

MAJOR FLOWERING TREES OF TROPICAL GARDENS

M. S. SWAMINATHAN • S. L. KOCHHAR



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Major Flowering Trees of Tropical Gardens

Home to over a thousand species and sub-species of plants and trees, the Indian subcontinent, after Brazil, is the second most botanically diverse region in the world. Almost every major type of habitat can be found here, ranging from the heaviest rainfall to the driest desert, from the coldest to the hottest climatic conditions, from the highest elevations down to the sea-level. Hence any comprehensive and well-illustrated text on the plant life of the region will find acceptability throughout the tropical countries and will also be of great interest to the worldwide readership.

Written by eminent scientists, this book discusses more than 200 of the most striking and widespread trees (both native and exotic) commonly encountered in the tropical climate and is beautifully illustrated with pictures depicting different facets such as growth habits and morphological details of stem, leaves, flowers and fruits. The text is an irresistible and vivid compendium providing details such as common and botanical names together with their synonyms, and information on many related aspects such as the names of taxonomic families, etymology (how the trees have derived their names), their native place and geographical distribution. It also provides fascinating glimpses into the folklore and mythology surrounding particular trees, their religious significance, detailed botanical descriptions, phenology (the time of leaf fall, flowering, and fruiting), preferred soil types, propagation characteristics, and valuable information on their economic uses, including medicinal usage. Even without consulting a specialist in the field, by just taking a look at the field specimens of twigs, leaves, flowers and fruits, an amateur nature lover will be able to identify with ease a tree species by comparing it with the colour images appearing in this book.

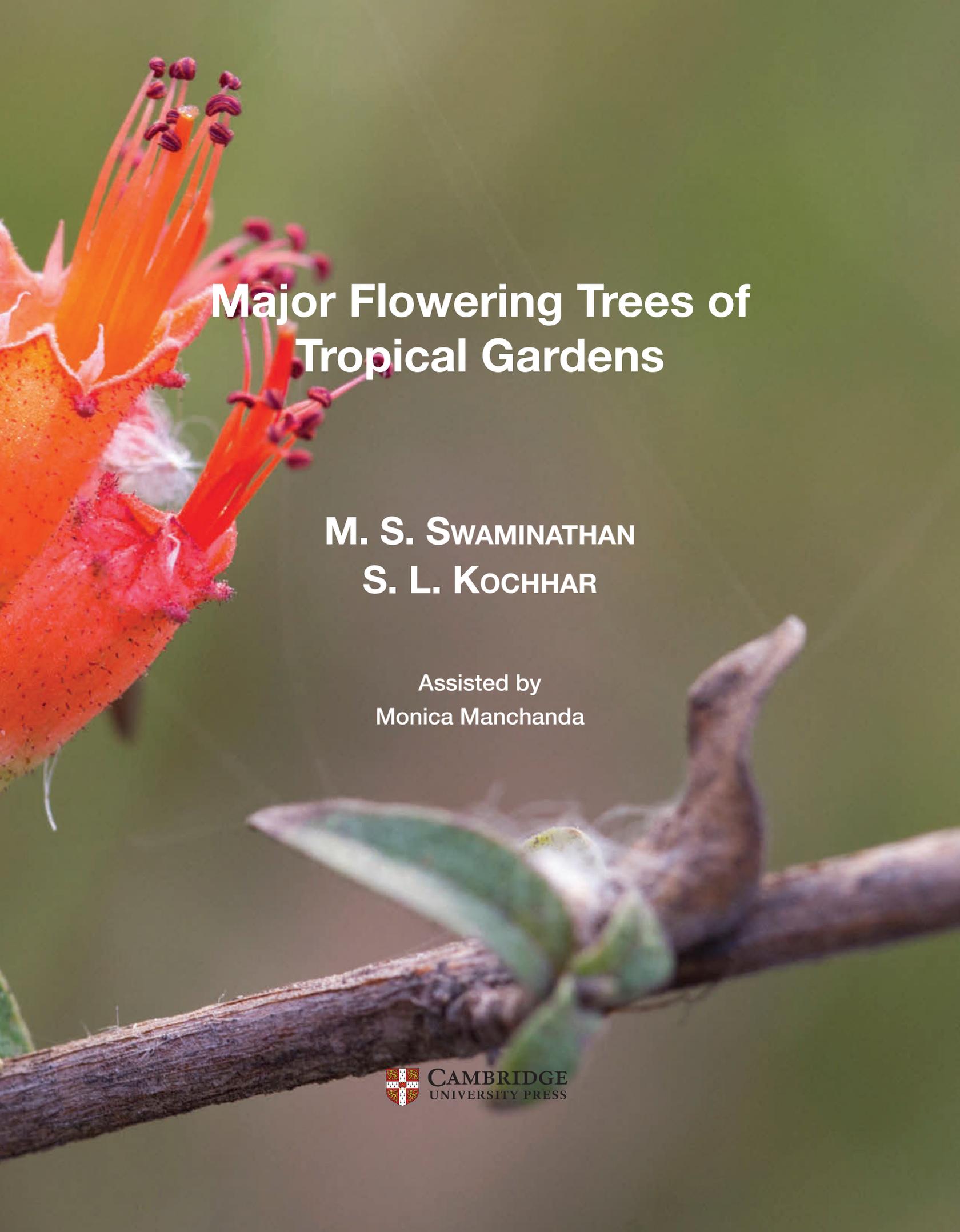
For students and scholars of botany, plant sciences, forestry, environmental studies, horticulture and alternative systems of herbal medicine, this revised edition not only includes information on many aspects of trees, it also provides a brief account of closely related species. A separate comprehensive index of botanical names is given at the end together with selected reading material for further reference.

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*To our associates in the fields of
botany, agriculture, forestry, alternative system of herbal medicines and
nature's enthusiasts
who have supported us in our endeavour*

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Preface to Third Edition

Groves of Beauty and Plenty: An Atlas of Major Flowering Trees in India was first published in 2004. There was overwhelming response to it, and within a year-and-half the stocks were exhausted. Keeping in view the reviewer's feedback and audience response, we preferred to go in for the Second Edition in 2007 rather than opt for a reprint. However, the book remained out of print due to some unforeseen reasons.

The Indian subcontinent region is indeed very rich in biological diversity and is the second richest in the world after Brazil in the number of plant species. It is estimated that about 45,000 plant species exist in our country. Its position at the confluence of three biogeographic realms is the main reason for the remarkable diversity of life forms that include also the elements of African, European, Chinese and Indo-Malayan flora. The richness of the Indian flora is due to its vastness (embracing so many degrees of latitude), its range of climate and topography. Almost every major type of habitat is to be found here, i.e., from areas of the highest rainfall to the driest desert, from the coldest to the hottest climatic conditions, from the highest elevations down to the sea-level. Thus we have here, in India, a great diversity of ecosystems ranging from the hot deserts of Rajasthan to the cold deserts of Ladakh, the dry scrubs of Punjab to the tropical rainforests of Assam, the Western Ghats, and Andaman and Nicobar Islands, the coniferous and broad-leaved forests of the Himalayas, and the vegetational types found in water courses, fresh water and brackish-water bodies and marine coastal areas, including in the several groups of islands in Lakshadweep.

With the mounting photographic collection of our Tropical Trees database, we thus decided to enlarge the scope of our earlier book on Major Flowering Trees. In this new Cambridge edition, we have included more than 200 ornamental tree species alongside many closely related species and genera that are largely grown in the tropical belt of the Americas, Africa, West Asia, the Indian Subcontinent, extending from Southeast Asia to

the Malayan Archipelago, going beyond across to the Pacific Ocean Islands, including parts of New Zealand and Australia. The book is illustrated with 708 high resolution coloured images, depicting the growth habit, the leaf architecture, floral organisation and fruits etc. This unique pictorial presentation will be of great help to the users in identifying tree species, during field studies, without any assistance from experts.

Like the earlier editions, the different tree species are organised according to Bentham and Hooker's system of plant classification, although other systems are in vogue. The text includes, besides the common names and botanical names together with their synonyms, information on many aspects such as the names of taxonomic families, etymology (how the trees have derived their names), their native place and geographical distribution, mythological notes, religious significance, references in folklore, a detailed botanical description, phenology (the time of leaf fall, flowering, and fruiting), preferred soil types, propagation and economic importance. A brief account of closely related species and genera is provided to make this compendium user-friendly. A separate comprehensive index of botanical names is given at the end together with indices for leaf architectural types, glossaries of botanical and medical terms, for the benefits of non-professionals. A listing of selected reading material is also provided at the end for further reference.

It is hoped that this compendium volume would be useful to the students and scholars of botany, horticulture, forestry, environmental studies, alternative system of herbal medicines and indeed to anyone who has interest in nature and natural resources, be they amateurs, gardeners, nurserymen, administrators or scientists. The tourists travelling in the tropics will encounter a world of strange and beautiful trees in their hotel complexes, streets, parks and gardens and for them too this book should be of great interest.

M. S. SWAMINATHAN
S. L. KOCHHAR

Preface to Second Edition

Groves of Beauty and Plenty: A Major Flowering Trees in India, first published in 2003, generated considerable interest and awareness about the vast diversity of flowering trees that could be made use of for improving the landscape architecture of our educational institutions, both schools and colleges, cities and towns, parks and gardens, public and private homes, tourist spots and hotel complexes, besides the airports, both domestic and international, where hundreds of thousands of tourists arrive everyday.

Within a period of an year and a half of its publication this Atlas went out of print. We felt the need to enlarge the scope of this book by bringing out its revised edition. We have included here sixteen other beautiful trees and shrubs along with their many closely allied species that could be grown to further ameliorate our surroundings.

The bibliography and nomenclatural details have been updated. Replacement photographs have been used to increase the usefulness of the Atlas and also to enhance the picture quality.

Macmillan India Ltd. has done a great service by publishing this non-subsidised edition for the benefit of students working for degrees in botany, horticulture, forestry and landscape architecture; garden enthusiasts and other people who have interest in nature and natural resources.

We are thankful to the Principal of Maharaja Agrasen Model School, Pitampura, Delhi for giving a free access to their excellent garden for our photographic work. Thanks are also due to Dr Gurucharan Singh for his help in updating the nomenclatural details.

It is hoped that this revised Atlas would be even more useful than the first edition. We shall appreciate very much receiving substitute coloured photographs or transparencies for the plants included in this edition, and also for some other garden trees and shrubs for subsequent editions.

M. S. SWAMINATHAN
S. L. KOCHHAR

Preface to First Edition

From very early times human beings have co-existed with nature, and forests have played a crucial role in their survival, providing the basics of life including food to eat (such as roots, succulent herbage, seeds, fruits, nuts and mushrooms at the forest floor), shelter (from wind, rain, snow and burning sunshine), wood (fuel for warmth, tools and weapons), some clothing and a host of other auxiliaries of life. In addition, they have helped to maintain a balance between carbon emissions and absorption because of their role in carbon sequestration. Even today, humanity's well being and ultimate survival are inextricably linked up with the natural resources, especially the trees for varying reasons, such as economic, ecological, and aesthetic, i.e. by providing a setting for recreation, sports, and beautifying the landscape, be these city roads, parks, gardens, public places and even the compounds of our homes. We have, at present, in use over 4,500 products that are derived wholly or in part from trees.

More than a thousand different kinds of trees occur naturally in India and many linguistic scholars and nature lovers have been struck by the beauty, richness and almost mystic allure of the tree life. We find charming description of most of our beautiful native trees in Kalidasa's *Ritu Samhara*, Valmiki's *Ramayana*, and sage Vyasa's *Mahabharata*. They have also been featured in our religions and ancient paintings and sculptures. In India, as perhaps in many other countries of the world, trees have been venerated since ancient times. Most Hindu temples have specific trees designated as 'temple trees'. Some other trees have been introduced at times from near and far-off lands and have become an integral part or component of our landscape, e.g. the famous Flamboyant or Flame tree (*Delonix regia*) and Traveller's Palm (*Ravenala madagascariensis*), both from Madagascar (earlier known as Malagasy); the Frangpani (*Plumeria* spp.), the rain tree (*Samanea saman*), Cannonball tree (*Couroupita guianensis*), and the Jacarandas with delicate fern-like foliage and mauve flower (*Jacaranda mimosaeifolia*), all from the New World tropics; the orange flowered African Tulip or Squirt tree (*Spathodea campanulata*) and Sausage tree (*Kigelia pinnata*)-both from tropical Africa; the Bird of Paradise (*Strelitzia* spp) from South Africa; the dazzling Golden Shower tree (*Cassia fistula*) from southeast Asia; and the Bottle Brush (*Callistemon* spp.) from Australia.

The number of trees is too large to make it possible for all species to be included here. This Atlas covers close to 125 most striking and widespread trees (both native and

exotic) from this bewildering profusion. The Atlas is an irresistible and vivid compendium portraying botanical details through more than 400 coloured photographs. The text includes, besides the common and botanical names together with their synonyms, information on many aspects such as the names of taxonomic families, chromosome number, etymology (how the trees have derived their names), their native place and geographical distribution, mythological notes, religious significance, reference in our folklore, a detailed botanical description, phenology (the time of leaf fall, flowering, and fruiting), preferred soil types, propagation and their economic importance. A brief account of closely related species is also given to make the Atlas user-friendly. Local vernacular names in different Indian languages have been provided wherever available. A comprehensive index, both for common English and botanical names, is given at the end together with selected reading material for further reference.

It is hoped that this Atlas would be useful to the students and scholars of botany, horticulture, forestry, environmental studies, and indeed to any one who has interest in nature and natural resources, be they amateurs, gardeners, nurserymen, administrators, or scientist. Tourists travelling in the tropics will encounter a world of strange and beautiful trees not only in the hotel complexes, streets, parks and gardens but also in the wild. By using the coloured photographs (showing details of foliage, flowers and fruits) and the text, it would be possible for them to identify with ease the individual species that grow in our neighbourhood.

We wish to end with two quotations to remind ourselves that we are in this planet as guests of green plants. Lord Buddha once said that tree is the only living organism capable of unilateral love, since it provides shade even to the axeman who comes to cut it. It will be appropriate to end with the following poem by Joyce Kilmore.

*I think that I shall never see
A poem as lovely as a tree
A tree whose hungry mouth is prest
Against the earth's sweet flowing breast
A tree that looks at God all day
And lifts her leafy arms to pray
Poems are made by fools like me
But only God can make a tree*

M. S. SWAMINATHAN
S. L. KOCHHAR

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Introduction

The tropical region lies between the Tropic of Cancer and the Tropic of Capricorn, 23° north and 23° south of the equator respectively. In this area, the sun's rays fall directly and because of the direct sunrays throughout the year, the temperature of this region remains high. Along with this, it also receives the highest amount of rainfall. The closer one gets to the Tropics of Cancer and Capricorn, the more noticeable are the dry periods. As one moves farther north or south of these lines, the more slanted the sun's rays fall resulting in lower temperatures. Within the tropical belt, on land, from east to west, there are various kinds of tropical ecosystems: from tropical rain forests to tropical open woodlands, deciduous forests, spiny or desert forests, savannah, semi-deserts and other habitats. There are often significant areas of biodiversity and species endemism can also be seen.

The Indian subcontinent along with Myanmar is the second richest region in the world after Brazil, in terms of the number of endemic plant species. It is effectively isolated from the rest of Asia by a desert along the western flank of Pakistan, and a continuous wall of mountains, dominated by the Himalayas, to the north and the east. The great basins of the Indus and Ganges separate this mountain fringe from the rolling plateau of the Indian peninsula, which is bordered by a line of coastal hills, the Eastern and Western Ghats. Sri Lanka is separated from India by a narrow channel of sea formed by the Palk Strait and the Gulf of Mannar. The subcontinent's position at the confluence of three biographic realms is the main reason for this remarkable diversity of life forms that include elements of African, European, Chinese and Indo-Malayan flora.

The Indian region (8°–38° N and 68–97.5° E) with a total area of about 329 million hectares, representing only 2.2 per cent of the world's land surface, is indeed very rich in biological diversity. It is estimated that about 45,000 plant species occur in our country. The vascular flora, which forms the conspicuous vegetation cover, is itself composed of 15,000 flowering species, of which more than 60 per cent are endemic and are largely concentrated in two principal biographical regions of India, namely the Himalayas (about 4,200 species) and peninsular India (about 2,600 species). Of the 15,000 known species of flowering plants, around 2,500 are trees.

The richness of the Indian flora is due to its vastness (embracing many degrees of latitude), its range of climate and topography. Almost every major type of habitat is found here, i.e. from areas of the heaviest rainfall to the driest desert, from the coldest to the hottest climatic

conditions, from the highest elevations down to the sea-level. Thus we have here in India a great diversity of ecosystems, from those of the hot deserts of Rajasthan to the cold deserts of Ladakh at 3,650–5,180 m, the dry scrubs of Punjab to the tropical rain forest of Assam, the Western Ghats, and Andaman and Nicobar Islands, the coniferous and broad-leaved forests of the Himalayas and the vegetational types found in water courses, fresh water and brackish-water bodies and marine coastal areas, including several groups of islands in Lakshadweep.

On the basis of their vegetational distribution pattern, the Indian forests are classified into the following major types:

- | | |
|------------------------------|--|
| Tropical: | <ol style="list-style-type: none">1. Wet Evergreen Forest,2. Semi-Evergreen Forest,3. Moist Deciduous Forest,4. Littoral and Swamp Forest,5. Dry Deciduous Forest,6. Thorn Forest,7. Dry Evergreen Forest. |
| Montane Sub-Tropical: | <ol style="list-style-type: none">1. Broad-Leaved Hill Forest,2. Pine Forest,3. Dry Evergreen Forest. |
| Montane Temperate: | <ol style="list-style-type: none">1. Montane Wet Temperate Forest,2. Himalayan Temperate Forest,3. Himalayan Dry Temperate Forest. |
| Sub-Alpine: | Sub-Alpine Forest. |
| Alpine: | <ol style="list-style-type: none">1. Moist Alpine Scrub,2. Dry Alpine Scrub. |

The Tropical moist and dry Deciduous forests occupy over 70 per cent of the country's forest areas, followed by the Tropical Thorn forest (about 6.9 per cent), Tropical Wet Evergreen (6 per cent) and Subtropical Pine forests (approximately 5 per cent). There are also extensive gregarious areas comprising planted Sal (*Shorea robusta* Gaertn. f.) and teak (*Tectona grandis* L.f.) forests (13 per cent), and a few other local species.

For the purpose of this compendium we have followed the classification based on different ecological zones that we come across as we travel through such regions. This compendium gives an in-depth account of over 200 off the best known trees. Many more are listed under the heading 'closely allied genera or species'.



Picture 1: A grove of *Cedrus deodara*. It is a large handsome tree with wide spreading horizontal branches, giving the cedar its characteristic skyscraper appearance. (Courtesy: Mr S. K. Singh)



Picture 2: Male cones of Indian Cedar standing perpendicular on the upper side of branches. (Courtesy: Dr Anil Kumar Thakur)



Picture 3: Female cones of *Cedrus deodara*. (Courtesy: Mr S. K. Singh)



Picture 4: A close-up of Blue Pine tree—*Pinus wallichiana*. When young, pine species are conical but they often become irregular in outline and extremely picturesque at maturity. (Courtesy: Dr Surendera Singh)

Western Himalayas

This region comprises the states of Jammu and Kashmir, Himachal Pradesh and the hills of Uttaranchal, stretching eastwards to Nepal and westwards to the Murree Hills in Pakistan and beyond. It is one of the most diverse regions of the world, with climate and vegetation varying from tropical to temperate and even arctic and arid types.

The following are sub-divisions of this zone.

- (a) *Submontane up to 1,500 m* (mainly the Shiwaliks and the adjoining areas.)

The forest is dominated by Sal (*Shorea robusta* Gaertn. f.), Flame of the Forest [*Butea monosperma* (Lamk.) Taubert], Red Silk Cotton Tree (*Bombax ceiba* L.), Jamun

[*Syzygium cumini* (L.) Skeels.], Safed Siris [*Albizia procera* (L.) Benth.], Toon (*Toona ciliata* M.J. Roem.), Amla (*Emblica officinalis* Gaertn.), Haldu [*Haldina cordifolia* (Roxb.) Ridsdale], Sandan [*Ougeinia oojeinensis* (Roxb.) Hochr.—the bark is used to intoxicate fish], Indian Laburnum (*Cassia fistula* L.), Semla (*Bauhinia retusa* Buch.-Ham. in riverine successions), Khair-Shisham formation [*Acacia catechu* (L.f.) Willd. and *Dalbergia sissoo* Roxb.]. For elevations over 1,000 m, the Chir pine (*Pinus roxburghii* Sarg.) begins to appear. Amongst the 'subtropical evergreen' vegetation in this range of 1,500 m are wild pomegranate (*Punica granatum* L.) and Olive (*Olea ferruginea* Royle).

- (b) *Temperate Zone 1,500 to 3,400–3,700*

On lower reaches are plants like Chir pine (*Pinus roxburghii* Sar.), Grey oak (*Quercus leucotrichophora* A. Camus, Syn. *Q. incana* Roxb.), Alder (*Alnus nepalensis* D. Don) while higher up are Blue pine (*Pinus wallichiana* A.B. Jackson), Deodar (*Cedrus deodara* Roxb. ex Lamb.) G. Don), West Himalayan Spruce (*Picea smithiana* Boiss.), Rhododendron (*Rhododendron arboreum* Sm.—absent in Kashmir), Horse Chestnut (*Aesculus indica* Colebr. ex Camb.), Himalayan poplar (*Populus ciliata* Wall.), Himalayan elm (*Ulmus wallichiana* Planch.), Himalayan cypress (*Cupressus torulosa* D. Don) and maple (*Acer caesium* Wall. ex Brandis).

Western Himalayan Fir (*Abies pindrow* Royle) forms a thick forest between 2,300–3,300 m while Yew (*Taxus baccata* L.) is scattered here and there. The edible Chilgoza pine (*Pinus gerardiana* Wall. ex Lamb.) occurs



Picture 5: A growth habit of *Picea smithiana*. (Courtesy: Mr Ashutosh Sharma)



Picture 6: Female cones of West Himalayan Spruce, *Picea smithiana*. They are long, cylindrical, pendent from the ends of the branches. (Courtesy: Dr Nidhan Singh)

in the inner dry valleys of Himachal Pradesh, Chitral and North Baluchistan—areas with high winter snowfall and scanty precipitation. Himalayan Pencil Juniper or Dhup (*Juniperus polycarpus* C. Koch) is found in the inner semi-arid valleys in Lahul, Kagan and in Baluchistan. At upper elevations are present Brown Oak (*Quercus semecarpifolia* Smith—absent in Kashmir) and Fir [*Abies spectabilis* (D. Don) G. Don]. The Silver Birch or Bhojpatra tree (*Betula utilis* D. Don) forms the upper limit of the timberline, along the Himalayas.

The Western Himalayas are dominated by the vast and gregarious coniferous forests of Chir Pine, Blue Pine, Deodar, Spruce and Fir.

Eastern Himalayas

This zone comprises the Darjeeling Hills (northern part of West Bengal), Sikkim, Bhutan up to Arunachal Pradesh. This area is far more evenly humid than the Western Himalayas because of its proximity to the Bay of Bengal. The monsoon is so intense here that the Shiwaliks have almost entirely been eroded over a period of time. High humidity is ideal for tree growth which is why the timberline in this zone extends to about 4,000 m as compared to 3,100–3,650 m in the Western Himalayas.

The following are some of the sub-divisions of this unit:



Picture 7: A close-up of fruits of Indian Yew, *Taxus baccata* L. Taxol, derived from the bark is used in the treatment of breast and ovarian cancer. The leaves are evergreen, linear, flat long needles with a pointed tip spreading in two ranks one on either sides of the shoot. The cones are berry-like structures consisting of a single seed enclosed in a fleshy aril ripening from green to red. The aril is open at the top. (Courtesy: Bhupinder Singh Rana)

Tropical Zone (up to 1,500 m)

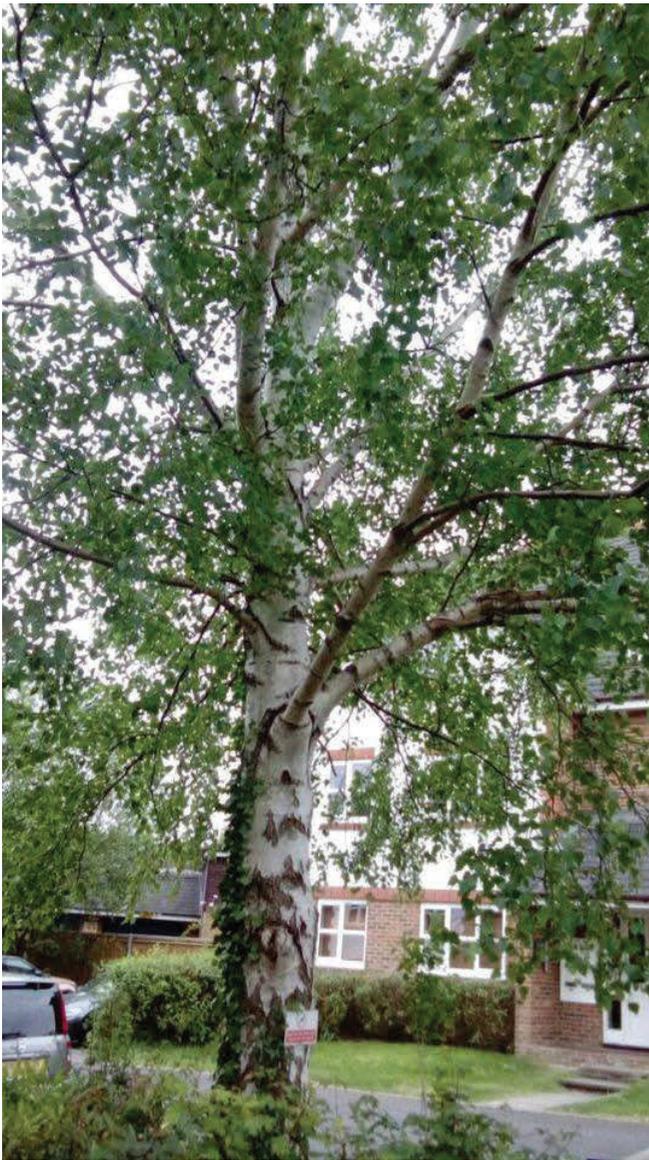
The vegetation is characterised by nutmegs (*Myristica* spp.), screw pines (*Pandanus* spp.), giant buttressed trees of jungli dungi (*Tetrameles nudiflora* R.Br.—a favourite nesting tree of hornbills), Hollock Tree (*Terminalia myriocarpa* Heurck and Muell.-Arg.—with masses of tiny cream coloured flowers turning into copper red, small winged fruits), the Tiger Tree (*Bischofia javanica* Blume—its bark is favoured by tigers for cleaning their claws), lampati (*Duabunga grandiflora* Roxb. ex DC.—with white flowers opening at night, smelling like sour milk), Kadam [*Neolamarckia cadamba* (Roxb.) Bosser], Elephant Apple (*Dillenia indica* Sm.), Gamari (*Gmelina arborea* L.), Red Cedar, Shingle Tree (*Acrocarpus fraxinifolius* Wight and Arn.—with green sepals, petals and crimson stamens), Golden and White Champa (*Michelia champaca* L. and *M. doltsopa* Buch.-Ham. ex DC. respectively), Heart Flower (*Talauma hodgsonii* Hook. f. and Thoms.—a member of Magnoliaceae), Kala damar (*Canarium strictum* Roxb.), Iron-wood, Nagkesar, Nag Champa or Nageshwar Champa (*Mesua ferrea* L.), Makrisal, Needle wood [*Schima wallichii* (DC.) Choisy], Alder (*Alnus nepalensis* D. Don).

Tree ferns, palm and bamboo abound in this zone. There are 26 species of bamboos (including the Rhinoceros or Kaghzi bamboo—*Dendrocalamus hamiltonii* Nees et Arn. ex Munro). The number of bamboo species decreases as we move westwards and are totally absent in the Kashmir valley.

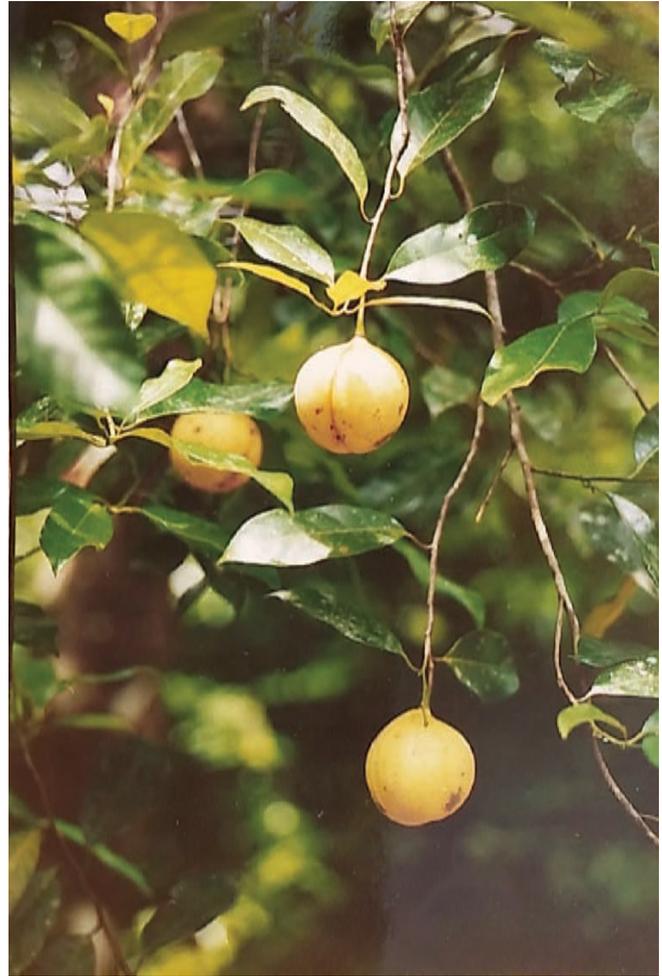
Temperate Zone (between 1,800–3,500 m)

Unlike the Western Himalayas the coniferous forests are not very vast but scattered, although exceeding in the number of species and genera such as Himalayan larch (*Larix griffithiana* Hort. ex Carr.), Indian Hemlock Fir [*Tsuga dumosa* (D. Don) Eichler], East Himalayan Fir (*Abies densa* Griff.), East Himalayan Spruce (*Picea spinulosa* (Wall.) Boiss.), Plum-Yew (*Cephalotaxus griffithii* Hook.f.), moisture loving Oaks (especially Bulk Oak (*Quercus lamellosa* Sm.), Safed Champa (*Michelia doltsopa* Buch.-Ham. ex DC.), Pipli [*Symingtonia populnea* R.Br. ex Griff.] van Steenis. Syn. *Bucklandia populnea* (R.Br. ex Griff.), Campbell's Magnolia (*Magnolia campbellii* Hook. f. and Thoms.—starring the mountain slopes of the Eastern Himalayas). There are 82 species of Rhododendrons, as compared to only 5 in the Western Himalayas. *Rhododendron arboreum* Sm. and *R. falconeri* Hook. f. are the prominent tree species of this zone (flowers are cream coloured with purple spots at the base). Shrubby rhododendrons have several shades of blood-red, creamy-white, and cinnamon-red.

Amongst the sub-alpine vegetation (2,900–3,500 m) are East Himalayan Fir (*Abies densa* Griff.), Black juniper (*Juniperus wallichiana* Hook.f. and Thoms.) and Himalayan Silver birch or Indian birch (*Betula alnoides* Buch.-Ham.)



Picture 8: The Silver birch or Bhojpatra—*Betula utilis*. Many ancient manuscripts in India were written on the bark of this tree. (Courtesy: Ratna Misra)



Picture 9: Fruiting branches of nutmeg—*Myristica fragrans*. (Courtesy: Professor K. V. Peter, KAU, Thrissur.)



Picture 10: A close-up of nutmeg fruit—a source of two distinct spices, nutmeg (seed) and mace (the aril). (Courtesy: Professor K. V. Peter, KAU, Thrissur.)



Picture 11: The beautiful, brilliant scarlet covering (mace) that encloses the seed. (Courtesy: Professor K. V. Peter, KAU, Thrissur.)



Picture 12: A close-up photograph of fruiting star anise (*Illicium verum* Hook.f.). Note the star shaped fruit in the inset which is often used in flavouring culinary preparations. The essential oil obtained from the fruits is used in the perfumery. (Courtesy: A. Pushpa Raj)



Picture 13: Few plants can rival the blaze of colour produced by *Rhododendron*. See the brilliant display of red colour. (Courtesy: Mr Bhupinder Singh Rana)

North West Dry Zone

This zone comprises Sind, Baluchistan, plains of North West Frontier Provinces, East and West Punjab, Haryana, Rajasthan, Delhi and Gujarat. This area is characterised by extreme climatic conditions with long, hot and dry summers and cold winters. The precipitation is very low and during most months very little rainfall occurs (less than 10 cm). The process of desertification is expanding eastwards and the sands are encroaching into more and more fertile land. The following main species are known to grow here:

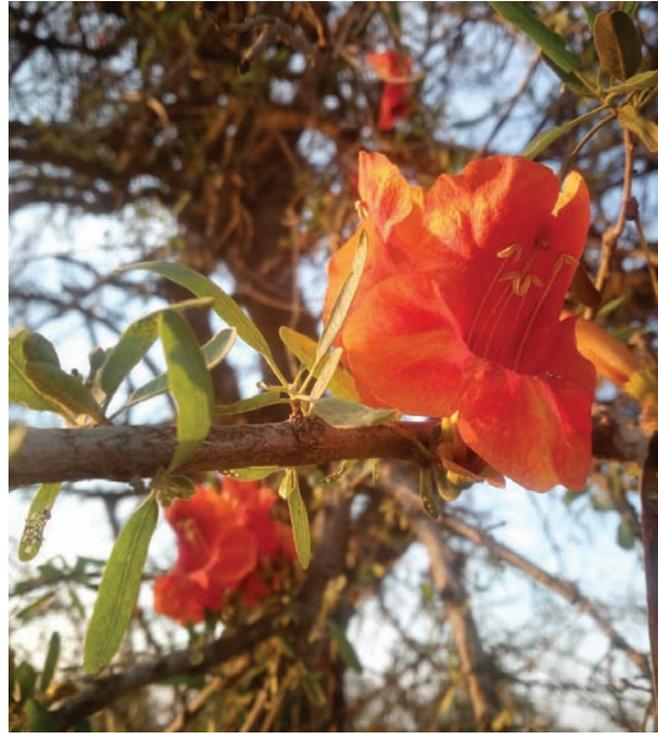
Khejari (*Prosopis cineraria* Druce); Pilu (*Salvadora oleoides* Decne.); Tamarisk or Athel [*Tamarix aphylla* (L.) Karst.]; Salai or Indian Frankincense Tree (*Boswellia serrata* Roxb. ex Colebr.); Dhaukra or Dhao (*Anogeissus pendula* Edgew.); Gum Karaya Tree (*Sterculia urens* Roxb.); hingu or hingot (*Balanites aegyptiaca* (L.) Delile—containing steroid sapogenins that are used for the synthesis of sex hormones; the woody endocarp is filled with gunpowder and used in fireworks); Gum Arabic Tree [*Acacia senegal* (L.) Willd.]; ber or Indian jujube (*Zizyphus* spp.); Rajasthan Teak (*Tecomella undulata* (Smith) Seem. with trumpet shaped orange-red flowers) Catechu or Black Cutch [*Acacia catechu* (L.f.) Willd.]; and Indus Poplar (*Populus euphratica* Olive.). Wild Date [*Phoenix sylvestris* (L.) Roxb.] is typical of this area. Mangrove vegetation of the Indus delta consists of mostly of *Rhizophora* and *Sonneratia* species.



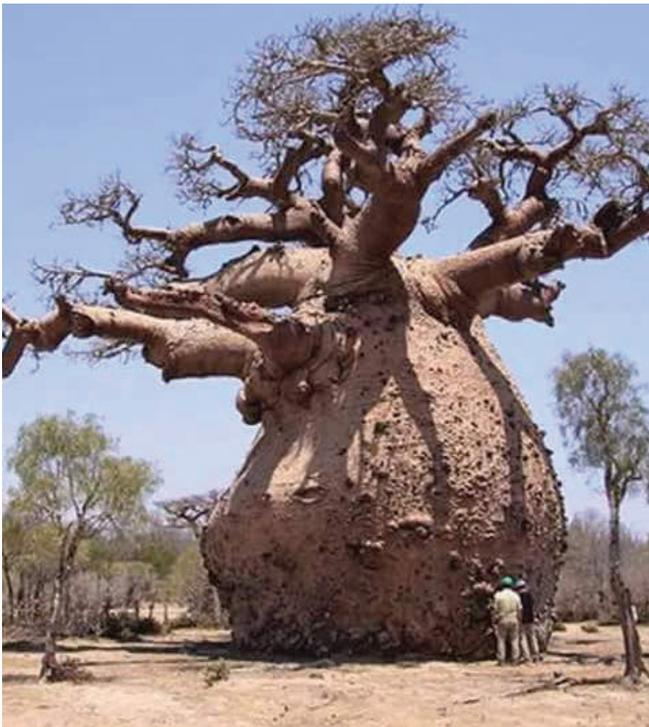
Picture 14: *Tamarix aphylla* in flowering. The tree is well adapted to saline areas. The numerous but minute, mauve or pink flowers are produced in open clusters.



Picture 15(a): *Tecomella undulata* (Rajasthan Teak) in flowering. Note the simple, narrowly oblong, greyish-green leaves with undulate margin. The bell-shaped, orange-red flowers are borne in bunches of 5–10. (Courtesy: Dr Manju Chaudhary)



Picture 15(b): A close-up photograph of flowers of *Tecomella undulata*. Note the bell-shaped, orange-red flowers which are borne in bunches of 5–10. (Courtesy: Dr Manju Chaudhary)



Picture 16: A growth habit of Upside-down Baobab tree (*Adansonia digitata*) (Courtesy: Professor P. C. Trivedi)

Indo-Gangetic Plains

This zone is comprised of flat, alluvial fertile plains of the river Ganges and tributaries of the river Indus, encompassing plains of Punjab, Haryana, Uttar Pradesh, Bihar, stretching to the Hoogly deltas of Bengal and adjacent littoral forests of the Sunderbans. Four distinct sub-divisions are recognised:

- (i) *The alluvial Plains* of Punjab and Haryana (rivers Jhelum, Chenab, Ravi, Beas and Sutlej) have moderately dry conditions that has given rise to Khair-Sissoo vegetation [*Acacia catechu* (L.f.) Willd.—*Dalbergia sissoo* Roxb. formation].
- (ii) *Middle Gangetic Plain:* It comprises parts of eastern Uttar Pradesh and Bihar. The main species are: Bengal Kino or Flame of the forest. [*Butea monosperma* (Lamk.) Taubert], Arjun [*Terminalia arjuna* (Roxb.) Wight and Arn.], Mahua Tree [*Madhuca longifolia* var. *latifolia* (Roxb.) A. Chev.], Ronj or Safed Kikar [*Acacia leucocephala* (Roxb.) Willd.], *Zizyphus* spp.; Chironji or Cuddapah almond [*Buchanania angustifolia* Roxb.], Khair or Catechu [*Acacia catechu* (L.f.) Willd.], Aonla (*Emblica officinalis* Gaertn.), Karunda (*Carissa spinarum* L.) and Kateera-gum sterculia (*Sterculia urens* Roxb.)

- (iii) *Upper-Ganga Plain*: It comprises the plains of Western Uttar Pradesh. The common species are *Acacia catechu* (L.f.) Willd., *Tamarix* spp., *Saccharum munja* Roxb. [now named *Erianthus arundinaceus* (Retz.) Jesw. ex Heyne].
- (iv) *West Bengal sub-division*: It is comprised of the deltaic tract of the river Ganges and its numerous distributaries where swampy or deltaic vegetation predominates. The main species occurring in Sunderbans delta are: *Rhizophora mucronata* Lam., *Avicennia alba* Blume, *A. marina* Vierh., *Ceriops roxburghiana* Arn., *Heritiera fomes* Buch.-Ham. (Syn.

H. minor Roxb.-Sundari, after which Sunderbans are named), *Excoecaria agallocha* L. (Blinding Tree, Agallocha, feared by wood cutter—the white latex coming out of cuts causes blindness), stilt-rooted *Bruguiera gymnorrhiza* (L.) Lamk. (the buttressed and largest of mangroves), *Sonneratia apetala* Buch.-Ham. with hanging branches and white flowers, and the stemless palm, *Nypa fruticans* Wurm. —it is much valued, particularly in the Philippines, for the sweet sap from the spadix—which is used for making jaggery, sugar, alcohol, and vinegar. Leaf midribs are used for making coarse brooms and as a fuel.



Picture 17: A heavily fruiting Gum Karya tree showing white, smooth stem bark that comes off in thin papery plates, like birch (bhojpatra). Karya gum is obtained from the tree trunk. The mature fruits are woody-brown, clothed with stiff stinging bristles. (Courtesy: Professor S. R. Yadav, University of Delhi.)



Picture 18: A brilliant display of red colour in young fruits of *Sterculia urens*. (Courtesy: Professor S. R. Yadav, University of Delhi.)



Picture 19 (a and b): *Bruguiera gymnorrhiza* is a common tree along the inland margin of mangrove swamps. A basal cupule (calyx) forms a persistent crown-like structure surrounding the petals and ovary. (Courtesy: Dr M. S. Kiranraj)

West Coast or Malabar Zone

This zone comprises the west coast of the country, extending from South Gujarat to Kanyakumari and covers parts of South Gujarat, Maharashtra, Karnataka, Kerala and Tamil Nadu. This is a region of high rainfall and excessive humidity, because of moisture bearing winds from the Arabian Sea. Precipitation is well distributed throughout the year. The mountains run parallel to the coastline with intervening lowlands or marshy expanses. The mountainous area is called the Western Ghats. Other hill ranges are the Nilgiris, Anamalai hills, etc.

The vegetation is very dense. It includes the virgin tropical monsoon forest of the Silent Valley, home of the lion-tailed macaque and a number of species hitherto unknown to mankind.

Based upon altitude, two subdivisions are recognised (a) the tropical zone up to 1,500 m (b) the temperate zone above 1,500 m.

(a) Tropical Zone up to 1,500 m

This may be further divided into 3 main types of forests: (i) Rain forests or Wet evergreen, (ii) Semi-evergreen, and (iii) Moist-deciduous.

Amongst the rain forest species are Gurjan or Ennai (*Dipterocarpus indicus* Bedd.), Spar Tree (*Calophyllum polyanthum* Wall.—used for the mast of sailing ships), Wild Durian or Karayani (*Cullenia exarillata* Robyn—food tree of the rare lion-tailed monkey-*Macaca silenus*), Indian Gutta Percha tree [*Palaquium ellipticum* (Dalz.) Engl.], Indian Copal tree (*Vateria indica* L.—a tree with



Picture 20: Fruiting Cashew Tree (*Anacardium occidentale*). The true, kidney-shaped fruit at the tip contains cashew nut kernel while the fleshy pear-shaped structure below (cashew apple) can be eaten fresh, preserved or used to produce a fermented liquor. (Courtesy: Directorate of Agriculture, Govt. of India.)

bright red young leaves and fragrant white flowers), Black dammer (*Canarium strictum* Roxb.—the gum used as an incense), Upas tree (*Antiaris toxicaria* Leschen—its latex is used by jungle dwellers to tip arrow and spears to hunt birds and animals), Jungli dungy (*Tetrameles nudiflora* R. Br.), Iron wood or Nagkesar, Nageshwar champa (*Mesua ferrea* L.—flowers like white roses, while the young leaves are scarlet), Narikel or Buddha's Coconut [*Pterygota alata* (Roxb.) R. Br., Syn. *Sterculia alata* Roxb.], Jack fruit (*Artocarpus heterophyllus* Lamk.), Talipot palm (*Corypha umbraculifera* L.—the flowering bud (over a meter high) bursts with a loud pop, releasing a majestic inflorescence; 6 m tall bearing 60 million flowers, and after flowering the palm dies off).

Semi-evergreen forests are represented by Red Silk Cotton Tree (*Bombax ceiba* L.), True laurel (*Terminalia crenulata* Roth.), Kinjel (*Terminalia paniculata* Roth.), nana (*Lagerstroemia lanceolata* Wall.), Rose-wood (*Dalbergia latifolia* Roxb.), Haldu [*Haldina cordifolia* (Roxb.) Ridsdale], Bahera, Belleric myrobalan [*Terminalia bellirica* (Gaertn.) Roxb.], Bijasal or Malabar Kino (*Pterocarpus marsupium* Roxb.—fruits are like the pouch of the Kangaroo, the bark exuding blood-red sap on cutting), Irul [*Xylia xylocarpa* (Roxb.) Taub., Syn. *X. dolabriformis* Benth.], giant-thorny bamboo [*Bambusa arundinacea* (Retz.) Willd.] and the male bamboo [*Dendrocalamus strictus* (Roxb.) Nees].

Mangrove species include dudhi baen (*Avicennia alba* Blume), *Sonneratia apetala* Buch.-Ham., Blinding Tree (*Exoecaria agallocha* L.) while littoral species are represented by *Calophyllum inophyllum* L., and Cashew nut (*Anacardium occidentale* L.).

Screw Pine [*Pandanus odorifer* (Forssk.) Kuntze], Anjani (*Memecylon edule* Roxb.—have brilliant blue flowers) and Chebulic myrobalan (*Terminalia chebula* Retz.) are three prominent trees of fresh water swamps.

(b) Temperate Forests above 1,500 m

This includes hill ranges of the Nilgiris, Anamalai and Palni. These peaks are flattened or gently sloping and can be compared to an elephant's head.

Typical trees predominating this region are: Nilgiri Rhododendron [*Rhododendron arboreum* ssp. *nilagiricum* (Zenker.) Tagg.], Nilgiri Champa (*Michelia nilagirica* Zenker.), Pala (*Xantolis tomentosa* (Roxb.) Rafin.—a spiny tree with yellow berries and white flowers), Holy (*Ilex* spp.—a tree typical of Europe and the Himalayas bearing red fruits and prickly leaves, much in demand during Christmas), Kaymone (*Ternstroemia japonica* Thunb. with pale yellow flowers and fruits containing red seeds) and Wintergreen (*Gaultheria fragrantissima* Wall.)

The tree ferns are represented by *Cyathea gigantea* (Wall. ex Hook.) Holtt. and *C. brunoniana* (Wall. ex Hook.) Clarke et Bak. *Nilgirianthus*, an undershrub with blue flowers that bloom gregariously at set intervals of 3 to 12 years or more, has given the name 'Blue Mountains' to the Nilgiris.



Picture 21: *Memecylon ellipticum* looks unusually attractive when the woody branches become covered with numerous clusters of blue flowers. (Courtesy: Jyotirmayi Parija)



Picture 22: A white flowered *Rhododendron*. (Courtesy: Dr Akhilesh Tewari)



Picture 23: The Bonfire Tree (*Firmiana colorata*) puts forth brilliant masses of flaming red or scarlet flowers from March to May. The tree is leafless when in bloom. (Courtesy: Professor S. R. Yadav, University of Delhi.)

Central Indian Region

This region comprises parts of Madhya Pradesh, Odisha, Chhattisgarh and Gujarat where the tract is more or less elevated as compared to the flat Indo-Gangetic plains. Small hill ranges constitute a part of this zone—the Aravallis in the West, the Satpuras in the south-west, the Vindhyas to the north and the Chotta Nagpur plateau to the east. The topography is dissected with umpteen number of ugly looking cancerous gullies which over the years have cut back into the hills. The following are the main species occurring in this zone: Teak (*Tectona grandis* L.f.), bahera (*Terminalia bellirica* Gaertn.), Haldu [*Haldina cordifolia* (Roxb.) Ridsdale], Rosewood (*Dalbergia latifolia* Roxb.), Satinwood (*Chloroxylon swietenia* DC.), Mahua (*Madhuca indica* J.F. Gmel.), Bonfire Tree (*Firmiana colorata* (Roxb.) R.Br.—dotting the hillsides of Peninsular India like masses of flaming red coral), Red Silk cotton Tree (*Bombax ceiba* L.), Gum Karaya (*Sterculia urens* Roxb.), Yellow Silk Cotton Tree or Butter-cup Tree (*Cochlospermum religiosum* (L.) Alston—with brilliant golden yellow flower when the tree is leafless, the gum is used for thickening ice creams, branches are used as torches in villages as they burn brightly because of their resinous nature), Flame of the Forest [*Butea monosperma* (Lamk.) Taubert with masses of brilliant orange flowers] and Salai or Incense Tree (*Boswellia serrata* Roxb.), Tendu (*Diospyros melanoxylon* Roxb.) and Dhaura and Gum Ghatti [*Anogeissus acuminata* (Roxb.) Wall. ex. Bedd. and *A. latifolia* (DC.) Wall. ex Bedd. respectively]. Sal (*Shorea robusta* Gaertn. f.) is widespread in Central India, presenting a striking sight when covered with masses of pale yellow fragrant flowers when leafless. The male Bamboo [*Dendrocalamus strictus* (Roxb.) Nees] is quite common.

Babul Khair [*Acacia catechu* (L.f.) Willd.], Khejari Tree (*Prosopis cineraria* Druce) and Hingu, Hingot or Hingan (*Balanites aegyptiaca* (L.) Delile—fruits when stuffed with gunpowder are used as crackers during Diwali, the festival of lights) are among the trees growing in the driest areas.

Among the mangroves on the deltaic region of Godavari are stilt rooted *Rhizophora mucronata* Lam. (earlier known as *R. mangle* Roxb., non L.), Kankra [*Brugiera gymnorhiza* (L.) Lamk.] and the Blinding Tree or Agallocha (*Excoecaria agallocha* L.—the irritating milky juice in the stem is said to cause blindness amongst the wood-cutters).

Deccan Plateau

The states of Maharashtra, Karnataka, Tamil Nadu and Andhra Pradesh in the Indian Peninsula, south of Godavari, form part of this zone which can be divided into (i) an elevated hilly plateau called the Deccan sub-

region and (ii) the lowland along the east (Coromandel) coastline, the Carnatic sub-region. The area is relatively dry, receiving about 100 cm of rainfall annually. The following species dominate the landscape.

(a) Deccan Sub-region

Khejari (*Prosopis cineraria* Druce); Umbrella Acacia (*Acacia planifrons* Wight and Arn.); Axle-wood [*Anogeissus latifolia* (DC.) Wall. ex Bedd.]; Satinwood (*Chloroxylon swietenia* DC.); Red Sanders (*Pterocarpus santalinus* L.f.—endemic to Cuddapah in Andhra Pradesh and the wood is wavy grained, used for musical instruments); Sandalwood (*Santalum album* L.—with strongly scented heartwood, being grown especially in Karnataka and Tamil Nadu); Rosewood (*Dalbergia latifolia* Roxb.—golden-brown to rose purple or deep purple heartwood, streaked with black); Black Siris [*Albizia lebbek* (L.) Benth.]; and ‘Talura’ and Tambugai (*Shorea talura* Roxb. and *S. tumbuggaia* Roxb. respectively), etc.



Picture 24: A close-up of flowering branches of *Rhizophora mucronata*, a component of marine ecosystem. The plant is supported by the arching tangles of aerial roots that are anchored in the mud flat below. (Courtesy: P. T. Rajasekharan Nair)



Picture 25: *Rhizophora mucronata* showing viviparous seed germination. (Courtesy: M. S. Swaminathan Research Foundation, Chennai)

(b) Carnatic sub-region

Palla or Khirni [*Manilkara hexandra* (Roxb.) Dub.], Mulsari (*Mimusops elengi* L.), True Ebony (*Diospyros ebenum* Koenig—the heartwood is jet black, used for carving, cabinet-work, decorative panelling, turnery and musical instruments, etc.) and Nux-Vomica Tree (*Strychnos nux-vomica* L.—fruits round, hard, of the size and colour of an orange; the seeds are source of drug ‘nux-vomica’ which is used for the treatment of paralysis and nervous disorders).



Picture 26: Picture of *Coffea arabica* in flowering showing snow-white, star-like flowers that are borne in dense axillary clusters. (Courtesy: Dr Pannai Kannan)



Picture 27: Picture of *Coffea arabica* in fruiting. The young fruits are green, turning crimson red at maturity. Note the presence of disk or navel at the tip of the fruits. (Courtesy: Dr Dilbagh Singh)

North Eastern Hills

This zone comprises a series of hill ranges in the extreme north-east of India, covering parts of Assam, Mizoram, Manipur, Tripura, Meghalaya, Nagaland, etc. These are characterised by heavy rainfall with Cherrapunji experiencing the heaviest (1,114 cm per annum). Very dense forests—both evergreen and semi-evergreen—characterise the hilly landscape. In certain areas, these forests are virtually impenetrable. The leaves, mostly, have pointed tips called the ‘drip tip’, which is a feature of plants growing in high rainfall areas to quickly drain-off rain water. Some of the main evergreen forest species are: Hollong (*Dipterocarpus macrocarpus* Vesque (now known as *D. pilosus* Roxb.—with fruits like a shuttle-cock with 2 wings), Chaplash (*Artocarpus chaplasha* Roxb.), *Michelia* spp.; *Abroma augusta* L. (with pendulous flowers having pale green sepals and chocolate coloured petals; Kala Damar (*Canarium strictum* Roxb. with fragrant resin), Rhinoceros bamboo (*Dendrocalamus hamiltonii* Nees et Arn. ex Munro—so called because the rhizome is shaped like the rhino horn.

Among the Tropical semi-evergreens are: Camphor [*Cinnamomum camphora* (L.) T. Nees and Eberm.], Heart Flower (*Talauma hodgsonii* Hook.f. and Thoms.—a member of Magnoliaceae with aromatic leaves (new foliage are red and heart-shaped flowers); Queen’s Flower (*Lagerstroemia speciosa* (L.) Pers.—flowers like crepe paper); Elephant Apple (*Dillenia indica* L.—flowers white or yellow, 8 inches across), Letkok or Buddha’s coconut [*Pterygota alata* (Roxb.) R. Br.], Gamari (*Gmelina arborea* Roxb.), Assam Rubber Tree (*Ficus elastica* Roxb.), Hollock

(*Terminalia myriocarpa* Heurck and Muell.—Arg.), Kadam [*Neolamarckia cadamba* (Roxb.) Bosser], Red Silk Cotton Tree (*Bombax ceiba* L.), Phul Hingri (*Sloanea assamica* Rehd. et Wilson—fruits 2 inches long, studded with long spines), Tree Rhododendron (*Rhododendron arboreum* Sm.), Pipli [*Symingtonia populnea* (R.Br. ex Griff.) van Steenis (Syn. *Bucklandia populnea* R.Br. ex Griff.)], Alder (*Alnus nepalensis* D. Don), Birch (*Betula alnoides* Buch.—Ham.), Iron-wood or Nagkesar or Nag champa, Nageshwar Champa (*Mesua ferrea* L.),



Picture 28: Top: The strangely attractive, brightly coloured flower of *Abroma augusta*. (Courtesy: Mr Achyut M. Gokhale, Ministry of Environment and Forests, Govt. of India.)



Picture 29: A native of Southeast Asia, *Aquilaria agallocha* Roxb. of Thymeliaceae family (Agarwood or Gharuwood) is a large fragrant tree with greenish white inflorescences. The fungal infected light brown to dark brown fragrant heartwood is primarily used for incense sticks, perfumes and beautiful carvings and sculptures. The tree is found in northeast India, Bangladesh, Bhutan, Laos, Myanmar, the Philippines and Thailand. (Courtesy: Ms Deepa Mohan)

Agarwood or Gharuwood (*Aquilaria agallocha* Roxb.), Tut (*Morus laevigata* Wall. ex Brandis) and many oaks belonging to *Quercus* genus. *Pinus insularis* Endl. (the Khasi Pine) is the only pine growing in this region.

Andaman and Nicobar Islands

This chain of islands in the Bay of Bengal form a distinct ecological unit with a typical coastal type climate having heavy precipitation. The Andamans have a chain of 204 islands and there are just 2 high peaks—Saddle peak in North Andamans (70 m) and Narcondam peak (56 m). Some of the main species occurring in this region are:

- (i) **Mangroves:** *Rhizophora mucronata* Lam.; *Bruguiera gymnorrhiza* (L.) Lamk.; the stemless palm, *Nypa fruticans* Wurm.; *Areca triandra* Roxb. – nuts used as substitute for betel-nut.
- (ii) **Littoral:** Bullet-wood, *Manilkara littoralis* (Kurz.) Dubbard, Alexandrial Laurel, *Calophyllum inophyllum* L.; White Bombway, *Terminalia procera* Roxb.; Indian Coral Tree, *Erythrina variegata* L.; Indian Tulip Tree, *Thespesia populnea* (L.) Soland ex Corr.; Screw Pine, *Pandanus odorifer* (Forssk.) Kuntze; Horse-tail tree or Whistling Pine, *Casuarina equisetifolia* J.R. and G. Forst.
- (iii) **Evergreen Forests:** Gurjan, *Dipterocarpus grandiflorus* Gaertn. f.; Chaplash or Nicobar Canoe Tree or Lal chini, *Calophyllum soulattri* Burm. f.; Red Bombway, *Planchonia littoralis* van Houtte.



Picture 30: Young leaves of *Mesua ferrea* showing brilliant display of red colour. (Courtesy: Dr Kshirod K. Mishra)

- (iv) *Semi-evergreen*: Gurjan, *Dipterocarpus alatus* Roxb.; Buddha's Coconut Tree or Letkok, *Pterygota alata* (Roxb.) R.Br., White Chuglam, *Terminalia bialata* Steud., Koko or Black Siris, *Albizia lebbek* (L.) Benth., Paduk, *Pterocarpus indicus* Willd. – exuding blood-red juice when cut, and Pynma, Andaman Crape Myrtle, *Lagerstroemia hypoleuca* Kurz.
- (v) *Deciduous Forests*: White Bombway, *Terminalia procera* Roxb.; White or Safed Chuglam, *Terminalia bialata* Steud.; Dhup, *Canarium strictum* Roxb.; South Indian Red Silk Cotton Tree or *Dida* (*Bombax insignae* Wall. with 400 stamens and larger petals); Andaman Marble wood, *Diospyros marmorata* Parker with Jet-black stripes; Jungly dungy, *Tetrameles nudiflora* R. Br.—a nestling tree favoured by hornbills; and the Drinking cane, *Calamus andamanicus* Kurz.

Nicobar has a chain of 22 islands. The highest peak is Mt. Thuillier (622 m). It abounds in springs, streams and has five rivers. The vegetation is predominantly of the Andaman type and is characteristically devoid of Gurjan—*Dipterocarpus* spp. (the principal Andaman timber) and Padauk. Tree ferns (*Cyathea* spp.) are common in the moist valley (but unknown in Andamans). *Podocarpus wallichianus* Presl. is known to occur on the hillside above Alexandra river and is grown as an avenue tree.

Different tree species included in the Atlas are organised according to Bentham and Hooker's system of classification of seed plants wherein they recognised 202 families, 7,569 genera and 97,205 species. A broad outline of the classification is presented in Table 1.1.

Table 1.1. An outline of the system of classification presented by Bentham and Hooker in Genera Plantarum (1862–83). Phanerogams or seed plants

Class 1. Dicotyledons—14 series, 25 orders, 165 families	
Subclass 1. Polypetalae (Calyx and corolla distinct, petals free)	
Series	1. Thalamiflorae ... 6 orders
	2. Disciflorae ... 4 orders
	3. Calyciflorae ... 5 orders
Subclass 2. Gamopetalae (Calyx and corolla distinct, petals fused)	
Series	1. Inferae ... 3 orders
	2. Heteromerae ... 3 orders
	3. Bicarpetalae ... 4 orders
Subclass 3. Monochlamydeae (Calyx and corolla indistinct, perianth 1-seriate, rarely entirely absent or if 2-seriate-both series sepaloid)	
Series	1. Curvembryeae
	2. Multiovulatae aquaticae
	3. Multiovulatae terrestres
	4. Microembryeae
	5. Daphanales
	6. Achlamydosporae
	7. Unisexuales
	8. Ordines anomali
Class 2. Gymnospermae—3 families	
Class 3. Monocotyledons—7 series, 34 families	
Series	1. Microspermae
	2. Epigynae
	3. Coronarieae
	4. Calycinae
	5. Nudiflorae
	6. Apocarpae
	7. Glumaceae

Magnolia, Laurel Magnolia, Southern Magnolia, Bull Bay, Lily Tree

Magnolia grandiflora L.

Class	Dicotyledons
Subclass	Polypetalae
Series	Thalamiflorae
Order	Ranales
Family	Magnoliaceae

This genus is named to commemorate Pierre Magnol (1638–1715), a professor of Botany and Medicine, and Director of the Botanical Garden at Montpellier (France). The specific epithet refers to the large grand flowers, often measuring 8 to 12 inches across. A native of North America, this tree is quite majestic, much cherished for its pyramidal shape, dark brownish-green glossy foliage and large attractive flowers. It is grown in private and public gardens as a botanical curiosity as the plant is considered to be one of the most primitive or ancient among the flowering plants, and is a center of attraction for visitors.



Picture 31: A picture of flower of *Magnolia grandiflora*. The flowers are very large, up to 30 cm in diameter, borne terminally on the shoots. The creamy-white sepals and petals are arranged in cycles of three. (Courtesy: N. S. Dngriyal)



Picture 32: The elongated floral axis showing numerous spirally arranged pistils with styles tipped by stigmas. The scars of fallen sepals and petals, and numerous spirally arranged stamens are clearly visible.



Picture 33: A rusty-brown, cone-like fruiting cluster showing numerous spirally arranged follicles. The bright-red seeds hang from the fruit by a slender thread-like funiculus.

It is a small to medium-sized evergreen tree (up to 20 m or more tall) with a dense pyramidal crown bearing erect branches that are downy, reddish when young. The trunk is covered with a smooth grey-black bark. The leaves are simple, alternate, thick, coriaceous, oblong to ovate (3.5 to 15 cm), glossy green above and rusty tomentose underneath. The margin is entire but sometimes wavy. Even the leaf stalk has a hairy growth that gives an overall fuzzy look. The leaf bud is enclosed in a rusty pubescent sheath which falls off as the leaf unfolds. The flowers are large, solitary, cream-coloured, scented and are borne terminally on branchlets. The sepal and petals are soft, thick, fragrant and supple, and are arranged in cycles of three. Numerous free stamens and pistils are all spirally arranged on the elongated floral axis—the carpels are organised in the upper part while the stamens are lower down in the basal region. Both stigma and style are present. The scars left behind by the different floral parts can be seen clearly on the axis of developing fruits. The fruits are more or less egg-shaped with many brilliant red seeds within the follicle. The seeds instead of dropping off from the dehiscent fruit, remain suspended by a silky thread-like funiculus.

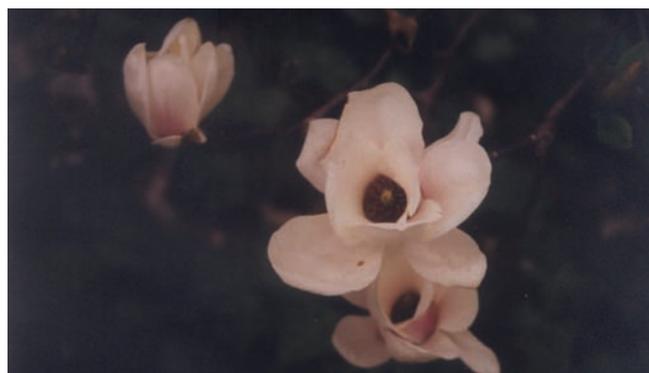
There are several cultivated varieties of this species, differing from each other mostly in the shape, size and colouration of flowers and leaves. The tree flowers from April to May and the fruiting happens from September to December. Fruit setting is very rare.

Propagation is done by seeds, most commonly from cuttings, air-layering and grafting. It does well up to an altitude of 2,000 m in the Himalayas and the Nilgiris. It is grown in the gardens and parks for its beautiful flowers. The leaves and flowers are extensively used in flower arrangements and bouquets. The highly scented flowers are used for worship throughout the subcontinent which is why it is commonly planted around temples. These are also much favoured by women for hair adornment. Even the leaves give off a fine odour when rubbed. The bark is a stimulant and tonic and is used for curing malaria and rheumatism. Most plant parts contain an essential oil which is used in perfumery. The wood is used for the manufacture of unbleached pulp.

Campbell's Magnolia (*M. campbellii* Hook f. and Thoms.) is one of the loveliest of Asian Magnolias and has a spectacular bloom of nearly 5,000 flowers when the tree is leafless. The forest floor covered with fallen petals adds to the spectacle. It is grown in the mist shrouded region of the Eastern Himalayas, especially in Darjeeling area and Arunachal Pradesh. The flowers are generally clear pink on the outside and a suffused combination of white and lighter pink on the inside.

Two more species of Asiatic origin that are occasionally grown are *M. soulangiana* Soul. (a hybrid between *M. denudata* Desr. and *M. liliflora* Desr.) and *M. stellata* (Sieb. & Zucc.) Maxim—both with numerous cultivars, in the former the 'Lennei' cultivar has very large saucer-shaped flowers, white inside and purple on the outside. The other species, *M. pterocarpa* Roxb., has a heavy rounded crown but comparatively small flower.

A native of Southwestern China (in Sichuan and Yunnan), the lily magnolia (*Magnolia liliflora* Desr.) is a bushy, rounded deciduous shrub (upto 4 m high) blooming profusely in early spring with large pink to reddish-purple showy flowers, before the leaf buds open. The leaves are large (8 inch long). This species is one of the parents of the very popular hybrid 'Saucer Magnolia' (*Magnolia x soulangeana*), the other parent being the Yulan magnolia, *M. denudata*.



Picture 34: The most frequently grown hybrid, *M. soulangiana*, is obtained by crossing *M. denudata* and *M. liliflora*. A spreading tree with erect, bell-shaped white flowers suffused with pink on the outside. (Courtesy: Dr (Mrs) Inderjeet Kaur Sethi)



Picture 35: The large pink to reddish-purple showy flowers of *Magnolia liliflora*, produced before the leaf buds open. (Courtesy: Dr Nidhan Singh)



Picture 36: The creamy-white or ivory flower buds of *Magnolia coco* open in the evening and fall of by morning, This species is a good houseplant. (Courtesy: Mrs Jyotirmayi Parija)

It is one of the smaller species found in the genus *Magnolia* and is now planted as an ornamental in North America and Europe or elsewhere, wherever conditions are favourable. It is suitable for home landscape. It is a lovely shrub for sunny or partially shaded spots, away from strong winds.

Dwarf Magnolia or Coconut Magnolia [*Magnolia coco* (Lour.) DC.], a native of southern China, is a slow growing, evergreen shrub, esteemed for its nodding small, highly fragrant, rounded, creamy-white or ivory flower buds that open in the evening. The oval bright green leaves are paler and downy on the reverse. By morning, the petals fall but the fragrance still lingers. The leaves are large, leathery and dark green with a paler undersurface. Unlike other

Golden Champa, Yellow Champa, Orange Champak, Fragrant Champak, Golden Champa

**Michelia champaca* L.
[Syn. *M. aurantiaca* Wall.]

Class	Dicotyledons
Subclass	Polypetalae
Series	Thalamiflorae
Order	Ranales
Family	Magnoliaceae

* Some taxonomists have renamed it as *Magnolia champaca*.



Picture 37: Picture of flowers of *Magnolia doltsopa*. (Courtesy: Dr Purushottam Gosavi)

magnolias, this species secretes a nectar-like exudate at the base of the petals and between the stigmas.

This species is a good houseplant, the most suitable magnolia for indoors. It can be planted near the patio or bedroom window. In temperate countries, it can be grown as a large houseplant for open, sunny rooms.

Another species, *M. doltsopa* Buch.-Ham. ex DC. is also grown for ornamental purpose and is worthy of introduction in parks in hilly areas with high rainfall. The flowers are white and scented. The wood is a source of first class timber, being used for furniture, doors, window frames, ceiling board, veneer, plywood and also for joinery work. The wood is much used in India, Sri Lanka and China.

The genus *Michelia* is named to commemorate Pietro Antonio Micheli (1679–1737), a Florentine botanist, while the specific name *champaca* is the Sanskrit name of this tree. It is indigenous to the foothills in many parts of tropical India and in Malaysia, and has been cultivated in gardens and near temples throughout East Asia. It produces a profusion of fragrant yellow or orange blossoms with a powerful fragrance that lasts long after they have been picked. Trees with relatively small flowers and pure white petals are also grown in some gardens. The carpels in *Michelia* are at the apex of the elongated receptacle but unlike *Magnolia* they are not found immediately above the stamens but are separated by a sterile zone in between.

Indian poets have written many a verse on Golden Champa, extolling the excellence of its bloom. For its beauty and fragrance, it was grown in abundance in the *tapabans* (gardens for meditation) of great Indian saints and in the precincts of temples.

It is a fast-growing, small to medium-sized evergreen tree with a tapering crown, usually up to 30 m in its native habitats, a girth of 3.5 m and ascending pubescent branches. The bark is thick, smooth, ash-grey, dull brown—the blaze turning reddish brown inside. The leaves are petiolate (stalk grooved), pale green, simple, lance-shaped (15–25 cm long and 5–8 cm broad), wavy margined, glabrous and shining above but slightly hairy underneath, tapering to a long point. The young leaf is protected by a sheath-like deciduous stipule.



Picture 39: The flowers are star-shaped, pale yellow to deep yellow or orange, and are borne singly in the leaf axils. They have a powerful fragrance that lasts long after they have been plucked. Champaca oil is distilled from the flowers to make a perfume. (Courtesy: Dr Ajayan Sadanandan)



Picture 38: An evergreen, small to medium-sized tree with a tapering crown and ascending pubescent branches. The leaves are simple, pale green, glossy, wavy margined, ovate-lanceolate, tapering to a long point. (Courtesy: Kshirod Mishra)



Picture 40 The waxy, grape-like fruits are clustered on a long, lax spike, and are often hidden under the dense foliage. (Courtesy: Dr Ajayan sadanandan)

The flowers are strongly scented, star-shaped, pale to deep yellow or orange, and are borne singly in the leaf axils (rarely terminal), 5–6 cm across and are hidden under the dense foliage. Each flower consists of 15–21 oblong, lance-shaped sepals; 15 to 21 deep yellow, fleshy, fine silky petals arranged in 3 series or whorls with the outer oblong-acute and the inner linear; numerous free spirally arranged stamens (with small filaments) and pistils present on an elongated thalamus. Each carpel has a swollen ovary, curved style and a beaked but simple stigma.

The fruits of *Michelia* look like waxy grapes, borne in a cluster on a long, lax spike about 7.5 to 15 cm long. Each one is a woody, dark coloured capsule with white specks called lenticels, dehiscing dorsally. The seeds are angular, brown with red fleshy aril on the outside and, like *Magnolia*, the seeds hang down by long white chords (funiculus).

It is propagated easily from fresh seeds which are sown immediately after ripening as they lose their viability soon. Stem cuttings are also used. The tree prefers moderate temperature, humid weather and a deep rich soil but cannot withstand waterlogging even for a short time.

The tree flowers from April to May and the fruiting taking place from June to August.

Golden Champa is widely cultivated in gardens—both public and private. It is regarded as a very sacred tree in southern India, the flowers being used in religious ceremonies. On festive occasions, ladies wear the blossom in their hair or weave them into garlands. Hindu women have special reverence for the flowers and they consider themselves blessed if an offering of this flower can be made to Lord Vishnu. A yellow dye is extracted from the flowers.

The flowers are a source of champaca oil—one of the most famous perfumes of India. The perfume is too heavy for bees to withstand, hence they may avoid it. The wood, known as *champ* in the timber trade, is strong and



Picture 41: An aggregate of follicles attached onto an elongated axis, several inches long. The dark coloured woody fruits with white specks called lenticels. They dehisce dorsally exposing angular brown seeds with pink fleshy aril.

durable, seasons and polishes well and is used for making furniture and sometimes for making statues, images and idols. The bark is a stimulant, expectorant and astringent. The fruits are said to be edible. The bark is browsed by deer. Parakeets and other birds eat the seeds.

Sugar Apple, True Custard Apple, Sweet Sop

Annona squamosa L.

Class	Dicotyledons
Subclass	Polypetalae
Series	Thalamiflorae
Order	Ranales
Family	Annonaceae

The genus *Annona* has been derived from the Haitian word *anon* which means scaly—the presence of scale-like structures on the surface of the fruit of custard apple. Linnaeus changed *anon* to the Latin *Annona*, meaning the ‘Fruit of the Year’ and this has lent its name to the entire family. The specific *epithet* in Latin means ‘rough’. As in Magnoliaceae, the floral parts are organised in threes or multiples thereof: three sepals and three or more often six petals. The stamens and carpels are numerous, and like *Magnolia* or *Michelia* are spirally arranged on the slightly elongated convex thalamus.

It is a native of the West Indies and South America, and is now widely grown throughout the tropics at low and medium elevations up to 3,500 ft. The fruit is particularly popular in the West Indies. Although not commercially grown, this fruit is still very popular in all parts of south India.

It is a straggling shrub or small deciduous tree up to 4 m tall having spreading branches and zig-zag branchlets with oil cavities in the stem and has a grayish pubescent bark pitted with lenticels. The leaves are alternate, petiolate with downy stalks, stipulate, ovate-lanceolate (20–38 cm long), glabrous, gland dotted, pale green, simple with entire margin and acuminate tip. The flowers are pedicellate, spirocyclic, greenish yellow, drooping, solitary or growing in clusters on short, leaf opposed peduncles or from the old woods (cauliflory). Each flower has 6 free, fleshy sepals (3 + 3); 6 petals arranged within each other in two whorls—the outer three are fairly big, oblong-linear, yellowish-green dotted with violaceous red, while the inner petals are small, ovate and keeled; numerous free spirally arranged stamens with short filaments and thick and broad connectives, projecting beyond the anthers into a sterile appendage; and many free carpels with unilocular ovaries.



Picture 42: The edible fruits of True Custard Apple (*Annona squamosa*) usually develop on old woods. The pulp is white or creamy-white and has a sugary taste and a delicate flavour.

The carpels develop into berries (9–15 mm long) whose fleshy tissue coalesces with each other and with the fleshy receptacle to form a globose or ovoid, many seeded multiple fruit or syncarp, 5 to 10 cm in diameter. Each individual fruit contains a shining black seed and it can be easily separated from the others. The pulp is white or creamy white, aromatic and has a sugary taste and a delicate flavour which is appreciated by many people. The fruit surface has a white or bluish bloom.

Propagation is done by seeds or grafting—a common method is eye-grafting. It is best suited for a hot and relatively dry climate. Flowering occurs from May to June while the fruiting occurs from August to November. The fruit should be picked before it fully ripens and then stored in cellars for ripening.

It is used mainly as a dessert fruit. The juice is widely used for making a refreshing drink. Occasionally it is cultivated



Picture 43: The flowers of Sugar Apple are greenish-yellow, drooping and are borne singly or in clusters on short, leaf opposed peduncles.

in gardens and other establishments for the benefit of the enthusiastic nature lovers. The seeds, leaves, and the immature fruits contain an insecticidal principle, which is attributed to anonine—a benzylisoquinoline alkaloid.

Among the other closely related species are: Soursop (*A. muricata* L.) having asymmetrical ovoid fruits with rows of recurved fleshy spines on the green rind, and may weigh up to 3 kg. The fruit pulp has a combination of the flavour of strawberries, pineapples, and cinnamon; Bullock's heart (*A. reticulata* L.) with heart-shaped fruits of buff or reddish brown colour and has a characteristic network of lines indicating the edges of individual fruits. The flesh is white and more solid; and 'Cherimoya' (*A. cherimolia* Mill.) which is said to be the tastiest of the four and is grown at higher altitudes, unlike the others that are suited for tropical humid lowlands. It has a brown velvety tomentum on the undersurface of the leaves.