Review Article

ROOTSTOCKS OF ALMOND

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Abstract : It is well known that rootstocks are used for tree size control but we may need to remind ourselves of their other benefits. They have other specific influences such as winter hardiness, early yield, good fruit size, phytopthora and collar rot resistance, replant disease tolerance and mildew and woolly aphid resistance. The one thing they all have in common is that they produce a uniform stand of trees .The attributes required for a rootstock have become more sophisticated over the years, but limiting excessive growth, precocity ,enhancing cropping efficiency and wider adoptability to biotic and abiotic factors remains the primary targets while using rootstocks. In recent past, clonal rootstocks of temperate fruits developed in Russia, Poland, USA, UK, France etc are being evaluated in the different areas of the world (M,MM, P, Bud, MAC, Ottawa series in Apple, OH x F, Oregon series in Pear, Gisela series in Cherry, Peach x Almond hybrids rootstocks etc). "Lapins" sweet cherry cutivar had lowest trunk cross sectional area under Giesela 5 but yield efficiency was highest. Mariana plum rootstock GF 8-1 resisted to water logging for 145 and 50-60 days in winter and summer respectively, highest than other stocks studied. Various clonal and seedling rootstocks of apple, pear, peach, plum, cherry etc have been rated for their resistance, tolerance or susceptibility to biotic and abiotic factors by different researchers Cherry rootstock Avima Argot and CAB 11 E resulted in 100% survival as compared to Colt (84.6%) under non irrigated conditions from 1996 to 2004 . Modern genetic engineering technology is starting to realize much of its promise in the identification of markers that will reduce reliance on tedious, expensive, long-term field trials and thus accelerate progress. Much good scientific work and challenges remain.

Keywords : Almond, Rootstocks, Tree

INTRODUCTION

Almond (*Prunus dulcis* M.) is one of the major and oldest nut tree crop known to the mankind with wide spread popularity throughout the world. The probable origin of this nut trees crop is believed to be the area around central Asian mountains including Iran, Afghanistan, India and Pakistan. Because of climatic limitations, the principal production areas for almonds have been the central valley of California, area bordering the Mediterranean sea, south east and central Asia, limited areas in Chile, south Africa and Australia with highest production in USA fallowed by Spain. In India, almond is mainly grown in the state Jammu and Kashmir and Himachal Pradesh. However, its large scale cultivation is confined mainly to the valley of Kashmir, occupying an area of 17153 ha with a total production of 12497 MT (Anonymous, 2009-2010). The productivity of J&K is 0.73 t/ha which is more than the national productivity of 0.7 t/ha but less than the global productivity of 1.15 t/ha.

Almond is grown mainly for its kernels which are concentrated source of energy rich in fat (54.0 g), protein (19.0 g), various minerals and vitamins. The kernels and their oil (Rogne-Badam) are known for their medicinal values and are important material media in Ayurvedic and Unani system of medicine. The performance of deciduous trees with respect to crop yield, fruit size, fruit quality, storability adaptability and long term productivity are highly dependent on root stocks. Nut crops are relatively long lived species whose performance reveals the integration over time of the plants genetic composition (both of scion and the root stock in grafted plants) with the effects of the site (composed of edaphic, climatic and other biotic variables), under the cultural system used for management. There is indeed a great potential for brining more area of land under almond cultivated , provided appropriate root stocks are available which overcome the problems of seedling almonds. Thus, development of improved root stocks for almond requires an understanding, appreciation and control of that entire potential source of variation.

Root stock influences are more obscure than scion effects. Systematic root stock development through breeding require the same commitment of time and resource for scion breeding while the demonstration of rootstock efficiency require additional care in test establishment and long term monitoring. Furthermore, various site specific challenges within otherwise homogenous regions of cultivar adaptation introduces additional complexity which possibly limiting broad deployment. The historic pattern of root stock development across nut crops has been one of the dynamic interaction between a knowledgeable grower community comprised of nursery men, traditional farmer and orchardists, an active plant introduction programme and an observant scientific community, all riding a mounting wave of developing technology.

Rootstock selection criteria vary between traditional and intensive culture system, the choices are primarily between almond seedling root (for day calcareous sites), peach seedling rootstock (for acid

sites), peach almond hybrids (vigorous growth on calcareous, dry sites) and mareanna plums (for use on heavy soil). In more intensive agricultural system, other rootstocks can contribute necessary attributes; peach seedling rootstock such as 'Nemaguard' has tolerance to nematode and may have an advantage on well-trained, acidic, irrigated sites. Breeding for a new generation of interspecific rootstocks of the type M x P, M x A and Mx (P x A) have been performed in a European project (1999-2003) in order to combine disease resistance carried by Myrobalan plum accessions P. 2175 and P. 2980 with major adaptive traits carried by the Amygdalus parent. Therefore several bi-specific or tri-specific hybrids between Myropalan plums and other source available have been characterized in different years for water logging (Dichio *et al.*, 2002; Dilewangel *et al.*, 2004), drought and chlorosis, after confirming their resistance against root knot nematode by biological testing (Rubio *et al.*, 2000) and applying MAS (Lecouls *et al.*, 2004).

The almond rootstock

Fruit trees, including almond, are complex individuals made up of the symbiotic scion/rootstock association. These two components interact mutually, depending on their genotypes and environmental influence. Rootstock characteristic however, have been less studied than those of the scion. Consequently, rootstock selection has been somewhat neglected and traditionally almond seedlings from unknown origin have been used. The root system, however, is very important as good production depends upon good adaptation of the root system to the soil conditions. A mistake in rootstock selection can only be solved by uprooting the orchard.

The genetic identity of almond rootstock was rarely maintained because of the difficulty of vegetative propagation. Consequently, almond seedlings of unknown origin have been traditionally used in all growing regions. Seedling from bitter almonds was preferred because they were believed to be more resistant to drought and to soil pests than sweet almond seedling. Additionally this offered a use for bitter kernels. These favorable characteristics, however, have not been confirmed in the orchard. In recent years seedling from selected cultivars have been recommended, because they are quite homogenous and show good nursery characteristics. This is the case for 'Dasmayo Roji', 'Garringuer' and 'Atocha' in Spain. An effort has been devoted to the selection of mother plants producing seedling with better characteristics (Oliver and Grasselly, 1988). Almond growing in irrigated conditions does not allow the use of almond seedling as rootstocks. Consequently, peach seedlings of selected cultivars such as 'Lovel' and 'Nemagourd' have been used, although the problem of tree heterogeneity has not been completely solved.

Repeated attempts to select a clonal almond rootstock have failed due to the difficulty of vegetative propagation in this species (Felipe, 1983, 1998; Nicotra and Pellegrini, 1989). Consequently, the first clonal rootstocks used for almond were different selections of plum, a species of generally easy vegetative propagation and good adaptability to soils with asphyscia and fungal problems. Plum rootstocks, however, require frequent irrigation and are not adapted to non-irrigated conditions. Moreover, plum rootstocks show cases of graft incompatibility with some amond cultivars (Felipe, 1977). Some hexoploid plum clones, however, show good graft compatibility with almond and can be used under irrigation. Therefore, breeding for a new generation of inter-specific rootstocks have been performed in a European project in order to combine disease resistance carried by Myrobalan plum with major adaptive traits carried by the Amygdalus parent (Xiloyannie *et al.*, 2007; Dichio et a., 2002 and Dirlorwanger *et al.*, 2004) developed several bi-specific and trispecific hybrids between Myrobalan plum and the Amygdalus and observed that genotypes derived from the cross P.2175 x GN15 were tolerant to water logging conditions and GN15 and GN22 showed greater sensitivity. Rubiocabetas *et al.* (2000) reported that P2175 x GN15-9, P2980 x GN15-9 clones which were genotypes with peach x almond hybrid percentage and the parent GN15 responded better to drought stress. The experience acquired during these studies has allowed the identification of different problems related to rootstock in almond and of the characteristics desired to solve these problems. Thus, we will review all the requirements of an almond rootstock in order to establish ideolypes according to biotic and abiotic factors by Dickmann *et al.* (1994).

Characteristics of an almond rootstock ideotype (Dickmann *et al.*, 1994).

1) **Nursery characteristics:**Easy propagation**,** seedling with high germination rates**,** homogenous plants, cuttings **(**early and unexpensive cutting production**,**easy rooting and strong root system) and nursery behavior**(**erect growth habit with few feathers at the budding point**,**easy distinction from the scion)
2) Graft compatibility : compatibility with all or most cultivars.
3) **Orchard characteristics:** High transplant rate**,** homogenous development**,** induced size adequate to the growing conditions**,** high precocity and productivity**,** high water and nutrient efficiency**,** good anchorage and low sucker production
4) **Resistance to biotic and abiotic factors:** Good adaptation to problematic soils (heavy and/or calcareous soils),resistance to adverse conditions**,** drought**,** root crown asphyxia and soil pathogens**(**Nematodes**,** Insects (Capnodis

etc.)**,**Bacteria (Agrobacterium)**,** Fungi (*Verticullium, Armillaria* etc.)

5) Good sanitary status: Free from known virus, phytoplasmas

The various rootstocks used for almond are described below :

I) Almond seedling rootstock: These have been primarily used in Europe and other Mediterranean countries where most orchards grow on highly calcareous soil and often without irrigation (Graselly and Olivier, 1977; Loreti and Marsai, 1990). This stock has been traditionally used in Australia (Bankes and Gathercole (1977) and many parts of the world. In irrigated and highly fertile soils, use of almond seedling as rootstock has ceased due to the problems of slow initial growth and delayed productivity (Kester *et al.*, 1985).

Positive characteristics: Great rusticity shown by their ability to survive on poor soils with high limestone content as well as with a scarce availability of water. They are more tolerant to excess boron and chloride.

Negative characteristics

1. They suffer from transplantation shock
2. They are sensitive to soil diseases, *Agrobacterium, Phytopthora, Armillaria* etc.
3. They are sensitive to root and collar rot.

II) Peach seedlings: Peach seedlings are the dominant rootstock for almond in California and in various other parts of the world where irrigation is practiced, soils are slightly acidic and highly intensive production practices exist.

Negative characteristics: Sensitive to crown gall, *Vrticillium,* oak root fungus, root knot nematode. The several peach seedlings rootstocks are :

A) Lovell: Better anchorage than nemguard**,**slightly more tolerant of wet soils than nemaguard**.**more tolerant to ring nematode

Disadvantage: Less vigorous than nemaguard**,**susceptible to all nematodes, bacterial canker (less than nemaguard) phytopthora, oak root fungus, crown gall, high lime soils and high salt and water (sodium, chloride, boron).

B) Nemaguard and nemared

Advantages: Immune to root knot nematode**,** vigorous and compatible with all almond varieties**,**perform well in sandy loam and loam soils and decent anchorage and Industry standard in San Joaquin valley.

Disadvantages: Susceptible to ring and lesion nematode, bacterial canker, phytopthora, oak root fungus, crown gall, high soil pH/high lime and high salt and water in soil (sodium, chloride, boron).

III) Peach-almond hybrids

Advantages: Very vigorous**,** excellent anchorage**,** highly tolerant to root knot nematode, high pH and lime and more tolerant to high chloride and drought than peach

Disadvantages: Very vigorous i) tree get too big on deep, fertile soil ii) delay fruit maturity**,**very susceptible to ring nematode and bacterial canker (Fig. 1), phytopthora, oak root fungus, crown gall (Fig. 2).

Fig. 1. Bacterial canker of almond on Hansen 536 rootstock

Fig. 2. Crown gall on Hansen rootstock

Peach-almond hybrids include: Hansen 536, Nickels, Cornerstone, Titan, Bright's hybrids and Almond x Nema guard peach

IV) Marianna plums

They are believed to have originated from cross of Myrobalan plum (*P. cerasifera*) x *P. hortulana* in the United States (Day, 1953). From this hybrid various seedlings have been grown from which vegetatively propagated clones have been chosen and introduced as rootstock. Two selections used for almond in California are known as 'Mariana 2623' and 'Mariana 2624'.

a) Mariana 2624

Advantages: Resistant to rootknot nematode**,**tolerant to 'wet feet' and crown gall**,**resistant to heart rots and oak root fungus.

Disadvantages: Highly dwarfing rootstock**,**suckers profusely (Fig. 3)**,**incompatible with non-pareil and Livingston (Fig. 4, 5).marginal compatibility with Butte and Monterey lesion nematode and bacterial canker.shallow root system (Fig. 6).

Fig. 3. Root suckering of Marianna 2624 plum rootstock

Fig. 4. Overgrowth at union on Marianna 2624 rootstock

Fig. 5. Incompatibility symptoms of nonpareil on Marianna 2624 plum rootstock

Fig. 6. Marianna 2624 is very shallow rooted

V) Interspecific hybrids of peach, almond, apricot and plum : they include :

a) Viking: Vigour is similar to nemaguard**,** better anchorage than nemaguard**,** resistant to root-knot nematode and ring nematode**,** tolerant to bacterial canker than other commonly used rootstocks.**,**more tolerant of high lime soil than nemaguard**,** less susceptible to chloride than nemaguard and susceptible to dehydration during cold storage or transplanting

b) Atlas:less susceptible to chloride than Nemaguard and Lovell.**,** more susceptible to ring nematode than Viking**,** more precocious than Nemaguard.

c) Plum x almond hybrids : They show good rootability and are compatible with both almond and peach.

d) *Prunus besseyi* x Myrobalan plum: A selection P2037 is being used in France which provides semi-vigours tree with good compatibility to almond. Yield efficiency is high.

e) *Prunus tomentosa* x *P. besseyi* : Very compatible with almond and produce weak tree.

f) *P. besseyi* x peach: A selection originating from Illinois was tested in France that give good vigour and compatibility with almond but has

poor anchorage.

g) 'Pollizo' plums: This group of plum rootstock, apparently *Prunus insititia* of the Saint Julien type has been traditionally utilized in the Murica district of Spain as rootstocks of peach, apricot and almond. This results from their adaptability to highly calcareous and compact soils in that area. Variation exists in their ease of propagation and compatibility with almond.

New Russian prunus rootstocks

1) Krymsk86: *Prunus persica* x prunus :Tree size similar to lovel, compatible with almonds, peach, nectarines, apricot and European plums, excellent graft or smooth union,tolerant to well and heavy soils and is cold hardy and high tolerance to high pH, precocious and increase fruit size and yield and with strong root system and propagate easily with soft and hardwood cuttings and perform well on replant sites
2) Kryansk 1 : *Prunus tomentosa* x *Prunus cerasifera*:Reduce tree size 40-50 per cent., compatible with peach, almond and nectarine, precocious with good field yield efficiency, tolerates to cold climate, wet and heavy soil conditions, sensitive to dry conditions,propagate easily with soft and hardwood cuttings
3) Krymsk 2: *Prunus incana* x *Prunus tomentosa*: Reduce size by 40 per cent, excellent graft union with no overgrowth, precocity with good yield efficiency, tolerant to dry soil conditions and cold climate and propagates easily with soft and hardwood cuttings

Rootstocks under trial (1) Butte (2) Colusa (3) Kern (4) San jaoquin

Problems to almond cultivation

The main problem for extension of almond cultivation (Dedampour *et al.*, 2006) are as under :High segregation of seedling rootstock, salinity and drought condition, calcareous and alkaline conditions, waterlogged condition, Diseases: Crown gall (*Agrobacterium* sp.), honey fungus (*Armillaria mellea*), crown rot and wet feet (*Phytopthora* sp.) and Nematode : Root-knot (*Meloidogyne* spp.), ring (*Mesocrickonema xenoplax*), lesion (*Pratylenchus* spp.), Dagger (*Xiphinema* spp.).To solve above problems, fruit breeders carried out research and released different rootstocks which can sustain these conditions. Dejampour *et al.* (2006) evaluated 120 genotypes and selected 11 promising genotypes were selected based on vegetative traits, cold hardiness, disease and pest resistance and stresses Tab.1

Table. 1 Hybrid rootstocks of almond

S. No.	Rootstock	Parentage	Vigor reduction with respect to GF677 (%)	Suckering	Adaptability (cold, disease and soil)
1.	HS419	Almond x peach	30	No suckering	Very good
2.	HS302	Apricot x plum	10	-do-	-do-
3.	HS312	Almond x peach	Similar to GF677	-do-	-do-
4.	HS407	Apricot x plum	10	-do-	-do-
5.	HS417	Almond x prune	10	-do-	-do-
6.	Hs324	Apricot x plum	30	-do-	-do-
7.	HS416	Apricot x prune	30	-do-	-do-
8.	HS411	Apricot x plum	20	-do-	-do-
9.	HS314	Almond x peach	10	-do-	-do-
10.	HS414	Plum seedling	50	-do-	-do-
11.	HN-1	Prunus Fenzlian	-	-	-

Pinochet *et al.* (2002) reported different response of rootstocks for root-knot, lesion nematode and crown gall which are indicated in Table 2.

Table 2. Rootstock resistant to nematodes

S. No.	Rootstocks	Parentage	RKN	LN	CG	Other interesting traits
1.	Cadaman	Peach	HR	S	S	-
2.	Flordaguard	Peach	HR	S	S	-
3.	Adarcias	peach x almond	4	S	-	Medium vigour
4.	Felinem	4	MR	MR	S	Resistance to iron chlorosis
5.	Mayor	4	S	S	-	11
6.	Ishatala	Plum	HR	S	-	Compatible with other prunus varietes
7.	Mareanna2624	Plum	HR	S	S	Resistance to Armilleria
8.	Torinal	Plum	MR	MR	MR	Multiple resistance to soil borne pathogen

RKN - Root-knot nematode, LN – Lesion nematode, CG – Crown gall
Resistance rating: HR – Highly resistant, R – resistant, MR – moderately resistant, S – susceptible
Anne-Chaire *et al.* (2004) observed Ma gene which is responsible for resistance in prunus speices. They observed different responses in prunus species which are indicated in Table 3.

Table 3. Nematode resistance in rootstocks

S. No.	Rootstock	Parentage	Host susceptibility				Resistance status and genetic control
			MA	MI	MJ	M. sp. Florida	
1.	Nemared	Peach	R	R	R	S	Two homozygous genes to MI (Mi and Mij) and one homozygous gene to Mj/Mij (Lu *et al.*, 2000)
2.	Alnem1	Almond	R	S	R	S	One homozygous dominant gene to MI (Kochba and Spiegel Roy, 1975)
3.	Garfi	Almond	S	S	S	S	Esmenjaud *et al.*, 1997)
4.	GF.557	Almond x peach	R	R	S	S	Species specific resistance (Esmenjaud *et al.*, 1994)

MA – *Melordogyne arenaria*, MI – *M. Incognita*, MJ – *M. javanica*
R – resistant, S – susceptible

Dirlewanger *et al.* (2004) studied new interspecific hybrids between nematode resistant Myrobalan plums, *P. cerasifera* (P. 2980 and P. 2175) and peach (*P. persica*) x almond (*P. amyydalus*) and reported that P.2175 x GN has significantly greater tolerance to waterlogged condition than its control rootstock (GF677). Rubio-carbetas *et al.* (2000), Lecolus *et al.* (2004) studied various interspecific hybrids and found that P2175 x Gn15-9, P2980 x GN15-9 which are genotypes of peach x almond and GN15 parentage responded better to drought stresses.The other horticultural influence by use of rootstock are :

1) **Vigour:** Rootstock has dwarfing effect which resulted introduction of different fruit production system including Palmette, Fusetta, perpendicular-V, spindle, Spanish bush and others (Balmer, 2001; Long, 2001). Duncan and Edstrom (2006) studied vigour of carmel and non-pareil cultivar on 16 rootstocks (Fig. 7). The figure indicates that smallest trees were on the plum rootstocks (Penta, Julior, Adesoto and Kuban) while as Nickels and Hansan produced largest trees.

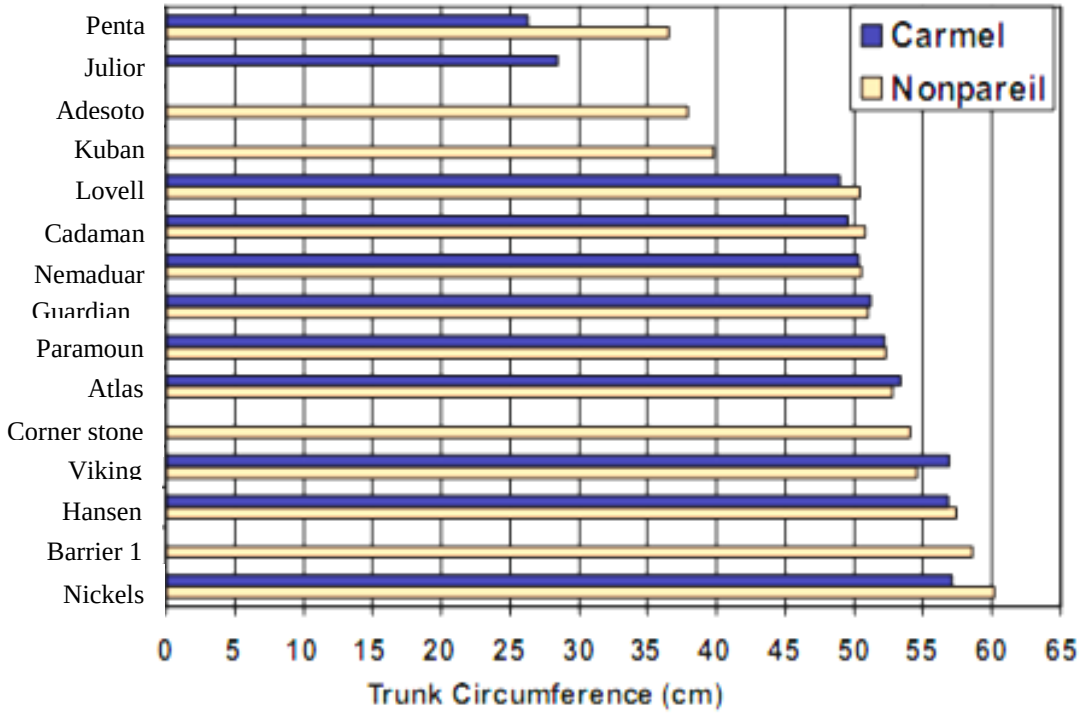

Fig. 7. Rootstock influence on size of 4th leaf nonpareil and carmel almond trees

2) Bloom time: The potential for a rootstock to promote or delay bloom probably deserves more attention than it receives while these effects are subtle for scion cultivars grafted onto rootstocks of same species, however, the use of other rootstock species can produce more significant shifts in bloom time (Reighard *et al.*, 2001). Such bloom date alternation can translate into proportional harvest date alternations and/or can be important for spring frost susceptibility or avoidance (Lang *et al.*, 1997). Duncan and Edstrom (2006) reported effect of different rootstocks on bloom percentage of almond scions (Fig. 8) which indicate that carmel bloom significantly later than non-pareil.

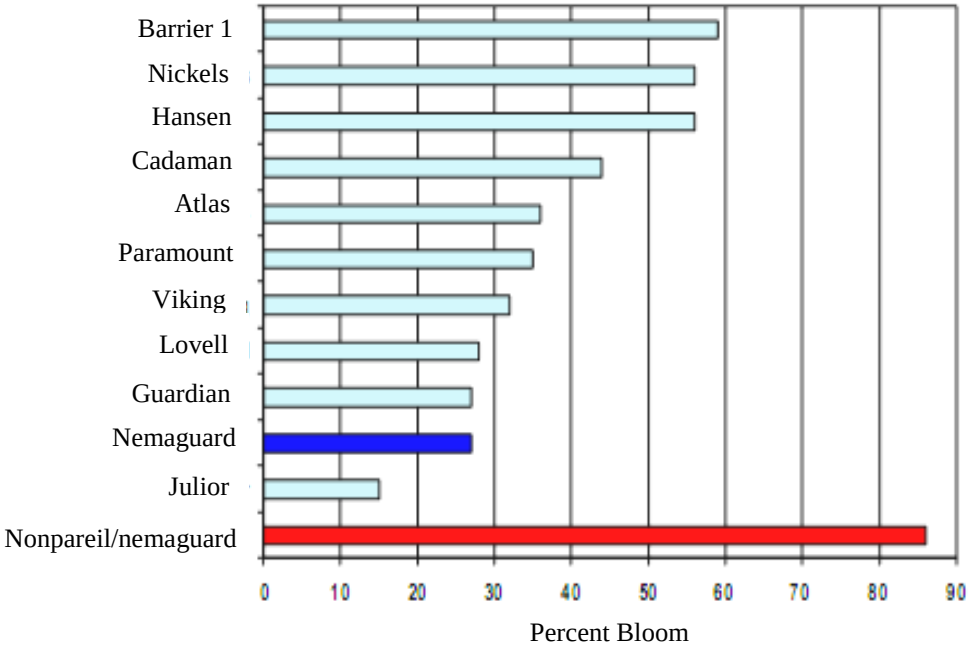

Fig. 8. Percent bloom of carmel almond as influenced by rootstock

3) Precocity and productivity : Perhaps just as important as vigour control, many of these rootstock induce profound increase in precocity and productivity, which have challenged researches and growers to develop appropriate crop insufficient annual growth (Choi and Andersen, 2001; Lang, 2001). Duncan and Edstrom (2006) studied effect of different rootstocks on the yield of carmel almond (Fig. 9).

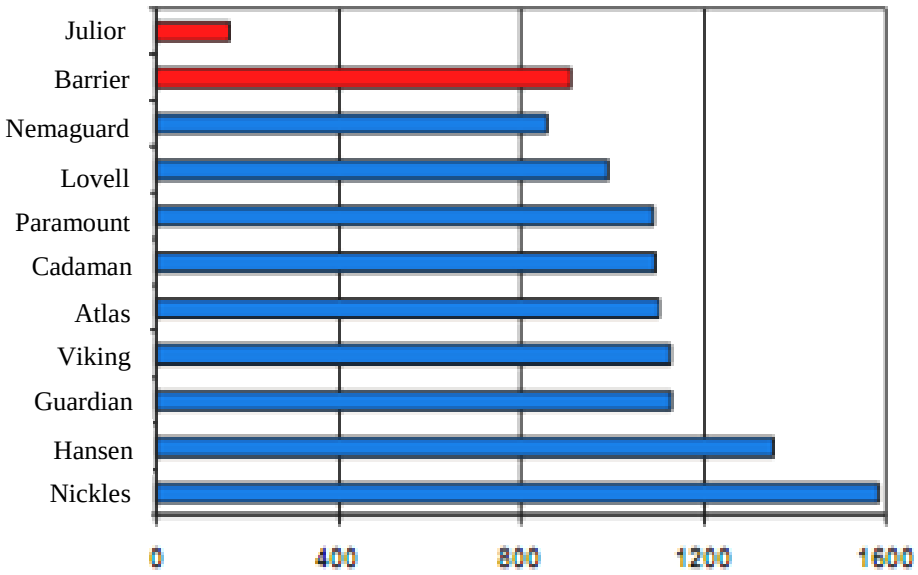

Fig. 9. Yield of 4th leaf Carmel Almond trees on various rootstocks

4) Graft compatibility: Scion/rootstock graft compatibility is a critical issue for orchard performance and longenvity. It is, perhaps most important problem in almond, apricot and cherry. Cannel (2006) identified two plum type rootstocks that were possibly compatible with non-pareil. The most important horticultural characteristics of several commercially available rootstocks are indicated in Table 4. The disease management of several commercially available almond rootstocks Table.5

Table 4. Most important horticultural characteristics of several commercially available rootstocks

S. No.	Rootstock	Parentage	Compatibility	Vigour	Anchorage	Drought rolerance	Salinity	Alkalinity	Boron tolerance	Wet feet	Suckering
1.	Lovel	Peach	Good	Low	Low	Low	Low	Low	Low	Medium	Low
2.	Nemaguard	Peach	Good	Medium	Medium	Low	Medium	Low	Low	Low	Low
3.	Nemared	Red leafed peach	Good	Medium-low	Low	Low	Low	Low	Low	Low	Low
4.	Peach x almond hybrids (Hansen, Brought, Nickele, Cornerstone paramount GF677	Peach x almond	Good	High	High	Medium	High	High	High	Very low	Low
5.	Mrianna 2624	Plum	Not compatible with Livingston marigin al compatibility with Buttle or Monterry	Low	High	Low	Low	Low	Low	High	High
6.	Atlas	Peach x almond x apricot x plum	Good	Medium-high	Medium	Medium	High	High	High	Low	Low
7.	Ishtera	Plum x wild peach x peach	Unknown	Low	Unknown	Unknown	Medium	High	High	High	High
8.	Krymsk86	Peach x plum	Unknown	Medium	High	Low	Low	Low	Low	High	Low
9.	Red titan	Red leafed peach x almond	Good	Medium-high	Medium-high	Medium	High	High	High	Very low	low

Table 5. Disease management of several commercially available almond rootstocks

S. No.	Rootstock	Parentage	RKN	RN	LN	Identified canker	Phytophthora	Crown gall	Armillaria
1.	Lovel	Peach	High	Low	Moderate	Low	Moderate	Moderate	Moderate
2.	Nemaguard	Peach	Resistant	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
3.	Nemared	Red leafed peach	Resistant	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
4.	Peach - almond hybrids (Hansen, Brought, Nickele, Cornerstone paramount GF677	Peach x almond	Most resistant paramount susceptible	High	Low	High	High	High	Moderate
5.	Mrianna 2624	Plum	Resistant	High	Moderate	High	Low	Low	Low
6.	Atlas	Peach x almond x apricot x plum	Resistant	High	Moderate	High	Moderate-high	Moderate-high	Moderate
7.	Ishtera	Plum x wild peach x peach	Resistant	High	Moderate	High	Low	Low	Low
8.	Krymsk86	Peach x plum	High	High	Moderate	High	Low	Low	Low
9.	Red titan	Red leafed peach x almond	Resistant	High	Low	High	High	High	Moderate
10.	Viking	Peach x almond x apricot x plum	Resistant	Low	Moderate	Low	Moderate-high	Moderate-low	Moderate

FUTURE WORK AND NEEDS

Preservation and Exchange of Germplasm

All breeding programs need germplasm as foundational, raw materials. Many recently introduced rootstocks are interspecific hybrids of conventional rootstock species with "exotic" unimproved species that often have no precedent in rootstock usage. A case in point is the USDA rootstock program in Georgia. Many of this program's *Armillaria*-resistant rootstock selections are hybrids with native North American plum species, which as a rule are woefully under-represented in the US Germplasm Repository system. Much of the "available" diversity in these native species is currently stored solely in the breeding collections of the stone fruit breeding programs outside the relative safety of the repository system. At the turn of the century, several hundred fresh market plum cultivars were available that were either selections or hybrids with native North American species (Wight, 1915). However, these were rapidly displaced by the introduction of improved plum cultivars utilizing introduced *P. salicina* materials. Today, barely a handful of the native species-based materials still exist, yet these and the native species from which they were developed have tremendous potential for utilization in solutions for many of our modern problems (Beckman and Okie, 1994). Moreover, much of the wild diversity has disappeared, either because of intentional eradication efforts to reduce wild reservoirs of diseases and insect pests, or because of land development. This is a worldwide problem and a troubling one.

As regionally-oriented stone fruit production industries grow and begin to provide product to national and international markets, a profound shift in germplasm usage also typically occurs as growers change varieties to suit these larger and often more lucrative markets. Such a shift has been seen in the Mexican peach industries, which utilized seedling land races or local cultivars grafted on locally-adapted seedling rootstocks. More dramatic shifts were seen as Spain's peach industry grew into a major supplier of stone fruit to European Union (EU) markets. Typically, no concerted effort has been made to preserve this potentially valuable germplasm since it is often viewed as "obsolete" and worthless.

Nevertheless, some of the most significant advances in rootstock adaptation were made with obscure germplasm, such as hardy peach accessions from northern China that produced clearly superior performers under harsh winter conditions in Canada (Layne, 1987). Germplasm exploration needs our continued support and involvement, but so does the preservation of native and naturalized materials in our own backyards that may be slowly disappearing right out from under our noses.

Efforts have been undertaken to evaluate and describe the variability and possible breeding value of some germplasm, such as the 'Vineyard' peaches in Yugoslavia (Vujanic-Varga *et al.*, 1994; Paunovic and Paunovic, 1996), Spanish peach seedling populations (Badenes *et al.*, 1998), and Mexican peach seedling populations (Perez *et al.*, 1993). With the exception of the 'Vineyard' peaches, only scion characteristics were evaluated. Some material has been collected and is being retained, if only on a regional basis at this time.

We also see an emerging problem as many breeding and development programs move forward in the production of complex interspecific hybrids. These materials often display varying levels of sterility, ranging from reduced flower density and set to complete infertility. In hybrids of both native North American plum species and complex plum hybrids with peach germplasm in the USDA program in Georgia, most interspecific hybrids have been completely infertile, producing non-germinating pollen (if any) and setting no fruit (T.G. Beckman, pers. obser.). This is a problem not only within a breeding program, but also for any external program hoping to build on another's releases. Hence, unlike variety breeding programs, which by definition must release materials capable of being intercrossed, many rootstock programs release materials that functionally are genetic dead-ends. A realization of the consequences of this should engender more, rather than less, cooperation and germplasm sharing between programs. However, the ever-expanding issues of intellectual property rights and their ownership may prove to be an increasingly difficult hurdle. Indeed, many programs already exchange and market material only with severe limitations on the use of that material in breeding programs. It is not unusual for non-propagation agreements to include "reach through" clauses giving the "donor" full rights to any hybrids made in the receiving program, be they F_1 or F_2, clearly a step above the traditional "essentially derived" definition of ownership.

Constraints on the exchange of materials will work against the progress and even survival of small and moderate breeding programs, unless they are part of a "group" of (most likely non-competing) programs that exchange germplasm and ideas freely among themselves. Corporate breeding programs, particularly vertically integrated ones that do not offer their cultivars for sale to the public (leasing them only to licensed growers), will end up becoming more or less 'one-way sinks' for germplasm and technology.

Seedling vs. clonal types

Despite the clear shift from seedling to clonal types over the last 10-20 years, seedling types still rule in most stone fruit industries. Obvious exceptions would be the use of peach x almond hybrids on calcareous soils, i.e., 'GF677' in southern Europe, and the likely large-scale shift to the new interspecific cherry hybrid selections where size control and precocity have been needed so badly. The reasons for the continued dominance of seedling types are obvious: low cost (pennies per plant vs. dollars in some cases) and convenience. The ease with which seedling types can be incorporated into the nursery production scheme should not be overlooked either. In those industries situated in suitable climates, the comparative ease of direct fall planting of a relatively hard to injure seed is a valuable asset compared to the management-intensive process of transplanting and caring for rooted cuttings or tissue-cultured plantlets. In many industries, the predominant production areas suffer from relatively few limitations and for those problems which seedling types have offered solutions, i.e. root-knot nematodes and PTSL, a clonally propagated alternative may be seen as overpriced. Niche planting is likely to be the most common use for many of the clonal materials produced to date, though this will not be true in some industries. The extensive need for tolerance to calcareous soils and adequate vigor on low fertility sites in many production regions of Europe will continue to drive the use of clonal peach x almond and peach x davidiana materials, since no comparable seedling counterpart has been developed.

One significant limitation to the future use of seedling types is the issue of uniformity. Outcrossing in seed production orchards no doubt varies widely but in peach appears to be typically between 2–6% (Beckman, 1998). The impact of these events goes largely unnoticed if only because of our inability to detect such events. The frustrating variability in delayed tree mortality due to graft incompatibility, as with certain seedling cherry and apricot rootstocks, is a clear example of the potential negative ramifications of this genetic variability. Also, as orchard management becomes more intensive in a highly competitive global market, increased uniformity of rootstock performance across various scion varieties will be more important for achieving efficient profitability. Virtually all of the dominant seedling stone fruit rootstocks lack any morphological feature, such as red leaves, to allow visual detection of outcrosses in the nursery setting. If good control of outcrossing, or at least efficient rogueing techniques, could be devised, then even interspecific hybrid seedlings could be made practical. Several potentially useful lines have been

proposed and developed but have not enjoyed adoption due, in part, to problems with nursery production efficiency and uncontrolled outcrossing with resulting variability. This area is worthy of more attention.

The use of doubled haploids is another avenue that deserves consideration. In the absence of an outcrossing event, this allows the production of a "seedling clone" of the mother plant (Scorza and Pooler, 1999). Such seedlings could then be handled like any conventionally produced sexual seedling, with the attendant lower production and management costs compared to conventional clones produced via cuttage or tissue culture. A major obstacle is the relative rarity of haploids.

Molecular analysis of key rootstock traits

This is a promising research area, with molecular analyses becoming more routine, automated (such as DNA microarrays), and genetically powerful (with tools such as the Arabidopsis genomic library). While such work pertinent to stone fruit rootstock breeding is increasing, little has yet to be found in the scientific literature. In cherry, DNA microarrays have been created to examine rootstock and rootstock-induced scion gene expression, with particular emphasis on genes associated with dwarfing and perhaps grafts incompatibility . Similarly, a homolog to the Arabidopsis flowering-associated gene, LFY,\ has been identified in sweet cherry, and is being used to probe rootstock\ induction of scion precocity and flower spur formation (G. Lang, pers. commun.). The molecular analysis of such traits is expected to lead to more efficient capabilities for developing and/or evaluating the improved expression of key horticultural or pathological traits in stone fruit rootstocks and grafted scions.

Rootstock Evaluation Methodology

Current testing programs such as the NC-140 in the United States (Perry *et al.*, 2000), the Working Group on Rootstocks in Italy (Loreti, 1997) and the International Cherry Rootstock Trials in Europe (Kemp and Wertheim, 1996), among others, are laudable in both their aims and progress to date, and will likely continue to grow in their sophistication and usefulness. Most new rootstocks were developed at least in part with some improved resistance to a disease, pest or edaphic limitation. With the possible exception of climatic adaptation, these characteristics are difficult to evaluate accurately in the current regional and international testing trials. Indeed, it would not be practical to evaluate characteristics pertinent to longevity in conjunction with a horticultural trial typically utilizing as few as 8-10 single tree replications, as is the case of the NC-140 trials. Even minimal tree losses during the course of the trial would seriously compromise the collection of meaningful horticultural data. Nevertheless, in the absence of an organized effort to provide meaningful, broad evaluation of the non-horticultural characteristics of these new materials, they will likely be introduced into distant marketplaces with only tentative recommendations for their use in dealing with the very diseases and problems they were developed to address. We propose that some effort needs to be made to provide uniform testing of disease, pest and edaphic performance under realistic field conditions as a counterpart to the horticultural trials currently performed. Necessarily, these will have to be limited in number, as probably only regional trials will be practical and affordable, especially given the larger replication needed to evaluate problems that can result in the death of non-resistant materials.

For the evaluation of rootstock impact on fruit quality issues, an economic analysis would be a useful addition to typical horticultural testing. In many markets, there is currently no economic incentive to provide improved quality characteristics beyond some minimal base level for example % soluble solids. However, in virtually all markets there is a premium paid for larger size fruit, in which case some trade-offs (e.g., reduced total yield) can be more than made up with the premium paid for larger fruit. Appropriate application of pricing structures at each trial location would help growers and extension personnel sort out which rootstock may maximize economic return. Additionally, the type of long term production data typically generated in large scale performance trials lends itself to a variety of statistical analyses to reveal genotype × environmental interactions and performance stability (Olien *et al.*, 1991), as well as relative production risk (Harper and Greene, 1998). Such analyses would provide valuable feedback to breeding programs and better inform growers and extension personnel.

Impact of marker assisted selection (MAS)

Although MAS holds promise for all areas of rootstock breeding through reduced cost and increased efficiency (and speed) of evaluations, it has the best potential for profound impact on those characteristics that are particularly difficult to evaluate. This is because the testing procedure itself relies on a currently expensive methodology, and/or the opportunity to score populations is infrequent. Either problem can severely slow progress. Field evaluation of cold hardiness or dwarfing is examples. Diseases that cause tree mortality well after establishment would also be prime candidates for the development of markers. Field evaluation for resistance to both PTSL and Armillaria root rot is difficult not only because of the lack of uniformly infected field sites, but also because field screens typically require at least 5-7 years to achieve sufficient mortality to allow differentiation of the resistant lines from the susceptible. Efforts are underway to develop markers for many important traits, including graft compatibility, precocity, and resistance to root-knot nematodes, PTSL and Armillaria root rot.

Those traits controlled by only a few genes are more likely to provide usable markers than are those controlled by many genes. The investment in effort to produce and accurately score a suitable segregating population to generate the initial marker trait associations, will doubtlessly require substantial effort in many cases. Molecular markers having few alleles per locus such as RAPDs and AFLPs are likely to have low transferability rates between pedigrees and may require mapping in each segregating population. Microsatellite (SSR) based markers which are typically codominant and have multiple alleles per locus are likely to be much more informative in inbred species such as peach.

Another application of this technology is the use of markers for the purpose of identifying rootstock cultivars (Cantini *et al.*, 2001). This has utility not only for the protection of intellectual property rights, but also for the field verification of rootstock identity (Struss *et al.*, 2002), which is often difficult (if not impossible) in nursery or orchard situations, yet would be extremely helpful when diagnosing performance problems.

CONCLUSION

Considerable progress has been made in recent years in the development of better adapted rootstocks for stone fruits. Indeed, in a few cases, such as waterlogging tolerance for almond, progress has been such that there has been a significant reduction in the perceived importance of the problem. Progress has been made in the development of more efficient screening procedures, which in turn leads to the identification of useful variability, both of which by necessity precede the development of commercially useful materials. Modern genetic engineering technology is starting to realize much of its promise in the identification of markers that will reduce reliance on tedious, expensive, long-term field trials and thus accelerate progress. Much good scientific work and challenges remain.

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SEABUCKTHORN – A VALUABLE RESOURCE OF THE COLD DESERT (LADAKH)

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Abstract: Seabuckthorn grows extensively throughout Ladakh region of J&K state (India). Its distribution extends from Nubra (District Leh) on one side upto Drass (District Kargil) on the other and encompasses Zanskar valley. It is a dioecious thorny shrub and if left undisturbed, attains the size of a small tree. The plant has gained tremendous importance by virtue of its pharmaceutical, cosmaceutical and nutraceutical value. Despite having such a potential, the plant is still under utilized in this region.

Keywords: Cosmaceutical, Dioecious, Ladakh, Nutraceutical, Pharmaceutical, Seabuckthorn, Underutilized

INTRODUCTION

The existing literature lacks clarity about the real identity of Seabuckthorn; the plant that has assumed tremendous importance during last few decades because of its multiple uses. It has earned several epithets such as the Golden Bush of Himalaya, Ladakh Gold and Wonder Plant. What is not clear from the existing literature is whether the name Seabuckthorn refers to all taxa of the genus *Hippophae* L. (Erkkola and Yang 2003; Naithani 2004) or specifically to *Hippophae rhamnoides* L. (Rousi 1971; Li 1999, Jeppsson *et al*.1999; Gao *et al.* 2000). A member of family Eleagnaceae (Oleaster family), Seabuckthorn is native to Europe and Asia (Hooker 1878).

Seabuckthorn holds the potential of changing the face of Ladakh, if exploited the way it has been in China, Russia, Mongolia, Canada, etc. China is the largest producer of SBT products; the total value of which is a little over 20 million US dollars. It is therefore not surprising that the area under cultivation of Seabuckthorn in different regions of China, has been extended from 6, 67,000 ha in 1985 to about 1,000,000 ha in 1990 (Rongsen, 1992). There are more than 200 SBT processing factories in China, developing more than 100 products including foodstuffs, beverages, medicines, cosmetics, healthcare products, chemicals, industrial material and so on. The annual yield of fresh SBT leaves in China is 15,945 kg/ha, which is 2.5 times that of alfalfa. In Northern China, every 0.13 ha of land under SBT provides fodder sufficient for rearing one sheep or goat. Fed with SBT a sheep or goat produces 5 kg more of mutton and 30% more cashmere. In a 4 year old man-made SBT forest each ha can produce 7.8 to 10.5 tons of firewood that roughly equals 6-8 tons of standard coal (Rongsen In: google/ISAexpert forum.com).

The plant can feed and sustain pharmaceutical, cosmaceutical and nutraceutical industries. To achieve this ultimate goal some basic problems need to be sorted out; foremost among these is the resolution of the taxonomic complexity of the genus *Hippophae* L., establishing the economic potential of specific taxa constituting the *Hippophae* species complex, undertaking survey for raw material availability for use in industry.

Taxonomy

Genus *Hippophae* is represented by 6 species [*H. rhamnoides* L., *H. salicifolia* D. Don, *H. tibetana* Schlecht, *H. goniocarpa* Lian, *H. neurocarpa* S. W. Liu et T. N. He and *H. gyantsensis* (Rousi 1971; Lian 2000) and 12 subspecies (Lian 2000; Naithani 2004). Of these, *Hippophae rhamnoides* is highly variable for which reason it has been split into 8 subspecies viz ssp. *rhamnoides, fluviatilis, carpatica, caucasica, turkestanica, mongolica, sinensis* and *yunnanensis.* Only 4 of these are considered economically useful. For example, *Hippophae rhamnoides* ssp. *mongolica* is extensively utilized in Russia, *H. rhamnoides* ssp. *sinensis* in China, *H. rhamnoides* ssp. *rhamnoides* in Germany, Finland, Sweden, Switzerland, Italy, etc; and *H. rhamnoides* ssp. *turkestanica* in India, Pakistan, Turkmenistan and Kirghistan (Lian 2000). Table1 summarizes the distribution range of different taxa and their present and prospective uses.

Indian Seabuckthorn

In India species of *Hippophae* grow in five states; 3 in the North-West (Himachal Pradesh, Uttaranchal and J&K) and 2 in the North-East (Sikkim and Arunachal Pradesh) Himalaya (Dwevidi *et al.* 2006) over a vast stretch of harsh, inaccessible, temperate area roughly 74,809 sq. km (Awasthi and Sankhyan In: google /Hippophae.com). Four species, namely *H. rhamnoides* ssp *turkestanica*, *H. salicifolia*, *H. tibetana*, and *H. gyantsensis* represent the genus in the country (Naithani 2004). In J&K, Seabuckthorn grows over more than 11,000 ha of land in five valleys of Ladakh viz. Leh, Nubra, Zanskar, Suru and Changthang. As per literature (Singh and Dogra 1996; Dwivedi *et al.*, 2004) Ladakh hosts *H. rhamnoides* ssp *turkestanica* and *H. salicifolia.* The two are easily distinguishable. *H. salicifolia* is a tree,

and *H. rhamnoides* is mostly bushy, but at many places, it attains the size of a tree.

Magnitude of Variability

Morphologically plants of *H. salicifolia* are less thorny with long straight or curved willow like branches. Its bark is reddish-brown with deep longitudinal furrows. Leaves are alternate, oblong-lanceolate and when young stellately pubescent on upper surface. Fruits are ovoid and yellow, longest among all the species, acidic to taste. *H. gyantsensis* (Rousi) Lian is similar to *H. salicifolia* but for its white bark, narrower leaves with whitish under surface and elliptical fruits. *H. tibetana* is densely branched shrub bearing thick, knobby tortuous thorny stem. Leaves 3 per node are whorled. Upper leaf surface is green with silvery rust coloured scales. Fruits borne on short peduncles are longer than broad.

As pointed out before also, *H. rhamnoides* is extremely variable which is attributed to its dioecious and cross pollinated nature; it can be arboreal or bushy. The 8 constituent subspecies of *H. rhamnoides* tend to intergrade with one another making their distinction arbitrary. Branching pattern, leaf size, shape, number and density; distribution of stomata, intensity of colour, pubescence of leaves and stem; shape, diameter, colour and distribution of hairs vary from plant to plant. Similarly, reproductive features like perianth shape and size, stylar length and thickness, stigma size and shape; fruit shape, size, number, colour, taste and vitamin C content; seed shape, size, texture, weight and germinability also differ considerably. *H. rhamnoides* Sp. *turkestanica* is a stiff shrub with erect or decumbent stems. Branches frequently dieback at the tips and become spiny. Twigs and young shoots bear silvery-brown scales. Leaves are sessile unlike the other three species, densely clothed with silvery brown scales along both the surfaces. Fruits are globose, orange-yellow or scarlet.

The plant species was exploited for the first time by the Field Research Laboratory, Leh for greening the mountainous terrain under Cold Desert Afforestation Programme and preparation of a herbal beverage under different trade names - Leh Berry, Ladakh Berry, Power Berry or Sindhu Berry (Dwivedi *et al.*, 2006). Except for this, no other major attempt has been made in India to tap and exploit this Nature's gift to mankind. Earlier, it was considered a weed and burnt off to clear the fields for cultivation (Brahma Singh 2004). The local populace does not know the full potential of this plant even now.

Uses

Because of its varied applications the plant is sometimes considered 'Kalptaru,"* (Duhoon *et al.* 1996; Naithani 2004). The main uses of the plant are briefly listed below to highlight the promise it holds. The nodulated roots bear *Frankia* sps. which fix nitrogen @80 kg/hectare/year. The quantity can be as high as 180 kg/hectare/year (Akkernans *et al.* 1983).

a) Stem is used as fuel which is a rare commodity in the alpine regions and burns without smoke. Its calorific value is 4785 cal/kg (Chaurasia 2003- 04).
b) Stem and branches are used for fencing fields, orchards and dwellings.
c) Bark is an effective blood purifier (Naithani 2004)
d) Leaves are utilized in preparing antioxidant rich beverage which is nutritious and refreshing (www.seabuckthorn.com). The protein rich leaves (23.9%) are used as fodder (Chaurasia 2003- 04).

   * Legendary tree of the epics - providing fruit as desired
e) SBT juice is fibrous and does not freeze at sub zero temperature and is nutritious and refreshing. Russian cosmonauts were supplied SBT beverages to enhance their health and resistance to stress. In fact, SBT juice is the first fruit juice that entered space (In www.seabuckthorn.com).
f) Fruits are used in making juice, jams, jellies, marmalades, pickles, snacks, S.B.T. milk and yoghurt (www.seabuckthorn.com; Dwivedi *et al.* 2006).
g) Seeds and fruits yield valuable oil which is in great demand for in pharmaceutical and cosmetic industries. Known to block UV radiation the oil is used in the preparation of sun screen lotions, hand and body creams, lip balm and lip gloss, SBT shampoos and conditioners and radio protective creams (Delabays and Slocanins 1995, Xu *et al.*, 2001).
h) The plant is a rich reservoir of 190 compounds present in its seed, fruit pulp and juice (Denise Code. In: www.seabuckthorn.com).These include a rare combination of fat soluble and other vitamins like C, B1 and B2, folic acid, 22 fatty acids (Chen *et al.*,1990), 42 lipids, organic acids, amino acids, carbohydrates, tocopherols and flavonoids (Yuzhen & Fuheng 1997), phenol, quercetin, terpenes and tannins and about 20 mineral elements (Denise Code. In: www.seabuckthorn.com).

i) Presence of omega-3 fatty acids (i.e linolenic acid) in SBT seed in quantities relatively higher than most other plant sources makes this plant appropriate for decreasing the risk of heart disease. The omega-3 fatty acids act by lowering triglycerides. It is also useful in treating rheumatoid arthritis, psoriasis, multiple sclerosis and systemic lupus – disorders in which the immune response is hyper-stimulated. Linolenic

acid acts on membrane phospholipids and thereby influences the immune system.

j) It finds use in medicine as anti-inflammatory, anti-irritant, anti-microbial, anti-ageing agent, as auto- immune moderator and skin conditioner. Its potential against atopic dermatitis, aphonia, cardio vascular disease, cancer, Parkinson's and Alzheimer's diseases have also been reported (www.seabuckthorn.com).

k) Under landscape management programmes the plant is used as popular garden and landscaping shrub because of its silvery leaves and stem. Florists for ornamentation use the branches (www.wikipedia/hippophae.com).

l) Considered a pioneer species, it colonizes open sites like abandoned agricultural lands, infertile wastelands, riversides, hilltops, slopes and rocky lands (Rongsen 1992).

m) It enhances ecosystem welfare by enriching oxygen deficient atmosphere of high altitudes; adding Nitrogen to infertile soils thereby promoting growth of vegetation in the scantily vegetated area; binding loose soil with its extensive root system, preventing erosion and conserving soil moisture (Rongsen 1992; Dhyani *et al.*, 2007).

With the present international market for Seabuckthorn products valued at over 60 billion US dollars per year, it is high time to utilize this forgotten gold mine lying unattended in an area otherwise poor in natural resources. The government needs to realize the importance of this plant, so that people can harness it for the economic development of Ladakh. To achieve this objective a strategy needs to be devised immediately.

Challenges

The first challenge lies in establishing which subspecies of *H. rhamnoides* is the true Seabuckthorn; followed by resolving the taxonomic wrangle of this species complex. At the same time, identification and prospecting of other species/ subspecies also need attention.

Other challenges follow. Quantification and availability of raw material that can be made available to the industry need to be determined. Similarly, morphological, cytological and molecular markers need to be employed to assess genetic variation for subsequent exploitation in breeding elite types. Hunt for spineless plants in nature as well as by induced mutation should be pursued vigorously because spines are a serious impediment for harvesting fruits. Detailed studies on reproductive biology, pollination ecology and seed-to-seed cycle need to be carried out, which will ultimately lay the foundation for selection and improvement of this nature's gift.

An initiative in this direction was taken in 2007 by the Department of Biotechnology, Govt. of India, with the identification of *Hippophae rhamnoides* as a promising bio-resource. A brainstorming session on "Sea buckthorn-problems, prospects and biotechnological interventions" was held on September 7, 2007 wherein a dire need to evolve a network programme was earnestly felt. Under the aegis of this programme, 14 research projects with funding to the tune of Rs 6.04 crore have been sanctioned to various groups engaged in Seabuckthorn research.

Table 1. Distribution and, known uses of *Hippophae* in different countries (as cited in Lu Rongsen In: google/ISAexpert forum.com)

Taxon	Areas of Distribution	Status of Utilization
1. *H. rhamnoides* subsp. *Rhamnoides*	Scandinavian countries, Baltic Sea countries, Germany, Belgium, Netherlands, Ireland, Poland, U.K, France, Russia.	Many varieties are cultivated in Canada and some European countries.
2. *H. rham.* subsp. *Sinensis*	The North, Northwest, Southwest of China.	Wild resources are used for ecological restoration and berries are processed for products. Some new varieties are in tests.
3. *H. rham.* subsp. *Yunnansis*	Sichuan, Yunnan, Tibet of China	Wild resources are used for ecological restoration only
4. *H. rham.* subsp. *Mongolica*	Siberia of Russia, Mongolia, Xinjiang of China.	More than 60 varieties are cultivated in Russia, Mongolia, and many East European countries. Many West European countries, Canada and China introduced the varieties for test
5. *H. rham.* subsp. *Turkistanica*	India, Pakistan, Afghanistan, Turkmenistan, Kirghistan, Uzbekistan, Kazakhstan, Iran, Turkey, Xinjiang, Tibet of China.	Wild resources are used for ecological restoration and berries are processed for various products
6. H. *rham* subsp. Fluviatilis	Around Alps Mountains: Germany, France, Switzerland, Austria, Czech, Slovakia, Italy.	Most of wild resources are protected as forest species. Some berries are collected for processing products

7. H. *rham* subsp. Carpatica	The Capathinan Mountains, Transsylvanian Alps, the valley and the mouths of the Donube and its tributary.	Most of wild resources are protected as forest species. Some selected varieties are cultivated for test
8. H. *rham* subsp. Caucasica	The Caucasus Mountains, Georgia, Azerbaijan, Armenia, Ukraine, Romania, Turkey, Bulgaria, Iran, Russia.	Most of wild resources are protected as forest species. Some varieties are cultivated for processing products
9. *H. gonocarpa*	Sichuan, Qinghai of China.	Most of wild resources are protected as forest species
10. *H. gonocarpa* subsp. *Litangensis*	Sichuan, Qinghai of China.	Most of wild resources are protected as forest species. Very few studies have been done on it
11. *H. neurocarpa*	Sichuan, Qinghai, Gansu of China.	Most of wild resources are protected as forest species. Very few studies have been done on it
12. *H. neurocarpa* subsp. *Stellatopilosa*	Sichuan, Qinghai, Tibet of China.	Most of wild resources are protected as forest species. Very few studies have been done on it
13. *H. tibetana*	Sichuan, Qinghai, Gansu of China Tibet of China.	Most of wild resources are protected as grassland species. Very few studies have been done on it
14. *H. gyantsensis*	Tibet of China.	Most of wild resources are protected as forest species. Some berries are collected for producing Tibetan medicine.
15. *H. salicifolia*	The Southern slope of Himalayan Mt. Tibet of China, Bhutan, Nepal, India.	Most of wild resources are protected as forest species. Some berries are collected for producing products.

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Fig. 1 (a - e) *Hippophae rhamnoides* . a. A population at Diskit, Nubra Valley; b. live stock foraging smaller plants ; c.male plant in bloom; d and e. female plants at fruiting stage: with unripe (d) and ripe (e) fruits.

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CORRELATION BETWEEN PHYSICO-CHEMICAL FACTORS AND PHYTOPLANKTON GROWTH WITH REFERENCE TO *MICROCYSTIS* SP. IN THE HERITAGE TANK BINDUSAGAR, ODISHA

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Abstract: The relationship between the nutrient level and growth of different phytoplanktonic forms was studied in Bindusagar (Bhubaneswar,Odisha). Growth of *Microcystis* sp.in a water body is regarded as an indicator of water pollution.It is a notorious, potentially toxic Cyanobacteria that causes problems in freshwaters all over the world. It contains gas vesicles that make it lighter than water, so that it can accumulate at the surface of the water column, forming toxic scums.All the organic substances, after religious performances, are thrown into the tank,round the year and this organic nutrition, in water encourages bloom formation. *Microcystis* produces hepatotoxic as well as neurotoxic protein known as microcystin that is harmful for aquatic flora, fauna, domestic animals, birds as well as for human beings.

Keywords: Algal forms, *Microcystis* sp. Pollution, Temple tank

INTRODUCTION

Comprehensive character of a water body can be assessed by studying the Limnology and the phytoplankton diversity.The quality and quantity of water decides the status of the tank like eutrophic,oligotrophic or mesotrophic.Eutrophic is a nutrient rich and Oligotrophic is a nutrient poor condition of water (Swain *et al*., 1994a). Eutrophy is a consequence of lake's nutrition enrichment (Swain *et al*., 1994b; Saha and Wujek, 1989) and it leads to loss of bio diversity, poor water quality, loss of recreational potential as well as it pollutes (Fig. B) the ground water (Kodarkar, 2004). Quality of water can be established by studying the physico-chemical as well as the biological factors. Now-a-days the aquatic organisms are called as "biological Litmus Paper" (Nandan and More, 1999). Thus the algal bioassay, combined with physico-chemical characteristics can be carried out to assess the quality of water in fresh water bodies (Krishnamoorthi and Choudhury, 1990).

Some of the Microcystis species as reported to be found globally from time to time are, *Microcystis ichthyoblabe* Kützing 1843, *Microcystis aeruginosa* (Kützing) Kützing 1846, *Microcystisflos-aquae* (Wittrock) Kirchner 1898, *Microcystis firma* (Kützing) Schmidle 1902, *Microcystis viridis* (A. Braun in Rabenhorst) Lemmermann 1903, *Microcystis densa* G.S. West 1909, *Microcystis pseudofilamentosa* Crow 1923, *Microcystis protocystis* Crow 1923, *Microcystis natans* Lemmermann ex Skuja 1934, *Microcystis bengalensis* Banerji 1936, *Microcystis botrys* Teiling 1942, *Microcystis lamelliformis* Holsinger 1954, *Microcystis wesenbergii* (Komárek) Komárek in Kondrateva 1968, *Microcystis novacekii* (Komárek) Compere ex Komárek 1974, *Microcystis comperei* Komárek 1984, *Microcystis smithii* Komárek et Anagnostidis 1995, *Microcystis panniformis* Komárek et al. 2002. *Microcystis argentea* Schiller 1954, *Microcystis elongate* Desicachary 1959, *Microcystis maxima* Bernard 1908, *Microcystlis pallida* (Farlow) Lemmermann 1940, *Microcystis prasina* (Wittrock) Lemmermann in Frémy 1930, *Microcystis punctata* Schiller 1954, *Microcystis ramose* Bharadwaja 1935, *Microcystis robusta* (Clark) Nygaard 1925, *Microcystis rosea* Kufferath 1942 *Microcystis scripta* (Richer) Geitler 1925, *Microcystis supersalsa* Schiller 1956, *Microcystis toxica* Stephes 1949 (http://www.cyanodb.cz/).

In Puri and Bhubaneswar four types of Microcystis have been identified (Swain and Adhikary, 1990). Different species of *Microcystis* have also been identified from other parts of India like, Udaipur Lakes (Chaudhary and Meena,2007), Upper lake (UL), Lower lake (LL) and Mansarovar reservoir, (MR), Bhopal (Garg and Garg, 2002), Unkal lake, Dharward, Karnataka (Ansari *et al*., 2008). Thus the establishment of correlation between the nutrients and the phytoplankton growth with special reference to bloom forming *Microcystis* (Fig. C, D), is the aim of this study.

MATERIAL AND METHOD

Description of the Tank: The site is situated adjacent to the famous ancient Lingaraj Temple, which is visited by thousands of devotees and tourists every year. The geographical location of Bhubaneswar is 20° 25' N, 85° 15' E, at an altitude of 45 meters above sea level in the east coast of India. Once upon a time, Bindusagar tank (Fig. A) was bordered by over 7000 temples and today 500 still survive. People believe that when a person takes a dip in the sacred Bindusagar Lake, the Holy water washes away all his/her sins and he/she will also be free of diseases. This rectangular tank was built approximately during

7th / 8th Century A.D and is about 21.5 acres in area having breadth and length of 320 and 450 meters respectively.

Physico-Chemical Factors: Sampling was made at monthly interval on clear days between 8 to 10 a.m.from Jan – Dec 1992. Water temperature, transparency and dissolved oxygen were measured on the spot. Other parameters were measured in the laboratory within next 24 hours following APHA (1975) and Adoni (1985).

Phytoplankton Factors: Phytoplankton samples were collected using plankton net (NXX 13, 15μ, Rigosha and Co. Ltd. Tokyo) transferred to screw cap plastic bottles, fixed with Lugol's iodine on the spot and analysed in the laboratory. Quantitative analysis was done by haemocytometer (Fein-Optic, Germany) and qualitative analysis was carried out by using relevant literatures (Desikachary, 1959; Philipose, 1967 and Adoni, 1985).

RESULT AND DISCUSSION

The daily minimum and maximum air temperature of Bhubaneswar varies from 20.2 – 37.4 (ºC), 20.0 – 32.9 (ºC) and 10.5 – 30.9 (ºC) during Summer (March – June), Rainy (July – October) and Winter(November – February) season respectively. But water temperature showed variation of 25 – 34 (ºC) throughout the year which might be due to convection of currents (Table – 1). *Microcystis* (Fig. C, D) blooms often appear in eutrophic waters at high temperature (Yoshinaga et al., 2006) as it happened in this study site during summer season. Average transparency with standard error was found to be 36.4± 2.36and it was minimum during April and is positively correlated to growth of *Microcystis* (Vijayvergia, 2008). Annual average pH was 8.93±0.09 with a maximum of 9.4 during peak summer, showing its alkaliphilic nature (Devi *et al.*, 2010). Ideal pH range is 6.7 to 8.4 while pH below 5.0 and above 8.3 is detrimental to health as per ICMR Standards (7.0 to 8.5) (Gupta *et al*.,2011). Study on Unkal lake showed similar range of pH (Ansari *et al*.,2008). The alkaline nature of water due to high pH values can be attributed to high productivity of water as evident by high growth rate of algal population (Singh and Balasingh, 2011) which utilized CO_2 through photosynthetic activity (Kumar and Kapoor, 2006) on surface water (Gupta *et al.*, 2011). Free $CO_2$was totally absent throughout the year. Dissolved Oxygen varied between 4.4 – 7.3 (mg/l).During April higher dissolved oxygen was observed along with highest growth of *Microcystis* due to the conditions during these periods, which were more favourable for high rate of photosynthesis (Kumar and Kapoor, 2006). Due to this activity of the organism, alkalinity was diligently higher (Dwivedi, 2010). Maximum bicarbonate was observed during March and minimum during January where the range of chloride content was 48.8 – 79.5 mg/l. The increased concentration of chloride is considered as an indicator of eutrophication (Mahananda *et al.*, 2010). Average Ca-hardness was 59.9mg/l. Comparatively higher total phosphorus(soluble reactive phosphate, polyphosphate and soluble as well as insoluble organic phosphorus) was found throughout the year (Nayak and Behera,2004).But during May when the water temperature was highest (34 ºC), phosphate amount was reduced to a significant amount due to its immediate utilization by the overgrowth of phytoplankton. It is a major nutrient for the growth of phytoplankton and its concentration can be used to predict the total biomass of phytoplankton (Somek *et al*., 2008).The tank water was moderately hard (Kannan,1991), which might be due the utilization of these ions by the organisms (Parikh andMankodi,2012). Higher range of nitrate-nitrogen, organic – nitrogen and ammonia was found (Retnaningdyah *et al.*, 2010). During the month of October magnesium was totally absent even if the average annual value recorded was 5.54 ± 0.89.

A total of 45 species of phytoplankton were identified from the lake consisting of 27 Chlorophyta, 13 Cyanophyta, 5 Bacillariophyta, (Table.2). Analysis of chlorophyll-a showed 66.8mg/l during January which was increased up to 158.8 mg/l during April. Range of cellular carbohydrate was 18.4mg/l (September) to 38.0mg/l(April) and GPP was 1.8 mg C/l/h to 2.85 mg C/l/h. *Microcystis* was present abundantly throughout the year having highest density during summer. Temperature plays a major role in determining the diversity, productivity and periodicity of algae (Sedamkar and Angadi, 2003).The bloom of *Microcystis* is an indicator of organic pollution, as observed by Ansari *et al.*(2008). Relation between abiotic factors,total phytoplankton and *Microcystis*: *Microcystis* and, total phytoplankton showed negative correlation with transparency and positive correlation with pH(Pradhan and Shaikh, 2011). But this routine survey showed, extensive development of *Microcystis* blooms, during the months of summer season (March to May).Similar observation was also reported by Kumar *et al.*(2011).For the confirmation of significant level of the correlation of total phytoplankton as well as of *Microcystis* sp. with various physico – chemical characteristics of water of the study sites, t- value was also calculated and depicted in Table – 3.The Cyanobacterial species and dissolved oxygen, bicarbonate and carbonate showed positive correlations as also observed by Muthukumar, *et al*. (2007).The sulphate, nitrate and bicarbonate content was higher in Unkal lake as compared to Bindusagar whereas the situation was reverse in case of phosphate content. This may be the reason for predominance of Chlorophyta in Unkal lake and predominance of *Microcystis* in Bindusagar Tank. It is desired that greater number of extensive

works be undertaken in India to find out other species and varieties of this pollution indicator. Recently Indian government has started taking steps to conserve this sacred tank by approving a project titled 'Conservation of the Heritage Tank Bindusagar of Bhubaneshwar' under 'Urban Renewal Sector' during Feb 2007.

Table 1. Monthly values of Physico-chemical characteristics of water of Bindusagar tank of Bhubaneswar

Parameters	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
Water Temp. (^oC)	25	25	30	30.2	34	32.8	31	30.8	30.2	29.8	28	26.6
Sacchi Transparency	41.9	40.9	45.7	20.8	29.5	38.8	30.6	39.4	48	42	30	29
pH	9	9.2	9.3	9.4	9.3	8.8	8.5	8.4	8.8	8.8	8.8	8.7
Dissolved Oxygen (mg/l)	6.75	6	6.2	8.1	7.05	6.3	6.45	5.78	4.43	4.49	7.13	7.28
Free CO_2 (mg/l)	0	0	0	0	0	0	0	0	0	0	0	0
Carbonate (mg/l)	22.5	28	46.5	58.5	45.5	41.5	31	23	14.5	16	11	15
Bicarbonate (mg/l)	23.8	32.5	58.8	43.3	39.6	32.9	27.9	16.7	8.33	20	29.6	22.5
Chloride (mg/l)	59.3	60.8	61.5	65.3	79.5	63.8	48.8	50.3	59	63.8	72	61.5
Ca-hardness (mg/l)	41.9	38.5	38	35.6	28.7	28.9	32.6	39.6	59.9	63.2	36.5	24.2
Total hardness (mg/l)	64	63.7	70	59.1	48	49.9	51.8	55.2	69	42	76	71.3
Phosphate(mg/l)	1	0.82	1.11	1.4	0.5	0.47	1.93	1.28	0.41	0.69	1.11	0.93
Nitrate-Nitrogen(mg/l)	0.95	0.97	0.99	1.2	1.1	1.3	1.6	.1.4	0.93	1.1	0.96	1.1
Nitrite-Nitrogen(mg/l)	0.022	0.015	0.013	0.024	0.033	0.029	0.031	0.04	0.022	0.031	0.041	0.034
Ammoniacal-Nitrogen (mg/l)	1.37	1.14	1.23	1.46	2.8	2.3	1.4	0.88	0.73	0.81	0.93	1.12
Total organic Nitrogen (mg/l)	4.7	5.9	6.15	3.58	2.8	2.41	3.09	2.88	2.72	3.35	4.05	5.9
Magnesium (mg/l)	5.37	6.12	7.78	5.71	4.69	5.08	4.68	3.78	2.22	0	9.59	11.5
Sulphate (mg/l)	1.14	0.94	0.67	0.6	0.47	0.53	5.89	4.65	3.25	0.71	0.59	0.65

Table 2. Monthly variation of Phytoplanton quality of Bindusagar Tank

PHYTOPLANKTON	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
CYANOBACTERIA												
Microcystis aeruginosa	OA	OA	DS	DS	DS	OA	OA	OA	OA	OA	OA	OA
Microcystis aeruginosa-flos-aquae	OA	OC	--	--	--	OC	OC	OC	OC	OC	OA	OA
Microcystis wessenberghii	OA	OC	OC	OC	OC	OC	OC	OC	OC	OA	OA	OA
Microcystis viridis	OC	OC	OC	OC	OC	--	--	--	--	--	OC	OC
Dactylococcopsis	--	OC	--	--	--	--	--	--	--	--		OC
Merismopedia	OC	OC	OC	OC	OC	OC	OC	OC	--	OC	OC	OC

PHYTOPLANKTON	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
punctata												
Lyngbya contorta	--	--	--	--	--	--	--	OC	--	OC	OC	OC
Occilatoria boryana	--	--	--	--	--	--	--	--	--	OC	OC	OC
Aphanizomenon flos-aquae	--	--	--	OC	--	--	--	--	--	--	--	OC
Anabaena flos-aquae	OC	OC	OC	OC	OC	OC	OC	--	--	OC	OC	OC
Anabaenopsis circularis	OC	OC	OC	OC	--	--	--	--	--	--	--	--
CHLOROPHYTA												
Pandurina sp	--	--	--	--	--	--	--	OC	--	--	--	--
Shoederia setigera	--	--	--	--	--	--	--		--	--	OC	OC
Coelastrum sphaericum	--	--	--	--	--	--	--	--	--	--	OC	OC
Pediastrum boryanum	--	--	--	--	--	--	--	--	--	--	--	OC
Chlorella conductrix	OC	--	--	--	--	--	--	--	OC	--	--	--
Chlorella parasitica	--	--	OC	--	--	--	--	--	--	--	--	--
Chlorella vulgaris	--	--	--	--	--	--	--	OC	OC	--	--	--
Ankistrodesmus convolutus	OC	OC	OC	--	--	--	OC	OC	--	--	--	--
Chlosterdium bengalicum	--	--	--	--	--	--	--	OC	--	--	--	OC
Chlosterdium obesum	--	--	--	--	--	--	--	--	--	--	OC	OC
Tetraedron minimum	--	--	--	OC	--	--	OC	OC	OC	OC	OC	OC
Tetraedron pentadricum	OC	--	--	--	--	--	--	--	--	--	--	--
Tetraedron regularae	--	OC	--	--	--	--	--	--	--	--	--	--
Tetraedron trilobulatum	--	--	--	--	--	--	--	OC	--	--	--	--
Selenastrum gracile	--	OC	OC	--	--	--	--	--	--	--	OC	--
Scenedesmus acuminatus	OC	OC	OC	OC	--	--	OC	--	--	--	OC	OC
Scenedesmus bijugatus var. bicellularis	--	--	--	--	OC	--	--	--	--	--	--	--
Scenedesmus bijugatus var.graevenitzii	OC	OC	OC	OC	OC	OC	--	--	--	--	--	--
Scenedesmus longus	--	--	--	--	--	--	--	--	--	--	OC	OC
Scenedesmus prismaticus	--	--	--	--	--	--	--	OC	--	--	--	--
Scenedesmus quadricauda var.longispina	--	OC	OC	OC	OC	OC	OC	--	--	--	OC	--

PHYTOPLANKTON	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Scenedesmus quadricauda var.quadrispina	--	--	OC	OC	--	--	--	OC	OC	OC	OC	OC
Crucigenia apiculata	--	--	--	OC	OC	--	--	--	--	--	OC	--
Cosmarium sp.	--	--	OC	--	OC	OC	OC	--	--	--	OC	--
BACILLARIOPHYTA												
Mastogloia danseii	--	--	--	OC	--	--	--	OC	--	--	--	--
Pinnularia nobilis	--	--	--	--	--	--	--	OC	--	--	--	OC
Stauroneis phoenicentron	--	--	--	--	--	--	--	--	--	--	--	OC
Cymbella cistata	--	OC	--	--	--	OC	--	--	--	--	--	--
Stephandiscus nigarae	--	OC	--	--	--	--	--	--	--	--	--	--

OC: Occurred, OA: Occurred Abundantly, DS: Dominant Species, AB: Absent

Table 3. Correlation coefficient (r) value and test of significance (t) value of cell number of *Microcystis* sp.and Number of Phytoplankton with Physico-chemical Properties of water of Bindusagar tank of Bhubaneswar

S.No.	Physico-chemical characteristics	Cell number of *Microcystis* sp.		Number of Phytoplankton	
		(r)	(t)	(r)	(t)
1	Water Temperature (°C)	-0.049	-0.155	-0.052	-0.165
2	Sacchi Transparency	-0.163	-0.522	-0.163	-0.522
3	pH	+0.784	+3.999	+0.783	+3.983
4	Dissolved Oxygen	+0.230	+0.748	+0.241	+0.784
5	Free CO_2	0	0	0	0
6	Carbonate	+0.489	+1.776	+0.485	+1.755
7	Bicarbonate	+0.408	+1.412	+0.416	+1.447
8	Chloride	+0.086	+0.971	+0.299	+0.992
9	Ca-hardness	+0.177	+0.567	+0.162	+0.518
10	Totalhardness	+0.145	+0.464	+0.169	+0.542
11	Phosphate	-0.006	-0.02	-0.006	-0.019
12	Nitrate-Nitrogen	-0.380	-1.281	-0.383	-1.312
13	Nitrite-Nitrogen	-0.440	-1.531	-0.425	-1.487
14	Ammoniacal-Nitrogen	-0.080	-0.264	-0.086	-0.274
15	Total organic Nitrogen	+0.127	+0.404	+0.132	+0.421
16	Magnesium	-0.055	-0.175	-0.031	-0.097
17	Sulphate	-1.364	-1.234	-0.369	-1.257

Fig. A. The Heritage Tank Bindusagar Located in the vicinity of Lingaraj Temple of Bhubaneswar.

Fig. B. Thick scum of *Microcystis* bloom along with the left over after religious performances thrown into the tanks by pilgrims.

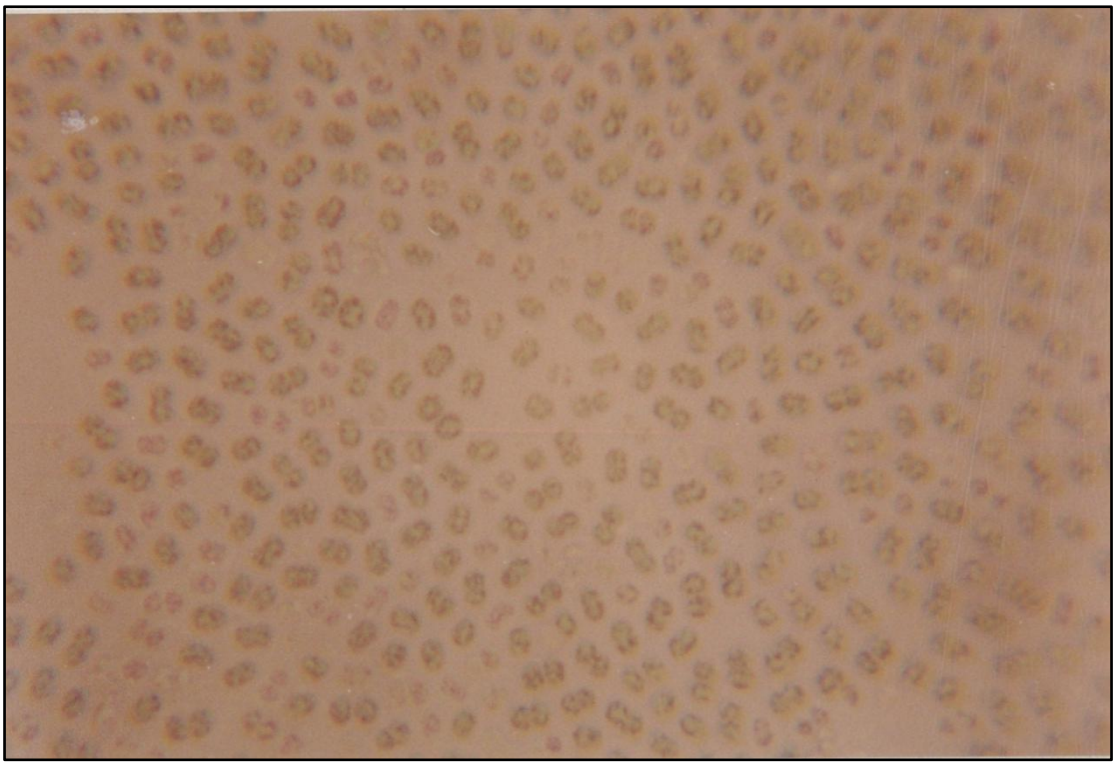

Fig. C. Light microscopic photograph of pure culture of *Microcystis aeruginosa* isolated from Bindusagar tank (x 1860).

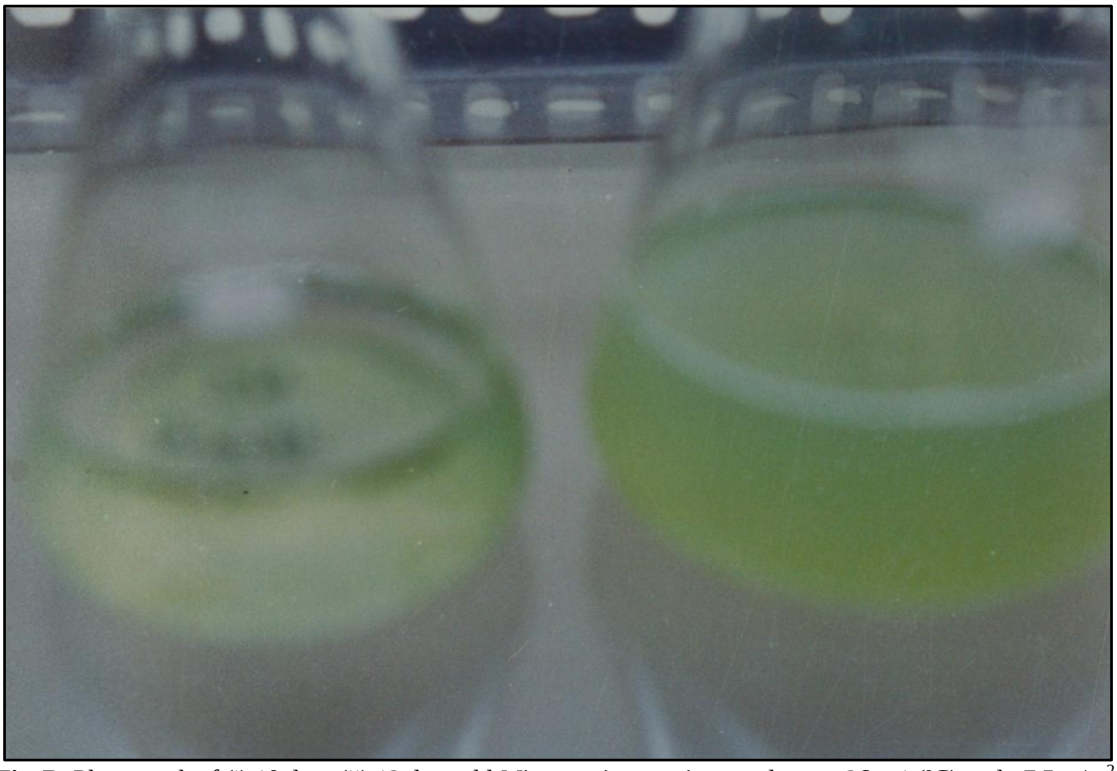

Fig. D. Photograph of (i) 10 days (ii) 12 days old *Microcystis aeruginosa* culture at 26 + 1 (ºC) under7.5 w/m^2.

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GENETIC DIVERSITY, DOMESTICATION AND CONSERVATION IMPLICATIONS OF FRUIT MORPHOMETRIC DATA ANALYSES FOR *DACRYODES EDULIS* IN SOUTHERN NIGERIA

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Abstract : *Dacryodes edulis* – African Pear is of socio-economic importance in the Southern region of Nigeria where it is a major auxiliary revenue source for farmers. Cluster and Principal Component analyses of the fruit data showed three distinct groupings; small-sized fruit, large-sized fruit and an intermediary group of mixed fruit types. These reflect the cadre of genetic diversity inherent in the taxon, and constitute a possible veritable tool for its improvement. Notwithstanding the diversity, the prevailing spread pattern of the taxon across the region threatens to erode a section of the species genetic richness; the small-sized fruit types - var. *parvicarpa*, as well as undermine the genetic integrity of large-sized fruit var. *edulis* population. The trend is driven by a vendor/farmer preference for the large-sized fruit type across the region, and except there is deliberate *In situ* and *Ex-situ* conservation efforts, these intraspecific diversities of the species may be lost altogether.

Keywords : African pear, Farmer/vendor, Genetic erosion, Intra-specific diversity, Spread pattern.

INTRODUCTION

Dacryodes edulis (G. Don) H.J. Lam., constitutes a veritable plant resource for timber and non-timber products in West Africa; with the potential to contribute immensely to the dietary, pharmaceutical, industrial raw materials requirement as well as offer environmental conservation potentials in such countries (Gbile and Adesina 1986).

The species evidently originated and is wide spread and cultivated in the humid, inter-tropical forest of southern Nigeria, Congo and Cameroun (Ngatchou and Kengu 1989). The species is plastic and grows at varied altitudes under a wide range of day length, temperature and edaphic factors. In Nigeria, the species is distributed along the "African pear belt" running from the South–West to the South-East of the country, between the very wet rain forest of the south and the drier savanna of the north. (Aubreville 1962; Kennedy 1936; Keay 1989).

Okafor (1983) identified two varieties of *Dacryodes edulis* var. *edulis* and var. *parvicarpa* on the basis of their fruit shape and size. The var. *edulis* is elongated and ellipsoid, more than 5 cm long and 2.5 cm across; var. *parvicarpa* is rounded to more or less conical, less than 5 cm long and 2.5 cm across. Youmbi *et al.,* (1989), Leakey and Ladipo (1996) and Silou *et al.,* (1999) have reported variation in fruit size and other fruit characteristics in Cameroun. Equally, there is also the report of tree-to-tree variation in fruits (Anegbeh, 2005). With all these variation within a more or less "Wild" population, the genetic resources offers an opportunity for plus-tree selection, such as is already recorded for *Irvingia gabonensis* (Atangana *et al.*, 2001).

Genetic Resources Utilization and Erosion

The characterization of the genetic resources (diversity) of *Dacryodes* is still in its early stage. Certain ecotypes are presumably cultivated in particular localities; however there are evidences of interbreeding coupled with a variety of selection pressures. Whether natural or artificial, selection pressures often focus on the desirable parts(s) of plants, which eventually results in a vast genetic pool as demonstrated for most domesticated plants. This genetic diversity form the basis for plant breeding and improvement efforts and where the integrity of the diversity is compromised, whether by failure to sustain the species, through selective cultivation, or by indiscriminate replacement with introduced forms; genetic erosion sets in (Mok and Schmiediche 1999), which can be exacerbated by deforestation and related activities.

D. edulis faces a stringent regime because the taxon exists only as stands in homestead and traditional agroforestry systems (Aiyelaagbe *et al.,* 1998; Akachuku 2006). The species have only begun to receive some attention and this poor attention coupled with habitat fragmentation, deforestation as well as unsustainable arable land use resulting from economic distresses, urbanization industrialization pressures (Obute and Osuji 2002; Ayodele 2005); prompted the present attempt to ascertain, through fruit morphometric data analysis; the genetic diversity status of the species, the prevailing domestication culture and spread pattern across southern Nigeria and its effects on the genetic integrity as well as conservation needs for *Dacryodes edulis*.

MATERIAL AND METHOD

Study Area

The study area falls within the humid Southern

Nigeria tropical rainforest (Fig. 1). Extending from the South-west (7°15' N; 5^0 55'E), to the South-east (6^0 8'N; 6^0 55'E).

Sampling Frame

The study area consisted of four primary sampling areas: South-west (SNW), South-south South-east (SNE), South-south (SNS) and South-north (SNN), within each sampling area, production areas were ascertained, from where sampling sites were determined. A total of 60 sampling sites were visited. Sampling points co-ordinates were recorded with a hand-help Garmin Colorado 400i GPS. Several collection trips were made to sampling sites, which comprised of homesteads, farmlands, rural (marginal) markets and urban (central) markets. Collection continued throughout the fruiting season from July to December of the 2008 - 2010.

Accession Identification and Sorting

Preliminary morphological identification of fruit accessions commenced at the collection point by direct field observation, with the assistance of farmers, vendors, and household members. Mature, ripe, dark coloured fruits were selected for examination and measurement. Information on local names, descriptions and uses supplied by farmers and vendors were employed for the initial selection, 96 fruit lots were generated from the field collections.

Fruit collections were harmonized and character descriptors to be measured were examined to ascertain their regularity amongst the various fruit lots from the different sampling areas. Duplicates collections as well as fruits with characters that were not consistent across the sampling areas were excluded. A total of 17 fruit samples were sorted for examination and measurement (Table 1).

Fruit Descriptors and Measurements

A total of thirteen (13) character descriptors (Table 3) were generated and examined for the study. Descriptors were generated according to IBPGR (1980); IPGRI (1996, 1997). Ten (10) mature fruits were measured per lot. Quantitative measurements were recorded to the nearest 0.01cm using a Vernier calliper. Single-multi state coding method was employed for descriptors coding. All measurements were completed within 12hours after each collection to avoid fruit pulp deterioration and discolouration and stored at under 4^0C in a non-frost Super-520 Laboratory Refrigerator afterward. Varietal identification of accessions lots was as outlined by Okafor (1983). Adopted colour chart is as charted by Royal Horticultural Society (RHS 1986).

Analysis of Data

Accessions diversity was examined by hierarchical cluster analysis (CA) from a Euclidean distance matrix and principle component analysis (PCA) ordination in space using SPSS 15.0 for Windows.

RESULT

Fruit Character Descriptors

Thirteen fruit character descriptors (Table 3.) generated for the study are: fruit size (fs), fruit shape (fsh), mature skin colour (msc), seed length (sl), seed shape (ssh), fruit/seed size ratio (f/s), fruit epicarp texture (ft), fruit apex (fa), fruit base (fb), fruit interior (fin), fruit pulp diameter (pd), seed position (sd) and endocarp detachment (edt).

Hierarchical Cluster Analysis

The dendogram (Fig. 1) from the cluster analysis separated into three clusters with a mix of the accession from the various zones.

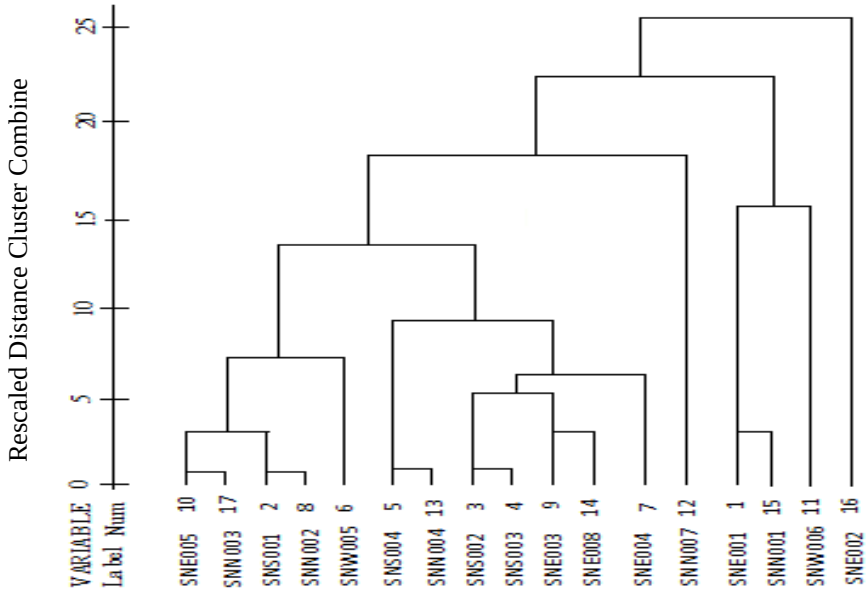

Figure 1. Cluster analysis of the 17 accessions: members of the first cluster are var. *parvicarpa*, (SNE005, SNN003, SNS001, SNN002, SNW005, the last cluster consist predominantly of var. *edulis* (SNE001, SNN001, SNE002, except SNW006); the middle cluster consists of var. *parvicarpa* and var. *edulis* accessions

Principle Component Analysis

The PCA clumping (Fig. 2) resulted in three groups (a-c) with accessions members similar to those of the clusters (Fig. 1).

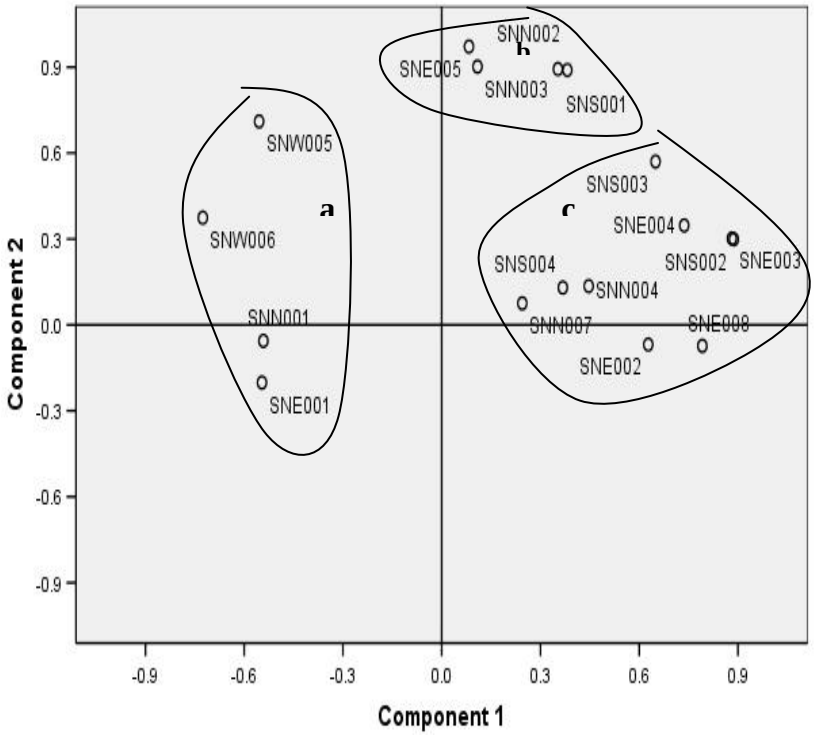

Figure 2. Principle component analysis - PCA ordination in space for the 17 accessions, showing the three groups. Clockwise: Group a, with 4 accessions, Group b with 4 accessions and Group c with 9 accessions.

Analysis Comparison

The squared Euclidean between group cluster analysis of the 17 accessions recorded 3 clusters of varied size. Two smaller clusters (Cluster 1 and 3) accounting for about 41% flank a middle larger cluster (Cluster 2). Similarly, the PCA clumping resulted in three groups (a-c) with similar members as the three clusters; except for the displacement of accession SNE002 by SNW005 in the first group (group a) the addition of two extra accessions to the with middle group b, with 53% accession membership and one accession less in group c.

There is a considerable degree of congruence between the CA and PCA results, with 82% similarity in the grouping pattern; resulting in three distinct groupings similar in size, and identical in membership. The similarity in membership in either analysis is one of the highlights of the present study and the uniformity of the results observed for both analyses is hinged on the consistency of the character descriptors as well as the number characters (13) employed for the analyses.

The dispersion observed for the clusters/groups are linked to a number of characters; fruit apex and base outline, fruit size, fruit shape and seed length that together exerted greater delimiting strength on the resultant grouping than other characters and account for 62.56% of the cumulative component strength under the PCA analysis (Table 4). The resultant groupings separate along the fruit characters line exerting the most delimiting strength as:

Group a (Cluster 1)

● 3.30-4.60cm by 2.50–2.80cm in size .....var. *parvicarpa*

○ Widely Ellipsoid - obovoid in shape

●Fruit with reniform apex, and ringed fruit base,

●Seed, 2.30 – 3.75cm in length

Group c (Cluster 2)

●4.00-7.00cm by 2.00 – 3.30cm in size. ..... var. *edulis; parvicarpa*

○ Narrowly Ellipsoid - ovoid in shape

●Fruit with reniform or oblique apex; ringed or ringless fruit bases,

●Seed, 3.20 – 4.50cm in length

Group b (Cluster 3)

●5.20-8.20cm by 2.40 – 3.30cm in size ..... var. *edulis*

○Narrowly Ellipsoid - Ellipsoid in shape

●Fruit with oblique, with ringless fruit bases,

●Seed, 4.00 – 4.35cm in length

DISCUSSION

One major indicator of the lack of research on *Dacryodes edulis* and other tropical indigenous tree crops is the dearth of information such as standard

character descriptors, which are of great importance in the selection, management and utilization of the genetic resources of the species; as well as for taxonomic, genetic diversity studies and improvement programmes. The thirteen character descriptors generated from the present study (Table 3) will be of immense application in studies involving *Dacryodes edulis*.

Genetic Diversity

The statistical grouping observed is important in interpreting the distribution and diversity of the taxon within the study area. The three groups recorded for both analysis, reflects the consistency of the characters in the construction of the dendogram and scatter plot (Figs. 1 and 2). The first grouping (cluster 1/group a) consists mainly of accessions classed as var. *parvicarpa*, the latter grouping (cluster 3/group b) almost exclusively clumped var. *edulis* accessions, and the mid grouping (cluster 2/group c) housed a mix of either varieties. This may suggest a convergence of the landraces/accessions toward the centre, with resultant mixing of erstwhile distinct accessions; a common situation with increased cultivation.

The characters employed for this delimitation are rather overlapping, hence the corresponding overlap nature of the groups. Earlier delimitation by Okafor (1983) employed only two characters (fruit size and fruit shape) when compared with the 13 engaged for the present attempt. Though overlapping, the resultant groupings present a more robust consideration and a finer (less ambiguous) delimitation for *D. edulis* at the sub species level as well as a better expression of the degree of intra-specific diversity inherent in the taxon, with three separation groupings. The presence of two distinct "*edulis"* "*parvicarpa"* groups agrees with Okafor (1983) earlier delimitation. However, the emergence of a third large group of mixed population differs with that submission, but rather points to an aspect of the population that may have been ignored altogether by the earlier demarcation. Evidently, the taxon posses a population of accessions unaccounted for by the earlier delimitation, distinct enough to substantiate the rich intra-specific variability and the possible degree of genetic diversity housed within the taxon.

Domestication Culture

The strongest intent and concern of all human cultures has been to satisfy hunger, and this constitute the fulcrum of evolution of human food and the main drive behind the various processes of domestication of wild plant for food (John 1990). Consequently, the demand for the edible part(s) of the plant have often determines it cultivation and possible spread.

Observed during the survey, is the growing cultivation of certain accessions of the species. This spread pattern has resulted in a westward cultivation of these accessions from the eastern end. The pattern is a reflection of the steady domestication going on in the western end of the study area, where hitherto, the species was not cultivated. Interestingly, the accessions implicated in the spread are the large-sized fruit type. This not surprising as the spread is directly linked with the seasonal production and sales of *Dacryodes edulis* fruit, which follows a unidirectional movement from the eastern production area to the western end with insignificant production. Certainly, higher income from sales in non producing areas have driven the resultant spread of the species toward such areas and expectedly, only those fruit types that attracts high prices will be sold into such areas and thus will be domesticated by people in these areas. This trade route constitutes the path of increased cultivation observed in the west; and while the drier north cannot support the plant growth; the wetter west can, and have encouraged a steady proliferation (Fig. 3).

Species/accessions with a narrow geographic distribution, specific habitat or small population sizes, are more likely to become victims of elimination where they particularly enjoy very little patronage by farmers/collectors and vendors alike (Rabinowitz 1981). This is the present situation with the small-sized fruits (var. *parvicarpa*) which have not enjoyed the same level of patronage as the large-sized fruit across the region, but have been restricted to marginal cultivation areas (Fig. 3), as well as markets in villages and often do not attract sizeable sales at all, except only in the latter end of the fruiting season when the large-sized fruits are out of season.

Fruit Dispersal and Spread

Most taxa of the Burseraceae family except for *Beiselia*, *Boswellia*, and *Triomma*, possess fruits adapted for endozoochoric dispersal, an attribute that has been integral to in the establishment of isolated oceanic island floras (Carlquist 1974); as well as the spread of most fruit through animal and *Homo sapenic* consumption and dispersal. This is the prime stimulus that drives the domestication of these fruit and one that have made *Dacryodes edulis* an esteemed fruit in Central and West Africa (Leakey *et al.*, 2003).

This spread and increase cultivation pattern observed for the large-sized var. *edulis* fruit however drives a trend that encourages only a slim genetic pool as it is entirely market/vendors rather than farmer driven. This is because the movement westward is entirely based on the price tag on the fruits; hence fruit that have not enjoyed vendors' patronage will certainly loss out of this spread, which leaves only a very lean selection from the diversity inherent in the south, east endemic area of the taxon. Similarly, farmers in the production area will increasingly loss interest in those accession/ecotypes that attract less attention

from vendors and may ultimately be abandoned or replaced altogether, a situation that is common with most indigenous fruits.

Figure 3. Southern Nigeria (Study area) with the direction of spread of the large fruit size Westward and the restricted movement of the small sized fruit

Neglect and Erosion and Conservation

The domestication and sales of species/ecotypes/accessions is often a critical issue and where the accessions enjoy less economic incentives to cultivate and conserve them; the resultant environmental and genetic implications are far reaching for the species and the genetic assortment it may hold for the future. (Leaman et al., 1997). In such situation, common cultural domestication practices cannot be relied on to conserve the species or the accession in question, as such common cultivation habits hinged only on economic incentives will often support only a narrow group of highly favoured accessions.

This present scenario is conservation-wise a worrisome one, in that the spread of the large-sized fruit types westward is driven entirely by the economic incentives it offers. This will certainly eliminate accessions that are not so prized and even amongst the large-sized accessions those without desirable and marketable traits will suffer similar fate. Equally, the small-sized accessions stands no chance at all at been selected for domestication outside the production area and even within the production areas, the small-sized fruits are increasingly under-cultivated and only marginally sold in rural markets, because they attract the least price and hence are of least interest to vendors and consequently farmers.

The overall choice of plant and plant parts consumed by local inhabitants are need-based driven by local cultures and specific attributes (Jain 2000). If the foregoing assertion holds, then the concern is that these small-sized fruits may be facing a race against genetic erosion and their genetic diversity integrity may inadvertently being undermined, by the prevailing domestication culture regarding the taxon within the study area. Interestingly, the study area constitute the zone where the taxon is cultivated in Nigeria, hence the selective cultivation of the large-sized fruits types over the less-fancied small-sized fruits driven by a vendor/farmer preference hinges on the high market profile of the large-sized fruits is worrisome for the species.

Genetic erosion of these accessions may eventually set in and the continuation of the presently observed cultivation preference will certainly exacerbate the condition. While the fruits of *Dacryodes edulis* are mainly eaten fried, roasted, or boiled; a few accessions are sourced for their contribution to medicinal preparations (Gill 1992); and majority of these medicinal fruit types are of the small-sized accessions. Hence the poor contribution of the small-sized fruits to farmers' purse may have fuelled

the observed trend. The medicinal potentials they hold are only localized and may not constitute enough incentives to change the trend and hence the accessions are increasingly isolated in the production areas (Fig. 3).

Considering these domestication trends, in comparison to the diversity present in *D. edulis* expressed by the analysis of its fruit morphometric data; conscious efforts whether *Ex-situ* and/or *In situ* conservation efforts must be engaged to conserve both set of accessions as only a very narrow genetic pool will be cultivated and ultimately a sizeable section of the genetic assortment of the species may be lost.

CONCLUSION

Dacryodes edulis an underexploited tropical fruit tree possess a rich genetic diversity as revealed by the fruit morphometric data analysis and some aspect of this diversity enjoys a gradual spread across the southern region of Nigeria. However, this genetic diversity is being threatened by a selective domestication culture that favours large-sized fruit, neglecting other less-fancied accessions. The small-sized tree accessions are continually under cultivated and only marginally sourced and utilized. This trend is not unconnected with farmer/vendors' preferences for the large-sized fruits types and except conscious efforts toward conservation of these small-sized, fruit trees and some aspects of the large-sized fruit, these veritable genetic resource may soon become a relic of the taxon rich diversity.

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CONCEPT OF ORGANIC FARMING AND GREEN FOOD PRODUCTION IN HORTICULTURE

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Abstract : Now a days, the term "Organic" is getting popularity in all aspects along with agricultural products. But as far as a farmer is concerned, the organic matter in the soil is important as it provides everything to the soil, good health, and character relation with crop, microclimate for microorganisms etc.

Keywords : Organic farming, Fertilizer, Production, Horticulture

INTRODUCTION

Organic farming is an alternative agricultural production system, which avoids or largely excludes the use of synthetically compound fertilizers, pesticides and growth regulating hormones. In other words, we can say that organic farming is minimal dependent on synthetic fertilizers, pesticides and antibiotics and is considered as a "system of cultivation and with use of organic manures crop rotation, legumes, green manures and aspects of biological pest control to maintain soil fertility and to supply all essential plant nutrients in suitable amount".

Soil organic matter consists of decomposing plant and animal residues along with living and dead microbial cells. It is a natural component and is one of the most important nutritious resources.

Organic Farming is not new to Indian agriculture, it is an old practice of natural farming, as per documented evidence organic agriculture in India started long back in 1900 by Sir Albert Howard, a British agronomist in local village of north India. Organic refers to agricultural production system used to produce food and fibre, all kinds of agricultural products are produced

organically including grains, meat, dairy, eggs, fibre such as cotton, flowers and processed food products.

Organic farming an eco-farming system has its base on the principle 'Feed the Soil not the Plant', it maintains the ecological balance without polluting soil, water and air. In this method, the use of chemicals is kept at the minimal level.

MATERIAL AND METHOD

Components of organic matter

Soil organic matter contains different groups of organic compounds, this includes – simple sugars, starch, simple proteins, crude proteins, cellulose, hemi cellulose, fats, waxes, lignins etc. These constituents decompose at different rates. Organic matter decomposition is primarily a microbiological process. Decomposition is carried out by heterotrophic microorganisms, including bacteria, fungi, actinomycetes and protozoa. Besides these other organisms like earthworms, termites etc. also play an important role to break down the organic residues. (Table-1)

Why Should We go for Organic Farming?

The prolonged use of chemicals on soils has resulted in human health hazards and pollution of air and water systems and further led to damage of soil structure and natural environment.(Fig-1),(Table-2). Besides the development of resistance among pests, pathogens, and weeds and reducing bio-life in soil and land degradation had further made the situation complex.

An estimation of world health organization has indicated that globally at least three million persons are poisoned by pesticides, every year out of whom at least 20,000 die. Now a days the chemical fertilizer are very costly.

In addition indiscriminate use of pesticides, fungicides and herbicides could cause adverse changes in biological balance as well as lead to cancer and other diseases due to the toxic residues present in the consumable parts. Hence there is a vital need for revolution through organic farming to ensure food security and safety environment. These issues can be overcome by shifting to organic culture.

Scope of organic farming

India has good opportunity to take up production of organic food for export and domestic use. Out of the 480 districts in our country data is currently available there are 29 districts which consume less than 10 kg N:P:K per hectare and 71 districts below 25 kg/ha. The major organic food markets for India are European Union, USA, Japan and Middle cast etc., the estimated value of export of organic products through APEDA was 30 million US $ during 2000 –

01. During the last decade organic agriculture has gained international recognition as valid alternative to conventional food products. The commercial organic farming as practiced today is still at a nascent stage [According to Survey of international federation of organic agriculture movements (IFOAM)] and Stiftung Okekologie & Landbau (SOEL), February, 2003. India has about 41,000 ha. area that can be put to organic farming. The world organic market is estimated at over US $ 26 bn in 2002, cultivated on a total area of about 20 million hectares worldwide with a world production of around 25 million tonne. Almost 92% of the organic industry comprise of farm products (around US $ 23 bn) and 8% of animal products (around US $ 2 bn). Organic products are almost over 95% consumed in developed countries. The major produces and importers of organic products are EU, USA and Japan.

The Indian organic farming industry is growing rapidly and has already made in roads into the world organic market in certain sectors, such as tea, coffee, spices, fruits and vegetables. Under various product segments of organic agriculture, organic tea and coffee production has done significantly well. India accounts for about 1% (around 0.370 metric tonne) of the total world's market in the organic spice market.

India is at very nascent stage in terms of organic fruits and vegetables exports, which is estimated to be in tune of Rs. 15 – 20 cores. Major potential organic fruits and vegetables for exports are banana, mango pineapple, grape, passion fruit and selected vegetables like mushroom, gherkin, baby corn, sprouting broccoli, asparagus etc., aromatic plants like vanilla, plantation crops, e.g. coconut, tea, coffee, cocoa and palm oil.

Organic farming is one of the fast growing segments of US agriculture during the 1990's USDA estimate that the value of retail sales of organic food in 1999 was approximately $ 6 billion. The no. of organic farmers is also increasing by about 12% per year.

Sources of soil organic farming

i) Natural sources : Plant animal and microbial materials are primary sources of organic matter,
ii) Organic manures : Crop residues, grasses, animal excreta (e.g. Fym) compost material, green manures, oil cakes etc. can be used as organic manures.
iii) Municipal and Industrial wastes : Municipal solid waste and organic waste etc.

(i) Farm yard manure

It is the most commonly used organic manure in most countries of the world. It is also called stable manure, dung and cattle manure. This manure consists of 0.5% N, 0.2% P_2O_5 and 0.5% K_2O. Application of partially or fully decomposed materials speed up the nutrient release already present in the soil to the growing crops.

Trenches of 6 m long, 2 m wide, 1 m deep are dug, daily collected materials dung and urine soaked daily are placed in these trenches, when each section is filled upto a height of about 0.5 mt above the ground level, the top of the heap is rounded off and plastered with slurry of cow dung. Before plastering apply 4 – 5 buckets of water in the pit – it conserves moisture and nitrogen. This manure becomes ready in 4 – 5 months after plastering.

It is possible to obtain 5 – 6 T of manure / year / head of cattle. Normally 10 – 25 cart loads of manure is applied per hectare.

(ii) Farm Compost

Decomposed plant residues / farm wastes are known as farm compost. It consists of 1.01% N, 0.5% P_2O_5 and 0.8 – 0.9% K_2O. Composting is a biological decomposition process that convert organic matter to a stable humus like product under controlled conditions. Compost
is the dark brown. Crumbly material that is produced when a collection of plant and animal material is decomposed into organic matter and further to humus. Once compost has been mixed into the soil it will undergo the process of mineralisation in which the humus releases minerals in the soil, making them available to the plants.

(iii) Urban Compost

In recent years, large scale composting in towns and cities had been taken up successfully by the municipal bodies and the corporations.

Trenches 1 – 1.2 mt wide, 75 cm deep are filled with successive layers of night soil, town refuse and earth in order and finally the compost gets ready in about 3 months.

Benefits of composting

When compost is added to the soil the level of organic matter increases, improves soil texture, permeability and water holding capacity of that soil. Compost can also be used as a mulch by nursery men and vegetable farmers. It is an excellent material for litter and bedding. Microbes play important role in decomposing these materials to convert them into compost.

Vermi compost

It is a stable fine granular organic matter. In vermi composting you speed up the process and end up with a rich end result called castings. It is a method of making compost with the use of earth worms, which generally lives in the soil. They eat biomass

and excrete it in digested form. This compost is generally called vermin compost. It is estimated that 1800 worms, which is an ideal population for 1 sq.mt can feed on 80 tones of humus per year. Earthworms can generally be called as biological indicators of soil fertility. Availability of earthworms in soil have always promoted plant growth.

There is abundant evidence that concentration of exchangeable Calcium, Sodium, Magnesium, Potassium, and available Phosphorus are higher in earthworms casts than the surrounding soils. Several valuable compounds are also produced through the earthworms micro

flora interaction, these include Vitamins (such as B_{12}) and plant growth hormones (such as gibberellins). In whole world only 3 – 4 species of earthworms are widely used, but in India only 2 species i.e., *Eisenia fetida* and *Eudrilus eugeniae* are mostly used.(Table-3).

Preparation of vermi compost

Selection of earthworm species is very important factor for preparation of vermi compost.

A tank of Brick line of 3 m x 1.5 m dimension having drainage facilities is built in shady condition.

In the tank about 10 – 15 cm layers of loam soil is spread out and about 5 – 6 kg of diluted dung is also spread and available earth worms may be placed. Dry leaves are put on the vermibed and kept moist for 3 – 4 weeks, every 4th day a 10 cm layer of straw leaves of plant, Kitchen wastes are spread on the bed. Finally the beds are covered with gunny cloth and it needs watering every day to keep sufficiently moist, after 30 days the garbage is turned up and down and again and covered with same and watering is maintained for another month or so. The earth worms feed on decaying organic matter and digested food comes out in the form of vermi compost within 2 months. About 10 kg of castings will be produced by 1 kg of worms. The mature compost is gray to brown coloured granular mass. Finally it is dried and packed.

Benefits of Vermi Compost

1) Vermi compost influences the Physio – chemical as well as the biological properties of soil.
2) It contains many micro – nutrients like Mg, Fe, Mo, Br, Cu, Zn etc. in addition to some of the growth regulators.
3) It also enhances the water holding capacity.
4) Buffering action of vermi compost neutralizes soil pH and helps in the availability of minerals and trace elements more easily to crops.
5) Enhances soil fertility status and reduce toxicity.
6) Enhances Quality, shelf life and nutritive value of horticultural crops.

Benefits of Organic Farming

1. Organic farming is more energy efficient than conventional farming.
2. Reduced soil health hazards by pollution.
3. Low incidence of plant pathogens, especially *Phythium* and *Rhizoctonia* infections in beans & peas.
4. Improved soil properties owing to higher levels of organic matter lower soil erosion better soil structure, permeability and drainage.
5. Availability of variable amounts of a whole range of plant nutrients and less loss of nutrients by leaching and run off because of higher cation exchange capacity.
6. Increased up take of nutrients and improves crop quality thus fetching higher market price.
7. Maintenance of proper soil temperature and soil aeration.
8. Binds soil particles, forming stable aggregates thus reducing soil erosion.

Risks

1) Occasional or more regular over supply of certain products may lead to dropping of prices of products, leading to insufficient profitability for producers and traders.
2) Other forms of environmental friendly and sustainable agriculture in the form of integrated farming systems may provide increased competition in future.
3) Media reporting of fraud, in the from of unscrupulous traders selling non-organic products for a higher price as organic food stuff could make the market more skeptical of products labeled as organic.

Should India go in for Organic Farming?

Keeping in view, the human population of India the 2nd most populous country in the world and is expected to cross 1.3 billion by 2020 AD, hence, the food grain requirement is much high. There are fears that India will not be able to meet the demands of food, oil, sugar, fibre, etc. of its growing human population. As productivity of organic farms is generally lower compared to those managed conventionally, it is but natural to expect lower production levels from organic farms. But by considering the merits of organic farming and organic produce no one can deny the acceptance of the system. So, it is felt that India should go in for organic farming.

Several success stories with respect to organic farming in different parts of the country amply justifies the above statement.

Strategies for green food production in horticulture

'Green Fod Production' refers to organically grown crops without using any synthetic pesticides, herbicides, insecticides, fungicids, fertilizers and synthetic hormones. No artificial flavours and colour is to be added right from the stage of seed treatment to final post harvest handling and processing. Green foods are not only free from harmful chemicals but are also safer, healthier and tastier. It is a holistic production management system. Most of the vegetables are eaten fresh, hence any contamination (chemical residue) may lead to various kind of health hazards. Hence Green food / organic food production offers a better possibility in horticultural crops rather than in field crops. In organic production system in general micronutrients are not taken care, there is every doubt that over long duration, their deficiencies may create production constraints and these technology might be a failure rather than a sustainable alternative to Bio-dynamic agriculture. Under the present scenario it appears to be a sound alternative. In present day, bio-dynamic farming is becoming popular in several countries, such as Germany, Australia, New Zealand, USA etc. Rodolf Steiver (1924) from Central Europe was founder of Bio-dynamic agriculture, the biodynamic farming is more than just another organic method. This system is based on the principle of harnessing the syneray between cosmos, mother earth, cow and plants. Basically there are two types of bio-dynamic preparations :

1) Bio-dynamic Compost Preparations (BD-502-507)
2) Bio-dynamic field sprays (BD-500-501), all these preparations are made in descending period of moon except BD-507. The BD set are used in cowpat pit (cpp), BD-compost, Bio-dynamic liquid manure and bio-dynamic liquid pesticides.

i) Cowpat pit (CPP) : It is also known as soil shampoo, it is a bio-dynamic field preparation. It is strong soil conditioner, it enhances seed germination, promotes rooting in cuttings and graftings improves soil texture, provides resistance to plants against pests and diseases etc. It may be prepared through out the years, depending upon the weather and temperature.

ii) Bio-dynamic Compost :- It is an immediate source of nutrient for a crop. It can be prepared by using green and dry leaves piled up in alternative layers of 15 – 25 cm thick. Bio-dynamic liquid manures and pesticides are prepared using liquid fish manure, liquid plant manure etc. An average preparation of liquid manure takes 8 – 12 weeks times. 1 litre of liquid manure is dissolved in 4 – 5 litres of water and used as foliar spray. Bio-dynamic pesticides are prepared from neem, pongamia and caliotropis leaves.

iii) Bio-dynamic Field Sprayes :- (BD 500 – 501) : Cow horns filled with fresh cow dung from lactating cows are buried in fertile soil, when the moon is descending during autumn (October – November) for incubation during whole winter. It is taken out in March – April, stored in earthen pots at dark and cool place.

iv) BD 501 (or Horn Silica Manure) :- It is prepared in ascending period of moon by filling cow horn with "Mealy" Silica powder and buried in spring (March and April), within 6 months the preparation is ready for use. 1 g. of it is dissolved in 13.5 litre of water solution is sprayed on leaves at sunrise. It encourages the development of fruits and seeds, quality and also improves shelf – life of pre-produce. Bio-dynamic farming is gradually being accepted by the farmers because of its low cost as well as for its multifarious role. It has been successfully utilised in nutrient management, pest and disease management in horticultural crops. However bio-dynamic preparations are always to be supplement with organic manures, Vermi-compost or inter cropping of legumes etc. for better nutrient management. Another important point is the time of operations in relation to the exact constellation is to be practiced for getting the best results. Some other related farming systems based on organic culture are Rishi Krishi (It advocates the use of rhizosphere soil of banyan tree to improve soil fertility and amrithpani –a mixture of cow dung honey and ghee in proportion for treatment of the seeds and the seedlings). Homafarming (It is based on "homa" i.e. purification through fire tuned to the rhythm of nature, time to sunrise and sunset biorhythm). Panchgavya Krishi (mixture of slurry, cow dung, urine, milk, curd, ghee along with sugar cane juice, coconut water, ripe banana encourages vegetative and reproductive growth of plants). All these different forms of farming comes under organic farming system and can safely be used in an ecofriendly manner. (Fig-2).

1) Various aspects of green food production particularly for horticultural commodities need to be standardized.
2) Promotion of establishment of demonstration for preparation of biodynamic compost, cow horn manure (BD – 500), horn silica (BD – 501), cowpat pit (cpp), liquid manures and liquid bio-dynamic pesticides.
3) Promotion for field demonstrations for biodynamic preparations.
4) Organizing intensive training to farmers, NGO representatives, entrepreneurs, and extension personal of Department of Horticulture for biodynamic preparations and their applications.
5) Helping State Agriculture Universities (SAUS) to initiate few courses on organic / biodynamic agriculture.

6) Facilitation for certification for green food production.
7) Establish National Standards for covering marketing of certain agricultural products as Green produces products.
8) Assure Consumers that there meet a consistent standard.
9) Market Promotion for 'Green Food' and their processed products.

Table 1. Nutrients Present in Some Common Materials

Approximate Analysis %.

	N	P	K
Bone meal	4	21	-
Blood dried	12	1	-
Meat meal	8	1	0.
Fish meal	8	8	-
Oil seed cake (avg)	6	1	1
Egg shells	1	0.4	0.1
Mushroom compost	0.6	0.5	0.9
Cattle dung, fresh	0.4	0.2	0.3
Sheep dung, fresh	0.7	0.5	0.3 – 1.0
Cattle urine	0.7 – 1.2	-	0.5 – 1.0
Human urine	0.6 – 1.0	0.1 – 0.2	0.2 – 0.3
Ash house hold	0.5 – 1.9	1.6 – 4.2	2.3 – 12.0
Ash wood	0.1 – 0.2	0.8 – 5.9	1.5 – 36.0
Rural compost (dry)	0.5 – 1.0	0.4 – 0.8	0.8 – 1.2
Urban compost (dry)	0.7 – 2.0	0.9 – 3.0	1.0 – 2.0
G/Nut husks	1.6 – 1.8	0.3 – 0.5	1.1 – 1.7

Green Manures (fresh)

	N	P	K
Cow pea	0.71	0.15	0.58
Green gram	0.72	0.18	0.53
Sun hemp	0.75	0.12	0.51
Black gram	0.85	0.18	0.53

Table 2. Anthropogenic Pollution of the Soil-plant-animal System.

Kinds of Soil Pollution :	
Pesticides :	(i) Insecticides, (ii) Fungicides, (iii) Herbicides, (iv) Antibiotics, (v) Rodenticides, (vi) Nematicides
Fertilizers Organic Wastes :	Municipal & Industrial Wastes, Some of which may be dumped in soil. (i) Garbage, (ii) Sewage effluent & sludge.
Other Pollutants :	(i) Soluble salts, (ii) Radio nuclides, (iii) Acid rains.

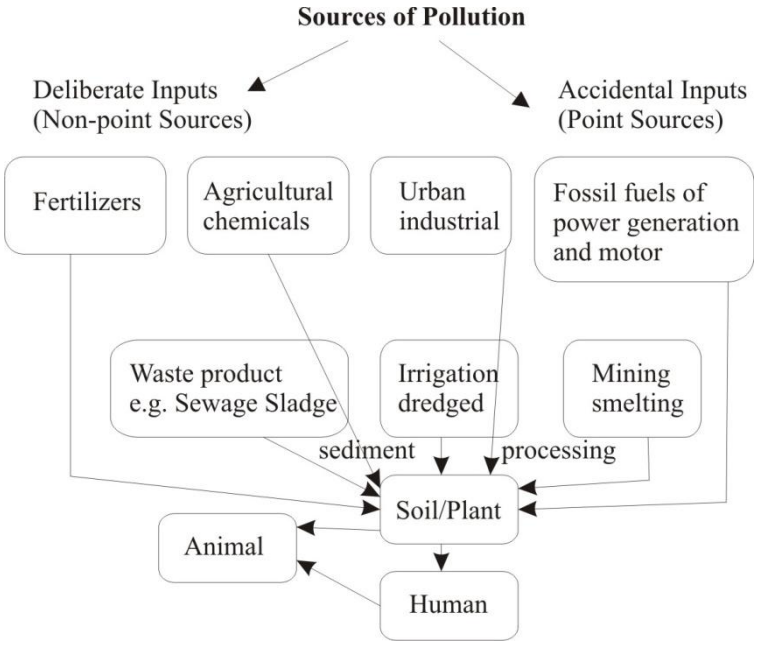
Table 3. Comparative Percentage of Nutrient Content in F.Y.M. and Vermi-compost.

S.No.	Nutrient	F.Y.M.	Vermi-compost
1.	N (%)	0.4 – 0.9	1.0 – 1.6
2.	P_2O_5 (%)	0.2 – 0.3	0.22 – 0.5
3.	K_2O (%)	0.2 – 0.5	0.67 – 1.5
4.	Ca (%)	0.91	0.44
5.	MG (%)	0.19	0.15
6.	Fe (ppm)	146.5	175.2
7.	Mn (ppm)	69.0	96.51
8.	Zn (ppm)	14.5	24.43
9.	Cu (ppm)	2.8	4.89
10.	C : N ratio	31.28	15.5

Nutrients Present In :

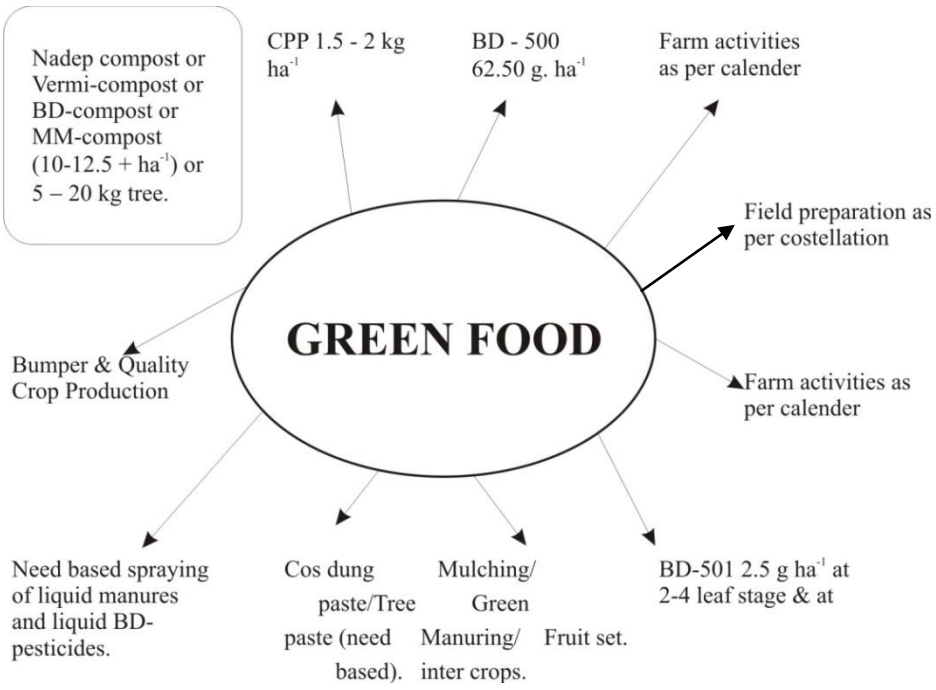
Farm compost :	N (%)	P_2O_5 (%)	K_2O (%)
	1.01 %	0.5	0.8 – 0.9
Sheep and Goat manure	3	1	2
Poultry manure	1.5	1.2	0.5
Crop residues	0.5	0.6	1.5
Rice husk	0.3 – 0.4	0.2 – 0.3	0.3 – 0.5
Press mud	1.25	2.0	--
Tea wastes	0.3 – 0.35	0.4	1.5

Fig. 1. Soil Pollution through Agro-Chemicals.



Strategies

Fig. 2. Schematic Presentation of Green Food Production



CONCLUSION

The population pressure, water loss, soil erosion, floods, saline and alkaline soils, weed and pest damage are considered to be the main indicators of unsustainability. Hence, supply and judicious use of production factors play a decisive role in the sustainable growth of agricultural production. We have discussed on almost all aspects of organic farming and can conclude that it is an economic, ecofriendly system, which attempts to provide a balanced environment,
maintains soil fertility, control insect pest and diseases and produce safer and qualitative food stuff. However technologies like organic farming or integrated management systems need to be assessed to their location, specific applicability and adaptability to bring about better sustainability. Over all organically grown food may not put more nutrients into once body but will surely optimize the health and production of inter-dependent communities of soil life, plants, animals and people. When one buys certified organic food and products, the money you spent cast a vote for a healthier planet.

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ELUCIDATION OF ANALGESIC ACTIVITY OF HYDROETHANOLIC EXTRACT OF *EUPHORBIA NERIIFOLIA* LEAVES IN SWISS ALBINO MICE

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Abstract : The study was carried out to elucidate the analgesic activity and the possible mechanism(s) of action of hydro-ethanolic extract (HEE) of *Euphorbia neriifolia* (EN) leaves using Swiss albino male mice (15-20g). The peripheral analgesic activity of HEE of EN (150, 300 and 400mg/kg body weight, oral) was studied using acetic acid induced abdominal constriction method. The central analgesic activity of HEE of EN was studied using tail immersion and hot plate method in mice. The principle findings of EN at the dose of 150, 300 and 400mg/kg p.o, showed significant ($p<0.01$) decrease in acetic acid-induced writhing, whereas significant ($p<0.05$ and $p<0.01$) increase in latency to tail flick in tail immersion method and elevated mean basal reaction time in hot plate method was also observed. Overall, results demonstrated that HEE of EN possesses significant analgesic activity which confirms the traditional claims of EN mentioned in Ayurveda.

Keywords : Analgesic activity, Aspirin, Albino mice, Acetic acid, *Euphorbia neriifolia*

INTRODUCTION

Approximately 80% of the population of developing countries uses traditional medicines (Perry, 1966; Kumara, 2001). Traditional healing practices are as old as the advent of man and are highly varied, being ethnic, community and eco-system specific. Drugs presently used for the management of pain condition are either narcotics e.g. opioids or non-narcotics e.g. salicylates and corticosteroids e.g. hydrocortisone. All of these drugs present well known side and toxic effects are expensive & limited in number in the market and for the successful introduction of a new product approximately 3000-4000 compounds are to be synthesized, screened and tested where the cost of development ranges from 0.5 to 5 million dollars.

Thus, the greatest drawback in the available potent synthetic analgesic drugs lies in their adverse effect, toxicity and reappearance of symptoms after discontinuation. Due to having adverse side effects, like gastric lesions, caused by NSAIDs (non-steroidal anti-inflammatory drugs) and tolerance and dependence induced by opiates, the use of these drugs as analgesic agents have not been successful in all the cases. Therefore, analgesic drugs lacking ill effects are being searched all over the world as alternatives to NSAIDs and opiates (Kumara, 2001; Zulfiker *et al*., 2010). On the contrary many medicines of plant origin had been used since long time without any adverse effects. Efforts should be made to introduce leads in new medicinal plants to develop cheaper drugs and fewer side effects (Ramesh, 2010). Active constituents from plant sources directly used as therapeutic agent and phytoconstituents are also served as lead molecule for the synthesis of various drugs (Kamboj, 2000; Verma S & Singh, 2006). Plants represent still a large untapped source of structurally novel compounds that might serve as lead for the development of novel drugs (Marston & Hostettmann, 2009). Albeit, systemic study of more plant to analgesic potential of different parts of plants like root, leaf, fruit, whole plant of *Adhatoda vesica, Bauhima racemosus, Ficus glomerata, Plumbago zeylenica, Scopania dulcis, Sida acuta, Stylosanthes fruticosa, Xeromorphis spinosa* etc. which is well documented (Malairajan *et al*., 2006; Chakraborty *et al*., 2010; Mittal *et al*., 2010 & Wahid *et al*., 2010) isolate the active phytoconstituents, investigate their therapeutic, toxic dose and work towards tapping their therapeutic utility.

Euphorbia neriifolia Linn. (Euphorbiaceae) grows luxuriously throughout the Deccan peninsula of India and commonly occurs in the dry hilly rocky grounds of north, south and central India. It is popularly known as "Common milk hedge" in English, "Sehund" or "Siju" in Hindi and "thuhar" in Rajputhana (Nadkarni, 1954; Sharma *et al*., 2011). In addition, EN has been reported to contain flavonoids, alkaloids, saponins and other active phyto-components (Pracheta *et al*., 2011a; b). Ayurveda describes the plant as bitter, pungent, laxative, improves appetite useful in abdominal troubles, tumors, loss of consciousness, delirium, leucoderma, piles, inflammation, enlargement of spleen, anaemia, ulcers, fever and in chronic respiratory troubles (Anonymous, 1952; Nadkarni, 1954; Bigonia & Rana, 2009; Pracheta *et al*., 2011c; Janmeda *et al*., 2011; Sharma *et al*., 2011). The global changing scenario is showing a tendency towards use of toxic plant products having good traditional medicinal background. This plant can be used safely for longer duration as a cheap source of active therapeutics for alleviation of commonly occurring ailments by the poor and underprivileged people of India.

The explicit aim of the present study was to screen out the analgesic activity and the possible mechanism(s) of action at three different dose levels (100, 200 & 400 mg/kg body weight, p.o) of the hydro-ethanolic extract of *Euphorbia neriifolia* leaves in different experimental models of analgesia.

MATERIAL AND METHOD

Drugs and Chemicals- All chemicals used in the study were of analytical reagent grade and of highest quality available, and are purchased from reliable firms and institutes (SRL, MERCK, HIMEDIA and SUYOG).

Experimental plant- *Euphorbia neriifolia* leaves were collected from Botanical garden of Banasthali University, Banasthali, India, in the month of September 2009. The plant was identified with the help of available literature and authenticated by Botanist of Krishi Vigyan Kendra, Banasthali Vidyapith, Banasthali, Tonk district.

Preparation of hydroethanolic extract- Freshly harvested *Euphorbia neriifolia* leaves were air dried in shade and coarse powder (500 g) was defatted in 1.5 L of ethanol (70% v/v) using soxhlet apparatus. The extracted mixture was evaporated at 40°C, using a hot air oven (Mvtex, India) and kept in desiccator for two days. The yield of the extract was 20% w/w of the powdered plant material. Dried extract was collected and stored at 4°C in air tight container. The residue was designated as hydro-ethanolic extract and used to assess analgesic activity.

Experimental animals*:* Male Swiss Albino mice (*Mus musculus)* weighing 15-30 g were obtained from Haryana Agricultural University, Hissar (India) for experimental purpose. The animals were acclimatized for a month prior to experiment. All experiments were conducted on adult Swiss albino male mice when they weighed 20-25g (3-4 months old). Colony bred adult male albino mice were maintained under standard laboratory conditions at a temperature of 22 ± 3ºC, relative humidity of 50±5 % and photoperiod of 12h (12h-dark and 12h-light cycle). The mice were housed in polypropylene cages. The Institutional Animal Ethical Committee approved the animal studies.

Assessment of Analgesic activity- The antinociceptive activity of HEE of EN leaves was assessed using three different methods as follows:

Acetic Acid- Induced Writhing test- In this method 30 Swiss albino mice (20-25g) were segregated into 5 groups of six animals each were treated by oral gavage using intragastric tube. Writhing (s) were induced by the method of Koster et al. (1959) and Devi et al. (2010). The groups were as follows: Group 1 served as control (normal untreated mice), received 0.9% saline solution by oral gavage. Group 2: received aspirin (25 mg/kg body weight: p.o), served as standard treated control group. Group 3, 4 and 5 were administered with hydro-ethanolic extract of leaves of EN (150, 300 and 400 mg/kg body weight: p.o), served as EN treated control group. The dose for plant and standard were decided and selected on the basis of LD_{50} calculated in the laboratory and on the basis of previous published reports (Sutar *et al*., 2008; Bigoniya & Rana, 2010; Pracheta et al., 2011c; Janmeda *et al*., 2011;).

One hour after administration of the test drugs, animals were injected intra-peritoneally with 1% acetic acid (1 ml/100 g body weight). The number of writhing responses such as contortions and stretching were recorded for 30 minutes. The results were evaluated by calculating the mean number of contortions per treated group and results compared to results obtained from control animals (0.9% saline). Percentage of protection or pain inhibition against acetic acid induced writhing was taken as an index of analgesia and it was calculated as follows:

$$\text{Pain inhibition (\%)} = \frac{Wc - Wt}{Wc} \times 100$$

Wc: mean number of contortions of the control group
Wt: mean number of contortions per treated group

Tail immersion method/Heat conduction method- This test was performed as described by Tumer, (1971). Group 1 to 5 received the saline, standard drug and test extract as in writhing test. The lower 3-5 cm portion of the tail was marked and immersed in a cap of water having temperature 55±1ºC. Reaction time was recorded before and after administration of saline, test extract and standard drug. The response time was noted at 0, 30, 60, 90, 120, 150, and 180 minutes after administration of standard and test solution, as the sudden withdrawal of the tail from the hot water. The cut off time was considered 10-12sec to avoid damage the tail for all groups.

$$\text{Percentage protection/inhibition} = \frac{\text{Latency (test)} - \text{Latency (control)}}{\text{Latency (Control)}} \times 100$$

Eddy's hot plate method- Hot plate method was performed as described by Eddy's and Leimback,(1953) Group 1 to 5 received the saline, standard drug and test extract as in writhing test. The animals were placed on a hot plate (Analgesiometer, Techno) maintained at a temperature of 55±1ºC. The basal reaction time, when the animals licked their paw or jumping occurred was recorded by a stop watch before 0 and 30, 60, 90, 120, 150, and 180 minutes after administration of standard and test solution. The initial reaction time was measured in each animal before the administration of doses of EN extract (at both doses). The reaction time was recorded 30 min after drug administration and 15 minutes intervals consequently for a period of 180 minutes. A cut off time of 15 sec was used. The increase in reaction time against control was calculated.

$$\text{Percentage protection/inhibition} = \frac{\text{Latency (test)} - \text{Latency (control)}}{\text{Latency (Control)}} \times 100$$

Statistical analysis- All the data are presented as mean ± SEM. Statistical analysis was performed using one-way analysis of variance (ANOVA) followed by Dunnett's test. Comparison between control and drug treated groups were considered to be statistically significant ($p<0.05$) and $P< 0.01$ as highly significant.

RESULT

The results of present study indicate the HEE of EN possesses analgesic effect, which is in accordance with its ethno-medicinal use. Analgesic effect of the extracts was demonstrated in the experimental models using writhing test, heat conduction method and Eddy's hot plate method using thermal stimuli, an increase in reaction time is generally considered an important parameter of analgesic activity.

Acetic acid induced writhing test- The effect of HEE of EN on acetic acid induced writhing is demonstrated in Table 1. The HEE of EN (150, 300 and 400 mg/kg, p.o) reduced writhing counts significantly ($p<0.01$) in mice. The results obtained were in dose dependent manner compared to control group. Maximum inhibition of writhing response by HEE of EN (400 mg/kg) was 88.07 %, which was comparable to aspirin (25 mg/kg) (graph 1). Standard aspirin (25 mg/kg) showed maximum inhibition of writhes (75.21%).

Tail immersion test- The analgesic activity of HEE of EN was evaluated using tail immersion method are presented in table 2. The extract exhibited marked central analgesic effect as evidenced by significant increase ($p<0.01$) in basal reaction time when compared with the control. HE of plant at all doses showed dose dependent increase in tail flick latency period and maximum inhibition was observed for 400 mg/kg. The results were also compared to the standard drug- aspirin in all three methods. The HEE of EN (150 mg/kg) did not show significant increase in latency to flick compared to control group ($p>0.05$). The HEE of EN at doses (250 and 400 mg/kg, p.o) showed significant ($p<0.05$ and $p<0.01$) increase in latency to flick tail compared to control group. The highest nociception inhibition of stimulus by HEE of EN (400 mg/kg) was observed at 30 minutes.

Hot plate test- The analgesic activity of HEE of EN using hot plate test is presented in Table 3. Oral administration of HEE at 150, 300, 400 mg/kg) resulted significant ($p<0.05$ and $p<0.01$) prolongation of latency time in hot plate test. The highest nociception inhibition of stimulus exhibited by HEE of EN (400 mg/kg) was observed at 30 minutes.

In general our results lend support to the recent finding of Gaur et al. (2009) and Venkataswami, (2012) on *E. neriifolia.*

DISCUSSION

Pain is a condition which is regularly dealt with in daily clinical practice. Hence, any attempt to contribute an easily available analgesic drug from the available flora is always accepted without any reluctance. Two different analgesic testing models were employed with the objective of identifying peripheral (acetic acid- induced writhing method) and central analgesic effect (hot plate and tail immersion method) of the test substances.

In the present study, hydro-ethanolic extract of EN leaves showed significant dose dependent anti-nociceptive activity. A large number of herbal drugs used in the indigenous system of medicine possess a variety of actions on the central nervous system. Acetic acid induced writhing test is widely used method for the evaluation of peripheral antinociceptive activity (Javan *et al*., 1997). Acetic acid is an irritating agent which stimulates the local peritoneal receptors to induce pain with characteristic abdominal constrictions when injected into the peritoneal cavity (Vogel & Vogel, 1997). In present study, EN extract markedly reduced the number of mice abdominal constrictions at all the three doses used. Hence it can be concluded that the EN extract showed a dose dependent inhibition of acetic acid induced writhing in mice.

The development of aspirin was a significant landmark in the history of medicine. Aspirin (acetylsalicylic acid -ASA), is a salicylate drug, often used as an analgesic to relieve minor aches and pains. Salicylic acid, the main metabolite of aspirin, is an integral part of human and animal metabolism. While much of it is attributable to diet, a substantial part is synthesized endogenously (John *et al*., 2008). The main undesirable side effects of aspirin taken by mouth are gastrointestinal ulcers, stomach bleeding, and tinnitus, especially in higher doses. In children and adolescents, aspirin is no longer indicated to control flu-like symptoms or the symptoms of chickenpox or other viral illnesses, because of the risk of Reye's syndrome (Macdonald, 2002). Aspirin reduces the leukocytes associated with acute rheumatic fever. When given on a long term basis, it reduces the haemoglobin level. Aspirin use can cause reversible hypo prothrombininemia by interfering with the function of Vitamin K in the prothombin synthesis. Aspirin both directly and indirectly stimulates respiration (Macdonald, 2002). In analgesic doses, aspirin increases oxygen consumption and carbon dioxide production. Therefore a new alternative in the form of phytochemicals are taken under investigations.

The acetic acid-induced writhing in mice is a visceral pain model that has been associated with release of free arachidonic acid from tissue phospholipids via cyclooxygenase (COX), bradykinins and substances prostaglandin (PGE_2 and $PGF_{2\alpha}$) biosynthesis plays a role in nociceptive mechanisms (Duarte *et al.,* 1988;

Ahmed *et al*., 2006; Baird-Lambert & Jamieson, 2007; Sah *et al.*, 2010). In other words, the acetic acid induced writhing has been associated with increased level of PGE_2 and PGF2α in peritoneal fluids as well as lipoxygenase products (Derardt *et al*., 1980). The acetic acid induced writhing method was found effective to evaluate peripherally active analgesics. The agent reducing the number of writhing, render analgesic effect preferably by inhibition of prostaglandin synthesis, a peripheral mechanism of pain inhibition (Duarte *et al*., 1988; Sah *et al.*, 2010; Ferdous et al., 2008). The significant pain reduction in acetic acid-induced writhes by plant extract might be due to the presence of analgesic principles acting with the prostaglandin pathways and suggests that the analgesic effect may be peripherally mediated via the inhibition of synthesis and release of PGs and other endogenous substances.

The hot-plate and tail-immersion methods are useful in elucidating centrally mediated antinociceptive responses, which focuses mainly on changes above the spinal cord level (Vongtau *et al*., 2004). The significant increase in pain threshold produced by HEE of EN in these models suggests involvement of central pain pathways. Pain is centrally modulated via a number of complex processes including opiate, dopaminergic, descending noradrenergic and serotonergic systems (Headley & Shaughnessy, 1985; Wigdor & Wilcox, 1987; Pasero *et al.*, 1999). The analgesic effect produced by the extract may be via central mechanisms involving these receptor systems or via peripheral mechanisms involved in the inhibition of prostaglandins, leucotrienes, and other endogenous substances that are key players in inflammation and pain.

Euphorbia neriifolia contains active constituents such as phenolics like triterpenes (nerrifolione), diterpenes, flavonoids, alkaloids and steroidal saponins (Pracheta *et al*., 2011a; b) and these constituents has been reported that they possess analgesic and anti-inflammatory actions (Hossinzadeh *et al.*, 2002). The increase in reaction time may be due to the presence of flavonoids and traces of salicylic acid in the plant extract. Flavonoids are known to inhibit the enzyme prostaglandin synthetase, more specifically the endoperoxidase (Ramaswamy *et al*., 1985) which is involved in the late phase of acute inflammation and pain perception (Adeyemi et al., 2010). Flavonoids are capable of modulating the activity of enzymes and affect the behaviour of many cell systems, suggesting that the compounds may possess significant antihepatotoxic, antiallergic, anti-inflammatory (Rao *et al*., 2003), antiosteoporotic and antianalgesic activities (Delorme, 1995; Mills & Bone, 2000). Since, prostaglandins are involved in the pain perception; inhibition of their synthesis so produce analgesic effects. Salicylates and allied compounds have analgesic property (John *et al*., 2008). The mechanism by which they act to reduce mild to moderate pain is based on the relationship between these compounds and prostaglandin synthesis. The component which makes up simple phenol includes salicyclic acid. Phenols have been hypothesized to possess traces of salicylic acid, which makes it a strong candidate as an analgesic agent. Some reports supported the role of tannins and saponins in anti-nociptive and anti-inflammatory activities. Saponins have also been reported to inhibit histamine release in vitro (Adeyemi et al., 2010; Rao et al., 2000). Thus, the presence of these active phyto-constituents in hydroethanolic extract of *Euphorbia neriifolia* could have accounted for its pain inhibition activity.

In conclusion, results of the present study reveal that the *Euphorbia neriifolia* leaf extract had potent analgesic activity. The extract exhibited marked central analgesic effect as evidenced by significant increase in reaction time when compared with the control, as this plant has immense potential and have broad spectrum of activity on several ailments.

Table 1: Effect of *E. neriifolia* on acetic acid -induced writhing response in mice
Each value is presented as Mean ± S.E.M.; n= number of animals in each group (6)

Groups	Treatment mg/kg	No. of writhes/30 min	Inhibition (%)
Group I	Vehicle	35.31± 0.26	-
Group II	25	8.75± 0.16*	75.21
Group III	150	10.75± 0.30*	69.55
Group IV	300	8.51± 0.37*	75.92
Group V	400	4.21± 0.31*	88.07

*p<0.01 compared with control values.

Table 2: Effect of HEE of *E. neriifolia* on latency to tail immersion method in mice
Each value is presented as Mean ± S.E.M.; n= number of animals in each group (6)

Groups	Treatment mg/kg	Tolerance	Reaction time in seconds						
			0 min	30 min	60 min	90 min	120 min	150 min	180 min
Group I	Vehicle	Latency (sec)	7.50±0.18	7.75± 0.18	7.50± 0.28	7.50± 0.18	7.75± 0.22	7.50±0.22	7.50± 0.31
Group II	25	Latency (sec)	5.10±0.24	4.10±0.14	3.25±0.22a	2.75±0.22*	2.50±0.25*	2.09±0.22*	2.02±0.28*
		% Protection	32.00	45.33	58.06	63.32	67.74	72.13	73.23
Group III	150	Latency (sec)	6.20±0.11	5.70±0.21	4.90±0.21a	4.10±0.11*	3.65±0.25a	3.50±0.18*	2.75±0.22*
		% Protection	17.33	24.00	39.77	45.00	52.9	53.33	63.31
Group IV	300	Latency (sec)	4.80±0.13	4.50±0.18	3.50±0.21*	3.15±0.19*	2.50±0.25a	2.12±0.11*	2.01±0.18*
		% Protection	36.00	40.00	54.83	58.26	67.74	70.53	73.21
Group V	400	Latency (sec)	3.50±0.25	2.50±0.18*	2.25±0.13*	2.01±0.05*	1.75±0.22*	1.51±0.11*	1.25±0.22*
		% Protection	53.33	66.65	70.96	73.2	77.41	79.86	83.33

[a]p<0.05, *p<0.01 compared with control values.

Table 3: Effect of HEE of *E. neriifolia* on latency to hot plate method in mice
Each value is presented as Mean ± S.E.M.; n= number of animals in each group (6)

Groups	Treatment mg/kg	Tolerance	Reaction time in seconds						
			0 min	30 min	60 min	90 min	120 min	150 min	180 min
Group I	Vehicle	Latency (sec)	8.75±0.54	8.5±0.25	8.5±0.25	8.5±0.25	8.5±0.25	8.5±0.25	8.5±0.25
Group II	25	Latency (sec)	5.75±0.11	5.52±0.25	4.05±0.25a	3.02±0.27*	2.25±0.13*	1.90±0.27*	1.75±0.12*
		% Protection	34.28	35.05	52.35	62.94	73.52	77.64	79.41
Group III	150	Latency (sec)	6.25±0.22	5.11±0.11	4.75±0.22 a	4.05±0.18*	3.65±0.21*	3.15±0.11*	2.75±0.13*
		% Protection	28.57	39.88	44.15	52.33	57.05	62.94	67.64
Group IV	300	Latency (sec)	5.50±0.25	4.75±0.22 a	4.05±0.18 a	3.02±0.18*	2.75±0.13*	2.25±0.13*	1.90±0.14*
		% Protection	37.14	44.12	52.35	64.47	67.65	73.52	77.64
Group V	400	Latency (sec)	5.12±0.21*	3.89±0.11*	3.15±0.11*	2.75±0.13*	2.01±0.18*	1.51±0.18*	1.12±0.22*
		% Protection	41.11	54.33	62.94	67.64	76.35	82.23	86.82

[a]p<0.05, *p<0.01 compared with control values.

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KARYOMORPHOLOGICAL STUDIES IN FOUR SEED SPICES OF UMBELLIFERAE

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Abstract: Karyomorphological studies were performed in four seed spices of Umbelliferae (the species also possesses immense therapeutic uses) namely, *Apium graveolens* L. (celery), *Cuminum cyminum* L. (cumin), *Foeniculum vulgare* Mill. (fennel) and *Trachyspermum amni* L. (ajowan) and it revealed six (celery: 2n = 22 = $4D^{sc}_{sm}$ + $2D_{sm}$ + $2C^{sc}_{m}$ + $10C_m$ + $2J_m$ + $2K_{sm}$; cumin: 2n = 14 = $2D_{sm}$ + $2E^{sc}_{st}$ + $4E_{st}$ + $2G_{sm}$ + $2H_{st}$ + $2I_t$ and ajowan: 2n = 18 = $2A^{sc}_{sm}$ + $2B_{st}$ + $2C^{sc}_{m}$ + $4C_m$ + $2D_{sm}$ + $6E_{st}$) and four (fennel: 2n = 22 = $8C_m$ + $4D^{sc}_{sm}$ + $2D_{sm}$ + $8F_m$) morphologically distinct chromosome types. Metacentric chromosomes were prevalent in celery and fennel; while, a telocentric pair was located in cumin. Characteristically two long and two short pairs of chromosomes were marked in ajowan and celery respectively. Total haploid chromatin length was noted to be 30.41 µm ± 2.30 in celery, 19.04 µm ± 1.61 in cumin, 29.12 µm ± 2.73 in fennel and 32.45 µm ± 3.52 in ajowan. Celery and fennel were found to possess symmetric karyotypes. Satellites in all the cases were associated to short arms.

Keywords: Karyomorphology, Seed spices, Umbelliferae

INTRODUCTION

Apium graveolens L. (celery), *Cuminum cyminum* L. (cumin), *Foeniculum vulgare* Mill. (fennel) and *Trachyspermum amni* L. (ajowan) are important seed spices of the family Umbelliferae not withstanding their significance as potential medicinal herbs (Pruthi 1998; Masoud *et al.* 2007). The spices are inadequately explored from the cytological point of view (Paul 2005; Ghaffari and Tajik 2007; Masoud *et al.* 2007; Zhao *et al.* 2011); although, cytological information is a prerequisite for crop improvement through efficient breeding methodologies. Paul and Datta (2003) provided a preliminary report on the cytological status of the above mentioned seed spices. Present investigation describes karyomorphology of celery, cumin, fennel and ajowan with the view to gather cytological information for effective exploration of the spices for further research on cytogenetical aspects, and subsequently crop improvement.

MATERIAL AND METHOD

Seeds of celery (*Apium graveolens* L.), cumin (*Cuminum cyminum* L.), fennel (*Foeniculum vulgare* Mill.) and ajowan (*Trachyspermum amni* L.) belonging to the family Umbelliferae (Apiaceae) were obtained from Zonal Adaptive Govt. Research Station, Krishnanagar, West Bengal, India, and for karyomorphological analysis seed samples were presoaked (over night in distilled water) and allowed to germinate (18ºC ± 1ºC) in petriplates lined with moist filter papers. Healthy root samples (2-3 mm in sizes) were pretreated (supersaturated para-dichlorobenzene and aesculine mixture for 3 to 4 hours at 16ºC ± 1ºC; initially samples were kept at 0ºC - 4ºC for 10 minutes), fixed (propiono-alcohol 1:3, v/v), stained (2% orcein-1N HCl mixture 9:1 following warming for 10–12 mins.) and subsequently the root tips were squashed in 45% acetic acid in a glass slide before observing under the microscope. Well scattered and properly condensed metaphase plates (on an average 3 to 5) were scored for each plant species. Data for karyotype analysis was computed from camera lucida drawings (magnification- × 1500).

Metaphase chromosomes of four seed spices were classified as metacentric (F%: 40.0 to 50.0), sub-metacentric (F%: 30.0 to 39.99), sub-telocentric (F%: 20.0 to 29.99) and telocentric (F%: 1.0 to 19.99) as per Hirahara and Tatuno (1967). Karyomorphological attributes analyzed were mean length of individual chromosome measured in µm, relative length of each chromosome represented as per cent length of longest chromosome, total form per cent (TF%) represented the total length of short arms as per cent of total chromosome complement (Huziwara 1962), percentage of total chromatin length (TCL) determined from total length of a chromosome divided by total length of chromosome complement × 100, S per cent representing relative length of the smallest chromosome × 100 and total haploid chromatin length measured in µm. Karyotype formulas were also assessed.

On the basis of chromosome length (long: >3.75 µm, medium: 2.5 µm to 3.75 µm, small: >1.5 µm to <2.5 µm and very small: ≤1.5 µm), F% and presence or absence of secondary constriction the chromosomes in the species were morphologically classified into following types: type A – long sub-metacentric chromosomes with satellites; type B – long sub-telocentric chromosomes; type C – medium metacentric chromosomes with or without satellites; type D – medium sub-metacentric chromosomes with or without satellites; type E – medium sub-telocentric chromosomes with or without satellites; type F – small metacentric chromosomes; type G – small sub-

metacentric chromosomes; type H – small sub-telocentric chromosomes; type I – small telocentric chromosomes; type J – very small metacentric chromosomes; type K – very small sub-metacentric chromosomes.

Metaphase plates were photomicrographed from temporary squash preparations.

FIGURE LEGENDS

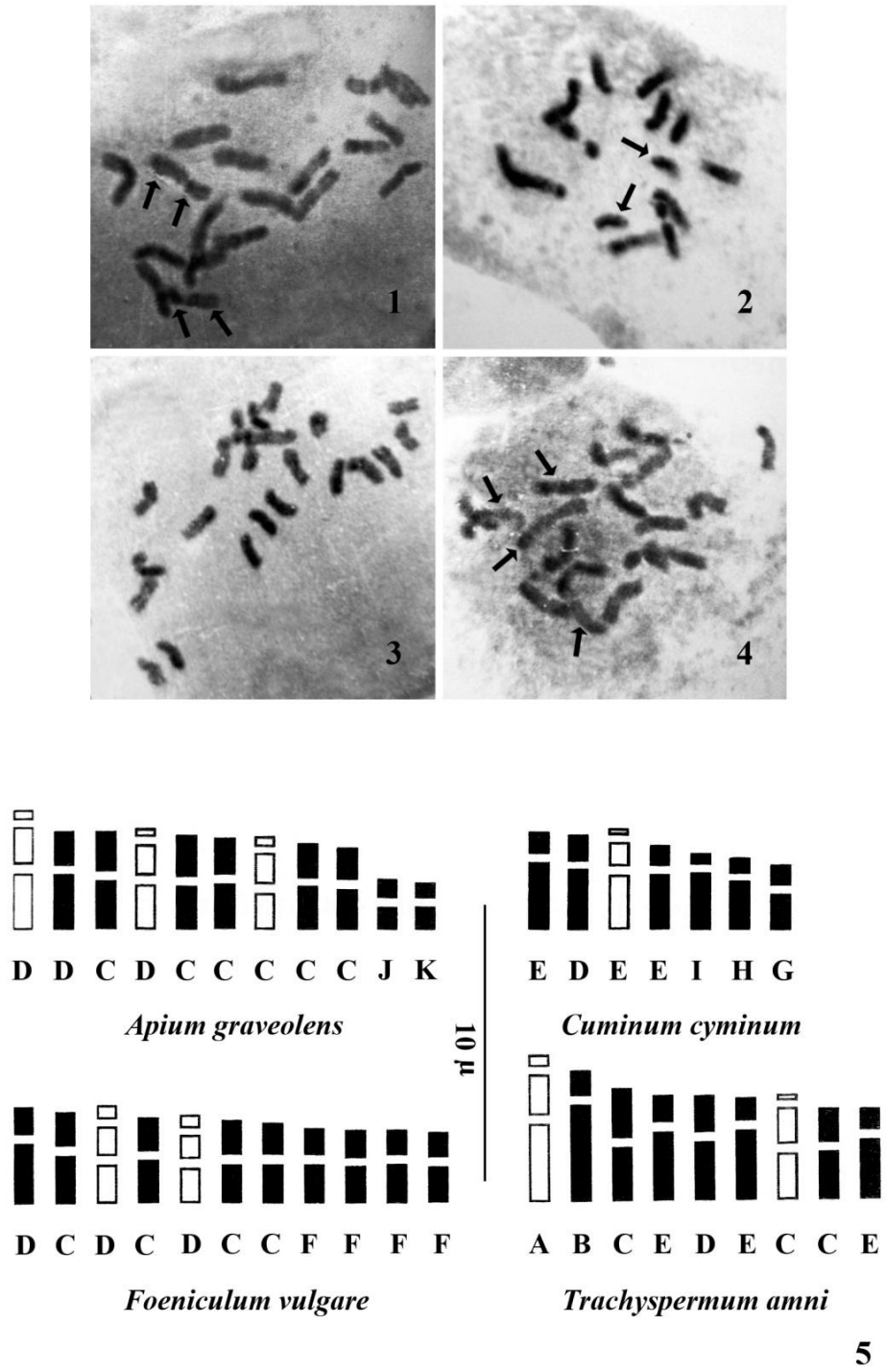

Figure plate I (1-5) showing metaphase chromosome complements **(1-4)** and idiograms **(5)** in seed spices of Umbelliferae. **(1)** *Apium graveolens* – 2n=22; **(2)** *Cuminum cyminum* – 2n=14, a telocentric pair marked; **(3)** *Foeniculum vulgare* – 2n=22; **(4)** *Trachyspermum amni* – 2n=18; **(5)** idiograms.

RESULT AND DISCUSSION

Karyomorphological parameters are presented in Table 1. Karyotype analysis revealed six (*A. graveolens*: $2n = 22 = 4D^{sc}_{sm} + 2D_{sm} + 2C^{sc}_{m} + 10C_m + 2J_m + 2K_{sm}$; *C. cyminum*: $2n = 14 = 2D_{sm} + 2E^{sc}_{st} + 4E_{st} + 2G_{sm} + 2H_{st} + 2I_t$ and *T. amni*: $2n = 18 = 2A^{sc}_{sm} + 2B_{st} + 2C^{sc}_{m} + 4C_m + 2D_{sm} + 6E_{st}$) and four (*F. vulgare*: $2n = 22 = 8C_m + 4D^{sc}_{sm} + 2D_{sm} + 8F_m$) morphologically distinct chromosome types in the seed spices of Umbelliferae (Figs. 1-5). Satellites in all the cases were associated to short arms. Metacentric chromosomes were prevalent in *A. graveolens* and *F. vulgare*; while, a telocentric pair was noted in *C. cyminum* (Fig. 2). Characteristically two long and two short pairs of chromosomes were marked in *T. amni* (Fig. 4) and *A. graveolens* (Fig. 1) respectively. Total haploid chromatin length, TF% and S% were observed to be 30.41 µm ± 2.30, 42.03 and 37.60 in *A. graveolens*; 19.04 µm ± 1.61, 26.63 and 63.98 in *C. cyminum*; 29.12 µm ± 2.73, 40.00 and 69.59 in *F. vulgare* and 32.45 µm ± 3.52, 33.04 and 62.92 in *T. amni* respectively. The somatic complement of *A. graveolens* and *F. vulgare* were symmetric in nature.

The chromosome number is in confirmity to earlier reports (Sharma and Ghosh 1954; Darlington and Wylie 1955; Bell and Constance 1957; Baijal and Kaul 1973; Ghaffari and Tajik 2007) but Subramanian (1986) suggested 2n = 18 chromosomes for the species. Baijal and Kaul (1973) reported seven chromosome types (A to G; four pairs A–D with sub-metacentric primary constrictions, rest had sub-telocentric constrictions) and the chromosomes length was found to vary between 2.32 µm and 4.33 µm (relative length – 63.95% to 100.0%) possessing three pairs of satellited chromosomes. On the contrary, Subramanian (1986) reported four chromosome types (4F + 4G + 6H + 4K) with one pair of chromosomes with satellites (length: 1.6 µm to 2.6 µm).

Chromosome number (2n = 22) of fennel observed in the present investigation is in accordance to earlier reports (Sharma and Ghosh 1954; Raghuvanshi and Joshi 1966; Hore 1976; Subramanian 1986; Deng *et al.* 2006). Subramanian (1986) designated three chromosome types (2n = 22; 4F + 10H + 8K) with seven pairs of chromosomes with median primary constrictions and four pairs with sub terminal centromeres. The author reported that the complement possesses one pair of chromosomes with secondary constrictions (length: 1.6 µm to 2.6 µm). Deng *et al.* (2006) described symmetric karyotype in fennel with predominance of metacentric chromosomes (ten pairs) along with a sub-metacentric pair. Masoud *et al.* (2007) also reported 2n = 22 chromosomes from 13 different populations collected from Iran. Zhao *et al.* (2011) performed karyotype analysis in *A. graveolens* (2n = 22) and the chromosome complement was found to possess three pairs metacentric, one pair sub-metacentric, four pairs acrocentric and three pairs telocentric chromosomes.

Table 1. Karyomorphological details in four spice yielding plants

Plant species	Chromosome number (2*n*)	Chromosome types	Range in the complement				Haploid chromosome length (µm)	TF%
			Chromosome length (µm)	Relative length (%)	TCL (%)	F%		
Apium graveolens	22	3D+6C+1J+1K	1.41-3.75	37.60-100.0	4.64-12.33	36.00-49.02	30.41±2.30	42.03
Cuminum cyminum	14	1D+3E+1G+1H+1I	2.06-3.22	63.95-100.0	10.82-16.91	16.60-36.41	19.04±1.61	26.63
Foeniculum vulgare	22	4C+3D+4F	2.22-3.19	69.59-100.0	7.62-10.95	31.35-46.99	29.12±2.73	40.00
Trachyspermum amni	18	1A+1B+3C+1D+3E	2.97-4.72	62.92-100.0	9.15-14.55	21.17-48.27	32.45±3.52	33.04

Karyotype formula:
Apium graveolens: $4D^{sc}_{sm}+2D_{sm}+2C^{sc}_{m}+10C_m+2J_m+2K_{sm}$
Cuminum cyminum: $4D_{sm}+2E^{sc}_{st}+4E_{st}+2G_{sm}+2H_{st}+2I_t$
Foeniculum vulgare: $8C_m+4D^{sc}_{sm}+2D_{sm}+8F_m$
Trachyspermum amni: $2A^{sc}_{sm}+2B_{st}+2C^{sc}_{m}+4C_m+2D_{sm}+6E_{st}$

CONCLUSION

Karyomorphological data obtained in four seed spices may be effectively explored in designing future research on cytogenetical aspects of the species.

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IMPACT ASSESSMENT OF REJUVENATION TECHNOLOGY AND INTEGRATED PLANT NUTRIENT MANAGEMENT IN OLD GUAVA ORCHARD THROUGH FARMERS PARTICIPATORY APPROACH

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Abstract : An on farm trial was conducted in old guava orchard to assess the rejuvenation and integrated plant nutrient management (IPNM) technologies to restore yield and quality traits from exhausted trees of cv. Allahabad Safeda for the three consecutive years i.e. 2007-10. The eighteen year old trees of selected guava orchard were pruned drastically at a height of 2.00 meter in 2007-2008. It was observed that topping and heading back increased the number of new shoots (below the cut portion) and spread of plant significantly resulting in reduced tree height and improved fruiting potential of trees as compared to farmers practice. As a result of pruning practices increased flowering shoots (39.66%) have given higher yield 63.44 kg tree-1 (average of Ist, IInd, IIIrd years) followed by un pruned well managed trees (44.16 kg tree-1), with having increased yield 107.72 per cent and 44.59 per cent over farmers practice (30.54 kg tree-1) respectively. However, initial yield was recorded lower in rejuvenated plants (29.00 kg tree-1) as compared to T2 (38.66 kg tree-1) and farmers practice (35.50 kg tree-1). The economic analysis revealed that B: C ratios were much higher in rejuvenated plants i.e. T1 (3.76) than T2 (2.38) and farmers practice T3 (1.43).

Keywords : Canopy management, Heading back, *Psidium guajava* L., Yield & quality attributes

INTRODUCTION

Guava (*Psidium guajava* L.) popularly known as apple of the tropics are commercially grown in U.P., M.P., Bihar and neighboring states since long as suited best to the region, but farmers harvesting low yield from the orchard than potential. Declining yield pattern from old guava orchard over the years are the major cause shifting the interest of farmers towards other crops and leaving the orchard unproductive. There are various limiting factors related to production and productivity which are pertinent and gravest for declining trends in bearing potential of old guava orchards (Singh et al. 2005). The study was particularly confined to Chandaul district of Uttar Pradesh, where average yield of traditional guava orchard is very low (7.5 mt ha-1) than the national average i.e. 11.7 mt ha-1 (NHB data base, 2010). Based on several research investigations it could be said that the fruiting potential of the tree is largely governed by its architectures of tree, canopy density and photosynthetic efficiency (Burondkan et. al. 2000; Singh and Singh 2003; Kalloo et. al.2005). Overcrowded old orchard planted in unsystematic manner favors decreased photosynthetic phenomenon, provides conducive environment to harbor pest and diseases was found the root cause of its decline in terms of production and productivity in the Chandauli district. An unproductive orchard is generally characterized by intermingling, overcrowded shoots with insect & disease infestation having branches not to capable to flower and fruit. The technological gap identified before the implementation of the experiment, revealed that farmers were not aware about pruning response and role of improved management practices. Topping and heading back of shoots in month of May and October were performed up to year 2009, regularly to develop a good framework and to develop better canopy. Practices of integrated plant nutrient management and other recommended cultural practices were also undertaken in rejuvenated and un- pruned plants of alternate rows and compared the performance with farmers practice in remaining trees of orchard. The yield obtained from pruned trees had better quality as compared to farmers practice. This experiment provided an eye opening result to farmers, not only to rejuvenated old unproductive orchard but also interaction effect of pruning response and integrated practices. After seeking the problems of un- productivity of an orchard in the region (Chandauli) an intensive extension approach were made to rejuvenate old guava orchard.

MATERIAL AND METHOD

Identification of technological gap and plan of on farm testing (OFT) :

A study conducted by Krishi Vigyan Kendra, Chandauli, U.P., based on survey and group discussion with farmers interactive group (F.I.G.), of guava growers in the guava belt of Chandauli district (i. e. Rema, Digghi, Ganjkhwaja, Faguiya and Tajpur villages) to identify root cause of low yield and technological gap between improved production technology and farmers practice given in Table-1.

Experiment was conducted at three farmers' orchard in two villages namely Faguiya in Sakadeeha block and Digghi in sadar block from 2007 to 2010 as

suggested by scientists P.F.D.C. (C.I.S.H., Lucknow, U.P.). Before implementation of OFT a group discussion with guava growers were made for identifying potential impediments in acceptance and growers involvement in OFT and willingness to adopt the rejuvenation technology. A list of constraints experienced by farmers on socio-economic, cultural and behavioral factors was prepared and sort listed as appended in Table-2. After assessing the cognitive domain and perception of guava growers as well as potential hindrances to acceptance of technology, an intensive extension program like informal meetings and focused group discussion, gosthies and scientist- growers' interface with video shows were conducted in association with P.F.D.C., Lucknow and department of horticulture Chandauli. Concentrated extension efforts led to change in the mind set of growers and at least nine growers came forward to have this trial in their old orchard. Among these, three farmers having 17-18 years old orchard with poor yield record were selected for the experiment. The farming situations studied of the selected orchards are given in Table-3.

Experimental plan and module of treatment

Each selected farmers provided 15 plants for heading back having marked decline in yield from his garden in alternate row to conduct the study and other fifteen un-pruned plants of adjoining row. Selected farmers were extended the facility of all the package of rejuvenation technology and remaining plants of orchard were treated as farmers practice in the study.
The experimental module included the heading back of branches at 2.00 meter height from ground level during May 2007. The newly emerged shoots as a result of rejuvenation pruning were allowed to grow up to length of about 40 to 50 cm. These were further pruned to about 50 per cent of its length. These shoots were further pruned to about 50 per cent of its total length in the month of October for emergence of multiple shoots below the pruning portion to modify tree structure and maintained canopy size. Shoot management was continued in 2008 and 2009 in May and October for the purpose. Pasting of copper oxychloride on cut surface and a paste of copper and lime were applied after each pruning.
The trees were irrigated regularly to maintain moisture for proper growth of shoot and fruiting twigs and application of 20 kg vermicompost plant^{-1} was made to each pruned plants. Integrated approaches for the supply of nutrients were adopted after six month of it, having 30 kg vermicompost + half kg neem cake + 1300 g urea + 1875 g single super phosphate and 500 g muriate of potash per plant in two split doses in the month of October and June. The details of treatments followed in the trial are as bellow.

T_1= Rejuvenation pruning followed by consistent pruning of emerging shoots at 50 per cent of length in October and May till 2010 + IPNM package + recommended management practices
T_2= Un-pruned trees + IPNM package + recommended management practices
T_3= Farmers practice (Application of DAP @ 300 g plant^{-1})
Data on vegetative growth were recorded in the month of October every year and for reproductive parameters after May and October shoot pruning. The observations on fruit analysis were noticed in composite sample of 5 fruits from 15 collected fruit of each rejuvenated and non rejuvenated plants. Total soluble solids were measured by Erma hand refractometer. Per cent increase in yield was calculated by using following formula.

$$\text{Increase (\%)} = \left(\frac{\text{Demo yield} - \text{farmers yield}}{\text{Farmers yield}}\right) \times 100$$

$$\text{B: C Ratio} = \frac{\text{Gross return}}{\text{Cost of cultivation}}$$

RESULT AND DISCUSSION

Cultivation of guava at commercial level in the Chandauli district of U.P., is very popular among the farmers due to its high yield and attractive prices, but data presented in Table-1 revealed that farmers involved in guava production in the district, didn't aware about recommended production technologies i.e. high yielding varieties, crop regulation, high density planting, nutrition management, mulching, intercropping, pruning response, use of bioregulator and plant protection measures. The competitive intercrops i.e. rice, bitter gourd and pigeon pea along with imbalance nutrition management not only reduces the yield and canopy development of orchard but also make the orchard decline due to higher incidence of diseases and pests. The lack of knowledge and skill about management of overcrowded orchard and combined production management approaches were the important causes held responsible to decline. These facts are also in conformity with the findings of Singh et. al.(2003).
The farming situation as given in Table-3 favours the commercial growing of guava in the district. It consist of sandy loam soil with pH 7.5- 8.00, lower N & P with medium K2O and sufficient rainfall which are suitable for guava production, but unmanaged, poorly nourished, overcrowded orchard taken under study were unable to produce higher yield and tend to become uneconomic.
In general, guava bears flower and fruit on newly emerging shoots. Irrespective of time of year, guava tree tend to grow in bush resulting in poor light penetration and utilization (Singh, 2005). In the present trial increase in tree canopy was directed by shoot pruning effectively. The growth of terminal and lateral shoots during the framework development of tree may be stimulated during

growth period (Singh et al. 2005) but these excessive growths must be well managed by pruning and removal of overcrowded shoots.

The experimental findings summarized in Table-4 revealed that significantly and consistently profuse flowering were observed in rejuvenated guava trees than well nourished un-pruned guava trees (T_2) and farmers practice(T_3). Increased branching complexity results in more fruiting shoots in young trees, promoting precious flowering and fruiting (Campbell and Wasielewski, 2000). Pooled fruit yield data of a year indicated that rejuvenated tree (T_1) had maximum fruiting shoots (39.66 per cent) in comparison to un-pruned well managed tree (T_2) 24.66 per cent and farmers practice (T_3) 15.66 per cent. It is very clear that consistent pruning responded well and stimulated new growth to convert in fruiting shoots. The data related to yield in Table-4 exhibited that rejuvenated trees consistently and significantly produced higher yield (29.00 to 96.00 kg tree^{-1}) as the year passes over the farmers practice (35.50 to 28.80 kg tree^{-1}). However, the yield from T_2 was also found consistently in increasing trend (38.66 to 51.33 kg tree^{-1}) but lower than rejuvenated trees. It is because of increased new growth in T_2 due to management practices, but less conversion of new shoots into bearing shoots in un-pruned trees. Declining in productivity of orchard could largely be due to poor photosynthesis efficiency besides several other compounding factors i.e. age of plants, dense and intermingling branches, neglected and poor management of the orchard (Kalloo et al. 2005). The per cent increase in average yield of three years period reported highest in rejuvenated trees (107.72 per cent) in comparison to un-pruned well managed trees (44.59 per cent) over the farmers practice. The data pertaining to quality parameters revealed that number of fruits plant^{-1} found maximum in farmers practice (330) followed by T_1 (305) and T_2 (300).While the average fruit weight recorded highest (206.66 g) in rejuvenated plants followed by T_2 (146.66 g) and T_3 (93.33 g).Total soluble solids observed maximum 12% in fruits of rejuvenated plants in comparison to T_2 and T_3 (11%). The differences in qualitative characters may be due to location of fruits and light distribution within canopy. It also indicated that even with proper handling and management of shoot within tree canopy is important for maintenance of fruit quality and production system (Campbell and Wasielewski, 2000). Economic aspect of the study listed in Table-5 stated that the margin (net return) was very poor in rejuvenated plants (Rs. 2953ha^{-1}) in 2008 than the T_2 (Rs. 17544 ha^{-1}) and farmers practice T_3 (Rs. 21167 ha^{-1}). However, it was recorded maximum in T_1 (Rs.56982) ha^{-1} and (Rs.97690) ha^{-1} in ensuing years 2009 and 2010 respectively than the T_2 (Rs.23162ha^{-1} and Rs.35192 ha^{-1}) and T_3 (Rs.11352 ha^{-1} and Rs.12088 ha^{-1}). The trend of negative net gain over farmers practice (Rs.-18234ha^{-1}) in rejuvenated plants (T_1) and T_2 (Rs.-3623/ha) were reported due to increased cost of production in 2008. It is because of higher input cost of heavy pruning of plants and better management practices. The B: C ratio was maximum in farmers practice (1.75) in initial year while it was too high in rejuvenated plants (2.70 and 3.76) in comparison to T_2 (1.64 and 2.38) and T_3 (1.42 and 1.43) in the year 2009 and 2010 respectively. It might be suggested to farmers that the yield loss in first year due to rejuvenation technology can be compensated by sale of pruned wood and better yield from intercrops having more light penetration and open space. Raising of intercrop like vegetables (potato, cucurbits, turmeric etc.) fetched income about Rs.45000 to 55000 ha^{-1}.

During the course of study (2007 to 2010) several field days and farmers visits were made by department of Horticulture, Chandauli, Uttar Pradesh. Growers with scientific temperament and entrepreneurial orientation appreciated the potential of technology and ready to adopt by having a refinement in technology by way of alternate row pruning. Farmers also appreciated the better management practice followed in T_2 as well.

CONCLUSION AND RECOMMENDATION

Significance of technology may be concluded by per cent increase in average yield of three years period as reported highest in rejuvenated trees (107.72 per cent) in comparison to un-pruned well managed trees (44.59 per cent) over the farmers practice. The result of On Farm Trial convincingly brought out that the rejuvenated trees consistently and significantly produced higher yield (29.00 to 96.00 kg tree^{-1}) as the year passes over the farmers practice (35.50 to 28.80 kg tree^{-1}). However the yield from T_2 was also found consistently in increasing trend (38.66 to 51.33 kg tree^{-1}) but lower than rejuvenated trees. It may be concluded that the success of this technique largely depends upon the proper management of shoots through precise and timely pruning. Constraint experienced in adoption of trail during the study may be taken under consideration by policy maker to start a campaign to popularize technology.

Table 1: Technological gap between improved management packages and farmers practices

S.N.	Technologies	Farmers Practices	Improved management package
1.	Selection of high yielding variety	Not aware, insist only grafted plants	Improved varieties i.e. Allahabad Safeda, L-49, Lalit etc.

2.	Crop regulation (Bahar treatment)	Not aware	Spray of urea 10-15% for deblossoming for rainy crop. Root exposure and water withholding for enforcing heavy crop.
3.	High density planting	Not aware	Accommodation of 555 plants at 6x3 meter spacing rather than 277 plants at 6x6 meter spacing
4.	Nutrient management	Application of chemical fertilizers at non judicious doses 2 kg DAP/plant	IPNM technology consisted 20 kg FYM +250 g Azotobactor +300 g N + 200 g P2 O5 +350 g K2 O in two split doses
5.	Mulching	Not aware	Mulching with paddy straw/ banana leaf or with black polythene
6.	Pruning and training	Not aware	Mild pruning in April in fruiting plants and rejuvenation of same orchard
7.	Use of bio-regulator	Not aware	Spray of NAA 100 PPM or GA3 150 PPM or Ethephone 300 ppm increasing fruit setting and reduces fruit drop
8.	Selection of intercrop	Growing rice, wheat and bitter gourd ; causes garden decline	Okra, cowpea, dolichus and turmeric can be grown as intercrop in guava orchard synergistically
9.	Pest and disease management	Non judicious use of pesticides	Application of IPM techniques Fruit fly management by use of Methyleugenol pheromone trap and spray of carbaryl and anthracnose management by use of Thiophenol 0.01% and Wilt management by application of Trichoderma and Aspergillus niger

Table 2: Constraints experienced by farmers in adoption of rejuvenation technology

SN	Identified constraints
1.	Lack of awareness and knowledge about rejuvenation technology
2.	Un willingness about deep root pruning in guava tree
3.	Lack of faith in rejuvenation techniques and risk of survival of orchard after deep root pruning
4.	Fear of economic loss by missing two crops
5.	Lack of risk taking willingness
6.	Unavailability of skilled labour and equipments
7.	Fear of forest law and police
8.	Complexity of work

Table 3: Details of farming situation of OFT on rejuvenation of guava

Treatments	Duration of study	Variety	Age of plant	Farming situation	Soil type	pH	Soil status			Seasonal rainfall	Avg. no. of rainy days
							N	P	K		
T_1- Rejuvenated trees	May 2007 to Nov. 2010	Allahabad safeda	18 years	Irrigated	Sandy loam	7.5-8.0	Low	Low	Medium	560 mm	29
T_2- Unpruned well managed trees											
T_3- Farmers practice											

Table 4: Effect of rejuvenation pruning and nutrition management on growth flowering and yield of guava **cv. Allahabad Safeda**

Treatment	Avg. tree height (m)	Emergence of new shoots (no.)	Flowering shoots in (%)	Yield in kg/tree			Avg. yield kg/tree	% increase in yield	Quality parameter		
				Ist year	IInd year	IIIrd year			No. of fruits plants-1	Avg. fruit wt.(g)	TSS (brix0)
T_1- Rejuvenated trees	2.0	7.8	39.66	29.00	65.33	96.00	63.44	107.72	305	206.66	12.00
T_2- Un-pruned well managed trees	7.4	4.0	24.66	38.66	42.50	51.33	44.16	44.59	300	146.66	11.00
T_3-Farmers practice	7.4	3.15	15.66	35.50	27.30	28.80	30.54	-	330	93.33	11.00

Table 5: Economic impact of rejuvenation technology on guava production cv. Allahabad Safeda

SN	Year	Total yield (q ha^{-1}) (@ 277 trees ha-1)			Avg. cost of inputs (Rs. ha^{-1})			Avg. gross of return (Rs. ha^{-1})*					Net return (Rs. ha^{-1})			Net gain OverFarmers practice (Rs. ha^{-1})		B: C ratio		
		T_1	T_2	T_3	T_1	T_2	T_3	T_1			T_2	T_3	T_1	T_2	T_3	T_1	T_2	T_1	T_2	T_3
								Yield	Pruned wood	Total										
1	2008	80.33	107.08	98.33	53832	36000	28000	40165	16620	56785	53544	49167	29953	17544	21167	-18234	-3623	1.05	1.48	1.75
2	2009	180.96	117.72	75.70	33500	35700	26500	90482	-	90482	58862	37852	56982	23162	11352	45630	11810	2.70	1.64	1.42
3	2010	265.92	142.18	79.77	35270	35900	27800	132960	-	132960	71092	39888	97690	33192	12088	85602	23104	3.76	2.38	1.43

* Sale of commodity @ Rs. 500 q^{-1}; T_1- Rejuvenated trees, T_2 – Un-pruned well managed trees and T_3- Farmers practice

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MAJOR WEEDS OF RABI CROPS IN BLOCK CHAMBA, DISTRICT TEHRI GARHWAL (UTTARAKHAND), INDIA

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Abstract : The present communication pertains to major weeds of Rabi crops in block Chamba district Tehri Garhwal (Uttarakhand).The study was based on the extensive and intensive field surveys carried out during different months of Rabi season 2009-11. During the course of field study the authors have selected 05 important agaracarian villages of block Chamba i.e Dharsal, Saundkoti, Sabli, Jagdhar and Nagani, Three sites were selected in each village for collection of weed species. A total of 66 weeds belonging to 01 monocot and 22 dicot families were reported from the study area. The maximum dominance was shown by family Asteraceae and Fabaceae having 14 and 09 weed species respectively. The monocot family (Poaceae) was represented by 05 weed species.

Keywords : Chamba, Tehri, Weed

INTRODUCTION

Weed is a plant growing where it is not desired. The concept of weed as an unwanted plant was born when man started to grow plants deliberately for their own purposes (Dangwal et.al.2010). Holm et. al. 1979 estimated about 8000 weed species all over the world. Out of these 250 weeds are important for agricultural crops. These are non indigenous plants that can invade or negatively alter native plant communities. Weeds differ from other plants in being more aggressive having peculiar characteristics that make them more competitive (Jim Blackburn, 2008).They have the ability to spread rapidly and reproduce in high numbers which enables them to effectively crowd out native plant population and established a kingdom of their own within a short period of time.

Crop fields are artificial ecosystem where the plants desired by man (crops) are grown but the weeds do come up and compete with crops mainly for space, sunlight, moisture, nutrients and hence reduced the yield of crops (Anderson 1996). Weeds usually absorb mineral nutrients faster then crop plants and accumulate them in their tissues in relatively larger amount thus the crops suffers from nutrient starved conditions and some time leads to complete failure. Weeds transpire more water than crop plants thus the weedy crops exhibit wilting and hence reduced in yield. Moreover, the weeds mature ahead of crops so that their seeds get mixed with crop seeds and distributed to other places. Weeds reduced the yield of wheat crop by 34.3% in India (Tiwari and Parihar, 1993).Weeds acts as a host for bacteria, viruses and nematodes that causes diseases in crop plants (Younkin 1949 and Peters 1955). Some noxious weeds are harmful, they adversely affects crop productivity, causes health hazards in human and animals hence affects the comfort and working efficiency of man. Weeds show allelopathic effects on crop plants by secreting allelochemicals that inhibits growth and germination of crop plants (Oudhia, P and Tripathi 1998a, b).

The present study area i.e. block Chamba, district Tehri Garhwal is located at an elevation range of 1524 m. asl and lies in between latitude of 30^0 -21'N and longitude of 78^0 -30' E. As Barley and Pea are the major Rabi crops sown in block Chamba but Wheat and Onion are also grown on small scale in this block.

MATERIAL AND METHOD

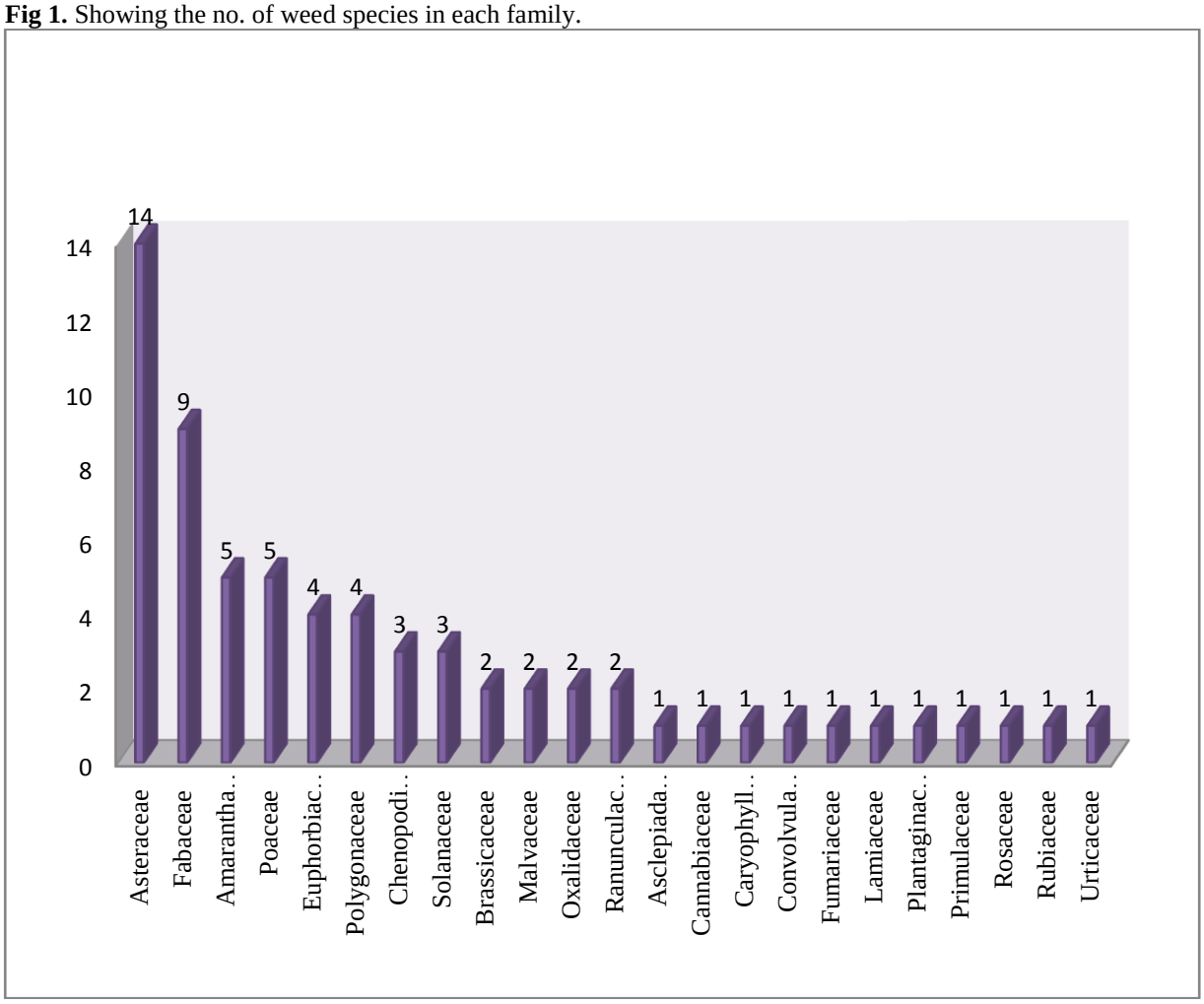
The present communication pertains to major weeds of Rabi crops in block Chamba of district Tehri Garhwal (Uttarakhand).The study is based on intensive and extensive field surveys made during different months of Rabi season 2009-11. During this period the authors have selected five important agricarian villages in block Chamba i.e. Dharsal, Saundkoti, Sabli Jagdhar and Nagani. Three sites were selected in each village. Periodic field trips were made twice a month in all the sites to collect the weed species. Important field notes on flowering and fruiting seasons of particular weed species were reported. The interviews were conducted from farmers and agriculturists of each site about seasonal weed species and their available vernacular names. The collected weed plants were dried, pressed, preserved, mount and properly identified with the help of available literature, monographs (Gaur, R. D.1982 &1999, Kaul, M.K.1986) and confirmed from the authentic regional herbaria i.e. Botanical Survey of India, Northern Circle (BSD), Dehradun and Forest Research Institute Herbarium (DD), Dehradun and deposited them in the H.N.B. Garhwal Central University Herbarium, Department of Botany, S.R.T. Campus, Badshahithaul, Tehri Garhwal, Uttarakhand.

RESULT AND DISCUSSION

A total of 66 weed species belonging to 01 monocot and 22 dicot families were reported from the Rabi

crops of the study area. The maximum dominance was shown by families Asteraceae and Fabaceae having 14 and 09 weed species respectively. The family Amaranthaceae and Poaceae contained 05 weed species each. The families Euphorbiaceae and Polygonaceae were represented by 04 weed species each. The family Chenopodiaceae and Solanaceae contained 03 weed species each. The families Brassicaceae, Malvaceae, Oxalidaceae and Ranunculaceae were represented by 02 weed species. The remaining families i.e. Asclepiadaceae, Cannabiaceae, Caryophyllaceae, Convolvulaceae, Fumariaceae, Lamiaceae, Plantaginaceae, Primulaceae, Rosaceae, Rubiaceae and Urticaceae were represented by 01 weed species each (Fig 1). Out of the 66 weed species mentioned in the communication the weeds like *Avena fatua, Anagallis arvense, Chenopodium album, Cirsium arvense, Fumaria parviflora, Lathyrus aphaca, Melilotus indica, Parthenium hysterophorus, Phalaris minor, Rumex nepalensis, Vicia hirsuta* and *Vicia sativa* are common weeds showing maximum diversity in crop fields. Comparative percentage of weed families of Rabi Crops in block Chamba is shown in Fig 2.

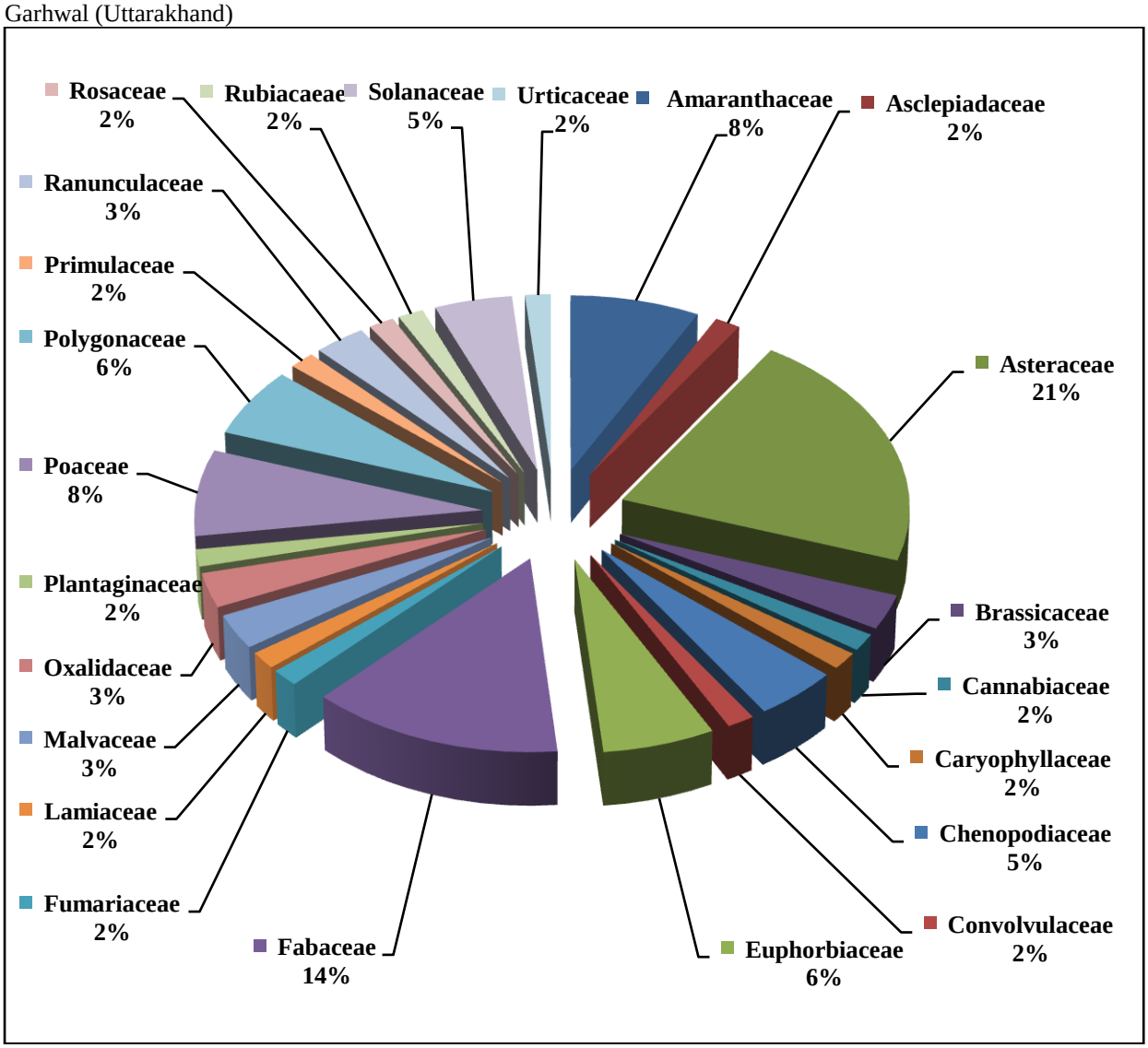
Fig 1. Showing the no. of weed species in each family.



Barley and Pea are the major Rabi crops of the block Chamba but along with Barley and Pea, Wheat and Onion are also grown on small scale by the agriculturists. The per hectare yield of crops in this block is less as compared to other parts of India due to many factors like lack of irrigation system etc. but the menance of weeds is also the major contributor to loss of production. The management of weeds involves costs therefore reduction in net returns makes harvesting and threshing of crops costly, laborious and reduces the value of production. Some of the weeds i.e. *Achyranthes aspera, Calotropis procera, Cannabis sativa, Chenopodium album, Cynodon dactylon, Datura stramonium, Taraxacum officinale* etc. are of medicinal importance. The weeds like *Amaranthus viridis*, *Chenopodium album*, *C. murale*, *Coronopus didymus*, *Lathyrus aphaca*, *Vicia hirsuta* and *Vicia sativa* are used in some cooking racapies of this area.

The present study was conducted as first ever attempt from the study area to explore and identify the major weeds of Rabi crops. It may help the taxonomists,farmers and agriculturists to identify the weeds and thus planning a suitable stratergy for their control.

Fig. 2. Showing Comparative percentage of weed families of Rabi Crops in block Chamba, District Tehri Garhwal (Uttarakhand)



CONCLUSION

Weeds are the severe competitor of crops. They compete with crops mainly for space, sunlight, moisture and nutrients and hence reduce the value of production. They cause enormous loss to the producers as they losses a part of their investment and the country suffers reduction in agricultural products. In the study area authors have reported **66** weed species belonging to **01** monocot and **22** dicot families.

The 01 monocot and 22 dicot families are arranged alphabetically with their botanical names, available vernacular names and flowering and fruiting seasons in

Table 1

S.No.	Family	Botanical name	Available vernacular name	Flowering and fruiting seasons
1)	Amaranthaceae	1) *Ahchyranthes aspera* L.	Poothkanda	Aug-Dec
		2) *Alternanthera pungens* Kunt.	-	Aug-Oct
		3) *Alternanthera sessilis* (L.)Dc.	-	Aug-Sept
		4) *Amaranthus spinosus* L.	Goja	Sept-Nov
		5) *Amaranthus viridis* L.	Chelari	Aug –Nov
2)	Asclepiadaceae	1) *Calotropis procera* (Ait.)F.	Aak	Apr-Jul
3)	Asteraceae	1) *Ageratum conyzoides* L.	Gandela	Sept-Oct
		2) *Artemisia vulgaris* L.	Chhamur	Jul-Aug
		3) *Bidens pilosa* L.	Saryala	Sep-Nov
		4) *Conyza ambigua* Dc.	-	Apr-May

		5) *Conyza bonariensis* L.	-	Aug –Sep
		6) *Cirsium arvense* Syn.	Kantili	Jan-Mar
		7) *Eupatorium adenophorum* Spreng.	Kala Bansa	Sep-Oct
		8) *Galinsoga parviflora* Cav.	Soch	Throughout the year
		9) *Gnaphalium luteo-album* L.	-	Mar-Apr
		10) *Parthenium hysterophorus* L.	Gajjar Ghass	Jun –Sep
		11) *Sonchus asper* L.	Badi Hand	Jun-Oct
		12) *Sonchus oleraceus* L.	-	Mar-May
		13) *Taraxacum officinale* Weber.	Hand	Mar-Oct
		14) *Tridex procumbens* L.	Kumur	Mar-Apr
4)	Brassicaceae	1) *Capsella bursa-pastoris* Medik.	Hallo	Jan-Mar
		2) *Cornopus didymus* L.	Jungle AJwain	Apr-Oct
5)	Cannabiaceae	1) *Cannabis sativa* L.	Bhang	Jul-Sep
6)	Caryophyllaceae	1) *Stellaria media* L.	Baarara	Feb-Mar
7)	Chenopodiaceae	1) *Chenopodium album* L.	Bathu	Mar-Apr
		2) *Chenopodium murale* L.	Lal Bathu	May-Aug
		3) *Chenopodium ambrosoides* L.	Booti	Aug-Oct
8)	Convolvulaceae	1) *Convolvulus arvensis* L.	Bel	Apr-Sep
9)	Euphorbiaceae	1) *Euphorbia dracunculoides* Lamk.	Doodal	Nov-Jan
		2) *Euphorbia geniculata* Orteg.	Badi Doodal	May-Jul
		3) *Euphorbia hirta* L.	Chota Dhudhiya	Sep-Oct
		4) *Euphorbia prostrata* Aiton.	Dhudui	Jul-Sep
10)	Fabaceae	1) *Indigofera dosua* Buch.	-	Apr-Jul
		2) *Lathyrus aphaca* L.	Jungle Matar	Feb-Mar
		3) *Medicago lupulina* L.	Maithi Ghass	Mar-Apr
		4) *Medicago polymorpha* L.	Meethu	Aug-Oct
		5) *Melilotus indica* L.	Khara Methi	Mar-Apr
		6) *Trifolium repens* L.	-	Apr-Jul
		7) *Trifolium tomentosum* L.	Stal	Mar –Apr
		8) *Vicia hirsuta* L.	Khanu	Mar-Apr
		9) *Vicia sativa* L.	Bada gaigla	Mar –Apr
11)	Fumariaceae	1) *Fumaria parviflora* Lamk.	Saitra	Sep-Nov
12)	Lamiaceae	1) *Leucas lanata* Benth.	Gumma	Jan-Oct.
13)	Malvaceae	1) *Malva parviflora* L.	-	May-Aug
		2) *Malvestrum coromendalinium* Syn.	Sonchal	Mar-Apr
14)	Oxalidaceae	1) *Oxalis corniculata* L.	Khati Methi	Feb-Nov
		2) *Oxalis latifolia* H.B.&K.	Teepatia	Jun-Oct
15)	Plantaginaceae	1) *Plantago major* L.	Badi Ghass	Apr-Oct
16)	Poaceae(Monocot)	1) *Avena fatua* L.	Kali Jaee	Mar-Apr
		2) *Cynodon dactylon* L.	Doob	Apr-Jul
		3) *Lolium temulentum* L.	Tinra	Mar-Apr
		4) *Phalaris minor* Retz.	Mandosi	Mar-Apr
		5) *Poa annua* L.	Khabal	May-Aug
17)	Polygonaceae	1) *Polygonum barbatum* L	-	Feb-Nov
		2)*Polygonum persicara* L.	Sawak	Feb-Nov
		3) *Rumex dentatus* L.	Khansu	Mar-Apr
		4) *Rumex nepalensis* Spreng.	Khanas	Aug-Sep
18)	Primulaceae	1) *Anagallis arvensis* L.	Krishna Neel	Feb-Apr
19)	Ranunculaceae	1) *Ranunculus arvensis* L.	Dhania Ghass	Mar-Apr
		2) *Ranunculus sceleratus* L.	Changeri	Mar-Apr
20)	Rosaceae	1) *Fragaria indica* Andrews.	Kai Phal	Mar-May
21)	Rubiacaeae	1) *Galium aparine* Linn.	Char-Chara	Feb-Mar
22)	Solanaceae	1) *Datura stramonium* L.	-	Apr-Jul
		2) *Solanum nigrum* L.	Makoi	Aug-Sep
		3) *Solanum xanthocarpum* Schrad.	Satyanashi	Jul-Oct
23)	Urticaceae	1) *Urtica dioica* L.	Bichhu Ghass	Nov –Feb.

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ANALYSIS OF SOCIO-ECONOMIC PROFILE OF THE ATMA BENEFICIARIES OF CHHATTISGARH

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Abstracts : The present study was carried out during 2011 in the Surguja district of Chhattisgarh state. This study was conducted in randomly selected 10 villages of three purposively selected blocks i.e. Ambikapur, Lundra, Surajpur located in Surguja district. The aim of this study to assess the socio-personal and socio-economic characteristics of the respondents. A total of 150 respondents including 100 beneficiary and 50 non-beneficiary farmers were selected randomly. The data collection was done by the use of interview schedule through personal interview. Data were analyzed with help of suitable statistical tools. The findings reveal that the majority of the beneficiary and non-beneficiary respondents were of middle age groups (36 to 50 years) having middle school and primary school level educated, residing in nuclear family system with small size of family (up to 5 members). Majority of beneficiaries had high level of social participation as compared to non-beneficiaries. Majority of the respondents were performing agricultural activities, however they were also engaged in 2 to 3 occupation. Majority of the respondents were having marginal land holding (up to 2.50 acre). Majority of the beneficiaries belonged to Rs. 30,001 to Rs. 50,000 (High category) annual income group as compare to non-beneficiaries earned Rs. 20,001 to Rs. 30,000 (Medium category). Majority of the respondents were taking short term credit facility extended by government organization.

Keywords : ATMA, Chhattisgarh, Socio-personal, Socio-economic characteristics

INTRODUCTION

ATMA is a society of key stakeholders involved in agricultural activities for sustainable agriculture development in the district. It is a focal point for integrating Research and Extension activities and decentralizing day-to- day management of the public Agricultural Technology System (ATS). It is a registered society responsible for technology dissemination at the district level. As a society, it would be able to receive and expand funds, entering into contracts and agreements and maintaining revolving accounts that can be used to collect fees and thereby recovering operating cost. The ATMA at district level would be increasingly responsible for all technology dissemination activities at the district level. It would have linkage with all the line departments, research organization, non-governmental organizations and agencies associated with agricultural development in the district. Research and Extension units within the project district such as ZRS or substations, KVK and the key line departments of Agriculture, Animal Husbandry, Horticulture and Fisheries, Forestry etc. would become constituent members of ATMA. Each Research-Extension (R-E) unit would retain its institutional identity and affiliation but programme and procedures concerning district-wise R-E activities would be determined by ATMA Governing Board (GB) to be implemented by its Management Committee (AMC).

Keeping this in view the present study was under taken to study the some selected socio-personal and socio-economic characteristics of the beneficiaries.

MATERIAL AND METHOD

This study was conducted in Surguja district of Chhattisgarh, during the year 2011. Chhattisgarh state has 18 districts out of which Surguja district was selected purposively because this district has got highest fund for the ATMA programme. From this district only three blocks i.e., Ambikapur, Lundra and Surajpur were selected purposively. From each selected block out of total villages, only 14 villages in Ambikapur, 12 villages in Lundra and 15 villlages in Surajpur block have been selected by Government of Chhattisgarh for carrying out the various activities under ATMA project. Out of these beneficiary villages, only 25 per cent villages in each block i.e. Rakeli, Darima, Nawanagar (Ambikapur), Lamgaon, Kot, Dorna (Lundra), Ajirama, Kalyanpur, Dwrikanagar and Jagatpur (Surajpur) were randomly selected (Total 10 villages) for the study. From each Farmers Interest Groups 10 tribal farmers were randomly selected those were beneficiaries of ATMA programme from each selected village as respondent. In this way, 30 farmers from Anbikapur, 30 farmers from Lundra and 40 farmers from Surjupur (30+30+40=100 beneficiary farmers) were selected to determine the impact of information sources in various activities of ATMA programme on socio-economic status of the farmers. The 5 non-beneficiary farmers were also selected from same village as non-beneficiary respondents (15+15+20=50). Thus, total of 150 (100 beneficiaries and 50 non-beneficiaries) farmers were selected as respondents for the present study. Respondents were interviewed through personal interview. Prior to interview, respondents were taken in to confidence by revealing the actual purpose of the study and full care was taken in to consideration to develop good

rapport with them. For the data collection well designed and pre-tested interview scheduled were used. Collected data were analyzed by the help of various statistical tools i.e. frequency, percentage, mean and standard deviation, etc.

RESULT AND DISCUSSION

Socio-personal characteristics of the respondents

Age, education, type of family, family size and social participation of ATMA beneficiary and non-beneficiary were considered as socio-personal characteristics of the respondents. These characteristics were analyzed and presented in Table 1.

Age of the respondents

The findings on age of the respondents were presented in Table 1. The majority of the (48%) ATMA beneficiaries belonged to middle age group (36 to 50 years), followed by 34 per cent respondents were under young age group (up to 35 years) and 18 per cent respondents were of old age group (above 50 years). Whereas, the majority of the (56%) non-beneficiaries belonged to middle age group (36 to 50 years), followed by 26 per cent respondents were under young age group (up to 35 years) and 18 per cent respondents were of old age group (above 50 years). Thus, it may be concluded that the majority of the respondents in the study area belonged to middle age groups who are the major beneficiaries of ATMA programme, followed by young age group and older age group. Shrivastava (1999), Rao (2001), Singh (2003), Kumar *et al.* (2007), Bharathi and Badiger (2009), Singh *et al.* (2009) and Bolarinwa and Fakoya (2011) also noted almost similar findings.

Education of the respondents

The data in Table 1 described that the majority of the ATMA beneficiaries (57%) were middle school level educated followed by 14 per cent were found under the category of primary school, 11 per cent respondents were illiterate, 10 per cent higher secondary level, 7 per cent high school level and only 1 per cent above higher educated. Whereas, the majority (64%) non-beneficiaries were primary school level educated followed by 10 per cent were illiterate, 8 per cent were found under the category of middle and high school level, 6 per cent higher secondary level and only 4 per cent above higher secondary level educated. Finally results clearly indicated that the majority of ATMA beneficiaries were having education up to middle school as compared to majority of non-beneficiaries were primary level educated. Singh *et al.* (2009) and Bolarinwa and Fakoya (2011) also observed almost similar findings.

Type of family

The data in Table 1 revealed that the majority (78%) of the ATMA beneficiaries belonged to nuclear family followed by 22 per cent come under the joint family. Whereas, the majority of (76%) non-beneficiaries belonged to nuclear family, followed by 24 per cent belonged to joint family as non-beneficiary respondents. Shrivastava (1999) also noted almost similar findings.

Table 1: Distribution of the selected respondents according to their socio-personal characteristics

Characteristics	Respondents			
	Beneficiary (n=100)		Non-Beneficiary (n=50)	
	Frequency	Percentage	Frequency	Percentage
Age				
• Young (up to 35 years)	34	34	13	26
• Middle (36 to 55 years)	48	48	28	56
• Old (above 55 years)	18	18	9	18
Education				
• Illiterate	11	11	5	10
• Primary (up to 5th class)	14	14	32	64
• Middle (6th to 8th class)	57	57	4	8
• High school (9th to 10th class)	7	7	4	8
• Higher secondary (11th to 12th class)	10	10	3	6
• Above higher secondary (>12th class)	1	1	2	4
Type of Family				
• Nuclear	78	78	38	76
• Joint	22	22	12	24

Family size				
• Small (up to 5 members)	63	63	27	54
• Medium (6 to 10 members)	35	35	20	40
• Large (> 10 members)	2	2	3	6
Social participation*				
• No membership	0	0	40	80
• Member of one organization	63	63	6	12
• Member of more than one organization	37	37	4	8

*Frequency based on multiple responses

Family size

The data regarding size of family Table 1 indicated that the majority (63%) of the ATMA beneficiaries had small family size (up to 5 members) followed by 35 per cent with medium family size (6 to 10 members) and 2.00 per cent belonged to large family size (above 10 members). The majority of the non-beneficiaries (54%) had small family size (up to 5 members) followed by 40 per cent with medium family size (6 to 10 members) and 6 per cent belonged to large family size (above 10 members). Gupta (1998) also noted almost similar findings.

Social participation

The data regarding social participation Table 1 shows that the majority of the ATMA beneficiaries (63%) had membership of one organization followed by 37.00 per cent beneficiaries who had members of more than one organization and it has been found that all the ATMA beneficiaries were participated minimum one organization. The majority (80%) of the non-beneficiaries not involved in any of the social organization, followed by 12 per cent non-beneficiaries had members of one organization and only 8 per cent had members of more than one organization. It clearly indicated that ATMA beneficiaries had high level of social participation as compared to non-beneficiaries. It means more participation in organization had towards active participation in ATMA or any programme. Singh *et al.* (2009) also noted almost similar findings.

Socio- economic characteristics of the respondents

The independent variables i.e. occupation, size of land holding, annual income and credit acquisition were considered as socio-economic characteristics of the respondents.

Occupation of respondents

Regarding involvement of respondents in various occupations, the data compiled in Table 2 shows that that the majority (96%) of the ATMA beneficiaries were involved in agriculture, followed by 79 per cent of the beneficiaries were involved in labour, while 22 per cent were involved in animal husbandry, 9 per cent of the beneficiaries had adopted business, 8 per cent were involved in horticulture and only 1 per cent beneficiaries had adopted other occupation with agriculture. Whereas, the 100 per cent of the non-beneficiaries were involved in agriculture, followed by 70 per cent of the non-beneficiaries were involved in labour, while 30 per cent were involved in animal husbandry, 6 per cent of the non-beneficiaries had adopt other occupation with agriculture, 4 per cent were involved in horticulture and only 2 per cent were involved in business.

Majority of the respondents (90%) in both the categories beneficiaries and non-beneficiaries were involved in 2 to 3 occupations including agriculture, whereas 9 per cent beneficiaries involved in one occupation followed by only 1 per cent beneficiaries involved in more than three occupations. In case of non-beneficiaries 10 per cent involved in one occupation and non-beneficiaries did not involved in more than three occupations. It indicated that due to lack of sufficient earnings from a single source such as agriculture, the respondents were engaged in other allied activities labour, animal husbandry, horticulture etc. This finding is supported by Shrivastava (1999), Kumar *et al.* (2007), Singh *et al.* (2009) and Bolarinwa and Fakoya (2011).

Table 2: Distribution of the respondents according to their involvement in various occupations

Particulars	**Beneficiary (n=100)**		**Non-beneficiary (n=50)**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Kind of occupation*				
Agriculture	96	96	50	100
Animal husbandry	22	22	15	30
Labour	79	79	35	70
Horticulture	8	8	2	4

Business	9	9	1	2
Others	1	1	3	6
Number of occupation				
Involved in on one occupation	9	9	5	10
Involved in 2 to 3 occupation	90	90	45	90
Involved in more than 3 occupation	1	1	0	0

*Frequency based on multiple responses

Land holding of respondents

The distribution of the respondents according to their land holdings are presented in the Table 3 the maximum number of the ATMA beneficiaries (46%) had marginal category of farmers (having up to 2.50 acre land holdings), followed by 44.00 per cent who belonged under small size of land holding (having 2.51 to 5 acre), 4.00 per cent of the beneficiaries were having medium size of land holding (5.1 to 10 acre) and land less farmer and only 2 per cent beneficiaries were big (above 10 acre) farmers. Whereas, the majority of the non-beneficiaries (48%) came under the marginal category of farmers (having up to 2.50 acre land holdings), followed by 44.00 per cent who belonged under small size of land holding (having 2.51 to 5 acre), 6 per cent non-beneficiaries had medium category of farmers (having 5.1 to 10 acre) and only 2 per cent of the non-beneficiaries came under the big farmers (having above 10 acre). This finding is supported by Dwivedi *et al.* (2007), Kumar *et al.* (2007) and Singh *et al.* (2009).

Table 3: Distribution of the respondents according to their size of land holding

Size of land holding	Beneficiary (n=100)		Non-beneficiary (n=50)	
	Frequency	Percentage	Frequency	Percentage
Land less farmer	4	4	0	0
Marginal (up to 2.50 acre)	46	46	24	48
Small (2.51 to 5 acre)	44	44	22	44
Medium (5.1 to 10 acre)	4	4	3	6
Big (above 10 acre)	2	2	1	2

Annual income of respondents

It is very difficult to assess the average annual income of each individual, as they are not maintaining any records. The attempt was made to collect the annual income of the respondents through discussion and interpretation from different angles. The distribution of the respondents according to their annual income is presented in Table 4. As regards to annual income the higher percentage of the ATMA beneficiaries (31%) were having their income ranging from Rs. 30,001 to Rs.50, 0000 (High category) per annum followed by 25 per cent of beneficiaries earned above Rs. 50,000 (Very high category) per annum, 23 per cent beneficiaries had their annual income in the range between Rs. 20,001 to Rs. 30,000 (Medium category) and 21 per cent had obtained income less than Rs. 20,000 (Low category).

Table 4: Distribution of the respondents according to their annual income

Annul income	Beneficiary (n=100)		Non-beneficiary (n=50)	
	Frequency	Percentage	Frequency	Percentage
Low (up to Rs. 20,000)	21	21	14	28
Medium (Rs. 20,001 to Rs. 30,000)	23	23	15	30
High (Rs. 30,001 to Rs. 50,000)	31	31	13	26
Very high (above Rs. 50,000)	25	25	8	16

Whereas, the majority of (30%) non-beneficiaries earned Rs. 20,001 to Rs. 30, 0000 (Medium category) per annum, followed by 28 per cent non-beneficiaries had obtained income less than Rs. 20,000 (Low category) per annum, 26 per cent had their annual income in the range between Rs. 30,001 to Rs. 50,000 (High category) and only 16 per cent non-beneficiaries had obtained annual income above Rs. 50,000 (Very high category).

The results clearly indicated that the majority of the beneficiaries belonged to Rs. 30,001 to Rs. 50,000 (High category) annual income group as compare to non-beneficiaries earned Rs. 20,001 to Rs. 30,000 (Medium category). This finding is supported by Bolarinwa and Fakoya (2011).

Credit acquisition of respondents

The findings regarding credit acquisition are presented in the Table 5. It is clear from this table that the majority of the ATMA beneficiaries (75%) acquired short term credit, followed by 18 per cent beneficiaries did not acquired credit, 4 per cent beneficiaries had taken long term loan and 3 per cent

beneficiaries had taken medium term loan. Whereas, the majority of (74%) non-beneficiaries acquired short term credit, followed by 18 per cent non-beneficiaries did not acquired credit. However, 6 per cent non-beneficiaries had taken long term loan and 2 per cent non-beneficiaries had taken medium term loan.

This indicated that beneficiaries were more aware to generate resources for development by availing loan facilities from banks and co-operatives.

Table 5: Distribution of the respondents according to availability of credit

Credit acquisition	Beneficiary (n=100)		Non-beneficiary (n=50)	
	Frequency	Percentage	Frequency	Percentage
Nil	18	18	9	18
Short term (6 to 15 months)	75	75	37	74
Medium term (15month to 5 years)	3	3	1	2
Long term (5 years to 20 years)	4	4	3	6

Regarding important sources and reason for acquiring credit the findings were tabulated in Table 6 showed that among credit users, the majority of the ATMA beneficiaries (53.66%) farmers acquired credit from co-operative societies, followed by 35.36 per cent beneficiaries acquired credit from nationalized banks. The share of non-institutional credit sources amongst the respondents were found quite low, while only 4.88 per cent beneficiaries had obtain credit from relatives, 3.66 per cent beneficiaries had obtain credit from friends/neighbours and only 2.44 per cent had obtain credit from money landers because majority of beneficiaries of ATMA were easily obtain the credit from institution. Whereas, the majority (51.21%) of the non-beneficiaries farmers acquired credit from co-operative societies, followed by 43.90 per cent non-beneficiaries acquired credit from nationalized banks and only 4.89 per cent non-beneficiaries had obtain credit from relatives.

Table 6: Distribution of the respondents according to their source and purpose of the credit

Particulars	Beneficiary (n=82)		Non-beneficiary (n=41)	
	Frequency	Percentage	Frequency	Percentage
Source of credit				
Nationalized bank	29	35.36	18	43.90
Co-operative society	44	53.66	21	51.21
Money lenders	2	2.44	0	0
Relative	4	4.88	2	4.89
Friends /Neighbours	3	3.66	0	0
Purpose of credit				
For agriculture purpose	63	76.83	35	85.38
Insecticide/ Feed	3	3.66	0	0
Domestic work	10	12.20	3	7.31
Others	6	7.31	3	7.31

As regard to purpose of credit, the majority of the ATMA beneficiaries (76.83%) farmers took credit for agriculture purpose like fertilizer, seeds etc., followed by 12.20 per cent beneficiaries had used their credit for domestic work, 7.31 per cent were taken loan for other purposes like tube well, purchasing of tractors and other agriculture implements and 3.66 per cent of the beneficiaries were also taken credit for the purchasing of insecticides and feeds for cattle. Whereas, the majority (85.38%) of the non-beneficiaries farmers took credit for agriculture purpose like fertilizer, seeds etc., followed by 7.31 per cent non-beneficiaries had used their credit for domestic work and other purposes like tube well, purchasing of tractor etc.

It could be concluded that 53.66 per cent beneficiary and 51.21 per cent non-beneficiary respondents had taken credit from co-operative society was the major agency of credit providing. As regard to purpose of credit, the majority of ATMA beneficiaries (76.83%) and non-beneficiaries (85.38%) farmers took credit for agriculture purpose like fertilizer, seeds etc.

Major crops and their area

Table 7: Distribution of respondents according to major crops grown along with their area

Crops	Beneficiary (n=100)			Non-beneficiary (n=50)		
	Number of farmers	Area		Number of farmers	Area	
		acre	%		acre	%

Kharif						
• Paddy	96	279.16	91.92	49	149.00	96.28
• Arhar	9	3.17	1.04	9	2.25	1.45
• Urd	5	2.30	0.78	3	0.85	0.54
• Sugarcane	9	14.29	4.70	2	1.50	0.98
• Others	12	4.75	1.56	3	1.15	0.75
Total cropped area		**303.67**			**154.75**	
Rabi						
• Wheat	62	110.35	58.70	32	54.00	48.32
• Sugarcane	15	15.52	8.27	7	7.75	6.93
• Lathyrus	12	19.00	10.10	6	17.00	15.21
• Gram	5	7.75	4.13	4	5.00	4.47
• Paddy	9	14.50	7.71	7	15.50	13.88
• Others	33	20.85	11.09	13	12.50	11.19
Total cropped area		**187.97**			**111.75**	

The data given in Table 7 indicates that in kharif season all the respondents were growing rice crops. Out of the total cropped area, 91.92 per cent area of beneficiaries and 96.28 per cent area of non-beneficiaries were found under rice crop. In addition to rice, 1.04, 0.78 and 4.70 per cent cropped area of beneficiary respondents was found under arhar, urd and sugarcane crops, respectively and remaining 1.56 per cent cropped area was found under other crops like vegetable, maize etc. Similarly, in case of non-beneficiaries 1.45, 0.54 and 0.98 per cent cropped area was found under arhar, urd and sugarcane crops, respectively and 0.75 per cent cropped area was found under other crops.

In rabi season, wheat was found as the most important crop cultivated on about 58.70 and 48.32 per cent cropped area of beneficiary and non-beneficiary respondents, respectively. Out of the total cropped area in rabi season, 8.27, 10.10, 4.13 and 7.71 per cent cropped area of beneficiaries were found under sugarcane, lathyrus, gram and paddy crops, respectively and remaining 20.85 per cent cropped area was found under other crops like vegetables. In case of non-beneficiary respondents 15.21 per cent cropped area was found under lathyrus crops followed by 13.88 per cent cropped area was paddy, others crop (11.19%) area, sugarcane (6.93%) area and 4.47 per cent cropped area was found under gram. The total rabi area of non-beneficiaries was far behind than the rabi area of ATMA beneficiaries may be due to non-availability of irrigation.

Marketing of agriculture produces

Distributions of the respondents according to their marketing of agriculture produces were presented in the Table 8. Before the ATMA programme was launched at the study area is 2004-05, the majority of ATMA beneficiaries (86%) were sold their agricultural produces to local shopkeepers, followed by merchant (83%), other (36%), mandi (3%) and only 1 per cent is unsure. After initiating the ATMA programme in 2010-11 sold their agriculture produce by the beneficiaries of the farmers to the co-operative society i.e. 79 per cent, followed by 55 per cent merchant, 39 per cent local shopkeepers, 28 per cent other, 8 per cent unsure and only 7 per cent were sold their agricultural produce in mandi.

Table 8: Distribution of the respondents according to their marketing of agriculture produce

Marketing of agriculture produce	**Beneficiary (n=100)**				**Non-beneficiary (n=50)**			
	2004-05		**2010-11**		**2004-05**		**2010-11**	
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**
• Merchant	83	83	55	55	48	96	29	58
• Local shopkeepers	86	86	39	39	46	92	19	38
• Mandi	3	3	7	7	2	4	3	6
• Co-operative society	0	0	79	79	0	0	31	62
• Un sure	1	1	8	8	1	1	2	4
• Others	36	36	28	28	6	12	8	16

F – Frequency, %- Per cent

In case of non-beneficiary respondents regarding marketing of agricultural produce the majority of respondents (96%) sold to merchant, followed by 92 per cent local shopkeepers, 12 per cent others, 4 per cent in mandi and 1 per cent were unsure marketing of agricultural produces in 2004-05. The majority of 62 per cent non-beneficiaries were sold their agriculture produce in co-operative society, followed by 58 per cent merchant, 38 per cent local shopkeepers, 16 per cent others, 6 per cent in mandi

and 4 per cent were unsure for marketing of agricultural produces in the present year 2010-11.

It could be concluded from above data, before ATMA programme respondents were sold of agricultural produce to merchant, local shopkeeper and after ATMA programme selling of agricultural produce in co-operative society. Some respondents were selling of agricultural produce in others like local market, Kerta sugar factory etc. It appears that ATMA programme has considerable impact in the knowledge of market linkage of the ATMA beneficiaries, which ascertain the good selling of cost of the ATMA beneficiaries.

CONCLUSION

From the above research works it can be concluded that the majority of the beneficiary and non-beneficiary respondent in the study area belonged to middle age groups (36 to 50 years) and having education up to middle school as compared to non-beneficiaries were primary level educated and residing in nuclear family system with small size of family (up to 5 members). Majority of the ATMA beneficiaries had high level of social participation as compared to non-beneficiaries. Majority of the respondents were performing agriculture, however majority of them were also engaged in 2 to 3 occupation to support their livelihood. Further majority of the respondents were having marginal farmers (up to 2.50 acre). Majority of the beneficiaries were high annual income as compared to non-beneficiaries medium level annual income earnings. In the study area majority of the respondents were taking short term credit facility extended by government organization.

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CLIMATE CHANGE AND CROP PRODUCTION

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Abstract : Changes in climate can be expected to have significant impacts on crop yields through changes in green house gases (Co_2, methane, nitrous oxide, chlorofluorocarbons *etc*.), temperature and water availability. Scientific evidence about the seriousness of the climate threat to agriculture is now unambiguous, but the exact magnitude is uncertain because of complex interactions and feedback processes in the ecosystem and the economy. The increasing Co_2 concentration is posing a serious threat as it leads an increase in the average global temperature but the same has been positively correlated with increased biomass and yield particularly in C_3 plants. The purpose of mitigation is therefore to attempt a gradual reversal of the effects by the climate change and sustainable development. There are several mitigation and adaptation practices that can be effectively put to use to overcome the effects of climate change with desirable results.

Keywords: Bio-diversity, Climate change, Crop production, Greenhouse effect, Mitigation

INTRODUCTION

Rational use of natural resources *viz*. soil, water, climate and bio-diversity will determine the prospects of food and nutritional security in world in 21st century. During the last more than three decades, these resources have been stretched and over exploited to meet food, fibre and shelter requirements of burgeoning human and livestock population. Over-exploitation of water, soil and bio-diversity in the recent past has resulted in their degradation beyond expectations.

Climate change is a change in the statistical distribution of weather over periods of time that range from decades to millions of years. It can be a change in the average weather or a change in the distribution of weather events over time (IPCC, 2001). Climate change is a complex alteration of climate, subtle and continuous, yet extremely important through its consequences on vegetation of various types that thrived under constant or relatively unchanged climates. At present, throughout the world, there exists a significant concern about the effects of climatic changes, as climate is one of the main determinants of agricultural production and it might cause variability in agricultural production. As climate pattern shifts, changes in the distribution of plant diseases and pests may also have adverse effects on agriculture. At the same time, agriculture proved to be one of the most adaptable human activities to varied climate conditions (Mendelson *et al*., 2001). In general, the tropical regions to be more vulnerable to climate change than the temperate regions for several reasons. (i) On the bio-physical side, temperate C_3 crops are likely to be more responsive to increasing levels of CO_2; (ii) The tropical crops are closer to their high-temperature optima and experience high temperature stress, despite lower projected amounts of warming; and (iii) insects and diseases, already much more prevalent in warmer and more humid regions, may become even more widespread (Varshneya, 2007)

Anthropogenic factors are the human activities that change the environment. In some cases, the chain of casuality of human influence on the climate is direct and ambiguous (for example, the effect of irrigation on local humidity) while in other instances it is less clear various hypothesis for human climate change have been argued for many years. Presently the scientific consensus on climate change is that human activity is very likely the causes for the rapid increase in global average temperature over the past several decades. Of most concern in these anthropogenic factors is the increase in Co_2 levels due to emissions from fossil fuel combustion, followed by aerosols (particulate matter in the atmosphere and cement manufacture, other factors include land use changes, ozone depletion, animals, agriculture use and deforestation are also of concern in the roles they play both separately and in conjunction with other factors affecting climate.

Green house effect: The green house effect is a natural feature of the climate system. Infact, without the atmosphere (and hence green house effect), the earth's average temperature would be approximately 33°C colder than is observed currently. The atmosphere is more efficient at absorbing long wave radiation, which is then emitted both upward towards space and downward towards the earth. This downward emissions serves to heat the earth further.

This further warming reradiated is known as the green house effect. Some gases in the atmosphere are particularly good at absorbing the long wave radiation and are known as the green house gases (GHG).

Gases that contribute to the greenhouse effect include.

- **Water vapor:** The water vapours are most abundant green house gas, but importantly, it acts as a feedback to the climate. As Water vapors increase, the earth's atmosphere warms, but so does the vapors possibility of clouds and precipitation, making these some of the most important feedback mechanism to the green house effect.
- **Carbon dioxide (CO_2):** A minor but very important component of the atmosphere, Co_2 is released though natural processes such as respiration and volcano eruptions and through human activities such as deforestation, land use changes, and burning of fossil fuels. Humans have increased atmosphere Co_2 concentration three times since the beginning of industrial revolution. This is the most important long-lived forcing of climate change.
- **Methane:** A hydrocarbon gas produced both through natural sources and human activities, including the decomposition of wastes in landfills, agriculture, and especially rice cultivation, as well as ruminant digestion and manure management associated with domestic livestock.
- **Nitrous Oxide:** A powerful green house gas that originates from the microbial breakdown of agricultural fertilizers, fossil-fuel combustion and biomass burning. Coal combustion is a major contributor of N_2O to the atmosphere.
- **Chloro-fluorocarbons** (CFCs): These are relatively inert class of manufactured industrial compounds containing carbon, fluorine and chlorine atoms. These compounds escape to the atmosphere where they destroy the stratospheric ozone layer that shields the earth from harmful ultra violet radiation. Their role in ozone depletion led to the first comprehensive international environmental treaty the Montréal protocol to phase out the use of CFCS. However they are also green house gases.

Table 1. Main green house and their global warming potential (IPCC, 2001)

Greenhouse gases	Chemical formula	Pre-industrial concentration	Concentration in 1994	Atmospheric lifetime (years)	Anthropogenic sources	Global warming potential (GWP)
Carbon dioxide	CO_2	278000 ppbv	358000 ppbv	Variable	Fossil fuel combustion, land use conversion, cement production	1
Methane	CH_4	700 ppbv	1721 ppbv	12.2	Fossil fuel, rice paddies, waste dumps, livestock	21
Nitrous oxide	N_2O	275 ppbv	311 ppbv	120	Fertilizers, industrial processes combustion	310
CFC-12	CCL_2F_2	0 ppbv	0.503 ppbv	102	Liquid coolants, foams	6200-7100
HCFC-22	$CHCLF_2$	0 ppbv	0.105 ppbv	121	Liquid coolants	1300-1400
Perfluoro-methane	CF_4	0 ppbv	0.070 ppbv	50,000	Production of almunium	6500
Sulphur Hexafluoride	SF6	0 ppbv	0.032 ppbv	3200	Dielectric fluid	23900

Consequences of Green house effect

The consequences of changing the natural atmospheric green house are difficult to predict, but certain effects seem likely.

- On average, earth will become warmer. Some regions may welcome warmer temperatures, but other may not.
- Warmer conditions will probably lead to more evaporation and precipitation. Overall, but

individual regions will vary some becoming wetter and other dryer.

- The observed warming over the 20th century was accompanied by a 10% increase in precipitation in the Northern Hemisphere and an increase in global seas-level of 4-8 inches.
- Mean while some crops and other plants may respond favorably to increased atmosphere Co_2 growing more vigorously and using water more efficiently. At the same time, higher temperatures and shifting climate pattern may change the areas where crops grow best and affect the makeup of natural plant communities.
- The climatic response to increasing green house gases has been assessed through various mathematical models. The surface air temperature due to Co_2 doubling as simulated by a variety of general atmospheric circulation models yields warming of order 4.2°C. The green house gases induced warming for the period 1950 to 2030 will be 1.5 and 6.1°C. An average rate of increase of global temperature during the next century is projected as 0.3°C per decade with an uncertainty range of 0.2-0.3°C (IPCC, 2007).

Two positive feedback effects of green house effect are that higher surface temperature causes more evaporation and thus higher water vapor concentrations and water vapor itself is an infra red absorber. The second effect is that higher surface temperatures will lead to more melting of snow and ice-cover on land and seas which energy instead of reflecting it back into space.

On the other hand, negative feed backs include the possibility that a higher surface temperature may lead to cloudiness and thus reduce incoming solar radiation. The cloudiness effect could lead to further warming in some circumstances as the clouds will also decrease the infra red heat loss from the surface.

Climate change and Agro ecosystem

The climate change will effect crop yields and cropping pattern due to direct effect of changes in atmospheric concentrations of green house gases in general and CO_2 in particular. Carbon dioxide is a perfect example of a change that could have both positive and negative effects. By now it is very clear that the atmosphere is being constantly enriched with Co_2 and is warmed up. However it is not so clear that how the expected rise in Co_2 level and air temperature will increase to affect the plant processes. If LAI increase with elevated Co_2 concentrations, the ET is expected to rise with further increase in temperature because increased temperature is associated with greater vapor pressure deficits, have greater moisture stress (Allen's, 1990). The occurrence of moisture stress during critical stages of crops like flowering and grain filling may further result in step reduction in post anthesis, photosynthesis and grain yield. Higher temperature also reduces plant development and shortens the growth period. Co_2 increase may affect the crop productivity directly and indirectly. Effects are both positive and negative.

It has been proved experimentally that for single leaf photosynthesis rate increase with increased Co_2 level especially in C_3 plant. When these experiments were extended to crop levels, it was found that increased Co_2 concentration to 600 ppm increased the number of tillers and branches and hence greater solar radiation interception. Further increased Co_2 reduced transpiration due to decreased stomatal aperture and may result in higher WUE (Allen's, 1990). Since those results were obtained from studies conducted in leaf chambers, green houses and growth chambers where other environmental factors were controlled at a desired level, these may not be applicable under field conditions.

The effect of global change on the soil conditions in relation to plant growth and crop production:

The main potential changes in soil forming factors (forcing variables) resulting directly from global change would be in organic matter supply from biomass, soil temperature regime and soil hydrology, the later because of shifts in rainfall zones as well as changes in potential evapo-transpiration. The important changes include.

- A gradual, continuing rise in atmospheric Co_2 concentration entailing increased photosynthetic rates and water use efficiencies of vegetation and crops hence increases in organic matter supplies to soils.
- Minor increases in soil temperatures in the tropics and sub-tropics; moderate increases and extended periods in which soils are warm enough for microbial activity (warmer than about 5°C) in temperate and cold climates, parallel to the changes in air temperatures and vegetation zones (Emanual *et al*. 1985.)
- Minor increase in evapo-transpiration in the tropics to major increase in high latitudes caused both by temperature increase and by extension of the growing period.
- Increases in amount and in variability of rainfall in the tropics; possible decrease in rainfall in a band in the subtropics pole ward of the present descants; minor increases in amount and variability in temperate and cold regions. Peak rainfall intensities could increase in several regions.
- A gradual sea-level rise causing deeper and tender inundation in river and estuary basins and on levee back slopes, and brackish-water inundation leading to encroachment of vegetation that accumulate pyrite in soils near the coast.

Co_2 fertilization effect

Plant photosynthetic rates generally increase linearly with light across relatively low ranges of light intensity, and then the rates decrease until they reach an asymptotic maximum. Because of crowding and

shading of many leaves, most crop canopies do not reach light saturation at full sunlight; that is, they would be able to respond to light bands well beyond full solar irradiance. Likewise, crop photosynthetic rates respond to increasing bands of Co_2 but then level off at higher concentration (around 700 µ mol/ mo1 or greater, depending upon species and other factors). However, leaf photosynthesis usually increases with temperature up to some maximum value, and then declines. Furthermore, temperature affects not only photosynthesis, but also respiration, growth and development phases as well as reproductive processes. Elevated Co_2 may have some effects on crop phenology, although stages of development are governed primarily by temperature, time and photoperiod. If dates of planting were to be changed because of green houses effect, then phenological phases of plants could be affected. For example, higher temperature could decrease yields by decreasing the duration of grain filling period or changes in photoperiod could shorten or lengthen the vegetative phase.

The Co_2 fertilization affect begins with enhanced photosynthetic Co_2 fixation. Non- structural carbohydrates tends to accumulate in leaves and other plant organs as starch soluble carbohydrates or polyfructosans, depending on species. In some cases, there may be feedback inhibition of photosynthesis associated with accumulation of non-structural carbohydrates. Increased photosynthetic accumulation, especially in lemma may be evidence that crop plant grown under Co_2 enrichment may not be fully adapted to take complete advantage of elevated Co_2. This may be because the Co_2 enriched plants do not have an adequate sink (inadequate growth capacity), or lack capacity to load phloem and translocate soluble carbohydrates. Improvement of photo assimilate utilization should be are goal of designing cultivars for the future (Hall and Allen, 1993).

Reproductive biomass growth as well as vegetative biomass are usually increased by elevated Co_2. However the harvest index under, or the ratio of seed yield to above ground biomass yield, is typically lower under elevated Co_2 conditions (Allen, 1991; Baker *et al*., 1989), which may also be evidence of large capacity to utilize completely the more abundant photo assimilate.

Under elevated Co_2, stomatal conductance in most species will decrease which may result in less transpirations per unit leaf area. However, leaf area index of some crops may also increase. The typical 40% reduction in stomatal conductances induced by a doubling of Co_2 has generally resulted in only a 10% (or less) reduction in crop canopy water use in chamber or field experiment conditions. Actual changes in crop evapotranspirations will be governed by the crop energy balance, as mitigated by stomatal conductance, leaf area index, crop structure and any change metrological factors.

Water-use efficiency (WUE) (ratio of Co_2 uptake to evapotranpiration) will increase under Co_2 conditions. This increase is caused more by increased photosynthesis than it is by a reduction of water loss through partially closed stomata. Thus, more biomass can be produced per unit of water used, although a crop would still require almost as water from sowing to final harvest. If temperature rises, however, the increased WUE caused by the Co_2 fertilization effect could be diminished or negated, unless planting dates can be changed to more favorable seasons.

Growth of plants under elevated Co_2 results in changes in partioning of photo assimilates to various plant organs over time. In soy bean, elevated Co_2 generally promoted greater carbon (dry matter) partitioning to supporting structure (stems, petioles and roots) than to the leaf lamina during vegetative stages of growth (Allen *et al*., 1991.) During reproductive stages, there tended to be lower relative partitioning to reproductive organs (pods) by plants under elevated Co_2.

Campbell *et al.* (1988) showed that soybean leaf exhibited higher photosynthetic rates when grown at 660 than 300 µ mol/ mol Co_2 when measured at common intercellular Co_2 concentrations. Furthermore, Campbell *et al. (*1988) measured rubisco activity and amount in leaves of soybean grown in Co_2 concentrations of 160, 220, 280, 330, 660 and 990 µ mol/mol. They found that rubisco activity was almost constant at 1.0 µ mol CO_2/min/mg soluble protein across this Co_2 treatment range. Leaf soluble protein was nearly constant at about g/m^2 with 55% being rubisco protein. Specific leaf weight increased across the 160 to 990 µ mol/mol Co_2 concentration range, so that rubisco activity and a leaf dry weight basis decreased.

Valle *et al.* (1985) found that midday maximum photosynthetic CO_2 uptake rates of soybean leaves ranged from 30 to 50 µ mol/m^2/s and 15 to 25 µ mol/m^2/s on plants grown at 660 and 330 µ mol/mol CO_2 respectively. Allen *et al.* (1990) reported that, at all light levels, leaf photosynthetic rates increased linearly with CO_2 concentration across the range of 330 to 800 µ mol/mol. Valle *et al.* (1985) used a Michaelis-Menten type of rectangular hyperbola to summarize photosynthetic responses of soybean leaves vs. CO_2 concentration. The plants had been grown at 330 and 660 µ mol/mol of CO_2 and then exposed to a wide range of CO_2 for a short period.

$$Y=(Y_{max} \times [C])/([C]+K_m)+Y_i \quad (4.1)$$

where Y is photosynthetic rate in µ mol CO_2/m^2/s; [C_3] is CO_2 concentration in µ mol/mol; Y_i is the y-axis intercept at zero [C_3], the apparent respiration rate, in µ mol CO_2/m^2/s; Y_{max} is the response limit of (Y - Y_i) at very high [C], the asymptotic photosynthetic rate, in µ mol CO_2/m^2/s; K_m is the value of [C] where (Y-Y_i)=Y_{max}/2, the apparent Michaelis-Menten constant, in (µ mol/mol; and $_c$ is the calculated [C] intercept at zero Y, the CO_2

compensation point, μ mol/mol (not shown in this equation). The average parameters for responses at 330 and 660 μ mol/mol are given in Table 2. There was no obvious down regulation of soybean leaf photosynthesis in response to elevated CO_2; in fact, photosynthetic capacity was increased. Leaf quantum yield increased from 0.05 to 0.09 in the soybean leaves exposed to CO_2 of 330 and 660 μ mol/mol, respectively (Valle *et al.,* 1985).

Table 2. Average asymptotic maximum photosynthetic rate (Y_{max}) with respect to y-intercept parameter (Y_i), apparent Michaelis-Menten constant for CO_2 (K_m, and CO_2 compensation point (μ_c.) for leaves grown at two CO_2 treatments and subjected to different short-term CO_2 levels. Condensed from Valle *et al.* (1985).

Growth CO_2 treatment	**Y_{max} μ mol/m^2/s**	**K_m μ mol/mol**	**Y_i μ mol/m^2/s**	**μ_c μ mol/mol**
330	51.8	359	-7.8	63
660	126.6	1 133	-4,6	42

Means of Y_{max} and Y_i were significantly different, p = 0.05, by a t-test.

Thus, pre-dawn respiration rates were closely connected to the previous CO_2 fixation rates.

Soybean seed yield tended to decrease slightly with temperature over the day/night range of 26/19 to 36/29°C (Table 3). The number of seed per plant increased slightly with increase of both CO_2 and temperature. Mass per seed decreased sharply with increasing temperature. Although CO_2 enrichment resulted in increased seed yield and above-ground biomass, harvest index was decreased with both CO_2 and temperature (Baker *et al.,* 1989). The data of Table 3 show no tendency for the growth modification factor to increase with temperature for either seed yield or biomass accumulation.

Table 3. Seed yield, components of yield, total above-ground biomass and harvest index of soybean grown at two CO_2 concentrations and three temperatures in 1987 (adapted from Baker *et al.,* 1989)

CO_2 conc. (μ mol/mol)	Day/night temperature (°C)	Grain yield (g/plant)	Seed/plant (no./plant)	Seed mass (mg/seed)	Above-ground biomass (g/plant)	Harvest index
330	26/19	9.0	44.7	202	17.1	0.53
330	31/24	10.1	52.1	195	19.8	0.51
330	36/29	10.1	58.9	172	22.2	0.45
660	26/19	13.1	58.8	223	26.6	0.49
660	31/24	12.5	63.2	198	27.6	0.45
660	36/29	11.6	70.1	165	26.5	0.44
F-values						
CO_2 conc.	12.3**	11.4**	2.5*	NA	NA	
Temperature	0.0 NS	8.4**	106.2**	NA	NA	
CO_2 x Temperature	2.0 NS	0.1 NS	11.2**	NA	NA	

Effect of higher day and night temperature on yield

Gaseous emissions from human activities are substantially increasing the concentrations of atmosphere green house gases, particularly carbon dioxide, methane, chloro-fluro carbons and nitrous oxides. Global circulation models predict that this increased concentration of green house gases will increase world's average temperature. Under the business as usual scenario of the inter-governmental panel on climate change (IPCC), global mean temperatures will rise 0.3^{o}C per decade during the next century with an uncertainty of 0.2 to 0.5 % (Houghton *et al*., 1990). Thus global mean temperature should be 1^{o}C above the present values by 2025 and 3^{o}C above the present value by 2100. Although global circulation models do not agree as to the magnitude, most predict green house warming. There is also general agreement that global warming will be greater at higher latitudes than in the tropics. Different global circulation models have predicted the global warming effects will vary diurnally, seasonally and with altitude.

It is also possible that there will be an auto cathartic component to global warming. Photosynthesis and respiration of plants and microbes increase with temperature, especially in temperate latitudes. As respiration increases more with increased temperature than does photosynthesis, global warming is likely to increase the flux of Co_2 to the atmosphere which would constitute a positive feedback to global warming.

CERES-Rice and CERES-Wheat have been validated for commonly sown cultivars of rice and wheat under Ludhiana (Punjab) conditions. Since rice and wheat are grown under assured irrigated conditions in

Punjab, optimum (non-limiting) moisture conditions were assumed (Hundal and Prabhjyot, 2007). Both maximum and minimum temperatures were increased or decreased by 0.5, 1.0, 2.0 and 3.0 ^{o}C from normal while keeping the other climate variables constant. Heading as well as maturity of rice was not much affected by increase or decrease in temperatures of 1.0 ^{o}C from normal (Table 4), but with a decrease in temperature by 3.0 ^{o}C heading and maturity were delayed by 15 and 12 days respectively, from normal. On the other hand, anthesis and maturity of wheat revealed more drastic changes as the phenology was significantly advanced by increasing temperature, but was delayed by decreasing temperature (Table 4).

Table 4. Effect of temperature change from normal on deviations in phenology (days) of crops (Hundal and Prabhjyot, 2007).

	Temperature change (^{o}C)								
Phenological event	-3.0	-2.0	-1.0	-0.5	Normal temperature	+0.5	+1.0	+2.0	+3.0
Rice									
Heading	5	2	0	0	101*	0	0	1	4
Maturity	12	6	2	0	141*	1	1	1	5
Wheat									
Anthesis	25	17	8	3	95*	-3	-6	-12	-16
Maturity	22	15	8	4	135*	-3	-6	-12	-17

*Number of days after sowing

When the maximum temperature decreased by 0.25 to 1.0 ^{o}C from normal and minimum increased simultaneously from 1 to 3 ^{o}C from normal keeping the other climate variables constant, the phenology of rice and wheat was advanced by as much as 1-8 days (Table 5). In rice and wheat, when minimum temperature increased by 1.0 to 3.0 ^{o}C and maximum temperature decreased by -0.25 to -1.0 ^{o}C from normal, both the anthesis and maturity were advanced by upto 8 days from normal.

Table 5. Effect of increasing minimum temperature above normal and decreasing maximum temperature below normal on deviation in phenology (days) of crops (Hundal and Prabhjyot, 2007).

		Minimum Temperature change (^{o}C								
		+1.0			+2.0			+3.0		
		Maximum temperature change(^{o}C)			Maximum temperature change(^{o}C)			Maximum temperature change(^{o}C)		
	Normal (DAS)	-0.25	-0.5	-1.0	-0.25	-0.5	-1.0	-0.25	-0.5	-1.0
Phenological event										
Rice										
Heading	101	-1	-1	-2	-2	-3	-3	-4	-4	-4
Maturity	141	-2	-2	-3	-4	-5	-4	-7	-8	-8
Wheat										
Anthesis	95	-2	-2	0	-6	-4	-3	-8	-8	-6
Maturity	135	-1	-1	1	-5	-4	-3	-8	-7	-6

Adverse effects of elevated levels of Ultra-violet (UV)-B radiation and ozone (O_3) on crop productivity

Surface-level ultra violet (UV)-B radiation (280-320 nm) and ozone (O_3) are components of the global climate and any increase in their levels can led to adverse effects on crop growth and productivity on a broad geographic scale (Krupa and Kickert, 1993). Possible increase in surface UV-B radiation are attributed to the depletion of the beneficial stratospheric O_3 layer (Cicerone, 1987). On the other hand, increase in surface-levels of O_3 that in many regions are largely the result of photochemical oxidant pollution, or also part of the general increase in the concentrations of the so called ‘‘green house gases’’ in the context of climate change, it is therefore important to maintain a holistic view and recognize that UV-B and O_3 levels at the surface are only parts of the overall system of atmosphere processes and their products. (Runeekles and Krupa, 1994).

Table 6. Effect of elevated surface levels of UV-B radiation or O_3 on crops

Plant characteristic	Effect of elevated	
	UV-B	O_3
Photosynthesis	Reduced in may C_3 and C_4 species (at low light intensities	Decreased in most species
Leaf conductance	Reduced (at low light intensities)	Decreased in sensitive species
Water use efficiency	Reduced in most species	Decreased in sensitive species
Leaf area	Reduced in many species	Decreased in sensitive species
Plant characteristic	Effect of Elevated	
	UV-B	O_3
Flowering	Inhibited or stimulated	Decreased floral yield, fruit set and yield delayed fruit set
Crop maturation time	not affected	Decreased floral yield, fruit set and yield delayed fruit set

Recent cases of climate change in India

Drought of 2002:

The drought of 2002 was one of the severest droughts of the last 100 years. Overall rainfall deficiency for the country as a whole was 19% and 56% area received deficient rains. Out of 36 metrological sub-divisions in the country, 21 sub divisions received deficient and scantly rain. The month of July received 49% less rainfall than the long range average rainfall. Water storage in 71 major reservoirs was 33% less than the average of previous 410 years (Singh, 2008). About 21.5 million ha areas was not sown and 47 million ha of sown crop was damaged, with a food grain shortfall of more than 29 million tons. About 300 million people and 56% of the total geographical area were affected.

Cold waves (2002-03):

Severe and prolonged cold wave prevailed over many parts of northern and north-eastern part of India during the winter season of 2002-2003 which considerably affected the survival and productivity of seasonal and perennial crops (Singh, 2008). Except the southern region of the Indian Peninsula, most of the country, particularly the Indo-Gangetic Plains was affected by freezing. The cold day's injuries had severe impact on crops, fruit trees, fishery, livestock and even human beings. Extreme fluctuations beyond normal variation in temperature due to cosmic events and anthropogenic activities that alter cardinal points of crop growth stages are a major concern in agricultural management and production. During December 2002 to January, 2003 daily maximum and minimum temperatures at several places in north India remained unusually below the normal continuously for 3-4 weeks.

Heat wave of March 2004.

The impact of abnormal temperature rise in March, 2004 on several winter crops including wheat, mustard and vegetables. Daily maximum temperature showed abnormal rise than the normal temperature at various places like Srinagar (3-12 ^{o}C) followed by Palampur (8-10 ^{o}C), Hisar (2-10 ^{o}C), Ludhiana (3- 6 ^{o}C), Jammu (1-6 ^{o}C), Uttarakhand (1-5 ^{o}C) and Jaipur (1-5 ^{o}C). Even minimum temperature during this period was higher than normal in several places. As a result of which loss of 4.6 million tons on wheat production was recorded which was very close to the advanced predication of about 4.4 million tons (Singh, 2008). The wheat crop matured 10-20 days in advance of normal period with reduced 1000 grain or test weight. Sowing of peas was advanced by one month due to early melting of snow in Lahul valley, apples flowered 15 days early in Chamber district and there was poor formation and filling of pods of rapeseed and mustard in Himachal Pradesh. Linseed yield was reduced by 50 per cent.

Mitigation options for climate change

The possible approaches to reduce or mitigation human induced climate change are:

Global initiative on soil-carbon sequestration

The IPCC estimates that the reduction in the options of agricultural GHG mitigation is cost-competitive with non-agricultural options for achieving long-term climate objectives. The carbon sequestration from the soil could in fact take effect very quickly and is very cost effective in agriculture. A win-win approach could be achieved by paying farmers for carbon sequestration (building organic matter), which sets up a scenario where Co_2 is removed from the atmosphere (mitigation) higher organic matter levels in soil increase the agro-ecosystem residence (adaptation) and improved soil fertility leads to better yields (production and income generation). However, sequestration of Co_2 in soils is not included in the clean development mechanism (CDM) agreed to in Kyoto protocol. The FAO Should play a leading role in this process, including the establishment of this process, including the establishment of a global soil carbon sequestration initiative, entrusted with the promotion of agricultural technologies that restore carbon pools and soil quality (*e.g.* organic agriculture, conservation agriculture) and to create tools to measure, monitor and verify soil-carbon pools and fluxes of green house gas emissions (*viz.* nitrous oxide) from agricultural soils, including crop lands and pastures.

Reduction in emissions from deforestation and forest degradation in developing countries

As the UN agency with the mandate for forestry and a comprehensive programme covering all aspects of

forestry as well as agriculture, FAO can play a leading role in

(1) Providing technical information and support for the development of methodological and policy options for reduction in emissions from deforestation and forest degradation in developing (REDD)
(2) Strengthening the capacity for countries undertaking REDD programmes, including development of systems for monitoring changes in forest carbon
(3) Addressing the underlying causes of deforestation and forest degradation rooted in both agriculture and forest sector. In addition, FAO can launch a comprehensive REDD support effort for the developing countries.

Reduce global warming or its effects by geo engineering

Geo-engineering is a large-scale schemes to manipulate the earth's climate and mitigate the effects of green house warming (Begley 1999, Schneider 2001). These include using fleets of large aircraft or large guns to release dust into the lower stratosphere and reflect sunlight back into space. Other proposals to reduce solar input to our planet would send billions of aluminized reflective ballons into the stratosphere. These schemes raise numerous questions regarding possible harmful effect on ecosystems. For example, reduced solar input, in addition to reduced solar input, in addition to reducing the green house effect, might reduce photosynthesis in crops and natural vegetation, reducing agricultural and forest productivity.

Enhance Natural Carbon Sinks

If natural of Co_2 could be enlarged, they would remove more Co_2 from the atmosphere. The ocean's role as a significant sink for Co_2 might be enhanced. Phytoplankton in the lighted surface layers of the Blean, assimilate dissolved Co_2, and through photosynthesis, convert it to organic carbon (biomass).

Forest carbon sinks could be enhanced. Trees, through photosynthesis, remove Co_2 from the atmosphere and store it as organic carbon until the trees die and decays, or is burned, releasing the carbon back into the atmosphere as Co_2. Planting a new tree could effectively effort some Co_2 emissions for the life of the tree, often 100 to 300 years, and large-scale reforestation could significantly reduce the rate Co_2 build up in the atmosphere. If we could double our current rate of reforestation each year, we could delay greenhouse warming for a decade or two, possibly long enough to develop alternative sources of energy (Botkin 1989).

Table 7. Ways to reduce house-gas emission (IPCC, 2007)

Sector	Key mitigation technologies and practices currently commercially available
Energy	Supply efficiency, fuel switching, nuclear power, renewable resources (hydro-power; solar, wind, geothermal aid bio-energy), combined heat and power, early applications of Co_2 capture and storage.
Transport	More fuel-efficient vehicles, hybrid vehicles, bio-fuels, modals shifts form road transport systems, cycling, walking, land use planning
Industry	More efficient electrical equipment, heat and power recovery, material recycling, control of non-Co_2 gas emissions.
Agriculture	Land management to increase soil carbon storage, restoration of degraded lands, improved rise cultivation techniques, improved nitrogen fertilizer application, dedicated energy crops.
Forests	A forestation, reforestation, forest management, reduced deforestation, use of forestry products for bio-energy
Waste	Land fill methane recovery incineration of waste with energy recovery, composing, recycling and waste minimization.

Crop/cropping system based technologies

These will be mainly centered on promoting the cultivation of crops and varieties that fit into new cropping systems and seasons, development of varieties with changed duration that can over winter the transient effects of change, release of varieties for high temperature, drought and submergence tolerance, evolving varieties which respond positively in growth and yield to high Co_2. Improved and novel agronomic and crop production prentices like adjustment of planting dates and the management of the plant spacing and input supply may help reduce the adverse effects of changes in some climatic parameters.

Development of resource conserving technologies

Use of resource conservation technologies like surface seeding or zero tillage not only restrict the release of soil carbon in the atmosphere but also sometimes help partially with stand the adverse climate, and provide better yield or stabilize it. For example, surface seeding or zero-tillage of upland corps after rice gives yields similar to that when planted under normal conventional tillage over a diverse set of soil conditions. However more research is needed for their applicability in the arid lands.

Diversified farming

A shift from role cropping to diversified farming system is highly warranted. Horticulture and agro forestry need to be given more encouragement where

as in the dries western part of the arid lands greater emphasis is required on pasture or biomass development for the livestock, which becomes a major component of the individual farmers economy. Use of farm-level land in the more vulnerable arid areas should be optimized to sustain production and manage risk, rather than to increase productivity.

Policy tools for resource management on a sustainable basis

Enabling policies on crop insurance (especially to with stand the impact of drought and flood), subsides and pricing related to water and energy uses need to be strengthened at the earliest. Policies that would encourage farmers to enrich organic matter in the soil and thus improve the soil health need emphasis (*e.g.* financial compensation or incentive for green manuring).

Contingency crop planning

Since *kharif* cropping is a primary activities in the rain fed areas of arid lands, where monsoon variability plays a crucial role in production, contingency crop planning will require a greater attention in these areas long term strategic approaches are also needed to efficiently conserve and utilize rain water on the one hand and un season tactical approaches to mitigate the adverse effects of weather aberrations on the other. Some of the approaches are water management, crop-row management, nutrient management, selection of crop varieties, in-season drought management, choice of crops with changing sowing condition, supplemental irrigation.

CONCLUSION

The issues of climate change and its potential impact on agriculture have been a major research, topic in recent times. We need to emphasis on the potential interactions between the effects of climate change and ongoing economic interactions. Global warming is already underway and adapting strategies are now a matter of urging, especially for the most vulnerable poor countries. An appropriate climate policy should be to minimize the effects of climate change at farm, regional, national and international level.

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ANALYSIS OF SOCIO-ECONOMIC PROFILE OF MARIGOLD GROWER IN ADOPTION OF IMPROVED MARIGOLD PRODUCTION TECHNOLOGY

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Abstract : The present investigation entitled "An analysis of Socio-economic Profile of Marigold Grower in Adoption of improved Marigold Production Technology in Chhattisgarh" was carried out during 2010 in two selected blocks of Bilaspur district. 150 randomly selected farmers who were practicing marigold cultivation were interviewed to collect the primary data on the basis of objective of the study. The data were tabulated and analyzed statistically to draw appropriate conclusions. The findings of this study revealed that majority of the respondents were found in middle age group (29 to 45 year) having high school level of education belonged to other backward caste, medium size of family (6 to 10 members) and had membership in more than one organization. Majority of the respondents were having marigold farming + other business as their main occupation, maximum number of the respondents belonged to medium size of land holdings category (2.1 to 4 ha.) with annual income category of Rs. 20,001 to Rs. 40,000 and maximum number of the respondents found credit for short term period from the co-operative society not easily available and other same agencies.

Keyword : Adoption, Marigold grower, Marigold production technology, Socio-economic profile

INTRODUCTION

The commercial cultivation of flowers known as floriculture has became big business. Flowers of all kinds are in great demand for decoration and as sources of essential oil. Marigolds are one of the most important decorative plants. In several states they are grown commercially in fields where they claimed by some to be more profitable than any other crops. India, share in the Rs. 300 crore world markets is 25 per cent while China top with 50 per cent. The other producer is Peru. Devedrobium, cymbidium, vanda species. The increasing demands for marigolds oleoresin pave the way for expanding the cultivation of this flower in the country. Currently, it is used in three applications such as poultry feed as additives, food colouring and leutracenticals. The potential for in are signed use in letter segmental is high as studies in recent years have commended use of lutein it food as it would help. Protect against cataracts and muscles degeneration two common age related eye, disorders. The leaves and flowers of marigold have medicinal value too. Leaf petals are used externally against boils and carbuncles. Flowers extract is considered as blood purifier and good remedy for eye diseases and ulcers. Good quality of perfumes can also be made from its essentials oils. Its petals are used for utility food colours. Since marigold is enriched with lutein, these are a big market for it in USA. However, major market of marigold oleoresin is Mexico where it is used in poultry feed additive to change the skin colours of the chicken and the yolk more in oranges. In facts, Mexico, where from marigold came to India and China continues to be the major market with 35 to 55 per cent followed by Europe and USA. The gestation period of the crop is around 3 month, Farmers pick-up the matured flowers and brings it to companies' collection centers at farm gets. Super hybrid seeds imported from the PAN America Seed Company in Chicago, US are supplied to the farmers under contract. The hybrid seeds give higher yields with high recovery, make of colour. Farmers are paid money every week for their produces and in fact even during off-season they get money. All the farmers are small and average yield per acre is 4-5 tones. They are paid Rs. 2 to Rs. 2.20/ kg. Since the duration of the crops is around 90 days the farmers can cultivated a supplementary crops. On the other as company is directly buying from the farmers no middleman is involved, being under contract farming there is no risk for farmers on price fluctuation (Kumar 2005).

The present study was undertaken with specific objective to assess the Socio-economic profile of the marigold growers.

MATERIAL AND METHOD

The present study was carried out in Bilaspur district of Chhattisgarh state. Bilaspur district has 10 blocks, out of which, only 2 blocks were purposively selected namely, masturi and Pendra because these two blocks are having fairly good marigold production. A list of marigold farmers of the selected blocks were obtained from the office of the horticultural department of Bilaspur district and from each selected block, 75 farmers those were practicing marigold cultivation were selected randomly. In this way total 150 marigold growers were selected as respondents. Respondents were interviewed through personal interview. Prior to interview, respondents were taken in to confidence by revealing the actual purpose of the study and full care was taken in to consideration to develop good rapport with them. For the data collection well designed and pre-tested interview scheduled were used. Collected data were analyzed by the help of various statistical tools i.e.

frequency, percentage, mean and standard deviation, etc.

RESULT AND DISCUSSION

Socio-economic profile of the respondents

Age

It is observed from the Table 1 that the majority of the respondents (69.33%) belonged to middle age group (29 to 45 year), 18.67 per cent respondents were under young age group (up to 28 year) and 12.00 per cent respondents were of old age group (above 45 years).

Table 1: Distribution of respondents according to their age (n =150)

S. No.	Age	Frequency	Per cent
1	Young (up to 28 years)	28	18.67
2	Middle (29 to 45 years)	104	69.33
3	Old (above 45 years)	18	12.00
	Total	**150**	**100.00**

$\bar{X}$ = 36.44 S.D. = 8.24

Thus, it may be concluded that the maximum marigold growers were belonging to middle age group (29 to 45 year). Thus the data clearly indicated that the respondents age group (29-45 years) has higher adoption whereas respondents from old age group (45 and above) has least adoptability to marigold production. This finding is supported by Patel (1993), Dongerdive (2002), Vathsala (2005), Sharma (2006), Siddiqui *et al.* (2006), Mewara and Pandya (2007) and Kumar and Munjunath (2008).

Education

Education builds the ability of an individual to improve knowledge understands and utilizes the knowledge in a better ways.

The data in Table 2 described that the 31.34 per cent of the respondents were educated up to high school followed by 18.67 per cent respondents were found under the category of up to middle school. Whereas, 17.33 per cent respondents each were educated up to higher secondary school and 16.00 per cent respondents were college and above level about 09.33 per cent of them were illiterate and only 07.33 per cent respondents has been educated up to primary school.

Table 2: Distribution of respondents according to their education (n =150)

S. No.	Education	Frequency	Per cent
1	Illiterate	14	09.33
2	Primary school	11	07.33
3	Middle school	28	18.67
4	High school	47	31.34
5	Higher Secondary school	26	17.33
6	College and above	24	16.00
	Total	**150**	**100.00**

Finally results clearly indicated that the majority of respondents were having education up to high school. It may be because of the fact that in most of the villages there are few colleges and above level education. Hence, the farmers with higher education would have easily adopted the recommended marigold production technology. This finding is supported by Vathsala (2005) and Walankhade *et al.* (2009).

Caste

Regarding the distribution of respondents according to their caste, it is observed from Table 3 that majority of respondents (44.67%) belonged to other backward class, followed by 42.67 per cent belonged to schedule tribes, 08.66 per cent respondents were from schedule caste and only 04.00 per cent respondents belonged to general caste.

Table 3: Distribution of respondents according to their caste (n =150)

S. No.	Caste	Frequency	Per cent
1	Schedule caste	13	08.66
2	Schedule tribes	64	42.67
3	Other backward class	67	44..67
4	General	06	04.00
	Total	**150**	**100.00**

It could be concluded that majority of the respondents belonged to other backward class. Thus the data clearly indicated that the other backward caste respondents having high adaptability towards marigold production technology over other categories because they were more educated and participate in more than one organization. This finding is supported by Ahirwar (2005).

Size of family

Regarding the distribution of respondents according to their size of family, it was observed from Table 4 that majority (56.67%) of the respondents had small size of family (up to 5 members) followed by 33.33 per cent with medium size of family (6 to 10 members). Rest of the respondents (10.00%) belonged to large size of family (above 10 members).

Table 4: Distribution of respondents according to their size of family (n =150)

S. No.	Size of family	Frequency	Per cent
1	Small (up to 5 members)	85	56.67
2	Medium (6 to 10 members)	50	33.33
3	Big (above 10 members)	15	10.00
	Total	**150**	**100.00**

This indicated that the maximum number of the respondents belonged to small size of family. Thus the data clearly indicated that the marigold growers with small size of family (up to 5 members) have high adaptability towards marigold production technology over other categories. This finding is supported by Kale (1994).

Social participation

Table 5: Distribution of respondents according to their social participation (n =150)

S. No.	Social participation	Frequency	Per cent
1	No membership in any organization	54	36.00
2	Membership in one organization	14	09.33
3	Membership in more than one organization	75	50.00
4	Executive/office bearer in organization	07	04.67
	Total	**150**	**100.00**

Social participation gives us an idea about the respondent's participation in social activities. The distribution of the respondents according to their social participation is presented in Table 5. It has been found that half of the respondents (50.00%) had membership in more than one organization followed by 36.00 per cent respondents who had no membership in any organization, 09.33 per cent respondents had membership in one organization and only 04.67 per cent respondents were found to be in executive/office bearer in organization category.

The results clearly indicated that the half of the respondents belonged to membership in more than one organization. This finding is supported by Rabari (2006) and Mewara and Pandya (2007).

Occupation

Regarding the distribution of respondents according to their occupation, it is observed from Table 6 that majority of the respondents (57.33%) were involved in marigold farming + other business, followed by marigold farming (24.00%), marigold farming + service (07.33%), marigold farming + animal husbandry (06.67%) and marigold farming + agriculture (04.67%) category, respectively as their main occupation.

Table 6: Distribution of respondents according to their occupation (n =150)

S. No.	Occupation	Frequency	Per cent
1	Marigold farming	36	24.00
2	Marigold farming + Service	11	07.33
3	Marigold farming + Animal husbandry	10	06.67
4	Marigold farming + Agriculture	07	04.67
5	Marigold farming + Other business	86	57.33
	Total	**150**	**100.00**

It could be concluded that majority of the respondents were involved in marigold farming + other business as their main occupation. A positive and significant relationship was observed between occupation and extent of adoption regarding recommended marigold production technology by the marigold growers. This may be explained as follows the growers with higher social participation and more land would have adopted and practices to a greater extent.

Size of land holding

The findings indicated in Table 7 that the maximum number of the respondents (44.67%) had medium size of land holdings category (2.1 to 4 ha), followed by 34.00 per cent who belonged under small size of land holding (1.1 to 2 ha), whereas 14.00 per cent of the respondents were having large size of land holding (above 4 ha) and only 07.33 per cent respondents were marginal (up to 1 ha) farmers.

Table 7: Distribution of respondents according to their size of land holding (n =150)

S. No.	Size of land holding	Frequency	Per cent
1	Marginal (up to 1 ha)	11	07.33
2	Small (1.1 to 2 ha)	51	34.00
3	Medium (2.1 to 4 ha)	67	44.67
4	Large (above 4 ha)	21	14.00
	Total	**150**	**100.00**

It could be concluded from the Table that maximum number of respondents belonged to medium size of land holding category (2.1 to 4 ha). Thus the data clearly indicated that the maximum number of the respondents have medium size of land holdings category (2.1 to 4 ha) those were involved in marigold production. This finding is supported by Patidar (2002) and Walankhade *et al.* (2009).

Annual income

Annual income of family helps to project the overall economic position and it is an indicator of the economic stability of the family. The distribution of the respondents according to their annual income is presented in Table 8.

Table 8: Distribution of respondents according to their annual income (n =150)

S. No.	Annual income (Rs.)	Frequency	Per cent
1	Up to Rs. 20,000	34	22.67
2	Rs. 20,001 to Rs. 40,000	53	35.33
3	Rs. 40,001 to Rs. 60,000	25	16.67
4	Above Rs. 60,000	38	25.33
	Total	**150**	**100.00**

It was found that 35.33 per cent respondents were having their annual income between Rs. 20,001 to 40,000 followed by 25.33 per cent of respondents were having their annual income above Rs. 60,001 whereas 22.67 per cent of respondents were having their annual income up to Rs. 20,000 and only 16.67 per cent of respondents having their annual income Rs. 40, 0001 to Rs.60, 000.

The results clearly indicated that the maximum number of the respondents belonged to Rs. 20,001 to Rs. 40,000 annual income group. A positive and significant relationship was observed between annual income and extent of adoption regarding recommended marigold production technology by the marigold growers. The respondents having annual income ranging from (Rs. 20,001 to Rs. 40,000) would have spent more money on farm development through the adoption recommended marigold cultivation practices.

Credit acquisition

Table 9: Distribution of respondents according to their credit acquisition (n =150)

S. No.	Particulars	Frequency	Per cent
1	**Credit acquisition**		
	Not found	89	59.33
	found	61	40.67
2	**Duration of credit (n = 61)**		
	Short term credit (6-18 month)	40	65.57
	Mid-term credit (15 month-5 years)	15	24.59
	Long term credit (5-20 years)	6	09.83

3	**Availability of credit (n = 61)**		
	Easily available	21	34.43
	Difficult to obtain	40	65.57
4	**Agencies of credit (n = 61)**		
	Cooperative society	31	50.82
	Nationalized bank	15	24.59
	Money lenders	04	06.56
	Friends / Neighbours / Relative / *etc.*	11	18.03

The data presented in Table 9 revealed that majority of the respondents 59.33 per cent had not acquired the credit, whereas, only 40.67 per cent respondents had acquired the credit. Out of the credit acquiring respondents (total 61) the majority of respondents 65.57 per cent of the respondents had taken the short term credit (6-18 month) followed by mid term credit (15 month-5 years) (24.59%) and long term credit (5-20 years) (09.83%). So majority of the respondents had acquired short term credit (6-18 month) while, minimum percentage of respondents had acquired long term credit (5-20 years). Short term credit (6-18 month) might have been taken for purchasing seeds, fertilizers, while mid-term credit (5-20 years) have been taken for irrigation facilities or buying implements.

The 50.82 per cent respondents said that they got credit from cooperative agencies followed by 24.59 per cent of respondents who had taken credit from nationalized bank, 18.03 per cent of respondents had taken credit from Friends/Neighbours/Relative *etc.* while only 06.56 per cent of the respondents had taken credit from money lenders. This revealed that the respondents were aware about the agencies of credit and facilities provided by co-operative societies.

Availability of credit 34.43 per cent respondents found that credit is available to them easily, whereas 65.57 per cent respondents found the credit is not easily obtained from the various agencies because paper work is more and obtaining procedure of credit critical.

It could be concluded that 40.67 per cent of the respondents had taken credit from cooperative society was the major agency of credit providing.

CONCLUSION

From the above findings it can concluded that the majority of the respondents (69.33%) were found in middle age group (29 to 45 year) with educated up to high school and comes under other backward caste. 56.67 per cent of the respondents had small size of family and 50.00 per cent of the respondents were found to be members in more than one organization. The maximum number of the respondents (44.67%) had medium size of land holdings and involved in marigold farming with others business and belonged to Rs. 20,001 to Rs. 40,000 annual income group. 40.67 per cent respondents had acquired the credit and co-operative society is the major credit source for the marigold growers.

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STUDY OF G × E INTERACTION AND STABILITY IN CHICKPEA (*CICER ARIETINUM* L.)

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Abstract : 50 genetically diverse genotypes of chickpea were studied for G x E interaction and stability parameters in 10 quantitative characters Days to 50 % flowering, Days to maturity, Plant height ,No. of branches, Number of pods/plant, No. of seed/pod, 100 seed weight (g), Biological yield/plant, Seed yield per plant and Harvest index. The linear component of genotype x environment interaction (G x E) was significant for plant height, number of branches, number of pods per plant, biological yield and seed yield. The non-linear component of genotype x environment (G x E) interaction was non significant for all the traits when tested against pooled error. three environment, namely E3 (8.28g), E5 (8.31g), E6 (8.32g) were significantly lower yielding and the 3 environments E1 (8.96 g), E2 (9.29g) and E4 (8.88g) were significantly higher yielding than the grand mean (8.70).

Keyword : *Cicer arietinum*, G × E interaction, Stability

Abbereviation : G × E - genotype by environment interaction

INTRODUCTION

Genotype × Environment interaction (GEI) is an important aspect of plant breeding programs. It may arise when certain genotypes are grown in diverse set of environments. A significant for a quantitative trait such as seed yield can seriously limit the efforts on selecting superior genotypes for both new crop production and improved cultivar development. The lack of consistency in performance across environments complicates cultivar selection; it can provide useful information to the researchers (Kang, 1998). For example, it can help justify the need for additional broad-based testing in different environments and predict the variability expected among testing locations. The GEI can be properly exploited to advantage through various approaches (Gauch and Zobel, 1996, Kang, 1998). Most agronomically and economically important traits, such as grain yield, are quantitative in nature and routinely exhibit GEI. This necessitates genotype evaluations across multiple environments (called multi-environment trials [MET]) in the advanced stages of selection. By growing cultivars in different environments, the highest yielding and most stable cultivars can be identified. When selecting genotypes for wide adaptation, plant breeders look for a noncrossover GEI or preferably the absence of GEI. Thus, the estimation of stability of performance becomes important to identify consistent-performing and high-yielding genotypes (Kang, 1998).

The choice of plant breeding methodology which is to be used for upgrading the yield potential, mainly depends on the availability of reliable information about the nature and magnitude of adaptability towards stable performance of various genotypes. By and large moisture stress during different phases of growth of chickpea affects productivity the most.

MATERIAL AND METHODS

The present investigation was carried out at Department of Botany, J.V College, Baraut (Bagpat) Uttar Pradesh.

The experiment material consisted of 50 divergence genotypes of chickpea. The genotypes were obtained from IARI New Delhi Pusa.

Fifty genotypes of chickpea were evaluated in a randomized complete block design with three replications during rabi seasons of 2006-2007 and 2007-2008. In each of the two year, the experiments were repeated over three dates of sowing. The three dates of sowing were 20 October, 05 November, 20 November. In each of the six experiments (3 sowing dates x 2 years), each genotype will be raised in a plot of 1.8 m2 (4 rows x 4m length x 40cm inter row distance) with a plant to plant distance 20 cm. in each replication. All the recommended agronomic practices were followed to raise a good crop. The observations were recorded on five competitive and random plants per replication and mean values expressed per plant basis, at harvest stage. The single plant observations were recorded on different groups of cultivars during both the years both the plantings, respectively. For analysis of seed yield and its component traits, non-destructive sampling was reported at harvesting stage.

The observations on ten morphological traits were recorded on the cultivars at harvest stages Days to 50 % flowering, Days to maturity, Plant height, No. of branches, Number of pods/plant, No. of seed/pod, 100 seed weight (g), Biological yield/plant, Seed yield per plant and Harvest index.

RESULT AND DISCUSSION

The ANOVA results presented in Table suggested that variances due to all different sources excepting environment + (G x E) in the table, such as genotypes, environments, genotype x environment, environment linear, G x E linear and pooled deviation are statistically significant for almost all the traits. This indicated the presence of substantial variation in the mean performance (gi) of all the 50 chickpea varieties over environments and in the environmental means (ej) over test varieties.

Perkins and Jinks Modal (1968a):

The components of genotype x environments interactions (G x E) based on modified form of model develop by Perkins and Jinks (1968). The genotype X environments interactions (G x E) was partitioned into (i) linear (ii) non linear (reminder).

Table 1. Analysis of variance (M.S) for G x E interaction for various quantitative traits of chickpea genotype during 2006-2008.

Source	d.f	Days to flowering	Days to maturity	Plant height	No of branches	No of Pod/plant	No of Seed/pod	100-seed weight	Biological yield	Seed yield	Harvest index
Genotype(G)	49	19.91**	7.67*	84.20**	4.87*	12.28**	5.38*	62.90**	7.31**	5.25**	14.43**
Environment(E)	5	6061.48**	1013.79**	598.01**	23.65**	397.47**	19.36**	41.21**	93.37**	9.17**	121.01**
G X E	245	13.71**	3.27**	30.90**	3.76	9.68*	2.41	21.02**	5.33	3.86*	10.68**
Eberhart & Russell Model (1966)											
Environment (Linear)	1	303081.79**	5072.06**	2984.07**	118.28**	1987.56**	96.08**	206.11**	467.13**	45.88**	605.26**
G X E (linear)	49	7.81*	2.65	37.04**	26.54**	19.74**	1.89	15.03**	7.80*	5.88	7.04**
Pooled deviation	200	14.88	3.34	28.80	39.27	7.02	2.58	22.07	4.61	3.26	11.36
Perkins & Jinks Model (1968a)											
Heterogeneity between regression	49	7.18**	2.65	37.04**	13.00	19.74**	9.27	15.03**	7.80**	5.88**	7.04**
Reminder	196	15.18	3.41	29.39	4.03	7.16	5.17	22.52	4.71	3.32	11.25
Pooled error	588	9.38	4.52	4.60	1.11	2.41	4.69	1.45	2.08	1.01	5.16

*,**: Significant at 5% and 1% levels, respectively

The linear component of genotype x environment interaction (G x E) was significant for plant height, number of branches, number of pods per plant, biological yield and seed yield. The non-linear component of genotype x Environment (G x E) Interaction was non significant for all the traits when tested against pooled error. The distribution of genotype on the basis of different stability parameters combination for the six quantitative traits/ characters are also depicts the distribution of 50 chickpea genotypes based on stability parameters, only genotypes found suitable for different situations have been given serial number for identification and result described character wise. Eberhart and Russell (1966) and Perkins and Jinks (1968a) pattern are given in Table Significant genotypic differences were observed for days to flowering, days to maturity, plant height, number of branches, number of pods, seeds/pod, 100 seed weight, biological yield, seed yield and harvest index. Genotype x environment component was also significant for these seven characters days to flowering, plant height, number of branches, seeds/pod, 100 seed weight, biological yield and

harvest index, however, the G x E interaction (linear) was found to be significant for days to flowering, plant height, number of branches, seeds/pod, 100 seed weight, biological yield and harvest index. The heterogeneity between regressions was found to be significant for days to flowering, plant height, 100 seed weight, biological yield, seed yield and harvest index.

Significant genotypic difference were observed for all the 10 quantitative traits viz., plant height, number of branches, number of pods per plant, number of seeds per pod, days to 50 per cent flowering, days to maturity, 100-seed weight, biological yield, seed yield and harvest index. The (G x E) component was also significant for plant height, number of branches, number of pods per plant, days to flowering, biological yield and harvest index. However, the G x E interaction (linear) was found to be significant for these traits also.

Interestingly, the heterogeneity between regressions was also found to be significant for all these traits except days to 50 per cent flowering. Genotype x environment interaction was found to be significant for productive branches per plant and seed yield per plant by Sharma and Maloo (1989) and for days to 50 per cent flowering, days to maturity and 100-seed weight by Singh and Kumar (1994). Significance of G x E interaction has been reported for different characters by various workers. However, all the characters studied may not show both linear and non-linear components of G x E.

In the present study two genotypes BG2023 and BG 1072 had mean lower days to 50% flowering than average, b=l and $S^2d=0$ would be ideal variety. Whereas seven genotypes viz. BG 2027, PUSA 1053, BG 1107, BG 1109, BGD 1004, BG2046 and BG 2045had lower mean value for days to maturity indicating that early maturity than the over all mean. only one genotypes BG 2056 for pods/plant and two genotypes BG 2027 and ICRISAT3074 for seeds/plant were desirable and stable identified on the basis higher grand mean, b=1 and $S^2di = 0$. The only one genotype PUSA1088 had significantly higher grain yield than grand mean (μ =12.22) which suggested that these genotypes showed stable performance for this trait over six environments used in present study.

Analysis of Mean Performance

The mean yields of 50 chickpea genotypes over six environments, their marginal means (environment means over genotypes and genotype means over environment), FW regression coefficients for genotypes, and IPCA1 scores for genotypes and environments. It can be noticed from this Table that yield ranged from 6.47g/ plant (genotype no. 43 inE5) to 10.34g/ plant (genotype no. 4 in E4) with an average of 8.70g/ plant. However, the genotype means averaged over six environments ranged from 46.63g / plant (genotype no. 37) to 57.63g / plant (genotype no. 1) and the environment means ranged from 8.31gper plant (E6) to 9.29 g per plant (E2). This indicated that the genotypes and the environments were diverse and as is apparent from their extent of range, environments seem to be far more diverse than the genotypes.

Among genotypes considering their mean yields over environments, only six genotypes, namely (BG 1063, PUSA 1108, PUSA 2024, PUSA 1003, BG 2046 and BG 5019) were yielding lower (though not significantly) than the check variety PUSA 362 used at all environments. However, 20 genotypes, namely BG1087, BGD1019, CSG 9505, GJG 9807, ICC 12237, ICC 11224, JG 62, BG 2023, BG 2027, BG 2066, BG 2049, CSG 8962, ICRISAT 3070, PUSA 1088, ICCV 5, BG 1072, BG 2054, BG2045.

Table 2. Mean yield , grand mean in gram per plant , IPCA1 score for 50chickpea genotype tested at six environments

Sl .No	Genotypes	Environments Code								
		E1	E2	E3	E4	E5	E6		IPCA1	
1	BG1087	7.22	9.19	7.93	10.32	7.78	9.19	9.66	-10.08	
2	BGD1017	9.86	9.52	8.36	8.97	7.77	8.52	8.83	2.96	
3	BGD1019	8.88	9.50	8	9.32	9.56	9.04	9.05	12.00	
4	CSG9505	9.28	9.58	8.39	10.34	9.11	9.24	9.32	3.26	
5	GJG9807	9.46	10.26	9.11	9.94	8.22	7.45	9.24	1.28	
6	GCP9504	9.67	9.52	8.36	10.07	7.15	7.69	8.74	22.40	
7	ICC12237	10.29	9.36	8.33	9.26	8.36	7.94	8.92	-4.12	
8	ICC11224	9.47	9.56	8.13	9.13	8.20	8.96	8.91	-20.34	
9	ICC11332	9.57	9.71	7.64	9.62	7.60	7.72	8.64	-14.54	
10	JG62	8.81	9.43	7.96	10.07	9.06	8.84	8.02	-11.23	
11	BG1075	8.63	8.34	8.23	9.82	8.44	7.80	8.54	2.40	
12	BG1077	9.23	8.40	8.30	9.27	7.68	7.86	8.45	5.37	
13	BG2023	9.69	9.69	8.24	9.98	7.76	8.29	8.94	1.34	
14	BG2025	8.40	9.83	7.86	7.98	8.72	8.62	8.56	-15.05	
15	BG2027	10.12	9.86	7.82	9.74	8.66	8.67	9.14	11.03	
16	BGD1016	9.66	9.35	7.60	9.81	6.79	8.10	8.55	6.48	

17	BG2066	9.68	10.17	7.91	9.34	8.46	8.81	9.06	6.67	
18	BLAK936	8.08	9.48	8.06	7.74	8.17	8.04	8.26	26.88	
19	BG2049	9.09	10.15	8.72	8.92	8.18	7.92	8.83	12.54	
20	PUSA372	8.35	8.43	8.81	7.87	8.67	8.32	8.40	7.75	
21	BG1063	8.46	9.71	8.23	7.98	8.14	8.12	8.44	-3.87	
22	BGD112	8.24	8.38	8.10	8.07	8.81	9.58	8.53	-11.96	
23	C-235	9.03	8.28	7.65	7.86	9.08	9.29	8.54	-11.56	
24	CSG8962	8.71	9.75	8.07	8.37	9.03	9.22	8.85	1.22	
25	ICRISAT3070	8.92	9.93	7.51	8.64	9.05	8.76	8.08	-18.25	
26	ICRISAT3074	8.66	9.69	8.44	7.96	8.24	8.32	8.53	-4.05	
27	ICRISAT3077	8.95	8.44	8.71	8.23	8.95	7.77	8.50	-6.86	
28	PUSA362	8.44	8.48	9.10	7.97	8.64	8.07	8.54	-16.95	
29	PUSA391	8.78	8.53	9.23	9.08	8.60	7.65	8.64	-6.35	
30	BG1103	8.57	7.98	9.58	8.55	8.32	8.10	8.52	5.11	
31	PUSA1053	9.08	9.47	8.12	9.33	7.33	8.23	8.59	1.37	
32	PUSA1088	9.04	9.61	8.32	9.71	8.85	8.81	9.15	-20.72	
33	BG1107	8.55	9.36	8.08	8.04	8.87	8.72	8.60	-21.62	
34	PUSA1108	9.17	9.76	8.35	7.45	7.79	7.84	8.39	4.80	
35	BG1109	9.07	9.29	8.08	8.09	8.60	7.91	8.50	9.41	
36	PUSA2024	8.62	9.58	7.99	7.66	9.18	7.60	8.43	15.35	
37	PUSA1003	8.30	8.13	7.82	8.03	6.53	7.82	7.77	1.25	
38	BGD1004	8.90	9.61	8.62	8.96	7.91	7.86	8.64	-2.32	
39	ICCV-5	9.29	9.75	8.29	9.04	8.29	8.14	8.93	15.59	
40	BG2060	8.86	9.38	7.86	8.67	8.20	8.20	8.52	-0.85	
41	BG1072	9.05	10.07	8.49	9.17	8.10	8.23	8.85	10.67	
42	BG2046	8.59	8.13	7.72	8.52	7.63	7.96	8.09	8.95	
43	BG2051	8.84	9.40	8.96	8.99	6.47	8.84	8.58	0.67	
44	BG5019	8.89	9.30	7.94	9.48	7.37	7.40	8.39	9.84	
45	BG2054	8.57	9.79	7.69	9.41	8.77	8.33	8.76	4.05	
46	BG2062	8.33	9.24	7.45	9.46	9.26	8.36	8.68	0.69	
47	BG2045	8.25	8.33	9.24	9.02	8.68	9.11	8.77	14.23	
48	BGD1035	8.80	8.37	9.04	7.68	8.76	8.39	8.51	-0.85	
49	BG2056	9.81	9.63	8.52	7.65	8.80	8.00	8.73	2.36	
50	PUSA1105	9.94	10.10	9.19	9.54	9.33	8.36	9.41	12.28	
	Mean	8.96	9.29	8.28	8.88	8.31	8.32	8.70		
	IPCAI	12.24	8.57	1.46	15.64	10.92	2.45			

BG 2056 and PUSA 1105 had significantly higher yields than the check variety. Similarly, three environment, namely E3 (8.28g), E5 (8.31g), E6 (8.32g) were significantly lower yielding when compared with grand mean (8.70g). On the other hand, of the 3 environments which had higher mean yields than the grand mean, only three. E1 (8.96 g), E2 (9.29g) and E4 (8.88g) were significantly higher yielding than the grand mean.

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ANALYSIS OF SOCIO-ECONOMIC PROFILE OF MAIZE GROWERS IN KANKER DISTRICT OF CHHATTISGARH

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Abstract : The present study was carried out in Kanker district of Chhattisgarh to assess the socio-economic profile of maize growers. 120 farmers were considered as respondents for this study. Respondents were interviewed through pre-tested and well structured interview schedule. Collected data were analyzed with the help of suitable statistical methods. The study revealed that the majority (53.33%) of the respondents were found in middle age group and educated up to primary school 35.83 per cent. The maximum (50.00%) number of the respondents had medium size of family and maximum (41.66%) number of respondents had membership in one organization. 42.50 per cent of the farmers were engaged in farming + labours. The maximum (40.83%) number of the respondents was having annual income between Rs. 20,001 to 40, 000.

Keywords : Chhattisgarh, Maize growers, Socio-economic profile, Tribal farmers

INTRODUCTION

Maize (*Zea mays*) is one of the most important crops in world agricultural economy grown over an area of 159 million hectares with a production of 817 million tonnes. In India, it is an important crop next only to rice and wheat and has an acreage around 8.36million ha with a production of 16.72 million tonnes. India ranks fourth in area and sixth in production of maize. As it has yield potential far higher than any other cereal, it is sometimes referred to as the miracle crop or the 'Queen of Cereals (*Anonymous, 2011*). The consumption pattern for maize produced in India at present includes poultry feed 52 per cent, human food 24 per cent, animal feed 11 per cent, starch 11 per cent, brewery 1 per cent and seed 1 per cent (*Sain Dass et.al., 2007*). In our country with the growth in demand of poultry feed the demand for maize is also going up. It is the crop with the highest per day productivity. Some estimates indicate that India may have to produce 55 million tonnes of maize to meet its requirement for human consumption, poultry, piggery, pharma industry and fodder by 2030.

The present study was undertaken with specific objectives to assess the socio-economic profile of the respondents about recommended maize production technology among the tribal farmers of Chhattisgarh.

MATERIAL AND METHOD

The present study was carried out in Kanker district of Chhattisgarh state. Kanker district has 7 blocks, out of which, 4 blocks namely Bhanupratappur, Antagarh, Narharpur, Koyaliberha were selected purposively because maize crop is grown by the maximum number of farmers in these blocks. A list of maize growers of the selected blocks were obtained from the office of the agricultural department of Kanker district and three villages were selected randomly from each block hence a total number of 12 villages namely Badetopal, Kodagaon, Kalgaon, Shalhe, Dumarkot, Iragaon, Pakhanjur, Devpur, Koygaon, Narharpur, Sarona and Devgaon were selected for this study. 10 farmers from each village were selected randomly. In this way a total of 120 farmers were considered as respondents for this study. Respondents were interviewed through personal interview. Prior to interview, respondents were taken in to confidence by revealing the actual purpose of the study and full care was taken in to consideration to develop good rapport with them. For the data collection well designed and pre-tested interview scheduled were used. Collected data were analyzed by the help of various statistical tools i.e. frequency, percentage, mean, and standard deviation, etc.

RESULT AND DISCUSSION

Socio-personal characteristics of the respondents

Age, education, caste, size of family and social participation were considered as socio-personal characteristics of the respondents. These characteristics are analyzed and presented in table 1.

Age

It is observed from the table that the majority of the respondents (53.33%) were belonged to middle age group (36 to 55 year), 35.00 per cent respondents were under young age group (up to 35 year) and 11.67 per cent respondents were of old age group (more than 55 year) This finding is in conformity to the findings reported by Kazan and Agunga (1997), Deshmukh *et al.* (2007) and Singh *et al.* (2007).

Thus, it may be concluded that the maximum maize growers were belonging to middle age (35 to 50 year).

Education

Education builds the ability of an individual to seek knowledge understand and utilize things better and hence assessment of respondent's education attainment was essential. When we discuss the data

in table 1 the level of education of the respondents, it was found that 35.83 per cent of the respondents were educated up to primary school level followed by 25.00 per cent respondents were found under the category of middle school level whereas 20.83 per cent respondents were illiterate. 13.34 per cent of the respondents had education up to high school and higher secondary level and only 5.00 per cent respondents had education up to college level and above.

The maximum number of maize growers had primary- middle school level education. It may be because of the fact that primary and middle school are found in most of the villages and the maize growers would have acquired, primary to middle level education attending the schools in their village itself without any need to go outside. Finally result clearly indicates that the majority of respondents were having education up to primary to middle level.

Table 1. Distribution of respondents according to their socio-personal characteristics

(n =120)

S. No.	Characteristics	Frequency	Per cent
1.	**Age**		
	Young (up to 35 years)	42	35.00
	Middle (36 to 55 years)	64	53.33
	Old (above 55 years)	14	11.67
2.	**Education**		
	Illiterate	25	20.83
	Primary school	43	35.83
	Middle school	30	25.00
	High school and Higher Secondary school	16	13.34
	College and above		
	Caste	06	05.00
3.	Schedule tribes		
	Schedule caste	82	68.33
	Other backward class	3	2.50
	General	19	15.83
	Size of family	16	13.34
4.	Small (< 5 members)		
	Medium (6 to 10 members)	53	44.16
	Big (> 10 members)	60	50.00
	Social participation	07	05.84
5.	No membership		
	Membership in one organization	30	25.00
	Membership in more than two organization	50	41.66
	Executive / officer bearer	37	30.84
		03	02.50

Caste

As regarded to caste, maximum number of the respondents (68.33%) belonging to schedule tribe's, followed by 15.93 per cent were under other backward caste, 13.34 per cent respondents were from general caste and only 2.50 per cent respondents belonged to schedule caste.

It can be concluded that majority of the respondents were belonged to schedule tribe.

Size of family

Maximum 50.00 per cent respondents had medium size of the family (6 to 10 members) followed by small size of family (up to 5 members) with 44.16 per cent. However, rest of 5.84 per cent respondents had big size of family (more than 10 members) this indicates that the majority of respondents had medium size of family.

Social participation

Social participation gives an idea about the respondent's participation in social activities. As regard to social participation, maximum number of respondents 41.66 per cent had membership in one organization followed by 30.84 per cent of respondents had membership in more than one organization. There were 25.00 per cent respondents who were having his no membership in any organizations and 2.50 per cent belonged to executive/ office bearer category. This finding is similar to the findings of Yadav (2008).

Socio- economic characteristics of respondents

The independent variables i.e. occupation, annual income, size of land holding and credit acquisition were considered as socio-economic characteristics of the respondents.

Occupation

Table 2. Distribution of respondents according to their occupation

(n =120)

S. No.	Occupation	Frequency	Per cent
1.	Farming	47	39.16
2.	Farming + labour	51	42.50
3.	Farming + service	10	8.33
4.	Farming + animal husbandry	03	2.50
5.	Farming + business + service	02	1.66
6.	Farming + others	07	5.85
	Total	**120**	**100**

Regarding the distribution of occupation, it is observed from table 2. that maximum respondents (42.50%) were involved in farming + labours, followed by 39.16 per cent were engaged in farming, 8.33 per cent were engaged in farming + service, 5.85 per cent respondents were involved in farming + others , 2.50 per cent engaged in farming + animal husbandry and only 1.66 per cent were engaged in farming + business + service.

Annual income

Table 3. Distribution of respondents according to their annual income

(n =120)

S. No.	Annual income (Rs)	Frequency	Per cent
1.	Up to Rs 20,000	15	12.50
2.	Rs 20,001 to 40,000	49	40.83
3.	Rs 40,001 to 60,000	31	25.83
4.	Above Rs 60,000	25	20.84
	Total	**120**	**100**

The distribution of the respondents according to their annual income presented in table 3.

It was found that 40.83 per cent respondents were having their annual income between Rs. 20,001 to 40, 000 followed by 25.83 per cent of respondents had their annual income between Rs. 40, 001 to 60, 000, whereas 20.84 per cent respondents had annual income above Rs.60, 000 and only 12.50 per cent respondents had annual income up to Rs.20, 000. The result clearly indicated that maximum number of the respondents belonged to Rs.20, 001 to 40, 000 annual income group.

Size of land holding

Table 4. Distribution of respondents according to their size of land holding

(n =120)

S. No.	Size of land holding	Frequency	Per cent
1	Marginal (up to 1 ha)	42	35.00
2	Small (1 to 2 ha)	45	37.50
3	Medium (2 to 4 ha)	25	20.83
4	Large (above 4 ha)	8	6.67
	Total	**120**	**100**

Table 4 indicates that the maximum number of the respondents (37.50%) had small size of land holding (1 to 2 ha.), followed by 35.00 per cent belonged under marginal category (up to 1 ha.), whereas 20.83 per cent of the respondents were having medium size of land holding (2 to 4 ha.) however only 6.67 per cent respondents had large size of land holding (above 4 ha.).

It could be concluded from the table that maximum number of respondents belonged to small size of land holding category.

Credit acquisition

Table 5 reveals that majority of the respondents (90.84%) acquired credit, whereas, only 9.16 per cent respondents did not acquire the credit. The majority of the respondents (49.09%) taken the short term credit followed by mid term credit (34.54%) and long term credit (16.37%). It is concluded that the maximum respondents had acquired short term credit, the reason is that the respondents wanted to acquired credit for short term because just after harvesting the crop, they use to deposit their entire loan because until and unless they do not deposit the balance amount of loan, they can not get credit (loan) again from credit agency.

Table 5. Distribution of respondents according to their credit acquisition

(n =120)

S. No.	Particulars	Frequency	Per cent
1.	**Credit acquisition**		
(i)	Not acquired	10	09.16
(ii)	Acquired	110	90.84
2.	**Duration of credit (n = 110)**		
(i)	Short term credit	54	49.09
(ii)	Mid term credit	38	34.54
(iii)	Long term credit	18	16.37
3.	**Source of credit (n = 110)**		
(i)	Cooperative society	39	35.45
(ii)	Nationalized bank	55	50.00
(iii)	Money lenders	07	06.37
(iv)	Friends / Neighbours/ Relative / Others	09	08.18
4.	**Availability of credits (n = 110)**		
(i)	Easy	76	69.09
(ii)	Difficult	34	30.91

The maximum number of the respondents (50.00%) had acquired credit from the nationalized bank followed by 35.45 per cent of respondents who had taken credit from cooperative society while 8.18 per cent respondents had taken credit from friends, neighbours and relatives only 6.37 per cent of respondents taken credit from money lenders. This table also reveals that the respondents were aware about the facilities provided by nationalized banks and co-operative societies. Out of total respondents, 69.09 per cent respondents were acquired credit easily whereas 30.91 per cent respondents faced much difficulty at the time of obtaining the credit.

Psychological characteristics of the respondents

Economic motivation

The table 6 shows that the distribution of the respondents according to their economic motivation, it was found that 79.16 per cent respondents had medium level of economic motivation, while 11.68 per cent and 9.16 per cent respondents had high and low level of economic motivation respectively.

Table 6. Distribution of respondents according to their economic motivation

(n = 120)

S. No.	Categories	Frequency	Per cent
1	Low level of economic motivation (up to 17 score)	11	09.16
2	Medium level of economic motivation (18-27 score)	95	79.16
3	High level of economic motivation (above 27 score)	14	11.68
	Total	**120**	**100**

$\overline{X}$ = 22.81, S.D. = 4.83

Innovative proneness

Table 7. Distribution of respondents according to their innovative proneness

(n=120)

S. No.	Categories	Beneficiaries	
		Frequency	Per cent
1	Low level of innovative proneness (up to 21 score)	20	16.66
2	Medium level of innovative proneness (22-32score)	81	67.50
3	High level of innovative proneness (above 32 score)	19	15.84
	Total	**120**	**100**

$\overline{X}$ =27.00, S.D. = 5.66

The result shows in table 7 that 67.50 per cent respondents had medium level and 15.84 per cent had high innovative proneness towards new maize production technology.

Marketing characteristics of respondents

Weighing accuracy

Table 8. Distribution of respondents according to weighing accuracy of maize produce weighted by the mandi personnel

(n =120)

S. No.	Categories	frequency	Per cent
1	Weighted accurately	48	40.00
2	Not weighted accurately	72	60.00
	Total	**120**	**100**

$\bar{X}$ = 1.29, S.D. = 0.73

The findings indicate in table 8. The study revealed that the majority of the respondents (60.00%) said that the maize produce was not being accurately weighted while only 40.00 per cent respondents were expressed their views that maize produced was being weighted accurately.

Distance of market from the village

Table 9. Distribution of respondents according to distance of market from the village about marketing of maize produce

(n =120)

S. No.	Distance	Frequency	Per cent
1	0-10 kms	37	30.83
2	11-20 kms	66	55.00
3	Above 20 kms	17	14.17
	Total	**120**	**100**

$\overline{X}$ = 1.33, S.D. = 1.03

Table 9 shows that maximum number of the respondents (55.00%) had 11-20 kms market distance from their villages followed by 33.83 per cent respondents had 0- 10 kms distance and only 14.17 per cent respondents had more than 20 kms market distance from their villages.

Support price

Table 10. Distribution of respondents according to support price value of their produce

(n =120)

S. No.	Sources	Frequency	Per cent
1.	Received produce value on support price	44	36.67
2.	Not received produce value on support price	76	63.33
	Total	**120**	**100.00**

$\overline{X}$ = 1.50, S.D. = 0.86

The data presented in the table 10 shows that the distribution of respondents according to receiving of support price value of produce. The majority of the respondents (63.33%) did not receive produce value of maize on support price while 36.67 per cent respondents received produce value of maize on support price.

Mediator's interference

Table 11. Distribution of respondents according to mediator's interference at time of marketing

(n =120)

S. No.	Categories	Frequency	Per cent
1	Interfered	92	76.66
2	Not interfered	28	23.34
	Total	**120**	**100**

$\overline{X}$ = 1.37, S.D. = 0.62

The data presented in the table 11 shows that majority of the respondents 76.66 per cent reported that mediators interfered in the market at the time of disposal of maize produce while 23.34 per cent respondents expressed that the mediators did not interfere in the market at the time of disposal of produce.

CONCLUSION

From the above research findings it can be concluded that the majority of the respondents were found in middle age group having primary school level of education belonged to schedule tribes, had medium family size with membership in one organization. Majority of respondents had farming + labour as their main occupation and most of the respondents belonged to the income category of Rs 20,001 to Rs. 40,000, had small size (1 to 2 ha) of land holding and maximum number of farmers acquired credit for short term period from nationalized bank easily. Maximum number of respondents was having medium level of economic motivation and innovative proneness. Majority of the respondents said that weighing of maize was not being done accurately. Maximum number of respondents did not receive produce value of maize on support price. Most of the respondents said that the mediators interference at the time of selling of produce in the market.

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SITE SPECIFIC NUTRIENT MANAGEMENT IN SOYBEAN (*GLYCINE MAX* L. MERRILL)

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Abstract : A field experiment was conducted during *kharif* season, 2008 on medium black clay soils (Vertisols) having pH 7.80 at Research Farm, College of Agriculture Indore (M.P.). To study the "Site specific nutrient management in soybean (*Glycine max* L. Merill.)". The experiment was conducted in randomized block design having nine treatments - T_1 - Fertilizer dose as per farmers' practice (50 kg DAP/ha), T_2 - T_1 + 40 kg S/ha through gypsum + 6.25 kg Zn/ha through $ZnCl_2$, T_3 - Recommended dose of fertilizer (RDF) i.e. 23.5 kg N, 60 kg P_2O_5, 23.5 kg K_2O through DAP and MOP , T_4 - T_3 + 40 kg S/ha through gypsum + 6.25 kg Zn/ha through $ZnCl_2$, T_5 - 150% of RDF i.e. 35.2 kg N, 90 kg P_2O_5, 35.2 kg K_2O through DAP and MOP, T_6 - T_5 + 40 kg S/ha through gypsum + 6.25 kg Zn/ha through $ZnCl_2$, T_7 - Soil test based RDF for 25 q/ha yield target (28.95:74.92:9.5 N:P_2O_5:K_2O kg/ha given through DAP and MOP), T_8 - T_7 + 40 kg S/ha through gypsum + 6.25 kg Zn/ha through $ZnCl_2$, T_9 - Control. The treatments were replicated 4 times. The treatment T_6 (150% RDF + 40 kg S + 6.25 kg Zn/ha) significantly produced maximum plant growth (i.e. plant height, branches/plant, dry matter accumulation, number of nodules/plant, leaf area/plant, LAI, chlorophyll content), seed yield/plant (10.03 g), biological yield (3400kg/ha), grain yield (1673 kg/ha) and straw yield (1727 kg/ha) followed by T_5 (150% RDF). The maximum net return of Rs. 20525/ha along with highest benefit: cost ratio of 3.00 was obtained with treatment T_5 (150% RDF), while gross income was highest (Rs. 31841/ha) with treatment T_6 (150% RDF+ 40 kg S + 6.25 kg Zn/ha).

Keyword: Nutrient management, Soybean

INTRODUCTION

Soybean *(Glycine max (L.) Merrill)* is basically a leguminous crop and is gaining importance as oilseed crop of India. It is rich in protein (40-42%) and oil (20-22%), which are of paramount importance in human diet and animal nutrition. In India, soybean is grown in 65.00 lakh hectares with total annual production of 76.1 lakh tones. Soybean occupies the highest area and production amongst the oilseeds in Madhya Pradesh state. In the state it is grown in 39.5 lakh hectares with total production of 25.7 lakh tones, attaining the productivity level of 1102 kg/ha. The major concern today is the low productivity of soybean in the state i.e. around 1 t / ha. One of the major concerns of low productivity is declining soil fertility. Continuous use of imbalance fertilizers has resulted in macro and micro nutrient deficiencies and is considered as the most important factor for low productivity of soybean after water management. Thus, nutritional management is one of the important constraints identified for restricting soybean productivity. Enhancement in soybean yield and its sustainability through nutritional management has been reported. Apart from limitations offered by major nutrients, correction of deficiency of sulphur (S) and zinc (Zn) in soils of Madhya Pradesh is of equal importance. In general farmers apply only nitrogen and phosphorus, which results in total negative balance of potassium and deficiency of secondary and micronutrients in the soil. Therefore, the present investigation was carried out with objectives of to find out the effect of different nutrient management strategies on plant growth, yield attributes and yield of soybean.

MATERIAL AND METHOD

The field experiment was conducted during *kharif* season of 2008 at Research Farm, College of Agriculture, Indore (M.P.). The soil of the experimental field was medium black clay (Vertisols) having pH 7.80, electrical conductivity 0.30 ds/m, organic carbon 0.45%, available N, P_2O_5, K_2O, S and Zn, 210, 13.6, 400, 9.6 kg/ha, and 0.50 mg/kg, respectively. This region belongs to sub-tropical semi-arid region having range of maximum temperature between 23º to 43º C and 6º to 25º C as minimum temperature. The average annual rainfall is 954 mm. The experiment was conducted in randomized block design having nine treatments, T_1 - Fertilizer dose as per farmers' practice (50 kg DAP/ha), T_2 - T_1 + 40 kg S/ha through gypsum + 6.25 kg Zn/ha through $ZnCl_2$, T_3 - Recommended dose of fertilizer (RDF) i.e. 23.5 kg N, 60 kg P_2O_5, 23.5 kg K_2O through DAP and MOP , T_4 - T_3 + 40 kg S/ha through gypsum + 6.25 kg Zn/ha through $ZnCl_2$, T_5 - 150% of RDF i.e. 35.2 kg N, 90 kg P_2O_5, 35.2 kg K_2O through DAP and MOP, T_6 - T_5 + 40 kg S/ha through gypsum + 6.25 kg Zn/ha through $ZnCl_2$, T_7 - Soil test based RDF for 25 q/ha yield target (28.95:74.92:9.5 N:P_2O_5:K_2O kg/ha given through DAP and MOP), T_8 - T_7 + 40 kg S/ha through gypsum + 6.25 kg Zn/ha through $ZnCl_2$, T_9 - Control. The treatments were replicated 4 times. Soybean var. 'JS.93-05' was sown @ 80 kg seed/ha in rows 45 cm apart on 20 June 2008. For analyzing the growth

pattern of the crops, five plants of uniform size were selected randomly and tagged from each treatment for recording various observations on growth and development at various growth stages.

RESULT AND DISCUSSSION

Plant height increasing progressively upto harvest, at 30, 45, 60, 75 DAS and at harvest, the maximum plant height (23.39, 42.98, 62.99, 71.68 and 68.52 cm respectively) was recorded with the application of 150% RDF + 40 kg S/ha + 6.25 kg Zn/ha (T_6) which was found significantly superior to rest of the treatments. The treatment 150 % RDF (T_5) comes next in order which was found at par with T_7 + 40 kg S/ha + 6.25 kg Zn/ha (T_8) at 60 DAS. While at 75 DAS T_6 was found at par with 150 % RDF (T_5), STCR based NPK for 25 q/ha yield target (28.95:74.92:9.5 N:P_2O_5:K_2O kg/ha) (T_7) and T_7 + 40 kg S/ha + 6.25 kg Zn/ha (T_8). At harvest T_6 was at par with T_3 + 40 kg S/ha + 6.25 kg Zn/ha (T_4), 150 % RDF (T_5), STCR based NPK for 25 q/ha yield target (28.95:74.92:9.5 N: P_2O_5:K_2O kg/ha) (T_7) and T_7 + 40 kg S/ha + 6.25 kg Zn/ha (T_8). Minimum plant height of soybean at 30, 45, 60, 75 DAS and at harvest (19.6, 33.10, 49.97, 59.76 and 56.78 cm, respectively) was found under control (T_9) which was at par with farmer's practice (50 kg DAP/ha) (T_1) at 60, 75 DAS and also with T_2 at harvest.

The dry matter accumulation per plant at different growth stages of the crop is presented in Table 2 and. It is revealed from the data that dry matter accumulation per plant continuously increased up to 75 DAS under all the treatments and rate of increase in dry matter accumulation per plant was more between 60 to 75 DAS as compared to 45 to 60 DAS, but slight reduction in dry matter accumulation per plant was noted at harvesting stage. Application of 150% of RDF along with 40 kg S and 6.25 kg Zn/ha (T_6) produced significantly more dry matter accumulation of 45.47, 67.55, 92.20 and 89.95 g per plant over rest of the treatments at 45, 60, 75 DAS and harvest, respectively but being at par with 150% of RDF (T_5), T_7 + 40 kg S/ha + 6.25 kg Zn/ha (T_8) and STCR based NPK for 25 q/ha yield target (28.95:74.92:9.5 N:P_2O_5:K_2O kg/ha) (T_7) at 45, 75 DAS and at harvest and with 150 % RDF (T_5) at 60. The minimum dry matter accumulation by soybean plant (34.67, 47.55, 59.27 and 58.87 g per plant, respectively, at each stage) was recorded under control (T_9).

Table 1. Effect of various treatments on plant height at successive growth stages

Treatments		Plant height (cm) at				
		30 DAS	**45 DAS**	**60 DAS**	**75 DAS**	**Harvest**
T_1	Fertilizer dose as per farmers' practice (50 kg DAP/ha, i.e. 9:23 N:P_2O_5 kg/ha)	19.71	33.85	50.19	61.05	58.76
T_2	T_1 + 40 kg S/ha + 6.25 kg Zn/ha	20.60	35.16	52.38	64.79	60.37
T_3	RDF(23.5:60:23.5 N:P_2O_5:K_2O kg/ha)	20.68	38.96	53.55	66.15	62.40
T_4	T_3 + 40 kg S/ha + 6.25 kg Zn/ha	20.90	38.99	54.48	69.31	65.94
T_5	150% of RDF	22.80	42.05	57.46	71.43	67.93
T_6	T_5 + 40 kg S/ha + 6.25 kg Zn/ha	23.39	42.98	62.99	71.68	68.52
T_7	STCR based NPK for 25 q/ha yield target (28.95:74.92:9.5 N:P_2O_5:K_2O kg/ha)	21.14	39.42	54.79	70.03	66.39
T_8	T_7 + 40 kg S/ha + 6.25 kg Zn/ha	22.16	40.20	57.33	70.62	67.69
T_9	Control	19.65	33.10	49.97	59.76	56.78
	SE (m) ±	0.16	0.19	0.13	0.58	1.41
	CD (at 5%)	0.47	0.56	0.38	1.70	4.12

The number of nodules per plant at different growth stages of the crop is presented in Table 2. It is revealed from the data that the number of nodules per plant continuously increased upto 60 DAS under all the treatments. Slight reduction in number of nodules per plant was noted after 60 days stage of the crop growth. Significant differences amongst the various treatments were observed at all crop growth stages. At 45, 60 and 75 DAS, the maximum number of root nodules per plant (67.19, 83.24 and 81.21, respectively) were recorded in treatment T_5 + 40 kg S/ha + 6.25 kg Zn/ha (T_6), which was statistically at par with 150% of RDF (T_5) at 45 and 60 DAS and with 150 % RDF (T_5) and T_7 + 40 kg S/ha + 6.25 kg Zn/ha (T_8) at 75 DAS and all these treatments were significantly superior to rest of the treatments. The control (T_9) resulted in significantly lowest number of root nodules per plant (37.12, 46.35 and 44.21,

respectively). Such enhancement effect might be attributed to the favorable influence of these nutrients on metabolism and biological activity and its stimulating effect on photosynthetic pigments and enzyme activity which in turn encourage vegetative growth of plant it is also supported by Agarwal *et al.* (1996), Dwivedi *et al.* (1999), Singh *et al.* (2001) and Paliwal *et al.* (2003).

Table 2. Effect of various treatments on dry matter accumulation and number of nodules per plant at successive growth stages.

Treatments		Dry matter accumulation (g/plant)				Number of nodules/plant		
		45 DAS	60 DAS	75 DAS	Harvest	45 DAS	60 DAS	75 DAS
T_1	Fertilizer dose as per farmers' practice (50 kg DAP/ha, i.e 9:23 N:P_2O_5 kg/ha)	35.50	48.85	63.87	62.40	37.35	48.47	47.09
T_2	T_1 + 40 kg S/ha + 6.25 kg Zn/ha	35.77	50.22	65.57	64.12	41.62	50.34	47.44
T_3	RDF (23.5:60:23.5 N:P_2O_5:K_2O kg/ha)	36.90	52.82	72.97	71.72	45.73	62.79	55.00
T_4	T_3 + 40 kg S/ha + 6.25 kg Zn/ha	37.90	54.45	74.12	72.47	57.28	67.55	64.06
T_5	150% of RDF	44.77	58.25	78.52	77.05	67.15	82.56	78.34
T_6	T_5 + 40 kg S/ha + 6.25 kg Zn/ha	45.47	67.55	92.20	89.95	67.19	83.24	81.21
T_7	STCR based NPK for 25 q/ha yield target (28.95:74.92:9.5 N:P_2O_5:K_2O kg/ha)	39.62	55.17	75.50	73.92	57.89	76.38	74.93
T_8	T_7 + 40 kg S/ha + 6.25 kg Zn/ha	40.85	55.30	78.10	76.07	64.14	76.40	76.66
T_9	Control	34.67	47.55	59.27	58.87	37.12	46.35	44.21
	SE (m) ±	1.97	3.46	5.47	5.29	0.61	0.62	1.92
	CD(at 5%)	5.76	10.11	15.95	15.47	1.77	1.80	5.60

Yield Attributes and yields

The number of pods per plant of soybean was significantly influenced by various treatments as presented in Table 3. Significantly higher number of pods (32.10/plant) was recorded under treatment T_5 + 40 kg S/ha + 6.25 kg Zn/ha (T_6) which was statistically at par with 150 % RDF (T_5), T_7 + 40 kg S/ha + 6.25 kg Zn/ha (T_8), T_3 + 40 kg S/ha+ 6.25 kg Zn/ha (T_4) and STCR based NPK for 25 q/ha yield target (28.95:74.92:9.5 N:P_2O_5:K_2O kg/ha) (T_7). Significantly lowest number of pods (22.00/plant) was recorded under control (T_9).

The seed yield per plant of soybean was significantly influenced by various treatments as presented in Table 3. Maximum seed yield (10.03 g/plant) was obtained with treatment T_5 + 40 kg S/ha + 6.25 kg Zn/ha (T_6) which was found at par with150% of RDF (T_5). The control (T_9) being at par with 50 kg DAP/ha (T_1), T_1 + 40 kg S/ha + 6.25 kg Zn/ha (T_2) and RDF (23.5:60:23.5 N:P_2O_5:K_2O kg/ha) (T_3) resulted in significantly lower seed yield of 5.94 g/plant.

The maximum seed index (8.50 g) of soybean was obtained in treatment 150% RDF + 40 kg S/ha + 6.25 Zn/ha (T_6) and minimum seed index (7.75 g) of soybean was obtained under control (T_9), but variation in seed index under all the treatments did not touch the level of significance (Table 3). Different treatments did not cause marked variation on seeds per pod in soybean as the statistical variations among the treatments were found to be non-significant

Biological and seed yield per hectare was significantly influenced by various treatments as presented in Table 4. Application of 150% of RDF along with 40 kg S and 6.25 kg Zn/ha (T_6) was influential in recording maximum biological (3400.50 kg/ha) and seed yield (1673.25 kg/ha) followed by 150% of RDF (T_5), T_7 + 40 kg S/ha + 6.25 kg Zn/ha (T_8) and STCR based NPK for 25 q/ha yield target (28.95:74.92:9.5 N:P_2O_5:K_2O kg/ha) (T_7). The minimum biological (2105 kg/ha) and seed yield (935.75 kg/ha) of was recorded under control (T_9).

The maximum straw yield (1727.25 kg/ha) was recorded with the application of 150% of RDF along with 40 kg S/ha and 6.25 kg Zn/ha (T_6) which was found at par with 150% of RDF (T_5). The minimum straw yield (1169.25 kg/ha) was recorded under control (T_9).

The harvest index is the economic (seed) yield expressed as the percentage of total biological (seed + straw) yield in terms of dry matter. The harvest index was significantly influenced by various treatments as presented in Table 4. However, the harvest index varied from 44.45 to 49.94 per cent. The maximum and minimum values of harvest index were registered with the treatment 50 kg DAP/ha (T_1) and control (T_9), respectively. This might be due to application of critical nutrients like sulphur and zinc along with NPK to soybean. The improvement in yield components might have resulted from favorable influence of fertilizers on the growth attributes. Pattanashetti *et al.* (2002), Singh *et al.* (2002), Srimathi *et al.* (2002) and Abraham and Lal (2003) also reported similar findings.

Table 3. Effect of various treatments on yield attributing characters

Treatments		Pods/ plant	Seeds/ pod	Seed yield (g/ plant)	Seed index (g)
T_1	Fertilizer dose as per farmers' practice (50 kg DAP/ha, i.e 9:23 N:P_2O_5 kg/ha)	24.62	3.18	6.30	7.76
T_2	T_1 + 40 kg S/ha + 6.25 kg Zn/ha	24.72	3.18	7.13	8.12
T_3	RDF (23.5:60:23.5 N:P_2O_5:K_2O kg/ha)	27.15	3.30	7.17	8.19
T_4	T_3 + 40 kg S/ha + 6.25 kg Zn/ha	29.35	3.40	7.96	8.37
T_5	150% of RDF	31.75	3.32	8.92	8.49
T_6	T_5 + 40 kg S/ha + 6.25 kg Zn/ha	32.10	3.33	10.03	8.50
T_7	STCR based NPK for 25 q/ha yield target (28.95:74.92:9.5 N:P_2O_5:K_2O kg/ha)	28.60	3.35	8.05	8.22
T_8	T_7 + 40 kg S/ha + 6.25 kg Zn/ha	29.72	3.36	8.12	8.45
T_9	Control	22.00	3.15	5.94	7.75
	SE (m) ±	1.61	0.06	0.50	0.19
	CD (at 5%)	4.69	NS	1.47	NS

Table 4. Effect of various treatments on biological, seed, straw yield and harvest index

Treatments		Biological yield (kg/ha)	Seed yield (kg/ha)	Straw yield (kg/ha)	Harvest Index
T_1	Fertilizer dose as per farmers' practice (50 kg DAP/ha, i.e 9:23 N:P_2O_5 kg/ha)	2705	1343.75	1369.25	49.94
T_2	T_1 + 40 kg S/ha + 6.25 kg Zn/ha	2854.5	1413.50	1441	49.38
T_3	RDF (23.5:60:23.5 N:P_2O_5:K_2O kg/ha)	3060.75	1501.50	1532	49.52
T_4	T_3 + 40 kg S/ha + 6.25 kg Zn/ha	3064.25	1528.75	1562.75	49.88
T_5	150% of RDF	3330.50	1615.25	1717.75	48.50
T_6	T_5 + 40 kg S/ha + 6.25 kg Zn/ha	3400.50	1673.25	1727.25	49.20
T_7	STCR based NPK for 25 q/ha yield target (28.95:74.92:9.5 N:P_2O_5:K_2O kg/ha)	3153	1573.25	1579.75	49.90
T_8	T_7 + 40 kg S/ha + 6.25 kg Zn/ha	3293	1596.75	1696.25	49.01
T_9	Control	2105	935.75	1169.25	44.45
	SE (m) ±	14.69	8.92	8.74	0.16
	CD (at 5%)	42.89	26.03	25.50	0.47

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ETHNO-BOTANY OF SOME USEFUL FOREST TREES OF NARENDRA NAGAR BLOCK, TEHRI GARHWAL (UTTARAKHAND), INDIA.

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Abstract : An ethno-botanical study was carried-out in order to document the folk uses of forest trees in the Narendra Nagar Block, District Tehri Garhwal, (Uttarakhand). The population of the region primarily depends upon plant resources for their domestic needs. A wide variety of tree species are present in the study area but this paper includes only those species whose common use is either known locally or they are in daily use for various purposes. Although the authors observed only 20 tree species are utilized for multiple purposes in the study area. Most of these tree species are also used for medicinal purposes. The informative data on ethno-botanical plants were conducted with the local inhabitants and selected informants. The ethno-medicinal data was gathered from the tribal medicine men, villagers and vaidhyas. Questionnaires were adopted during the surveys in order to get qualitative and participatory approach about the plant resources and their utilization by the local people. Questions concerning the utility of different plants, quantity of plants used, rate of consumption, availability, economics/ market value and fuel wood / fodder head loads had been asked.

Keywords : Ethno-botany, Forest, Trees, Tehri

INTRODUCTION

Ethno-botany, an area of human ecology, defines the interface between people and their forests, and offers clues needed for rural development based on sustainable yields of forest products (Thomas *et al.,* 1989). The importance of timber and other tree products from outside forests is interesting to increase attention, to help meet growing demands and reduce pressure on natural forests and plantations (Holding *et al*., 2001). Trees growing in open areas seem to have potentials to provide options for rural livelihoods and biodiversity conservation (Pasicznik *et al*., 2006). These trees can contribute to poverty mitigation serving as subsistence "safety nets" or low income "gap fillers". In addition to environmental stabilization, trees are useful for industrial, cultural, pharmaceutical, and socio-economic purposes to man, contributing billions of dollars yearly to the world's economy. Estimates have shown that about 90 percent of cooking and heating energy comes from trees (WWF, 1994). Traditional societies in Africa and elsewhere have always used plants to promote healing and traditional medicine is still the predominant means of health care in developing countries (Bussmann *et al*., 2006; Okali et al 2007). Trees growing in the open areas of this region can contribute to the wide-ranging needs of the local people. These trees are currently used in the region for multiple purposes such as honey production, food, dye, fibre, fodder, medicines, fuel wood, building materials and production of kitchen utensils. Some of these trees have support roles for sustainable agriculture, livestock production, and hunting activities while others have cultural, religious or judicial functions. Most of the activities of forest trees are to generate major income of local inhabitants. For example, collection and marketing of the wide range of non-timber products such as edible fruits, nuts, seeds and medicines. The barks of some trees are used to produce ropes, straps and traditional oil containers while the woods of some are often valued for fuel wood and furniture. While the knowledge on the usefulness of these plants remains high and lead to the high percentage of exploitation. Ethnobotanical studies have reported useful plant species in Garhawal Himalaya (Gaur, 1999), but no ethnobotanical surveys of trees in the area of Narendra Nagar block, Tehri Garhwal (Uttarakhand) have been carried out by earlier plant explorers. The purpose of this investigation was therefore, to document the uses of indigenous and cultivated species of forest trees growing in this block

MATERIAL AND METHOD

Study area

Garhwal Himalaya is famous for its natural assets, landform, water sedges, lush green forest and floristic diversity. The Large human populace with diverse life styles, beliefs, traditions and cultural heritage inhabiting Garhwal Himalaya has learnt to utilize natural resources and products in various ways. Tehri Garhwal is one of the hilly district of Uttrakhand state, India. It has nine (9) blocks. Out of these one of the botanically interesting block in the district Tehri Garhwal is Narendra Nagar which sustains unique and rich vegetation in wide range of habitats from Tarai- Bhabar tracts (275-1900m asl.) to the high range of lesser Himalaya. It lies in between 30 10'-30^0 17' N Latitude and 78^0 18'-78^0 30'ELongitude and covering in the area of 6,8123 hectors. It stretches from Dhalwala to Than, Amsera,

Jaikot, Gaja to Marora, Nigyer and Dhalwala to Kauriyala etc. Eight villages were investigated in this study (Dhalwala, Than, Amsera, Jaikot, Gaja, Marora, Nigyer, Dhalwala and Kauriyala). Semi-structured questionnaires were used to interview the local population about their ethnobotanical knowledge of trees.

Plant survey and Identification

Field surveys have been made during 2008–2011 to gather data on traditional uses of medicinal plants across various villages in the block. Personal interviews and inquiries were also conducted during field trips. Interviewees were chosen without distinction of gender after seeking the consent from each respondent. People from all age groups, except children below 18 years were interviewed on their knowledge about the uses of trees in this region. The random sampling technique was used and a total of 80 questionnaires were distributed out to 35 males and 45 females in the site of the study. Information regarding the different folk uses of trees, parts used, availability status, and vernacular names was recorded. Informants were asked to name trees they knew, and to reveal the uses of the respective species. Informants often accompanied the investigators to the field to collect plant material. In cases of illiterate informants, photographs and fresh plant specimens from the field were presented to them and questionnaires were filled from their responses. Information was also recorded on the medicinal use of trees, plant parts used, diseases treated, modes of preparation and administration (Table 1).

Table 1. Ethno-Botany of Some Useful Forest Trees of Narendra Nagar Blocks Tehri Garhwal (Uttarakhand), India.

Botanical name\Family	Local name	Status	Plant parts used and mode of administration
Trees			
Acacia catechu (L.f.) Willd. (Mimosaceae)	Khair	+++	Decoction of wood and bark is given in cough and inflammations of throat. It is given in diarrhea and applied on mouth sores. Wood is used locally for making agricultural tools and fuel wood. Sometimes leaves are used as fodder.
Acacia nilotica (L.) Willd.(Mimosaceae)	Kikar	++	Infusion of bark and leaves used in fever, bronchitis, asthma and dysentery. Wood is used locally for making agricultural tools and fuel wood. Leaves are used as fodder.
Aegle marmelos (L.) Correa (Rutaceae)	Bel	+	Decoction of root is given in fever, cough and hoarse throat. Fruit pulp useful in diarrhea, dysentery, stomach infection and bronchial inflammation.
Bombax ceiba L.	Semal	++	Gum from stem given in diarrhea, dysentery and leucorrhoea. Decoction of fruits is given in suppressed urination. Sometimes roots powder used in epilepsy.
Dendrocalamus strictus (Roxb,) Nees	Bans	++	Leaves are given to horses for curing cough and cold. Branches are used as building material, for making ladder, thatching huts, carts and pipes. The splits stem is woven into baskets and mats. Low cost fuel wood.
Ficus religiosa Roxb.	Peepal	++	Bark decoction is given in gonorrhea and scabies while fruit are edible, laxative and also given in infertilty. Leaves used in psychomedicine especially in snake bite
Grewia optiva J.R. Drummond ex Burret (Tiliaceae)	Bheemal	+++	Fruit is used in digestive disorders. Bark juice is given to women to facilitate delivery and used in shampoo. Leaves are used as fodder. Bark from branches is used for fiber and making ropes.
Juglans regia L. Juglandaceae	Akrot	+++	It is used in standard furniture, also used for carving. Bark is used for cleaning and sparkling teeth. Leaves are also used as lips make-up. Nuts can infect throat due to its oily nature. It has warm nature and can cause jaundice. It is also used as a dye. Decoction of leaves is given in eczema and

			intestinal worms.
Mallotus philippensis (Lam.) Muell.-Arg. (Euphorbiaceae)	Ruina	+++	Bark juice is given to children in diarrhea and dysentery. Paste of fruit powder is applied externally on cuts, wounds and also used in natural dye. It is used as fuel wood.
Melia azedarach L. (Meliaceae)	Dharik	++	Decoction of bark used in gonorrhea, bark paste is applied on skin eruptions. Infusion of heart wood is given in asthma. Leaves, fruits and seeds are useful in skin diseases.
Phyllanthus emblica L. (Euphorbiaceae)	Amla	++	Fruits are used in digestive disorders and fruit juice useful in leucorrhoea. Fruit powder is given in fever. Fruit is a best source of vitamin-C, hair oil, conditioner, shampoo, achnes, and mouth ulcer, quench thrust and mixed with Triphalla Churna (Seeds powder of *Terminellia bellirica* and Seeds powder of *T. chebula*).
Pinus roxburghii Sargent. (Pinaceae)	Chir	+++	Timber wood, fuelwood, used for making furniture, cones are used for burning and decoration purposes. It yields edible seeds. Needles are used for sheltering and for keeping fruits in crates. Resin of bark, locally known as "Jaula", is stimulant used in ulcer, snake bites, scorpion stings, skin diseases and blood purifier. Saw dust is used by barbars to warm water, it is also used for cleaning utensils.
Punica granatum L. (Punicaceae)	Darim	++	Leaves are used in skin diseases, dysentery. Fruit is astringent, cooling, blood purifier. Fruit pericarp is used for whooping cough, it is laxative. Seeds are dried and known as "anardana" which are condiments and used as spices. Bark of stem and root is anthelmintic, mouthwasher, antipyretic and expectorant.
Pyrus pashia Buch.-Ham. ex D. Don (Rosaceae)	Melu	++	Fruits are edible, astringent, febrifuge, sedative and laxative. Fuel wood. It serves as rootstock for grafting apple and pear. Honey bee species.
Quercus leucotrichophora A. Ca mus	Banj	+++	Stem used as best agricultural implements, gun buts and walking sticks, fuel. Leaves used as fodder. Seeds are sometimes edible, astringent and diuretic, used in diarrhea, indigestion and asthma. Children use seed cups as playing tops
Syzygium cumini (L.) Skeels (Myrtaceae)	Jamun	++	Stem used in making furniture. Root bark is given in cough. Fruit paste is applied on burns.Fruits are edible and best source of vitamins and minerrals. Rind chewed as Paan for curing the diabietes
Rhododendron arborium Smith (Ericaceae)	Burans	+++	Its wood is used as fuel. Flowers are ornamental and are sold in the market. Flower petals are used as heart tonic and are eaten by local people. Juice makes from petals (Burans Juice)
Terminalia alata Heyne ex Roth (Combretaceae)	Asin	+	Fruit powder used in dropsy, asthma, fever, cough and cold. Bark decoction is given in cough and headache
Terminalia bellirica (Gaertn.) Roxb. (Combretaceae)	Bahera	+	The dried fruits used in indigestion with honey. Fruit mixed with the ginger juice is taken in loss of appetite
Terminalia chebula Retz. (Combretaceae)	Hedera	+	The dried fruits used in indigestion with honey. Fruit mixed with the ginger juice is taken in loss of appetite. It is a product of triphala.

+++ (Very common), ++ (common), + (Uncommon)

RESULT AND DISCUSSION

A total of 20 tree species were recorded in this study and all of them were reported as being useful in the lives of the local populations. Many people in the villages are still depends on plants and plant products growing around them for most of their needs. The younger generations in this region are more interested in modern lifestyles but some indigenous knowledge of plants still remains. All of the species are utilized by the local people to improve their livelihoods. The population has to be educated on propagation and conservation of the plants especially those used to treat the most common ailments.

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MOLECULAR MARKERS: APPLICATION IN TREE IMPROVEMENT PROGRAMMES

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Abstract : A molecular marker is a nucleotide sequence corresponding to a particular physical location in the genome. Molecular markers are important tools for forest tree improvement. The most important markers are restriction fragment length polymorphisms (RFLPs), polymerase chain reaction- (PCR) based markers such as random amplified polymorphic DNA (RAPD), and fingerprinting markers. DNA markers can supplement isozyme markers for monitoring tree improvement activities such as estimating genetic diversity in breeding populations, germplasm identification, verifying controlled crosses, and estimating seed orchard efficiencies. Isozyme markers have been applied extensively during the past 15 years and have contributed significantly to tree breeding programs. Isozymes generally provide ample genetic information and are relatively inexpensive, rapid, and technically easy to apply, thus they should continue to play an important role in forest tree improvement.

Keywords : Molecular markers, RAPD, Tree improvement programmes

INTRODUCTION

The use of traits in plant as markers for their genetic relationship predates genetics itself. In the 18th century, Carl Linnaeus used the number and arrangement of plants sexual organs to determine their systematic relationship. Gregor Mendel derived his principles of inheritance by following visible traits in the progeny of sexual crosses, and the use of morphological markers has continued to the present day. Markers play an essential role today in the study of variability and diversity, in the construction of linkage maps, and in the diagnosis of individuals or lines carrying certain linked genes. Within this context, the limitations of morphological markers became quickly apparent. They tend to be restricted to relatively few traits, display a low degree of polymorphism, are often environmentally variable in their manifestation, and can depend on the expression of several unlinked genes. Furthermore, some may affect plant viability or seed set, distorting gene frequencies in the progeny. The emergence of marker systems has, for the last 30 years, closely tracked developments in biochemistry and molecular biology. Morphological markers were largely supplemented by biochemical markers, particularly isoenzymes that could be easily scored by electrophoresis (Ganapathy and Scandalios 1973; Tanksley 1983). The limitations of isoenzmyes as markers, in particular both the limited number of polymorphic enzymes that can be conveniently stained and the environmental effects on expression pattern, were apparent already twenty years ago (Tanksley 1983). The shortcomings drove the development of markers based on DNA polymorphisms. These marker types generate ‘‘fingerprints,’’ distinctive patterns of DNA fragments resolved by electrophoresis and detected by staining or labeling. A molecular marker is in essence a nucleotide sequence corresponding to a particular physical location in the genome. Its sequence needs to be polymorphic enough between plant accessions to allow its pattern of inheritance to be easily followed.

Genetic markers

A genetic marker is a measurable character that can detect variation in either a protein or DNA sequence. A difference, whether phenotypic or genotypic, may act as a genetic marker if it identifies characteristics of an individual’s genotype and/or phenotype, and if its inheritance can be followed through different generations. A genetic trait may not have necessarily observable consequences on an individual’s performance. Sometimes, however, this trait may be linked to, or correlated with, other traits that are more difficult to measure and do affect the individual’s performance. In such cases, these unobservable genetic traits may be used as genetic markers for the linked traits because they indirectly indicate the presence of the characteristics of interest. The two measures can be correlated, using an analysis of inheritance and studying the distribution of the characteristics in both parents and offspring. Molecular markers specially RAPD are being applied to a greater extent in forest trees to study genetic diversity and contributes about 25% of the total molecular markers (Fig. 1) used in forest biotech activities (FAO, 2004). Molecular markers assess variations in the nucleotide sequence of DNA of different individuals. Molecular markers are numerous and therefore a large genome can be easily assayed for existence of any variation, such genetic markers are easy to score. Use of molecular markers therefore provides an objective assessment of genetic diversity in a

plant species and enables unequivocal identification of elite genotypes.

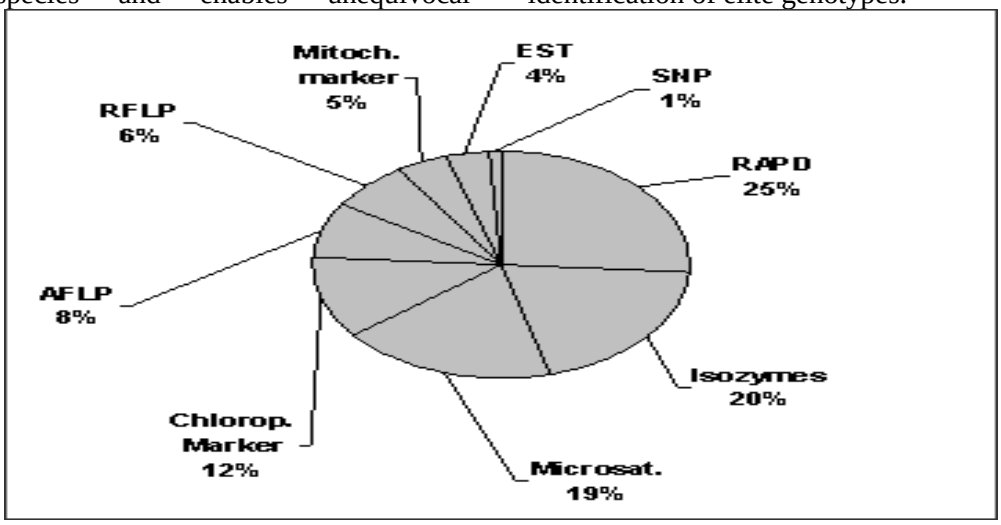

Fig 1: Distribution of molecular markers used in forest biotechnology activities

Types of Genetic markers

1. Morphological markers

Traditionally, diversity within and between populations was determined by assessing differences in morphology. These measures have the advantage of being readily available, do not require sophisticated equipment and are the most direct measure of phenotype, thus they are available for immediate use, an important attribute. However, morphological determinations need to be taken by an expert in the species, they are subject to changes due to environmental factors and may vary at different developmental stages and their number is limited.

2. Protein (biochemical) markers

To overcome the limitations of morphological traits, other markers have been developed at both the protein level (phenotype) and the DNA level (genotype). Protein markers are usually named biochemical markers' but, more and more; they are mistakenly considered as a common class under the so-called 'molecular markers'.

Protein markers (seed storage proteins and isozymes) are generated through electrophoresis, taking advantage of the migrational properties of proteins and enzymes, and revealed by histochemical stains specific to the enzymes being assayed.

Detecting polymorphisms i.e. detectable differences at a given marker occurring among individuals in protein markers is a technique that shares some of the advantages of using morphological ones. However, protein markers are also limited by being influenced by the environment and changes in different developmental stages. Even so, isozymes are a robust complement to the simple morphometric analysis of variation.

3. DNA (molecular) markers

DNA polymorphisms can be detected in nuclear and organelle DNA, which is found in mitochondria and chloroplasts. Molecular markers concern the DNA molecule itself and, as such, are considered to be objective measures of variation. They are not subject to environmental influences; tests can be carried out at any time during plant development; and, best of all, they have the potential of existing in unlimited numbers, covering the entire genome.

Classification of molecular markers based on the basic strategy

1. **Non PCR based approaches**
   - RFLP (Restriction fragment length polymorphism)
2. **PCR-based approaches**
   - RAPD (Random Amplified Polymorphic DNA)
   - SSR (Simple Sequence Repeat)
   - SCAR (Sequence characterized amplified regions)
   - CAPS (Cleaved amplified polymorphic sequence)
   - ISSR (Inter-simple sequence repeats)
   - AFLP (Amplified fragment length polymorphism)

DNA Sequencing

DNA sequencing is the most fundamental measure of diversity because it detects polymorphisms within the DNA's building blocks themselves. DNA sequencing is done by breaking the DNA into fragments, which are then subcloned. Each short piece is used as a template to generate a set of fragments that differ in length from each other by a single base. Fragments are separated by gel electrophoresis. The base at the end of each fragment is identified ('base-calling').

The original sequence of As, Ts, Cs and Gs is recreated for each short piece generated in the first step. The short sequences are assembled into one long sequence.

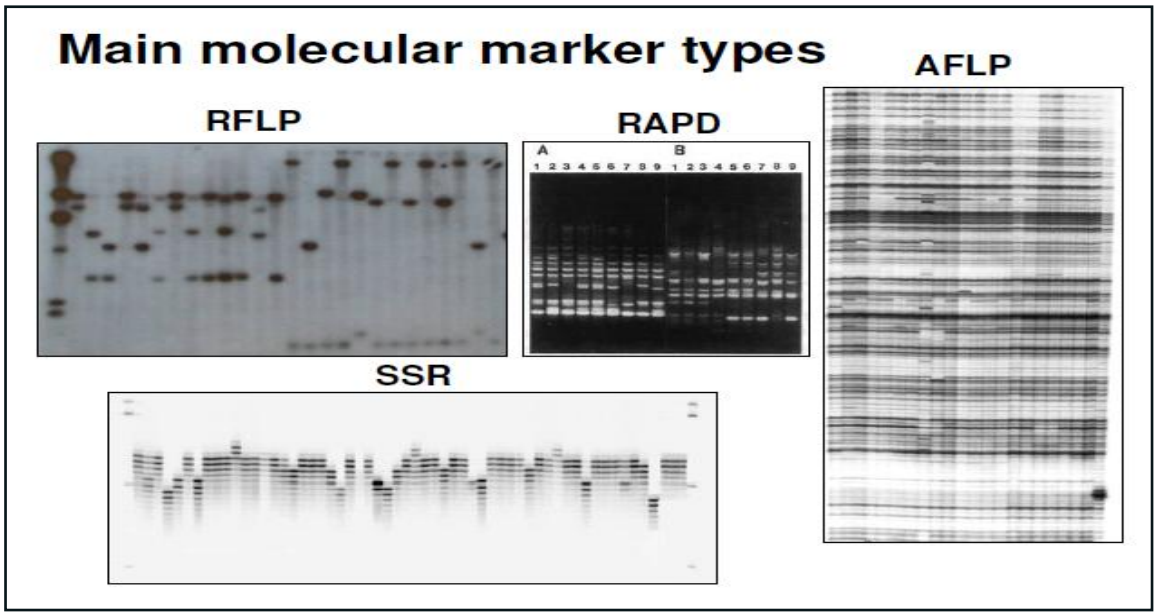

Fig: 2: Comparison of banding patterns generated by different markers

Application of molecular markers in forest tree improvement programmes

1. **Molecular markers for identification of subspecies: rapid PCR-based diagnostic test**
   Using five informative microsatellite markers and a Bayesian statistical approach, we developed an efficient polymerase chain reaction-based diagnostic tool for the rapid identification of individuals and populations of the *Acacia saligna* species complex of Western Australia. 189 individuals from 14 reference populations previously characterized based on morphology and used these data to investigate population structure in the species complex. High total genetic diversity (HT=0.729) and high population differentiation (¸=0.355) indicated strong intra- specific structuring. With the provision of prior population information, the reference data set was optimally resolved into four clusters, each corresponding to one of the four main proposed subspecies, with very high membership values (Q>97%). The reference data set was then used to assign individuals and test populations to one of the four subspecies. Assignment was unequivocal for all test individuals from two populations of subsp. *lindleyi* and for all but one individual of subsp. *stolonifera*. Individuals from populations of subsp. *saligna* and subsp. *pruinescens* showed a degree of genetic affinity for the two subspecies in their assignments, although the majority of individuals were correctly assigned to subspecies. The diagnostic tool will assist in characterizing populations of *A. saligna*, especially naturalized and invasive populations of unknown origin (Millar *et al*., 2008).

2. **Molecular markers for genome sequence of black cottonwood (*Populus trichocarpa*)**
   The genome sequence of *Populus trichocarpa* was screened for genes encoding cellulose synthases by using full-length cDNA sequences and ESTs previously identified in the tissue specific cDNA libraries of other poplars. The data obtained revealed 18 distinct CesA gene sequences in *P. trichocarpa*. The identified genes were grouped in seven gene pairs, one group of three sequences and one single gene. Evidence from gene expression studies of hybrid aspen suggests that both copies of at least one pair, CesA3-1 and CesA3-2, are actively transcribed. No sequences corresponding to the gene pair, CesA6-1 and CesA6-2, were found in Arabidopsis or hybrid aspen, while one homologous gene has been identified in the rice genome and an active transcript in *Populus tremuloides*. A phylogenetic analysis suggests that the CesA genes previously associated with secondary cell wall synthesis originate from a single ancestor gene and group in three distinct subgroups. The newly identified copies of CesA genes in *P. trichocarpa* give rise to a number of new questions concerning the mechanism of cellulose synthesis in trees (Djerbi *et al., 2005*).

3. **Genetic linkage map of european chestnut (*Castanea sativa* MILL.) based on RAPD, ISSR and isozyme markers**
   A genetic linkage map of European chestnut (*Castanea sativa* Mill.) based on RAPD, ISSR and isozyme markers was constructed using the two-way pseudo- testcross strategy. A total of 96 individuals from a F1 full-sib family were genotyped with 381 molecular markers (311 RAPDs, 65 ISSRs, 5 isozymes). Markers in

testcross configuration, segregating 1:1, were used to establish two separate maternal and paternal maps including 187 and 148 markers, respectively. The markers identified 12 linkage groups based on the haploid number of chestnut. The female and male framework maps reached a total length of 720 and 721 cM (Kosambi), respectively, representing a 76% and 68% coverage of the overall genome. A total of 46 markers, found in intercross configuration, segregating 3:1 and 1:2:1, were used to identify homologous linkage groups between parental maps; out of 12 linkage groups 11 could be joined. RAPD and ISSR markers showed a good and comparable reliability, allowing for the first time the establishment of a saturated linkage map for European chestnut. These maps will be a starting point for studies on the structure, evolution and function of the chestnut genome. Identification of QTLs for adaptive traits in chestnut will be the primary target (Casasoli *et al*., 2001).

4. **Molecular markers for testing genetic fidelity:**

More recently, molecular markers have also been used for testing the genetic fidelity during micropropagation/*ex situ* conservation on the one hand, and for characterization of plant genetic resources on the other. This aspect of the use of molecular markers has received attention in recent years due to the significance that is being attached to micropropagation of elite genotypes and to the *in situ* and *ex situ* conservation of plant genetic resources (PGRs). Molecular markers have particularly been suggested to be useful for confirmation of genetic fidelity in micropropagated tree species, where life span is quite long and performance of micropropagated plants could only be ascertained after their long juvenile stage in field conditions. a study on *Picea* the genetic integrity during somatic embryogenesis has been studied using RAPDs. In India also, an extensive study on genetic fidelity and molecular diagnostics in micropropagation systems was carried out where several molecular markers including RFLPs (using rDNA probes and mtDNA probes), RAPDs, MP-PCR and oligonucleotide in-gel hybridization were used in micropropagated clones of 4 tree species namely *Populus deltoides, Eucalyptus tereticornis, E. camaldulensis* and *Coffea Arabica*(Rani *et al* 1998*).* RFLPs (using nDNA and cpDNA probes) and RAPDs were also used for characterization and identification of genetic resources of perennial crops like *Musa* and to solve problems related to plant genetic diversity conservation (Bhat, 1997).

5. **DNA fingerprinting and classification of geographically related genotypes**

A reliable and reproducible method to detect RAPD and AP-PCR polymorphisms, using DNA from olive-tree (*Olea europaea* L.) leaves was developed. Starting from their natural orchards, fifty-six olive-tree cultivars throughout Málaga province, including oil and table olive cultivars, were screened and grouped into 22 varieties. A total of 62 informative polymorphic loci that provide 601 conspicuous bands were enough to differentiate the varieties. Clustering analyses managing 3 different pairwise distances, as well as phylogenetic analyses, led to the same result: olive-trees in Málaga can be divided into three main groups. Group I (90% of certainty) contains wild type and two introduced varieties, group II (83% of certainty) covers some native olive-trees, and group III (58% of certainty) is a heterogeneous cluster that includes varieties originating and cultivated in a number of Andalusian locations. Geographic location seems to be the first responsible of this classification, and morphological traits are needed to justify the group III subclustering (Claros *et al.*, 1997*).*

6. **Molecular markers for establishing distinctness in vegetatively propagated crops**

Distinctness, uniformity and stability (DUS) testing of varieties is usually required to apply for Plant Breeders' Rights. This exam is currently carried out using morphological traits, where the establishment of distinctness through a minimum distance is the key issue. The possibility of using microsatellite markers for establishing the minimum distance in a vegetatively propagated crop (grapevine) has been evaluated. A collection of 991 accessions have been studied with nine microsatellite markers and pair-wise compared, and the highest intra-variety distance and the lowest inter-variety distance determined. The collection included 489 diVerent genotypes, and synonyms and sports. Average values for number of alleles per locus (19), Polymorphic Information Content (0.764) and heterozygosities observed (0.773) and expected (0.785) indicated the high level of polymorphism existing in grapevine. The maximum intra-variety variability found was one allele between two accessions of the same variety, of a total of 3,171 pair-wise comparisons. The minimum inter-variety variability found was two alleles between two pairs of varieties, of a total of 119,316 pair-wise comparisons. In base to these results, the minimum distance required to set distinctness in grapevine with the nine microsatellite

markers used could be established in two alleles (Ibáñez *et al*., 2009).

7. **Molecular markers for ex situ conservation**
The enormous losses suffered by the European elms during recent Dutch elm disease outbreaks led to concern over the conservation of elm genetic resources, and the subsequent establishment of a series of ex situ collections. However, as ex situ collections are inevitably finite in size, some consideration needs to be given to selecting which samples to include in them. To contribute towards this process for European ex situ elm collections we have undertaken genetic studies on a Europe-wide sample of 535 individuals. A major aim has been to use genetic markers to clarify the identification of samples to ensure that the ex situ collections contain a representative spread of taxonomic diversity. This is important given the paucity of mature elms in the landscape due to Dutch elm disease. The lack of mature material (critical for identification) compounds identification problems in what was already a taxonomically difficult group. Our data (derived from random amplified polymorphic DNA and inter-simple sequence repeats) have provided a useful supplement to morphology in undertaking such sample identifications. The molecular data served to highlight mis-identified samples and led to extensive revisions of sample identities within individual countries. Our results were less useful in detecting regional intra-specific genetic structure, and do not provide sufficient information for prioritizing within-species sample selections (Copestake *et al*., 2005).

8. **Molecular markers for genetic variation and putative hybridization**
Genetic variability was estimated by enzyme electrophoresis in 239 Belgian clones from the *Salix alba-S, fragilis* complex. Most of the allozyme differentiation was between the species and less between the regions. The goal was mainly to estimate the size of a 'population' at the level of a location, and to identify possible hybrid populations (or with a relevant proportion of hybrid and introgressed individuals). Objective of this study further was to investigate as well the use of allozyme variation in *Salix* clones from the field in order to detect the amount and hierarchical distribution of the genetic diversity. This morphological complex suggested a high frequency of hybrids. The clones were pooled as a single coadapted species complex and secondly as belonging to either species, i.e. being *S. alba-like* or *S. fragilis-like.* The standard genetic variability measures showed higher values for the complex than for the separate species (Triest, 1999)

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STUDY OF PHYSICO-CHEMICAL AND BIOLOGICAL PROPERTIES OF GANGA WATER AT MISHERPUR(HARIDWAR) AND ITS IMPACT ON *CUCURBITA MAXIMA*

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Abstract : An experiment was conducted at Misherpur (Haridwar) during June 2010 . The water samples were collected from Misherpur (Haridwar) The parameter adopted for knowing the pollution load of samples were Colour , Odor, Temperature , D.O (Dissolve Oxygen) , B.O.D (Biochemical Oxygen Demand) , C.O.D (Chemical Oxygen Demand) , Ph , Nitrate , Nitrite ,T.D.S (Total Dissolve Solids) , T.S.S (Total Suspended Solids) , Amm Nitrogen , Total Nitrogen , Alkalinity , Hardness , Chloride , R-Cl (Residual Chlorene) , Turbidity , Metal , Tc (Total Coleform), Fc (Fecal Coleform) , Abundance of fungi and presence of Phyto-planktons. The *Cucurbita maxima* was selected for observing the effect of polluted water. The seven concentrations (0% ,10% ,20% ,40%, 60%, 80% 100%) were used to see their effect on germination and growth of plant .In the result 80% concentration was found more beneficial for plant growth and germination.

Keywords : *Cucurbita maxima*, Ganga water, Seed germination, Seedling growth

INTRODUCTION

The Ganga is most sacred river of the world. The people of India rely on Ganga for most life functions. Today over 29 cites and 70 town and thousands of village extended along the bank of Ganga. Nearly all their sewage which is nearly 1.3 billion liter per day goes directly into the river. Over the past century city population along the Ganga has grown at the tremendous rate while west control infrastructure has relatively unchanged. The ecosystem of river Ganga is one of the rich aquatic ecosystem in world Time to time many workers focked their study on it (Gaur Anupama etal., 2009 , Khana D.R., 2009 Gaur, A etal.,2010) . The present study has been conducted at Haridwar city. Haridwar is located in the foothills of shivalika (Himalya) . The river Ganga enters in Haridwar after flowing for 253 km fromits source at Gaumukha at the edge of Gangoteri glacier, enters into Indo- Gangatic plain of North India for first time in Haridwar. The position of Haridwar is 29^0 28'Nlatitude and $78^0$13' E longitude on the globe.The water quality of river Ganga is very good at Haridwar in the comparison of othe site of Indo- Gangatic plain , but at some place the pollution load in Ganga is very high and the site from where we collected samples was one of highly polluted site of Haridwar . It is only 1.5 km away from S.T.P plant of city. Plant receives much more domestic effluent then its capacity due to this region a big amount of treated and untreated effluent has been relished in to the stream of river Ganga named Nill Dhara . The domestic effluent is the main polluting agent of aquatic environment across the world (Sing A.k etel.,1985 Dubey Sujata etal.,2010) . The domestic effluent alsoaffects the various life function of plants at particular amount as reported by Bishnoi etal.,(1999) Qusim M.S etal., (2000) and Gupta Suman etal., (2003). Gupta Rudhera etal., (2005) and many others focused their study on the effect of various pollutants on plants. In.the present study *Cucurbita maxima* was selected to observe the effect of pollution on plant . *Cucurbita maxima* is most growing crop in Ganga basin and it is also the most edible crop of India, so that is the main region of selection of it as research plant . The seven test solution (0% ,10% ,20% ,40%, 60%, 80% 100%) were prepared by diluting the polluted water including blank for knowing the effect of polluted water on plant . The distilled water was used as controller and blank solution

The first step of study was done in Petri dishes, where we observe the effects of pollution on seeds germination . In the second step the plants were cultivated in plastic begs for a month. In this step the effects were observe on growth of plants.

MATERIAL AND METHOD

(a) Collection of Sample: - Water samples were collected from Misherpur (Haridwar) during 5^{th} of June2005 Monday 8.40 am. The water samples were collected in six B.O.D Bottles , 6 M.P.N Bottles and plastic cans. The samples were analyzed at the level of different parameters according to A.P.H.A 21th edition.

(b). Method Adopted for Study physicochemical and biological Properties:- -

Sr. No.	Test	Methods
1	Odour & Colour	Detected by naked eye and smelling (at site)
2	Temperature	Detected by digital thermometer
3	Ph	Detected by digital ph meter
4	D.O	Detected by titration with sodium thio-sulphate

5	B.O.D	Detected by titration method
6	C.O.D	Detected by open reflux method
7	T.D.S	Detected by evaporation (Dry weight)
8	T.S.S	Detected by evaporation (Dry weight)
9	Amm- N2	Detected by spectrophotometer (according A.P.H.A)
10	Electrical conductivity (E.C) – Detected by digital E.C meter	
11	Alkality	Detected by titration with H2So4
12	Hardness	Detected by titration with E.D.T.A
13	Chloride	Detected by titration with AgNo3
14	Total N2	Detected by T.K.N method
15	Nitrite	Detected by spectrophotometer (according A.P.H.A)
16	Nitrate	Detected by spectrophotometer (according A.P.H.A)
17	R-Cl	Detected by Ortho -Toluidine (at site)
18	Turbidity	Detected by digital turbidity meter
19	Metals	Detected by A.A.S
20	Tc, Fc -	Detected by Filter plating Technique
21	Phyto- plankton -	with the help of sedgwich rafter cell and wippel gride
22	Fungi -	Detected by using P.D.A media and preparing slide

(c) Germination experiment:-

Six test solutions (0%, 10%,20%,40%,60%,80%100%) prepared by diluting polluted water . The distilled water was used as controller. The germination test on *Cucurbita maxima* was conducted as per I.S.T.A (International rule of seedling testing annexure Annon .1985) method. According which healthy and undamaged seed of equal size were placed in sterilized Petri dish. The seed also covered by wetted tissue paper with different concentration polluted water. The measured amounts of test solutions were added in each Petri dish.

(d) Growth experiment:- The growth experiment was carried out in plastic bags during June 2009 Haridwar . Experiment setup consisted of 10 replicate beg per treatment and their were total seven treatments made by diluting samples with distilled water (0%,10%,20%,40%,60%,80%100%)

Plant growth and development were recorded through out the growing season through biweekly measurements. The leaf areas of third leaf of each plant were measure with the help of electronic leaf area meter at the end of one month.

RESULT AND DISCUSSION

Pollution Load and Water Quality of River

Because of high pollution load the Ganga water becomes brownish black in colour and the odour was also unpleasant. The temperature of water at this site was observed 19º C. This was 3ºC more then other clean area of Haridwar.

The enhancement in water temperature was due to bio-chemical reactions which were operating in water sample by microbes. The ph of water at the site was 7.8. It was also high, the main reason behind it that the domestic effluent contain big amount of detergent .The Electric Conductivity of sample was observed 553μhs.

It was high due to presence of big amount of free ions (presence of Co2 increases Electric Conductivity). B.O.D (Bio-chemical oxygen demand) of sample was 19 Ppm. It is high due to presence of large number of micro-organism as they operate many bio-chemical reactions which require oxygen.

C.O.D (Chemical Oxygen Demand) was also high because the domestic effluents contain big amount of different chemical. D.O (Dissolve Oxygen) of sample was 4.3 Ppm . It is very low due to high pollution in Ganga water.

Alkality of sample was 302 Ppm. It is high due to presence of high concentration of detergent and alkaline salt in sewer water. Hardness of water sample was 250 Ppm Nitrate was 1.5 Ppm and Nitrite was 1 Ppm. T.D.S was 500 mg/L and T.S.S was 75 mg/L these value are very high due to high concentration of sludge and solavel material. R-Cl was not detected in sample . Chloride was found 16 Ppm in water sample . It was due to natural presence of NaCl in sewage water.

Turbidity of water was 250 Ppm because water sample contain big amount of sewage water , which has many soluble material in it.

Total coliform , and fecal coliform was 2.6×10^6 and 1.2×10^6 as these bacteria found in fecal matters of human being . K, Na, Mn, Fe, Zn, were found in sample but Hg, Pb, Cd, Cr were not detected in sample .

Table 1: Physico -chemical Properties

Sr	Parameters	Value

1	Colour	Brownish black
2	Odour	Unpleasant
3	PH	7.8
4	B.O.D	19
5	C.O.D	57
6	D.O	4.3
7	T.D.S	500 mg/L
8	T.S.S	75 mg/L
9	Total N2	14 Ppm
10	Amm N2	39.45 Ppm
11	Alkalinity	300 Ppm
12	Nitrate	1.5 Ppm
13	Nitrite	1 Ppm
14	R-Cl	N-D
15	Chloride	16
17	Hardness	250 Ppm
18	Turbidity	250 Ppm
19	E.C	553 µhs
20	K	4.065 Ppm
21	Hg	B.D.L
22	Na	4.759 Ppm
23	Pb	N-D
24	Mn	.365 Ppm
25	Cd	N-D
26	Cr	N-D
27	Fe	.64759 Ppm
28	Zn	8.433Ppm

Biological properties

The micro organism are living catalysts which operates vast number of chemical reaction in water. The knowledge of relationship between organism and ecological factors can be used as an Indicator of pollution level of water as Panday G. N *et al.,* (1980) had revelved the role of micro flora in the assessment of pollution level of river Ganga. In the sample the 28 species of phytoplankton was found. The membre of class Chlorophyceae were found in highest number percentage in the samples of river water then other class of algae. Which was 43.3% of total number of plankton, it was followed by the member of Bacillariophyceae 38.8 % , Cynophyceae 9.7%. The member of class Euglenophyceae was found in lowest number in the samples 8.2 % of total number phytoplankton detected in the samples. A number of workers have reported many algal species as indicator of water pollution (Bilgrami K.S etal.,1985, Sikander .M 1987, Khana D.R *et al.,* 2009) . In the current study the occurrence of Occillatoria , Navicula and Euglena were indicating the higher degree of organic pollution. Which has been reported by Gadag etal.,(2005).

The fungi is the main component of aquatic ecosystem , It is naturally found in river water and domestic effluent Bilgrami K. S *et al.,* (1991). Curtis B.L.C (1920) gave a description on sewage fungi and its effect. The fungi is also considered as the bio indicator of pollution as the presence or absence of some species represent the different kind of pollution in the water fungi also show more tolerance from high concentration of pollutants reported by Blaudez *et al.,* (2000). Fungi cause many Sevier disease in plants and animals. The fungal genera Achlya, Saprolegnia, Isoachlya Aphanomyces , Dictycus , Pythim , Mucor, Ascobolus, Olpidlopsis, Phoma , Fusarium are the one of them they effect the health of plant by causing different disease in the different part of life cycle.

Coliform bacteria are a commonly used bacterial indicator of water pollution, although not an actual cause of disease. Other microorganisms sometimes found in surface waters which have caused human health problems include: (Tyagi, Sing A.K *et al.,* 1985)

High levels of pathogens may result from inadequately treated sewage discharges. This can be caused by a sewage plant designed with less than secondary treatment (more typical in less-developed countries). In developed countries, older cities with aging infrastructure may have leaky sewage collection systems (pipes, pumps, valves), which can cause sanitary sewer overflows. Some cities also have combined sewers, which may discharge untreated sewage during rain storms.

Pathogen discharges may also be caused by poorly managed livestock operations. The water samples contain a big number of T.C and F.C which exposed heavy pollution load on the river water at this site.

Bilgrami K.S *et al.,* 1985 and Sikander. M 1987 studied the relation between microorganism and

ecosystem of river Ganga. The number of microbes (Algae, Fungi, Bacteria) are increase with pollution level.

Table 2:

Sr	Name of phytoplankton	N.o of Units
1	Cynophyta-	
	a. Ocillatoria	4
	b. Anabaena	2
	c. Microcystis	3
	d. Coelospaeriumum	2
	e. Phormidium	4
2	Chlorophyta –	
	a. Hydrodictyon	5
	b. Cladophora	3
	c. Spirogyra	8
	d. Stigeoclonium	9
	e. Chlamydomonas	5
	f. Oedogonium	3
	g. Pandoria	4
	h. Eudorina	3
	i. Pediastrum	2
	j. Synura	15
	k. Scendesmus	3
	l. Chlorella	2
	m. Scenedesmus	8
3	Bacillario phyta –	
	a. Navicula	10
	b. Fragillarioa	7
	c. Synedra	6
	d. Pinnularia	6
	e. Denticula	8
	f. Diatoma	7
	g. Melosira	11
	h. Nitzschia	5
4	Euglenophyceae	7
	a. Euglena	6
	b. Phacus	157
	Total Units	

Table 3:

Sr	Name of Fungi	Present/ Absent
1	Achlya	+
2	Saprolegnia	+
3	Isoachlya	-
4	Apanomyces	+
5	Dictychus	-
6	Pythium	+
7	Mucor	+
8	Ascobolus	+
9	Olpidiopsis	-
10	Phoma	+
11	Fusarium	+

Population of T.C and F.C –

Table 4:

Sr	T.C	F.C
	2.6×10^6	1.2×10^6

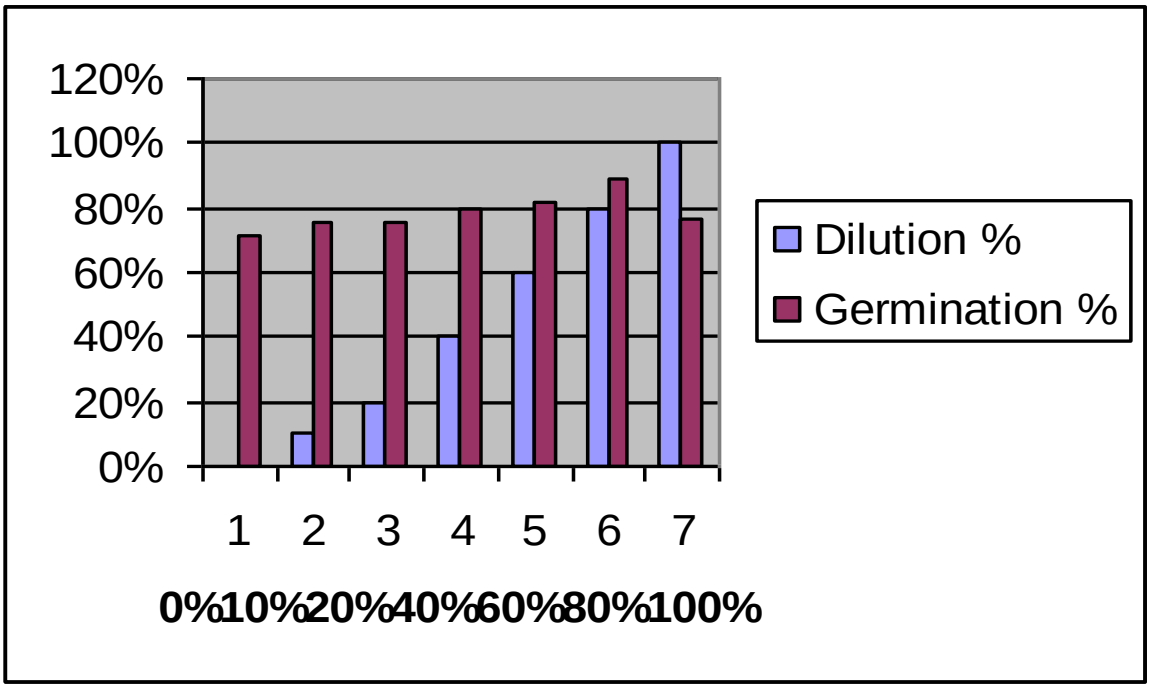
Germination and Plant Growth : Initially the germination percentage was increasing with the concentration of test solution. It shows maximum growth on 80% concentration of test solution. But at

full strength of test solution the germination percentage suddenly got retire.

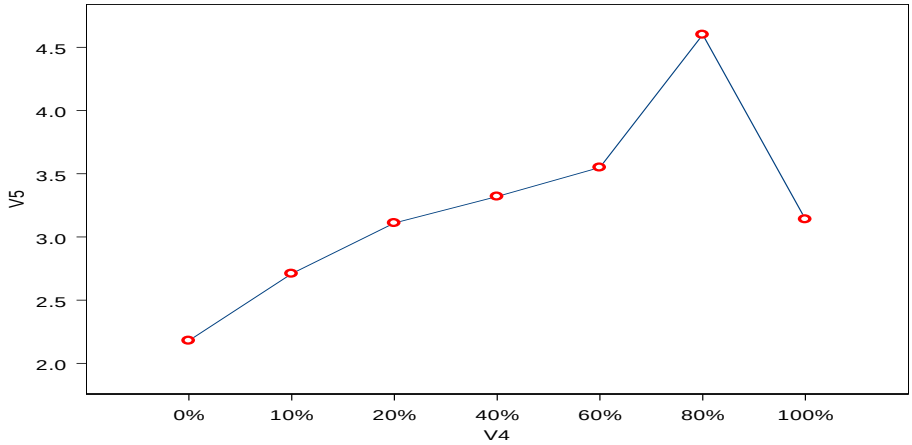
The growth of radicle and plumule significantly increase with the concentration till 80% and suddenly get degreed at 100%. The 2 week and 4 week mature plants root and shoots also followed this pattern. The leaf area (3ed leaf) of one month mature plants leaf was found maximum at 80% concentration as defining in table 5. This study revolved that the domestic effluent contains such of many substances which are very helpful in the growth and germination of plant at particular percentage, with these beneficial substances effluent also has many substances which work as growth inhibitor and also starts affecting the plant at high concentration as reported by Qusim M.S *et al.*, (2000). There 100 % was that concentration where all growth inhibiter (Microbes, Detergent and metal) show high per activation. In other hand 80% concentration of sample was found more beneficial than other concentration of samples.

Table 5 :

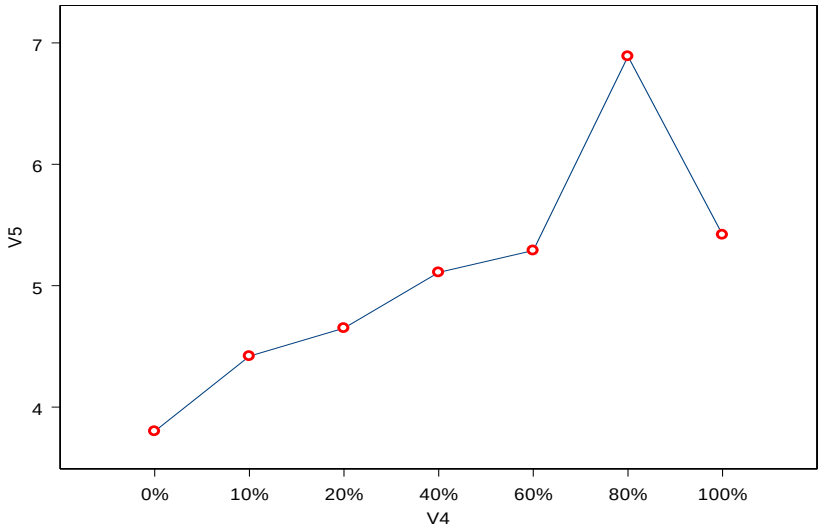
Concentration	Germination	1week Radicle	1week Plumule	Shoot length 2 week	Shoot length 4 week	Root length 2 week	Root length 4 week	Leaf aria of 3ed leaf
0%	71% ±0.2	2.18 ±0.01	3.80 ±0.04	11.64 ±0.02	45.65 ±0.8	3.42 ±0.2	4.50±0.3	324.3 ±3.0
10%	76% ±0.3	2.71 ±0.01	4.42 ±0.01	12.10 ±0.3	46.48 ±0.9	3.65 ±0.07	4.95±0.5	390.0 ±2.9
20%	76% ±0.3	3.11 ±0.1	4.65 ±0.3	12.35 ±0.4	48.15 ±0.6	4.13 ±0.3	5.30±0.2	440.5 ±2.9
40%	80% ±0.3	3.32 ±0.01	5.11 ±0.01	13.26 ±0.3	48.79 ±0.8	4.50 ±0.2	5.75±0.3	455.7 ±3.3
60%	82% ±0.2	3.55 ±0.01	5.29 ±0.01	13.75 ±0.3	49.25 ±1.0	4.90 ±0.3	6.32±0.3	503.2 ±4.0
80%	89% ±0.1	4.60 ±0.01	6.89 ±0.01	17.35 ±0.4	55.14 ±0.7	5.32 ±0.3	7.80±0.2	667.8 ±5.3
100%	77% ±0.3	3.41 ±0.1	5.42 ±0.01	14.22 ±0.5	50.21 ±0.6	5.13 ±0..3	6.28±0.3	536.4 ±5.7



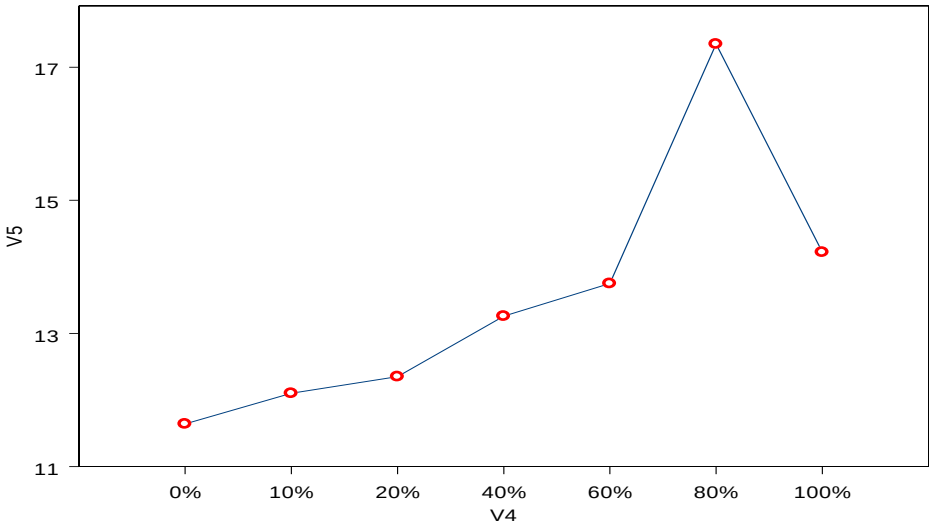
Graph of Germination



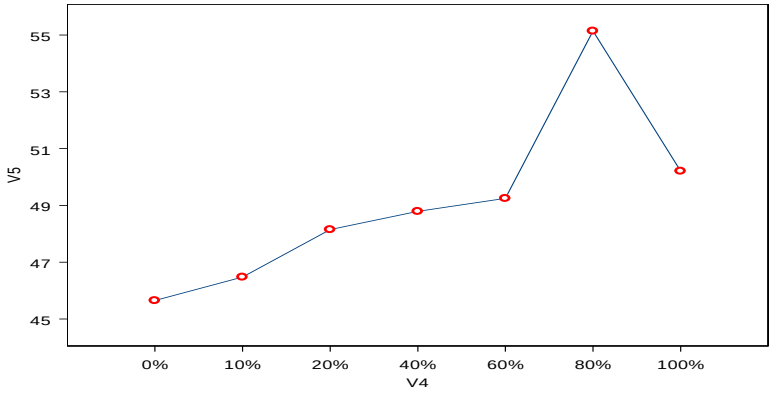
Graph of Radicle



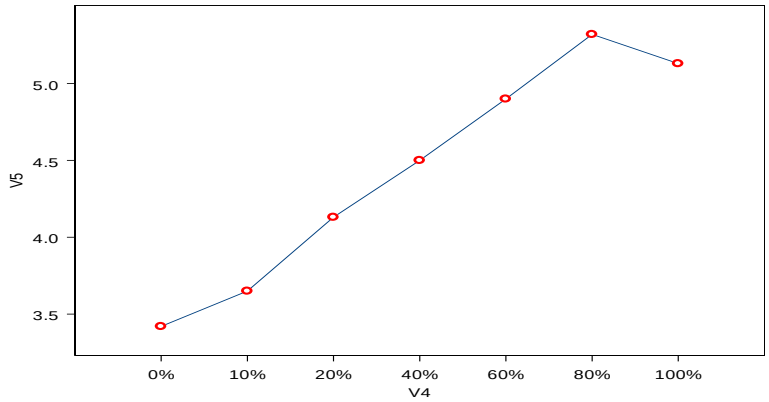
Graph of Plumule



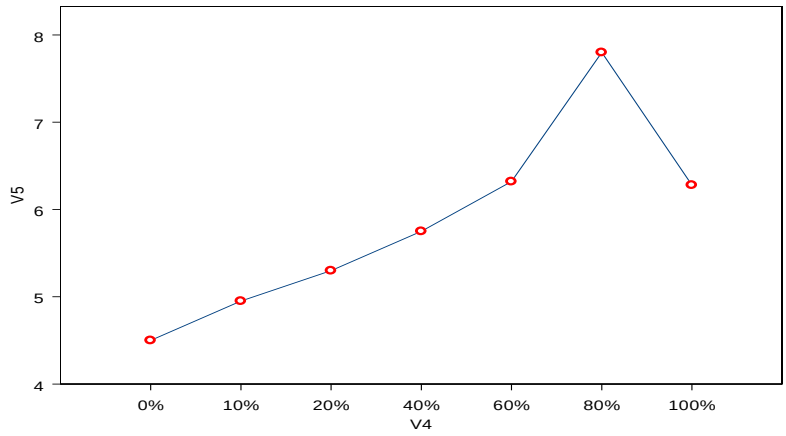
Graph of Shoot length(2week)



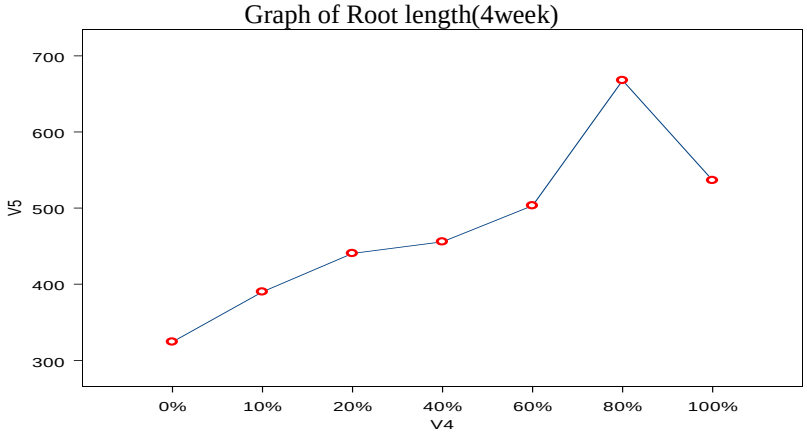
Graph of Shoot Length(4week)



Graph of Root length(2week)



Graph of Root length(4week)



Graph of Leaf Area(4week)

CONCLUSION

The water of river Ganga at this site received a big amount of domestic effluent as described before so the quality of water samples was very poor as the colour of samples was brownish black . The result of this study demonstrates the germination was significantly low at full strength treatment than 80% concentration. The root length, shoot length of 2weeks and 4 weeks mature plants also follow above pattern of growth. The leaf area (3ed leaf) of plants which was treated with 80% concentration test solution was maximum. In the conclusion we can say the dilute concentration (80%) was found more beneficial than full strength

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IMPACT OF ATMA ON CROP PRODUCTIVITY AMONG TRIBALS OF CHHATTISGARH

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Abstract : The present study was carried out during 2011 in the Surguja district of Chhattisgarh state. This study was conducted in randomly selected 10 villages of three purposively selected blocks i.e. Ambikapur, Lundra, Surajpur located in Surguja district. The aim of this study to assess the impact of ATMA on crop productivity among tribals of Chhattisgarh. A total of 150 respondents including 100 beneficiary and 50 non-beneficiary farmers were selected randomly. The data collection was done by the use of interview schedule through personal interview. Data were analyzed with help of suitable statistical tools. The findings reveal that Out of the total cropped area, 91.92 per cent area of beneficiaries and 96.28 per cent area of non-beneficiaries were found under rice crop. The majority of ATMA beneficiaries (86%) were sold their agricultural produces to local shopkeepers. The major crops area of ATMA beneficiaries were subsequently increased in others crops 90 per cent.

Keywords : ATMA, Crop productivity, Tribals

INTRODUCTION

Agriculture is the only sector where the production has increased four fold since independence from 51 million tonnes in 1950-51 to 209 million tonnes in 2000-01 against as three fold increase in population. Rapid growth of agriculture is essential not only to achieve self-sustenance at national level but also for food, nutrition and environmental security (Sengar *et al.*, 2008).

The concept of ATMA was introduced in 1999 as an autonomous organization under the National Agricultural Technology Project (NATP) by providing flexible working environment with an objective of integrating research, extension and all other stake holders at the district level to support the farmer's needs and interest through an integrated approach of strategic plan. ATMA is a society of Key stake holders involved in agricultural activities for sustainable agricultural development in the district. Involvement of farmers can be achieved at the village level through farmer's interest groups (FIGS) at the block level as a member of farmer advisory committee (FAC) and at district level as the member of ATMA Governing Board. As a registered society ATMA is responsible for technology dissemination at the district level. The concept of ATMA envisages paradigm shift from "top down" to "bottom up" in planning and implementation of agriculture development programmes (Satya Prakash and Dipak De, 2008). The scientific study of technology transfer system is essential for making the future programme more effective. Keeping this in view the present study was under taken to study the impact of ATMA on crop productivity among tribals of Chhattisgarh.

MATERIAL AND METHOD

This study was conducted in Surguja district of Chhattisgarh, during the year 2011. At the time study Chhattisgarh state had 18 districts out of which Surguja district was selected purposively because this district has got highest fund for the ATMA programme. From this district only three blocks i.e., Ambikapur, Lundra and Surajpur were selected purposively. From each selected block out of total villages, only 14 villages in Ambikapur, 12 villages in Lundra and 15 villlages in Surajpur block have been selected by Government of Chhattisgarh for carrying out the various activities under ATMA programme. Out of these beneficiary villages, only 25 per cent villages in each block i.e. Rakeli, Darima, Nawanagar (Ambikapur), Lamgaon, Kot, Dorna (Lundra), Ajirama, Kalyanpur, Dwrikanagar and Jagatpur (Surajpur) were randomly selected (Total 10 villages) for the study. From each Farmers Interest Groups 10 tribal farmers were randomly selected those were beneficiaries of ATMA programme from each selected village as respondent. In this way, 30 farmers from Anbikapur, 30 farmers from Lundra and 40 farmers from Surjupur (30+30+40=100 beneficiary farmers) were selected to determine the impact of ATMA on crop productivity among tribals of Chhattisgarh. The 5 non-beneficiary farmers were also selected from same village as non-beneficiary respondents (15+15+20=50). Thus, total of 150 (100 beneficiaries and 50 non-beneficiaries) farmers were selected as respondents for the present study. Respondents were interviewed through personal interview. Prior to interview, respondents were taken in to confidence by revealing the actual purpose of the study and full care was taken in to consideration to develop good rapport with them. For the data collection well designed and pre-tested interview scheduled were used. Collected data were analyzed by the help of various statistical tools i.e. frequency, percentage, mean and standard deviation, etc.

RESULT AND DISCUSSION

Major crops and their area

Table 1: Distribution of respondents according to major crops grown along with their area

Crops	Beneficiary (n=100)			Non-beneficiary (n=50)		
	Number of farmers	Area		Number of farmers	Area	
		acre	%		acre	%
Kharif						
• Paddy	96	279.16	91.92	49	149.00	96.28
• Arhar	9	3.17	1.04	9	2.25	1.45
• Urd	5	2.30	0.78	3	0.85	0.54
• Sugarcane	9	14.29	4.70	2	1.50	0.98
• Others	12	4.75	1.56	3	1.15	0.75
Total cropped area		**303.67**			**154.75**	
Rabi						
• Wheat	62	110.35	58.70	32	54.00	48.32
• Sugarcane	15	15.52	8.27	7	7.75	6.93
• Lathyrus	12	19.00	10.10	6	17.00	15.21
• Gram	5	7.75	4.13	4	5.00	4.47
• Paddy	9	14.50	7.71	7	15.50	13.88
• Others	33	20.85	11.09	13	12.50	11.19
Total cropped area		**187.97**			**111.75**	

The data given in Table 1 indicates that in kharif season all the respondents were growing rice crops. Out of the total cropped area, 91.92 per cent area of beneficiaries and 96.28 per cent area of non-beneficiaries were found under rice crop. In addition to rice, 1.04, 0.78 and 4.70 per cent cropped area of beneficiary respondents was found under arhar, urd and sugarcane crops, respectively and remaining 1.56 per cent cropped area was found under other crops like vegetable, maize etc. Similarly, in case of non-beneficiaries 1.45, 0.54 and 0.98 per cent cropped area was found under arhar, urd and sugarcane crops, respectively and 0.75 per cent cropped area was found under other crops.

In rabi season, wheat was found as the most important crop cultivated on about 58.70 and 48.32 per cent cropped area of beneficiary and non-beneficiary respondents, respectively. Out of the total cropped area in rabi season, 8.27, 10.10, 4.13 and 7.71 per cent cropped area of beneficiaries were found under sugarcane, lathyrus, gram and paddy crops, respectively and remaining 20.85 per cent cropped area was found under other crops like vegetables. In case of non-beneficiary respondents 15.21 per cent cropped area was found under lathyrus crops followed by 13.88 per cent cropped area was paddy, others crop (11.19%) area, sugarcane (6.93%) area and 4.47 per cent cropped area was found under gram. The total rabi area of non-beneficiaries was far behind than the rabi area of ATMA beneficiaries may be due to non-availability of irrigation.

Marketing of agriculture produces

Distributions of the respondents according to their marketing of agriculture produces were presented in the Table 2. Before the ATMA programme was launched at the study area is 2004-05, the majority of ATMA beneficiaries (86%) were sold their agricultural produces to local shopkeepers, followed by merchant (83%), other (36%), mandi (3%) and only 1 per cent is unsure. After initiating the ATMA programme in 2010-11 sold their agriculture produce by the beneficiaries of the farmers to the co-operative society i.e. 79 per cent, followed by 55 per cent merchant, 39 per cent local shopkeepers, 28 per cent other, 8 per cent unsure and only 7 per cent were sold their agricultural produce in mandi.

Table 2: Distribution of the respondents according to their marketing of agriculture produce

Marketing of agriculture produce	Beneficiary (n=100)				Non-beneficiary (n=50)			
	2004-05		2010-11		2004-05		2010-11	
	F	%	F	%	F	%	F	%
• Merchant	83	83	55	55	48	96	29	58
• Local shopkeepers	86	86	39	39	46	92	19	38
• Mandi	3	3	7	7	2	4	3	6
• Co-operative society	0	0	79	79	0	0	31	62

• Un sure	1	1	8	8	1	1	2	4
• Others	36	36	28	28	6	12	8	16

F – Frequency, %- Per cent

In case of non-beneficiary respondents regarding marketing of agricultural produce the majority of respondents (96%) sold to merchant, followed by 92 per cent local shopkeepers, 12 per cent others, 4 per cent in mandi and 1 per cent were unsure marketing of agricultural produces in 2004-05. The majority of 62 per cent non-beneficiaries were sold their agriculture produce in co-operative society, followed by 58 per cent merchant, 38 per cent local shopkeepers, 16 per cent others, 6 per cent in mandi and 4 per cent were unsure for marketing of agricultural produces in the present year 2010-11.

It could be concluded from above data, before ATMA programme respondents were sold of agricultural produce to merchant, local shopkeeper and after ATMA programme selling of agricultural produce in co-operative society. Some respondents were selling of agricultural produce in others like local market, Kerta sugar factory etc. It appears that ATMA programme has considerable impact in the knowledge of market linkage of the ATMA beneficiaries, which ascertain the good selling of cost of the ATMA beneficiaries.

Impact of ATMA programme on area of various crops

The data given in Table 3 indicates that in kharif season all the respondents were growing rice crop. After initiating the ATMA programme in selected villages the total cropped area is increased in both kind of respondents beneficiaries (2.08%) and non-beneficiaries (1.67%) over the 2004-05 to 2010-11. The major crops area of ATMA beneficiaries were subsequently increased in others crops 90 per cent, followed by arhar (24.31%), sugarcane (24.26%), urd (1.76%) and paddy 0.18 per cent area were increased. Whereas, in case of non-beneficiaries others crops area were increased 130.00 per cent, followed by sugarcane (50.00%), arhar (32.35%), paddy (0.57%) and no change observed in urd crop area over the 2004-05 to 2010-11.

As for rabi season, the total cropped area is increased in both the respondents beneficiaries (98.34%) as compared to non-beneficiaries (83.95%) over the 2004-05 to 2010-11. The paddy area is slightly increased in beneficiaries 360.31 per cent, followed by wheat area (157.52%), sugarcane (93.51%), gram (55.00%), others crop area (36.72%) and lathyrus is (-7.31%) slightly decreased. Whereas, in case of non-beneficiaries wheat area is slightly increased 227.27 per cent, followed by other crops area (72.41%), gram (66.66%), sugarcane and paddy (55.00%) and lathyrus is (-10.52%) slightly decreased over the 2004-05 to 2010-11.

Table 3: Impact of ATMA on crop diversification in Surguja district of (C.G.)

Heads	**Beneficiaries (n=100)**			**Non-beneficiaries (n=50)**		
	2004-05	**2010-11**	**% change**	**2004-05**	**2010-11**	**% change**
Crop diversification (in acre)						
Kharif						
• Paddy	278.65	279.16	0.18	148.15	149.00	0.57
• Arhar	2.55	3.17	24.31	1.70	2.25	32.35
• Urd	2.26	2.30	1.76	0.85	0.85	0.00
• Sugarcane	11.50	14.29	24.26	1.00	1.50	50.00
• Others	2.50	4.75	90.00	0.50	1.15	130.00
Total cropped area	**297.46**	**303.67**	**2.08**	**152.2**	**154.75**	**1.67**
Rabi						
• Wheat	42.85	110.35	157.52	16.50	54.00	227.27
• Sugarcane	8.02	15.52	93.51	5.00	7.75	55.00
• Lathyrus	20.50	19.00	-7.31	19.00	17.00	-10.52

• Gram	5.00	7.75	55.00	3.00	5.00	66.66
• Paddy	3.15	14.50	360.31	10.00	15.50	55.00
• Others	15.25	20.85	36.72	7.25	12.50	72.41
Total cropped area	**94.77**	**187.97**	**98.34**	**60.75**	**111.75**	**83.95**

Impact of ATMA programme on productivity of various crops

The productivity of crops is given in Table 4. After ATMA programme launched at selected area it has been observed that productivity of the crop is also increased i.e. paddy 44.59 per cent, followed by sugarcane (39.32%), urd (14.85%) and arhar 1.86 per cent. Same way it was observed that non-beneficiary farmers production and productivity of the crop is adequately increased i.e. sugarcane 38.88 per cent, followed by paddy (32.35%), arhar (16.66%) and urd 6.10 per cent increased in kharif season.

Table 4: Impact of ATMA programme on crop productivity (q acre^{-1})

Crops	Beneficiaries (n=100)		% Change	Non-beneficiaries (n=50)		% Change
	2004-05	2010-11		2004-05	2010-11	
Kharif						
Paddy	11.01	15.92	44.59	11.93	15.79	32.35
Arhar	1.37	1.56	13.86	1.56	1.82	16.66
Urd	1.01	1.16	14.85	1.31	1.39	6.10
Sugarcane	230.86	321.65	39.32	240.00	333.33	38.88
Rabi						
Wheat	6.18	7.78	25.88	6.42	7.03	9.50
Sugarcane	240.38	345.16	43.58	285	332.21	16.56
Lathyrus	1.09	1.24	13.36	1.16	1.36	17.24
Gram	2.19	3.13	42.92	2.32	3.19	37.5
Paddy	13.9	17.45	25.53	14.14	18.7	32.24

In rabi season sugarcane crop productivity is substantially increased in ATMA beneficiaries 43.58 per cent, followed by gram (42.92%), in wheat (25.88%), paddy (25.53%) and lathyrus 13.36 per cent productivity increased. In case of non-beneficiaries garm crop productivity is increased 37.50 per cent followed by paddy (32.24%), in lathyrus (17.24%), sugarcane (16.56%) and wheat crop productivity is 9.50 per cent increased over the 2004-05 to 2010-11. This indicated that productivity was increased by the adoption of hybrid rice varieties through ATMA programme. It appears that there is positive impact of ATMA on productivity of various crops. It is evident from the result that there is positive and good impact found in ATMA beneficiaries in terms of increasing the area and increasing the productivity. The reason might be through ATMA programme give the training, demonstration and visit about various improved agronomic practices and new technology to the farmers for enhancing the crop production and productivity.

CONCLUSION

It concluded from the results that after initiating the ATMA programme in selected villages the total cropped area is increased in both kinds of respondents beneficiaries (2.08%) and non-beneficiaries (1.67%) over the 2004-05 to 2010-11 and at selected area it has been also observed that productivity of the crop is also increased i.e. paddy 44.59 per cent, followed by sugarcane, urd and arhar, respectively. In rabi season sugarcane crop productivity is substantially increased in ATMA beneficiaries 43.58 per cent.

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IMPACT ASSESSMENT OF INTEGRATED PLANT NUTRIENT MANAGEMENT IN BRINJAL (*SOLANUM MELONGENA* L.), THROUGH FARMERS PARTICIPATORY APPROACH

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Abstract : Adoptive experiments on the integrated plant nutrient management (IPNM) with farmer's participatory approach were conducted during Rabi 2008 and Rabi 2009 by Krishi Vigyan Kendra, Chandauli at farmer's field in two villages to assess the technological gap in Brinjal production and potential. Eight numbers of technological gaps including application of fertilizers and pesticides for commercial Brinjal production were identified. The package of IPNM includes application of 10 tons FYM ha^{-1} + 150:80:60 kg ha^{-1} NPK respectively +Soil application of Azospirillum biofertilizers @ 10kg ha^{-1} + foliar spray of Zn and Bo@ 50 ppm at 30, 45 and 75 days after transplanting were applied at farmers field. Findings of experiment revealed that maximum marketable fruit yield 404 q ha^{-1} in Rabi 2008 and 390 q ha^{-1} in rabi 2009 were obtained from IPNM plots and subsequently 25.72 and 24.00 per cent increase in total yield were recorded over farmers practice in respective seasons. The per cent loss of yield from total production due to diseased and inferior quality fruits were observed nearly double (13.07 & 12.00) in farmer practice when compared with IPNM plot (7.67 & 7.17%) respectively. Partial budget analysis revealed that the net returns obtained from IPNM plot in Rabi 2008 and Rabi 2009 were higher i.e. Rs. 1, 24,110 and Rs. 1, 16,114 respectively than the farmers practice (Rs. 76,740 and Rs. 71,235) in respective years. Reduction in cost of cultivation of Rs. 8,170 and Rs. 8,879 were also reported in IPNM plot in comparison with farmers practice . B:C ratio were found maximum 4.25 in Rabi 2008 and 4.23 in Kharif 2009 respectively in IPNM plot, whereas , in farmers practices it were 2.98 and 2.82 in respective seasons. Minimization in hazardous use of pesticide was also appreciated.

Keywords : Brinjal, IPNM, OFT, Participatory approach

INTRODUCTION

Brinjal is one of the most important vegetable widely grown in all over the country due to its wide adoptability and versatility. The fruits of brinjal are an excellent remedy for those suffering from liver disorders. White brinjal is well known medicinal use in blood sugar control (Varmudy, 2011). Processing of brinjal as prickles and in form of chilled brinjal for export purpose opened door to generate employments for rural people. Being a remunerative cash crop its commercial cultivation is widely adopted by progressive farmers in an area of 0.612 million hectares with production 10.563 million tones and productivity in India is 17.3 t ha^{-1} (NHB database, 2010). Cultivation of brinjal in eastern plain region of U.P. is followed commercially round the year, but productivity is very low (13.9 mt ha^{-1}) as compared to national average (NHB database 2010).

Intensive cultivation of brinjal in peri urban areas of Chandauli district is very common as it is an important segment of famous traditional dish "Bati-Chokha" in eastern U.P. and is in continuous demand and market opportunity in Varanasi city. This is resulted in decline in soil fertility due to depletion of plant nutrients in larger quantity as Brinjal is heavy nutrient feeder. Unawareness and injudicious use of chemical fertilizers by the farmers for harvesting higher yield not only created imbalances in buffer stock of soil nutrients but adversely affect the plant growth and development with inviting severe attack of disease and pest. Injudicious use of chemical pesticide to control pest and diseases also causes environmental disturbances as well. Seeking the problems, emphases on balanced nutrients management were made through trainings and Gosthi but the farming communities were not very aware about the technologies. The major reasons of non adoption of these technologies are non participation of farmers in technology development, assessment and demonstration.

Keeping the problems into considerations adoptive trials on integrated plant nutrient management (IPNM) in brinjal were conducted after specifying the location specific needs with the active participation of farmers. The module of IPNM on tomato given by IIVR Varanasi (Nirmal de *et al.* 2004) adopted after small modification accordingly.

METHODOLOGY

The On Farm Testing (OFT) on IPNM in brinjal was carried out by Krishi Vigyan Kendra Chandauli (U.P.) during Rabi, 2008 and Rabi, 2009 at the five farmer's field in two villages i.e. Kanta Vishunpura and Rema in Chandauli district. Technological gap between improved management package and farmers practices were studied based on survey and group discussion with farmers interactive group (FIG) of brinjal growers in the selected villages. The brinjal growers of these villages had small land holdings. The total numbers of farmers were 100. Out of these 20 farmers were selected randomly from selected villages and discussion were made on eight improved management package to study the technological gap. A list of constraints experienced by farmers was prepared and shortlisted. It was observed that majority of problems were directly or indirectly related with use of imbalanced fertilizer applications.

IPNM module given by IIVR, Varanasi viz. 5 tons press mud + 120:60:60 kg ha^{-1}NPK + Application of Azospirillum biofertilizers @ 10kg ha^{-1}. + foliar spray of Zn and Bo @ 50 ppm at 30, 45 and 75 days after transplanting was modified on the basis of soil testing report and availability of organic matter and fertilizers. Finally module of IPNM was designed with the active participation of selected farmers as 10 tons FYM + 150 :80:60 kg ha^{-1} NPK +Soil application of Azospirillum biofertilizers @ 10kg ha^{-1} + foliar spray of Zn and Bo @ 50 ppm at 30, 45 and 75 days after transplanting and assessed at selected farmers field. All the participants raised their nurseries on raised bed with following improved nursery raising techniques jointly. The variety popular in the area Navkiran was selected for the trials. The area of each trial was 1000 m^2. Recommended basal dose of NPK 75:80:60 kg ha^{-1} and Azospirillum biofertilizers @ 10kg ha^{-1} along with FYM @ 10t ha^{-1} were applied before the last ploughing and making of layout. Scientific cultivation practices were followed for the raising good crop. Top dressing of remaining nitrogen @ 75 kg ha^{-1} was applied in two split doses at 30 and 75 DAT. Recommended IPM practices as per need and availability were followed strictly. The data were recorded on different parameters and calculated accordingly. The per cent increase in yield over farmers practice was calculated using following formula as given below:

$$\text{Increase (\%)} = \left(\frac{\text{Demo yield} - \text{farmers yield}}{\text{Farmers yield}}\right) \text{x } 100$$

RESULTS AND DISCUSSION

The data presented in Table-1 revealed that farmers involved in brinjal production in the district, didn't aware about recommended crop production technology i.e. nursery raising seed rate, seed treatment, sowing and transplanting methodology, balanced nutrition and plant protection measures. They were using disease susceptible hybrid varieties along with high dose of nitrogen and phosphorus (300:200 kg ha^{-1}) respectively in anticipation to harvest maximum yield. Imbalanced fertilizer application not only reduces the proper development of plants and its potentiality to provide quality yield, but also invite higher incidences of disease and pest resulting in reduced marketable yield and unhealthy soil. To control incidence of disease and pest, farmers used higher doses of pesticides in injudicious way which adversely affects the ecology and environment. The lack of knowledge and skill about production technology and plant protection measures in brinjal crop were the important reason behind it.

The experimental findings summarized in Table 2, exhibited that increased plant height in both the seasons were recorded with farmers practice during the course of study as compared to IPNM plot of experiment. The differences in plant height were much higher between T_1 and T_2 in Rabi, 2009 than the Rabi 2008. It is observed that higher dose of nitrogenous fertilizer application by farmers was the major cause of increased plant height. However, maximum number of primary branches was found in IPNM plot in comparison with farmers practice**.** Balanced application of fertilizer and use of Azospirillum may be cited as principal cause of the better branching ultimately resulted in higher yield as also suggested by Satesh Kumar and Sharma (2002).

The highest average yield 435q ha^{-1} and 418 q ha^{-1} were found in T_2 (IPNM plot) during Rabi 2008 and Kharif 2009 respectively as compared with T_1(FP) as 346 q ha^{-1} and 336 q ha^{-1} respectively in Rabi 2008 and rabi 2009 and subsequently 25.72 and 24.00 per cent increase in total yield were recorded over farmers practice in respective years. The actual marketable yield after shorting and grading of commodity were 410 q ha^{-1} and 390 q ha^{-1} from T_2 in both the years respectively while the marketable yield of farmers practice reported only 346 q ha^{-1} and 300 q ha^{-1} in both Rabi 2008 and Rabi 2009 respectively. The data also showed that the per cent loss of yield from total production due to diseased and inferior quality fruits were observed nearly double (13.07 & 12.00) in farmer practice when compared with IPNM plot (7.67 & 7.17%) respectively. It may be correlated with higher incidence of disease and pest in farmers practice in comparison with IPNM plots. It was due to application of higher dose of nitrogenous fertilizers and mismanaged plant protection practices in brinjal in respective years. The present findings are in conformity with Shashidhara, G. B. (2000).

The study also exhibited in Table 3 that adoption of IPNM module for production of brinjal not only gives the opportunity of higher yield, but also provide higher benefit cost ratio 4.31 to 3.91 in IPNM Plot in respective years with minimal cost of production from Rs. 8,170 to Rs. 8,879 per hectare as compared to farmers practice. It also opens a way for sustainable production of brinjal by improving soil structure, reduces the chemical concentration in soil and as reduced pesticides application. The similar findings were also reported by Ramanathan, K. M.(2006 **).**

CONCLUSION

There were technological gaps between the improved management packages and farmers practices in brinjal productions in Chandauli district of Uttar Pradesh. The present on form testing conducted at the formers field, produced significant positive results and provides potentials and profitability of improved technology under real situation, which they have been advocating for a long time. The IPNM module assessed during the study proved as an effective tool in changing attitude, skill and knowledge of integrated nutrient management in eco-friendly brinjal production which gives better yield

due to proper utilization of plant nutrient, improved soil health and minimizing disease incidences. The farmer`s feedbacks were noticed that the use of IPNM module in brinjal is highly acceptable, easily compatible in existing production and cropping system in Chandauli district. Moreover, steps should be taken to popularized technology in entire brinjal growers in the district to bridge the gaps on technology between potential and in actual practices to promote the INM to enhance the yield, quality with maximum economic benefit in sustainable manner.

Table 1: Technological differences between improved production technology and farmers practice

S.No.	Particulars	Technological interventions	Farmers practices
1.	Variety	Navkiran	Navkiran
2.	Seed treatment	Overnight dip in Solution of Captan 0.2%	No seed treatment follows
3.	Seed rate	200-250 g ha^{-1}	300-350 g ha^{-1}
4.	Nursery raising	Raised bed techniques, line sowing	Conventional flat bed techniques
5.	Situation	Upland sandy loam irrigated	Upland sandy loam irrigated
6.	Irrigation facility	Private tube well	Private tube well
7.	Fertilizer application	Integrated nutrient management 10 tones FYM + 150:80:60 kg ha^{-1} NPK +Soil application of Azospirillum biofertilizers @ 10kg/ha. + foliar spray of Zn and Bo @ 50 ppm at 30, 45 and 75 days after transplanting	Application of 300 kg N and 200 Kg P_2O_5 ha^{-1}
8	Plant Protection	Need based application of pesticides	Use of Pesticides at higher doses

Table 2: Impact of IPNM on yield and yield attributing characters in brinjal crops as compared to farmers practices.

Year	Treatments	parameters				Average Yield q ha^{-1}	% increase in yield q ha^{-1}	Marke-table Yield q ha^{-1}	%of yield from total Production
		Plant height (m)	No. of primary branches	Avg. fruit wt. (g)	No. of fruit $plant^{-1}$				
Rabi 2008	T_1 - (F.P.) No use of organic matter and 300 kg N + 200 kg P ha^{-1}	90.31	6.89	90.00	23.67	346.00	-	306	13.07
	T_2-(IPNM Module) 10 tones FYM + 150:80:60 kg ha^{-1}NPK +Soil application of Azospirillum biofertilizer @ 10kg/ha. + foliar spray of Zn and Bo @ 50 ppm at 30, 45 and 75 DAT	85.90	7.15	105.00	31.65	435.00	25.72	404	07.67
Rabi 2009	T_1 - (F.P.) No use of organic matter and 300 kg N + 200 kg P ha^{-1}	99.41	7.32	95.00	22.05	336.00	-	300	12.00
	T_2-(IPNM Module) 10 tones FYM + 150:80:60 kg ha^{-1}NPK +Soil application of Azospirillum biofertilizers @ 10kg ha^{-1} + foliar spray of Zn and Bo @ 50 ppm at 30, 45 and 75 DAT	90.71	7.77	100.00	28.76	418.00	24.40	390	7.17

Table 3: Economic performance of brinjal production using IPNM modules in Chandauli districts.

Year	Treatments	Marketable yield q ha^{-1}	Gross Return * (Rs.)	cost of cultivation (Rs.)	Effective saving over cost of cultivation (Rs.)	Net returns (Rs.)	BCR
Rabi 2008	**T_1** - (F.P.) No use of organic matter and 300 kg N + 200 kg P ha^{-1}	306	122400	45660.00	-	76740.00	**2.68**
	T_2-(IPNM Module) 10 tones FYM + 150:80:60 kg ha^{-1}NPK +Soil application of Azospirillum biofertilizers @ 10kg ha^{-1}+ foliar spray of Zn and Bo @ 50 ppm at 30, 45 and 75 DAT	404	161600	37490.00	8170.00	124110.00	4.31
Rabi 2009	**T_1** - (F.P.) No use of organic matter and 300 kg N + 200 kg P ha^{-1}	300	120000	48765.00	-	71235.00	2.46
	T_2-(IPNM Module) 10 tones FYM + 150:80:60 kg ha^{-1}NPK +Soil application of Azospirillum biofertilizers @ 10kg ha^{-1}+ foliar spray of Zn and Bo @ 50 ppm at 30, 45 and 75 DAT	390	156000	39886.00	8879.00	116114.00	3.91

*Rate Rs400 q^{-1}; DAT =Days after transplanting

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PSEUDOMONAS: UNIQUE PLANT GROWTH PROMOTING RHIZOBACTERIA

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Abstract : Plant growth promoting rhizobacteria promote plant growth and productivity has internationally been accepted. Fluorescent pseudomonas have been extensively studied as a plant growth promoting rhizobacteria (PGPR). Pseudomonads are known to interact with host plant via chemical mediators that develop a symbiotic relationship. During their close association, they influence the growth of host plant by delivering beneficial effects in rhizosphere. Pseudomonads promote the growth of plants either by direct supply of nutrients, synthesis of phytohormones, solubilization of minerals, or indirectly as a biocontrol agent suppressing the pathogens. Cumulative effect of combination of above properties projects it as bacteria of great economic importance. This is usually achieved by either one or blend of several factors released in rhizosphere by symbiont. These include secretive secondary metabolites e.g. Antibiotics, toxins, enzymes, HCN etc. which inhibits the pathogen or chelators like siderophores which generate the microenvironment, a competitive one for pathogen. These bioformulations also enhanced soil fertility and the PGPR activity also increased grain yield.

Keywords : Growth promoting, Pseudomonas, Rhizobacteria

INTRODUCTION

Soil-born plant pathogenic fungi cause heavy crop losses all over the world. With its variable climate in different ecological zones, major crops in India are susceptible to diseases caused by soil borne fungal pathogen in the light of present day constraints on plant disease control practices. Chemical control is used to control pathogen but Chemical farming disturbs environment, subvert ecology, degrade soil productivity, mismanage water resources (Ayala and Rao, 2002; Deshwal *et al*., 2011a). The chemical agriculture affected the soil environment is well known. Biofertilizer such as microbial inoculant which can promote plant growth and productivity have internationally been accepted as an alternative source of chemical fertilizer. PGPR represent a wide variety of soil bacteria which, when grown in association with a host plant, result in stimulation of growth of their host (Deshwal *et al*., 2003; Deshwal *et al*., 2010; Deshwal *et al*., 2011a)

Biocontrol provides an alternative means of reducing these pathogens, which are otherwise difficult to control due to their survival strategies. The renewed interest in biocontrol is due to its environmental friendliness, long lasting effect and safety feature. Some of the bacterial antagonists have however also been found to show direct growth promoting effect on crop plants as inoculants and hence these effect plant growth by increasing phosphorous and nitrogen uptake and providing roots with compound such as phytohormones and solubilised iron, but also release antibiotics and chelate iron (Glick *et al*., 1995; Deshwal *et al*., 2012).

Fluorescent pseudomonads make up a dominant population in soil along with other bacteria like *Serratia*, *Azotobacter*, *Clostridium*, *Bacillus*, *Arthrobactrer*, Alcaligens, *Agrobacterium*, *Bradyrhizobium* and *Rhizobium*. Collectively these bacteria have been termed "Rhizobacteria". Certain fluorescent pseudomonads increase yield or control biologically one or more soil-borne plant pathogens when applied as seed or seed piece inoculants to agriculture crops (Burr and Caesar, 1984; Deshwal *et al*., 2011b). When PGPR strains are applied in field, the root exudates also enhanced which attract the rhizosphere microbs (Prinkyl and Vancura, 1980) and *Pseudomonas* (biological control) by production of siderophore that sequester iron in the root environment, making it less available to competing deleterious microflora (Kloepper *et al*., 1980, Bagnasco *et al*., 1998; Deshwal *et al*., 2012)

Some strains of *Pseudomonas fluorescence* and *P. putida* were reported to be biological control agent against various soil borne fungi (Weller, 1988). Lim and Kim (1995) reported that *Pseudomonas* controlled *Fusarium solani* by production of metabolites which decompose the fungal wall. Bagnasco *et al.* (1998) reported that fluorescent pseudomonads suppressed the growth of phytopathogenic fungi *Pythium ultimum* and *Rhizoctonia solani*. Similarly Lim *et al.* (1998) noted the role of siderophore in biological control of *Fusarium solani*. Gupta *et al*. (1999) observed that fluorescent pseudomonas strain GRC_1 inhibited growth of *Macrophomina phaseolina* and *Fusarium oxysporum in vitro*. Recently, Deshwal *et al*. (2012) reported that *Pseudomonas aeruginosa* strains inhibited the growth of *Sclerotina sclerotiorum* by 62-83% inhibition zone as compared to control. *Pseudomonas* MR-18 strains showed maximum inhibition. *In vitro* study revealed that *Pseudomonas* strains effectively reduced the growth of *Sclerotina sclerotiorum*.

The production of antimicrobial compounds by some pseudomonas strains has been recognized as a major factor in the suppression of many root pathogens (O'Sullivan and O' Gara, 1992). *Pseudomonas* improves the root colonization and higher population control the growth of deleterious pathogens (Expert

and Degit, 1995). Similar to PGPR (particularly fluorescent pseudomonads) the symbiotic rhizobacteria enhance plant growth due to IAA production (Gupta *et al*., 2002) and also solubilize insoluble inorganic phosphorus (Defreitas *et al*., 1992). Lippman *et al.* (1995) stated that PGPR could directly enhance plant growth by phytohormones production and enhanced nutrient uptake. Noel *et al.* (1996) observed that under gnotobiotics conditions, direct growth promotions of the early radicle formation occurred due to IAA and cytokines. It is established that *Pseudomonas* enhances the population of rhizobia resulting in increased nodulation and nodule weight, along with increase in yield of different legumes.

Hence, the capability of rhizosphere bacteria to promote the growth of host plant by both, direct and indirect mechanisms make this group of organisms of great research interest and also project their applicable economic importance. It has been known that endophytic bacteria as biological control agent are more successful as compared to rhizoplane dwellers, other colonizer and internal colonizer. The protection of root from the attack of the fungal and other pathogens by *Pseudomonas* is due to the production of diverse metabolites like siderophore (Gupta *et al*., 1999), HCN (Deshwal *et al*., 2012), antibiotics (Shanahan *et al*., 1992).

The ability is elicited due to bacterial HCN, which inhibit multiplication and survival of parasitic pathogens. Although to achieve this root colonization is an important step due to interaction between PGPR group of bacteria and host plant (Kloepper and Beauchamp, 1992). In order to harness potential benefits of biofertilizer in commercial agriculture, the consistency of their performance should be improved. This requires research in many diverse areas, as their biological system involves complex interactions with the host, other rhizosphere co-existing microflora and fauna.

Field application

The distribution of the rhizobacteria on hybrids of maize was of *Pseudomonas* spp. This was observed to be to be most prominent group. The effect of PGPR on crop plants has been evaluated under field condition (Lim *et al.*, 1999). PGPR enhanced plant yield in a wide range of crop plants such as vegetables, rapeseed (Brown, 1974; Iswandi *et al.*, 1987), spring and winter wheat by 8-16% (Brown, 1974), sugar beet to 7-10% (Suslow and Schroth, 1982) and in radish 60-144% (Schroth and Hancock, 1981). Deshwal *et al*. (2011a) mentioned that *Pseudomonas aeruginosa* improved plant growth in *Mucuna* plant.

(i) Reduction of phytopathogens

Fluorescent pseudomonads have another merit on controlling several phytopathogenic fungi besides simultaneously enhancing the growth and yield of various vegetables, mustard or rape seed and cereals (Iswandi *et al.*, 1987; Bagnasco *et al.*, 1998). Lim and Kim (1995) reported that *Pseudomonas* reduced disease incidence and controlled *Fusarium solani* by production of metabolites which decompose the fungal wall. Bagnasco *et al.* (1998) reported that fluorescent pseudomonads suppressed the growth of phytopathogenic fungi *Pythium ultimum* and *Rhizoctonia solani*. Similarly Lim *et al.* (1999) noted the role of siderophore in biological control of *Fusarium solani*. Deshwal *et al*. (2012) reported that *Pseudomonas aeruginosa* MR-18 showed maximum inhibition zone against *Sclerotina sclerotiorum.*

(ii) Improve root colonization

Beneficial rhizobacteria are known to colonize rapidly and aggressively the root system, suppress pathogenic microorganism, and enhance plant growth and development (Weller, 1988). A successful antagonist should colonize the rhizosphere at the time of seed germination itself or another word, the antagonist should move from spermosphere to rhizosphere and establish there (Weller, 1983). Gu and Mazzola (2001) suggested the application of procedures to enhance colonization of the rhizosphere by biocontrol. Fluorescent pseudomonas can lead to improved management schemes to control soil borne plant pathogens as observed by large number of workers (Seong and Shin 1996; Lim and Kim, 1997; Bagnasco *et al.*, 1998; Gupta *et al.*, 1999). Poor colonization of the distal parts of the root has been frequently observed in seed inoculation treatments (Hatzinger and Alexander, 1994).

(iii) Beneficial to other microbes

Polonenko *et al*. (1987) demonstrated that some pseudomonads stimulated nodulations of legumes by *Rhizobium* spp. and *Bradyrhizobium* spp. Furmann and Wollum (1989) found that three fluorescent pseudomonads that consistently increased nodule occupancy of the more efficient *B. japonicum* USDA 123 and USDA 31 (now *B. elkanii*) in soybean and presumably because of siderophore production. Deshwal and Vig (2011) mentioned that *Pseudomonas* PVK-23 improved *Rhizobium* RVK-21 and enhanced plant growth activity of Peanut.

(iv) Enhancement of plant by uptake of several nutrients

Pseudomonads enhance the plant growth productivity by production of metabolites such as siderophore, HCN, chitin and β-1,3-gluconase, antibiotic production which control the pathogenic

microorganism in rhizosphere. Pseudomonads produces IAA production, phosphate solubilization, vitamins by which plant root elongation occurs, rhizosphere bacterial population is also improved. Such PGPR activities are given below:

(a) Siderophore production

Competition for iron is another mechanism by which fluorescent pseudomonads may inhibit the growth of pathogens. Siderophores of PGPR in the rhizosphere under iron deficient environment could efficiently chelate environment iron and inhibit the growth of native microflora including root pathogen (Lim and Kim, 1990). The fluorescent pseudomonads are characterized by their production of yellow green pigments, termed pyoverdines or pseudobactins, that fluorescence under UV irradiation and function as siderophore (Abdallah, 1991). Pyoverdines produced by fluorescent pseudomonads inhibit the growth of variety of microorganisms in iron –depleting culture media (Buyer *et al*., 1989). In most biocontrol strains in which siderophore production has been described as an important mechanism but may contribute to control of pathogen when soil condition are favorable for production (Thomshow and Weller, 1995).

(b) HCN production

Pseudomonads produce HCN which control the root rot pathogen. Thomshow and Weller (1995) observed same observation that pseudomonads exert there beneficial effect on plants by the production of diverse microbial metabolites like HCN. Bagnasco *et al*. (1998) reported that Pseudomonas strains produced HCN. Gupta *et al*. (1999) reported that fluorescent pseudomonas GRC_1 produced HCN and resulted in inhibition of growth of pathogenic fungus *M. phaseolina* and *Fusarium oxysporum*. Deshwal *et al*. (2011a, b) mentioned that *Pseudomonas* strains isolated from Mucuna produced HCN. Recently, Deshwal *et al*. (2012) mentioned same observation.

(c) Chitin and β-1, 3-gluconase production

Hyperparasitism and lysis are the most important forms of biological control of soilborne plant pathogens by microbial antagonists. The mechanism appears to involve the enzymatic hydrolysis of chitin and glucan component of fungal hyphal walls. The lytic activity of bacterial and fungal antagonists is mainly due to the extracellular lytic enzymes chitinase and β-1, 3-glucanase (Henis and Chat, 1975). An antifungal *Pseudomonas stutzeri* YPL-1 produced extracellular chitinase and β-1, 3-glucanase that were key enzyme in the decomposition of fungal hyphal walls. These lytic extracellular enzymes markedly inhibited mycelial growth of the phytopathogenic fungus *Fusarium solani* (Lim and Kim, 1995). These enzymes have been found to be responsible for the control activity of some bacteria (Inbar and Chet, 1991). Chernin *et al*. (1995) reported that gluconase and chitin, lytic enzyme which degrade the fungal walls, also are involved in the biocontrol against certain pathogens.

(d) Antibiotic production

During the past decade many researchers have focused on the role of antifungal metabolites. The production of antimicrobial compounds by some strains of *Pseudomonas* has been recognized as major factor in the suppression of many root pathogens (Dowling and O'Gara, 1994). Key antibacterial compounds include phenazines (Thomshow and Weller, 1988) and 2, 4-diacetylphloroglucinol "DAPG" (Shanahan *et al*., 1992).

(e) Plant growth promoting hormones

Gupta *et al*. (2002) isolated the IAA producing fluorescent pseudomonads in the potato rhizosphere. Glick *et al*. (1999) reported that IAA producing rhizobacteria enhanced the root length which is one of the plant growth promoting activity rhizobacteria. Rhizobacteria also produce Gibberellic acid (Mahmoud *et al*., 1984), cytokinins (Tien *et al*., 1979), and ethylene (Glick *et al*., 1995). Deshwal *et al*. (2011c) reported that *Pseudomonas* strains improve plant growth in soybean crop.

(f) Phosphate solubilization

Unsolubilized phosphate is not taken up by plant but some rhizobacteria solubilize phosphate that is readily taken up by plant. Whitelaw *et al*. (1997) reported that some P- solubilizing organism have been reported as plant growth promoters. Chabot *et al*. (1996) observed that P-solubilizing rhizobacteria increased plant growth, productivity in maize, lettuce. Pseudomonad is also P-solubilizer (Gupta *et al*., 2002). Deshwal *et al*. (2011c) observed that *Pseudomonas* strains solubilized Phosphorous. Again, Deshwal *et al*. (2011d) reported Phosphorus solubilizing *Pseudomonas aeruginosa* PMV-14 enhanced productivity in Rice crop.

(g) Vitamins

Certain fluorescent pseudomonsds included among plant growth promoting rhizobacteria, have a direct effect on the plant growth by the production of vitamins (Lifshitz *et al*., 1987). Growth factors such as vitamins are also produced by pseudomonads and also indirectly effect the growth of rhizobia in the rhizosphere (Derylo and Skorupska, 1993), reason behind this is some strains of genus of rhizobia don't produces biotin, these strain may benefit when grown with biotin producing bacteria.

Factors affecting bioformulation in rhizosphere

According to Baker (1968) competition for particular nutrient is an operational mechanism for bio control. The addition of such nutrient should therefore, must eliminate the bio controls activity. Unless an organism can compete with other organism and effectively scavenge and utilize the available nutrients only then it will constitute a significant proportion of the rhizoplane population (Hattori, 1988). The activity of biocontrol agents is influenced profoundly by extrinsic factor of the environment. Microorganism competes with each other for carbon source, mineral and infection sites of roots. The efficient competitors should have the ability to colonize at faster rate so as to displace pathogen for disease suppression. The competitive exclusion of deleterious rhizospheric organisms is directly linked to an ability to successfully colonize the root surface. This mechanism has been suggested to play a role in biocontrol by fluorescent *Pseudomonas* species against *S. sclerotiorum*, *M. phaseolina*, *Fusarium* spp. (Elad and Baker, 1985; Gupta *et al*., 2001).

Benefits

Chemical control of disease is very harmful to human as well as they reduce the soil fertility so there is need to select such a type of alternative which is not harmful and also improves soil fertility and increase microbial niche. So, Pseudomonads is one of the potential bacterial, which controlled the pathogens and also enhanced the plant growth by production of metabolites.

In many crop pathogen systems, the primary mechanism of biocontrol by *Pseudomonas* is production of antibiotics (Shanahan *et al*., 1992). Under certain conditions, antibiotics improve the ecological fitness of these rhizobacteria in rhizoshpere, which can further influence long-term biological control efficacy (Shanahan *et al*., 1992). Pseudomonads have capacity to uptake iron from soil and this chelation reduces the chlorosis in plant (Bienfait, 1989). Siderophores that chelate iron and other metals also contributes to disease control by confirming a competitive advantage to biological control agent for the limited supply of essential trace minerals in natural habitats (Höfte *et al*., 1994). Siderophore producing strain *P. fluorescens* GL 20 inhibited spore germination and hyphal growth of *Fusarium solani* because strain uptake iron which is necessary for germination and growth of fungus (Lim *et al*., 1999). Other biological control metabolites such as HCN, extracellular lytic enzymes like chitinase and β-1, 3-glucanase also controls deleterious pathogens. Glick *et al*. (1998) observed that seven bacterial strains which were positive for ACC deaminase production promoted canola (*Brassica napus* L.) seedling root elongation under gnotobiotic conditions.

Paulitz (1991) proposed that bacterial antagonist may catabolizes specific component of seed exudates that function as chemical "signals" in triggering sporangial germination of *Pythium ultimum*. Such observation have exciting implications for the potential specificity of interaction between bacterial antagonists and target soil borne pathogen that is reminiscent of the specific interactions between epiphytic bacterial populations. It has been observed that biocontrol pseudomonads potentially show more competency of establishment to form the root colonization of host plant in pathogenic soil (Bagnasco *et al*., 1998). So it gives clear-cut advantage with potential biologically active *Pseudomonas*. Root colonization is an important and first step in the process of interaction of beneficial bacteria with plants (Kloepper and Beauchamp, 1992). *Pseudomonas* is well-known biocontrol agent and rhizobia *are* known as symbiotic N_2 fixer. When co-inoculated, they enhanced the growth and yield of forage legume (Fuente *et al*., 2002). Deshwal and Vig (2010) mentioned that Co-inoculation of *Pseudomonas*-MP3 and *Rhizobium*-GR-23 enhanced plant growth activity of Peanut (*Arachis* hypogaea L.).

***Pseudomonas* in Field trials**

Pseudomonas fluorescence strain F113 produces antibiotics "DAPG", which colonizes the rhizosphere of sugar-beet seedling and controls damping-off disease in soil microorganisms prepared with *Pythium* infection (Fenton *et al*., 1992). In pot trials of bean with *P. fluorescens* GL 20, disease incidence was remarkably reduced up to 94% compared with *Fusarium solani* (Lim *et al*., 1999). Cattelan *et al*. (1999) observed that Pseudomonas GN 1201 increased significantly the dry shoot weight, root length and root dry weight in soybean crop as compared to control. Pseudomonads increase plant growth and grain yield in wide range of crops like rapeseed (Hofte *et al.*, 1991), kidney beans (Lim and Kim, 1997) and Wheat (Raaijmakers *et al.*, 1999).

Further, experiments carried out by Prikryl and Vancura (1980) showed that root colonized by microorganism like *Pseudomonas* release up to twice the amount of root exudates released aseptically is unclear, it could be due to the ability of some bacteria to increase the cell permeability of roots as was proposed by Bowen (1980). Expert and Degit (1995) observed that antagonistic strain Tl-5 control growth of *S. sclerotiorum* when at least $1x10^6$ antagonistic bacteria in the spermosphere are present and successfully colonize the rhizosphere so it shows that biocontrol bacterial population also play an significant role to control pathogens.

Future Research Priorities

At present only a few of them have been identified as biological control agent. By intensifying and diversifying the research, we stand to diversify the base of mechanisms, in turn would increase the chance for formulating biological control agent or mixture of agents that will provide predictable control. It is, therefore, essential to continue the screening process to obtain potential strains.

In order to harness potential benefits of biofertilizer in commercial agriculture, the consistency of their performance must be improved. This requires research in many diverse area as these biological system involves complex interactions among the host, other rhizosphere microflora and funa and the environment. The survival and competitive ability of the strains to be introduced must be improved. Very little is known about the competitiveness of the microorganism and factors governing it. These biological bacteria some time inhibit the pathogen in vitro but fail in field trails. Question arise that what are the factors that control the biological control in field or other bacteria which inhibit biocontrol bacteria or control their biocontrol activity.

Research to understand the mechanism by which the introduced microorganism benefits the crop is critically important. Although pseudomonads are well known for their specific function biocontrol ability, siderophore, HCN, IAA and phosphate uptake, research has shown that these properties improved crop productivity. So it is better when the biological control bacteria have some other plant growth productivity activity so that it can control deleterious bacteria by competition and enhance plant growth productivity. Lot of research should gain considerable attention in future in this field.

CONCLUSION

The plant pathogen presence and higher use of chemical control reduce plant growth as well as total yield. This causes an enormous loss of productivity. Although chemical treatments show immediate effect but disturb soil environment, contaminate underground water as well as proved toxic to mammals. Moreover, repetitive application of these chemicals develops resistant variety of target pathogens, which respond weakly or may even remain completely unaffected. This again projects a series of problems with metastatic effect over environment, economy as well as human population. On the other hand, biocontrol agents are cheaper, have no harmful effect on human population, they have long term effect in soil and markedly, showed no deleterious effect on environment.

Plant growth promoting rhizobacteria can affect plant growth either directly or indirectly. The direct promotion of plant growth usually entails by providing the plant either a compound viz. synthesized by bacterium and / or, bacteria facilitate the uptake of nutrient from soil by the plant. The indirect promotion of plant occurs when PGPR prevent the deleterious effect of one or more pathogens. It is therefore, desirable to replace these chemical agent with biological control agents which are eco-friendly and non-hazardous.

Pseudomonads can produce a variety of substances that can limit or inhibit the growth of pathogen in spermosphere, rhizosphere and phyllosphere. Although inoculation of seed with large numbers of bacterial cells result in the establishment of population of the introduced strain in rhizosphere (Suslow, 1982), the size of these populations is generally only a fraction of that of total heterotrophic bacteria that can be culture in the rhizosphere (Loper *et al*., 1984). Thus, the impact of introduced population on precluding population establishes a small competition in the rhizosphere. Moreover, pseudomonads show synergism with different type of resident soil microorganism such as rhizobia and result in plant growth enhancement. Now scientists are concerned with *Pseudomonas* that has capability to control pathogens along with unique characteristic such as phosphate solubilization and IAA production. Such type of PGPR activity also enhanced the plant growth. Enough phosphate is present in soil but plants are not able to uptake total required phosphate for growth, main reason behind this is most of phosphate present in soil is not in solubilized form but pseudomonads have capability to solubilize phosphate, and then plants can uptake it. Many researchers observed that P-solubilizing rhizosphere bacteria increased plant growth and productivity. Pseudomonads also produced plant growth promoting hormones. These hormones enhanced the root-elongation, root-branching, plant height, leaf area etc.

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RIVER BIODIVERSITY: A STUDY OF RIVER BAGAD (A TRIBUTARY OF GANGA)

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Abstract : River boundaries are transitional zones between the terrestrial and aquatic environment. These habitats perform major ecological role in the biosphere. Many of the fossil fuels are known to be produced and preserved by the swampy environment of the carboniferous period. Rivers are of immense use to mankind both economically and ecologically. They are unique habitats and substantial biodiversity. A large number of aquatic plant and animals species restricted only to river. Their survival depends totally on the existence of these habitats. The rivers of India are defined as "one of the richest regions in terms of biodiversity and it is often referred to as a biodiversity hotspot". The ecosystem of river has experienced tumultuous changes due to river valley and other development projects in the last 60 years. Inventorying and monitoring the biodiversity and ecology of river would help in the formulation and implementation of appropriate conservation and management strategies in the Bagad river. This report documents the biodiversity significance of the Bagad river. The trees were cut at that time and the openings created resulted in the extinction of most of swamps. River are one of the most productive ecosystems and thus subjected to human greed which is yet another reason for their extinction. In winters it provides a good habitat for migrating waterfowls, that come here in large numbers.

Keywords : Bagad River, Biodiversity, Phytoplankton, Swamps, Zooplankton

INTRODUCTION

Environmental conditions play a vital role in governing the life history, behavior, distribution and abundance of organism particularly in the aquatic environments. Knowledge of the environmental feature in highly essential for understanding the occurrence and abundance of aquatic organism . Biodiversity is the totality of genes, species and ecosystem in a region. Biodiversity means variability among living organisms at all levels and from all sources. It represents sum total of various types of microbes, plants and animals present in a system in a given area. Biodiversity is the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystem and the ecological complex of which they are a part. It includes diversity within species, between species and ecosystem. Freshwater ecosystems of the tropics and subtropics are undergoing rapid deterioration due to developmental pressures and opportunistic exploitation and neglect. The challenging issues here are to improve the current knowledge of its biodiversity so that it would aid in sustainable management of the ecosystem through suitable conservation approaches. Generally, the conservation importance of an area is determined by assessing its ecological values and functions. Assessments are based on the unique habitats and species composition, but in recent times it has been advocated to consider the catchment of a river for assessment involving the distribution and abundance of plants and animals with a catchment. This is in a way to bring the linkages between aquatic and terrestrial ecosystems, such an approach was lacking in earlier studies.

An important step is to understand the variation in relation to soil type, water status, altitude etc. This necessitated inventorying, mapping and monitoring of the ecosystem, to arrive at viable conservation and sustainable management strategies. The Bagad River is one of the most important tributaries of river Ganga. This report focuses on the biodiversity of Bagad river carried out by a multidisciplinary team, which helps to diagnose the adverse effects of the ongoing land use changes on the ecology. This study also addresses the issues like environmental management, restoration of natural ecosystem, restitution of corridors of animal migration and quality of aquatic ecosystem. These are an addition to the benchmark database on existing biodiversity and ecology of river basin. The main objective of the study was to enlist the species diversity in the region, to highlight the ecological sensitivity of the region. The floral components included are trees, shrubs, herbs, orchids etc., whereas fauna comprised of butterflies, odonates, fish, amphibians, reptiles, birds and mammals.

MATERIAL AND METHOD

Study Area

The Bagad river and its selected sampling sites located in the area of Gajraula town. The five selected sites are situated in some distance from Gajraula town. The site is shabazpur dor, Naipura Khadar, Tigaria Bhur, Sultanpur Dhar and Soharka. These all sites are villages which are situated on side of the Bagad river. Gajraula town is situated in the northern part of India and western part of Uttar Pradesh. It is located at 28.85 ^{0}N, 78.23 ^{0}E. It is a Nagar Panchyat of J.P. Nagar district of Uttar Pradesh State. It is fast growing town and has been urbanized and industrialized rapidly during last 20

years. The river systems with numerous perennial streams with typical tropical evergreen forested catchment areas are the regions of high conservation value. It provides an ideal habitat for a larger number of migratory waterfowl from the temperate region across the Himalayas during winter season (October–March). There are many resident species of water fowl living in the reservoir and nearby area. The maximum rainfall occurs during the months of July-August and minimum is recorded during January-February. The maximum temperature reaches up to 42 ^{0}C in May-June and minimum 10-12 ^{0}C December-January.

Collection of Aquatic Flora and Fauna

Collection was made by using nets (bag net, cast net, drag net etc) as well as by hand picking. The plankton samples were collected with standard plankton nets. Both dry and wet specimen were preserved in the appropriate laboratory reagents such as 4% formalin and rectified spirit. Identification of the specimen was carried out in the respective laboratories. Parts of different types of vegetation having flower, bud, node etc where collected and then pressed in newspaper and dried for identification. Rare and unidentified specimens were collected for herbaria using dry method. Fresh specimens were identified with the help of regional and other floras. Apart from primary data, we have also collected secondary data in term of research paper published, interview and interaction with knowledgeable local people and scientists who earlier worked in the region. This helped in a better understanding of the ecological sensitiveness of the region.

RESULT

People of the region have from time immemorial depended on the forest ecosystem for most of their need including water.

Plant Diversity

The aquatic biodiversity of Bagad river affected by the industrial effluents discharged by different industries. These industrial effluents affect directly or indirectly to the aquatic biodiversity. So, the aquatic biodiversity present is very less in Bagad river. The aquatic vegetation of the reservoir consists of Eichhornia Crassipes, Photamogeton pectinatus, Typha elepantina and Ceratophyllum demersum. The other plant diversity is arranged in following list.

Table 1. List of Plants

	Plants		
	Aquatic Plant	•	*Polygonum globrum*
•	*Eichhornia crassipes*	•	*Polygonum lanigerum*
•	*Photamogeton pectinatus*	•	*Aeschyonomene sp.*
•	*Typha elepantina*	•	*Phyllanthus sp.*
•	*Cerothyllum demersum*	•	*Monochoria hastate*
	Trees	•	*Mosla dianthera*
•	*Shorea rubusta*	•	*Lantana Camara*
•	*Bombax cebia*		**Herbs**
•	*Bischofia Javanica*	•	*Acorus calamus*
•	*Lannea coromandelica*	•	*Parthenium*
•	*Dalbergia sisso*	•	*Hysterophorus*
	Shrubs		**List of Algae**
•	*Eclipta prostrata*		**Bacillariophyceae**
•	*Ipomea fistulosa*	•	*Navicula*
•	*Cyperus sp.*	•	*Cymbella*
•	*Mimosa pudica*	•	*Diatoma*
•	*Tabelleria*	•	*Chlorella*
•	*Synedra*	•	*Spirogyra*
•	*Flagillaria*	•	*Chladophora*
•	*Meridion*	•	**Myxophycela**
•	*Cocconeis*	•	*Oscillatoria*
	Chlorophyceae	•	*Spirulina*
•	*Ulothrix*		

Animal Diversity

Animla diverstiy found in the wetland include basically those residing permanently or termporary in and around

the river or aquatic ecosystem. A total 20 species of fish and other species are found in the river.

Table 2. List of Fishes found in the Bagad River

	Vernacular Name	**Scientific Name**
1	Pathal	*Chagunius chagunio*
2	Phuti	*Puntius sophore*
3	Boala	*Labeo dyochelius*
4	Kali Machchi	*Tor chelyoides*
5	Mahaseer	*Tor putitora*
6	Makhni	*Tor tor*
7	Childi	*Barilius barna*
8	Chalra	*B. vagra*
9	Chand	*Danio devaoir*
10	Chal	*Esomus danricus*
11	Asela	*Schizothorax richardsonii*
12	Saknera	*Crossoocheilus latius latius*
13	Gadera	*Nemacheilus beavani*
14	Gadera	*N. botia*
15	Gadera	*N. doonensis*
16	Ghiwa	*Lepidocephalus coudofurcatus*
17	Ghiwa	*L. guntea*
18	Chiri	*Badis badis*
19	Bam	*Macroganathus pancalus*

Amphibian

Amphibians are one of the best biological indicators of ecosystem health. In the present study, opportunistics surveys were carried out in four localities. This regions being biologically rich and following table enlists the previous records of amhibians from the region.

Species

- **Family: Bufonidal**
  - Bufo parietalis boulenger
  - Bufo brevirostris
- **Family: microhyidae**
  - Ramanella mormorata
  - Ramanella triangularis
  - Ramanella minor
- **Family: Peteropedetidae**
  - Indirana semipalmatus
  - Indirana gundia
  - Indirana longicrus
  - Indirana tenuilingua

Availability of perennial sources of water has provided ample habitats for amphibians hence they are persisting in this region even during non-monsoon periods. (our sampling period)

Reptiles

A checklist of reptiles observed from the region is provided in following table. This list adds to the richness of the species in the region. Rat snake and Indian ornate flying snake were sighted in the area.

Table 3. Checklist of Reptiles found in the Region

	Common Name	**Scientific Name**
•	Common Indian monitor lizard	Varnus bengalensis
•	Lizard	Calotes sp.
•	Cobra	Naja - naja
•	Common hump nosed pit viper	Hyphnale- hyphnale
•	Water snake	Xenochrophis piscator piscator
•	Vine snake	Ahaletula nasuta
•	Rat snake	Ptyas mucosus mucosus
•	Python	Python molurus molurus

DISCUSSION

Biodiversity through time and space has provided the panorama of the genesis and diversification of various life form, their interdependence, and link between life and support system, triggering a holistic approach to knowledge-building focused on various aspects of human affairs. These areas have already lost vast area of virgin forests as evident from

seasonal streams, local extinction of species, etc. with many still existing as revenue land waiting to be logged and gone for ever. Unplanned developmental activities in the region will further diminish the biodiversity, hydrology and ecology of the region. It is high time for us to understand nature, its importance for our sustainable living and for future generations to come than taking *adhoc* decisions to build dams across rivers and inundate the natural resources forever. the factors which are adversely affecting the Bagad river and responsible for the deterioration of ecological conditions and posing threats to the resident and migratory birds species of the area include weed infestation, siltation drainage of water at wrong time, non-sustainable tourism and poaching. The threats to the river biodiversity may be divided into two broad categories: Natural threats and anthropogenic threats, which may be direct or indirect. Natural threats include eutrophication, erosion, storm damage drought or biotic interference other than by human which may lead to destruction of river biodiversity. Many researchers previously suggested a distinct link between macro algal form and its functions, and argued that predictable growth of weeds may be found under given levels of environmental stress or disturbance (Steneck and Watling, 1982, Litter and Littler, 1984a, Dethie, 1994, Steneck and Dethie, 1994, piazzai et al., 2002). Higher deforestation rate results in the loss of topoil, which is drained off with rainwater and settles down in the stream. This result in rise of soil level in swamps making then much shallower, with reduced water spread area. Freshwater ecosystems are damaged primarily because the potential impacts of industrials, Urban, energy and agriculture policies on these ecosystems are disregarded. Around the world, hydropower and irrigation development has destroyed freshwater habitat and pollutants from farms, cities and factories have been discharged into river, killing off species and dramatically altering riverine ecosystems.

Strategies for the Conservation of River

Industry already burdened with environmental regulation is far from enthusiastic about biodiversity conservation, but it should be. The corporate interests that stand to lose form biodiversity conservation are those that base their profits on unsustainable resource use. But for industries that do seek to manage resources sustainably, biodiversity conservation provides significant opportunities. Strict laws should be implemented for the protection of this area. Suitable measures should be undertaken for controlling the unchecked growth of Ipomea, Typha and Elchhornia, that are rapidly converting the river into a unsuitable habitat for various animal species. River are the sources, sinks and transformers of chemical biological and genetic materials. They play an important role in environment by providing a unique habitat for a wide variety of flora and fauna. Thus in order to conserve it mass awareness is must and for this regular camps should be organized in which people should be educated about the importance of conserving the river biodiversity. Unless people realize the need to safeguards wetland ecosystems and are made aware of how they can contribute to this effort, there is little hope for the survival of these ecologically valuable and vulnerable habitats. Considering the importance of this river, the international organization viz. International body for conservation of nature (IBCN) and Bird International has declared it as an important Bird Area of India (IBA). Thus, it is very important to conserve this biodiversity natural resources.

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EFFECT OF COPPER AND MERCURY ON GROWTH PARAMETERS IN *LEMNA MINOR*

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Abstract : Theability of aquatic plants to accumulate heavy metals from water is well documented. In this study, duckweeds plants (*Lemna minor*) were exposed to different concentrations of Cu and Hg. Various growth parameters (fresh weight, dry weight and growth index) in different seasons(summer and winter) were studied. The effect of all concentrations on plant parameters was toxic. The plant growth was decreased as the concentrations of heavy metals were increased. The results suggest that the *L.minor* can be effectively used as phytoremediator for waste water polluted with more than one heavy metal at moderate concentrations.

Keywords : Cu and Hg, Heavy metal, *Lemna minor*, Plant-toxicity, Phytoremediation

INTRODUCTION

Heavy metal pollution is an important environmental problem due to wide spread use of metals for industrial and agricultural purposes in the world. Pollution of environmentby toxic metals arises as a result of various industrial activities and has turned these metals ions intomajor health issue (Waisberg *et al*., 2003). Although several adverse effects of the toxic metal have been known for a long time exposure to heavy metals continues, and is even increasing in some parts of the world, is particular in less developed countries. Heavymetal pollution is also a multi element problem in many areas (An *et al*.,2004). Under these circumstances synergistic and antagonistic interaction may be important and predicted impact based on individual effects of each metal species is likely to be erroneous (Ting *et al*.,1991). In contrast with most organic material metals cannot be transformed by microorganisms and therefore accumulate in water, air, soil, bottom sediments and living organisms (Miretzky *et al*.,2004). There is therefore a clear need to understand the interactive effects produced by combinations of metal ions at different concentrations. The possible adverse effects of heavy metal pollution and their phytotoxic effects have been reported by several workers (Chiba and Takahashi,1977; Haele and Ormrod,1983; Lebloava *et al*.,1986).

Copper is one of the oldest known metals and is the 25th most abundant element in the Earth's crust. Copper was identify as a plant nutrient in the 1930s (A.L. Somer,1931; C.B. Lipman and Mackinney, 1931).Cu contributes to several physiological processes in plants including photosynthesis, respiration,corbohydrate distribution, nitrogen and cell wall metabolism (Kabata-Pendias and Pendias,2001). The higher concentration of Cu may account for the suppressed root growth, leaf chlorosis, observed in plants (Baker and Walker, 1989).Mercury is a toxic heavy metal that is found naturally in the environment in various forms. Mercury poisoning has become a problem of current interest as a result of environment pollution on a global scale. Hg is a strong phytotoxic as well as genotoxic metal(Fridovich I,1986; Suszeynsky E.M. *et al*., 1995). Toxic effect of Hg in plantsinclude growth reduction, decreased chlorophyll content and nitrate reductase activity (Vyas and Puranik, 1993). Decreased water uptake and antioxidant enzymes, biomass etc. (Gardea – Torresdey *et al*., 2005).Duckweed (family Lemnaceae) is a small, fragile, free floating aquatic plant that flourishes in quiescent shallow water bodies (Rahmani and Sternberg, 1999). Due to its special features, it is used as a test organismfor aquatic studies and for waste water treatment. In the present study, the effect of Cu and Hg on *Lemna minor* was examined by exposing the aquatic plants separately to each of the two metal species and then to combination of the two at various concentrations. Effects on biomass growth were studied.

MATERIAL AND METHOD

Duckweed plants obtained from Nakatia river situated in Bareilly (U.P.). The plants were washed very well and rinsed in distilled water three times for five minutes. Plants were exposed to individual trace elements $CuSO_4$ and $HgCl_2$ i.e. 5.0 mg/l , 10.0 mg/l , 20.0 mg/l and 1 mg/l , 3 mg/l, and 5 mg/l respectively, separately as well as in combination (2.5 mg/l Cu and 0.5 mg/l Hg; 5mg/l Cu and 1.5 mg/l Hg; and 10 mg/l Cu and 2.5 treatment . Initially in each tub 5.0 mg/l of biomass *(L. minor*) was added. Comparisons of metal exposed plants were made with untreated (control) plants. The data pertaining to plant growth (fresh weight, dry weight, biomass index) were obtained after three and five days after treatment. All experiments were conducted in summer season (June) and winter (December) in 2010.

Fresh Weight : colonies were transferred to pre weighted polystyre tubes with small (1 mm) holes in the rounded bottoms. The tubes were then

centrifuged at 3000 rpm for 10 minutes at room temperature. Tubes, containing the now dried colonies are re weighed and the fresh weight is calculated by substracting the weight of empty tubes.

Dry weight: colonies were collected from each of test vessels and rinsed with distilled or deionised water. They were blotted to remove excess water and then dried at 60̊ C to a constant weight. Any root fragments also be included.

Biomass index : a plant growth index was calculated as follows

Growth index= Biomass (end of the test)/ Biomass (initially biomass).

RESULT AND DISCUSSION

It was observed that 5 mg of Cu and 1 mg of Hg sharply decreased the growth of *Lemna minor*at the end of three days and five days in both seasons. The results pertaining to effect of different concentration of heavy metals on biomass yield of *Lemna minor* are depicted in tables.The concentrations of 20mg/l cu and 5 mg/l of Hg proved to be toxic affecting the plant growth severely. Fresh weight after five days decreased from 6.01 to 3.97 gm in summer and 6.44 gm to 4.07 gm in winter with 20 mg/l of Cu, in summer fresh weight after five days decreased from 6.01 gm to 3.83 gm and 6.44 gm to 3.92 gm in winter with 5 mg/l of Hg. Whereas higher concentration of mix (Cu and Hg) metals decreased fresh weight after five days from 6.01 gm to 3.92gm in summer and 6.44gm to 3.97gm in winter.It was observed that dry weight also effected severely. 20 mg/l of Cu decreased dry weight from .254 to .205 mg in summer and .262 to .208 in winter, 5 mg/l of Hg decreased dry weight from .254 to .183 in summer and .262 to .186gm in winter and 10 mg/l of Cu and 2.5 mg/l of Hg decreased dry weight .254 to .195 in summer and .262 gm to .199 in winters.Biomass index also decreased in all three manners in both seasons. According to N. Khellaf et al. (2009) Cu when present in the nutrient solution at concentrations less than or equal to 0.2 mg/l a concentration higher than 0.4 mg/l Cu caused the photosystem alteration by reduction electron transport. According to Teisseire and Vernet (2000), CuSO4 at 10 µM was inhibitory for *L. minor*, at this concentration activities of glutathione S- transferase and glutathione reductase were inhibited. Zayed *et al.* (1998) used *L. minor* for phytoaccumulation of copper in quarter strength Hoagland's solution at pH 6; the lowest Cu concentration causing > 10 % growth reduction was 5 mg/l. G. Quzounidou *et al.*(1992) and W. Maksymiec *et al.* (1995) also supported the results that in excess, the absorbed copper can be considered as a toxic element leading to growth inhibition.

It is generally accepted that heavy metal toxicity to plants is positively correlated to the concentration of metals in plant tissues; higher metal concentrations in the tissues usually induce stronger damage to the plants.Several studies have shown that most *Lemna* species retain less than 3% of their weight biomass after drying (Landesman 2000; Mkandawire, 2005). This means that the highest percentage of *Lemna* content is water just like many other aquatic emersed and even submersed macrophytes and algae (Mkandawire and Dudel, 2007). The results showed that for the growth of *L. minor* in winter season was very good. It was supported by Classen et al., 2000. According to Cheng *et al*. (2002) duckweed cold tolerance allows it to be used for year round wastewater treatment in areas where tropical macrophytes, such as water hyacinths can only grows in summer, Mkandawire *et al.* (2005) also showed that optimal temperature for *L. minor* is 18- 24° c.

Table 1. Effect of different concentrations of Cu on the fresh weight (gm) of *Lemna minor*

Cu (ppm)	SUMMER		WINTER	
	3 DAYS	5 DAYS	3 DAYS	5 DAYS
Control	5.54	6.01	5.84	6.44
5	4.87	4.62	5.02	4.82
10	4.63	4.26	4.85	4.36
20	4.34	3.97	4.52	4.07

Table 2. Effect of different concentrations of Hg on the fresh weight (gm) of *Lemna minor*.

Hg(ppm)	SUMMER		WINTER	
	3 DAYS	5 DAYS	3 DAYS	5 DAYS
Control	5.54	6.01	5.84	6.44
1	4.42	4.28.	4.45	4.32
3	4.30	4.08	4.31	4.15
5	4.05	3.83	4.05	3.92

Table 3. Effect of different concentrations of Cu+Hg on the fresh weight (gm) of *Lemna minor*.

Cu + Hg (ppm)	SUMMER		WINTER	
	3 DAYS	5 DAYS	3 DAYS	5 DAYS
Control	5.54	6.01	5.84	6.44
2.5+0.5	4.52	4.38	4.64	4.44
5+1.5	4.40	4.21	4.48	4.26
10+2.5	4.17	3.92	4.25	3.97

Table 4. Effect of different concentrations of Cu on the dry weight (gm) of *Lemna minor*.

Cu (ppm)	SUMMER		WINTER	
	3 DAYS	5 DAYS	3 DAYS	5 DAYS
Control	.241	.254	.247	.262
5	.228	.224	.231	.226
10	.226	.214	.228	.219
20	.212	.205	.218	.208

Table 5. Effect of different concentrations of Hg on the dry weight (gm) of *Lemna minor*.

Hg (ppm)	SUMMER		WINTER	
	3 DAYS	5 DAYS	3 DAYS	5 DAYS
Control	.241	.254	.247	.262
1	.218	.207	.222	.213
3	.205	.198	.214	.202
5	.197	.183	.200	.186

Table 6. Effect of different concentrations of Cu+Hg on the dry weight (gm) of *Lemna minor*.

Cu +Hg (ppm)	SUMMER		WINTER	
	3 DAYS	5 DAYS	3 DAYS	5 DAYS
Control	.241	.254	.247	.262
2.5+.5	.226	.214	.228	.220
5+1.5	.217	.203	.221	.208
10+2.5	.207	.195	.213	.199

Table 7. Effect of different concentrations of Cu on the biomass index of *Lemna minor*.

Cu (ppm)	SUMMER		WINTER	
	3 DAYS	5 DAYS	3 DAYS	5 DAYS
Control	1.108	1.202	1.168	1.288
5	.977	.925	1.005	.964
10	.927	.852	.957	.872
20	.872	.795	.904	.814

Table 8. Effect of different concentrations of Hg on the biomass index of *Lemna minor*.

Hg(ppm)	SUMMER		WINTER	
	3 DAYS	5 DAYS	3 DAYS	5 DAYS
Control	1.108	1.202	1.168	1 .288
1	.886	.856	.890	.898
3	.861	.817	.863	.830
5	.810	.767	.818	.784

Table 9. Effect of different concentrations of Cu+Hg on the biomass index of *Lemna minor*.

Cu +Hg (ppm)	SUMMER		WINTER	
	3 DAYS	5 DAYS	3 DAYS	5 DAYS

Control	1.108	1.202	1.168	1.288
2.5+0.5	.905	.877	.929	.889
5+1.5	.880	.842	.896	.853
10+2.5	.834	.784	.850	.794

The result that Hg is more toxic than any other metal was also supported by Servilla et al.(2005). They showed it on tomato growth. N.Dirilgen (2011)also showed that Hg is more toxic than Pb for *L.minor*. The effect of single metal is known to be influenced by the presence of other metals,resulting in inhibited or enhanced growth of one metal in the mixture (An et al.,2004). Several studies reported that the presence of one metal influenced the uptake of other metal (Peralta-Videa et al.,2002). Our studies show a higher effect of Hg than Cu, which confirms the results of An et al.(2004). The results of binary metal interactions was also supported by N. Dirilgen (2011). In this study it was observed that the metal effect efficiency of *L.minor* decreased in the presence of binary combinations of Cu and Hg with the increase in the toxicant concentrations as compared to cases where either metal was alone in the medium. This was classified as an antagonistic interaction.

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EXISTING MARKETING PATTERN AND SLAUGHTERING SYSTEM OF GOAT IN CHHATTISGARH

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Abstracts : This study was conducted on 120 goat keepers selected from twelve villages of Mahasamund district of Chhattisgarh state during the year 2010 to ascertain the existing marketing pattern and slaughtering system of goats. The study reveals that majority of respondents had sold live animal only and sold them at home and most of the respondents had no transport facilities for selling their goats. About 13 per cent of the respondents had been slaughtering their goats of less than 12 months old age and they slaughtered their goats anywhere as per suitability. The price of the live goat rate ranged from Rs. 1500 to 6000 and average rate per goat was Rs. 2725 and range of chevon/ kg rate varied from Rs. 80 to 200 with average rate of Rs. 140/kg.

Keywords: Goat rearing, Marketing pattern, Slaughtering system

INTRODUCTION

Goat popularly known as poor man's cow is widely distributed and clearly associated with poor people, their economic contribution is extremely important for the security and livelihood of these people throughout the developing countries. This contribution is varied, and the importance is reflected in terms of revenue generation, cash security and enhanced qualitative human nutrition. The contribution of goat to all the above said is well documented (Devendra, 1992; Kumar and Singh; 1992; Kumar *et al*., 1986; Naidu *et al*., 1991; Singh and Ram, 1987).

The total livestock population in the world is estimated at 4435.1 million heads in which current population of cattle, buffaloes, sheep, and goat is around 1355, 174, 1081, and 808 million, respectively. Asian region possesses about 33.61, 96.88, 42.29, and 64.33 per cent and India 13.65, 56.31, 5.79, and 14.87 per cent of the total world's production of the four respective livestock species. The developing countries of the world have about 94.5 per cent of the goats and the developed countries have only the rest 5.5 per cent. India possesses about 124 million goats making 14.87 per cent of the world population stands second to China. Although the population of all livestock species shows increasing trend since 1951, the goat population has increased at a much faster than other in India. The growth rate of goats in India has varied from 0.95 to 5.10 per cent with an average of 3.05 per cent during 1951 to 2005 in spite of about 41 per cent slaughter and about 15 per cent natural annual mortality. The goats around the world contributed 12438.4 TMT of milk, 4562.1 TMT of meat and 985.9 TMT of fresh skins per annum. The Asian region contributed 54.08 per cent of the milk, 75.34 per cent of the meat and 79.91 per cent of the fresh skins of the world production of goats. India produced 2700 TMT of milk, 475 TMT of meat and 130 TMT of skins, 8.5 MT pumina and 400 TMT of manure which make 21.71 per cent of the milk, 10.47 per cent of the meat and 13.15 per cent of fresh skins of the world goat production. The estimated value of different types of goat produces works out to about Rs. 1, 06,335 million per annum.

India stands 8th rank in meat production and 3rd in goat meat production in the world. Between 1961 and 2006, the total meat production in India increased from 1.69 MT to 6.10 MT (2.23% of total world meat production). The share of goat meat is estimated at 0.475 MT (23 % of total meat). The per capita consumption of meat (8.3kg) is quite low as compared to other developed countries of the world. The goat sector also generates about 5 per cent rural employment and about 20 million families belonging to small and marginal farmers and landless laboures are engaged in goat keeping (*FAO*, 2006-07).

In India the total goat population is about 124.4 million or 16.20 per cent of global population heads with the annual growth rate of 0.22 per cent (Anonymous, 2006). There are 12 research centers on goat in India (Prasad, 2009). There are 250 commercial goat farms have been established in different parts of the country (Singh, 2007). Goats make important economic contribution in India. The size and magnitude of the contributions have not been adequately assessed. However, a few reports available do justify their claim to equally if not superiority with other livestock. They are so vital to a large human population that their contribution to national economy cannot be over looked.

Keeping this consideration in view, an attempt was made to make an in depth analysis of goats farming in general with the following specific objectives:

To determine the marketing pattern and slaughtering system of goats in the selected villages.

MATERIAL AND METHOD

The study was conducted in three blocks of Mahasamund District of Chhattisgarh state, viz., Pithora, Basana, and Saraypali. Four villages from each block (Total 3X4=12) were selected purposively. In this way the villages namely Thakurdiya, Bagarpali, Chaukbeda and Durugpali villages from Pithora block, the villages Bhukel, Bitangipali, Chhuhipali and Barpeladih from Basana block and Harratar, Sahajpani, Dudumchuaan and Mohanmuda villages from Saraypali block were selected randomly. 10 goat keepers from each selected villages were taken randomly by using proportional size of sampling techniques.

Therefore, the total sample size for this study was 120 goat keepers. The data were collected with the help of pre-tested structural interview. These information's were measured with the using suitable statistical methods such as frequency, percentage, range and mean (average).

RESULT AND DISCUSSION

Marketing pattern

The data regarding existing marketing pattern of goat are presented in the Table 1. The findings indicated that the majority of the respondents (86.67%) had reported that they were selling goats in live only, while only 13.33 per cent had sold live + slaughtered goats for getting remuneration to meet out their daily needs. Selling of only slaughtered meat (chevon) was nil.

Regarding place of selling of goats, the data revealed that the majority of the respondents (53.33%) were selling of their goats at home, followed by 26.67 per cent of the respondents had sold their goats in the market and only 20 per cent respondents reported that there was no fixed place for selling of their goats.

Regarding ways of selling goats, majority of the respondents (85.84%) were selling their goats by themselves followed by 10.33 per cent and 3.33 per cent of the respondents were selling their goats by other members of family and permanent/ casual labour, respectively.

About optimum age for selling of goats, the data revealed that the maximum number of the respondents (45%) had considered 1 ½ years old age of goats for live selling, followed by 43.33 per cent and 11.67 per cent had considered less than 1 years old and above 1 ½ years old age of goats for live selling, respectively.

Regarding suitable season for selling of goats, majority of the respondents (65%) reported that there was highest selling of goats in summer season, followed by 27.50 per cent and 7.50 per cent of the respondents had reported that the rainy and winter season is suitable for selling of their goats, respectively.

Table 1: Distribution of respondents according to their existing marketing pattern of goats

Particulars	Frequency	Percentage
I. Kind of sale		
• Live animal only	104	86.67
• Slaughtered (chevon)	00	00.00
• Live + slaughtered	16	13.33
II. Place for selling		
• No fixed place	24	20.00
• At home	64	53.33
• In the market	32	26.67
III. Ways for selling		
• Self	103	85.84
• Other member of the family	13	10.83
• Permanent/ casual labour	04	03.33
IV. Optimum age for selling of goats		
• < 1 year old	52	43.33
• 1 to 1 ½ year old	54	45.00
• > 1 ½ year old	14	11.67
V. Suitable season for selling		
• Rainy season	33	27.50
• Winter season	09	07.50
• Summer season	78	65.00
VI. Major occasion for selling		
• Bakri Id	16	13.33

• Christmas/ new year	23	19.17
• Holi/ Dashahara	48	40.00
• Others (*Chher-Chhera, Sawan, Election, Marriage season, Id-Ul-Fitar etc.*)	33	27.50
VII. Transportation facilities		
• No transport facilities	69	57.50
• Rickshaws/ Cycle	46	38.33
• Tempo/ Taxi	03	02.50
• Motor cycle	02	01.67

(n=120)

Regarding major occasion for selling of goats, majority of the respondents (40%) reported that the Holi/ Dashahara were the major occasion for maximum selling of their goats followed by 27.50 per cent, 19.17 per cent and 13.33 per cent of the respondents reported that the other occasions (Chher-chhera, Sawan, Elections, Marriage season and Id-Ul-Fitar etc.), Christmas/ New year and Bakri Id was the most suitable occasion for the optimum selling of their live goats, respectively.

Regarding transportation facilities, majority of the respondents (57.50%) had no transportation facilities followed by 38.33 per cent, 2.50 per cent and 1.67 per cent of the respondents had used transportation facilities to transport their goats to the market by rickshaws/ cycle, tempo/ taxi and motor cycle, respectively. Acharya and Singh (1992), Ajala *et al.* (2008) and Mohan *et al.* (2007) also found similar findings in their study.

Existing slaughtering system

The data regarding existing slaughtering system are presented in the Table 2. Only 16 respondents are involved in slaughtering of goats. Out of total involved respondents in slaughtering, majority of them (56.25%) considered less than 12 months old age for slaughtering of their goats followed by 31.25 per cent and 12.50 per cent considered 13 to 18 months old and more than 18 months old for optimum age for slaughtering, respectively. As regards to place of slaughtering, 81.25 per cent of the respondents slaughtered their goats in anywhere and 18.75 per cent of the respondents had slaughtered their goats in the slaughtering house.

As regards to member involved in slaughtering, 50 per cent respondents had slaughtered their goats by self followed by 31.25 per cent and 18.75 per cent had slaughtered by other family members and other professional/ hired person, respectively. About 62.50 per cent of the respondents had slaughtered the goats occasionally and similar number of respondents i.e. 18.75 per cent of the respondents had slaughtered their goats regularly and rarely. As regards to rate of live goats, the range varied between Rs. 1500 to 6000 and average rate of per goat was Rs. 2725. About rate of chevon/ kg, the range varied between Rs. 80 to 200 and average rate of chevon/kg was Rs. 140.

Table 2: Perception of the respondents about their existing slaughtering system (n = 16)

Particulars		Frequency	Percentage
I.	**Optimum age for slaughtering**		
•	< 12 months	09	56.25
•	13 to 18 months	05	31.25
•	> 18 months	02	12.50
II.	**Place for slaughtering**		
•	In slaughtering house	03	18.75
•	Anywhere	13	81.25
•	Other's	00	00.00
III.	**Member involves in slaughtering**		
•	Self	08	50.00
•	Other family member	05	31.25
•	Other professional/ hired person	03	18.75
IV.	**Level of slaughtering**		
•	Regular	03	18.75
•	Occasional	10	62.50
•	Rarer	03	18.75
V.	**Rate of live goats (n = 120)**		
•	Range	Rs. 1500-6000	
•	Average	Rs. 2725	

VI.	Rate of chevon/ kg	
•	Range	Rs. 80-200
•	Average	Rs. 140

CONCLUSION

On the basis of findings of the study it may be concluded that the majority of the respondents had sold live goats only and sold them at home. Most of the goat keepers considered 1 to 1 ½ years were optimum age for live selling and less than 12 months was the optimum age for slaughtering. Summer season was the highest selling season and holi/ dashahara was the highest selling occasion. For transportation they used mostly rickshaw/ cycle, tempo/ taxi and motor cycle.

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INFLUENCE OF *PSEUDOMONAS* VP-2 ON GROWTH OF SOYBEAN CROP

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Abstract: *Pseudomonas* VP-2 showed highest shoot, root dry weight, number of nodules per plant and nodules dry weight by 186.36, 283.33, 201.33 and 225% respectively as compared to control. All *Pseudomonas* strains showed improved shoot dry weight, root weight ranges between 147 to 186% and 194.66 to 201% respectively as compared to control. Although control plant also produced nodules but *Pseudomonas* bacterized seeds improved nodulation by 188 to 201% as compared to control. Similarly, nodules dry weight also got enhanced by 212.5 to 225% as compared to control. All the results suggested that *Pseudomonas* improves the plant growth and productivity in Soybean crop.

Keywords: *Pseudomonas*, PGPR, Soybean

INTRODUCTION

Plant growth promoting rhizobacteria (PGPR) were first defined by Kloepper and Schroth (1978) to describe soil bacteria that colonize the roots of plants following inoculation onto seed and they enhance plant growth. These biofertilizer is alternative source of chemical fertilizer (Deshwal et al., 2011a). Biofertilizer can promote plant growth and productivity. They have internationally been accepted as an alternative source of chemical fertilizer. These rhizobacteria effectively colonize plant root and increases plant growth by production of various plant growth hormones, P-solubilizing activity, N_2- fixation and biological control activity (Deshwal et al., 2003). Few strains from genera such as *Pseudomonas*, *Azospirillium*, *Azotobacter*, *Bacillus*, *Burkholderia*, *Enterobacter*, *Rhizobium*, *Erwinia* and *Flavobacterium* are well known PGPR (Rodriguez and Fraga, 1999; Misko and Germida, 2002).

Pseudomonas sp. is ubiquitous bacteria in agricultural soils and and has many traits that make them well suited as PGPR. The most effective strains of *Pseudomonas* have been *Fluorescent Pseudomonas* spp. Considerable research is underway globally to exploit the potential of one group of bacteria that belong to *Fluorescent pseudomonas* (Flops). FLPs help in the maintenance of soil health and are metabolically and functionally most diverse (Lata et al., 2002; Lugtenberg and Dekkers 1999). *Pseudomonas* sp has been reviewed for the biofertilizer, phytostimulator and phytopathogen biocontrol activities. Direct plant growth activities of *Pseudomonas* sp include the production of Indole Acetic Acid (IAA) (Vasanthakumar and McManus, 2004) and siderophore (Dey *et al*., 2004), phosphate solubilization (Wu *et al*., 2005), ACC deaminase production, root elongation, degradation of toxic compound (Bano and Musarrat, 2003), as biological control agent for phytopathogens (Dey *et al*., 2004) and residual effect of *Pseudomonas* has been observed in Rice crop (Deshwal et al., 2006). In present study, *Pseudomonas* strains were selected due to their plant growth activity and also evaluated there PGPR activity.

MATERIAL AND METHOD

Isolation of *Pseudomonas* strains: *Pseudomonas* strains were isolated from soil of cultivated field. 1g of rhizosphere soil dissolved in 9ml sterilized distilled water in test tube and mixed well. Sample was diluted up to $1/10^5$ dilution. 0.5ml sample of each tube was spread on separate King's B Agar plates. Plates were incubated at 28^oC for 24h. Fluorescent colonies on agar medium were purified.

Characterization of *Pseudomonas* strains: Twenty *Pseudomonas* strains were characterized on the basis of gram staining and bio-chemicals tests. These tests were done according to Bergey's manual of Determinative Bacteriology (Holt et al., 1994).

Screening of Plant growth promoting activity of *Pseudomonas* strains: These strains were screened on the basis of plant growth promoting activity such as IAA, HCN, siderophore production and P-solubilization.

(i) Indole production test: Tryptone broth was prepared and transferred into test tubes. After sterilization, these test tubes were then inoculated with the culture and one tube was kept uninoculated as control. These inoculated tubes incubated at 28^0C for 24h. After 24h of incubation, added 1ml of kovac's reagent to each tube including control. Shaked the tubes gently after intervals for 10-15 mins and allowed tubes in standing position. Development of cherry red colour in the top layer of the tube indicated a positive result.

(ii) HCN production: *Pseudomonas* strains were streaked on TSM medium plates supplemented with 4.4g per litre glycine with simultaneously supplemented filter paper soaked in a 0.5% picric acid in 1% Na_2CO_3 in the upper lid of Petri plate. The plates were sealed with paraffin and control plates did not receive any *Pseudomonas* inoculum. Plates were incubated at 28 ± 1^0C for 1-2days. Change in colour of the filter paper from yellow to brown,

moderate brown to strong reddish brown indicated HCN production.

(iii) Siderophore production: Siderophore production was tested by using chrome-azurol S (CAS) assay medium. *Pseudomonas* strains were spread over tryptic soya agar medium and incubated at 28±1°C for 24 h. Thereafter, a thin layer of CAS reagent in 0.7% agar was spread over the colonies of *Pseudomonas* and plates were re-incubated at 28±1°C for 24-48h. Observation formation of yellow-orange halo around the colony shows siderophore production.

(iv) P- solubilization test: *Pseudomonas* strains were transferred on Pikovaskya's Agar medium and inoculated at 28±1°C for 3-5days. Observed clear zone around the colony showed P- solubilization.

Pot experiment

(a) Seed bacterization: Soybean seeds were surface-sterilized with 0.5% NaOCl solution for 1–2 min, rinsed in sterilized distilled water and dried under a sterile air stream. Cells of *Pseudomonas* strains were grown under continuous shaking condition (120 rpm) on King'B broth respectively, at 28 ± 1°C for 24h. Each culture was separately centrifuged at 7000 rpm for 15 min at 4°C. The culture supernatant was discarded and the pellets were washed with sterile distilled water (SDW) and resuspended in SDW to obtain a population density of 10^8 cfu ml^{-1}. The cell suspension was mixed with 1% carboxymethylcellulose (CMC) solution. The slurry was coated separately on the surface of soybean seeds and allowed to air-dry overnight in aseptic condition. The seeds coated with 1% CMC slurry without bacterial strains served as control.

(b) Pot size and soil: Sterile earthen pots (24 cm × 12 cm × 12 cm) were filled with unsterilized sandy loam soil (0.25% total organic matter, 0.096% total organic C, 38% water-holding capacity, pH 6.5).

(c) Treatments: Total 09 treatments were prepared and these are treatment I: *Pseudomonas* VP-2, treatment II: *Pseudomonas* VP-5, treatment III: *Pseudomonas* VP-7, treatment IV: *Pseudomonas* VP-11, Treatment V: Pseudomonas VP-15, Treatment VI: *Pseudomonas* VP-16, Treatment VII: *Pseudomonas* VP-19, Treatment VIII: *Pseudomonas* VP-20 and Treatment IX: control (non-bacterized seeds). After 15 days, thinning was done to raise only single healthy plant in each pot. The plants were irrigated with sterilized water whenever required. Plant data such as plant shoot dry weight; plant root dry weight, number of nodule per plant and nodule dry weight per plant were recorded after 60 days of sowing.

Table 1. Production of HCN, siderophore, IAA and phosphate solubilization by *Pseudomonas* strains.

Pseudomonas	HCN	Siderophore	IAA	P-solubilization
Pseudomonas VP- 1	+	+	-	+
Pseudomonas VP-2	+	+	+	+
Pseudomonas VP-3	+	-	+	-
Pseudomonas VP-4	-	+	+	+
Pseudomonas VP-5	+	+	+	+
Pseudomonas VP-6	+	+	+	-
Pseudomonas VP-7	+	+	+	+
Pseudomonas VP-8	-	-	+	+
Pseudomonas VP-9	-	+	+	+
Pseudomonas VP-10	+	+	-	+
Pseudomonas VP-11	+	+	+	+
Pseudomonas VP-12	+	-	+	+
Pseudomonas VP-13	+	+	+	-
Pseudomonas VP-14	-	+	+	+
Pseudomonas VP-15	+	+	+	+
Pseudomonas VP-16	+	+	+	+
Pseudomonas VP-17	-	+	+	+
Pseudomonas VP-18	-	-	+	+
Pseudomonas VP-19	+	+	+	+
Pseudomonas VP-20	+	+	+	+

Table 2. Effect of *Pseudomonas* on plant growth of Soybean plant after 60DAS.

S. No	Treatment	Shoot dry weight (g/plant)*	Root dry weight (g/plant)**	Number of nodules / plant*	Nodules dry weight (g/plant)**
1	*Pseudomonas* VP-2	8.2	3.4	75.5	0.54

2	*Pseudomonas* VP-5	6.5	2.6	71.5	0.50
3	*Pseudomonas* VP-7	7.9	3.0	74.0	0.53
4	*Pseudomonas* VP-11	6.1	2.4	73.0	0.52
5	*Pseudomonas* VP-15	7.9	3.0	74.0	0.53
6	*Pseudomonas* VP-16	6.5	2.6	70.5	0.51
7	*Pseudomonas* VP-19	8.0	3.2	74.5	0.53
8	*Pseudomonas* VP-20	6.1	2.3	70.5	0.52
9	Control	4.4	1.2	37.5	0.24

Values are mean of four replicates. Ns- non-significant at 0.05 level of ANOVA *- significant at 0.05 level of ANOVA, **- significant at 0.01 levels of ANOVA.

RESULT AND DISCUSSION

Twenty *Pseudomonas* strains were characterized on the basis of different bio-chemicals tests. Our results were compared with Bergey's Manual of Determinative Bacteriology (Holt et al., 1994). Further, these strains were screened on the basis of plant growth activity such as HCN, Siderophore, IAA and P-solubilization.

Change in colour of filter paper soaked in 0.5% picric acid in 1% Na_2CO_3 from yellow to brown, which showed that strains were HCN positive. *Pseudomonas* VP-1, VP-2, VP-3, VP-5, VP-6, VP-7, VP-10, VP-11, VP-12, VP-13, VP-14, VP-15, VP-16, VP-19 and VP-20 were HCN positive. In Siderophore positive strains showed yellow orange halo around the colony when grown on chrome-azurol S (CAS) assay medium. Such observation had been seen in *Pseudomonas* VP- 1, VP-2, VP-4, VP-5, VP-6, VP-7, VP-9, VP-10, VP-11, VP-13, VP-14, VP-15, VP-16, VP-17, VP-19 and VP-20. All *Pseudomonas* strain except *Pseudomonas* VP-1 and VP-10 produced Indole Acetic Acid (IAA) which is plant growth hormones. IAA reacts with ortho-phosphoric acid and produced pink colour. Clear zone around the colony of *Pseudomonas* strains on Pikovskya's agar medium showed P-solubilization. All *Pseudomonas* strains except *Pseudomonas* VP-3, VP-6, VP-13 were solubilised Phosphorous (Table 1). *Pseudomonas* VP-2, VP-5, VP-7, VP-11, VP-15, VP-16, VP-19, VP-20 improved shoot dry weight by 186.36, 147.72, 179.54, 138.63, 179.54, 147.72, 181.81, 138.63 % respectively as compared to control. *Pseudomonas* VP-2, VP-5, VP-7, VP-11, VP-15, VP-16, VP-19, VP-20 enhanced root dry weight by 283.33, 216.66, 250.00, 200.00, 250.00, 216.66, 266.66, 191.66% respectively as compared to control. *Pseudomonas* VP-2, VP-5, VP-7, VP-11, VP-15, VP-16, VP-19, VP-20 showed number of nodules per plant by 201.33, 190.66, 197.33, 194.66, 197.33, 188.00, 198.66, 188.00,% respectively as compared to control. *Pseudomonas* VP-2, VP-5, VP-7, VP-11, VP-15, VP-16, VP-19, VP-20 increased nodules dry weight by 225.00, 208.33, 220.83, 216.66, 220.83, 212.50, 220.83, 216.66% respectively as compared to control (table 2).

Results suggested that isolated *Pseudomonas* strains showed plant growth promoting activity such as HCN, Siderophore, IAA and P-solubilization. Deshwal et al., (2011b) reported that Plant growth promoting Rhizobacteria improved the plant growth by production of HCN, IAA, Siderophore and P-solubilization. Lippman *et al.* (1995) stated that PGPR could directly enhance plant growth by phytohormones production and enhanced nutrient uptake. Further, our data showed that these strains improved the plant growth activity in Soybean crop. Similarly, Deshwal et al., (2006) observed the same observation in *Pseudomonas* GRC_1 and mentioned the residual effect of *Pseudomonas* in Rice crop. Deshwal et al., (2011c) observed that *Pseudomonas* P3 improved dry shoot weight, dry root weight in *Mucuna* plant by 168, 132% respectively as compared to control. All the above data and information clearly indicated that isolated strains showed plant growth promoting activity in soybean crop.

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GENETIC VARIABILITY IN DIFFERENT ENVIRONMENT IN CHICKPEA (*CICER ARIETINUM* L.).

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Abstract : 50 genetically diverse genotypes of chickpea were studied for Variability Heritability, and Genetic advance in 10 quantitative characters Days to 50 % flowering, Days to maturity, Plant height, No. of branches, Number of pods/plant, No. of seed/pod, 100 seed weight (g), Biological yield/plant, Seed yield per plant and Harvest index. In the vary late sowing condition (E3 and E6) five traits, days to flowering, plant height, total branches, seeds per pod and 100 seed weight showing high estimates of PCV. It was also concluded that days to flowering, plant height, pods/plant, 100 seed weight and harvest index showed high heritability coupled with high EGA. The influence of changing plantings dates was significant on various parameters of variability.

Keyword : Variability, Heritability, Genetic advance

Abbereviation : PCV- Phenotypic coefficient of variation, EGA-Expected genetic advance

INTRODUCTION

India is the largest pulses producing nation in the world. Pulses are mainly grown in rainfed area. India has 35 per cent of the world area and 21.2 per cent of the production of chickpea (*Cicer arietinum* L.) and is the major grain legume crop of the country. It is grown over an area of 6.50 million hectares and produces 5.32 million tones. Some favorable trends have been observed in recent past as the production of pulses was 13.00 million tons in 2001-2002 and the productivity was 603 kg per hectare.

Genetic variability is very important for the improvement of crop plants. More the variability in the population the greater are the chances for producing desired plant types. Heritability estimates and genetic advance in a population provides information about the expected gains in the following generations. The most important function of heritability estimates in the genetic studies of quantitative characters is their predictive role possible advances through selection based on phenotypic values can be predicated only from knowledge of the degree of correspondence between phenotypic and genotypic values.

Variability may be created after hybridization if this is not present among Genetic the parents in self-pollinated crops to the desired extent. Coefficient of variability is an important parameter used to measure variability (phenotypic and genotypic) in the breeding material.

Since all characters are not influenced by environment to the same extent, the observed total or phenotypic variability is not a true indicator of the genetic variability present in the material for measuring the progress that is possible by affecting selection in the genetically diverse material. Hence a valuable guiding criterion for a plant breeder is an estimation of genetic advance.

MATERIAL AND METHOD

The present investigation was carried out at Department of Botany, J.V College, Baraut (Bagpat) Uttar Pradesh. The experiment material consisted of 50 divergence genotypes of chickpea. The genotypes were obtained from IARI New Delhi Pusa.

Fifty genotypes of chickpea were evaluated in a randomized complete block design with three replications during rabi seasons of 2006 -2007 and 2007-2008. In each of the two year, the experiments were repeated over three dates of sowing. The three dates of sowing were 20 October, 05November, 20 November. In each of the six experiments (3 sowing dates x 2 years), each genotype will be raised in a plot of 1.8 m2 (4 rows x 4m length x 40cm inter row distance) with a plant to plant distance 20 cm. in each replication. All the recommended agronomic practices were followed to raise a good crop. The observations were recorded on five competitive and random plants per replication and mean values expressed per plant basis, at harvest stage. The single plant observations were recorded on different groups of cultivars during both the years both the plantings, respectively. For analysis of seed yield and its component traits, non-destructive sampling was reported at harvesting stage.

The observations on ten morphological traits were recorded on the cultivars at harvest stages Days to 50 % flowering, Days to maturity, Plant height, No. of branches, Number of pods/plant, No. of seed/pod, 100 seed weight (g), Biological yield/plant, Seed yield per plant and Harvest index .

RESULT AND DISCUSSION

Statistically, the total variability is expressed in terms of phenotypic coefficient of variation (PCV) and the genotypic variability is expressed in terms of genotypic coefficient of variation (GCV). These parameters of variability are particularly very informative when a breeder is interested in having a stock of the comparative account of variability present in different traits, which might have been measured in different units.

Variability in population, especially in respect to the characters for which improvement is sought, is a prerequisite for successful selection. The population under study was therefore examined to assess the amount of variability presented among different cultivars in respect to a number of metric traits.

In the present study, a wide range of variation was displayed by different traits across the environment. The success of selection depends on the extent of genetic variability present for the trait in the vary late sowing condition (E3 and E6) five traits, days to flowering, plant height, total branches, seeds per pod and 100 seed weight showing high estimates of PCV. Suggested that adequate variability is present for these traits and hence there is a scope for employing suitable breeding programs for bringing about improvement in these traits under late sown condition.

Data in Table Revealed that heritability estimates in environment (E1) were highest for 100 seed weight (95.10) and lowest value for heritability were found for the trait days to flowering (50.20). In E2, heritability varied from biological yield (29.80) to 100 seed weight (86.50). In very late sowing of first year (E3) the heritability was lowest (41.40) for seed yield per plant and highest for seeds per pods (92.00). On the other hand, the estimates of heritability in early sowing in second year E4 varied from 84.90 for days to flowering to 93.30 for 100 seed weight. In E5, the lowest value of heritability was recorded for the trait biological yield (87.50) and the highest value was recorded for the total branches (92.70). In E6, the values varied from 6.16 for biological yield to 91.0 for seeds per pods.

The estimates of heritability in relation to plant height were changing from environment to environment between the ranges of 95.10 to 50.20 per cent which indicated the influence of varying environmental conditions on the expressivity of the heritability of this trait. It is pertinent to mention that GCV, PCV and GA for plant height under varying environments were of low magnitude which shows that varying environments has negligible influence on these parameters of variability.

It is interesting to note that when these parameters were studied on the basis of pooling of data the magnitude was also of low order. High estimates of heritability were also reported by Chandra (1968), Mishra *et al.* (1988), Mishra (1991), Sandhu and Mandal (1989), Sharma *et al.* (1990) and Rao *et al.* (1994) for this character.

Thus, it is evident that pant height was influenced by change in planting dates.

The heritability estimates for number of branches under all the environments were observed between 73.20 to 92.70 per cent which suggest that heritability was influence by environmental changes. The PCV for this trait was observed between 8.77 to 11.19 in different environments which again show some marginal influence of environmental changes for this trait. Genetic advance for this trait, it was of very low magnitude with some marginal difference from environment to environment. On pooling basis the heritability estimates were of medium range and GCV, PCV and GA were of low magnitude. The low heritability estimates were reported by **Rao *et al.* (1994)** and high by Mathur and Mathur (1996) for this trait. High genetic advance was reported by Mishra *et al.* 1988, Rao *et al.* (1994) Thus, it was suggested that changing environmental conditions played major role in the expressivity of this trait.

Data in table Indicate that estimates of expected genetic advance (EGA) in E1 or early sowing of first year varied from 0.29 for seeds per pod to 7.11 for plant height, whereas in second year early sowing E4 it's ranged from 0.23 for seeds per pod to 16.86 for plant height similar as (E1). In E2 second date of sowing of first year the EGA varied from 0.09 for seeds per pod to 7.18 for days to flowering whereas, in E5 second date of sowing of second year the expected genetic advance varied from seeds per pod (0.23) to plant height (12.82). In E3 it's varied from 0.46 for seeds per pod to 13.03 for plant height whereas, in E6 the lowest EGA value was recorded as 0.46 for seeds per pod and the highest EGA was recorded for the trait plant height 13.39.

In the present study the value of EGA was high for four traits in all the six environments. High value of genetic advance for these traits, such as days to flowering, plant height, pods per plant and 100 seed weight shows that these characters are governed by additive gene action and selection will be rewarding for improvement of such traits. If the value of genetic advance is low, it indicates that the character is likely to be governed by non-additive gene action and the heterosis breeding may be useful for such traits. Similar result obtained by **Rao *et al.* (1994)** and high by Mathur and Mathur (1996) for this trait. High genetic advance was reported by Mishra *et al.* 1988, Rao *et al.* (1994) Thus, it was suggested that changing environmental conditions played major role in the expressivity of this trait.

Table : Estimates of mean, range, phenotypic coefficient of variation, heritability and genetic advance for 10 traits of six environments in chickpea

S.No.	Traits	Environments	Parameters				
			Mean	Range	PCV	H^2	EGA
1	daDays to 50%	E1	57.26	47.06 – 63.76	7.59	50.20	4.49
	Flowering	E2	55.23	43.80 – 67.02	10.55	59.80	7.18
		E3	39.28	30.42 – 46.20	11.51	72.50	6.76
		E4	67.19	60.60 – 70.47	3.81	84.90	4.47
		E5	56.22	45.93 – 61.66	8.79	48.10	1.83
		E6	39.41	31.40 – 46.20	11.83	69.70	6.69
2	Days to maturity	E1	106.97	103.89 – 110.10	1.70	82.80	3.10
		E2	105.96	101.76 – 109.16	2.02	43.10	1.90
		E3	106.99	102.13 – 112.38	2.79	56.90	3.50
		E4	117.73	115.74 – 122.21	2.44	16.90	1.00
		E5	106.73	104.40 – 108.96	2.88	42.10	1.49
		E6	107.07	103.03 – 112.38	2.70	55.30	3.30
3	Plant height	E1	145.75	138.86 – 153.11	2.78	85.30	7.11
	(cm)	E2	144.58	140.53 – 151.10	2.32	69.80	4.81
		E3	149.51	133.33 – 163.52	4.74	89.30	13.03
		E4	153.35	134.55 – 169.15	5.70	93.70	16.86
		E5	152.22	139.31 – 166.49	4.67	55.90	12.82
		E6	149.13	137.51 – 162.29	4.86	89.70	13.39
4	Total branches	E1	7.07	5.17 – 8.08	10.72	79.10	1.24
		E2	7.70	9.02 – 5.84	10.29	77.60	1.27
		E3	5.93	4.78 – 7.00	11.19	75.00	1.03
		E4	6.72	4.84 – 7.67	9.12	73.20	0.93
		E5	6.83	5.75 – 7.68	8.77	92.70	0.82
		E6	5.92	4.53 – 7.41	11.16	82.30	1.12
5	Pods per plant	E1	32.79	24.90 – 36.36	8.54	73.00	4.21
		E2	29.81	23.85 – 36.79	9.62	75.20	4.43
		E3	29.29	22.56 – 36.99	11.54	77.50	5.40
		E4	36.29	27.37 – 44.50	14.26	88.00	9.39
		E5	33.15	29.12 – 38.53	7.24	75.44	2.82
		E6	29.23	22.56 – 33.83	10.98	80.20	5.30
6	Seeds per pod	E1	1.39	1.17 – 1.82	12.21	83.70	0.29
		E2	1.30	1.26 – 1.61	6.31	52.50	0.09
		E3	1.33	1.05 – 1.93	18.32	92.00	0.46
		E4	1.28	1.06 – 1.62	11.19	76.70	0.23
		E5	1.45	1.15 – 1.74	10.07	56.90	0.23
		E6	1.34	1.08 – 1.92	18.11	91.00	0.46
7	100 seed weight	E1	23.75	15.01 – 33.25	21.74	95.10	5.18
	(g)	E2	23.83	20.34 – 29.67	13.41	86.50	5.70
		E3	21.98	11.26 – 33.29	30.01	97.30	13.22
		E4	22.99	14.67 - 32.94	21.92	93.30	9.69
		E5	24.10	15.81 – 33.25	20.29	66.00	9.35
		E6	22.15	11.90 – 33.57	29.98	96.80	13.25
8	Biological yield	E1	29.82	23.76 – 34.56	10.74	72.00	5.18
	(g)	E2	28.63	26.24 – 30.89	5.62	29.80	0.99
		E3	27.54	24.69 – 32.03	6.36	40.10	1.45
		E4	30.64	17.71 – 46.68	13.86	85.70	7.50

		E5	30.21	27.04 – 33.96	7.79	87.50	2.71
		E6	27.49	24.69 – 32.03	6.16	41.90	1.46
9	Seed yield / plant	E1	8.96	7.22 – 10.29	7.00	81.60	1.06
	(g)	E2	9.29	7.98 – 10.26	8.28	50.90	0.81
		E3	8.28	7.45 – 9.58	7.84	41.40	0.55
		E4	8.88	7.45 – 10.34	9.52	89.40	1.56
		E5	8.31	6.53 – 9.56	10.91	40.68	0.79
		E6	8.32	7.45 – 9.58	8.44	36.80	0.53
10	Harvest Index	E1	30.35	25.31 – 36.68	11.53	78.80	5.60
	(%)	E2	32.51	27.41 – 36.10	9.31	35.10	2.19
		E3	30.21	24.85 – 35.19	10.69	47.50	3.16
		E4	29.64	17.32 – 46.59	19.04	88.60	10.31
		E5	27.69	21.40 – 33.47	13.41	17.90	3.68
		E6	30.39	24.85 – 34.59	10.93	43.70	2.99

Data in table Indicate that estimates of expected genetic advance (EGA) in E1 or early sowing of first year varied from 0.29 for seeds per pod to 7.11 for plant height, whereas in second year early sowing E4 it's ranged from 0.23 for seeds per pod to 16.86 for plant height similar as (E1). In E2 second date of sowing of first year the EGA varied from 0.09 for seeds per pod to 7.18 for days to flowering whereas, in E5 second date of sowing of second year the expected genetic advance varied from seeds per pod (0.23) to plant height (12.82). In E3 it's varied from 0.46 for seeds per pod to 13.03 for plant height whereas, in E6 the lowest EGA value was recorded as 0.46 for seeds per pod and the highest EGA was recorded for the trait plant height 13.39.

In the present study the value of EGA was high for four traits in all the six environments. High value of genetic advance for these traits, such as days to flowering, plant height, pods per plant and 100 seed weight shows that these characters are governed by additive gene action and selection will be rewarding for improvement of such traits. If the value of genetic advance is low, it indicates that the character is likely to be governed by non-additive gene action and the heterosis breeding may be useful for such traits. Similar result obtained by Rao *et al.* (1994) and high by Mathur and Mathur (1996) for this trait. High genetic advance was reported by Mishra *et al.* 1988, Rao *et al.* (1994) Thus, it was suggested that changing environmental conditions played major role in the expressivity of this trait.

From Table it can be seen that the high estimates of heritability and EGA were observed for the traits: days to flowering, plant height, pods / plant, 100 seed weight and harvest index in all the environments which suggested that selection may be effective for these traits for all the six environments. In contrast high estimates of heritability coupled with low expected genetic advance were observed for the traits: days to maturity, no of total branches, biological yield and seed yield / plant indicating non-additive gene action.

In very late sowing (E3 and E6) the three traits days to flowering, plant height, pods/plant, 100 seed weight and harvest index showed high heritability coupled with high EGA, indicating that considerable improvement in these three traits may be achieved through selection in this environment.

The heritability estimates for this trait indicated that under normal and late plantings it was of higher and moderate magnitude, respectively. Thus, the influence of normal and late plantings was clearly visible in case of heritability for seed yield. When data was pooled the heritability estimates were approximately of moderate range and in case of GCV, PCV and GA, this range was of medium order in all the environments and also on pooling basis. The same pattern of heritability and genetic advance were reported by Rao *et al.* (1994). However, Mathur and Mathur (1996), Jahagirdar (1996) and Mandal and Bahal (1983) observed low genetic advance for seed yield.

Thus, it is important to mention that most of the quantitative traits have significantly superior performance under normal plantings in comparison to late plantings. It was also concluded that days to flowering, plant height, pods / plant, 100 seed weight and harvest index showed high heritability coupled with high EGA, indicating that considerable improvement in these three traits may be achieved through selection in (E3 and E6) environment.. Therefore, it was suggested that these two traits are stable in nature and selection can be exercise for these two traits at any point of generation advancement. The influence of changing plantings dates was significant on various parameters of variability.

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ETHNOMEDICINAL USES OF SOME PLANTS AMONG THE TRIBAL PEOPLE OF POONCH DISTRICT OF JAMMU AND KASHMIR NORTH WEST HIMALYA (INDIA)

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Abstract : The present manuscript highlights the occurrence of some common plants used to cure different ailments by the tribal and rural people along with local names in different areas of poonch district of jammu and Kashmir .An ethno botanical survey was made from jannuary 2010 - jannuary2012 and the data was collected through the cross examination of the inhabitants by visiting along with them in the field and in some cases by showing the herbarium sheets,live collection of the plants and photographs .The most common plant parts used to cure different disease are root, rhizome, leaves and even whole plant parts for the treatment of abdominal colic, sexual disorder ,spermmatorea,white discharge, dysentery and even the most dreaded diseases like cancer. The paper will be very useful for the scientific community in general and also for the conservation of traditional knowledge of the region .

Keywords : Ethno traditional, Knowledge, Poonch district (J&K) India, Rural, Tribal

INTRODUCTION

The ethno botanist all over the world are continuously trying to collect the information on the use of plants for various purposes ,such as food ,shelter and medicines at local regional and global level.The peoples in remote areas and tribals in far – flung areas have great faith in the effectiveness of medicinal herbs available from their surroundings. India is the rich repository of floral elements with more than 17500 flowering plant species out of which 3000 plant species have officialy recognized for their medicinal value .It is generally established that over 6000 plants in india are used for traditional ,folk and herbal medicines ,representing about 75% of the medicinal need of the third world countries(Rashid 2010).Significant work has been done to explore the medicinal plants of jammu and Kashmir as well as other parts of the country and world like[Kachroo and Nehvi(1976), Kacroo et al (1977), Sharma and Singh (1990), Jain (1991), Aswal (1996), Kapur (1999), Dangwal and Gour (2000), Sajim and Gosai (2006), Khan (2008), Chak *et al.* (2009), Tantry *et al.* (2009), Khan *et al.* (2009), Khan *et al.* (2010), Rashid (2010), Khan *et al.* (2011), Khan et al (2012) ,Mahmmod and Shah (2012).

The himalyan region of jammu and Kashmir in the lap of western Himalya decorated with snow coverd silver headed mountains is a reservoir varied types of floristic diversity and is also the home of many nomadic tribes like Gugger, Bakerwals and Paharis possessing rich amount of traditional knowledge about the plants .The way they have taken adventage of the surrounding vegetation has long been the subject of research .The jammu and Kashmir is having a good number of medicinal plants as compared to other parts of the country and so does the india with respect to other parts of the world .

Poonch district of Jammu and Kashmir is one of the hilly district of the state bounded by district rajouri in the west and Shopian in the east and Muzafrabad in the west .The district lies in between 33˚ 35 – 34˚ 10° north latitude and 73˚ 30° - 74˚ 35° east longitude with a total area of 16 74 square Kilometer Out of the total 1674 sq km about 56 %area is under forest where vegetation is degrading at an alarming rate due to cutting of roads and huge no of cattle .The altitude of the poonch district varies from 100 m above sea level to 400 m and above. The district has 4 tehsils 6 c d blocks an 8 Niabet. Due to lack of proper moterable roads and being in far-flung areas the , tribal and rural find it feasible to rely upon local herbal medicines for the treatment of various diseases by using plants in their own traditional method .Because of its wide altitudinal range , topography and climatic conditions the area under study shows a great deal of variation in its vegetation from subtropical to temperate and alpine. The collected ethno medicinal plants have been enumerated alphabeticay providing scientific name local name in bract and the cureable diseases in table-1.

S No	Botanical name	Family	Parts used	Disease to be cured	Method of preparation and mode of use
	Achyranthus aspera Linn. (Phutkanda)	Araceae	Rhizome	Kidney stone	Take 5 to 10 gram of fresh apmarg root and grind it in about 10 to 20 gram water .Give this solution of water to the patient it cures stone in urinary blader by breaking it into fine pieces .

	Acorus calamus Linn. (Bach)	Araceae	Rhizom e	Paralysis and abdominal worms	Give two to three gram of it rhizome powder along with water.
	Abelmoschus esculentus L (Bhindi)	Malvacea e	Fruit	Heamaturea	Grind about 100 gram of bhindi in about 250 gram of water until it gives mucilage.Give 60 to 70 gram of it to the patient again and again.
	Aconitum heterophyllum Linn. (Patrees)	Ranuncul aceae	Root	Fever	Take two gram pweder of patrees in about 10 30 gram butter it is usefull in malarial fever
	Adhatoda vesica Medikus (Baiker)	*Acanthac eae*	*Leaves*	*Toothache* *Cough and cold*	*Prepare decoction of its leaves and use it to gargle the teeth.* *Prepare decoction of about 20 gram of its leaves and add misri(sugar)in it .Give it to the patient at morning and evening time.*
	Ajuga bracteosa Wallich ex Benth (Rati booti)	lamiaceae	Whole plant	Diuretic	About 10-2-0 gram fresh plant is grnded with stones and juice of the plant is given on urinary disorder
	Alium cepa Linn. (Payas)	sexual problem & heart p roblem			1;Take about 200 gram to 250 gram onion daily as slad . 2;About 10 -12 gram juice of onion is very usefull for heart patient.
	Alium sativum Linn. (Thoom)	Lilliaceae	Bulb	Dog bite	Paste of bulb is applied externally .About 2 to 4 gram bulb is also taken orally for three to four days.
	Argyrolobium indica (Baguni)	Fabaceea	All aerial parts	White discharge and spermmator r	About 20 to 30 gram its areal parts are grinded and the soaked in about 200 ml of water at night and given in the morning .
	Asparagus filicinus Buch.Ham. (Bansabooni)	Asparaga ceae	Root	Dandruf	Grind its roots in water and wash hairs with it.
	Abies pindrow	Pinaceae	Stem bark	Abdominal colic	Decoction of the bark is taken on abdominal colic .
	Berberis lycium	Berberida ceae	Fruit and leaves	Constipatio n and wounds	Take fruits of it as much as can eaten or about 250 gram two to three times in a day. Paste of leaves is applied on wounds caused by sickle during cutting of grass.
	Calotropis procera R Br (Ak)	Asclepedi aceae	1 Eye pain 2 Earache	Latex and leaves	1 Smear the nails of right foot if the pain is in left eye and left foot if the pain is in right eye.It will give quick pain in eyes . 2 crush the leaves and take their jues put two to three drops in ear.
	Capscicum annuum Linn. (Rati marchi)	Solanace ae	Fruit	Cholera	Dip finely dried powder in honey and give this to the patient of cholera equal to the grain of wheat(1 rati) after an interval of two hours.
	Chenopodium album Linn. (Bathwa)	Chenopo diaceae	Leaves	Bladder stone	Biol about 60 -70 gram of its leaves in water at night as you make vegetable .Give this vegetable to the patient at morning at empty stomach for one month it cures the stone of urinary bladder
	Coriandrum sativum L. (Tandel)	Apiaceae	Leaves	Dysentry & Vomiting	Take 10 gram leaves of coriander 6 gram ajwain 6 gram salt and crush them in water to form a solution and give this solution to the

					patient.
	Dactylorhiza Hategera (Panj anglio)	Orchidaceae	Root	Sexual problem	**About 6 gram poweder is used daily along with milk.**
	Datura stramonium Linn. (Tatura)	Solanaceae	Fruit	Rheumatism	Paste of seeds is made by grinding with stones along with water .Apply this paste on rheumatoid swelling of knees at bed time and tie with the help of cotton cloth
	Flemengia fruticulosa Linn. (Morini jari)	Fabaceae	Root	Respiratory problem	Prepare a deep red decoction of root by mixing with milk and salt as per taste and give the patient on phelum in chest.
	Fumaria indica L. (Papera)	Fumaraceae	Whole plant	Blood purifier	Use five gram of its poweder daily
	Gerbera Gossypina Royle (Kough)	Asteraceae	Whole plant	Sexual problem	Take about 20 gram of whole plant of gerbera and grind it .Add about 200 gram of water and sugar (misri) ,soak it for at over night .Give this to the patient at morning .It cure sexual disorder caused by heat.
	Heleanthus annus	Asteraceae	Leaves	Maleria	Grind about 12 gram of its leaves in 5 kali mirch pipper nigrum and give the patient to drink .
	Hydrocotyl asiatica (ghorey sumbhi)	Apiacea	Whole plant	Dysurea and burning sensation in urin	Grind about 10 to 12 gram of its leaves in water and add misri in it .Give this to the patient at morning .
	Jasminum dispermum Wallich in Roxb (Chamba)	Oleaceae	Leaves	Healing up of wounds &crack of heals	Dried poweder is applied on cuts and wounds. Apply fresh juice obtaind by grinding with stones
	Jurinia macrocephala (Guggal)	Asteraceae	Root	Muscular pain in body &backache	Roots are grinded with stones and finley bruised .The bruised roots are boiled in water and after frying in excess ghee rice are boiled by adding jaggery .(gur).The soup of rice is the taken and boiled rice are eaten.
	Linium usitatissimum L. (Alsi)	Linaceae	Seeds	Backache and muscular pain Sexual potency	Prepare its halva in desi ghee it is very usefull in muscular pain Take about 5 gram line seed with black pepper and honey it thickens the semen and also increase the sexual potency
	Malvastrum coromandalianum L. (Tamni)	Malvaceae	Leaves	Spermmatorea and white discharge	Take about 5 to 10 gram poweder of its leaves daily at morning and evening time. Soak about 20 to 40 gram fresh leaves (crushed and grinded with stones) in about 200 gram of water at night or until it gives mucilage and give the patient at morning time or two tmes if seriously ill.
	Mangifera indica	Anacardiacaea	Kernal	Diarroea	Take 4 to 5 gram pooweder of its kernel along with water.
	Mentha arvensis L. (Poodna)	Lamiaceae	Leaves	Dog bite	Paste of leaves is applied externally.Take decoction of about ten gram leaves in one cup of water for four to five days.
	Narium indicum L. (kaner)	Apocynaceae	Leaves	Cold	Use about two drops of its juice as nasya. It will cause sneezing and give releaf from cold.
	Pinus roxburgi Sargent (chir)	Pinaceae	Wood	Renal colic	Burn its wood and prepare powder .Mix four gram black salt in 12 gram of poweder and

					prepare four doses .Give its one dose after an interval of 4 hours.
	Pistacia chinensis (Kanger)	Anacardiaceae	Galls	Dysentry and nose beeding	Take about 3 to 4 gram poweder of galls and take it along with curd on dysentery. About 2 gram powedr of galls is given along with butter on nose bleeding.
	Plumbago zylenica L. (Chitri boot i)	Plumbaginaceae	Root	Delivery	Dry its root in shade and grind it to form poweder .Give 10 gram of its powedr with 10 15 gram honey it causes easy delivery.
	Polygonatum verticillatum L. (Shirkunkal)	Lilliaceae	Root	Weakness	Roots are collected in the month of sept and dried in shade .10- 20 grame of root powedr is taken along with one glass of milk
	Polygonatum multiflorum L. (Kachli)	Lilliaceae	Root	Complexation and weakness	About 10 to 20 gram root poweder is given along with one glass of milk daily
	Potentilla fragriod	Rosaceae	Root	Cough and fever	A deep red decoction of the root is prepared and given on cough (particularly to children) and fever with red rashes (rati mori in local dialect)
	Pleurospermum candolli (Sanji, Bri jari)	Apiaceae	Leaves and whole plant	Healing up of wounds and cancer	1 Paste of leaves is applied on wounds 2, About 5 to 7 gram poweder of whole plant is given .
	Quercus leucotrichphora (Rein)	Fagaceae	Kernals	Diarea	Grind its kernel and give about 3 to 5 gram to the patient along with water
	Sarcococa saligna (Bansathra)		Root	Blood purifier	Give about three to four gram powedr of its root bark .
	Skimmia anquitilia (Nera, Patla, Sagli)	Rutaceae	Leaves	Peumonia, parasthesis and cancer	Prepare decoction of its leaf to the patient by adding milk or alone
	Sorghum halepense L. (Baru)	Poaceae	Root	Swelling of throat	Apply paste of it externally on throat .
	Thalictrum foliosum D. C. (Beny)	Ranunculaceae	Root	Blood purifier	Give 10 gram juice of its root daily to the patient .
	Viburnum grandiflorum Linn. (Kuch)	Caprifoliaceae	Flower	Pneumonia	Biol about 5 to 7 gram of flower in one glass and give it to the patient on pneumonia.
	Valeriana jatamonsi Jones (Bala)	Valerianaceae	leaves	Wounds	Paste of leaves is applied on wounds.
	Vitis lanata Roxburg (Dakh)	Vitaceae	Stem juice	Diuretic	Make a small hole in the stem of the plant and tie an earthen pot with it for at night so that the juice come in it. Use half to one glass of this by adding sugar at morning it cures retention of urine and dysurea.
	Vitis vinefera L. (Angur)	Vitaceae	Leaves	Kidney stone	Grind leaves of the plant in water and give this to the patient.
	Withania somnifer L. (Asgandh)	Solonaceae	Root	Sexual disorder	5 gram of its root powder is given daily along with milk
	Zea mays (mak)	Poaceae		Renal colic	Give decoction of its cob hairs .

	Zingiber officinale Roscoe (Adrak)	Zingebraceae	Rhizome	Sexual disorder	Take 10 gram juice onion 10 juice of ginger 10 gram pure honey and one egg yolk (remove white albumen from egg yolk completely) and give the patient at bed time it cures erectile dysfunction in three to four days.
	Zyzyphus vulgaris (Broi)	Rhamnaceae	Leaves	White discharge &Spermmatorea	Take about 50 gram leaves and grind them .Soak the leave in water for at overnight and give the patient at morning.

MATERIAL AND METHOD

The paper is based on the data collected on the use of ethno medicinal plants by tribal, rural and elder citizen of the area from January 2010 to jannuary 2012.The author collected a total of 30 plant species from different localties of the poonch district used for medicinal purpose by the tribal and rural people. All the plants found in a particular area used for medicinal purpose were collected and the precise location of each plant was recorded on a separate note book.

Plant material was collected freshly from the respective villages and standered method of collection preservation and maintenance of specimens ware followed as suggested by (Jain &Rao 1977).The plant species were identified with the help of available floras [Hooker (1872-1897);(Duthie 1903-1929);(Gour 1999).Doubtfull plant specimens were matched with the herbaria housed at Indian Institute of integrative medicine jammu .The standard methodology regarding the documentation was followed as suggested by Schultzes (1990), Jain (1981-1987) and Ford (1978) .

OBSERVATION AND DISCUSSION

The Himalya ,known for its loftiest and longest mountain ranges in the world is a reservoir of enormous natural resources including the wealth of medicinal plants .The present paper enlists 44 plant species belonging to --- genera and -----families Among the enlisted plant species --- are monocotyledons and ---- are dicotyledons .In the upper pir panjal and hilly areas of the district the traditional health care system is commonly practiced by the majority of the population of the tribal and rural people ,both logistically and economically. The traditional health care system as practiced in the region consists of two system ; classical stream and folk stream .The folk stream system is based on oral traditions practiced elderly village people and tribal communities (Non Codified system –N C S) wherease classical stream is based on theoretical knowledge , experimental and philosophical explanation provided by many learned physian of early time like charak ,Sushruta ,Galen and Rhazes etc (Codified System – C S).Most of the modern drugs that have revolutionized the modern medical practices have been isolated from plants and were used in the recent past for one or more purposes .Vincoblastin ,Strophanthine, ,Resprine Colchicine, Podophylotoxin , Steriods and Cortisone are some of the examples. The most common plant parts used are leaf stem root bark and rhizome as fresh or in dried up condition and the preparations are mostly internally or sometimes externally in the form of juice, powder .Plant specimens are mostly collected from their surrounding and sometimes from long distantly located forest areas .The enlisted plant specimens are used to cure some common diseases like weakness, sexual disorder, fever, cough, pneumonia, parasthesis, muscular pain, cancer, dysurea, bladder, stone and toothache. The ethno medicinal uses of pleurospermum candolli and skimmia anquitillia against cancer have been reported for the first time but the detail method of preparation and ,mode of use could not be worked out due to very rare information so the uses have been marked with astrisk .The pharmacological activity of the above said plant are still required to be investigated which may become a milestone towards the identification of new compounds for the treatment of cancer.In the present day conditions most of the peoples of the rural areas are accepting the modern allopathic drugs leaving their traditional herbal medicine for the treatment of different diseases . But inerstingly,it has been noticed that the tribal people in the upper pirpanjal range.

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AN ANALYSIS OF SOCIO-ECONOMIC AND PSYCHOLOGICAL TRAITS OF FINGER MILLETS GROWERS IN ADOPTION OF RECOMMENDED FINGER MILLET PRODUCTION TECHNOLOGY AMONG THE TIRBAL FARMERS OF BASTAR DISTRICT OF CHHATTISGARH

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Abstracts : This study was conducted in three selected block of Bastar district of Chhattisgarh. A total of 150 respondents were randomly selected from the each selected blocks for the study. The present study was undertaken to assess the socio-personal and socio-economic and psychological traits of finger millet growers in adoption of recommended finger millet production technology. The data collection was done by the use of pre-tested interview scheduled and through personal interview. Data were analyzed with help of suitable statistical analysis. The study showed that majority (74%) of the respondents belonged to middle age group (34 to 56 years), illiterate (33.34%) and leaved in joint family (63.33%) with membership in one organization. Majority (54%) of the respondents were medium farmers (2.1 to 4 ha) and the surviving with their low annual income (Up to Rs 20,000). Majority (96%) of the selected respondents had acquired credit for finger millet production.

Keywords: Finger millets, Psychological traits, Socio-personal traits, Socio-economic traits, Tribal farmers

INTRODUCTION

Small millets are unique to Indian agriculture even though their contribution is only about 2.50 per cent to the grain production in the country. The importance lies in the ecological niche they occupy where no other food crop can be profitably grown (Gowda *et al.*, 1997). Small millets are the traditional crop, agronomically more adapted to impoverished soils. The important small millets grown in India are finger millet, kodo millet, little millet, foxtail millet, barnyard millet and common millet. Millet grains have been the food for the traditional consumers and population of lower economic strata in India and Africa and as a feed ingredient in many developed countries (Malleshi, 1997). Millets are important food grains in the diets of a large section of population in India and Africa.

Finger millet ranks third in importance among millet in country in area and production after sorghum and pearl millet. The area under this crop is around 2 million hectares which is 7.5 per cent of the total millets area, but its contribution (2.5 to 2.6 million tones) to total millet production is around 13 per cent. Finger millet produce is mostly consumed at the home /village level. As a result the true value of crop has not been appreciated. Marketing channels are very poorly developed. The minimum support price announced regularly by the government does not help the farmers as the authorized agencies intervene in the market and produce.

Despite constraints in production, finger millet will continue to have a significant role in the food economy of the people who grow and consume it increasing production will have to be achieved to ensure regional food security. Utilization as food and feeds will continue to be of particular importance in areas of its production (Seetharam, 1997).

A number of traditional food preparations are made out of Ragi grain in rural India. Ragi for meal is consumed mainly in the form of dumpling (mudde), unleavened bread (roti) and porridge (ganji). In addition to the above, there are at least 80 different types of recipes made out of Ragi by both rural and urban commodities. Most popular among them being dosa, uppita, several snack preparations made out of popped grain (hurihittu), and many other bakery products including Ragi bread, bun and biscuits.

Composite flour can also be prepared by mixing Ragi flour with wheat flour / rice flour/ sorghum flour. It is possible to obtain different blends to meet the needs taking into account economic, nutritional and organoleptic considerations. Special blends could be made by mixing malted Ragi flour with green gram flour to be used as weaning food. There are surveys made to indicate that rice eaters have lesser micronutrient in their diet compared to Ragi consumer (M.P, 1997). Chhattisgarh has sizeable area under minor millets 2, 04,261 hectare and production is 39,301 metric tones. The minor millets play a vital role in the food basket of tribals of Chhattisgarh state.

Keeping this in view a study was conducted to know the socio-personal and socio-economic profile/ traits and socio-psychological traits of finger millet growers in the adopted blocks.

MATERIAL AND METHOD

This study was conducted with randomly selected finger millet grower's of three blocks (i.e. Jagdalpur, Pharasgoan, and Makdi) located in Bastar district of Chhattisgarh (India). These three blocks were

selected out of 12 blocks because maximum finger millet growers are found in the district. From each of these selected blocks 50 tribal farmers were selected for the study. Thus in this way a total of 150 respondents were selected as respondents for study. Four socio-personal traits (namely age, education, type of family and social participation), three socio-economic traits of finger millet growers (namely size of land holdings, credit acquisition and annual income) and two psychological traits of finger millet growers (namely innovative proneness and scientific orientation) were selected for analysis. For assessing level of innovative proneness and level of scientific orientation of finger millet growers a points continuum scale adopted i.e. "Low", "Medium" and "High" with the score 1, 2 and 3, respectively. The data were collected through personal interview with the help of structured interview schedule. Collected data were analyzed and presented in frequency, percentage, mean and standard deviation.

RESULT AND DISCUSSION

Socio-personal traits

Age, education, type of family and social participation were considered as socio-personal traits of the respondents. These traits are analyzed and presented in table 1.

Table 1: Distribution of respondents according to their socio-personal traits

(n =150)

S. No.	Traits	Frequency	Percentage
1.	**Age**		
	Young (up to 34 years)	22	14.66
	Middle (34 to 56 years)	111	74.00
	Old (above 56 years)	17	11.34
	Total	**150**	**100**
$\overline{X}$ **= 45.37,**		**S.D = 11.17**	
2.	**Education**		
	Illiterate	50	33.34
	Primary school	46	30.67
	Middle school	29	19.34
	High school	07	04.66
	Higher Secondary school	16	10.66
	College and above	02	01.33
3.	**Type of family**		
	Nuclear family	55	36.67
	Joint family	95	63.33
4.	**Social participation**		
	No membership	49	32.67
	Membership in one organization	62	41.33
	Membership in more than one organization	35	23.33
	Executive / officer bearer	04	02.67

1. Age

It is observed from the table that the majority of the respondents (74.00 %) belonged to middle age group (34 to 56 year), 14.66 per cent respondents were under young age group (up to 34 year) and 11.34 per cent respondents were of old age group (above 56 years). Thus, it may be concluded that the maximum finger millet growers were belonging to middle age group (34 to 56 year). This finding is in conformity to the findings reported by Kazan and Agunga (1997), Deshmukh *et al.* (2007), Singh *et al.* (2007) and Dhruw (2008).

2. Education

Education builds the ability of an individual to improve knowledge understand and utilize the things in a better way, hence assessment of respondent's education level must be done. The data in table 01 shows that the 33.34 per cent of the respondents were illiterate followed by 30.67 per cent respondents were found under the category of up to primary school. Whereas, 19.34 per cent respondents were educated up to middle school and 10.66 per cent had been educated up to higher secondary level about 5.0 per cent respondents had been educated up to high school and only 01.33 per cent respondents were educated up to college and above.

The maximum number of finger millet growers were illiterate and have been educated up to primary school level. It may be because of the fact that in most of the tribal villages there are no school and only a few of the villages have the school which is up to primary level. On account of this, finger millet growers had not acquired the education or had only primary level education. Thus the results clearly

indicate that the majority of respondents were either illiterate or had been educated up to primary school standard.

3. **Type of family**

It had been found that the majority of respondents (63.33%) were residing in joint family system; however 36.67 per cent of the respondents prefer to live in nuclear family system in the study area. (Fig.4.3). Almost similar findings were also observed by Manker, *et al.* 2000 and Singh, *et al.* 2007.

4. ***Social participation***

Social participation gives us an idea about the respondent's participation in social activities. As regards to social participation, maximum number of respondents (41.33%) have membership in one organization followed by 23.33 per cent respondents had membership in more than one organization and only 02.67 per cent respondent, were found to be in office bearer's category. However 32.67 per cent of the respondents where having no membership in any organization. This finding is similar to the findings of Dhruw (2008) and Yadav (2008).

Socio- economic traits

The independent variables i.e., size of land holding, credit acquisition and annual income were considered as socio-economic traits of respondents.

1. Size of land holding

Table 2. Distribution of respondents according to their size of land holding

(n =150)

S. No.	Size of land holding	Frequency	Percentage
1	Marginal (up to 1 ha)	10	06.67
2	Small (1.1 to 2 ha)	48	32.00
3	Medium (2.1 to 4 ha)	81	54.00
4	Large (above 4.1 ha)	11	07.33
	Total	**150**	**100.00**

Table 2 indicates that the maximum number of the respondents (54.00%) had medium size of land holding (2.1 to 4 ha.), followed by 32.00 per cent who belonged under small size of land holdings category (1.1 to 2 ha.), whereas 07.33 per cent of the respondents were having large size of land holding (above 4.1 ha.) and only 06.67 per cent respondents were marginal (up to 1ha.) farmers. It could be concluded from the table that maximum number of respondents belonged to medium size of land holding category. This finding finds support from the work of Rajni (2006), Dhruw (2008), Patel (2008) and Yadav (2008).

2. Credit acquisition

Table 3. Distribution of respondents according to their credit acquisition

(n =150)

S. No.	Particulars	Frequency	Percentage
Credit acquisition			
(i)	Not acquired	06	04.00
(ii)	Acquired	144	96.00
Duration of credit (n = 144)			
(i)	Short term credit	76	52.78
(ii)	Mid-term credit	43	29.86
(iii)	Long term credit	25	17.36
Availability of credits (n = 144)			
(i)	Easy	110	76.38
(ii)	Difficult	34	23.62
Source of credit *			
(i)	Cooperative society	125	83.33
(ii)	Nationalized bank	74	49.33
(iii)	Money lenders	12	08.00
(iv)	Friends / Neighbours/ Relative / Others	05	03.33

*Frequency based on multiple responses.

Table 3 revealed that majority of the respondents (96.00%) acquired credit from various agencies, whereas, only 04.00 per cent respondents had not acquired the credit facilities from the agencies providing the credit. Out of those respondents who had acquired credit, the majority of the respondents

(52.78%) had taken the short-term credit followed by mid- term credit (29.86%) and long-term credit (17.36%). It can be concluded that the maximum respondents had acquired short term credit; the reason may be behind that they could be repay it just after harvesting the crop. As for as similar results had been observed by Patel (2008). Obtaining the credit from the various credit agencies, it has been confirmed from the collected data that the maximum number of the respondents (83.33%) had acquired credit from the cooperative society followed by 49.33 per cent of respondents who had taken credit from nationalized bank while 08.00 per cent respondents had taken credit from money lender. Only 03.33 per cent of respondent had taken credit from friends, neighbours and relatives. This table also revealed that the respondents were aware about the facilities provided by nationalized banks and co-operative societies. Out of total 144 respondents, who had acquired credit 76.38 per cent respondents were of the view that they had acquired credit easily from the credit agencies, whereas 23.62 per cent respondents reported that they faced difficulty in acquiring credit because of illiteracy and cumbersome official procedure of credit agencies for obtaining the credit.

3. Annual income

Table 4. Distribution of respondents according to their annual income

(n =150)

S. No.	Annual income (Rs)	Frequency	Percentage
1.	Up to Rs. 20,000	67	44.67
2.	Rs. 20,001 to 40,000	27	18.00
3.	Rs. 40,001 to 60,000	16	10.66
4.	Above Rs. 60,000	40	26.67
	Total	**150**	**100.00**

The distribution of the respondents according to their annual income is presented in table 04. From the data we can infer that the 44.67 per cent respondents were having their annual income up to Rs. 20,000 followed by 26.67 per cent of respondents who had their annual income above Rs. 60,000 and 18.00 percent respondents had annual income between Rs. 20,001 to 40,000. Whereas only 10.66 per cent respondents had annual income between Rs.40, 001 to 60,000 .The result clearly indicates that maximum number of the respondents belonged to less than Rs. 20,000 thousand annual income groups which comes below the poverty line. This finding is similar to the findings of Dhruw (2008).

Psychological traits

1. **Innovative proneness**

Table 5. Distribution of respondents according to their innovative proneness

(n=150)

S. No.	Categories	Beneficiaries	
		Frequency	Percentage
1	Low level of innovative proneness (up to 19 score)	14	09.33
2	Medium level of innovative proneness (20-23 score)	117	78.00
3	High level of innovative proneness (above 23 score)	19	12.67
	Total	**150**	**100.00**

$\overline{X}$ = 21.44 S.D. = 2.41

The result in table 05 clearly indicates that 78.00 percent respondents had medium level innovative proneness and 12.67 per cent had high innovative proneness towards recommended Finger millet production technology. While only 09.33 per cent respondent had low innovative proneness towards recommended finger millet production technology. Thus it may be concluded that majority of the respondents 78.00 per cent had medium level of innovative proneness toward recommended finger millet production technology. This finding finds support from the work of Dhruw (2008).

2. **Scientific-orientation**

Table 6. Distribution of respondents according to their scientific orientation

(n = 150)

S.N.	Categories	Frequency	Percent
1.	Low scientific orientation (up to 16 score)	29	19.33
2.	Medium scientific orientation (17– 25 score)	107	71.33
3.	High scientific orientation (above 25 score)	14	09.34
	Total	**150**	**100**

$\overline{X}$= 20.9 S.D.= 4.18

The results in the Table 06 shows that 71.33 per cent of the respondents had medium level of scientific–orientation, followed by 19.33 per cent respondents who had low level of scientific–orientation while, 09.34 per cent of respondents had high level of scientific-orientation regarding finger millet production technology. It can be concluded that most of the respondents 71.33 per cent had medium scientific-orientation toward finger millet production technology. This finding finds support from the work of Sudha (1997) and Patel (2008).

CONCLUSION

From the above findings it can be concluded that the majority (74.00 %) of the respondents were found in middle age group (34 to 56 year), maximum (33.34%) number of the respondents were found to be illiterate and leaves in joint family, maximum (54.00%) number of the respondents had medium size of land holding (2 to 4 ha.), 83.33 per cent number respondents had taken loan from co operative societies, maximum (44.67%) number of the respondents were having annual income up to Rs. 20,000. Majority (78.00%) number of respondents had medium level of innovative proneness; maximum (71.33%) number of respondents had medium scientific orientation about recommended finger millet production technology.

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PERFORMANCE OF HYBRID TOMATOES IN CROP CAFETERIA: AN EFFECTIVE TOOL FOR TECHNOLOGY EVALUATION AND DISSEMINATION

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Abstract : A tomato crop cafeteria was conducted at the instructional farm of KVK Chanduli during summer season 2009-10 to assess the performance of tomato hybrids (*Solanum lycopersicon* L.) against the locally popular variety sel-22. Observations recorded on yield and yield contributing characters revealed that the maximum yield was obtained from Hybrid B.S.S. 39 (35.69 t/ha) followed by Phule Hybrid (35.02 t/ha) and Century-12(23.76 t/ha). Among the yield contributing characters, highest total number of fruits were recorded with Phule Hybrid-1 (60.35) followed by B.S.S.-39 (41.60) as compared to check, whereas average fruit weight was found maximum with HOE 303 followed by Ratna (98.66), Century-12(85.83 g), BSS-39 (70.66 g) than the check S-22 (65.70 g). Quality parameters assessed in the experiment exhibited highest ascorbic acid content with BSS-39 (31.15 mg) and Phule Hybrid-1 (29.08 mg) as compared to Check S-22(27.32 mg). Juice content was recorded highest in control variety S-22(83.60%) than the hybrids under study. Demonstration of these hybrids in crop cafeteria for relative performance and scientific production technology at a place were found very effective to upgrade the knowledge and skill of farming communities and tomato growers.

Keywords : Crop cafeteria, Performance, Quality parameters, Tomato hybrids

INTRODUCTION

Tomato (*Solanum lycopersicon* L.) is one of the most important vegetable worldwide and belongs to the Solanaceae family. World tomato production in 2001 was about 105 million tons of fresh fruit from an estimated 3.9 million ha. As it gives high yield and economically attractive, the area under cultivation is increasing day by day. This family also includes other well-known species, such as potato, tobacco, peppers and eggplant (aubergine). It has its origin in the South American Andes. The cultivated tomato was brought to Europe by the Spanish conquistadors in the sixteenth century and later introduced from Europe to southern and eastern Asia, Africa and the Middle East. More recently, wild tomato has been distributed into other parts of South America and Mexico. Tomatoes contribute to a healthy, well-balanced diet and are rich in vitamins, minerals, essential amino acids, sugars and dietary fibers. Tomato fruits are consumed fresh in salads or cooked in sauces, soup and meat or fish dishes. They can be processed into purées, juices and ketchup etc. Canned and dried tomatoes are economically important processed products. Yellow tomatoes have higher vitamin A content than red tomatoes, but red tomatoes contain lycopene, an anti-oxidant that may contribute to protection against carcinogenic substances

India ranks second in area (0.59 million ha) and production (1.115 million tons) next to china with a productivity of 18.6 metric tons /ha. The current excitement over tomato cultivation is occurred in north India due to its high yield potential and relatively good processing quality. But disease susceptibility and low yield capacity of traditional variety is limiting factors in tomato cultivation in eastern Uttar Pradesh. Whereas, tomato hybrids are not only highly productive but also contain desired attributes i.e. greater vitality, rapid growth and development, uniformity and wide adoptability. There is pressing demand to find out location specific, high yielding suitable tomato hybrids to meet out farmer's need. It contributes 8.6% in total vegetable production in India with 7.5% area under cultivation (N.H.B database, 2009)

The present investigation was therefore, undertaken to evaluate the yield and quality of some tomato hybrids under micro climatic conditions of Chandauli district of Uttar Pradesh.

MATERIAL AND METHOD

The seeds of five tomato hybrids viz., Phule Hybrid-1, HOE 303, Century-12, Ratna and BSS-39 were used to raise seedling in nursery at instructional farm of KVK Chandauli, U.P. The planting was done at 60 x 45 cm spacing in September month for the production of autumn crops. Variety Sel-22 was also grown as check for comparison. All the scientific production technologies were applied during the study period. The fruits were harvested at full maturity from second fortnight of December and subjected to assess various yield and quality parameters i.e. number of fruits/plant, earliness, fruit weight (g), total yield, juice percentage, total soluble solids (%) with the help of hand referactometer and ascorbic acid content (mg/100 ml) by the titration method as described by A.O.A.C.(I). Randomized block design was applied to calculate critical differences at 5% level of significance.

RESULT AND DISCUSSION

It was observed that recently released tomato hybrids have higher yield as compared to variety Sel-22 at all the picking dates except 60 days after transplanting (Table 1). The maximum yield was noted in all the hybrids at second picking stage (91 days after planting) after which it decreased gradually at the

next picking. Tomato hybrid Ratna and Century-12 sustained significant market yield even upto last picking stage (120 days), whereas Sel-22 has already ceased to produce any yield. Similar results had been noticed by N.C. Nainiwal (1991).

All the tomato hybrids produced significantly higher marketable yield than check (Sel-22) except HOE 303 which showed yield statistically at par with the variety Sel-22. Maximum yield on the basis in terms of t/ha and g/plant was observed for hybrid B.S.S.-39 followed by Phule Hybrid-1 and Century-12.

The total number of fruits produced per plant was significantly lower in tomato hybrids than Sel-22 at 60 days after transplanting. However at 90 days after transplanting, Phule Hybrid had maximum number of fruits followed by B.S.S.-39 and Ratna. Similar trends had been reported by Johnson C.F. and Hernandez T.P. (1980).

Table 1. Number of fruit production and yield of tomato hybrids.

Hybrids	Number of Fruits/plant		Marketable Yield	
	60 DAT	90 DAT	g/plant	t/ha
Phule hybrid-1	23.00	27.35	929	35.02
HOE 303	11.40	21.10	547	20.67
Century-12	13.20	21.93	629	23.67
Ratna	9.40	14.40	582	22.01
B.S.S.-39	17.06	24.40	957	35.69
Sel-22	23.80	8.40	461	17.43
CD at 5%	4.86	6.82	-	12.75

The average weight of fruits was much higher in all the hybrids as compared to Sel-22. Maximum fruit weight was observed with hybrid HOE 303 and Ratna followed by Century-12, Phule Hybrids-1 and B.S.S. 39. Similar facts have also been reported by Bajwa et al. (1969).

The juice content of tomato hybrids was recorded in percentage. The maximum juice percent was observed in B.S.S.-39 followed by Sel-22 and HOE 303 and minimum was with Phule hybrid-1, while maximum T.S.S. content was recorded in Phule Hybrid-1 followed by B.S.S.-39 and Sel-22.

So for as maximum ascorbic acid content was recorded with B.S.S.-39 followed by Century-12, Phule Hybrid-1 and sel-22. The variation among all the varieties was significant and minimum ascorbic acid content was noticed in HOE-303.

Table 2. Average fruit weight (g), juice percentage and content of total soluble solids (%) and ascorbic acid (mg/100 ml) of tomato hybrids.

Hybrids	Weight (g/fruit)	Juice (percentage)	T.S.S. (%)	Ascorbic acid (mg/100 ml)
Phule hybrid-1	60.16	79.00	5.00	29.08
HOE 303	103.33	83.30	4.30	24.44
Century-12	85.83	80.60	4.06	30.50
Ratna	98.66	80.00	4.26	26.24
B.S.S.-39	70.66	85.10	4.83	31.15
Sel-22	65.70	83.60	4.76	27.32
CD at 5%	10.00	0.315	0.15	2.50

Considering the facts and figures summarized as above it may be concluded that out of 5 hybrids and one check, B.S.S.-39 emerged significantly best in productivity per unit area, adoptability and overall performance followed by Phule Hybrid-1. According to these facts hybrid tomato have advantageous under Chandauli district as they yielded higher and till longer period over variety Sel-22 used as check. However the quality of the fruit from hybrids was not sowing longer differences.

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ADOPTION OF BIO-PESTICIDES AND BIO-CONTROL AGENTS

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Abstract : Bio-pesticides (also known as Biological Pesticides) are certain types of pesticides derived from such natural materials as animals, plants, bacteria and certain minerals, for example at the end of 1998 there were approximately 175 registered Bio-pesticide active ingredients and 700 products of bio-pesticides.
The Chemical Pesticide consumption is increasing @ 20% per annum. The pest and disease cause over Rs. 29,000 cores crop losses per annum. This situation has been caused by indiscriminate use of chemical pesticides resulting in development of resistance in pests and resurgence of minor pests. Rejection of Indian argil exports are more than Rs. 4000 cores per annum, because of very high pesticide residue contents. WHO estimates 1 million pesticide-poisoning cases and 20,000 death every year globally. This is due to high pesticide residues in food chain. Chemical pesticides cause significant health hazards like Vomiting, Paralysis, Blindness, Coma, Death, damage to respiratory tract, allergies, anemia etc.

INTRODUCTION

Success Stories of Bio-pesticides in India

The use of Bio-pesticides and bio-control agents in India is on the increase but not up to the desired levels of growth. All though presently a decrease or decline in chemical pesticide consumption is indicated, only 1% of 143 Million ha, cropped area and only 2500 villages out of over 6 lakh villages in the country have been covered so far under IPM. They are many encouraging success stories of Bio-pesticides and bio-control agents in Indian agriculture : (Table 1).

1) Control of Diamond back moth by B.t. in Delhi and Ajmeer,
2) Control of Mango hoppers and mealy bugs by *Beauveria* in Malihabad (Luk),
3) Control of white fly on cotton by 1500 neem products in Haryana, Punjab, Gujarat and West Bengal.
4) Control of *Helicoverpa* on Cotton, Pigeon pea, tomato, by B.t. in Haryana, Punjab, Gujarat and West Bengal.
5) Control of Rots in various Vegetable by *Trichoderma* based bio-control agents in Haryana, Rajasthan, Maharashtra.

Some common bio-pesticides and control agents

1) ***Predators*** **:** *Chrysoperla Carnea* is a general entomorphagous predator which is commercially produced in many countries including India for use as a biological control agent against aphides similarly *Malada astur* is a another predators mainly predates on white fly.
Orius tantilus is a common predaceous anthocorid in India, which attacks the aphid nymph mites and thrips. *Orius indicus* exclusively predates on thrips, aphids, leaf hoppers.

2) ***Trichogramma*** **:** *Trichogramma* is one of the most popular biological control agents used against many lepidopteron insects. It is a egg parasitoids of stem borer of paddy, maize, sorghum, and sugar cane. This is sensitive to chemical pesticides.

3) ***Bacillus Thruingiensis*** **(Bt) :** It is one of the most important bacterial bio-pesticides used worldwide. It was first produced in USA in 1957 and was registered as bio-pesticide in 1961. It is commonly called "Bt" which contains a protein called *Bacillus thruingiensis*, toxin. It is primarily a pathogen of Lepidopteron pests. This Bt gene also has been introduced into
plants like cotton, potato, corn and soybean. Commonly available commercial Bt products are Delfin, Spicturin, Agree etc.

4) ***Trichoderma*** **:** *Trichoderma* is a well known potent biological control agent for some soil born plant fungal pathogens. It was first used in 1930, and is effective against root pathogens and used for seed treatment. It is particularly effective in the case of Ground nut, Sunflower, Beans, Grams and Chick Pea particularly against *Pythium*, *fusarium Rhizoctonia* and *Sclerotium*.
Several species of *Tcichederma* are available *T. viridae* and *T. harzianum* are widely used as bio control agents against many diseases.
Trichoderma spp is used for seed treatment (dry) @ 4 g/kg seed. It can be directly applied to soil, it is compatible with fertilizers like *Rhizobium* and *Azospirillum*.

5) **N. P. V. (Nuclear Polyhedrosis Virus) :** It has been found to be effective in the control of many pests, it can be applied individually or in combination with many chemical insecticides or neem. Two types are available one is NPV (Ha) and NPV (S). NPV (Ha) has been found to control *Helicoverpa armigera* where as NPV (S) controls *Spodoptera litura.*

6) Pheromones : These are used for light traps and sexlures / Pheromonals to monitor the activity of fruit sucking moths and other Lepidopteron pests.

Plant Bio-pesticides

Neem :- The neem tree *Azadirachta indica* produces a variety of substances with antifeedent property. It was first isolated by Buffer-worth and Morgan in 1908. Neem is reported to be effective against over 300 pest species. Neem formulation have a commercial potentiality in south and south east Asia, USA, and Australia. The Govt. of India has approved registration of a no. of neem formulations only in 1992. The different types of insect pests controlled by various neem compounds including mites, aphides, jassides, whitefly, fruit & shoot borers, caterpillars, weevils, nematodes, as well as plant pathogenic fungi and bacteria. Now the registration committee has divided to approve the formulation with azadirachtin content ranging from 300 – 50,00 ppm. Research has shown that neem extracts can influence nearly 200 species of insects, neem EC is the general purpose botanical pesticide of choice for organic agriculture. (Table 2).

Several constituents of neem seed or neem oil have been found to possess pest control properties. These include Solanin, Salanol, 3-deacenty 1 Salanin, azadirachtin, nimbin, epinimbin, epinimbocinol etc. Different kinds of Azodirachtins (A – K) have been isolated, the most abundant of which is Azadirachtin – A. This component acts as feeding deterrent when the leaf is treated with neem product because of presence of Azadirachtin Salanin and meleandriol there is an anti peristaltic wave in the elementary canal and this produces Vomiting Sensation in the insect as a result of which the insect does not feed. Another mode of deterrence is through oviposition blockade i.e. not allowing the female insects to lay eggs. Besides, essential oils obtained from cedar, eucalyptus, lavender, and citronella are extensively used to ward of pest through repletion by odour a mission. Bioactive natural compounds have been isolated complants possessing insecticidal, antifeedent and insect growth regulatory properties.

E.g. Plumbagin from plumbago species.

Rotenone from the roots of *Lonchoarpus* sp. *Pyrethrum* from Chrysanthemum, Nicotine from tobacco etc.

What are the Advantgages of Using Bio-pesticides?

1. Bio-pesticides are inherently less harmful than conventional pesticides.
2. These are designed to effect only one specific pest in some cases a few target organisms.
3. When used in IPM programme Bio-pesticides can greatly decrease the use of conventional pesticides, while crop yield remain high.
4. Usually do not destroy beneficial organisms besides being easily bio-degradable in nature.

CONCLUSION

The population pressure, water loss, soil erosion, floods, saline and alkaline soils, weed and pest damage are considered to be the main indicators of unsustainability. Hence, supply and judicious use of production factors play a decisive role in the sustainable growth of agricultural production. We have discussed on almost all aspects of organic farming and can conclude that it is an economic, ecofriendly system, which attempts to provide a balanced environment, maintains soil fertility, control insect pest and diseases and produce safer and qualitative food stuff. However technologies like organic farming or integrated management systems need to be assessed to their location, specific applicability and adaptability to bring about better sustainability. Over all organically grown food may not put more nutrients into once body but will surely optimize the health and production of inter-dependent communities of soil life, plants, animals and people. When one buys certified organic food and products, the money you spent cast a vote for a healthier planet.

Table 1. Bio - Products

Active Ingredient	Recommended Usages	Dose of Application
Trichoderma Viridi	Seed treatment, Nursery	5-10 g/kg seed treat.
	Drenching, Soil Application	3 g/lt for nursery
	Foliar Spray for Control of	drenching 2 kg/ac
	Fungal diseases like wilt,	in compost.
	Root rot, Sheath rot etc.	
Beauveria bassiana	Wide spectrum insecticide	5 – 10 g/lt. of
	for control of Helicoverpa	Water.
	Spodoptera and other suck-	
	ing and chewing pests.	
Verticillium Lecanii	For Control of Mealy bugs,	5 – 10 g/lt. of

	Scales, Thrips and other	Water.
	Sucking pests.	
Metarhizium anisoplae	For Control of Soil pests like	5 – 10 g/lt. of
	Root Grubs, Termites.	Water.
Bacillus Thuringiensis	For Control of DBM and	400 – 500 g/acre.
		Other Caterpillar pests.
N. P. V.	For Control of Spodoptera	250 ml/acre.
	Litura.	
Paecilomyces spp.	For Control of Nematodes	2 kg/acre with
	In Banana, Potato, Flowers	Compost.
		And Fruit Crops.
Azadiarchtin 0.15%	Wide Spectrum in	750 ml/acre &
EC & 0.03% EC	Secticides.	1 lt/acre.
Nitrogen Fixing	Atmospheric Nitrogen	2 kg/acre.
Bacteria.		Fixation.
Phosphorus Solubili- zing bacteria.	Solubilises Phosphorus in Soil.	2 kg/acre.
Amono Acid	For Protein assimilation,	500 ml/acre
	better fruiting.	
Humic Acid	Complete Plant Food and	500 ml/acre
	Imparts Stress tolerance.	
Neem Cake	Bio Fertilizer, Nematicide.	200 kg/acre.

Table 2. Effect of Neem Formulation (ACHOOK) on infestation and yield of Brinjal and Lady's finger.
[Location : Institute of Agriculture, Sriniketan]

Treatment	Brinjal		Lady finger	
	% of Fruit infestat due to *Leucinoi orbonalis*	Fruit yield Tons/ha.	% of Fruit infestat due to *Eariasvitella*	Fruit yield Tons/ha.
Achook wp 0.5%	29.42	21.41	25.38	20.12
at 15, 30 Dp*				
Achook wp 0.5%	28.11	25.84	18.45	23.48
at 15, 30, 45 Dp				
Achook wp 0.5%	23.99	24.29	18.68	25.09
at 15,30,45,60 Dp				
Achook wp 0.5%	28.76	22.27	16.51	23.39
at 15, 30 Dp				
Achook wp 0.5%	24.06	20.00	15.01	26.48
at 15, 30, 45 Dp				
Achook wp 0.5%	20.54	24.34	11.70	27.16
at 15,30,45,60 Dp				
Control	38.13	18.54	38.45	17.56

Dp* = Days after planting.

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Short Communication

HETEROSIS FOR TUBER YIELD AND ITS COMPONENTS IN SWEET POTATO (*IPOMOEA BATATAS* (L.) LAM.

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Abstract: In a line (6 x 4) study degree of heterosis varied from cross to cross for all the traits. The highest relative heterosis for tuber yield was observed in the progeny of IGSP-16 x Indira Madhur (39.45%). None of the progenies exhibited significant positive heterobeltiosis for tuber yield per plant whereas, fifteen progenies showed significant positive heterobeltiosis for number of tuber per plant. Heterosis was observed for number of tubers per plant and number of leaves per plant. While, low heterosis value were observed for tuber yield per plant, average weight of tubers, harvest index and number of veins per plant; moderate heterosis was observed for days to maturity , vein hight, fresh weight of top per plant and dry matter content. Overall, frequency of heterotic crosses was higher among the crosses involving parents with average gca effects.

Keywords: Heterosis, *Ipomoea batatas*, Tuber

INTRODUCTION

Sweet potato (*Ipomoea batatas* (L.) Lam.) locally known as Shakarkand belongs the family "Convolvulaceae" and is one of the most popular tuber crops in India and abroad because of its yield potential and high calorific value. Sweet potato is the world's seventh most important food crops other than wheat, rice, maize, barley, potato and cassava. It contains raw protein in fresh storage roots which ranges from 2.24 to 4.9 per cent on wet basis (Walter and Catignani,1981). The starch content in raw sweet potato storage roots varies from 33-73 per cent on dry basis (Truong *et al.*, 1986).

Heterosis breeding is here to stay as a potent genetic tool for exploiting the genetic divergence. Heterosis in F_1 generation is of much importance in cross pollination crops like sweet potato as heterotic crosses may give transgressive segregates for economic traits in the advanced generation. The phenomenon of heterosis which itself by greater vitality, rapid growth and development of F_1 has been extensively exploited in many cross pollinated crops. The heterotic response over mid as well as better parents could be in formative to identify true heterotic cross combination.

The knowledge of heterosis for economic traits can be effectively utilized in selective the desired traits in breeding programme. The relative heterosis and heterobeltiosis provide an idea about the role of dominance and over-dominance type of genetic control of the character.

MATERIAL AND METHOD

The experiment was conducted to randomized block design with three replication at Vegetable farm,All India Crop Research Project of Tuber, Department of Horticulture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during rabi season 2009-10. The experimental materials was comprised of 6 lines,4 tester,24 F_1's and 1 standard check. F_1's were obtained by crossing in line x tester mating design. Analysis of variance was based on mean values (Panes and Sukhatme,1978) and heterosis over mid parent, better parent and standard check (Sree rethna) for each character was computed out as suggested by (Fonesca and Patterson,1968).

RESULT AND DISCUSSION

In the study, low magnitude of heterosis was observed for tuber yield per plant. Thesee finding were in agreement the result of Buso *et al.* (2003) and Luthra *et al.* (2001). Tuber yield per plant was the highest in the progeny of IGSP-C-16 x Indira Madhur (750 g) followed by Indira Naveen x IGSP-C-14 (725 g) and IGSP-C-16 x Indira-9 (700 g). The highest relative heterosis for this trait was registered by progeny of IGSP-C-16 x Indira-9 (35 %) followed by Indira naveen x IGSP-C-16 (28.35 %) and IGSP-17 x Indira-9 (22.36 %),while, the highest standard heterosis was observed in IGSP-16 x Indira madhur followed by Indira Naveen x Gauri (42.56 %) and IGSP-C-16 x Indira vardhini (41.34 %) out of 24 progenies, none exhibited significant positive heterobeltiosis for tuber yield per plant, whereas,11 progenies progenies exhibited significant positive heterobeltiosis for number of tubers per plant. Among 24 progenies, 5 progenies viz. F-6 x Indira madhur, E-5 x Gauri and F-6 x Indira-9 exhibited the highest significant positive heterosis over mid parent, better parent and standard check respectively, for number of tubers per plant.

In general,high heterosis was observed for number of tuber per plant and number of leaves per plant and moderate heterosis for days to maturity,vein height,fresh weight of tops per vein and dry matter percent per plant. While low heterosis was observed for tuber yield per plant,average weight of

tubers,harvest index and number of lobes per leaves. Only one progenies E-5 x Gauri showed significant positive heterosis over mid parent,better parent and standard check for average weight of tuber. The results indicated that negative heterotic effect in most of the progenies for tuber yield contributing attributing. These types of finding were earlier reported by Mishra *et al.* (2003) in potato. A comparison of the five best progenies showing heterobeltiosis for tuber yield were made with the heterotic response for other yield components (Table 1 and 2).

It showed that the positive heterobeltiosis for tuber yield resulted from number of lobes per leaves, total number of tubers per plant, average weight of tubers, harvest index and dry matter content.

Among all the yield attributes, total number of tubers per plant was observed to be the most important yield component, as had positive heterosis in most of the progenies.

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Table 1. Comparative study of the five best heterotic crosses for tuber yield and other characters.

Best heterotic crosses	Tuber yield /plant (g)	Days maturity	Vein length (cm)	No of lobes/ leaves	Fresh weight of foliage of (g)
IGSP-C-16 x IM	22.45	2.47	-34.56	-4.25	8.00
IGSP-C-17 x Indira-9	14.95	10.36**	-8.62	-3.09	39.57**
IGSP-15xIndira Madhur	12.46	-1.09	-34.35**	-7.05	-6.95
Indira Naveen x Gauri	11.25	-6.67	-42.79**	-6.65	18.95
IGSP-C-14 x Gauri	9.08	2.36	-21.34**	-2.57	16.34

****** indicates significant at P<- 0.05 and P<-0.01 levels,respectively.

Table 2. Comperative study of the five best heterotic crosses for yield characters

Best heterotic crosses	Total no of leaves/plant	No of tubers /plant	Average weight of tuber (g)	Harvest index (%)	Dry matter (%)
IGSP-C-16 x IM	59.95**	26.46*	0.95	2.34	-8.53
IGSP-C-17 x Indira-9	29.98	55.66**	-27.53*	-6.25*	-0.95
IGSP-15xIndira Madhur	-24.59	14.55	-14.72	4.00	-4.25
Indira Naveen x Gauri	-24.45	25.75*	-9.64	-4.45	-4.09
IGSP-C-14 x Gauri	78.46**	35.46**	-23.31	0.69	9.43*

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SYNERGISTIC EFFECT OF *RHIZOBIUM* AND AM FUNGI INTERACTION ON PHOTOSYNTHESIS, ROOT PHOSPHATASE ACTIVITY AND GRAIN QUALITY IN URD BEAN (*VIGNA MUNGO* (L.) HEPPER) UNDER RAINFED FIELD CONDITIONS

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Abstract : Two varieties of urd bean (PU-35, T-9) inoculated with *Rhizobium* and vesicular arbuscular mycorrhiza fungi (applied through layering technique) were raised under field conditions. The synergistic effect was noticed with the combined treatment over any of the bacteria or AM fungi, in terms of chlorophyll content, photosynthetic rate and root phosphatase activity. The interaction enhanced the dry matter production, grain yield and quality also. The carbohydrate, fat and protein content also increased in the *Rhizobium* inoculated seeds; however, it was higher when *Rhizobium* and mycorrhiza fungi were combined together. *Rhizobium* inoculation enhanced the nitrogen content in grain and straw where as *Rhizobium* + AM treated plants had enhanced phosphatase activity and nitrogen content.

Keywords : AM fungi, Photosynthetic rate, *Rhizobium*, Root Phosphatase activity and grain quality, Urd bean

INTRODUCTION

Legumes have unique quality in term of nodulation and biological nitrogen fixation for sustainable crop productivity with improved soil health and soil fertility. It is widely recognized that biological nitrogen fixation by legume-*Rhizobium* synthesis is an important component of productivity in tropical agriculture where it is grown in farm land that are marginal either in terms of distance from the market or small farm size and poverty of the farmers (Giller, 2001). The symbiotic association between leguminous plants and species of *Rhizobium* has been well known (Shiv Kumar and Shiva Dhar, 2008) through the process of biological nitrogen fixation. Now-a-days mycorrhizal roots are known to extract more nutrients from the nutrient deficient soils than are non-mycorrhizal roots because hyphae exploit greater volume of soil than root alone. The use of AM fungi increases the uptake of P as well as micronutrients particularly Zn, Cu and Mn (Pandey *et al.,* 2006, Panwar and Thakur 1995) and had been reported to enhance water extraction from the deeper zone of the soil (Marschner *et al.,* 2006, Panwar, 1993).

The combined inoculation of *Rhizobium* and AM fungi may be beneficial for plant growth and development. How does it affect the physiological processes and seed quality was the main objective of this study and hence was undertaken under rain fed field condition.

MATERIAL AND METHOD

The seeds of two varieties of urd bean (PU-35 and T-9) were obtained from the National Seed Corporation, Delhi and the *Rhizobium* culture and Arbuscular Mycorrhiza fungi (*Glomus sps*) were obtained from the Division of Microbiology, Indian Agricultural Research Institute, New Delhi. Before sowing, the seeds of both the varieties were inoculated with *Rhizobium* culture using jaggary solution and dried under shade except control and AM treated (alone) plants. The AM fungus was applied through layering technique. All the package and practices were followed for successful rising of the crop under field conditions. The data was collected on three representative plants and for grain quality tests; the harvested seeds from different treatments in all the three replications were collected. The chlorophyll content in leaves was measured using the DMSO (Dimethyl Sulphoxide) as per procedure followed by Hiscox and Israelstam (1979) and Photosynthetic rate was measured by LI-6200 portable photosynthesis system containing LI-6250 analyzer. The activities of root acid phosphatase enzyme were measured following the modified procedure as described by Tabatabai (1994) (Amaya-Carpio, *et al.,* 2009) based on the hydrolysis of p-nitro phenyl phosphate substrate to yield p-nitro phenol and inorganic phosphate. The protein content in seed was estimated following the procedure as adapted by Jackson (1958). Fat was estimated through cold percolation method (Kartha and Sethi, 1957) and carbohydrate content for reducing sugar was followed by Hodge and Hofreiter (1962) and non-reducing sugar through Nelson method (1944). The statistical analysis was done by adopting the Analysis of Variance as described by Panse and Sukhatme (1967).

RESULT AND DISCUSSION

The two varieties of urd bean grown under rain fed condition following the *Rhizobium*, AM either alone or combined inoculation enhanced the leaf area per plant. The leaf area at 60 Days stage was more in T-9 as compared to PU-35. The *Rhizobium* and AM treated plants attained more leaf area, however, it was significantly higher with combined inoculation

in both the varieties (Table 1). T-9 has higher leaf chlorophyll content as compared to PU-35 but *Rhizobium* inoculation either alone or with AM had significantly higher chlorophyll content than AM alone or untreated control. The plants supplied with AM fungi had higher chlorophyll content than control in both the varieties.

The net photosynthetic rate as measured by Infrared Gas Analyzer (IRGA), it was found that variety PU-35 had attained higher photosynthetic rate at 60 DAS as compared to T-9. The *Rhizobium* treated plants either alone or with AM maintained higher photosynthetic rate than AM treated plants and untreated control. However, the AM treated plants maintained significantly higher photosynthetic rate than control plants. The total biomass production was higher in variety T-9, than PU-35. The combined inoculation of *Rhizobium* and AM has significantly higher biomass over *Rhizobium*/AM treated plants as single inoculation, there was not much significant difference were not observed between *Rhizobium* and AM treated plants but were significantly higher over untreated control in both the varieties. The grain yield was significantly higher in variety T-9 as compared to PU-35. Though, *Rhizobium* and AM treated plants attained higher grain yield over untreated control but the synergistic effect on yield was noticed with combined inoculation. The harvest index was significantly higher in *Rhizobium* and AM treated plants either alone or in combination that was significantly higher over uninoculated controls in both the varieties. Our results are in conformity with the earlier reports for enhancing photosynthetic rate (Sinha *et al.,* 1988, Cooper, 1984, Thakur, 1994 in mung bean),the combined inoculation of *Rhizobium* and AM inoculation in pigeon pea in presence of Rock phosphate (Jain *et al.,* 2008), Panwar and Thakur , 1995 in mungbean, Hodge, 2000, Srivastava *et al.,* 1998, in pea. Under rainfed conditions the hyphae of AM fungi extract more moisture and different nutrients like P, Zn, Fe and Cu (Thakur and Panwar, 1997) helped in maintaining the water status of the plant as well the *Rhizobium* fix nitrogen and made it available to the plant during later stages of growth and grain development has helped in terms of enhanced leaf area, photosynthetic rate, chlorophyll content for better growth and development. The enhanced root phosphatase activity has also helped in mitigating the energy requirement of the plant. The combined inoculation of AM and *Rhizobium* has not only helped the yielding potential of the plants, but also enhanced the quality of the grains.

It can be seen from Table-2 that the AM fungi either alone or with *Rhizobium* enhanced the phosphorus uptake measured in terms of root phosphatase activities in both the varieties and has significantly higher values than *Rhizobium* alone or untreated control. Radersma and Grierson, 2004, and Marschner *et al.,* 2006, had shown that the AM treated plants revealed the increase in the root phosphatase activity under P deficient soil in wheat, rye and triticale and a significant positive correlation between root phosphatase activity and root, shoot and total dry matter production (Pandey, 2006).

The grain analysis revealed that the N and protein content (%) was more in T-9 as compared to PU-35 and combined inoculation of *Rhizobium* and AM had significantly higher N and protein content than uninoculated control. There was marginal increase in the fat and carbohydrate content but it was superior in the dual inoculation as compared to either of the inoculants which was significantly higher over uninoculated control. Our results are in accordance to the earlier reports, Jain *et al.,* 2007 and 2008 in mung bean, Jain *et al.,* (2008) in pigeon pea. It may be concluded that the *Rhizobium* and AM has shown higher leaf area, chlorophyll content, net photosynthesis resulting higher biomass in both the varieties, but the combined (dual) inoculation was superior to either of the inoculated plants in both the varieties. The combined inoculation not only enhanced the physiological processes and root phosphatase activity but improves the grain yield and quality also in urdbean. The application of *Rhizobium* along with AM fungi will enable the farmers to have better yield advantage with economical and ecofriendly cropping system under rainfed conditions.

Table 1: Effect of Rhizobium and AM inoculation on leaf area, chlorophyll content,net photosynthetic rate and yield in two different varieties of urd bean

Variety	Treatment	Leaf Area per Plant (cm^2) 60DAS	Chlorophyll Content(mg/gm fresh weight) 60 DAS	Net Photosynthetic Rate (μ.moles/m^2 s) 60DAS	Yield per Plant (g) at harvest	Harvest Index (%)
PU-35	**Controlled**	374.71	1.111	7.00	2.41	27.10
	Rhizobium	539.12	1.199	8.32	3.26	31.46
	AM	635.63	1.166	7.24	3.55	32.06
	***Rhiz.*+AM**	840.61	1.489	12.14	4.24	32.02
T-9	**Controlled**	459.39	1.361	4.91	2.65	29.23
	Rhizobium	655.75	1.557	6.94	3.72	31.80

	AM	885.32	1.495	4.45	3.90	31.77
	***Rhiz.*+AM**	946.61	1.643	9.11	4.81	32.35
CD at 5%						
Variety		21.31	0.0600	0.2784	0.080	0.2510
Treatment		30.13	0.0848	0.3936	0.112	0.2880
VxT		42.62	N.S.	0.557	0.159	0.3780

Table 2: Effect of Rhizobium and AM inoculation on root phosphatase activity and protein, fat and arbohydrate content in the seeds of two different varieties of urd bean.

Variety	**Treatment**	**Root Phosphatase activity (m.mole.kg^{-1} FM)**	**Grain Nitrogen content per plant(%)**	**Protein content(%)**	**Carbohydrate content(%)**	**Fat content (%)**
PU-35	**Controlled**	2.600	2.74	16.77	52.11	1.53
	Rhizobium	2.503	2.94	18.19	53.06	1.66
	AM	3.377	2.88	18.62	52.97	1.69
	***Rhiz.*+AM**	3.853	3.08	19.85	54.73	1.77
T-9	**Controlled**	2.800	2.83	17.68	52.33	1.53
	Rhizobium	2.677	2.96	18.47	53.68	1.59
	AM	3.640	3.07	19.18	54.34	1.61
	***Rhiz.*+AM**	3.813	3.27	20.31	55.16	1.660
C.D. at 5%						
	Variety	0.0185	0.0826	0.5164	0.4294	0.0116
	Treatment	0.0261	0.1165	0.7538	0.6073	0.0165
	V x T	0.0370	0.1650	N.S.	N.S.	0.0230

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SOME MORPHOLOGICAL AND BIOCHEMICAL STUDIES OF PLANT PARTS OF *VICIA FABA*.

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Abstract: The Pollen morphology is of great significance particular in cultivar taxonomy. Man has been always interested to find out micro organisms, pollen grains and fungal spore in air for better air quality. From time to time many workers as Vishnu Mittra & Gupta (1966) worked on pollen morphology. Nair &Sharma (1962) also studied on pollen morphology and pollen analysis of certain economically important families of angiosperms such as Liliaceae, Fabaceae. Sateesh and Nair (1993) also carried study of pollen grains at Tirachira pali (T.N.) in atmosphere. It was of interest to carry some work on morphological and bio-chemical studies on selected cultivars crops near college field. The studies with pollen morphology show that size of pollen grain increases under acetolysed as compared to non acetolysed condition. Similar decline in nitrogen content was observed more in infected plant soil as compared with healthy plant soil.

Keywords: Biochemical, Pollen morphology

INTRODUCTION

From time to time many workers Vishnu Mittra & Gupta (1966) worked on pollen morphology. Nair (1963) did several studies on pollen morphology and pollen analysis of certain socio-economical important families of angiosperms such as Liliaceae (1965), Fabaceae (Nair & Sharma, 1962). Singh et.al (1994) worked on air borne fungi in the hospitals of metropolitan like Delhi. Similarly, Mandal et. al (1988) worked on aero-biology of Shanti Niketan,West Bengal. Sathes & Nair (1993) also carried study on pollen grains at Tirachira pali in atmosphere.

MATERIAL AND METHOD

Anther and Pollen grains of experimental plants collected on glycerin jelly coated micro slides exposed during flowering session on the roof of college field of games room and side by side similar jelly coated slide were kept in the wooden trap under field condition . Pollen grains were identified with the help of reference slides. Anther and Pollen grains were also collected from mature healthy and diseased plants grown in the field areas of the college field. These slides and material were used for the experimental work. For morphological studies Acetolysis method proposed by Erdtman (1952) and modified by Nair (1960) was followed.

Plant sample for biochemical analysis were taken on 0, 40 th, 80 th day of seedling appearance, based on crops. Stem, leaf, anther & pollen grains were collected. Dry weight & dry samples of experimental plants were used for qualitative estimation of total nitrogen uptake. For estimation of nitrogen the digestion was done according to Snell & Snell (1954) & later nitrogen in the digest was estimated calorimetrically.

Observations

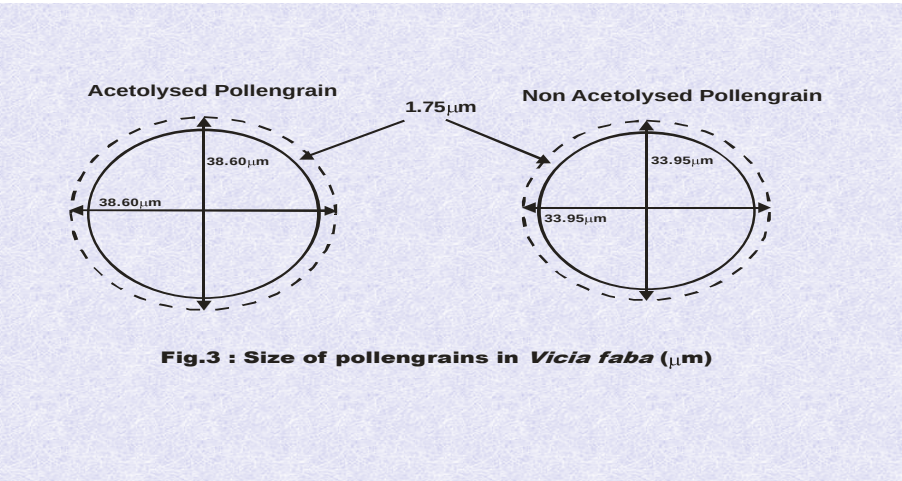

Fig.3 : Size of pollengrains in *Vicia faba* (μm)

Table 1.

Size of Pollen grains			Morphological features of Pollen grains		
Species	Acetolysed diameter (µm)	Non-Acetolysed diameter(µm)	Pore diameter (µm)	Annulus diameter (µm)	Exine Thickness diameter (µm)
Vicia faba	38.60 ±3.15	33.95 ±2.86	4.80 ±0.30	1.75 ±0.49	1.75 s±0.49

Table 2. Total Nitrogen (per gram dry weight) uptake & distribution in healthy and infected plant parts of *Vicia faba*.

Plants without infection

S.No.	Days from emergence	Soil without plant (Blank)mg/kg	Soil with plant mg/kg	Total nitrogen level in stem(mg/gm dw)	Total Nitrogen level in Leaf(mg/gm dw)	Total nitrogen level in Anther(mg/gm dw)	Total nitrogen level in pollen grain(mg/gm dw)
1	0	550.0	550.0	-	-	-	-
2	40	540.0		12.00	16.50	-	-
3	80	520.0	580.0	523.80	14.50	16.50	15.00

Plants with infection

S.No.	Days from emergence	Soil without plant (Blank)mg/kg	Soil with plant Mg/kg	Total Nitrogen level in stem(mg/gm dw)	Total Nitrogen level in Leaf(mg/gm dw)	Total Nitrogen level in Anther(mg/gm dw)	Total Nitrogen level in pollen grain (mg/gm dw.
1	0	550.00	550.0	-	-	-	-
2	40	536.0	552.0	7.53	10.50	-	-

RESULTS AND DISCUSSION

Observations indicate that non-acetolysis pollen grains of *Vicia faba* shows reducation in size of pollen grains by Ca as 13% compared to acetolysis pollen grains of *Vicia faba* . Result shows the pore diameter, annulus diameter & exine thickness in *Vicia faba*. The study with pollen morphology shows that size of pollen grain of *Vicia faba* increases under acetolysed as compared to non acetolysed condition. The results are in agreement with the results of Sampat & Ramanathan (1957), Sheeba & Vijayvalli (1998),Rawat et. al. (2003) and Bokalial and Borah (2004). Results shows that the nitrogen uptake and its distribution in healthy and infected plant parts at 40^{th} and 80^{th} days in *Vicia faba* decrease in total nitrogen content in infected plant parts. Results also show that there is a general inhibition of total nitrogen content in most of the plant parts in presence of infection. Table also indicates that total nitrogen content on gram dry weight basis is not much affected in this plant .However there is some decrease in the total nitrogen content on gram dry weight basis in infected plant parts. Thus total nitrogen content in infected leaf at 40th and 80th days are 63.6 % & 82.7 % as compared to healthy leaves. This result shows some recovery of total nitrogen of infection. Likewise total nitrogen content of infected plant in anther & pollen grains are 83.9 % and 73.4 % as compared to healthy plant anther and pollen grains respectively. Results also shows that in case of blank soil, the total nitrogen content / kg soil decline from 0 and 80th days in soil of crop fields. Results also indicate that among the blank soil there is slightly more nitrogen content loss then the soil with plant. However, in soil with plant, Total nitrogen content/kg soil also declines from 0 and 80 days in both, healthy and infected plant soil. However, this decline is more in infected plant soil with plant.

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QUANTIFICATION OF FUEL LOADS IN FIRE AFFECTED AREAS OF TROPICAL MOIST DECIDUOUS FORESTS OF ACHANAKMAR-AMARKANTAK BIOSPHERE RESERVE

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Abstract : Fuel load assessment in fire affected areas of Tropical Moist Deciduous Forests was carried out in Achanakmar-Amarkantak Biosphere Reserve. Historical ground based fire data of last 10 years was used for delineation and identification of fire affected areas. The fuel load was analyzed in different fire zones (i.e., High, Medium, Low and Non-fire) of the pre-fire and post- fire season in the area. The components of fuel load are assessed by laying a quadrat size of 1m x 1m. The biomass of duffs litter and wood litter were summed to derive total fuel load. The net change in fuel load was assessed by subtracting the fuel load existing in pre-fire and post-fire seasons in each fire zone. The total fuel load in different fire zones during pre-fire seasons followed the order: non-fire > medium fire > high fire > low fire zones, whereas during post-fire season it was in the follow the order: non-fire > low fire > medium fire > high fire zones. The results indicated that the duffs litter and wood litter in both high fire and medium fire zones in the post-fire season was decreased. While in low fire and non-fire zones the fuel load was increased due to protection from fire. There is urgent need for management strategies to these forests.

Keywords : Biomass, Duffs litter, Fuel load, Wood litter

INTRODUCTION

Fire has been a part of the co-evolution of seasonally dry-forests and grasslands across the globe (Keeley and Bond, 1999)**.** Forest fires cause enormous loss to the forest ecosystem, diversity of flora and fauna, and economic wealth. In India, out of 67.5 million ha of forests, about 55% of the forest cover is being annually subjected to fires (Gubbi, 2003). In accordance with positive attributes that fire enhances the productivity of ecosystems by releasing chemicals and nutrients locked up in the old herbage, but the uncontrolled fire destructs the micro-flora and micro-fauna in the top soil and litter layers in forests could have impacts on the organic decomposition and soil fertility (Kodandapani, 2001). Indian forests are burnt every summer, as it is believed to encourage the growth of succulent fresh grasses after the first rains. The forests are also burnt for collecting non-timber forest products, hunting and various other reasons. Very few studies that are available from Indian forests report that fires mostly affect ground vegetation.

Study site

The Achanakmar-Amarkantak Biosphere Reserve lies between 22^0 15' to 22^0 58' North latitude and 81^0 25' to 82^0 5' East longitude (Figure 1), having an area of 3836 sq. km, partly in Madhya Pradesh and partly falling in Chhattisgarh State. The state-wise distribution of the area shows that 1224.98 sq. km area comes under Madhya Pradesh and remaining 2610.53 sq. km. area in Chhattisgarh.

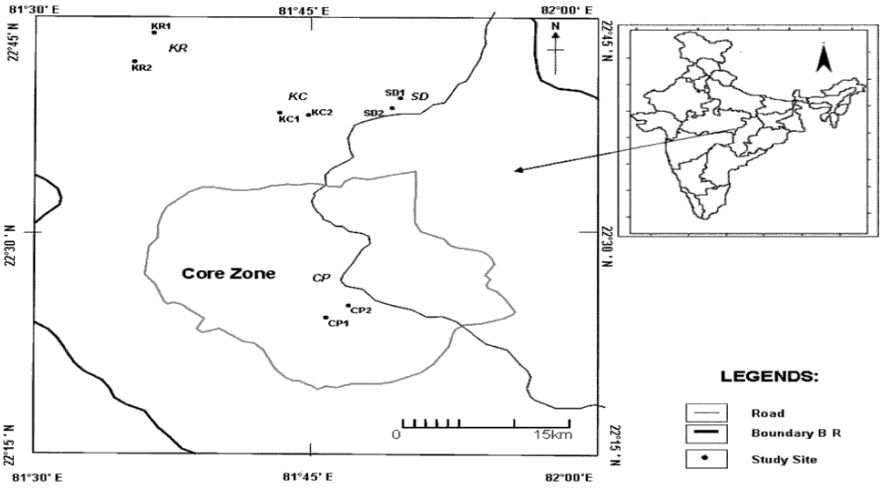

Fig. 1: Location map of the study area

The biosphere area has a typical monsoon climate, with three distinct seasons- summer from March - June, rainy from July - October and winter from November-February. Generally, May and June are the hottest months, whereas December and January are the coolest months of the year. The average annual rainfall of the area is about 1624.3 mm. The forest area of the Achanakmar-Amarkantak biosphere reserve represents tropical deciduous vegetation and can be classified into Northern Tropical Moist Deciduous and Southern Dry Mixed Deciduous forests (Champion and Seth, 1968). The former type predominates in the Biosphere Reserve area.

METHODOLOGY

Historical ground based fire data for last 10 years was used for delineation and identification of fire affected areas. Based on the frequency and spatial extent of forest fire damage, the fire affected areas were divided into four fire regime *viz.*, high, medium, low and non-fire zones. Under each fire zone the fuel loads assessment was done during pre-fire (January-February) and post-fire (May-June) seasons in order to assess both qualitative and quantitative changes in forest floor biomass.

The total fuel load in each fire zone was estimated following Kodandapani *et al.* (2008). The fuel load is assessed by a quadrat of 1m x 1m was laid out to measure the Duffs (dead grass, leaf litter, organic matter, etc.) and wood litter. The biomass of duffs litter and wood litter were summed to derive total fuel load. The net change in fuel load was assessed by subtracting the fuel load existing in pre-fire and post-fire seasons in each fire zone.

RESULTS AND DISCUSSION

Results on the components of fuel load *viz.* Duffs litter (duffs litter includes leaf, grass, flowers, bark and twig litters) and wood litter on forest floor during pre-fire and post-fire seasons are presented in table 1 and figure 2.

Pre-fire season

The major contributing components of fuel load include the duffs litter and wood litter existed on the forest floor. The duffs litter ranged from 1.77 Mg/ha to 2.62 Mg/ha and wood litter from 0.43 Mg/ha to 0.76 Mg/ha. Both wood litter and duffs litter were highest under non-fire zone, whereas it was lower under high and low fire zones.

Total fuel load on the forest floor varied from 2.2 Mg/ha to 3.38 Mg/ha. It was highest under non-fire zone and lowest in low fire zone. The total fuel load in different fire zones during pre-fire seasons followed the order: Non-fire > Medium fire > High fire > Low fire zones.

Post-fire season

During the post-fire seasons, the duff litter varied from 0.26 Mg/ha to 3.25 Mg/ha. It was highest under non-fire zone and lowest under high fire zone. The medium and high fire zones comparatively had lower amount of duffs litter just after the post-fire season. The fuel load of 0.392 Mg/ha and 0.37 Mg/ha was lost due to burning. Whereas the 0.11 Mg/ha and 0.83 Mg/ha of total load were accumulated in low fire and non-fire zones, respectively. Wood litter varied from 0.96 Mg/ha and 1.88 Mg/ha. It was higher under medium fire and high fire zones, whereas lower under low and medium fire zones. Total litter varied from 1.8 Mg/ha to 4.21 Mg/ha. The total litter during post-fire seasons was in the following order: Non-fire > Low fire > medium fire > High fire zones

The net change in fuel load was positive under high and medium fire zones and negative under low and non-fire zones. The present results indicated that fuel load ranged from 2.2 to 4.2 Mg/ha in pre and post-fire seasons, which is comparable with fuel load observed in dry mixed deciduous forests of Thailand between 4000 – 5000 kg /ha (FFCD, 2009). Increase in litterfall and with it increasing fine woody fuels, would seem to be a biological phenomenon in stands in early stages of stand development, where crown development, branch shedding and canopy closure occur at a relatively rapid rate compared to latter stages of stand development (Oliver and Larson, 1996). The trend in leaf litter (serving as fuel) accumulation is similar to that in the monsoonal forests of the Western Ghats, Australia and East Africa (Murali *et al.*, 1993; Troup, 1921).

Table 1: Duffs and Wood litter quantification (Mg/ha) in different fire zones during pre and post-fire seasons in Achanakmar- Amarkantak Biosphere Reserve

	Pre Fire Season			**Post Fire Season**			
Fire Regimes	Duffs litter	Wood litter	Total litter	Duffs litter	Wood litter	Total litter	Net change
High Fire	1.82	0.46	2.28	0.218	1.67	1.888	0.392
Medium Fire	1.77	0.74	2.51	0.26	1.88	2.14	0.37
Low Fire	1.77	0.43	2.2	0.76	1.55	2.31	-0.11
Non-Fire	2.62	0.76	3.38	3.25	0.96	4.21	-0.83

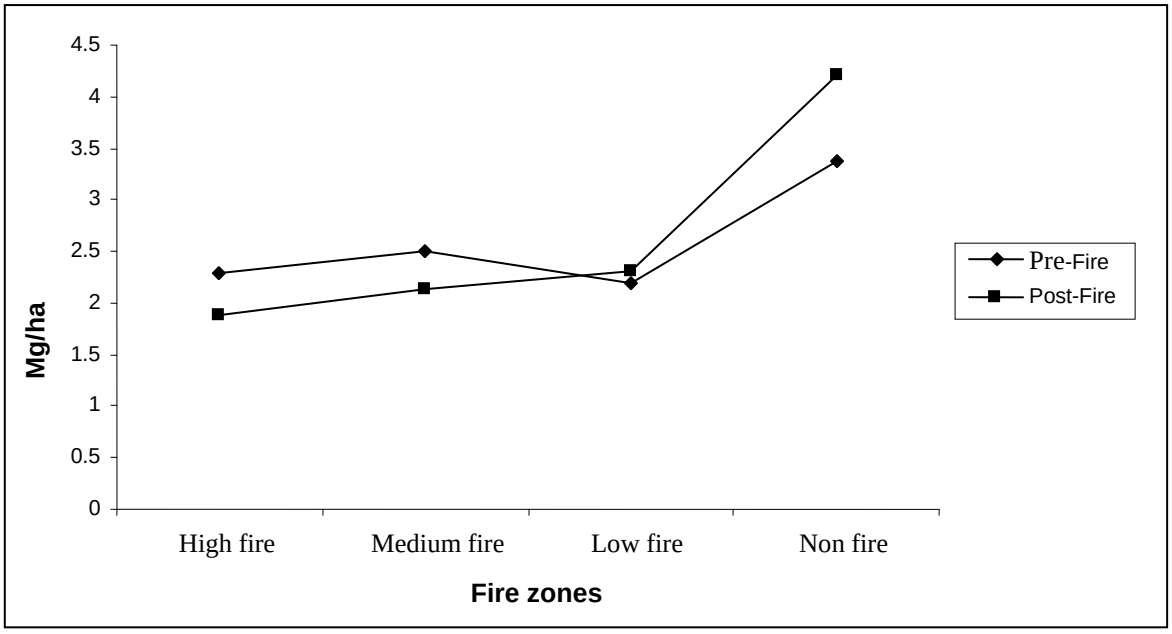

Fig. 2: Duffs litter and Wood litter quantification (Mg/ha) in different fire zones during pre and post-fire seasons in Achanakmar- Amarkantak Biosphere Reserve

CONCLUSION

The duffs litter and wood litter in both high fire and medium fire zones in the post-fire season was decreased. While in low fire and non-fire zones the fuel load was increased due to protection from fire. However, due to the repeated effect of fires on these forests are slowly decreasing the stability of the fragile moist deciduous ecosystem. The forest fires alter the structure, diversity and results the community of lesser important secondary species. The management of fire and vegetation in the forests of the central India has a long history. Prescribed burning can be applied to reduce the high intensity of wild fires. Prescribed burning especially under moist conditions could be pursued to reduce the fuel loads and create a spatial mosaic of fuel load distribution.

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Short Communication

A STUDY ON ENTREPRENEURSHIP OF VEGETABLE GROWERS IN INDORE DISTRICT IN MADHYA PRADESH

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Abstract : A study was conducted Indore district, as farmers cultivating vegetable crops the research study was conducted in Indore district of Madhya Pradesh. A representative sample of 90 vegetable growers was drawn from the 10 randomly selected villages of two blocks *viz.*, Indore and Depalpur and data were collected with the help of an interview schedule (pre-tested) The mean entrepreneur success of vegetable growers was 27.93, indicating that the most of them had medium level of entrepreneur success. The study also revealed that the entrepreneur success of large farmers was higher than the medium and small farmers. It was further observed that family type, material possession, economic status, risk taking willingness and were positively correlated at 0.05 level of probability and economic motivation at 0.01 level of probability with entrepreneurial success.

Keywords : Growers, Production, Vegetable

INTRODUCTION

Vegetables enjoy a significant place in our daily diet as they provide essential nutrition including vitamins and minerals. Any meal is considered usually incomplete without vegetables. Most of the Indians, being vegetarian, relay heavily on vegetables for balanced nutrition. According to ICMR, the per capita requirement of vegetables has been put at 300 grams per day. Hence, there is a very high demand for vegetables. But the per capita availability of vegetables was quite low as per the data available: 154 grams per day in 1975 and 194 grams per day in 1994. The gap is about 35.33 per cent which is quite high.

The production of vegetable crops in Madhya Pradesh was at 2327 thousand metric tonnes in 1995-96 which later increased to 3470 thousand metric tonnes in 1999-2000, but later reduced to 2621 thousand metric tonnes in 2004-05.

The productivity of vegetable crops in Madhya Pradesh has also increased from 12.3 metric tonnes per hectare in 1995-96 to 15.5 metric tonnes per hectare in 1999-2000, but letter reduced to 14.17 metric tonnes per hectare in 2004-2005 .

The production of vegetable crops in Indore district was at 567 thousand metric tonnes in 1999-2000 which later increased to 661.7 thousand metric tonnes in 2003-2004, but later reduced to 266.45 thousand metric tonnes in 2005-06 and further increased to 360.11 thousand metric tonnes in 2006-07

Objectives

1. To study the entrepreneurship in vegetable growers
2. To analyze the relationship between socio–personal, economic, and psychological attributes of vegetable growers and their entrepreneurial success..

METHODOLOGY

In order to achieve these objectives, the research study was conducted in Indore district of Madhya Pradesh. A representative sample of 90 vegetable growers was drawn from the 10 randomly selected villages of two blocks *viz.*, Indore and Depalpur and data were collected with the help of an interview schedule (pre-tested).The entrepreneurial success index used for the study included six indicators viz., gross return per unit investment (net profit), enterprise diversification, share of profit reinvested, degree of satisfaction, employment of family labour and social prestige gained. The collected data was classified and tabulated and interpretations were made with the help of statistical tools like percentile, mean, standard deviation and coefficient of correlation analysis.

RESULT AND DISSCUSSION

(1)-Entrepreneurial success in vegetable growers:
The study reveals that more than half of respondents (61.11%) had medium level of entrepreneurial success while 24.44 percent had high and only 14.44 percent had low level of entrepreneurial success. The study also reveals that the overall mean entrepreneurial success score was 27.93.

Table 1. Distribution of vegetable growers according to their entrepreneurial success.

(n=90)

S. No.	Entrepreneurial success.	Small	Medium	Large	Total
1	**Low (<24 score)**	10 (33.00)	2 (6.66)	1 (3.33)	13 (14.44)
2	**Medium (24-32 score)**	17 (56.66)	22 (73.33)	16 (53.33)	55 (61.11)
3	**High (>32 score)**	3 (10.00)	6 (20.00)	13 (43.33)	22 (24.44)
	Total	**30**	**30**	**30**	**90**
	Mean	**25.57**	**28.43**	**29.80**	**27.93**
	S.D.	**3.52**	**3.47**	**2.26**	**3.82**
	"t" value	Small and Medium = **3.17****			
		Small and Large = **4.83****			
		Medium and Large = **1.57**			

** Significant at 1 % level
* Significant at 5 % level

(2)-Relationship between socio- personal, economic and socio-psychological attributes of vegetable growers and their entrepreneurial success:

It was observed socio-personal and economic variables, two variables namely material possession and economical status were significant at 0.01 level of probability with entrepreneurial successes, while, one variable namely family type was significant at 0.05 level of probability.

It was further revealed that out of five socio-psychological variables the correlation coefficient of one variable namely economic motivation was significant at 0.05 level of probability. While, one variable namely risk taking willingness was significant at 0.01 level of probability.

Table 2. Relationship between socio- personal, economic and socio-psychological attributes of vegetable growers and their entrepreneurial success.

S.N.	Factor	Coefficient correlation (r)
A)	**Socio-personal**	
1.	Age	0.177
2.	Education	0.135
3.	Family type	0.249**
4.	Family income	0.088
5.	Land size	0.117
6.	Value of house	0.183
7.	Material possession	0.360**
8.	Economic status	0.337**
9.	Credit worthiness	0.043
B)	**Socio-psychological**	
1.	Economic motivation	0.266*
2.	Risk taking willingness	0.342**
3.	Market orientation	0.089
4.	Owning Responsibility	0.155
5.	Level of knowledge	0.047

* Significant at 5 % level of probability
** Significant at 1 % level of probability

CONCLUSION

Most of the farmers had medium level of entrepreneurship. The study also revealed that the entrepreneurship of large farmers was higher than the medium and small farmers. It was further observed that family type, material possession, economic status, risk taking willingness were positively correlated at 0.05 level of probability and economic motivation at 0.01 level of probability with entrepreneurial success.

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Short Communication

ASSESSMENT OF POPULATION STRUCTURE OF MAJOR TREE SPECIES IN FIRE AFFECTED AREAS OF ACHANAKMAR-AMARKANTAK BIOSPHERE RESERVE

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Abstract : Assessment of population structure of major tree species in fire affected areas of Achanakmar-Amarkantak Biosphere Reserve was carried out for the study by using stratified random sampling technique. The population structure was analyzed in different fire zones (i.e., High, Medium, Low and Non-fire zone) of the region. The trees and saplings were analyzed by randomly laying out five quadrats of size 20 x 20 m. A subquadrat of 5 x 5 m size was randomly laid for measuring seedlings. The study concluded that the species population in the moist deciduous forests, instead of continuous distribution of all size classes in these forests there had a discontinuation in size classes of several important major tree species in the forests vegetation due to repeated fire effect on these forests more importantly the major species population behaved differently in different fire zones.

Keywords : Fire zone, Population structure, Size classes, Species

INTRODUCTION

The forest fire is a good servant but bad master therefore, forest fires should be first prevented and then controlled (Negi, 2008). Although fire under control may be a beneficial and un-controlled fire is always harmful. Fire is therefore, innately neither destructive nor constructive, it simply causes changes, whether these changes are viewed as desirable or not dependent upon their compatibility with overall objectives. Different vegetation types have different susceptibility to fire, different fire frequencies and intensities. Interactions between the climatic regime, soil type and topography are all involved, as these features determine the vegetation type, the likelihood of fire and the probability that it will spread.

Controlled fires are beneficial in improving the site conditions, thereby ensuring the adequate regeneration of native vegetation. Fire enhances the productivity of ecosystems by releasing chemicals and nutrients locked up in the old herbage. The controlled fires enhance the microbial activity and ameliorate the physico-chemical properties of forest soil. On the other hand, the un-controlled fire is always harmful to both flora and fauna. The uncontrolled surface fires kill the young regeneration, saplings and small trees. It will arrest the progression of succession and lead to development of secondary forest communities of invasive and economically unimportant fire hardy species. The impact of fire will be detrimental to the growth of vegetation and microclimate of the area (Devagiri *et al.* 2006). Therefore the study was conducted for assessment of structural distribution of vegetation in fire prone areas of Achanakmar-Amarkantak Biosphere Reserve.

Study area

The Biosphere Reserve of Achanakmar –Amarkantak lies between 22^0 15' to 22^0 58' North latitude and 81^0 25' to 82^0 5' East longitude, having an area of 3836 sq. km, partly in Madhya Pradesh and partly falling in Chhattisgarh State. The forest area represents tropical deciduous vegetation and can be classified into Northern Tropical Moist Deciduous and Southern Dry Mixed Deciduous forests (Champion and Seth, 1968). The moist and dry Sal, Teak mixed and Bamboo brakes are predominant vegetation types found in the sanctuary. The biosphere area has a typical monsoon climate, with three distinct seasons- summer from March - June, rainy from July - October and winter from November-February. During the last few decades, these forests were subjected to severe biotic disturbances. The forest fires have became major threat in certain pockets due to repeated forest fire and illegal logging these forests. The government of India had long been started protecting these forests due to their importance in both ecologically and socio-economically.

METHODOLOGY

The population structure was analyzed for in different fire affected zones (i.e., High, Medium, Low and Non-fire zone) of the region. The trees and saplings were analyzed by randomly laying out five quadrats of size 20 x 20 m. The girth at breast height (i.e., 1.37 m above the ground) of all the trees and saplings in each quadrat was measured and recorded individually. For tree species, the individuals > 31.5 cm GBH are categorized as tree, < 31.5 cm but > 10 cm as saplings. In each of these quadrat, a subquadrat of 5 x 5 m size were randomly laid for measuring

seedlings (< 10 cm GBH). To show the regeneration pattern of tree species, the population structures were developed based on different tree girth classes in addition to seedlings and saplings. The total number of individuals belonging to these girth classes was calculated for each species on each site. In addition to seedling (A) and sapling (B) classes, three more size classes (based on G.B.H.) i.e., 31.5-70.0 cm (C); 70.1-110.0 cm (D) and > 110 (E) were arbitrarily established for each population. The total number of individuals belonging to these diameter classes was calculated following Saxena and Singh (1984).

RESULT AND DISCUSSION

The interpretation of population structure of tree species was based on the assumption that size class corresponds with age of individuals. Though the size distribution often differs from the age class distribution, the former in case analyses properly can also be useful for interpretation of patterns of population changes.

In the high fire zone the seedling size class (A) and sapling size class (B) were represented by *Diospyros melanoxylon, Dalbergia sissoo, Shorea robusta* and *Tectona grandis*. The nil or negligible presence of intermediate species (*Tectona grandis*, *Dalbergia sissoo, Shorea robusta* and *Diospyros melanoxylon*). The *Ougeinia oojeinensis* and *Anogeissus latifolia* were only represented intermediate size (B) or (C) classes. The younger and older trees are higher in *Tectona grandis* and *Dalbergia sissoo* this represented that once the intermediate trees are higher but consequently disappeared due catastrophic effects like logging and forest fires Knight (1975) referred to the species showing such population structure as infrequent reproducer.

Medially fire affected zone showed *Anogeissus latifolia* and *Emblica officinalis* were represented only by saplings size class (B) and small trees size class (C). *Lannea coromandelica* and *Semicarpus anacardium* showed higher proportion of older tree, while *Anogeissus latifolia* and *Shorea robusta* represented all diameter classes. The young seedlings and older trees are nil or negligible (*Emblica officinalis, Anogeissus latifolia*, *Tectona grandis* and *Lannea coromandelica*) in the medially fire affected zone, according to Saxena and Singh (1984), Bargali *et al.* (1987) the population is on the way to extinction if such a trend continues. The proportion of saplings class (B) and small trees class (C) to older tree size class (D and E) increased gradually (*Shorea robusta*) while in *Lannea coromandelica* class (C) to class (E) the proportion was decreased.

The low fire zone represented that mostly seedlings layer of all the species are dominated, exemplified by *Lagerstroemia parviflora*, *Shorea robusta*, *Cassia fistula* and *Diospyros melanoxylon*. The entire or negligible presence of all the older trees are represented by all the species, except *Terminalia tomentosa*, while the *Ougeinia oojeinensis, Buchanania lanzan* and *Semicarpus anacardium* represented the more saplings (B) and younger trees (C) in the lowly fire affected zones.

The non-fire zone represented that dominant seedling class (A) except by *Terminalia tomentosa*. The size classes (C), (D) and (E) represented negligible presence or entire absence of older trees, exemplified by *Saccopetalum tomentosum, Schleichera oleosa, Diospyros melanoxylon, Emblica robusta* and *Lagerstroemia parviflora*. The sapling size represented by class (B) to older size class (E) was increased proportionally (e.g. *Shorea robusta* and *Terminalia tomentosa*). Kafle (2004) also reported that very young trees were quite abundant in the unburnt areas as compared to the burnt areas.

The hump in the middle size classes may indicate comparatively fast growth or less mortality in individuals once they successfully crosses the sapling layer and attained the first tree size class (C) as exemplified by *Tectona grandis, Terminalia tomentosa* and *Ougeinia oojeinensis* in high fire zone and *Ougeinia oojeinensis* in medium fire zone, *Semicarpus anacardium* and *Ougeinia oojeinensis* in low fire zone and in non-fire zone recorded by *Shorea robusta*. According to West *et al.* (1981) such type patterns indicate the heavy exploitation of older individuals and greater mortality among young individuals by repeated forest fires.

On the basis of the population structures of different tree species in different stands following six general patterns are recognizable.

(1) Generally greater population of individuals of *Shorea robusta* in seedling size class (A) as compared to sapling size class (B) and slightly higher percentage of individuals in third and fourth size classes and sometimes decline or increase the higher size class (E). This situation might have resulted from rapid conversion of seedlings into saplings and that of saplings into trees in the past but the rate has been showed down at present. This species can be referred as a fair reproducer.

(2) The concentration of individuals in intermediate size classes with generally absence or negligible representation of individuals both towards higher and lower size classes (e.g., *Semicarpus anacardium*, *Terminalia tomentosa*). According to Saxena and Singh (1984), Bargali *et al.* (1987) the population is on the way to extinction if such a trend continues. Knight (1975) referred to the species showing such population structure as infrequent reproducer.

(3) A greater population of individuals in lower size classes compared to larger classes as exemplified by *Cassia fistula, Tectona grandis, Emblica robusta, Schleichera oleosa, Diospyros melanoxylon* and *Lagerstroemia parviflora*. The structure represents frequent reproduction according to Knight (1975).

(4) A lesser population of individuals in lower size classes compared to larger size classes as exemplified by *Shorea robusta, Semicarpus anacardium, Terminalia tomentosa, and Ougeinia oojeinensis*. These species have produced abundant population in the past with better conversion rate from one size class to another but at present though the seedlings are not comings up frequently, though the species might have produced the seeds but, the environment is not supporting their proper establishment.

(5) *Lagerstroemia parviflora, Diospyros melanoxylon, Cassia fistula* was represented by mainly two size classes i.e. seedling and sapling. These species are facing much pressure and unable to grow towards the higher size classes. If this situation will exhibit for longer time these species may be washed out.

(6) *Buchanania lanzan, Tectona grandis* and *Anogeissus latifolia* were represented by single size class (B) these may be referred as either an accidental or the nomads, in future if these species will found the suitable environmental conditions and they will survive or otherwise washed out if the condition not favor with the progress of time.

CONCLUSION

The study concluded that the species population in the moist deciduous forests, instead of continuous distribution of all size classes in these forests there had a discontinuation in size classes of several important major tree species in the forests vegetation due to repeated fire effect on these forests more importantly the major species population behaved differently in different fire zones. The species like *Terminalia tomentosa, Ougeinia oojeinensis* and *Anogeissus latifolia* population was more in high fire zone. Distribution of *Diospyros melanoxylon* and *Shorea robusta* of size class (A) population was more in medium and low fire zone. But the size class (C), (D) and (E) population *Lagerstroemia parviflora, Cassia fistula, Buchanania lanzan* and *Diospyros melanoxylon* are negligible of or nil. The *Lagerstroemia parviflora, Diospyros melanoxylon and Shorea robusta* of lower size class (A) and (B) had more population as compared to *Terminalia tomentosa, Ougeinia oojeinensis* and *Buchanania lanzan* in low fire zone. In case of non-fire zone the population of intermediate size class (B) and (D) exemplified by *Schleichera oleosa, Terminalia tomentosa, Diospyros melanoxylon* and *Emblica officinalis* are absent or negligible. If this type of size class discontinuation persists in these forests, there will be problem for sustainable harvesting and management in these moist deciduous forests and moreover there might be even species extinction if a repeated forest fire continues over several years. Therefore there is urgent need for new policy formation and adaptation of scientific forest protection measures against catastrophic hazards like forests fires.

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Short Communication

PERFORMANCE OF PARENTS OF SWEET POTATO FOR SEED PRODUCTION AT CHHATTISGARH

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Abstract: 24 (twenty four) crosses were made in Line x Tester design utilizing 6 Female and 4 Male parents of wide genetic base to as certain the performance of parents for TSPS attributes. Among these crosses Indira Navin x Sre rethna for capsule set, Indira Navin x Gauri for seeds per capsule and IGSP-C-15 x Sree rethna for 100 seed weight were found promising. Parental lines Indira Madhur, Sree rethna and Gauri were good females and all four testers were good males for TSPS production.

Keywords : Performance, Potato, Production, Seed, Sweet

INTRODUCTION

In sweet potato breeding, flower production and capsule setting are two basic requisites ,for making desired crosses. The use of TSPS as a means of propagation has enhanced the importance of attributes like pollen fertility, seed per capsule and 100 seed weight (Gaur and Pandey, 1990). Genetic constitution of male and female parental lines determines the TSPS quality and quantity (Upadhyay *et al*., 1984). The present investigation was undertaken to study the performance of sweet potato parental line for duration of flowering, pollen fertility, capsule and 100 seed weight and to identify the promising crosses with desirable attributes for TSPS production.

MATERIAL AND METHOD

The study was carried out at Vegetable Farm (AICRP) Tuber (Sweet potato) Horticulture Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) (24^0-5'N latitude and 72^0 E longitude, 360 m msl) during Rabi season of 2009-10. Sweet potato flowering at Raipur during the crop season, thus flowering was induced by prolonging photoperiod by 4 to 6 hours and temperature is very higher. Crosses were made in Line x Tester design utilizing 6 female and four male of wide genetic base. Minimum of 10 bunches (40-50 flower buds) were pollinated per crosses. Data were recorded on progenies for duration of flowering (days), viable pollen grains (%), capsule setting (%), and numbers of seed per capsule and 100 seed weight (mg). Performance of male and female parents was calculated by taking average of each parent's performance over crosses with four male and six female parents, respectively.

RESULT AND DISCUSSION

The duration of flowering ranged from 41.33 days (Indira Navin and Indira Nandini) to 62.67 days (IGSP-C-15) in female parents, whereas all four male parents had around 63 days flowering duration. IGSP-C-15, IGSP-C-16, Indira Nandini, Indira Navin, IGSP-C-16 and IGSP-C-14 had longer flowering during. All female parents had around 50 % viable pollen grains. Among the pollen parents, maximum percent of viable pollen grains were in IGSP-C-16 (91.22 %) followed IGSP-C-14 (89.73%), Indira Navin (75.04 %) and Indira Nandini (67.92 %) (Table 1). The exent of capsule setting ranged from 22.08 % (Indira Navin x Sree Rethna) to 95.03 (IGSP-C-16 x Gauri) maximum capsule setting among female was Indira Navin (90.14) followed by IGSP-C-15 (88.75 %), Indira Nandini (83.66%), IGSP-C-16 (83.46 %) and IGSP-C-17 (79.03 %), while among males it was maximum in Indira-9 (72.62 %) followed by Gauri (71.68 %) and Indira Madhur (69.45 %) Table-1). A large variation has found for number of seeds per capsule (Pandey and Gupta, 1995). In the present study number of seeds per capsule ranged from 15.53 (IGSP-C-16 x Gauri) to 3 (IGSP-C-15 x Gauri) to 5 (IGSP-C-16 x Sree Rethna). Among female parents maximum seeds per bery were in IGSP-C-16 (5) followed by IGSP-C-14 (4), Indira Navin (3) and Indira Nandini (2) Table 1). Among the pollen parents, maximum seeds per capsule were in Indira Madhur (5) followed by Gauri (4), Sree Rethna (3) and Indira-9 (2). The 100 seed weight in various crosses ranged from 23.31 mg (IGSP-C-15 x Sree Rethna) to 128.7 mg (IGSP-C-14 x Indira Madhur). Among the females IGSP-C-14 (98.41 mg) produced maximum 100 seed weight followed by IGSP-C-15 (78.86 mg), IGSP-C-16 (77.64 mg), Indira Navin (72.29 mg) and Indira Nandini (69.84 mg). Crosses IGSP-C-15 x Indira Madhur, IGSP-C-16 x Sree Rethna and IGSP-C-14 x Indira Madhur were promising for capsule setting seeds per capsule and 100 seed weight respectively. IGSP-C-15, Indira Navin, IGSP-C-16, Indira Nandini and IGSP-C-14 were found good female and all four males Sree Rethna, Gauri, Indira Madhur and Indira-9 good males for various characters important to TSPS production.

Table 1. Performance of parental lines for characters important to TSPS production.

Parents	Duration of flowering (days)	Viable pollen grains (%)	Capsule setting (%)	Seeds/capsule (no)	100 seed weight (mg)
Female					
Indira Navin	61.86	74.50	76.75	5.5	58.75
Indira Nandini	63.32	73.85	75.75	4.6	57.50
IGSP-C-14	62.75	72.95	72.75	5.9	62.78
IGSP-C-15	60.75	86.75	67.85	4.5	61.25
IGSP-C-16	63.56	83.89	65.75	3.78	68.75
IGSP-C-17	61.56	78.78	68.75	4.25	57.65
Male					
Sree Rethna	62.67	75.04	69.45	5.60	57.00
Gauri	62.33	89.73	71.68	5.20	54.66
Indira Madhur	64.00	91.22	64.93	4.05	65.93
Indira-9	63.33	67.93	72.92	3.68	59.78

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