lf, Rt	Eye imflamation, asthma, bronchitis, leucoderma, jaundice, body swelling, cold, flu, pyorrhea, bone fracture
232	*Wrightia arborea* [Apocynaceae]	Aulae khirra	Mk	St, Rt Bk	Snake bite, scorpion stings, treatment of male sex organs, renal complaints, menstrual disorders, haemorrhage
233	*Zanthoxyllum acanthopodium* [Rutaceae]	Bokay Timbur	S	Fr, Sht, Bk	Gastric problems, diarrhoea, asthma, cholera, cough & cold, headache, indigestion, piles, nervous debility, blood purifier, liver disorders
234	*Zanthoxyllum alatum* [Rutaceae]	Bhalay Timbur	Mk, S	Fr	Indigestion, diarrhoea
235	*Zanthoxyllum budrunga* [Rutaceae]	Timbur	S	Fr	Gastric problems
236	*Zanthoxylum nitidium* [Rutaceae]	Parpare timbur	Mk	Fr	Digestive, hepatic tonic or in gastritis
237	Zanthoxylum oxyphyllum [Rutaceae]	Bhainsi timbur	S,T	Fr	digestive and hepatic tonic or in gastritis
238	*Zingiber officinale* [Zingiberaceae]	Adhuwa	Mk, S, T	Rhz	Apetiser, cough & cold, influenza, carminative, circulatory stimulant, antiseptic, fever, nausea, intestinal infections
239	*Zizyphus mauritiana* [Rhamnaceae]	Baer	Mk	Bk	Diarrhea

Tea Garden workers from Terai have reported the use of 201 species of plants in their different practices of tackling ailments of man and their pets. These are coming under 161 genera and 78 families [Pteridophytic 3, Monocotyledonous 15 & Dicotyledonous 60]. All these plants are of diverse habit groups and are coming from different wide range habitat structures.

Tea Garden workers from Darjiling Hills reportedto use a total of 239 species of medicinal and aromatic plants to use against the ailments of man and their domesticated herbivores. These plants are covering under 187 genera and 84 families [Pteridophytes 6, Gymnosperms 2, Monocotyledonous 13 & Dicotyledonous 63]. And, as for the Terai, these plants are of diverse habit groups and are coming from different wide range habitat structures, including exotics.

It is also important to note that all the reported plants are not growing in Tea Garden areas. A good proportion of them are collected from other vegetations or even from markets. Local practitioners of traditional medicine collect and preserve many of these plants in their house/ dispensary. Sometimes they grow some plants in their gardens which they require in good amount but are not always available in nearby areas. It is also fact that for most of the traditional medicines freshly collected plant materials produce much better results. However, majority of these plants are available in the locality and even within Tea Garden areas.

These poor people suffer from wide variety of diseases and some of those are really serious. Not only that, they need medication for general health care and for contraception. A scan through application of these plants show the diversity of diseases they recognise and, eventually, they try to tackle with local natural resources. Common problems like cough and cold, indigestion, diarrhea, dysentery etc can be treated with a large number of plants. It is not that one particular plant will always give good result for all persons, but different plants are sometimes required to treat them which they select after keen observation of symptoms of individual patients.

Again, practitioners in Terai and in hills sometimes use different sets of plants, but, certainly there is exchange of knowledge and plant materials. People from different communities staying here together forming mixed communities and it is quite possible that one community will learn cultures of other communities gradually under that situation. Even then, especially in Terai, people of some very primitive ethnic communnities like Oraons, Santals, Mundas etc are very much conservative about their traditional knowledge and it's sharing.

However, the medicine men are also mostly non-cooperative especially when the question of formulation comes under discussion. They can recognize a plant and are ready to discuss the properties but are not ready to divulge the set of plants use together as a medicine and their proportion. At the same time there are definite methods of preparation of a medicine which one need to learn with time and patience. Again, these traditional people generally pass over their knowledge only to their own family man and this is true for most of the communities.

A survey to the diseases they treat shows that ailments like Nervous debility, Piles, Diptheria, Liver disorders, Snake bites, High Blood Pressure, Ulcers, Gonorrhoea, UTI, Enlarged Spleen, Cardiac disorders, Post-delivery bleeding, Seminal weakness, Insanity, Tonsilitis, Food Poisoning, Tumors, leucoderma etc. attempted to tackle by these herbalists.


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13.12 Dye Yielding Plants

Dye is required for different purpose in our every day life. That may be for colouring cloth, for ceremonies, for food, for cosmetics or even for medicines. The preference for the use of natural dye is always there in the traditional society and at the same time, the demand is increasing in the international market with no limit. Like minerals, plants are also a rich source for natural dye and like any other tribal dominating area; in Darjiling hills and Terai also people use some plants for the extraction of dye. The present survey has reorded the use of nine species of plants for this purpose as has been presented in Table 13.7.

Table-13.7: List of plants used by Tea garden workers as dye yielding Plants in Terai and hills of Darjiling in West Bengal.

[*Abbreviations used*: **G** = Gungaram T.E., **H** = Hansqua T.E., **K** = Kamalpur T.E., **M** = Matigara T.E., **Mo** = Mohurgong & Gulma T.E., **Mk** = Makaibari T.E., **S** = Soom T.E., **T** = Tamsong T.E.]

Sl. No.	Plants [Families]	Local Name	T.E. where recorded	Parts Used	Purpose of use
01	*Clerodendrum serretum* [Verbenaceae]	Andekhi	H, Mo	Leaves	Green dye
02	*Curcuma longa* [Zingiberaceae]	Hardi, Haldi, Halus	G, H, Mo, Mk, S, T	Rhizome	Yellow; use in cooked food; in dying cloth during relegious ceremonies, etc
03	*Deeringia amaranthoides* [Amaranthaceae]	Bakri saag	G, H, Mo	Ripe fruits	Red ink
04	*Mahonia nepaulensis* [Berberidaceae]	Chuttro, Keshari	S, T	Ripe fruits	Yellow dye for fabrication of cloths and hand made paper
05	*Mallotus philippensis* [Euphorbiaceae]	Sindure	H, K, M, Mo	Seeds	Vermilion
06	*Morinda angustifolia* [Rubiaceae]	Hardi kath	G, H, Mo	Stem	Yellow dye for fabrication of cloths and hand made paper
07	*Rubia manjith* [Rubiaceae]	Majito	S, T	Root	Red dye for cosmetics
08	*Terminalia bellirica* [Combretaceae]	Barra	H, K, Mo	Fruits	Hair dye
09	*Toddalia asiatica* [Rutaceae]	Singane kanra	Mk, S	Root	Yellow dye

Out of the recorded nine species of dye yielding plants at least two are in regular trade. *Curcuma longa* is a multipurpose economic plant. It is a spice, a medicine and also a dye producer. The use of this species is long known to the Indian society as is also known by these people. The species is widely cultivated in this part of the country.

The use of Monjistha (*Rubia manjith*) is nicely documented in Ayurveda, the ancient Indian medical literature. The international market demand for the root of this species is quite high and its population is sharply decreasing due to regular exploitation from the natural habitat.

Traditional people generally do not like synthetic vermilion. The seeds of *Mallotus philippensis* produce a red dye and that is used as vermilion in traditional Nepali society.

The dye extracted from *Mahonia nepaulensis* is also exploited semi-commercially. Nepalees prepare a traditional paper from the bark of *Daphne cannabina* and *Edgwarthia gardneri*. The dye extracted from *Mahonia* fruits is regularly used in this paper. Dye extracted from *Clerodendrum serratum, Deeringia amaranthoides, Morinda angustifolia, Terminalia bellirica* and *Toddalia asiatica* are also used for this purpose. In addition, the dye extracted from Barra fruits are also used commonly as hair dye by hill people.

13.13 Religious Plants (including Super Natural Forces)

Common man's belief and faith is expressed in the religion. In every religion there are some religious practices and performances for with numerous plants are in use. Similarly, when man living in his forested environment they need to fight with numerous uncomfortable conditions and or natural forces. Whenever they fail to understand the reason of the misery or discomfort they impose it to the activities of the evil forces. So, people need to fight and/or satisfy also to these evil forces. Many religious practices, taboos, totems, social rites etc are imposed in traditional societies for this purpose. For this purpose these people sometimes take the help of some natural objects including plants. They believe that these plants are with some natural forces which can fight back with the harmful evil forces.

During the present Ethnobotanical survey, at least 41 species of plants has been recorded those are either used for worshiping the deities as religious offerings or as super natural forces to fight back the evil spirits. These plants have been presented below in Table 13.8.

Table-13.8: List of plants used by Tea garden workers as Religious Plants (including Super Natural Forces) in Terai Region of Darjiling Hills in West Bengal.
[***Abbreviations used***: G = Gungaram T.E., H = Hansqua T.E., K = Kamalpur T.E., M = Matigara T.E., Mo = Mohurgong & Gulma T.E., Mk = Makaibari T.E., S = Soom T.E., T = Tamsong T.E., SF = Supernatural Force]

Sl. No.	Plants [Families]	Local Names	T.E. where recorded	Parts Used	Purpose of use
01	*Achyranthes bidentata* [Amaranthaceae]	Chitchithii	G, H, Mo, Mk, S, T	Root, Whole plant	Marriage; driving away evil spirits
02	*Acorus calamus* [Acoraceae]	Bojo	G, H, M, Mo, Mk, S, T	Rhizome	Driving away evil spirits

03	*Aegle marmelos* [Rutaceae]	Bael, Bel	G, H, K, M, Mo	Whole plant, leaf	Abode of deity; worship of deities
04	*Artemisia dubia* [Asteraceae]	Titepati	Mk, S, T	Whole plant, leaf	Repellent of evil spirits. Used by Nepalese for worship and religious ceremonies
05	*Bauhinia variegata* [Caesalpiniaceae]	Koiralo	G, H, K, Mk, S, T	Stem	Cultural value in society
06	*Buddleja asiatica* [Buddlejaceae]		G, Mo, Mk, S, T	Dry stem	As incense in religious ceremonies by local priests
07	*Butea monosperma* [Fabaceae]	Palash	G, H, Mo	Flower	Worship
08	*Cannabis sativa* [Cannabaceae]	Bhengri, Bhang	G, H, Mo, T	Twig, Flower	Taken in little amount during worship
09	*Cryptomeria japonica* [Taxodiaceae]	Dhupi	S, T	Dry Twig	As incense during Buddhist religious ceremonies locally called dhup
10	*Cupressus corneyana* [Cupressaceae]	Weeping cypress	Mk, S, T	Dry Twig	As incense during religious ceremonies in Buddhist. Tree planted near monasteries
11	*Cynodon dactylon* [Poaceae]	Durba	G, H, K, M, Mo, Mk, S, T	Leafy twig	Worship of deities
12	*Datura metel* [Solanaceae]	Dhutura	G, H, K, Mk, T	Fruit, Seed	For worshiping Lord Siva
13	*Datura stramonium* [Solanaceae]	Seto Dhutura	G, H, K, M, Mk	Fruit, Flower	For worshiping Lord Siva
14	*Euphorbia royleana* [Euphorbiaceae]	Shionni	G, H, K, M, Mo, Mk	Whole plant	Planted near houses to be believed repeller of evil spirits
15	*Ficus benghalensis* [Moraceae]	Bor, Bot	G, H, K, M, Mo, Mk, S, T	Whole plant, leaf	Abode of deity, used in different ceremonies
16	*Ficus religiosa* [Moraceae]	Pipal, Aswath	G, H, K, M, Mo, Mk, S, T	Whole plant, leaf	Abode of deity; used in different ceremonies, like marriages, rituals
17	*Haldina cordifolia* [Rubiaceae]	Karam	G, H, K	Leafy braches	Treated as deity bt Santals & Oraons
18	*Lannea coromendelica* [Anacardiaceae]	Jiga, Dobdobe	G, H, K, M, Mo	Whole plant	Sacred to Oraon community
19	*Laportea terminalis* [Urticaceae]		Mk, S, T	Stem	Tie the string of a part of fibrous stem to newly born babies to repel evil spirits and to prevent loose motion
20	*Lycopodium pseudoclavatum* [Lycopodiaceae]	Nagbeli	Mk, S, T	Whole plant	Used in religious ceremonies and festivals
21	*Lygodium flexuosum* [Lygodiaceae]	Kukri larang	G, H, K, M, Mo	Leafy Twig	Fortune seeker
22	Malvaviscus arboreus [Malvaceae]	Jabakusu m	G, H, Mo, Mk,	Flower	Worship of deities

23	*Mangifera indica* [Anacardiaceae]	Aam	G, H, K, M, Mo, Mk	Leafy Twig, leaf	Worship of deities
24	*Mimosa himalayana* [Mimosaceae]	Arari kanra	Mo, Mk, S, T	Long branches	Death ceremony; protect the place of worship
25	*Musa bulbisiana* [Musaceae]	Kala, Bonkera	G, H, K, M, Mo, Mk, S, T	Leaf, leaf sheath, pseudo stem	Ceremonial decoration & plates for offerings, last-rites
26	*Neyraudia aurandinacea* [Poaceae]	Ghung ring	Mk, S, T	Flowering twigs	Used in religious purpose in Nepalese
27	*Ocimum tenuiflorum* [Lamiaceae]	Tulsi	G, H, K, M, Mo, Mk, S, T	Leaf	Worship of deities
28	*Oroxylum indicum* [Bignoniaceae]	Totola, Taloyar, Dakdewa	G, H, K, M, Mo, Mk, S, T	Seeds	Seeds sacred to Buddhists, remover of evil spirits
29	*Oryza sativa* [Poaceae]	Chaule, Chawor	G, H, K, M, Mo, Mk, S, T	Grains	Unhusked & husked grains in many religious ceremonies; fortune seeker
30	*Plumeria rubra* [Apocynaceae]	Rukh chuwa	G, H, Mo	Flowers	Worship of deities
31	*Prunus cerasoides* [Rosaceae]		Mk, S, T	Slender branches	Different ceremonies
32	*Pupalia lappacea* [Amaranthaceae]	Chirchithi	G, H, K, Mo, Mk	Root	Driving away evil spirits
33	*Rauvolfia serpentina* [Apocynaceae]	Nagbeli	G, H, Mo, Mk	Root	SF
34	*Rhus chinensis* [Anacardiaceae]	Bhakimlo	Mk, S, T	Twigs	Used in rhymes of nepali cultural festivals
35	*Ricinus communis* [Euphorbiaceae]	Reri	Mo, Mk, S, T	Leaf	Driving away evil spirits during worship of Goddess Kali
36	*Scoparia dulcis* [Scrophulariaceae]	Atibala,Barier, Jangli Dhania, Ghuma, Darcheto war	G, H, K, M, Mo	Root (keep in pocket)	Driving away evil spirits; brings Good Fortune
37	*Shorea robusta* [Dipterocarpaceae]	Sakhuwa	G, H, K, M, Mo, Mk, S	Resin; whole plant	Used as incense is sal dhup in religious ceremonies; abode of deities to Santal and Oraon societies
38	*Tagetes patula* [Asteraceae]	Shaey patri	G, H, K, M, Mo, Mk, S, T	Flower	Flowers for warship
39	*Thuja orientalis* [Thujaceae]	Chapte dhupi	Mk, S, T	Dry leaves & twigs	As incense during religious ceremonies in Buddhist
40	*Thysanolaena latifolia* [Poaceae]	Amliso, Jharu	G, H, K, M, Mo, Mk, S, T	Shoot and infloresce-nce	For religious purposes
41	*Urtica ardens* [Urticaceae]	Ghariya sisnu	Mk, S, T	Fibrous stem	To make cords and tied around the waist of newborn baby for repelling evil spirit

As much as 41 species has been recorded for this non-commercial, faith dependent uses of plants. Out of these five plants [*Aegle marmelos, Ficus benghalensis, Ficus religiosa, Haldina cordifolia* and *Shorea robusta*] are treated as abode of deities by different groups of tribal people.

For driving away of the evil forces ten plants has been recoded during the present survey which are *Achyranthes bidentata, Acorus calamus, Artemisia dubia, Euphorbia royleana, Laportea terminalis, Oroxylum indicum, Pupalia lappacea, Ricinus communis, Scoparia dulcis* and *Urtica ardens*. These plants are used in different manner and to realize the integration of these social practices one need to be associated with such society for a long time and shold try to understand the intricate philosophy of tribal life and society.

However, in addition, there are some fortune seeker plants like *Lygodium flexuosus, Oryza sativa* and *Scoparia dulcis*.

13.14 Ornamental and Decorative Plants used by Tea Garden workers in Terai and hills of Darjiling.

Ornamental and decorative plants are in great demand in all the societies. The flora of Eastern Himalaya is always a rich source of ornamental and decorative plants. The floricultural nurseries and plant hunters of this region were collecting beautiful plants of this region and were exporting those even in the ninth decade of the last century. Numerous endemic species of *Primala, Impatiens, Chirita, Dedymocarpus, Allium, Rhododendron*, orchids etc. has been sold away from this country against meager price by gridy tradesmen. Many of such plants are now not available in our country but are available in European gardens.

Table 13.9 has recorded the common ornamental and decorative plants used by the people of target groups.

Table 13.9: List of ornamental and decorative plants used by Tea garden workers in Terai and Hills of Darjiling in West Bengal.

[*Abbreviations used*: G = Gungaram T.E., H = Hansqua T.E., K = Kamalpur T.E., M = Matigara T.E., Mo = Mohurgong & Gulma T.E., Mk = Makaibari T.E., S = Soom T.E., T = Tamsong T.E., NK = Not known]

Sl. No.	Plants [Families]	Local Name	T.E. where recorded	Parts Used	Purpose of use
01.	*Aloe vera* [Liliaceae]	Ghew kumari	G, H, Mk	Leaf	Ornamental
02.	*Alstonia scholaris* [Apocynaceae]	Chhatiyan	G, H, K, Mo, Mk	Grown plant	Ornamental tree
03.	*Ardisia solanacea*	Damai phal	G, H, K	Flowers and	Ornamental

[Myrsinaceae]			fruits	
Asparagus racemosus [Asparagaceae]	Kurilo	G, H, K, Mo, Mk	Grown plant	Ornamental
Bauhinia purpurea [Caesalpiniaceae]	Kochnar, Taki	G, H, K, M, Mo, Mk, S, T	Grown plant, Flower	Ornamental tree
Bambusa spp. [Poaceae]	Bans	G, H, Mk, S, T	Stem, Leaf, Inflorescens	Decorative
Berginia ciliata [Saxifragaceae]	Pakhan bet	Mk, S, T	Grown plant	Ornamentals
Cassia alata [Caesalpiniaceae]	Baro chakar	G, H, K, M, Mo	Inflorescence	Decoration
Cassia fistula [Caesalpiniaceae]	Raj briksha	G, H, K, M	Grown plant	Ornamental
Catharanthus roseus [Apocynaceae]	Nayantara	G, H, K, Mo, Mk, T	Flower	Ornamental
Clerodendrum viscosum [Verbenaceae]	Ghato, Vhauti	G, H, K, M, Mo,	Flower	Ornamental
Clerodendrum inerme [Verbenaceae]	NK	G, H, Mo,	Grown plant	Hedge
Clitoria ternatea [Fabaceae]	Aparajita	G, H, K, Mk, T	Flower	Ornamental
Coix lachryma-jobi [Poaceae]	Ghanrey mala	G, H, Mk, S, T	Stony bracts	Jewelry
Costus speciosus [Zingiberaceae]	Bet lauree	G, H, K, M, Mk, T	Grown plant	Ornamental
Crinum amoenum [Amaryllidaceae]	NK	G, H, Mo,	Flower	Ornamental
Datura stramonium [Solanaceae]	Dhutura	G, H, K, Mk	Flower	Ornamental
Delonix regia [Caesalpiniaceae]	Gulmohar	G, H, K, M, Mo, Mk, T	Pods, Flower	Decorative
Dillenia pentagyna [Dilleniaceae]	Tantari	H, Mo, Mk	Leaf	Decorative
Erythrina stricta [Fabaceae]	Phaledo	S, T	Grown plant	Ornamental tree
Euphorbia pulcherrima [Euphorbiaceae]	Lalupate, Ratopate	G, H, K, M, Mo, Mk, S, T	Grown plant	Ornamental
Ficus benjamina [Moraceae]	Kabra	G, H, K, M, Mo, Mk	Grown plant	Ornamental
Hibiscus rosasinensis [Malvaceae]	Jaba	G, H, K, M, Mo, Mk, S, T	Flower	Ornamental
Jasminum sambac [Oleaceae]	Chameli	G, H, K, M, Mo	Flower	Ornamental, aromatic
Jatropha curcas [Euphorbiaceae]	Sada Varenda	G, H	Grown plant	Hedge
Justicia adhatoda [Acanthaceae]	Basak	G, H, K, M	Grown plant	Hedge
Justicia gendarussa [Acanthaceae]	Jagatmadan	G, H, M, Mo	Grown plant	Hedge
Lagerstroemia reginae [Caesalpiniaceae]	Jarul	G, H, K, M, Mo,	Fruit flowers	Decorative


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PLATE XIX : Some common potential ornamental plants of Tea Garden area:

1. *Primula melacoides*
2. *Cestrum aurantiacum*
3. *Poinsettia pulcherrima*
4. *Erigeron karvinskianus*
5. *Anaphalis margaritacea*
6. *Dahlia imperialis*
7. *Arundina graminifolia*
8. *Impatiens arguta*


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29.	*Lantana camara* [Verbenaceae]	Kuttus, Putus kanta	G, H, Mo	Grown plant	Hedge
30.	*Lycopodiella cernua* [Lycopodiaceae]	NK	H, K, Mo, S, T	Shoot	Decorative
31.	*Lycopodium pseudoclavatum* [Lycopodiaceae]	Nagbeli	S, T	Whole plant	Decorative
32.	*Lygodium salicifolium* [Lydodiaceae]	Kukri Larang	G, H, K, Mo,	Leafy branches	Decorative
33.	*Malvaviscus arboreus* [Malvaceae]	Jaba ful, Lanka-jaba	G, H, K, Mo, Mk	Flower	Ornamental
34.	*Maranta aurandinacea* [Marantaceae]	Ararut	G, H, M, Mk	Grown plant	Ornamental
35.	*Melastoma malabathricum* [Melastomataceae]	Dnatrangi, Chulasi	G, H, Mo, Mk, S, T	Flower	Ornamental
36.	*Mirabilis jalapa* [Nyctaginaceae]	Jahajuhin, Krishnakali	G, H, K, M, Mo, Mk	Flower	Ornamental
37.	*Murraya paniculata* [Rutaceae]	Kamini	G, H, K, M, Mo, Mk, T	Flower	Ornamental , aromatic
38	*Neolamarckia cadamba* [Rubiaceae]	Kadam	G, H, K, M, Mo, Mk	Grown plant, Flower	Ornamental tree
39	*Oroxylum indicum* [Bignoniaceae]	Totola	Mo, Mk, S, T	Seed, Fruit	Decorative
40	*Plumbago zeylanica* [Plumbaginaceae]	Chetoar, Chitawar	G, H	Flower	Ornamental
41	*Plumeria rubra* [Apocynaceae]	Rukh chuwa	G, H, K, M	Grown plant, flowers	Ornamental
42	*Polyalthia longifolia* [Annonaceae]	Dewdar	G, H, K, M, Mo	Leafy branches, Grown tree	Decorative
43	*Prunus cerasoides* [Rosaceae]		Mk, S, T	Grown tree	Ornamental tree
44	*Sansevieria trifaciata* [Dracaenaceae]	Sarpahara	G, H, K, M, Mo	Grown plant	Ornamental
45	*Sterculia villosa* [Sterculiaceae]	Odal	G, H, K, M, Mo	Fruit	Decorative
46	*Swietenia macrophylla* [Meliaceae]	Mehgini	G, H, K, Mo,	Fruit axis	Decorative
47	*Swietenia mohaginy* [Meliaceae]	Mehgini	G, H, K M,	Fruit axis	Decorative
48	*Tagetes patula* [Asteraceae]	Ganda, Shaey patri	G, H, K, M, Mo, Mk, S, T	Flower	Ornamental, worship, ceremonies
49	*Zephyranthes carinata* [Amaryllidaceae]	Piyaziful	G, H, K, M, Mo, Mk, S, T	Grown plant	Ornamental

It is difficult to prepare a list of ornamental and/or decorative plants of this area as almost all the demands its incorporation in this category. However, the Table 13.9 has recorded 50 species those were particularly using by these people. Hill people love gardening very much.

Almost every house or cottage is having few pots of ornamental plants. But, the Tea Garden workers in general are extremely poor people and they can not spare enough money or time for this purpose. Even then they are using ornamental plants. A close scruninee of the listed plants shows that there are a good number of exotic plants like *Aloe vera, Catharanthus roseus, Clitorea ternatea, Delonix regia, Euphorbia pulcherrima, Hibiscus rosa-sinensis, Justicia gendarussa, Lantana camara, Malvaviscus arboreus, Mirabilis jalapa, Swietenia macrophylla, Swietenia mohaginy, Tagetes petula, Zephyranthes carinata*, etc.

The selection of ornamental plants in Terai garden workers are mainly related to their religious requirements. Use of decorative items is rare among them. Majority of the decorative items reported here are from hill workers and only few are either overlapping or are from Terai workers.

13.15 Fibre Yielding Plants

Fibre is one indespensable product in the human society. We need it for our dresses, for building our houses, tieing our domesticated animals and for innumerable other jobs. Apart from the body hairs of few animals, most of the fibres we collect from plants. Fibres are sclerenchymatous tissue generally remain closely associated with the vascular bundles and save the plant body from stress and strain. But, the usable fibres are not available in all plants. So, proper search for usable fibre is very inportant.

People in the traditional societies are testing the natural products for thousands of years. They have also discovered the uses of many fibres available in their locality. For different species of plants method of fibre extraction is not same. And, in many cases they do not extract the fibre in final form and, instead, they use the bark itself as fibre/ chord/ rope. Fibres are also available from different parts of a plant body. Root, stem, leaf, fruit and seed are the major fibre yielding parts in different species of fibre yielding plants. The recorded 15 species of fibre yielding plants are presented below in Table 13.10.

Table 13.10: List of plants used by Tea garden workers in Terai and hill region of Darjiling for the extraction of fibre.

[***Abbreviations used***: G = Gungaram T.E., H = Hansqua T.E., K = Kamalpur T.E., M = Matigara T.E., Mo = Mohurgong & Gulma T.E., Mk = Makaibari T.E., S = Soom T.E., T = Tamsong T.E., NK = Not known]

Sl. No.	Plants [Families]	Local Name	T.E. where recorded	Parts Used	Purpose of use
01	*Ambroma augusta* [Sterculiaceae]	Sano Kapasi	H, Mo, Mk, S, T	Stem	Yields fibre
02	*Boehmeria macrophylla* [Urticaceae]	Kamli	S, T	Stem	A strong fibre
03	*Bombax ceiba* [Bombacaceae]	Simal	G, H, Mo, Mk, S, T	Floss	Foss for stuffing pillow, mattress, etc.
04	*Corchorus capsularis* [Tiliaceae]	Paat	G, H, K	Fibre from stem	Mats, rope
05	*Crotalaria juncea* [Fabaceae]	Sanaiful	G, H, M	Fiber from Stem	Rope, fishing net
06	*Dendrocnide sinuata* [Urticaceae]	Moringe, Chotra	H, Mo	Stem	Fibre for rope
07	*Girardinia diversifolia* [Urticaceae]	Vangre Sishnu	Mk, S, T	Stem	Yields fibre for making hand bags, gunny cloths, etc.
08	*Gossypium herbaceum* [Malvaceae]	Kapas	G, H, K, M, Mo, Mk, S, T	Lint on seeds	Cotton to make cloths, stuffing bed, pillows, quilt, etc.
09	*Moutia puya* [Urticaceae]	NK	Mk	Stem bark	Strong fibre for making rope
10	*Musa balbisiana* [Musaceae]	Bankera	G, H, K, M	Leaf-sheaths	Fibre prepared for making rough rope
11	*Sida rhombifolia* [Malvaceae]	Bariari ghash, Khareto	G, H, K, M	Branched Stem	Produce good quality fibre
12	*Sterculia villosa* [Sterculaceae]	Odal	G, H, K, M, Mo, Mk	Barks	Ropes, head and shoulder straps to carry loads in remote areas which is durable in rainy seasons
13	*Urena lobata* [Malvaceae]	Bheray kuro, Kuray pat	G, H, K	Stem	Yields strong fibre
14	*Urtica dioica* [Urticaceae]	Sishnu	S, T	Stem	Yields fibre for making hand bags
15	*Urtica parviflora* [Urticaceae]	Sishnu	S, T	Stem	Yields fibre for making hand bags

Urticaeae is dominating in the list of reported fibre yielding plants. Six, out of 15 plants are from this family. It is followed by Malvaceae with three species and Sterculiaceae with two species. Bombacaceae, Fabaceae, Musaceae and Tiliaceae are represented with one species only. Of these 12 species produce usable fibres from their stem-bark; two from seeds (*Bombax ceiba, Gossypium herbaceum*) and only one from leaf sheaths (*Musa bulbisiana*). Of these four species are regularly exploited for commercial production of fibre those are *Bombax ceiba, Corchorus capsularis, Crotalaria juncea* and *Gossypium herbaceum*. And, except *Bombax ceiba* remaining three species are in regular cultivation and at least two (*Corchorus capsularis, Gossypium* *herbaceum*) are industrial plants. But the fibre extracted from some other species like *Boehmeria macrophylla, Sida rhombifolia, Sterculia villosa, Urena lobata* and *Urtica dioica.*

In fact, there are many more fibre-yielding plants available in the flora of Darjiling region but the present enumeration is based on the plants used by Tea Garden workers only.

13.16 Plants of Miscellaneous Uses

For leading a normal life man need to depend on many more plants for to meet up various other needs for survival. Though these people survive with the most minimum requirements even the list prepared in Table 13.11 became quite long with the incorporation of 79 species of plants.

Table 13.11: List of plants of miscellaneous uses by Tea garden workers in Terai and hill region of Darjiling Hills in West Bengal.

[***Abbreviations used***: G = Gungaram T.E., H = Hansqua T.E., K = Kamalpur T.E., M = Matigara T.E., Mo = Mohurgong & Gulma T.E., Mk = Makaibari T.E., S = Soom T.E., T = Tamsong T.E., NK = Not known]

Sl. No.	Plants [Families]	Local Name	T.E. where recorded	Parts Used	Purpose of use
01	*Acacia catechu* [Mimosaceae]	Khayer	G, H, K, M, Mo, Mk, S, T	Resin, wood	Catch or khayer chewing with pan, mature stem for timber and fuel wood
02	*Actinidia strigosa* [Actinidiaceae]		T	Fruit	Brewing
03	*Alnus nepalensis* [Betulaceae]	Utis	S, T	Trunk	Timber, fuel
04	*Aloe barbadensis* [Liliaceae]	Ghiukumari	G, H, K, Mk, T	Leaf	Cosmetic
05	*Artemisia dubia* [Asteraceae]	Titepati	Mk, S, T	Dry plant	Plant smoke is insect repellent
06	*Azadirachta indica* [Meliaceae]	Neem	G, H	Leaf, trunk	Timber used for construction, furniture, lvs as insecticides
07	*Bambusa* spp. [Poaceae]	Bansh	G, H, M, Mo, Mk, S, T	Culm	Construction, Buskets, walking sticks
08	*Bauhinia purpurea* [Caesalpiniaceae]	Taki	G, H, Mo, Mk, S, T	Bark	Tanning
09	*Bauhinia vahlii* [Caesalpiniaceae]	Bhorla	Mo	Leaf	Plates, hats
10	*Betula alnoides* [Betulaceae]	Shour	S, T	Trunk	Timber
11	*Bidens pilosa* [Asteraceae]	Kuro	Mk, T	Yng Sht	Crushed and kept in fine cotton cloth and used as tea or as substitute of green tea
12	*Boehmeria macrophylla* [Urticaceae]	Kamli	S, T	Stem	Fibre

13	*Boehmeria rugulosa* [Urticaceae]	Daar	H, K, Mo, Mk	Stem	Used to make many household vessels
14	*Bombax ceiba* [Bombacaceae]	Simal	G, H, M, Mo, Mk	Timber	Packing boxes, match box, plywood.
15	*Buddleja asiatica* [Buddlejaceae]	Bhimsen pati	Mk, S, T	Mature leaves, Rt	Prevent mite infestation of poultry birds. Ingredient of starter mixture for local traditional drinks
16	*Cajanus cajan* [Fabaceae]	Arhar	G, H, Mo	Stem	Fuel
17	*Calamus erectus* [Ericaceae]	Bet	Mk, S, T	Stem	Making chairs, stools, table etc.
18	*Callicarpa arborea* [Verbenaceae]	Gwelo	G, H, Mo, Mk	Wood	Fuel
19	*Camellia kissi* [Theaceae]	Lekali, Hingua	S, T	Leaves, trunk	A substitute of tea; timbers strong used for axe and hoe handles
20	*Camellia sinensis* [Theaceae]	Chia, Chha	Mk, S, T	Leaf	Cosmetic
21	*Canna edulis* [Cannaceae]	Phul tarul	Mk, S, T	Rhizome	Janr, a traditionally fermented beverage prepared from it
22	*Cannabis sativa* [Cannabaceae]	Bhengri, Bhang, Ganja	G, H, K, M, Mo, Mk, S, T	Leaf, Flower	Hallucinatory
23	*Chromolaena odorata* [Asteraceae]	Banmara	G, H, K, Mo	Whole plant	Aproduce good green manuare
24	*Clerodendrum inerme* [Verbenaceae]	NK	G, H, K, Mo, Mk	Branches, grwn plant,	Thatch
25	*Coix lachryma-jobi* [Poaceae]	Ghanrey mala	G, H, Mk, S	Stony bracts	Jwellery
26	*Colebrookea oppositifolia* [Lamiaceae]	Dhusrey	Mk	Foliage	Incubation of unripe fruits
27	*Cryptomeria japonica* [Taxodiaceae]	Dhupi	Mk, S, T	Bark strips, timber	Kitchen roof and houses. Timber good for partition, ceiling, floor works
28	*Cupressus corneyana* [Cupressaceae]	Weeping cypress	S, T	Timber	Very valuable; wood as incense
29	*Cymbopogon nardus* [Poaceae]	Citronella ghash	G, H, Mo, Mk, T	Leaf	Insect repellent , soil binder
30	*Dicranopteris linearis* [Gleicheniaceae]	Kalame Unew	Mk, S, T	Stem	Writing pens made from stout hollow stem
31	*Dioscorea pentaphylla* [Dioscoreaceae]	Rani bhyagur	G, H, K	Yam	Used to wash cloth
32	*Ehretia acuminata* [Ehretiaceae]	NK	G, H, K, M, Mo	Wood	Fuel
33	*Elaeocarpus sphaericus* [Elaeocarpaceae]	Rudraksha	G, H, Mk, S, T	Stones from fruits	Used as holy rosary beads
34	*Elsholtzia fruticosa* [Lamiaceae]	Bhote pati	Mk, S, T	Dry leaves	Used as incense
35	*Emblica officinale* [Euphorbiaceae]	Amala	G, H, K, M, Mk, S	Bark	Used in tanning

36	*Gmelina arborea* [Verbenaceae]	Khamari, Gamari	G, H, K, M	Wood	Furniture, drum, & others domestic purposes
37	*Hyptis suaveolens* [Lamiaceae]	Gande jhar	G, H	Leaves	Used as shampoo for lice and parasite infestation
38	*Imperata cylindrica* [Poaceae]	Siru	G, H, K, Mo, Mk	Rhizome	Thatch, rope
39	*Jatropha curcas* [Euphorbiaceae]	Hatikane	G, H, K, Mo	Latex	Children make bubble with soapy sap from detached petiole
40	*Justicia adhatoda* [Acanthaceae]	Asuro	G, H, K, Mo, Mk	Leaves	Good insecticide
41	*Litsea glutinosa* [Lauraceae]		G, H, Mo, Mk	Trunk	Timber durable
42	*Luffa aegyptiaca* [Cucurbitaceae]	Gomra, Dhundhul	G, H, K, M, Mo,	Fibrous mesocarp	Bath sponge
43	*Machilus villosa* [Lauraceae]	Kawlo	G, H, Mo, Mk	Bark	Raw material for incense stick
44	*Mahonia nepaulensis* [Berberidaceae]	Chuttro, Keshari	Mk, S, T	Stem	Handles of khukuri
45	*Malvaviscus arboreus* [Malvaceae]	Jabakusu m	Mk	Leaves	Hairs softening
46	*Michelia champaca* [Magnoliaceae]	Chanp	G, H, K, Mo, Mk	Trunk	Good timber
47	*Michelia doltsopa* [Magnoliaceae]	Rani Chanp	S, T	Trunk	Good timber
48	*Morus australis* [Moraceae]	Sano kimbu	G, H, Mk, S, T	Grown plant	Rearing of silkworms
49	*Murraya paniculata* [Rutaceae]	Bajradant hi	G, H, K, M, Mo	Stem	Handles of domestic tools
50	*Oroxylum indicum* [Bignoniaceae]	Totala	G, H, Mo, Mk, T	Foliage	Good fodder for cattle
51	*Oryza sativa* (Poaceae)	Dhan	G, H, Mk, T	Straw	Insulator
52	*Ostodes paniculata* [Euphorbiaceae]	Bepari	S, T	Mature seeds, gum	Used as lamp by burning in remote areas. Gum as natural adhesive
53	*Oxalis corniculata* [Oxalidaceae]	Amarchin gari, Khatta saag, Amruli	H, K, Mk, S	Whole plant	Washing utensils
54	*Pandanus nepalensis* [Pandanaceae]	Keya	Mo, Mk, T	Stem	Used as pillar
55	*Persicaria chinensis* [Polygonaceae]		Mk, S, T	Leaves	Cleaning copper utensils
56	*Persicaria hydropiper* [Polygonaceae]	Kusurpota Sukurpota	G, H, K, M	Whole plant	Fish poison
57	*Phrynium pubinerve* [Marantaceae]	Kamaiko pat	Mo, Mk, S	Leaves	Making ***ghum***
58	*Pongamia pinnata* [Fabaceae]	Karanj	G, H	Twigs	Toothbrush
59	*Premna bengalensis* [Verbenaceae]	Baro sinduwer,	G, H	Leafy Twig	Repellent

		Gineri			
60	*Prunus cerasoides* [Rosaceae]	Painyun	Mk, S, T	Timber	Construction, furniture
61	*Psidium guajava* [Myrtaceae]	Ambak	Mo, Mk	Stem	Handles of khukuri, other carpenter's tools
62	*Pterospermum acerifolium* [Sterculiaceae]	Hattipaila	G, H, K, M, Mk	Leaves	Meal plates used during ceremonies; rain guards in gardens.
63	*Saccharum officinarum* [Poaceae]	Ikh, Ukhu	G, H, Mo,	Leaves	Fuel
64	*Sapindus mukorossi* [Sapindaceae]	Ritha	G, H, K, Mk	Pericarp	Good substitute for washing soap; popular herbal shampoo
65	*Schima wallichii* [Theaceae]	Chilaune	H, K, Mo, Mk, S, T	Timber	Household purposes
66	*Sesbania sesban* [Fabaceae]	Dhanche, Jayanti	G, H, K, M	Whole plant	Green manure
67	*Shorea robusta* [Dipterocarpaceae]	Sal, Sakhuwa	H, K, Mo	Resin, leaves	Inscens (fumigating rooms to repel mosquitoes); leaf-plates; durable timber
68	*Sida acuta* [Malvaceae]	Bariari ghash, Khareto	G, H, K, M	Branched Stem	Broom (Khareto)
69	*Sida rhombifolia* [Malvaceae]	Bariari ghash, Khareto	G, H	Branched Stem	Broom (Khareto)
70	*Terminalia chebula* [Combretaceae]	Harra	G, H, M, Mk, S	Dry fruits	Tanning
71	*Terminalia myriocarpa* [Combretaceae]	Panisaj	G, H, K, Mo, Mk, T	Timber	Furniture and construction
72	*Tetradium fraxinifolium* [Rutaceae]	Khanakpa	Mk, S, T	Timber	Tea chests, match sticks, etc.
73	*Thysanolaena latifolia* [Poaceae]	Phul jharu, Amliso	S, T	Inflorescen ce	Broom
74	*Toona ciliata* [Meliaceae]	Tooni	G, H, K, Mo, Mk	Trunk	Good timber, construction & furniture
75	*Trema orientalis* [Ulmaceae]	Khas-khasia	G, H, K, Mo	Wood	Good fuel
76	*Vetiveria zizanioides* [Poaceae]	NK	G, H, Mo	Root	Perfumery oil, mat
77	*Vitex negundo* [Verbenaceae]	Sinduwer	G, H, K	Leafy Twig	Hedge
78	*Wrightia arborea* [Apocynaceae]		G, H, K	Wood	Household porpuses
79	*Zizyphus mauritiana* [Rhamnaceae]	Baer	G, H, Mo, Mk	Bark, trunk	Tanning. Wood for fuel

Out of the 79 species of plants recorded here a good number of them are already in trade and commerce. Plants *Acacia catechu, Aloe barbadensis, Azadirachta indica, Bambusa* spp., *Bombax ceiba, Calamus erectus, Cannabis sativa, Cryptomeria japonica, Cymbopogon nardus, Gmelina arborea, Imperata cylindrica, Michelia champaca, Morus australis, Oryza sativa,* *Sapindus mukorossi, Terminalia myriocarpa, Toona ciliata* and *Vetiveria zizanioides* are already in trade for the same use those are recorded here. Some of these plants are also grown commercially for the purpose. Many of these are of multipurpose use in the society as well as in the industry. Shorea robusta is a good example. Its resin, lef-plates and very high quality durable strong timber – all are in high demand in the market. Plants like *Azadirachta indica* and *Bambusa* spp.are also with multipurpose use as mentioned in Table 13.10.

Apart from these a good number of other plants of this list are also used in the outer world for similar purpose like *Coix lachryma-jobi, Elaeocarpus sphaericus, Jatropha curcas, Luffa aegyptiaca, Machilus villosa, Oxalis corniculata, Sesbania sesban,* and *Vitex negundo.*

Many other plants of this table can easily be adopted by the outer society for the similar purpose and can improvise the basic material and/or the use.

13.17 Discussion

The present Ethnobotanical survey among the Tea Garden workers in five Tea Estates in Terai and three in Darjiling Hills has resulted in the record of large number of plants under different categories as has been classified below [Table 13.12]:

Table 13.12: Numerical abstract of representation of different types of recorded Ethnobotanical plants as reported by Tea Garden workers in Terai and hills of Darjiling.

Ethnobotanical Category	**Terai**	**Hill**	**Common**	**Total**
Edible Plants	85	69	14	140
Fodder Plants	45	48	36	57
Medicinal & Aromatic Plants	201	239	104	336
Dye Yielding Plants	06	04	01	09
Religious Plants (including Super Natural Forces)	32	36	28	41
Ornamental and Decorative Plants	45	30	26	49
Fibre Yielding Plants	10	09	04	15
Miscellaneous uses	54	57	32	79

A consolidated list [Table 13.13] of recorded ethnobotanically important plants revealed the total number as 420 species.

Table 13.13: Consolidated list of plants recorded during Ethnobotanical survey in Tea Gardens of Terai and hills of Darjiling.

	Plants [Families]	**Edible**	**Fodder**	**Miscella-neous**	**Fibre**	**Ornam-ental**	**Reli-gious**	**Dye**	**Medi-cinal**
1	*Acacia catechu* [Mimosaceae]	Ed	*	Msc	*	*	*	*	Med
2	*Achyranthes aspera* [Amaranthaceae]	*	*	*	*	*	*	*	Med

3	*Achyranthes bidentata* [Amaranthaceae]	*	*	*	*	*	Rlg	*	Med
4	*Acmella calva* [Asteraceae]	Ed	Fd	*	*	*	*	*	Med
5	*Aconogonum molle* [Polygonaceae]	Ed	Fd	*	*	*	*	*	Med
6	*Acorus calamus* [Acoraceae]	*	*	*	*	*	Rlg	*	Med
7	*Actinidia strigosa* [Actinidiaceae]	Ed	*	Msc	*	*	*	*	*
8	*Adenanthera pavonina* [Mimosaceae]	Ed	*	*	*	*	*	*	*
9	*Adiantum capellusveneris* [Adiantaceae]	*	*	*	*	*	*	*	Med
10	*Aegle marmelos* [Rutaceae]	Ed	*	*	*	*	Rlg	*	Med
11	*Ageratina adenophora* [Asteraceae]	*	*	*	*	*	*	*	Med
12	*Ageratum conyzoides* [Asteraceae]	*	*	*	*	*	*	*	Med
13	*Ageratum houstonianum* [Asteraceae]	*	*	*	*	*	*	*	Med
14	*Ajuga macrosperma* [Lamiaceae]	*	*	*	*	*	*	*	Med
15	*Albizia lebbek* [Mimosaceae]	*	*	*	*	*	*	*	Med
16	*Albizia odoratissima* [Mimosaceae]	*	*	*	*	*	*	*	Med
17	*Alnus nepalensis* [Betulaceae]	*	*	Msc	*	*	*	*	*
18	*Alocasia macrorrhiza* [Araceae]	Ed	*	*	*	*	*	*	*
19	*Aloe barbadensis* [Liliaceae]	*	*	Msc	*	*	*	*	Med
20	*Aloe vera* [Liliaceae]	*	*	*	*	Orn	*	*	Med
21	*Alstonia scholaris* [Apocynaceae]	*	Fd	*	*	Orn	*	*	*
22	*Alstonia scholaris* [Apocynaceae]	*	*	*	*	*	*	*	Med
23	*Alternanthera paronichioides* [Amaranthaceae]	Ed	*	*	*	*	*	*	Med
24	*Alternanthera sessilis* [Amaranthaceae]	Ed	Fd	*	*	*	*	*	*
25	*Amaranthus lividus* [Amaranthaceae]	Ed	*	*	*	*	*	*	*
26	*Amaranthus spinosus* [Amaranthaceae]	Ed	*	*	*	*	*	*	*
27	*Amaranthus viridis* [Amaranthaceae]	Ed	Fd	*	*	*	*	*	*
28	*Ambroma augusta* [Sterculiaceae]	Ed	*	*	Fbr	*	*	*	Med
29	*Ammania baccifera* [Lyth]	Ed	*	*	*	*	*	*	Med
30	*Amomum subulatum* [Zing]	*	*	*	*	*	*	*	Med
31	*Amorphophallus paeoniifolius* [Araceae]	Ed	*	*	*	*	*	*	Med
32	*Ampelocissus barbata* [Vita]	*	*	*	*	*	*	*	Med
33	*Ananus comosus* [Brom]	*	*	*	*	*	*	*	Med
34	*Andrographis paniculata* [Brom]	*	*	*	*	*	*	*	Med
35	*Annanus comosus* [Brom]	*	*	*	*	*	*	*	Med

36	*Annona reticulata* [Annonaceae]	Ed	Fd	*	*	*	*	*	Med
37	*Annona squamosa* [Annonaceae]	Ed	Fd	*	*	*	*	*	Med
38	*Antidesma acidum* [Euphorbiaceae]	Ed	*	*	*	*	*	*	Med
39	*Ardisia solanacea* [Myrsinaceae]	Ed	*	*	*	Orn	*	*	*
40	*Argemone mexicana* [Papaveraceae]	*	*	*	*	*	*	*	Med
41	*Artemisia dubia* [Asteraceae]	*	*	Msc	*	*	Rlg	*	Med
42	*Artemisia indica* [Asteraceae]	*	*	*	*	*	*	*	Med
43	*Artemisia vulgaris* [Asteraceae]	*	*	*	*	*	*	*	Med
44	*Artocarpus heterophyllus* [Moraceae]	Ed	Fd	*	*	*	*	*	*
45	*Artocarpus lacucha* [Moraceae]	Ed	Fd	*	*	*	*	*	Med
46	*Asparagus racemosus* [Asparagaceae]	*	*	*	*	Orn	*	*	Med
47	Astilbe rivularis [Saxifragaceae]	*	*	*	*	*	*	*	Med
48	*Averrhoa carambola* [Averrhoaceae]	*	*	*	*	*	*	*	Med
49	*Axonopus compressus*	*	Fd	*	*	*	*	*	*
50	*Azadirachta indica* [Meliaceae]	Ed	*	Msc	*	*	*	*	Med
51	*Bacopa monierii* [Scrophulariaceae]	Ed	*	*	*	*	*	*	Med
52	*Bambusa* sp. [Poaceae]	*	*	*	*	*	*	*	Med
53	*Bambusa* spp. [Poaceae]	*	Fd	Msc	*	Orn	*	*	*
54	*Bauhinia purpurea* [Caesalpiniaceae]	Ed	*	Msc	*	Orn	*	*	Med
55	*Bauhinia vahlii* [Caesalpiniaceae]	*	Fd	Msc	*	*	*	*	*
56	*Bauhinia variegata* [Caesalpiniaceae]	Ed	Fd	*		*	Rlg	*	Med
57	*Begonia palmata* [Begoniaceae]	*	*	*	*	*	*	*	Med
58	*Begonia picta* [Begoniaceae]	*	*	*	*	*	*	*	Med
59	*Berginia ciliata* [Saxifragaceae]	Ed	*	*	*	Orn	*	*	Med
60	*Betula alnoides* [Betulaceae]	*	*	Msc	*	*	*	*	*
61	*Bidens pilosa* [Asteraceae]	*	Fd	Msc	*	*	*	*	*
62	*Biophytum sensitivum* [Oxalidaceae]	*	*	*	*	*	*	*	Med
63	*Bischofia javanica* [Euphorbiaceae]	*	Fd	*	*	*	*	*	Med
64	*Blumea balsamifera* [Asteraceae]	*	*	*	*	*	*	*	Med
65	*Boehmeria macrophylla* [Urticaceae]	*	Fd	Msc	Fbr	*	*	*	*
66	*Boehmeria rugulosa* [Urticaceae]	*	Fd	Msc		*	*	*	Med
67	*Boerhavia coccinea*	Ed	*	*	*	*	*	*	Med

	[Nyctaginaceae]								
68	*Bombax ceiba* [Bombacaceae]	*	*	Msc	Fbr	*	*	*	Med
69	*Brassaiopsis hainla* [Araliaceae]	*	Fd	*	*		*	*	Med
70	*Brassica campestris* [Brassicaceae]	Ed	*	*	*	*	*	*	*
71	*Brassica juncea* [Brassicaceae]	Ed	*	*	*	*	*	*	Med
72	*Bridelia retusa* [Euphorbiaceae]	*	*	*	*	*	*	*	Med
73	*Buddleja asiatica* [Buddlejaceae]	*	*	Msc	*	*	Rlg	*	*
74	*Buddleja asiatica* [Buddlejaceae]	*	*	*	*	*	*	*	Med
75	*Butea monosperma* [Fabaceae]	*	*	*	*	*	Rlg	*	*
76	*Cajanus cajan* [Fabaceae]	Ed	*	Msc	*	*	*	*	Med
77	*Caladium hortulanum* [Araceae]	*	*	*	*	*	*	*	Med
78	*Calamus erectus* [Arecaceae]	Ed	*	Msc	*	*	*	*	*
79	*Calamus tenuis* [Arecaceae]	*	*	*	*	*	*	*	Med
80	*Callicarpa arborea* [Verbenaceae]	*	*	Msc	*	*	*	*	Med
81	*Calotropis gigantea* [Asclepiadaceae]	*	*	*	*	*	*	*	Med
82	*Camellia kissi* [Theaceae]	*	*	Msc	*	*	*	*	*
83	*Camellia sinensis* [Theaceae]	Ed	*	Msc	*	*	*	*	Med
84	*Canarium strictum*	*	*	*	*	*	*	*	Med
85	*Canna edulis [Cannaceae]*	Ed	Fd	Msc	*	*	*	*	*
86	*Cannabis sativa* [Cannabaceae]	*	*	Msc	*	*	Rlg	*	Med
87	*Capsicum frutescens* [Solanaceae]	*	*	*	*	*	*	*	Med
88	*Cardamine hirsuta* [Brassicaceae]	Ed	*	*	*	*	*	*	Med
89	*Carica papaya* [Caricaceae]	Ed	*	*	*	*	*	*	Med
90	*Cassia alata* [Caesalpiniaceae]	*	*	*	*	Orn	*	*	Med
91	*Cassia fistula* [Caesalpiniaceae]	*	*	*	*	Orn	*	*	Med
92	*Cassia occidentalis* [Caesalpiniaceae]	Ed	*	*	*	*	*	*	Med
93	*Cassia sophera* [Caesalpiniaceae]	*	*	*	*	*	*	*	Med
94	*Cassia tora* [Caesalpiniaceae]	Ed	*	*	*	*	*	*	Med
95	*Catharanthus roseus* [Apocynaceae]	*	*	*	*	Orn	*	*	Med
96	*Catunaregam longispina* [Rubiaceae]	Ed	*	*	*	*	*	*	*
97	*Centella asiatica* [Apiaceae]	Ed	*	*	*	*	*	*	Med
98	*Chenopodium album* [Chenopodiaceae]	Ed	*	*	*	*	*	*	Med
99	*Chenopodium ambrosoides* [Chenopodiaceae]	*	*	*	*	*	*	*	Med
100	*Choerospondias axillaria* [Anacardiaceae]	Ed	*	*	*	*	*	*	*
101	*Chromolaena odoratum*	*	*	Msc	*	*	*	*	Med

	[Asteraceae]								
102	*Cinnamomum bejolghota* [Lauraceae]	Ed	*	*	*	*	*	*	*
103	*Cinnamomum sp.* [Lauraceae]	*	*	*	*	*	*	*	Med
104	*Cinnamomum tamala* [Lauraceae]	Ed	*	*	*	*	*	*	Med
105	*Cissampelos pariera* [Menispermaceae]	*	*	*	*	*	*	*	Med
106	*Cissus quadrangularis* [Vita]	*	*	*	*	*	*	*	Med
107	*Citrus aurntium* [Rutaceae]	Ed	*	*	*	*	*	*	Med
108	*Citrus grandis* [Rutaceae]	Ed	*	*	*	*	*	*	*
109	*Citrus maxima* [Rutaceae]	Ed	*	*	*	*	*	*	Med
110	*Citrus mlica [Rutaceae]*	Ed	*	*	*	*	*	*	Med
111	*Clematis buchananiana* [Ranunculaceae]	*	*	*	*	*	*	*	Med
112	*Cleome rutidosperma* [Cleomaceae]	*	*	*	*	*	*	*	Med
113	*Clerodendrum indicum* [Verbenaceae]	*	*	*	*	*	*	*	Med
114	*Clerodendrum inerme* [Verbenaceae]	*	*	Msc	*	Orn	*	*	*
115	*Clerodendrum serretum* [Verbenaceae]	*	*	*	*		*	Dye	Med
116	*Clerodendrum viscosum* /Verbenaceae]	Ed	*	*	*	Orn	*	*	Med
117	*Clinopodium umbrosum* [Lamiaceae]	*	*	*	*		*	*	Med
118	*Clitoria ternatea* [Fabaceae]	*	*	*	*	Orn	*	*	Med
119	*Coccinia grandis* /Cucurbitaceae]	Ed	*	*	*	*	*	*	*
120	*Coffea arabica* [Rubiaceae]	*	*	*	*	*	*	*	Med
121	*Coix lachryma-jobi* [Poaceae]	Ed	Fd	Msc	*	Orn	*	*	Med
122	*Colebrookea oppositifolia* [Lamiaceae]	*	*	Msc	*	*	*	*	Med
123	*Colocasia esculenta* /Araceae]	Ed	*	*	*	*	*	*	Med
124	*Commelina benghalensis* [Commelinaceae]	Ed	Fd	*	*	*	*	*	Med
125	*Corchorus capsularis* [Tiliaceae]	*	*	*	Fbr	*	*	*	*
126	*Coriandrum sativum* [Apiaceae]	Ed	*	*	*	*	*	*	Med
127	*Costus speciosus* [Costaceae]	Ed	*	*	*	Orn	*	*	Med
128	*Crassocephalum crepidioides* [Asteraceae]	*	*	*	*	*	*	*	Med
129	*Crinum amoenum* [Amaryllidaceae]	*	*	*	*	Orn	*	*	*
130	*Crotalaria juncea* [Fabaceae]	Ed	*	*	Fbr	*	*	*	Med
131	*Croton bonplandianus* [Euphorbiaceae]	*	*	*	*	*	Rlg	*	Med
132	*Cryptomeria japonica* [Taxodiaceae]	*	*	Msc	*	*	*	*	*
33	*Cupressus corneyana* [Cupressaceae]	*	*	Msc	*	*	Rlg	*	
34	*Curculigo capitulata*	*	*	*	*	*	*	*	Med

	[Hypoxidaceae]								
135	*Curculigo orchioides* [Hypoxidaceae]	*	*	*	*	*	*	*	Med
136	*Curcuma amada* [Zing]	*	*	*	*	*	*	*	Med
137	*Curcuma aromatica / caesia* [Zing]	*	*	*	*	*	*	*	Med
138	*Curcuma longa* [Zing]	*	*	*	*	*	*	Dye	Med
139	*Curcuma z1oaria [Zing]*	*	*	*	*	*	*	*	Med
140	*Cuscuta reflexa* [Cuscutaceae]	*	*	*	*	*	*	*	Med
141	*Cyanthillium cinereum* [Asteraceae]	Ed	*	*	*	*	*	*	*
142	*Cymbopogon citratus* [Poaceae]	*	*	*	*	*	*	*	Med
143	*Cymbopogon nardus* [Poaceae]	*	*	Msc	*	*	*	*	Med
144	*Cynodon dactylon* [Poaceae]	*	Fd	*	*	*	Rlg	*	Med
145	*Cyperus rotundus* [Cyperaceae]	*	*	*	*	*	*	*	Med
146	*Dalbergia sissoo [Fabaceae]*	*	*	*	*	*	*	*	Med
147	*Datura fastuosa* [Solanaceae]	*	*	*	*	*	*	*	Med
148	*Datura metel* [Solanaceae]	*	*	*	*	*	Rlg	*	Med
149	*Datura stramonium* [Solanaceae]	*	*	*	*	Orn	Rlg	*	Med
150	*Datura suaveolens* [Solanaceae]	*	*	*	*	*	*	*	Med
151	*Deeringia amaranthoides* [Amaranthaceae]	Ed	*	*	*	*	*	Dye	Med
152	*Delonix regia* [Caesalpiniaceae]	*	*	*	*	Orn	*	*	*
153	*Dendrocnide sinuata* [Urticaceae]	*	*	*	Fbr	*	*	*	*
154	*Desmodium triflorum* [Fabaceae]	*	*	*	*	*	*	*	Med
155	*Dicliptera bupleuroides* [Brom]	*	*	*	*	*	*	*	Med
156	*Dicranopteris linearis* [Gleicheniaceae]	*	*	Msc	*	*	*	*	*
157	*Dillenia indica* [Dilleniaceae]	Ed	Fd	*	*	*	*	*	Med
158	*Dillenia pentagyna* [Dilleniaceae]	*	Fd	*	*	Orn	*	*	*
159	*Dioscorea alata* [Dioscoreaceae]	Ed	Fd	*	*	*	*	*	Med
160	*Dioscorea belophylla* [Dioscoreaceae]	Ed	*	*	*	*	*	*	Med
161	*Dioscorea bulbifera* [Dioscoreaceae]	Ed	*	*	*	*	*	*	Med
162	*Dioscorea deltoidea* [Dioscoreaceae]	*	*	*	*	*	*	*	Med
163	*Dioscorea floribunda* [Dioscoreaceae]	*	*	*	*	*	*	*	Med
164	*Dioscorea pentaphylla* [Dioscoreaceae]	Ed	*	Msc	*	*	*	*	Med
165	*Dioscorea prazeri* [Dioscoreaceae]	*	*	*	*	*	*	*	Med
166	*Diplazium esculentum* [Athyriaceae]	Ed	*	*	*	*	*	*	Med

167	*Drymaria diandra* [Caryophyllaceae]	*	*	*	*	*	*	*	Med
168	*Drymaria villosa* [Caryophyllaceae]	*	*	*	*	*	*	*	Med
169	*Dryopteris filix-mas* [Dryopteridaceae]	Ed	*	*	*	*	*	*	*
170	*Eclipta prostrata* [Asteraceae]	*	*	*	*	*	*	*	Med
171	*Ehretia acuminata* [Ehretiaceae]	*	Fd	Msc	*	*	*	*	*
172	*Elaeocarpus lancaefolius* [Elaeocarpaceae]	Ed	*	*	*	*	*	*	*
173	*Elaeocarpus sphaericus* [Elaeocarpaceae]	*	*	Msc	*	*	*	*	*
174	*Elephantopus scaber* [Asteraceae]	*	*	*		*	*	*	Med
175	*Elettaria cardamomum [*Zing]	*	*	*	*	*	*	*	Med
176	*Eleusine indica* [Poaceae]	*	Fd	*	*	*	*	*	Med
177	*Elsholtzia blanda* [Lamiaceae]	*	*	*	*	*	*	*	Med
178	*Elsholtzia fruticosa* [Lamiaceae]	*	*	Msc	*	*	*	*	*
179	*Emblica officinale* [Euphorbiaceae]	Ed	*	Msc	*	*	*	*	Med
180	*Entada rhelii [Fabaceae]*	*	*	*	*	*	*	*	Med
181	*Enydra fluctuans* [Asteraceae]	Ed	*	*	*	*	*	*	Med
182	*Equisetum debile* [Equisetaceae]	*	Fd	*	*	*	*	*	Med
183	*Equisetum diffusum* [Equisetaceae]	*	*	*	*	*	*	*	Med
184	*Erycibe paniculata* [Convolvulaceae]	*	*	*	*	*	*	*	Med
185	*Eryngium foetidum* [Apiaceae]	Ed	*	*	*	*	*	*	*
186	*Erythrina arborescence* [Fabaceae]	*	*	*	*	*	*	*	Med
187	*Erythrina stricta* [Fabaceae]	*	*	*	*	Orn	*	*	Med
188	*Euphorbia hirta* [Euphorbiaceae]	*	*	*	*		*	*	Med
189	*Euphorbia pulcherrima* [Euphorbiaceae]	*	*	*	*	Orn	*	*	Med
190	*Euphorbia royleana* [Euphorbiaceae]	*	*	*	*	*	Rlg	*	Med
191	*Euphorbia tirucalii* [Euphorbiaceae]	*	*	*	*	*	*	*	Med
192	*Evodia fraxinifolia* [Rutaceae]	*	*	*	*	*	*	*	Med
193	*Fagopyrum debotrys* [Polygonacea]	Ed	*	*	*	*	*	*	*
194	*Ficus benghalensis* [Moraceae]	Ed	Fd	*	*	*	Rlg	*	Med
195	*Ficus benjamina* [Moraceae]	Ed	Fd	*	*	Orn	*	*	*
196	*Ficus hispida [*Moraceae]	Ed	*	*	*	*	*	*	Med
197	*Ficus hookeriana* [Moraceae]	*	Fd	*	*	*	*	*	*
198	*Ficus neriifolia* [Moraceae]	*	Fd	*	*	*	*	*	*
199	*Ficus religiosa* [Moraceae]	*	Fd	*	*	*	Rlg	*	Med
200	*Girardinia diversifolia* [Urticaceae]	*	Fd	*	Fbr	*	*	*	Med
201	*Glinus oppositifolius*	Ed	*	*	*	*	*	*	

	[Caryophyllaceae]								
202	*Gmelina arborea* [Verbenaceae]	*	*	Msc	*	*	*	*	Med
203	*Gonostegia hirta* [Urticaceae]		*		*	*	*	*	Med
204	*Gossypium herbaceum* [Malvaceae]	*	*	*	Fbr	*	*	*	*
205	*Haldina cordifolia* [Rubiaceae]	*	*	*	*	*	Rlg	*	*
206	*Hlychium spicatum [Zing]*	*	*	*	*	*	*	*	Med
207	*Hlyotis scandens [Rubiaceae]*	*	*	*	*	*	*	*	Med
208	*Heliotropium indicum* [Boraginaceae]	*	*	*	*	*	*	*	Med
209	*Hemiphragma heterophylla* [Scrophulariaceae]	*	*	*	*	*	*	*	Med
210	*Heracleum nepalense* [Apiaceae]	Ed	*	*	*	*	*	*	Med
211	*Heracleum wallichii* [Apiaceae]	*	*	*	*	*	*	*	Med
212	*Hibiscus rosasinensis* [Malvaceae]	*	*	*	*	Orn	*	*	*
213	*Holarrhena pubescens* [Apocynaceae]	*	*	*	*	*	*	*	Med
214	*Houttuynia cordata* [Saururaceae]	Ed	*	*	*	*	*	*	Med
215	*Hydrocotyle himalaica* [Apiaceae]	*	*	*	*	*	*	*	Med
216	*Hydrocotyle sibthorpioides* [Apiaceae]	*	*	*	*	*	*	*	Med
217	*Hygrophila auriculata* [Brom]	Ed	*	*	*	*	*	*	Med
218	*Hypericum japonicum* [Hypericaceae]	*	*	*	*	*	*	*	Med
219	*Hypericum petulum* [Hypericaceae]	*	*	*	*	*	*	*	Med
220	*Hyptis suaveolens* [Lamiaceae]	*	*	Msc	*	*	*	*	*
221	*Ichnocarpus frutescens* [Apocynaceae]	*	*		*	*	*	*	Med
222	*Imperata cylindrica* [Poaceae]	*	Fd	Msc	*	*	*	*	Med
223	*Ipomoea aquatica* *[*Convolvulaceae]	Ed	*	*	*	*	*	*	Med
224	*Ipomoea batatas*	*	*	*	*	*	*	*	Med
225	*Jasminum sambac* [Oleaceae]	*	*	*	*	Orn	*	*	Med
226	*Jatropha curcas* [Euphorbiaceae]	*	*	Msc	*	Orn	*	*	Med
227	*Justicia adhatoda* [Brom]	*	*	Msc	*	Orn	*	*	Med
228	*Justicia gendarussa* [Brom]	*	*	*	*	Orn	*	*	Med
229	*Kaemferia rotunda* [Zing]	*	*	*	*	*	*	*	Med
230	*Kalanchoe pinnata* [Crassulaceae]	*	*	*	*	*	*	*	Med
231	*Lagerstroemia reginae* [Lyth]	*	*	*	*	Orn	*	*	Med
232	*Lannea coromandelica* [Anacardiaceae]	*	*	*	*	*	Rlg	*	Med
233	*Lantana camara* *[*Verbenaceae]	Ed	*	*	*	Orn	*	*	Med
234	*Laportea terminalis* [Urticaceae]	*	*	*	*	*	Rlg	*	Med

235	*Leucas indica [*Lamiaceae]	Ed	*	*	*	*	*	*	Med
236	*Lindenbergia grandiflora* [Scrophulariaceae]	*	*	*	*	*	*	*	Med
237	*Litsea citrata* [Lauraceae]	*	*	*	*	*	*	*	Med
238	*Litsea cubeba* [Lauraceae]	Ed	*	*	*	*	*	*	Med
239	*Litsea glutinosa* [Lauraceae]	*	Fd	Msc	*	*	*	*	Med
240	*Lobelia nummularia* [Lobeliaceae]	*	*	*	*	*	*	*	Med
241	*Luffa aegyptiaca [*Cucurbitaceae]	Ed	*	Msc	*	*	*	*	Med
242	*Lycopodiella cernua* [Lycopodiaceae]	*	*	*	*	Orn	*	*	*
243	*Lycopodium pseudoclavatum* [Lycopodiaceae]	*	*	*	*	Orn	Rlg	*	Med
244	*Lygodium flexuosum* [Lygodiaceae]	*	*	*	*	*	Rlg	*	*
245	*Lygodium salicifolium* [Lydodiaceae]	*	*	*	*	Orn	*	*	*
246	*Lyonia ovalifolia* [Ericaceae]	*	*	*	*	*	*	*	Med
247	*Macaranga indica* [Euphorbiaceae]	*	*	*	*	*	*	*	Med
248	*Machilus villosa* [Lauraceae]	*	*	Msc	*	*	*	*	
249	*Maesa chisia* [Myrsinaceae]	*	*	*	*	*	*	*	Med
250	*Mahonia nepaulensis* [Berberidaceae]	*	*	Msc	*	*	*	Dye	Med
251	*Mallotus philippensis* [Euphorbiaceae]	*	*	*	*	*	*	Dye	Med
252	*Malva verticillata* [Malvaceae]	Ed	*	*	*	*	*	*	*
253	*Malvaviscus arboreus* [Malvaceae]	*	*	Msc	*	Orn	*	*	Med
254	Malvaviscus arboreus/ / Flowers for	*	*	*	*	*	Rlg	*	
255	*Mangifera indica* [Anacardiaceae]	*	Fd	*	*	*	Rlg	*	Med
256	*Manihot esculenta* [Euphorbiaceae]	Ed	*	*	*	*	*	*	*
257	*Maranta arundinacea* [Marantaceae]	*	*	*	*	Orn	*	*	Med
258	*Marsilea minuta* [Marsileaceae]	Ed	*	*	*	*	*	*	Med
259	*Mazus japonica* [Scrophulariaceae]	*	*	*	*	*	*	*	Med
260	*Melastoma malabathricum* [Melastomataceae]	Ed	*	*	*	Orn	*	*	Med
261	*Melissa parviflora* [Lamiaceae]	*	*	*	*	*	*	*	Med
262	*Melochia corchorifolia* [Sterculiaceae]	Ed	*	*	*	*	*	*	*
263	*Mentha arvensis* [Lamiaceae]	Ed	*	*	*	*	*	*	Med
264	*Mentha piperata* [Lamiaceae]	Ed	*	*	*	*	*	*	Med
265	*Mesua ferrea* [Clusiaceae]	*	*	*	*	*	*	*	Med
266	*Michelia champaca* [Magnoliaceae]	*	*	Msc	*	*	*	*	Med
267	*Michelia doltsopa* [Magnoliaceae]	*	*	Msc	*	*	*	*	*

268	*Mikenia micrantha* [Asteraceae]	*	Fd	*	*	*	*	*	*
269	*Mimosa himalayana* [Mimosaceae]	*	*	*	*	*	Rlg	*	Med
270	*Mimosa pudica* [Mimosaceae]	*	*	*	*	*	*	*	Med
271	*Mimusops elangi* [Sapotaceae]	Ed	*	*	*	*	*	*	Med
272	*Mirabilis jalapa* [Nyctaginaceae]	*	*	*	*	Orn	*	*	Med
273	*Molineria gracilis* [Hypoxidaceae]	*	*	*	*	*	*	*	Med
274	*Momordica charantia* [Cucurbitaceae]	*	*	*	*	*	*	*	Med
275	*Momordica dioica* [Cucurbitaceae]	Ed	*	*	*	*	*	*	Med
276	*Morinda angustifolia* [Rubiaceae]	*	*	*	*	*	*	Dye	Med
277	*Moringa oleifera* [Moringaceae]	*	*	*	*	*	*	*	Med
278	*Morus alba* [Moraceae]	*	*	*	*	*	*	*	Med
279	*Morus australis* [Moraceae]	Ed	*	Msc	*	*	*	*	Med
280	*Morus macroura* [Moraceae]	*	Fd	*	*	*	*	*	Med
281	*Moutia puya* [Urticaceae]	*	*	*	Fbr	*	*	*	*
282	*Mucuna pruriens* [Fabaceae]	Ed	*	*	*	*	*	*	Med
283	*Murraya koenigii* [Rutaceae]	*	*	*	*	*	*	*	Med
284	*Murraya paniculata* [Rutaceae]	*	Fd	Msc	*	Orn	*	*	Med
285	*Musa balbisiana* [Musaceae]	Ed	Fd	*	Fbr	*	Rlg	*	Med
286	*Mussaenda macrophylla* [Rubiaceae]	*	*	*	*	*	*	*	Med
287	*Mussaenda roxburghii* [Rubiaceae]	Ed	*	*	*	*	*	*	Med
288	*Mussaenda treutleri* [Rubiaceae]	*	*	*	*	*	*	*	Med
289	*Nasturtium officinale* [Brassicaceae]	Ed	*	*	*	*	*	*	Med
290	*Neolamarckia cadamba* [Rubiaceae]	Ed	*	*	*	Orn	*	*	Med
291	*Nephrolepis cordifolia* [Nephrolepidaceae]	*	*	*	*	*	*	*	Med
292	*Neyraudia aurandinacea* [Poaceae]	*	*	*	*	*	Rlg	*	*
293	*Nyctanthes arbortristis* [Verbenaceae]	*	*	*	*	*	*	*	Med
294	*Ocimum tenuiflorum* [Lamiaceae]	*	*	*	*	*	Rlg	*	Med
295	*Oldenlandia corymbosa* [Rubiaceae]	Ed	*	*	*	*	*	*	Med
296	*Oldenlandia diffusa* [Rubiaceae]	Ed	*	*	*	*	*	*	Med
297	*Opuntia dillenii* [Cactaceae]	*	*	*	*	*	*	*	Med
298	*Oroxylum indicum* [Bignoniaceae]	Ed	Fd	Msc	*	Orn	Rlg	*	Med
299	*Oryza sativa* (Poaceae)	*	Fd	Msc	*	*	Rlg	*	*
300	*Osbeckia nepalensis* [Melastomataceae]	*	*	*	*	*	*	*	Med

301	*Ostodes paniculata* [Euphorbiaceae]	Ed	*	Msc	*	*	*	*	*
302	*Oxalis corniculata* [Oxalidaceae]	Ed	*	Msc	*	*	*	*	Med
303	*Oxalis corymbosa* [Oxalidaceae]	Ed	*	*	*	*	*	*	*
304	*Paleria foetida [Rubiaceae]*	Ed	*	*	*	*	*	*	Med
305	*Pandanus nepalensis* [Pandanaceae]	Ed	*	Msc	*	*	*	*	*
306	*Passiflora 1ulis [Passifloraceae]*	Ed	*	*	*	*	*	*	*
307	*Peperomia pellucida* [Piperaceae]	*	*	*	*	*	*	*	Med
308	*Percompylus glaucus* [Menispermaceae]	*	*	*	*	*	*	*	Med
309	*Perilla frutescens* [Lamiaceae]	*	*	*	*	*	*	*	Med
310	*Persicaria chinensis* [Polygonaceae]	Ed	Fd	Msc	*	*	*	*	Med
311	*Persicaria hydropiper* [Polygonaceae]	Ed	*	Msc	*	*	*	*	*
312	Persicaria microcephala [Polygonaceae]	*	*	*	*	*	*	*	Med
313	*Phlogacanthus thyrsiflorus* [Brom]	Ed	*	*	*	*	*	*	Med
314	*Phrynium pubinerve* [Marantaceae]	*	*	Msc	*	*	*	*	*
315	*Phyla nodiflora* [Verbenaceae]	*	*	*	*	*	*	*	Med
316	*Phyllanthus amarus* [Euphorbiaceae]	*	*	*	*	*	*	*	Med
317	*Phyllanthus simplex* [Euphorbiaceae]	*	*	*	*	*	*	*	Med
318	*Phyllanthus urinaria* [Euphorbiaceae]	*	*	*	*	*	*	*	Med
319	Physalis peruviana [Solanaceae]	*	*	*	*	*	*	*	Med
320	*Pinus roxburghii* [Pinaceae]	*	*	*	*	*	*	*	Med
321	*Piper chava* [Piperaceae]	Ed	*	*	*	*	*	*	*
322	*Piper longum* [Piperaceae]	*	*	*	*	*	*	*	Med
323	*Piper peepuloides* [Piperaceae]	*	*	*	*	*	*	*	Med
324	*Plantago erosa* [Plantaginaceae]	*	*	*	*	*	*	*	Med
325	*Plumbago zeylanica* [Plumbaginaceae]	Ed	*	*	*	Orn	*	*	Med
326	*Plumeria rubra* [Apocynaceae]	*	*	*	*	Orn	Rlg	*	Med
327	*Polyalthia longifolia* [Annonaceae]	*	*	*	*	Orn	*	*	*
328	*Polygonum plebeium* [Polygonaceae]	Ed	*	*	*	*	*	*	*
329	*Pongamia pinnata* [Fabaceae]	*	*	Msc	*	*	*	*	*
330	*Portulaca oleracea* [Portulacaceae]	Ed	*	*	*	*	*	*	*
331	*Pouzolzia zeylanica* [Urticaceae]	*	*	*	*	*	*	*	Med
332	*Premna bengalensis* [Verbenaceae]	*	*	Msc	*	*	*	*	Med

333	*Premna mucronata* [Verbenaceae]	*	*	*	*	*	*	*	Med
334	*Premna obtusifolia* [Verbenaceae]	*	*	*	*	*	*	*	Med
335	*Prunus cerasoides* [Rosaceae]	Ed	*	Msc	*	Orn	Rlg	*	Med
336	*Psidium guajava* [Myrtaceae]	Ed	*	Msc	*	*	*	*	Med
337	*Pteridium aquilium* [Pteridiaceae]	Ed	*	*	*	*	*	*	*
338	*Pterospermum acerifolium* [Sterculiaceae]	*	*	Msc	*	*	*	*	*
339	*Punica granatum* [Punicaceae]	Ed	*	*	*	*	*	*	Med
340	*Pupalia atropurpurea* [Amaranthaceae]	*	*	*	*	*	*	*	Med
341	*Pupalia lappacea* [Amaranthaceae]	*	*	*	*	*	Rlg	*	Med
342	*Raphanus sativus* [Brassicaceae]	Ed	*	*	*	*	*	*	Med
343	*Rauvolfia serpentina* [Apocynaceae]	Ed	*	*	*	*	Rlg	*	Med
344	*Rhododendron arboreum* [Ericaceae]	*	*	*	*	*	*	*	Med
345	*Rhus chinensis* [Anacardiaceae]	*	*	*	*	*	Rlg	*	Med
346	*Rhus semialata* [Anacardiaceae]	*	*	*	*	*	*	*	Med
347	*Ricinus communis* [Euphorbiaceae]	*	*	*	*	*	Rlg	*	Med
348	*Rosa brunonii* [Rosaceae]	*	*	*	*	*	*	*	Med
349	*Rubia manjith* [Rubiaceae]	*	*	*	*	*	*	Dye	Med
350	*Rubus calycinus* [Rosaceae]	*	*	*	*	*	*	*	Med
351	*Rubus ellipticus* [Rosaceae]	*	*	*	*	*	*	*	Med
352	*Rubus lineatus* [Rosaceae]	*	*	*	*	*	*	*	Med
353	*Rumex nepalensis* [Polygonaceae]	Ed	Fd	*	*	*	*	*	Med
354	*Rumex trisetifer* [Polygonaceae]	*	*	*	*	*	*	*	Med
355	*Saccharum officinarum* [Poaceae]	*	*	Msc	*	*	*	*	Med
356	*Saccharum officinarum* [Poaceae]	*	*	*	*	*	*	*	*
357	*Sansevieria trifaciata* [Dracaenaceae]	*	*	*	*	Orn	*	*	Med
358	*Sapindus mukorossi* [Sapindaceae]	*	*	Msc	*	*	*	*	Med
359	*Sauraja nepalensis* [Actinidaceae]	*	Fd	*	*	*	*	*	*
360	*Schima wallichii* [Theaceae]	*	*	Msc	*	*	*	*	Med
361	*Scoparia dulcis* [Scrophulariaceae]	Ed	*	*	*	*	Rlg	*	Med
362	*Senesio scandens* [Asteraceae]	*	*	*	*	*	*	*	Med
363	*Sesbania grandiflora* [Fabaceae]	Ed	*	*	*	*	*	*	Med
364	*Sesbania sesban* [Fabaceae]	Ed	*	Msc	*	*	*	*	*
365	*Setaria palmifolia* [Poaceae]	*	Fd	*	*	*	*	*	*

366	*Shorea robusta* [Dipterocarpaceae]	*	*	Msc	*	*	Rlg	*	Med
367	*Sida acuta* [Malvaceae]	*	*	Msc	*	*	*	*	Med
368	*Sida cordifolia* [Malvaceae]	*	*	*	*	*	*	*	Med
369	*Sida rhombifolia* [Malvaceae]	*	*	Msc	Fbr	*	*	*	Med
370	*Skimmia arborescens* [Rutaceae]	*	*	*	*	*	*	*	Med
371	*Smilax ovalifolia* [Smilacaceae]	*	*	*	*	*	*	*	Med
372	*Solanum indicum* [Solanaceae]	*	*	*	*	*	*	*	Med
373	*Solanum nigrum* [Solanaceae]	Ed	*	*	*	*	*	*	Med
374	*Solanum torvum* [Solanaceae]	Ed	*	*	*	*	*	*	Med
375	*Spinacea oleracea* [Chenopodiaceae]	*	*	*	*	*	*	*	Med
376	*Spondius pinnata* [Anacardiaceae]	*	*	*	*	*	*	*	Med
377	*Stellaria m1ia [Caryophyllaceae]*	Ed	*	*	*	*	*	*	*
378	*Stephania glabra* [Menispermace]	Ed	*	*	*	*	*	*	Med
379	*Stephania hernandifolia* [Menispermaceae]	*	*	*	*	*	*	*	Med
380	*Stephania japonica* [Menispermaceae]	Ed	*	*	*		*	*	Med
381	*Sterculia villosa* [Sterculaceae]	*	*	*	Fbr	Orn	*	*	Med
382	*Streblus asper* [Moraceae]	*	Fd	*	*	*	*	*	Med
383	*Swietenia macrophylla* [Meliaceae]	*	*	*	*	Orn	*	*	*
384	*Swietenia mohaginy* [Meliaceae]	*	*	*	*	Orn	*	*	*
385	*Syzygium cumini* [Myrtaceae]	*	Fd	*	*	*	*	*	*
386	*Tagetes patula* [Asteraceae]	*	*	*	*	Orn	Rlg	*	Med
387	*Tamarindus indica* [Caesalpiniaceae]	*	*	*	*	*	*	*	Med
388	*Taxus baccata* [Taxaceae]	*	*	*	*	*	*	*	Med
389	*Tectaria coaduanata* [Tectariaceae]	*	*	*	*	*	*	*	Med
390	*Terminalia alata* [Combretaceae]	*	*	*	*	*	*	*	Med
391	*Terminalia arjuna* [Combretaceae]	*	*	*	*	*	*	*	Med
392	*Terminalia bellirica* [Combretaceae]	Ed	*	*	*	*	*	Dye	Med
393	*Terminalia chebula* [Combretaceae]	Ed	*	Msc	*	*	*	*	Med
394	*Terminalia myriocarpa* [Combretaceae]	*	*	Msc	*	*	*	*	Med
395	*Tetradium fraxinifolium* [Rutaceae]	Ed	Fd	Msc	*	*	*	*	Med
96	*Tetrameles nudiflora* [Datiscaceae]	*	*	*	*	*	*	*	Med
97	*Thuja orientalis* [Thujaceae]	*	*	*	*	*	Rlg	*	*
98	*Thysanolaena latifolia* [Poaceae]	*	Fd	Msc	*	*	Rlg	*	Med

399	*Tinospora cordifolia* [Menispermaceae]	*	Fd	*	*	*	*	*	Med
400	*Toddalia asiatica* [Rutaceae]	Ed	*	*	*	*	*	Dye	*
401	*Toona ciliata* [Meliaceae]	*	*	Msc	*	*	*	*	Med
402	*Trema orientalis* [Ulmaceae]	*	Fd	Msc	*	*	*	*	Med
403	*Trewia nudiflora* [Euphorbiaceae]	*	*	*	*	*	*	*	Med
404	*Trichosanthes dioca* [Cucurbitaceae]	*	*	*	*	*	*	*	Med
405	*Trichosanthes lepiniana* [Cucurbitaceae]	Ed	*	*	*	*	*	*	Med
406	*Trifolium repens* [Fabaceae]	*	Fd	*	*	*	*	*	Med
407	*Urena lobata* [Malvaceae]	*	*	*	Fbr	*	*	*	Med
408	*Urtica ardens* [Urticaceae]	Ed	*	*		*	Rlg	*	Med
409	*Urtica dioca* [Urticaceae]	Ed	Fd	*	Fbr	*	*	*	Med
410	*Urtica mairei* [Urticaceae]	*	*	*	*	*	*	*	Med
411	*Urtica parviflora* [Urticaceae]	Ed	Fd	*	Fbr	*	*	*	Med
412	*Vallaris solanacea* [Apocynaceae]	*	*	*	*	*	*	*	Med
413	*Vetiveria zizanioides* [Poaceae]	*	*	Msc	*	*	*	*	Med
414	*Vibernum erubescens* [Caprifoliaceae]	*	*	*	*	*	*	*	Med
415	*Vitex negundo* [Verbenaceae]	*	*	Msc	*	*	*	*	Med
416	*Wattakaka volubilis* [Asclepiadaceae]	Ed	*	*	*	*	*	*	*
417	*Wlelia montana [Asteraceae]*	Ed	*	*	*	*	*	*	Med
418	*Wrightia arborea* [Apocynaceae]	*	*	Msc	*	*	*	*	Med
419	*Youngia japonica* [Asteraceae]	*	*	*	*	*	*	*	Med
420	*Zanthoxyllum acanthopodium* [Rutaceae]	*	*	*	*	*	*	*	Med
421	*Zanthoxyllum alatum* [Rutaceae]	*	*	*	*	*	*	*	Med
422	*Zanthoxyllum budrunga* [Rutaceae]	*	*	*	*	*	*	*	Med
423	*Zanthoxylum nitidium* [Rutaceae]	Ed	*	*	*	*	*	*	Med
424	*Zanthoxylum oxyphyllum* [Rutaceae]	Ed	*	*	*	*	*	*	Med
425	*Zephyranthes carinata* [Amaryllidaceae]	*	*	*	*	Orn	*	*	*
426	*Zingiber officinale [*Zing]	Ed	*	*	*	*	*	*	Med
427	*Zizyphus mauritiana* [Rhamnaceae]	Ed	*	Msc	*	*	*	*	Med
	Total number of species	**141**	**57**	**79**	**15**	**49**	**41**	**9**	**336**

A scan through the list expresses the diversity within the useful plants. There are Pteridophytic, Gymnospermous, Dicotyledonous and Monocotyledonous plants in the list. There are exotic and endemic species also in their menu.

The most interesting condition is presented by medicinal plants. A high number of 336 species of plants has been reported by these people as Medicinal Plants. It is not at all suggested to use these plants based on the available informations, but should be used after proper investigation and prescription by a trained and/or qualified person.

The record of 140 species of edible plants is also interesting. Many of these plants are available round the year, which means the availability of human food in the vegetation even during the period os scarecity.

However, all the recorded information need scientific evaluation befor their use except for those plants which are already in use for the same purpose as reported here.

CHAPTER 14

General Discussion

The entire work has been designed to understand different aspects of the weeds of Tea Gardens in Terai and hills of Darjiling district of West Bengal. The richness of the flora in general of the concerned area is well known and that has attracted the plant scientists and naturalists equally at least for the last three centuries.

The donation of the Darjiling Hills part of Sikkim to the British-Indian Government in February 1835 has initiated the exploitation of its green wealth. Construction of a motorable road, rail-line and the establishment of a sanatorium at Darjiling were the first few strikes of the axe of development.

Just four years later (in 1839) Chinese tea-plants were introduced in Darjiling Hills and a few years later in Terai and Duars. This single species has caused the removal of the original vegetation cover from numerous hills and occupied entire hill surfaces. Of course, there is no any doubt that these Tea Gardens have completely changed the economic scenario of the area. Darjiling Tea is now world-famous for its naturally produced aroma and is one of the leading earners of foreign currency to the country's exchequer.

14.1 Aspects of the Present Dissertation

It is now important to know that (i) how much is really the effects of tea plantations on the floristic diversity of the region; (ii) if any rare and/or endemic plant can still survive in Tea Garden environment; (iii) what are the plants actually growing inside Tea Gardens; (iv) determination or recognition of important weeds; (v) uses of weedy plants; (vi) dependence of Tea Garden workers on local vegetation, and (vii) controlling the growth of weeds in Tea Gardens.

All these inquiries have been checked through a number of studies and the results were presented and discussed in different chapters. Based on those accumulated data and realisation gained through discussions, it now essential to understand and/or clarify the above mentioned basic ideas of the present dissertation.

14.2 Effects of Tea Gardens on the Floristic Diversity of the Region

Das (1995, 2002, 2004), Bhujel (1996), Bhujel & Das (2002) has discussed the floristic diversity of the region. And, based on all these and earlier studies Das (2005) provided an estimate for the flora of Darjiling [Table 1.1]. It is not possible to get an absolute floristic picture through sample survey but a realistic picture can be obtained.

The flora of Tea Garden areas has been presented in Chapter 6 of the present report. This data has now compared with the estimated flora for Darjiling district in Table 14.1.

Table 14.1: Comparison of the Flora of Tea Gardens of Darjiling with that of the numerical estimation for the flora of Darjiling (Das 2005).

Area	TAXA									
	Algae	Fungi	Lichen	Bacteria & Virus	Bryo.	Pterido.	Gymnos.	Dicot.	Monocot.	TOTAL
Darjiling District	*No proper record*	*No proper record*	*No proper record*	*No proper record*	200	250	12	2200	700	**3662**
Darjiling Tea Gardens	*Not record -ed*	*Not record -ed*	*Not record -ed*	*Not record -ed*	*Not record -ed*	82	03	591	142	**818**

14.2.1 Lower non-vascular Taxa

Till date no any consolidated work has been done of these floristic groups like algae, fungi, lichens, bacteria & viruses and Bryophytes. These groups also were not considered for the present work. So, it is not possible to understand the effects on these groups. But the rampant uses of chemical fertilizers and pesticides certainly have some deleterious effects on these groups. And, it is realised that studies on these floristic groups should be taken up to understand the actual picture.

14.2.2 Pteridophytes

The estimate for the district is 250 species of Pteridophytes. The present work has recorded only 82 (i.e. 32.8%) species. So, the Tea Garden habitat is not at all suitable for the normal growth of Pteridophytic plants. In fact, most of these plants are found growing in garden margins, i.e. along the paths and roads and if there is any left over patches.

14.2.3 Gymnosperms

Only three species from three different genera covering two families have been recorded from the seven gardens under floristic survey. Again, none of these three plants are growing there naturally. One [*Tsuga dumosa*] is purely ornamental, *Pinus roxburghii* is also ornamental but its timber is quite useful and *Cryptomeria japonica* has been planted purely for its good quality timber. Of these, the third species is an exotic. However, 12 species of Gymnosperms are known to grow naturally in the district. All such plants are either tree-like or are trees and are unsuitable for growing naturally inside Tea Gardens.

14.2.4 Angiosperms: Dicotyledons

Bhujel (1996) has recorded 1900 species & varieties of dicotyledonous plants with much emphasis on the hill region. And, the estimate for the district is 2200 species & varieties. But, the present work has recorded only 591 species & varieties of dicotyledonous plants from the Tea Garden areas. This is a dangerous situation. Sample area is not less. The total area of seven Tea Gardens is quite large enough and covering very wide altitudinal range. Even then only nearly 27% plants have been recorded.

14.2.5 Angiosperms: Monocotyledons

The situation is worse for this group and only little over 20% of the estimated 700 species have been recorded.

14.2.6 The overall picture

This picture can not be encouraging from the floristic points of view as Tea Gardens are covering really very wide areas and forming effective barrier for migration of most of the species of macrophytes. Low height dense and nearly continuous canopy, regular cleaning of weeds and overgrowth in non-plantation areas within garden, felling of trees, use of different chemicals, mulching practices etc are creating the environment quite unsuitable for the growth of most of the species of plants. For the tea-planters this must be treated as a very happy situation as they need to tackle a lesser number of weedy plants in their plantations.

The most affected habit groups include trees, climbers, geophytes, epiphytes and parasites. Except shade trees and saplings of very few trees this habit group of plant is completely missing from actual plantation areas. Climbers cover the upper surface of tea-bushes and directly affect the growth of tea-plants. So, these plants are eradicated from plantation areas with much higher priority. Probably the low height of tea-bushes makes them unsuitable for hosting the epiphytic plants.

The exception is the record of 82 species of pteridophytes and a good proportion of them are actually from plantation areas. Sometimes a thick mat of *Selaginella* found to develop on the floor of the plantation. This low biomass plant effectively cover the soil surface and help in checking soil erosion. But these are very sensitive and are killed with the application of any one of the commonly used herbicides. - - Probably the rhizomes of ferns are not easily killed with herbicides when their foliage are damaged soon helped so many species in Tea Garden areas.

14.3 Endemic Plants

The endemic status of Darjiling flora is quite high, around 30% (Das 2004). Even in severely disturbed Tea Garden environment quite a good number of such plants are growing. These endemic plants are of different categories like Endemic to Darjiling Hills, Endemic to Darjiling & Sikkim, Endemic to Eastern Himalaya, Endemic to Darjiling & NE States of India, Endemic to Himalayas and Endemic to India.

Some of the common endemic plants recorded here include: *Persicaria microcephala, Begonia flaviflora, Elatostemma sikkimensis, Acer hookeri, Ajuga macrosperma, Asystasia macrocarpa, Beaumontia grandiflora, Neanotis gracilis, Pilea bracteosa, Piper chuvya, Rubia charaefolia, Rungia himalayensis, Sauropus quadrangularis, Stellaria sikkimensis, Strobillanthes thomsonii, Viola hookeri, Acer thomsonii, Actinodaphne sikkimensis, Aeschynanthes sikkimensis, Ampelocissus sikkimensis, Argyreia roxburghii, Begonia dioica, Cyclea bicristata, Eriobotrya petiolata, Hypericum hookerianum, Lithocarpus elegans, Morinda angustifolia, Pilea cordifolia, Piper sylvaticum, Psychitria erratica, Dioscorea deltoidea, Peliosanthes macrophylla*, etc.

The total number of endemic species recorded is over 50. However, some of those need further verification.

14.3 Plants actually growing inside Tea Gardens

A Tea Estate is generally a large area, divided into a number of sectors where plantatios are made. In between the plantations some amount of land remain open. Tea processing factories, ware houses, labour colony etc all are generally constructed inside the Estate. For the biodiversity concerned people, these open areas are very important because, a large number of plants those fail to grow inside the plantations they can grow in such places.

Except the planted shade trees, other species of trees can not be expected inside plantations. Most of the sciophytic herbaceous plants are growing there fighting with a large number of inhospitable habitat conditions. Some tree saplings are also found growing there escaping the dreadful eyes of garden managers but they remain mixed with tea-bushes maintaining the same height. Some common climbers like *Mikania micrantha, Lygodium flexuosum* etc are sometimes growing on bushes. In hill gardns *Drymaria diandra* sometimes form a loose network on bushes. But, all these are regularly cleaned. So, the flora presented in Chapter 6 is actually recorded all plants growing inside Tea Estates including the open areas. Plants cultivated in ornamental gardens are not recorded in the present work.

If the Tea Plantation flora is considered in strict sense, then it will be limited to small herbaceous plants only.

14.5 Important Weeds and their Uses

Species of plants treated as weeds in the cultivation of a particular crop are not essentially be treated as all useless plants. Chapter 12 of the present report dealt with the useful plants those are recorded here as Tea Garden flora. Table 12.1 has recorded 137 species of plants those are growing in Tea Garden areas as useful plants. This is a very conservative list and majority of these plants are not only of common and wider use but are also regularly marketed. These include plants of edible, medicinal, fodder, ornamental, decorative, timber, busketry, and religious etc. importance. These are not regularly exploited from Tea Garden areas by the outside world as the plantations are treated with a large number of poisonous chemicals. But, Tea Garden workers quite often use these plants.

In addition to the list of useful plants, the Table 12.2 has presented a list of poisonous plants. Again, most of the poisonous plats are also useful in different ways. For the hills, the most common example may be the case of *Urtica dioica.* This wild nettle bears dangerous stinging hairs and cause unbearable irritations and allergic reaction if come in touch with human skin. But, its young twigs are sold in the market as vegetable with very good nutritional value. The plant is also used as a fodder for increasing milk output in cattle. Similar is the situation for *Girardinia diversifolia.* Apart from these, many of these plants are medicinally useful ones like *Datura* spp. The case of *Jatropha curcas* needs special mention. Consuming a few seeds will lead to the collapse and then to the death. But, the cultivation of this species is now promoted by the both state and central Governments as source of biodisel. The species is also known to have medicinal uses and as a hedge plant in fencing the crop fields.

So, both the tables, 12.1 & 12.2 recorded the plants which are all important plants and are all growing within the Tea Garden areas in Terai and hills of Darjiling. This is a direct evaluation of the Tea Garden weeds and proved that quite a large number of useful plants are growing in Tea Garden areas and can be exploited for human welfare and are not merely useless plants.

14.6 Dependence of Tea Garden Workers on Local Vegetation

Most of the Tea Garden workers are basically very poor people and are exploited by their employers with very low wages, poor rationing, bad accommodation and only minimum or no medical facilities. Again, a high proportion of them are tribal people but are the inheritors of rich traditional knowledge. Their poverty and miseries have forced them to survive with the aids of natural resources, judging or evaluating with their traditional knowledge. They are collecting numerous species of plants not only from the Tea Garden areas also from outside vegetation to meet up their daily requirements.

Chapter 13 dealing with the ethnobotany of Tea Garden workers has, in fact, recorded as much as 420 species of plants. This includes (i) 141 edible plants, (ii) 57 fodder, (iii) 15 fibre yielding plants, (iv) 49 decorative & ornamental plants, (v) 41 religious plants, (vi) 336 medicinal plants, (vii) nine dye yielding plants and (viii) 79 species with miscellaneous uses.

Many of these 427 species of plants has multipurpose use. *Prunus cerasoides* is used as edible (fruits), ornamental (whole plant), religious (branches), medicinal (fruit, stem, bark) and also of miscellaneous uses. Another small tree, *Oroxylum indicum* is used as edible, ornamental & decorative, religious, medicinal and also have other miscellaneous uses. Like these, many other recorded species have multipurpose uses.

14.7 Weed Control in Tea Gardens

The aim of a Tea Garden manager is to produce better tea in larger amount. They do not understand the importance of conserving biodiversity or the diversity index on an area. They know only one species that is *Camellia sinensis*. So, the garden managers try to kill all other plants growing inside the plantations and for that purpose the generally take the help of a class of chemicals generally referred as 'herbicides' or 'weedicides'.

The present work also tested the efficacies of three of these chemicals, namely 2, 4 – D, Glyphosate and Paraquat [Chapter 10] and found that all these can kill a large number of species efficiently. But, even after the regular uses of these chemicals in most of the gardens weeds are the major management concern.

This is possible due to two basic factors: (1) successful weeds are early flowering, that means, they are producing mature seeds within the intervals of two successive applications of herbicides, which they generally use in four months interval; (2) arrival of new seeds and propagules from the wild vegetation outside the plantation areas.

But, to develop one most efficient method for weed eradication/ control, specially when use of hazardous chemicals are not liking by the society for this purpose, one need to know the phenology [Chapter 7] and reproductive potential [Chapter 9] of these plants.

14.8 Natural Perpetuation of Weedy Plants

Weedy plants need to maintain their population themselves. For this they adjusted their phenophases in such way so that they get proper opportunity to release mature seeds in the habitat before they are killed or die naturally. However, in most of the cases [Chapter 8] these plants follow the local climatic cycle. They try to avoid winter months for thei germination and vegetative growth. So, there will be less weeds in the plantation during winter but that is of no use. In most of the gardens bushes are kept in dormant condition by pruning their leafy branches.

Tea bushes start sprouting during late March to April, when a large number of weedy plants also start appearing. Gardens are regularly irrigated during dry months in spring and summer. Weeds also use this moisture for their appearance and growth.

14.9 Important Weeds of Tea in Terai and Hills of Darjiling

Through the phytosociological investigations as presented in Chapter 7, ten most important species of weeds (Table 7.66) has been determined, those are *Borreria alata, Drymaria diandra, Ageratum conyzoides, Oxalis corniculata, Borreria ocymoides, Ageratum houstonianum, Oplismenus compositus, Oplismenus burmanii, Digitaria ciliaris* and *Desmodium triflorum*. Of these, except *Desmodium triflorum* all others are distributed over a wide variation in climatic conditions.

It is important to understand the reproductive potential and reproductive strategies of these weeds and that has been attempted in Chapter 9. However, all ten weeds mentioned above are high reproducers with the production of very large number of seeds and their efficient dispersal. These plants distribute their seeds taking help from (i) air currents: *Ageratum conyzoides, Ageratum houstonianum, Oplismenus compositus, Oplismenus burmanii;* (ii) insects like ants: *Borreria alata, Borreria ocymoides, Oplismenus compositus, Oplismenus burmanii;* (iii) water: *Drymaria diandra, Oxalis corniculata, Borreria ocymoides, Borreria alata, Digitaria ciliari, Desmodium triflorum;* etc. In fact, the strategies for seed dispersal are very important. These plants produce very small seeds, light in weight and take the help of different agencies for their dispersal. One efficient weed should take the help of more than one agency for this purpose.

So, the efficient weed may be characterised from the reproduction point of view in the following ways: (i) short life cycle, (ii) easy pollination, (iii) high seed production, (iv) high rate of germination, (v) high rate of seedling survivability, (vi) efficient dispersal of seeds, (vii) wide range of climatic tolerance, etc.

14.10 Similarities and Differences in Flora

Selected seven Tea Gardens for the present dissertation are located in two distinct zones. The first four gardens [*Hansqua Tea Estate, Kamalpur Tea Estate, Matigara Tea Estate* and *Mohurgong & Gulma Tea Estate*] are located in the rolling plains of Terai with very minor undulations. And, the second group is on the hills and the minimum elevation being the 1300 m. Three gardens are there in this category namely *Makaibari Tea Estate, Soom Tea Estate* and *Tamsong Tea Estate*. The first group of garden experience a tropical summer but a chilling winter and the second group located in sub-temperate and temperate regions which remain cool throughout the year and the winter is severe specially in Soom and Tamsong.

This clear difference in climatic regime is expected to support two different sets of plants. An analysis of the floras in these gardens shows that while there are some core tropical plants those are growing only in Terai gardens and some core temperate plants those are growing only in hill gardens, also there are a considerable number of species those are with quite broad ecological amplitude and are growing both in Terai and hill gardens. The number of this third group of plants is not less than 25.6% (as determined through the phytosociological analysis). This is due to (i) the contiguity of vegetation of Terai and hills of outer Himalayas specially when these hills receive very strong tropical sun round the year and the hills of Kurseong region (i.e. for Makaibari TE) is facing the hot plains of the country; and (ii) the vertical distribution of hill gardens is also considerable leading to their presence in comparatively warmer environment in lower reaches and cooler environment in upper reaches.

Due to the contiguity of vegetation in Terai and Duars located at the lap of the Himalayas at this region with the vegetation on hills, it is expected that upward and downward vertical movement of different floristic elements will be there leading to the gradual broadening of the environmental tolerances of such species specially in regard to the ambient temperature that is the most important controlling factor of the environment. The entire region receive quite high and well distributed precipitation and maintain high percentage of atmospheric humidity round the year so, water relation can not be the controlling factor.

14.11 Tea Gardens and Biodiversity Conservation

Tea Gardens are responsible for the loss of region's biodiversity. Those have eradicated thousands of species of plants and animals from their home or only home. Das (1995) provided a short list of angiospermic climbers those have been extinct probably due to change in their habitat structure. The process is continuing today with a much higher rate. So, the protected areas in this region will somehow survive for some time with no corridor for the migration of their biological elements. This dangerous and will cause the destruction or death of our entire bulk of the biological wealth.

So, now it is important to involve all these Tea Gardens into the region's conservation activities. With proper modification of prevailing legislation, they may be forced to maintain conservation corridors through their gardens and may establish some *ex situ* conservatories through their collective efforts.

CHAPTER 15

Conclusions

The floristic and the phytosociological studies under the present dissertation has exposed the poor status of plant-biodiversity in the Tea Estates located in Terai and hills Darjiling. Very large scale modification of wild natural habitat has made numerous species homeless and became extinct, specially when we know that a considerable proportion of local species have very narrow range of habitat tolerance. Quite a good number of species are known to grow over extremely small areas like one hill-slope or one small valley. So, any type of disturbance or modification in those places will lead to the extinction of species. This has really happened in the area. And, North Bengal's most efficient economic back-bone, the Tea Industry has killed really a large number of local or endemic species and made even a larger number of species threatened and endangered for survival.

The area under study, the Terai and hills of Darjiling, is situated within the IUCN recognised Himalayan Hotspot for conservation. The endemic species content (both plants and animals) is quite high. So, for the sake of the proper survival of the biosphere all our developmental activities should consider the conservation-factor at the beginning. Any failure at that level will lead to the disaster.

The activities necessary to maintain or to manage the Tea Gardens include the killing of weedy-plants growing within the plantation. Here also we need to consider that while only a very small fraction of region's flora succeed to survive in that highly inhospitable habitat, killing those plants mean being merciless to all other creature except the man. A conversion to the biological management of Tea Gardens may improve the situation as most of the chemicals now under use are highly poisonous to the wild species.

May be a few species are surviving there braving all these attacks and inhospitable environment but, may be, a good number of other sciophytic and saprophytic plants could have been survive there if these chemicals are taken away from the practice of garden management.

It is also important to use these garden managements to involve in the practices for region's biodiversity conservation. For this purpose just the modification and strict implementation of legislation are not enough. The first step should be the 'awareness generation' about the biodiversity, its importance and need for conservation. Then only the imposition of some environment friendly conditions on them will find the effective result. The present situation in Darjiling is quite alarming. No tract of vegetation is undisturbed. Reduction of natural vegetation covers almost in all the corners at a continuously increasing rate will certainly destroy our entire natural biological wealth store. And, that will be the loss for not only to the local people but will also be the loss for the entire human society.

So, if we can conserve the biodiversity today, that will provide us materials for survival in future. The decrease of some amount of tea production or the non-availability of settlement areas for human in this region will not affect the people so seriously.

CHAPTER 16

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List of Publications made by the Author

I. BOOKS:

Medicinal Plants: Suitable for cultivation in Northern Bengal

By: A.P. Das, M.U. Alam, **Chandra Ghosh**, Sujoy Sen (**2006**). University of North Bengal

II. FULL PAPERS:

Ghosh, Chandra; Sharma, Bidya D. & Das, A.P. 2004. Weed flora of tea gardens of Darjiling Terai. ***Bull. Bot. Surv. India,*** 46: 151 – 161.

Pandit, P. K.; **Ghosh, Chandra** & Das, A. P. 2004. Non-timber Forest Produces of Jaldapara Wild Life Sanctuary: an Assessment. **Indian Forester, 130**: 1169 – 1185. |*S.K. Seth Prize winner*|

Ghosh, Chandra & Das, A.P. 2004. The materials and method of Jhara preparation by the tribal inhabitants of Tea Gardens in Terai of West Bengal (India). ***Indian Journal of Traditional Knowledge,*** 3(4): 373 – 382.

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Ghosh, Chandrâ; Biswas, Rajib & Das, A.P. (2006). Pteridophytic plants growing in the Tea Gardens of Terai, Duars and Hills of Darjiling. [Communicated]

III. ABSTRACT OF PAPERS:

Ghosh, C.; Sharma, B.D. & Das, A. P. 2001. **Weed flora of tea gardens in Terai of Darjeeling district of West Bengal**. *Abstr. Nat. Sem. Pl. Syst. 21st Cent. Appro. Prosp.*, BSI, Dehradun. P 31.

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Chandra Ghosh & A. P. Das 2005. **Weed flora of Tamsong Tea Estate in Darjiling Hills** ***Abstr. National Seminar on Emerging Trends in Plant Taxonomy.*** R.T.M. Nagpur University, Nagpur-440 033.

A. P. Das, **Chandra Ghosh** & Subhra Paul 2005. **Muralophytes of Siliguri township located at the feet of Darjeeling Himalaya.** ***Abstr. National Seminar on Emerging Trends in Plant Taxonomy.*** R.T.M. Nagpur University, Nagpur-440 033.

C. Ghosh & A. P. Das 2005. **The Flora of Jaldapara Wildlife Sanctuary with special Reference to Rhino Fodder.** ***Abstr. National Conference on Current Researches in Plants and Microbial Sciences.*** Burdwan University, Burdwan, WB.

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IV. POPULAR ARTICLES: 2

Das, A. P. & **Ghosh, Chandra** 2005. Pollution control and conservation through avenue plantations. ***Udyan*** 21(1): 6 – 9.

Das, A. P. & **Ghosh, Chandra** 2006. Prospects of Medicinal Plants cultivation in Terai Duars and Darjeeling Hills. ***Udyan*** 22(1): 18 – 21.

Prizes & Awards:

1. S.K. Seth Prize, 2004 [Indian Forester, ICFRE]

2. Felicitation by Siliguri Horticultural Society for identification of Road-side Trees in Siliguri Municipal area

Research Experience:

i. **Project Assistant:** *EIA/EMP for Teesta Low Dam Hydroelectric Project, Stage-III* [includes intensive floristic survey & mapping in the Teesta Valley]. Sponsor: **NHPC**

ii. **Project Assistant**: *EIA/EMP for Teesta Low Dam Hydroelectric Project, Stage-IV* [includes intensive floristic survey and mapping in the Teesta Valley]. Sponsor: **NHPC**

iii. **Project Assistant**: *Estimation of Palatable Biomass of Jaldapara Wild Life Sanctuary* for the period of August to December 2002. **Sponsor UNDP**.

iv. **Project Assistant**: *Biological survey of proposed corridors between the natural conservatories in Darjiling Hills.* Sponsor: **ICIMOD**

v. *Naming of Trees in NBU Campus*

vi. **Identification Assistant**: *Identification of plants in the forest preservation plots, Silviculture Division, Darjiling.* Sponsor: **FSI**

vii. **Research Fellow**: *Survey, conservation, development of propagation techniques and popularisation of cultivation of medicinal plants in Terai, Duars, Hills of North Bengal and Sikkim.* Sponsor: **NMPB**

viii. *Monitoring of Plantations in Jalpaiguri Forest Division and Baikunthapur Forest Division.* Sponsor: **NAEB**