ISOLATON, BIOCHEMICAL CHARACTERIZATION AND PREPARATION OF BIOFERTILIZER USING *RHIZOBIUM* STRAINS *(VIGNA MUNGO)* FOR FARMERS USE

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Abstract: A pot experiment was conducted at Sardar VallabhBhai Patel University of Agriculture & Technology, Meerut (U.P.) to evaluate the effect of *Rhizobium* as a biofertilizers on different plant parameters related to yield performance of Black gram (*Vigna mungo*) cv.urd shekhar-2 during the period from March to June 2013. The trial composed of four treatments such as T_1=control, T_2=DAP, T_3=IARI (Urd 10B) and T_4=Native strain. Irrespective of treatment differences the black gram plant as a pulse crop showed a lag phase for slow dry matter production in early growth stage that decrease upto harvest. This greater dry matter production eventually partitioned to root length, seed number, seed weight, dry pod weight, number of pods, number of nodules and microbial count. The results revealed that biofertilization perform significant improvement in plant productivity and quality. The maximum germination and increase in plant root length, seed number, seed weight, dry weight, number of pods and microbial count was increased progressively in treatments treated with *Rhizobium*.

Keywords: Isolation, biofertilizer, *Rhizobium*

INTRODUCTION

Today as there is much scarcity of food which provide sufficient nutrient for the human body, In such condition we need to grow such food crops which are high in nutrients like protein, vitamins and several other nutritional supplements needed for a human body. The main role playing such important nutrient supplement is pulses. Pulses are such food supplements which complete the protein requirement of the body.

Black gram or *Vigna mungo* is one such crop which plays a vital role in filling up the protein deficiency (S. K. Nitu, M. M. Ud-Deen *et al.,* 2009). Nitrogen based fertilizers may serve for better growth of crop plants but efforts should be oriented towards augmenting biological nitrogen fixation mediated by microorganisms. An average area of grain legumes like soybeans, beans, or peas provides sufficient protein for 1000-2000 days for one person, whereas an average area of plant materials converted to animal protein like beef and poultry provides only for 75-250 days (Burns and Hardy, 1975).

Rhizobia encompass a range of bacterial genera, including *Rhizobium*, *Bradyrhizobium*, *Sinorhizobium*, *Mesorhizobium*, *Allorhizobium*, and *Azorhizobium*, which are able to establish a symbiosis with leguminous plants. They elicit the formation of specialized organs, called nodules, on roots or stems of their hosts, in which they reduce atmospheric nitrogen and make it available to the plant. Symbiotic nitrogen fixation is an important source of nitrogen, and the various legume crops and other species often fix as much as 200 to 300 kg. nitrogen per hectare (Peoples *et al.,* 1995).

MATERIAL AND METHOD

Plant growth and nodulation

The trial was conducted at green house of Sardar Vallabh Bhai Patel University of Agriculture and Technology. Seeds of black gram were bought and were soaked in the inoculums of Rhizobial strains to germinate for 4 days. These seeds were then sowed in 32 pots. These pots were divided in four treatments viz control (Tc), Diammonium phoaphate, IARI and native. The first treatment comprises of seeds which were soaked for 4 days in water, the second treatment comprises of same seeds and the soil contains an additional fertilizer which is DAP (diammonium phosphate). This DAP was also added to rest of the pots. The seeds present in the third treatment were soaked in Rhizobial inoculums which were taken from IARI (Indian Agriculture Research Institute) and the fourth treatment consists of seeds soaked in Rhizobial inoculum which were taken from the nearby area of Sardar Vallabh Bhai Patel University of Agriculture and Technology which was termed as Native Strain.

Two seeds were sowed in each pot and were watered at regular interval of 2 days.This irrigation schedule was maintained for 83 days and after 83 days uprooting of the plant was carried out. From each trial 3 pots were randomly selected for the recording the observation on attributes like root length, seed number, seed weight, dry pod weight, number of pods, number of nodules and microbial count.

Isolation of Rhizobial strains

The roots of Blackgram were transported to the laboratory in plastic bags. The roots of plants were

thoroughly washed and nodules were severed and sterilized in 95% ethanol for 5 s and 0.1% $HgCl_2$ for 5 min. Each nodule was crushed and the content of the nodule was transferred onto a petri dish with yeast-extract mannitol agar (YEMA) **(Vincent 1970; Somasegaran and Hoben 1985)**. Petri dishes were incubated at 28 °C until typical colonies of rhizobia appeared. Single colonies were marked and checked for purity by repeated streaking on YEMA medium **(Vincent 1970)** and verifying a single type of colony morphology, absorption of congo red (0.00125 mg kg-1) and a uniform Gram-stain reaction.
From the above method the native strains were isolated and the IARI strain was also restreaked for better and fresh colonies.

Soaking of seeds
For soaking of seeds the slurry was prepared. This slurry contains about 150g of charcoal which was thoroughly mixed with 200ml of YEMA broth containing the Rhizobial strain. Like this two different slurry were prepared one with the Native Rhizobial Strain and another one with the IARI Rhizobial strain. After that 5g of seeds of black gram were taken in four petri dishes. The seeds in first petri dish were soaked in tap water, the second one was also soaked in same tap water, the third one was soaked in slurry which was containing the IARI strain and the fourth one was soaked in the slurry containing the native Rhizobial strain.

Sowing of seeds
After 4 days when the seeds were properly germinated then the procedure of sowing was carried out.
32 Pots were taken and for each of the four treatments 8 pots were allocated. The pots were marked as Tc (control), DAP (Diammonium Phosphate), IARI and Native. 8 kg of soil which was taken from the nearby area of the Sardar Vallabh Bhai Patel University of Agriculture and Technology were added to the pots. Except the control one all the pots were treated with 400ml of DAP solution which was having a concentration of 1.2 %(w/v). After that the germinated seeds in different treatments were sowed in the already marked pots (2 seeds per pot). Then the irrigation schedule was maintained. The pots were regularly watered at interval of 2 days.

Uprooting of plants for recording observation
After 83 days of sowing uprooting was done. Randomly 5 pots from each treatment were selected for recording the observation. The characteristics which were observed were root length, seed number, seed weight, dry weight of pods, number of pods and microbial count.

Root Length
The roots of the uprooted plants were washed by dipping them in beaker filled with tap water very firmly so that no breaking of roots occur. The roots were then blot dried by keeping them on blotting paper and remained undisturbed for half an hour. After drying the root length were measured by scale.

Table 1. Length of root

TREATMENT	PLANT 1	PLANT 2	AVERAGE
Tc(control)	45	40	41.3
Tc(control)	45	40	
Tc(control)	53	25	
DAP	30	19	33.5
DAP	35	25	
DAP	59	33	
IARI	30	31	33.5
IARI	33	34	
IARI	50	23	
NATIVE	44	28	30.5
NATIVE	27	28	
NATIVE	29	27	

Seed number
The pods present on each plant were removed and the seeds from each pod were removed out counted manually.

Table 2. Seed number

	Data for 2 plants per pot(Seed number)					AVERAGE	Avg(1 plant per pot)
TC	40	33	81	105	120	75.8	37.9
DAP	26	62	105	93	130	83.2	41.6
IARI	61	87	87	115	72	84.4	42.2
NATIVE	134	95	90	90	118	105.4	52.7

Seed weight
The counted seeds were weighed on weighing balance and the data was recorded.
Table 3. Seed weight

	Data for 2 plants per pot(Seed weight in gm)					AVERAGE	Avg(1 plant per pot)
TC	1.26	1.07	2.97	2.57	3.25	2.224	1.112
DAP	1.16	3.54	4.06	3.972	6.11	3.7684	1.8842
IARI	2.98	3.74	4.19	4.47	3.38	3.752	1.876
NATIVE	6.36	4.61	3.82	4.2	4.92	4.782	2.391

Dry pod weight
The pods were kept for drying for 15 days. After drying the pods were weighed on a weighing balance and the data was recorded.

Table 4. Dry pod weight

	Data for 2 plants per pot(dry weight of pods in gms)					AVERAGE	Avg(1 plant per pot)
TC	2.09	1.7	5.16	4.48	5.83	3.852	1.926
DAP	1.96	5.83	7.32	6.91	9.3	6.264	3.132
IARI	5.67	6.56	6.43	8.02	5.56	6.448	3.224
NATIVE	9.63	7.86	6.26	6.61	8.55	7.782	3.891

Number of pods
The pods present in each of the uprooted plant were counted manually and the data was recorded.

Table 5. Number of pods

	Data for 2 plants per pot(number of pods)					AVERAGE	Avg(1 plant per pot)
TC	9	8	19	22	26	16.8	8.4
DAP	7	16	30	31	29	22.6	11.3
IARI	27	23	16	32	21	23.8	11.9
NATIVE	30	23	37	15	28	26.6	13.3

Microbial count
The microbial population present in the soil was estimated in which the uprooted plants were grown.
Enrichment of sample
1g of soil sample was weighed on weighing balance and was mixed in 10ml of YEMA broth. This broth was then kept for incubation at 28^0C for 48 hours. After 48 hrs of incubation, the Rhizobium gets enriched. This enriched broth of Rhizobia was then subjected to serial dilution.

Serial dilution
1ml of this enriched broth was diluted in 9ml of distilled water and this dilution was termed as 10^{-1}. Now from this dilution 1ml of the sample was taken and transferred to the next tube containing 9ml of distilled water and this dilution was termed as 10^{-2} and in the same way the serial dilutions were prepared upto 10^{-9} dilutions.

Plating of diluted sample
The serially diluted samples were poured on YEMA plates. Two dilutions i.e. 10^{-8} and 10^{-9} were taken for assessment of microbial population. 1ml of dilution was taken with the help of pipette and poured on the YEMA plates. The sample was then spread equally on the YEMA medium with the help of L-shaped glass rod and was incubated at 28^0C for 48 hours. After 48 hours, small and isolated colonies of *Rhizobium* were observed on the YEMA plates. The small and isolated colonies were counted on colony counter and the microbial population was estimated.

Table 6. Microbial count

Treatment	Dilutions		Average
	10^{-8}	10^{-9}	
Tc	191	152	221.7
Tc	336	291	
Tc	284	179	
Tc	226	160	
Tc	216	182	
DAP	350	328	332.1
DAP	776	636	
DAP	286	172	
DAP	137	129	
DAP	268	239	
IARI	444	421	401.7
IARI	321	287	
IARI	782	720	
IARI	348	254	
IARI	291	149	
NATIVE	490	403	435.2
NATIVE	319	288	
NATIVE	816	788	
NATIVE	337	304	
NATIVE	315	292	

RESULT AND DISCUSSION

The growth and yield parameters of black gram such as root length, seed number, seed weight, dry weight, number of pods and microbial count were significantly increased by plant growth promoting Rhizobacteria (PGPR) application in all concentrations when compared to control. Utilization of biological fertilizer increases the other nutrient absorption, also biological phosphate fertilizer can be used as a solution for increasing phosphate and micronutrient absorption in the alkaline soil (Zahir *et al*.). in maize both qualitative and quantitative characteristics were significantly increased by phosphate-solubilizing microorganisms and also increased the growth and resistance of plants in water deficit conditions (Ehteshami *et al.*, 2007). Hoshang Naserirad *et al.* and Asad Rokhzadi indicated that inoculation with biofertilizers containing *Azotobacter* and *Azospirillum* increased the plant height, leaf number per plant, fruit mean weight and yield in compare to control (without biofertilizer). In this study also we found that due to inoculation of Rhizobial strains in two treatments of IARI and Native, there is a relative decrease in root length of plants as compared to the plants treated with DAP and the non-treated control plants. This result shows that the roots of the plant get their nitrogen source in their nearby rhizosphere so there is no need that roots could grow and extend their length to find the nitrogen at the bottom. The variants treated with Native and IARI strains also showed a remarkable increase in the seed number, seed weight, dry weight, number of nodule and microbial count also.

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SYNTHESIS AND CHARACTERIZATION OF NOVEL FUNCTIONALIZED CHALCONES AS POTENT ANTIMICROBIAL AGENTS

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Abstract: Two series of novel chalcones (6a-6g and 7a-7g) have been synthesized by solution phase Claisen-Schmidt condensation. All the new final products have been purified by silica gel column chromatograpgy and characterized on the basis of their infrared (IR) and proton nuclear magnetic resonance (^{1}H NMR) spectroscopic data, and elemental analysis. All the final compounds (6-7) were exploited for their antimicrobial activity by the cup-plate method. From the antibacterial screening it was observed that the compounds, 6 (a, b, e and f) and 7 (b, c and g) shows good antibacterial activity against *Staphylococcus aureus* (zone of inhibition,10-16 mm) as compared to standard streptomycin (zone of inhibition, 18 mm) whereas compounds 6 (a, b, d, e and g) and 7 (b, c and g) showed good antibacterial activity against *Escherichia coli* (zone of inhibition,10-18 mm) as compared to streptomycin (zone of inhibition, 22 mm). Fungicidal screening data also revealed that compounds 6 (a and b) and 7 (d and e) imparted maximum activity against *Aspergillus niger* (zone of inhibition, 10-15 mm) as compared to standard griesofulvin (zone of inhibition, 17 mm), whereas compounds 6 (a, c, e and f) and 7 (e and g) showed good activity against *Candida albicans* (zone of inhibition, 10-16 mm) as compared to griesofulvin (zone of inhibition, 20 mm).

Keywords: Chalcones, Claisen-Schmidt Condensation, Antimicrobial activity, IR, ^{1}H NMR

INTRODUCTION

Chalcones, 1,3-diarylprop-1-enones, are a class of compounds consisting of two aryl rings linked by an α,β- unsaturated ketone moiety. Chalcones moieties are common substructures in numerous natural products belonging to the flavonoid family. [1-3] The compounds with the backbone of chalcone have been reported to exhibit a wide variety of pharmacological effects including, antimalarial[4-6], antiviral[7-9], antibacterial[10-12], antituberculosis[13], antifungal[14-16], anticancer[17-19], antileishmaninal[20], antiinflammatory [21], antipyretic[22], analgesic[23], antiulcerative[24], antihyperglycemic[25], antioxidant[26], antiinvasive[27], antiplatelet[28] and insect antifeedent[29]. A number of chalcone derivatives have also been found to inhibit several important enzymes in cellular systems, including xanthine oxidase[30], aldose reductase[31], epoxide hydrolase[32], protein tyrosine kinase[33] and quinone reductase[34]. Interest in chalcones as antimalarials was initiated by the discovery of antiplasmodial activity of Licochalcone A, an oxygenated chalcone isolated from the roots of the Chinese licorice during routine screening.[35] Computational structural analysis also identified chalcones as potential plasmodial cysteine protease inhibitors consistent with the experimental data.[36] Herein, we designed and synthesized new chalcone derivatives and evaluated their antimicrobial activity.

MATERIAL AND METHOD

Experimental

All the reagents used were of analytical grade and purchased from Sigma-Aldrich, Merck, CDH, SRL and Spectrochem. Solvents were used after their purification by suitable methods and distillation.

Test of homogeneity/purity

Homogeneity / purity of all products were tested by conducting their thin-layer chromatography with silica gel "G" adsorbant. Sample solutions of last step products in MeOH were loaded on silica gel layers and plates were developed in petroleum ether-Ethyl acetate (8:2, v/v) solvent. Chromatograms with multispots visualized in Iodine fumes, indicate impurity of samples. Impure samples were then purified by crystallization in ethanol to obtain pure products.

Analyses and physical measurements

Melting points determined in the open capillaries were uncorrected. IR spectra and microanalyses for carbon, hydrogen and nitrogen contents of samples were obtained from I.I.T., Delhi. ^{1}H NMR spectra were recorded in DMSO-d_6 medium on Brucker-400 MHz spectrometer at Jamia Hamdard University, Delhi.

Syntheses

Twenty eight compounds have been synthesized in solution phase according to following scheme.[37, 38] The synthesised compounds (6-7) were screened for their in vitro antimicrobial activity against *Staphylococcus aureus*, *Escherichia coli* and antifungal activity against *Aspergillus niger*, *Candida albicans* by measuring the zone of inhibition in mm. The antimicrobial activity was performed by cup plate method[39-41] at concentration 500 µg/mL and reported in Table 1. Nutrient agar was employed as culture medium and DMSO was used as solvent control for antimicrobial activity. Streptomycin and griseofulvin were used as standard

for antibacterial and antifungal activities respectively.

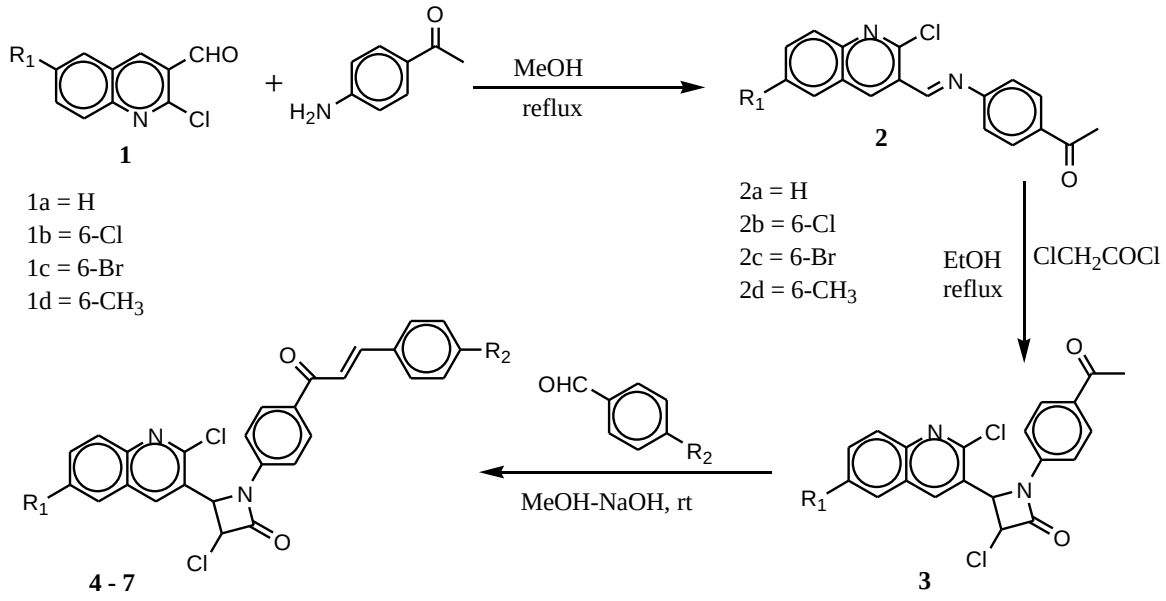
RESULT AND DISCUSSION

The antimicrobial activity of synthesized chalcones (**6-7**) were performed against two bacteria, *Staphylococcus aureus* (*S. aureus*) and *Escherichia coli* (*E. coli*) and two fungi, *Aspergillus niger* (*A. niger*) and *Candida albicans* (*C. albicans*) by cup plate method. Streptomycin and Griesofulvin were used as antibacterial and antifungal drug control. The activity was measured as zone of inhibition in mm and the values are depicted in table 1. From the antimicrobial screening it was observed that all the compounds exhibited activity against all the organisms employed. The compounds, **6 (a, b, e, d, g** and **f)** and **7 (b, c** and **g)** shows good antibacterial activity where as other compounds showed moderate to good activity. Fungicidal screening data also revealed that compounds, **6 (a, b, c, e** and **f)** and **7 (e** and **g)** imparted maximum activity against *Aspergillus niger*, where as other compounds showed moderate activity. Perusal of all results obtained from antibacterial and antifungal tests together it is concluded that entire compounds tested are active towards bacteria and fungi.

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Scheme



1

1a = H
1b = 6-Cl
1c = 6-Br
1d = 6-CH_3

2

2a = H
2b = 6-Cl
2c = 6-Br
2d = 6-CH_3

3

3a = H
3b = 6-Cl
3c = 6-Br
3d = 6-CH_3

4 - 7

4a R_1 = H, R_2 = H
4b R_1 = H, R_2 = Cl
4c R_1 = H, R_2 = Br
4d R_1 = H, R_2 = Me
4e R_1 = H, R_2 = OMe
4f R_1 = H, R_2 = $N(Me)_2$
4g R_1 = H, R_2 = $N(Et)_2$

5a R_1 = Cl, R_2 = H
5b R_1 = Cl, R_2 = Cl
5c R_1 = Cl, R_2 = Br
5d R_1 = Cl, R_2 = Me
5e R_1 = Cl, R_2 = OMe
5f R_1 = Cl, R_2 = $N(Me)_2$
5g R_1 = Cl, R_2 = $N(Et)_2$

6a R_1 = Br, R_2 = H
6b R_1 = Br, R_2 = Cl
6c R_1 = Br, R_2 = Br
6d R_1 = Br, R_2 = Me
6e R_1 = Br, R_2 = OMe
6f R_1 = Br, R_2 = $N(Me)_2$
6g R_1 = Br, R_2 = $N(Et)_2$

7a R_1 = CH_3, R_2 = H
7b R_1 = CH_3, R_2 = Cl
7c R_1 = CH_3, R_2 = Br
7d R_1 = CH_3, R_2 = Me
7e R_1 = CH_3, R_2 = OMe
7f R_1 = CH_3, R_2 = $N(Me)_2$
7g R_1 = CH_3, R_2 = $N(Et)_2$

Scheme General route for the synthesis of new chalcones.

Table 1. Antimicrobial activity of chalcones (4-7)

S. No	Compounds	Antibacterial[a]		Antifungal[a]	
		S. aureus	*E. coli*	*A. niger*	*C. albicans*
1	6a	10	13	11	10
2	6b	11	14	12	09
3	6c	08	07	07	14
4	6d	07	17	03	09
5	6e	14	18	05	16
6	6f	16	09	04	10
7	6g	09	10	06	04
8	7a	06	08	04	08
9	7b	12	12	09	06
10	7c	13	15	05	07
11	7d	08	06	14	09
12	7e	09	05	12	16
13	7f	06	09	04	07
14	7g	11	15	06	12
15	Streptomycin	18	22	--	--
16	Griesofulvin	--	--	17	20

[a]zone of inhibition was measured in mm. *Staphylococcus aureus* (*S. aureus*), *Escherichia coli* (*E. coli*), *Aspergillus niger* (*A. niger*) and *Candida albicans* (*C. albicans*).

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EFFECT OF SALINITY ON SEEDLING PARAMETERS OF INDIAN WHEAT VARIETIES

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Abstract: Salinity is one of the most important abiotic stress conditions. Wheat (*Triticum aestivum* L.) is major cereal crop of world; it's grown in worldwide under different agro climatic, environmental condition and geographical condition as well as in tremendous heterogeneity of saline soil. Response of salt stress under four salinity concentrations levels 0 (only distilled water: control), 1.227, 2.629 and 5.550 g l^{-1}) on five varieties of wheat *viz.,* U 2594, K-816, Sujata, HD-2733 and PBW 373 were conducted The data showed that reduced significantly with subsequent treatment affected the growth attributes such as germination percentage (%), plumule and redical length, fresh and dry weight of root and shoot for all varieties. Number of germinated seeds was finally recorded after seven days. Results showed significant decreases in germination percentage of Indian wheat varieties due to increasing salinity. Among the wheat varieties Sujata showed that tolerable against salinity while UP 2594 most susceptible variety.). Any impairment in seed germination or seedling development due to salt stress can cause significant depressions in yield formation. It appears that the bread wheat genotypes Sujata can perform well on saline soils, at least during the early growth stages. The existence of such impressive genotypic variation in tolerance to NaCl could be very useful for the development of high-yielding salt-tolerant genotypes and better understanding of the physiological and molecular mechanisms contributing to salt-stress tolerance in wheat. This study showed the existence of an impressive variation in tolerance to increasing NaCl treatments during the early growth stage.

Keywords: Abiotic stress, salinity, seed germination and variety

INTRODUCTION

Salinity is the scourge of intensive agriculture (Mer *et al.,* 2000). Salinity causes undesirable effects on plant growth, development, physiological and biochemical activities (Kayani *et al.,* 1987 and Rehman *et al.,* 2000), which causes due to the low osmotic potential of soil solution (Osmotic stress); specific ion effects (Salt stress); nutritional imbalance or a combination of these factors (Ashaf, 2004). Winter crop is more extensively grown than spring in saline condition due to good ion transport properties and cellular compartmentation (Munns, 1988). Sodium exclusion was a general characteristic of salt tolerance in wheat lines, salt tolerant display much higher shoots sodium level than sensitive lines. Shoot growth was reduced by salinity due to inhibitory effect of salt cell division and enlargement in growing period (Mecue *et al.,* 1990).

Early flowering reduced by dry matter, increased root: shoot ratio and leaf ratio and leaf size caused by salinity may be considered as possible ways of decreasing yield in wheat under salt stress condition (Mass *et al.,* 1989 and Rawson *et al.,* 1986). Physiological salt tolerance mechanism revealed that plants may reduce detrimental effects of salts by control of salt uptake (Wye *et al.,* 1980) reduced damages under excessive ion uptake and osmotic adjustment (Jeschke *et al.,* 1984).

Salt stress effect on wheat seedling respiration is not demonstrated while other environment stresses including drought and submergence have been shown to affect electron partitioning and alternative pathways in leaves. Net photosynthesis was decreased due to reduction rate per leaf area. Salt tolerance wheat cultivars were showed to produce more ATP than a salt sensitive one (Miqual *et al.,* 2005). Rapid and uniform seed germination under saline condition not only increase early seedling establishment but also has the advantage of higher drought tolerance (Bradford *et al.,* 1995).

Wheat is major cereal crop of world; it's grown in worldwide under different agro climatic, environmental condition and geographical condition as well as in tremendous heterogeneity of saline soil. Screening in filed for salinity tolerance in wheat crop is inefficient and impossible to carry in controlled condition. (Meneguzoo *et al.,* 2000; Sabir and Ashaf, 2007; E1-Hendway, 2009) concluded that all plant growth stages are to salinity especially seedling. Morpho-physiological traits have been used previously to evaluate the genetic diversity for salt tolerance in crop species.

In this experiment was conducted at Department of Agri. Biotechnology at Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut. The wheat varieties used in the studies were UP 2594, K-816, Sujata, HD-2733 and PBW-373. The characteristics of the five varieties wheat varieties are shown in Table 1. All varieties are improved and are under production by farmers.

Table 1. Characteristics of Five varieties of wheat

Wheat Variety	Height (cm)	No. of Tiller	Length of spikelet	Spikelet/ spike	Ripening Period (days)	No. of grain per spike	Harvest Index (%)	1000 gm weight
UP 2594	90-95	9-11	9-11	49-52	130-135	50-55	31.77	34-37
PBW 373	90-95	8-10	10-12	40-43	130-135	53-57	32.42	36-39
Sujata (HI-617)	120-130	10-11	12-14	35-37	135-140	40-43	39.44	42-45
K-816	78-80	10-12	9-11	45-47	135-140	52-54	32.88	38-41
HD-2733	84-87	13-15	11-13	45-47	130-135	56-62	37.30	40-43

Germination Experiment

The experiments were carried out to assess total germination percentage and seedling growth (radicle and plumule) in response to salt levels. Uniform 20 seeds of each variety were placed on filter paper lined glass petri dishes. NaCl treatments of 0, 1.227 g l^{-1}, 2.629 g l^{-1} and 5.550 g l^{-1} were dissolved in distilled water corresponding to 0 (control), 2, 4 and 8 dSm^{-1}. 10 ml of appropriate solution was applied to each petri dish. The germination was conducted in a laboratory; the room temperature was 25 ±1 °C with 12 h daylight. The petri dishes were arranged in a completely randomized block design with four replications.

The number of germinated seeds was counted after 5 days. A seed was considered to have germinated when both plumule and radicle had emerged ≥0.5 cm. Seedling shoot dry weight and root dry weight, in form of combind (root and shoot) and fresh weight were taken after 12 days. Total germination was expressed as a percentage of that in the control treatment for each variety.

Wheat Plumule length

Mean length of plumule of wheat seedling were significantly influenced by different salt levels, varietal differences and the interaction of both. The data show that wheat plumule lengths of all varieties were reduced by increasing salt levels. In general variety Sujata had the highest mean seedling plumule length while PBW-373 had the lowest. Maximum plumule length have secured in 6.47cm at 0 dSm^{-1}, 5.74 cm at 2 dSm^{-1}, 5.31 cm at 4 dSm^{-1}, 2.18 cm at 8 dSm^{-1} for Sujata although minimum plumule length founded in UP-2594 4.93cm at 0 dSm^{-1}, 4.02 cm at 2 dSm^{-1}, 3.64 cm in K-816 at 4 dSm^{-1} and 2.03 cm for HD-2733 at 8 dSm^{-1}.

Wheat radical length

The highest mean radical length was recorded for variety Sujata and the lowest for the PBW-373. The radical length of Sujata 8.70 cm, 10.39 cm, 7.77 and 6.29 at 0 dSm^{-1}, 2 dSm^{-1}, 4 dSm^{-1} and 8 dSm^{-1} respectively. Minimum mean radical length were 8.42 cm for K-816, 7.52 for HD-2733, 5.95 cm for PBW-373 and 4.57cm for PBW-373 at 0 dSm^{-1}, 2 dSm^{-1} 4 dSm^{-1} and 8 dSm^{-1} respectively.

Germination

The highest mean germination percentages (100-95 %) were recorded for variety Sujata and the lowest variety for (100-78%) for PBW-373. Seeds for the latter practically failed to germinate at 8 dSm^{-1} salt concentration. The germination of UP-2594 and K-816 were similar in their germination at 4 dSm^{-1} concentration. The germination of Sujata between 0 dSm^{-1} and 4 dSm^{-1} was not different.

Dry weight

Dry weight of wheat radical and plumule in salinity condition was recorded in broad variation range under the salinity condition. The dry weight of 0.62 gm, 0.50, 0.52 and 0.50 of Sujata at 2 dSm^{-1}, 0 dSm^{-1}, 4dSm^{-1} and 8 dSm^{-1} respectively. Least minimum range have got in 0.24 gm ,0.30 gm , 0.26 gm , 0.28 gm in HD-2733 at 0 dSm^{-1}, 2 dSm^{-1} 4 dSm^{-1} and 8 dSm^{-1} respectively.

Fresh weight

The total fresh weight of wheat seedlings were varied from high to low in different varieties at different ranges of salinity. The fresh weight of Sujata wheat seedlings 1.95 gm, 1.90gm 0.99 gm , 0.90 gm at 0 dSm^{-1}, 2 dSm^{-1} 4 dSm^{-1} and 8 dSm^{-1} respectively while K-816 have showed 1.46 gm, 1.29 gm, 1.27 gm and 0.73 gm at 0 dSm^{-1}, 2 dSm^{-1} 4 dSm^{-1} and 8 dSm^{-1} respectively. UP-2594 wheat variety showed 1.25 gm at 0 dSm^{-1}, 2 dSm^{-1} 4 dSm^{-1} and 8 dSm^{-1} respectively.

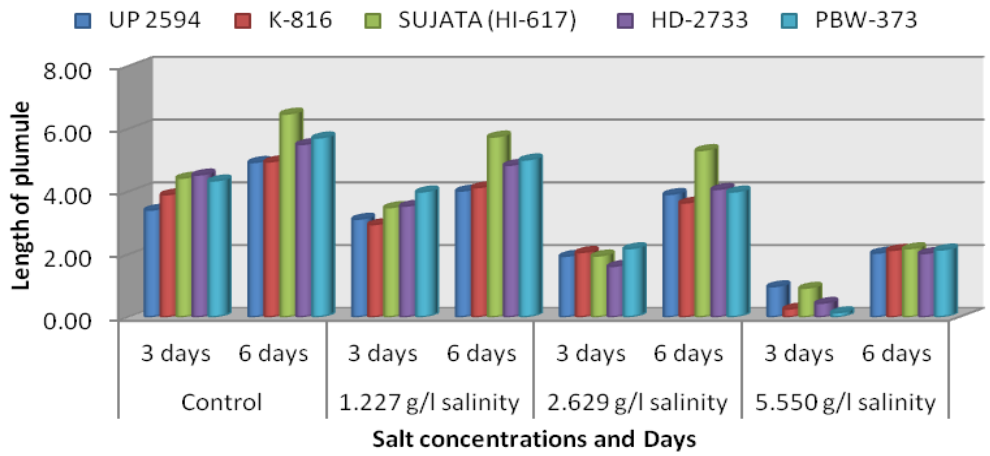


Fig.1. Mean length of plumule of five wheat varieties at different salt concentration.

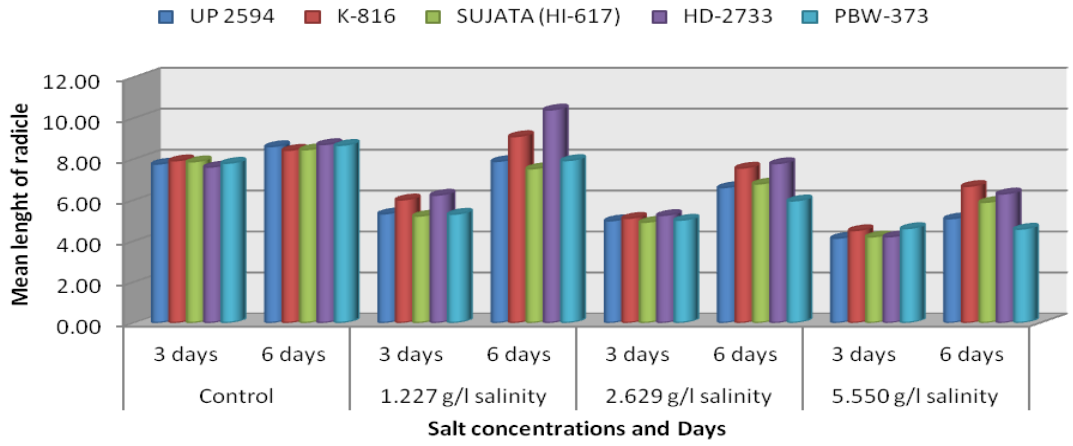


Fig.2. Mean length of radical of five wheat varieties at different salt concentration.

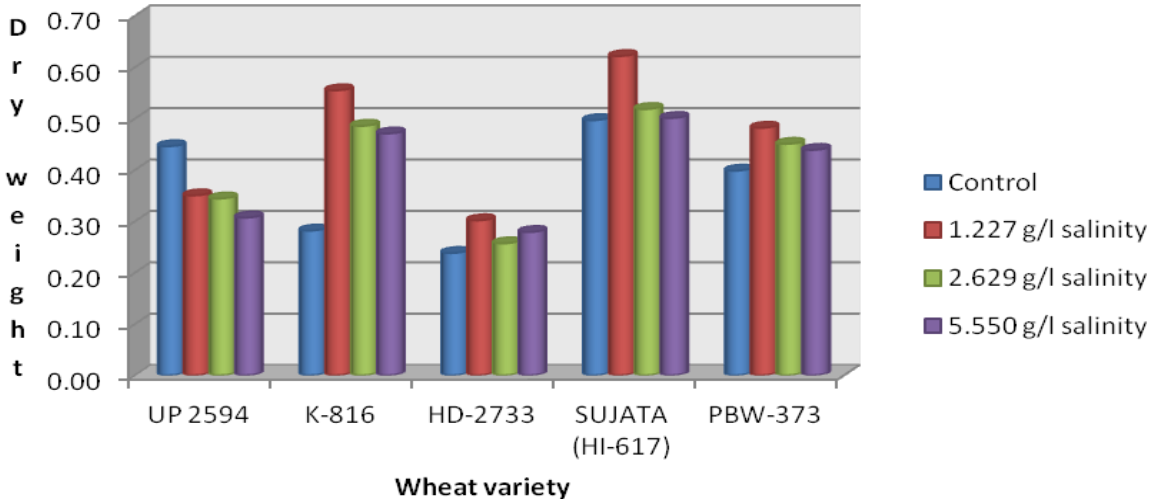


Fig.3. Mean of dry weight of five wheat varieties at different salt concentration.

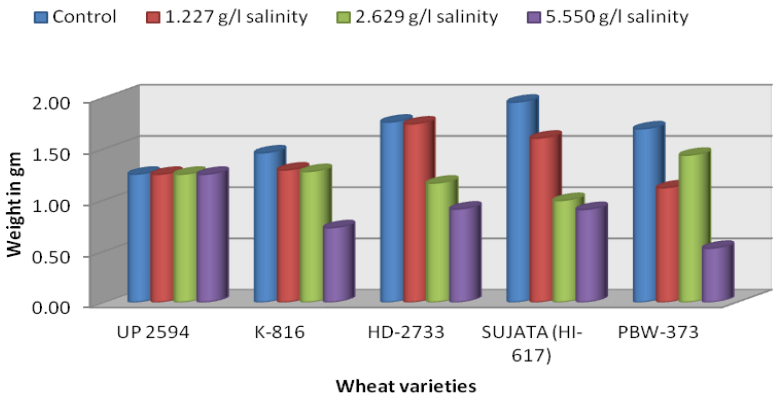


Fig.4. Mean of fresh weight of five wheat varieties at different salt concentration.

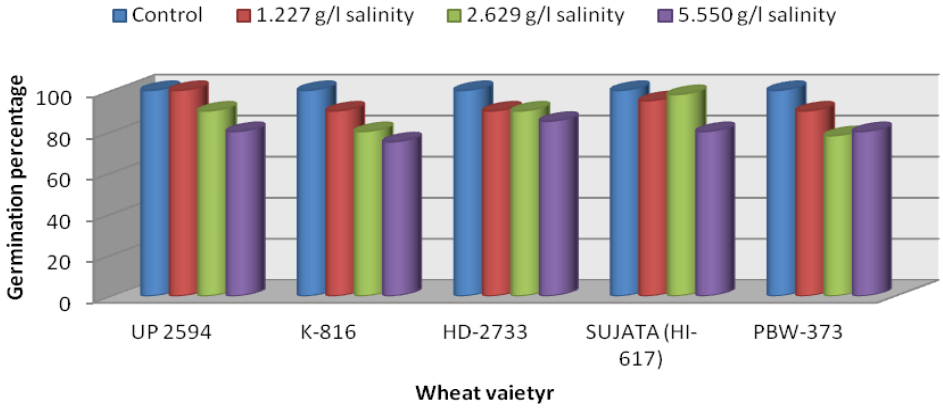


Fig.5. Mean of germination of five wheat varieties at different salt concentration.



Fig.6

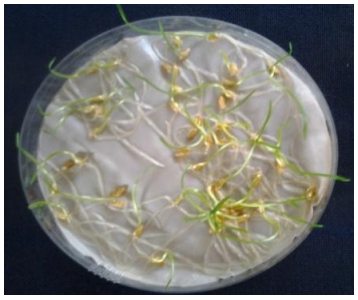


Fig.7



Fig.8

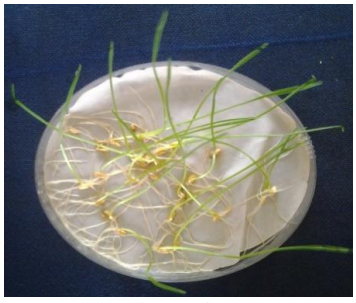


Fig. 9

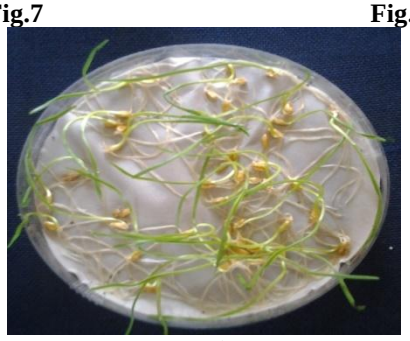


Fig.10

Fig. 6-10. Germinated seed of Wheat varieties under salinity condition *viz;* UP 2594, Sujata, PBW-373 HD-2733, and K-616.

DISCUSSION

This study showed the existence of an impressive variation in tolerance to increasing NaCl treatments during the early growth stage. Of the 5 bread wheat genotypes tested, all varities have given moderate and good response in salinity condition (Figure 6-10; Table 1). The existence of such impressive genotypic variation in tolerance to NaCl could be very useful

for the development of high-yielding salt-tolerant genotypes and better understanding of the physiological and molecular mechanisms contributing to salt-stress tolerance in wheat. In a previous study, Gunefl et al. (1997) also indicated that Gerek-79 possesses a very high tolerance to salt stress. Genotypic variation in tolerance to NaCl stress has been reported several times for wheat (Ashraf *et al*., 1997; Singh *et al*., 1997; Munns *et al*., 2000). It is also reported that the salt tolerance at the early growth stage differs from that developed during the late growth stages (Ashraf et al., 1997; Mano and Takeda, 1997; Almansouri et al., 2001).

However, there is increasing evidence showing that better germination and seedling growth have a great effect on final yield as shown in different cereals (Mosaad et al., 1995; Grieve et al., 2001; Willenborg et al., 2005). Any impairment in seed germination or seedling development due to salt stress can cause significant depressions in yield formation. It appears that the bread wheat genotypes Sujata can perform well on saline soils, at least during the early growth stages. Thus, these genotypes should be exploited in breeding programs.

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STUDY OF TRICHOME MORPHOLOGY ON FLORAL PARTS OF SOME MEMBERS OF ERICACEAE

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Abstract: A detailed study of trichome morphology was carried out in floral parts of eight members of Ericaceae viz. *Enkianthus deflexus* Schneider, *Gaultheria hookeri Clarke*, *Lyonia villosa* Hand- Mazz, *Pieris formosa* Don, *Agapetes serpens* Sleumer, *Vaccinium retusum* Hook and *Vaccinium vacciniaceum* Slemer. The present investigation dealt with the structure, development and distribution of tricromes on the floral parts. They are of different sizes and shape. Glandular head and a stalk is only observed in *Agapetes serpens*. In rest of the members they are non- glandular type which are unicellular papillate hook type, thorn type filamentous type, filamentous brached type and uniseriate 2 called and 5-6 celled trichromes. They serve as important parameter for taxonomic purpose.

Keywords : Trichomes, floral parts, Ericaceae

INTRODUCTION

The importance of trichomes as a parameter for taxonomic purpose has been stressed by a number of workers (Stace, 1980, Jyoti 1990). A detailed study may show significant light on the identification and relationship between the members of family Ericaceae. The present investigations deal with the structure, development and distribution of trichomes on the floral parts. A study in the family reveals that they can be broadly described in eight members of the family into Glandular Trichomes and Non Glandular Trichomes.

Glandular trichomes are multicellular with a multicellular stalk and globular head. The cells are densely cytoplasmic with a prominent nucleus.

Non Gladular trichomes are non secretary and their cells do not have any content at maturity. They are present at both young and mature organs. They are of two types i.e. unicellular and multicellular. Unicellular trichomes were further of six types in the family. Unicellular papillate type, unicellular Knobbed trichome, unicellular hook shaped trichome, unicellular thorn shaped trichome, unicellular filamentous trichome, unicellular branched filamentous trichome. Multicellular unbranched – trichomes were of two types i.e. uniseriate 2 celled trichome, Uniseriate many celled trichome. Various types of trichomes observed show a specific distribution on different parts of the flower. A detailed description of different trichomes according to genus were studied.

MATERIAL AND METHOD

Material in the form of flower buds of different stages of development were fixed in F.A.A. for anatomical and morphological studies. To study the surface characters of stamen and pistil, maceration technique (Jeffrey, 1928) was used. In this technique peels were hydrated by passing through ascending series of alcohol and xylene. The hydrated peels were stained in 1% fuschin and were mounted in DPX. The diagrams were drawn with the help of camera lucida.

RESULT AND DISCUSSION

***Agapetes serpens* (Wight) Sleumer (*Pentaterygium S.* (Wight) Klotzsch)**

Gladular trichomes with head and stalk are present on pedicel, sepal, petal and ovary. Unicellular, long papillate trichomes are present on the anther surface. Filament and the spur is covered by unicellular thorn shaped trichomes. Style is found to be smooth.

***Cassiope fastigiata* (Wallich) D. Don**

Unicellular papillate trichomes are present on pedicel, sepal, anther and spur. On pedicel and anther they are long while on sepal and spur small in size. Uniseriate 2- celled trichomes are present on petals; unicellular filamentous brached trichomes are present on the filament. Thorn shaped small trichomes with broad base are also found on the spur with unicellular papillate trichomes. Ovary and style is found to be glabrous.

***Enkianthus deflexus* (Griffith) Schneider**

Unicellular papillate trichomes are present on pedicel, sepal, petal, filament and spur. Thorn shaped small and long unicellular trichomes are present on the another surface. Long, Unicellular filamentous trichomes are also found on the filament with papillate trichomes. Ovary is found to be glabrous. Numerous unicellular thorn shaped and long fulamentous trichomes occur over the style.

***Gaultheria hookeri* (C.B. Clarke)**

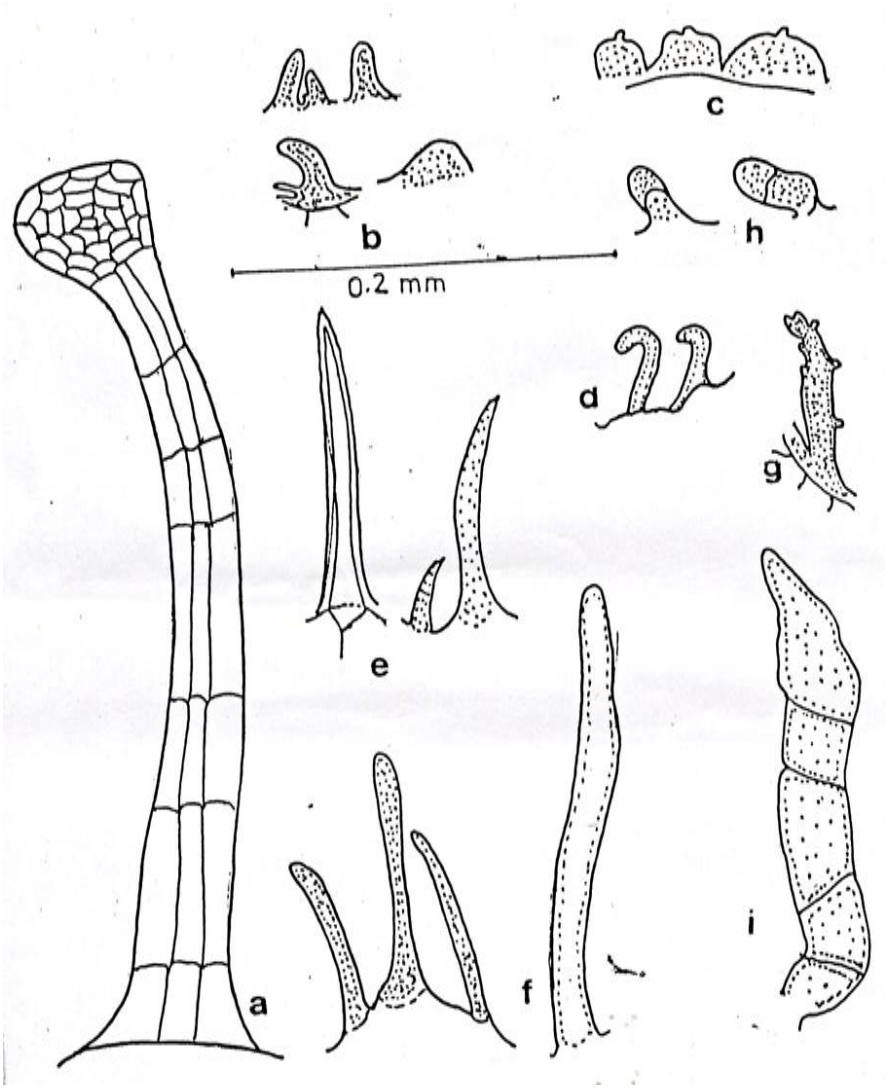
Unicellular thorn shaped trichomes are present on pedicel, sepal spur and ovary. Petal is covered with unicellular hooked trichomes with rounded apex and unicellular papillate trichomes. Anther and filament are covered with unicellular small sized papillate trichomes. Style is founded to be glabrous.

***Lyonia villosa* (Hook. F.) Hand- Mazz**
Pedicel, sepal, petal, are covered with uniseriate multi-cellular 5-6 celled trichome with conical apex. Anther is covered with small unicellular papillate trichomes. Unicellular thorn like trichomes and long, unicellular filamentous trichomes are present on the filament. Spur, ovary and style are found to be glabrous.

***Pieris formosa* (Wallich) D. Don**
Pedicel, sepal, petal, anther, ovary and style are glabrous. Filament is covered by unicellular, long thorn shaped trichomes and small, unicellular pappilate trichomes are present on the spur. Sepals and petals are covered with unicellular papillate trichomes.

***Vaccinium retusum* (Griffith) Hook F. ex. C.B. Clake**
Unicellular, small sized papillate trichomes are present on pedicel, & spur, long sized on speal and small and long both sized on petal. Small, unicellular thorn shaped trichomes present on anther, filament and style.

***V. vaccineacum* (Roxb) Sleumer**
Small unicellular papillate trichomes are present on pedicel, sepal, anther, spur and style. Small, unicellular papillate trichomes with knob or projection on the apex are present on petals. Filament is covered with long, unicellular thorn shaped trichomes. Ovary is glabrous.
Trichomes are present on all the floral parts. They are of different shapes and sizes. Glandular trichomes which are multi- cellular bearing a head and a stalk is only observed in *Agapetes serpens*. On the rest of the members they are non glandular type which are unicellular pappillate type, hook type, thorn type, filamentous type, filamentous brached type, and uniseriate 2 celled and 5-6 celled trichomes.



Explanation of the Figures
Figures (a-i). Showing different types of trichomes present in eight members of Ericaceae
Fig – a Glandular trichomes

Fig – b Unicellular papillate type
Fig – c Unicellular knobbed type
Fig – d Unicellular hook shaped
Fig – e Unicellular thorn shaped
Fig – f Unicellular filamentous type
Fig – g Unicellular branched filamentous
Fig – h Uniseriate-2 celled trichome
Fig – i Uniseriate many celled trichome

Table 1. Showing the distribution of trichomes on different parts of a flower in the eight members of Ericaceae.

S. No.	Name of species	Pedicel	Sepal	Petal	Stamen			Carpel	
					Anther	Filament	Spur	Ovary	Style
1.	*Agapets serpens*	a	a	a	b	e	e	a	–
2.	*Cassiope fastigiate*	b	b	h	b	g	b, e	–	–
3.	*Enkianthus deflexus*	b	b	b	d	b, f	b	–	e, f
4.	*Gaultheria hookeri*	e	e	d	b	b	e	e	–
5.	*Lyonia villosa*	i	i	i	b	e, b	–	–	–
6.	*Pieris formosa*	–	–	–	–	e	b	–	–
7.	*Vaccinium retusum*	b	b	b	e	e	b	–	b, e
8.	*V. vacciniaceum*	b	b	c	b	e	b	–	b

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GENETIC VARIABILITY STUDIES IN *ALOE VERA* USING RAPD MARKERS

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Abstract: Studies were conducted to evaluate the genetic diversity among twenty genotypes of Aloe vera using the RAPD markers. RAPD analysis with ten primers generated all polymorphic bands and no monomorphic band was observed. The number of polymorphic allele ranged from 2 to 6 with different primers. Genetic diversity of twenty genotypes as estimated by polymorphic information content (PIC) value ranged from 0.52 to 0.96. The cluster dendrogram of RAPD showed similarity values from 0.65 to 0.92. Dandrogram generated using RAPD data showed two major clusters. Cluster I consist of two genotypes however, cluster II included eighteen genotypes. Dendrogram revealed that Rishekesh Aloe-1 was distinctly related with home Aloe at a similarity coefficient 0.54. PIC values of RAPD primers namely MAP-4, MAP-1and MAP-9 were 0.96, 0.88, 0.86, respectively and provides maximum accessions coverage in the aloe vera genome. These RAPD primers are useful for genetic variability studies in aloe vera.

Keywords: RAPD, *Aloe vera*, Genetic variability

INTRODUCTION

Aloe vera is an important medicinal plant. It belongs to the family Liliaceae. It is mostly grown in hot and dry climates (Reynolds and Dweck; 1999). There are over 300 species of aloe vera grown around the world. However, only two species are grown today commercially namely *Aloe barbadensis* Miller and aborescens. An understanding of germplasm diversity and genetic relationships in a germplasm collection is a valuable aid for crop improvement strategies. The past limitations associated with morphological, biochemical and cytological markers for assessing genetic diversity in cultivated and wild plant species have largely been solved by the development of DNA markers such as RFLP, AFLP and SSR. However, these molecular markers have technical differences in terms of cost, speed, amount of DNA needed, technical skills, and degrees of polymorphism, precision of genetic distance estimates and the statistical power of tests. RAPDs which are simple to use and do not require the use of radioactive materials (Williams *et al*., 1990). The technical ease of RAPD markers and the facility of their application in forest trees, crops, medicinal plants and lower plants for genetic linkage mapping, phylogeny and systematic (Caetano Anolles *et al.,* 1991) have opened new avenues. There are very scanty reports in the literature on genetic variability studies in aloe vera using molecular techniques. Thus the present study was conducted to characterize the aloe vera germplasm accessions collected from different parts of Uttar Pradesh, Uttarakhand and Rajasthans for investigating genetic diversity using RAPD markers.

MATERIAL AND METHOD

In current studies plant material (leaf samples) were collected from Horticulture Research Centre of S.V.P. University of Agriculture & Technology, Meerut, U.P. India. The details of a twenty genotypes included in the present study are presented in table 1. Total DNA was extracted from fresh leaves by the cetyl tri-methyl ammonium bromide (CTAB) method as described by Murray and Thompson (1980). The quality and concentration of extracted DNA were estimated by using a UV-Vis spectrophotometer. The details of primers used for RAPD analysis is presented in Table 2. DNA amplification reaction for RAPD was performed in a total volume of 25 µl containing 2 µl of genomic DNA, 1µl primer, 0.5 µl dNTPs, 3 µl MgCl2, 2.5µl PCR buffer, 1 µl tag polymerase and 15 µl sterile distilled water. Ten random primers (obtained from Banglore Genei, India) were selected for analysis. Amplification was performed in a thermal cycler (BIO-RAD Cycler^{TM}) with the following profile: 95^0C for 5 min (initial denaturation), 94°C for 1 min, 30-32°C for 1 minutes, 72°C for 2 minutes for 44 cycles with a final extension at 72°C for 10 minutes. The RAPD-PCR products were analyzed directly on 2% agarose gels in TAE buffer and were visualized by staining with ethidium bromide and transillumination under short-wave UV light. Pair wise comparison of genotypes, based on the presence (1) or absence (0) of unique and shared polymorphic products was used to generate similarity coefficients of Jaccord's coefficient by NTSYS-pc version 2.1 software (Rohlf 2000). Dendrogram was constructed by the unweighted pair group method with arithmetic averages (UPGMA) according to (Rohlf 1993). Analysis was performed by using dendrogram along with Jaccard's coefficient. The polymorphism information content (PIC) values were computed as described by (Botstein *et al.,* 1980).

RESULT AND DISCUSSION

Number of alleles

Among ten RAPD primers, all primers produced polymorphic loci which were fully distributed on genome. A total of 37 alleles were detected. The overall size of amplified products ranged from 200

bp to 1000bp. The number of alleles per locus varied from 2 to 6. The result on genetic variability analysis, number of polymorphic alleles, monomorphic alleles for each RAPD locus and PIC values are presented in Table 3. The highest number of alleles were observed in MAP-1 (six alleles) followed by MAP-7 (five alleles), MAP-2, MAP-3, MAP-9 (four alleles each), MAP-5, MAP-6, MAP-8, MAP-10 (three alleles each) and MAP-4 (two alleles each) that provides the summarized data regarding the number of distinctive alleles and their distribution in various genotypes.

Polymorphism of RAPD markers

The alleles revealed by RAPD markers showed a high degree of polymorphism, all 10 primers produced 100% polymorphic bands. The number of polymorphic alleles ranged from 2 to 6. The PIC values, derived from allelic diversity and frequency among the genotypes, were not uniform for all the RAPD loci tested. The PIC value for the RAPDs loci ranged from 0.52 to 0.96. The higher PIC values were observed from primers MAP-4, MAP-1, MAP-9 and their PIC values were 0.96, 0.88 and 0.86 respectively (Table 3). Markers with PIC values of 0.5 or higher are highly informative for genetic studies and are extremely useful in distinguishing the polymorphism rate of a marker at a specific locus. Similar results were also reported by (DeWoody *et al.*, 1995). Such results further suggested that application of these markers in genotype identification can be used successfully in case of aloe vera.

Similarity Vs Dissimilarity Analysis

The cluster dendrogram of RAPD revealed two major clusters that were demarcated at a cut off similarity coefficient level of 0.65, below which the similarity values narrowed conspicuously (Fig.1). Cluster II included eighteen genotypes while clusters I comprising of only two genotypes. Jaccard's coefficient of similarity revealed that high degree of similarity to the extent of 92 % exists between genotypes (AV-4 and AV-8). The cluster I consists of only two genotypes namely AV-3 and AV-5 with similarity coefficient between 0.75 to 0.92. The first subgroup of cluster II consists of 3 genotypes namely, AV-1, AV-18 and AV-10 at a similarity coefficients varied from 0.79 to 0.92. The second subgroup of cluster II consists of 9 genotypes namely AV-2, AV-9, AV-11, AV-4, AV-8, AV-13, AV-16, AV-17 and AV-9 with the similarity coefficients ranged between 0.77 to 0.92. The third subgroup of the cluster II includes four genotypes namely AV-12, AV-19, AV-14 and AV-20 with a similarity coefficient from 0.75 to 0.92 The fourth subgroup of the cluster II include 2 genotypes, namely AV-6, AV-15 with similarity coefficient from 0.65 to 0.9. Based on dendrogram the AV-1, AV-5, AV-15, AV-7, AV-8 and AV-11 genotypes belong to different clusters hence, they are genetically diverse. The results of the present investigations on genetic diversity provide estimates on level of genetic variation among diverse materials that can be used in assessing the purity and variability of genotypes for future breeding programs.

Table1. Details of twenty genotypes of *Aloe vera* included in studies.

S. No.	Name of genotype	Genotype code	Leaves Characteristics	Origin
1	Rishikesh Aleo-1	AV-1	Light green, Linear ovate	Rishikesh
2	Rishikesh Aleo-2	AV-2	Light green, Linear Lanceolate,	Rishikesh
3	Rishikesh Aleo-3	AV-3	Green, Linear Lanceolate	Rishikesh
4	Rishikesh Aleo-4	AV-4	Green, Linear ovate	Rishikesh
5	Home Aloe	AV-5	Green, Linear Lanceolate	Bareilly
6	Pant-1	AV-6	Dark green,Linear Lanceolate	Pantnagar
7	Pant-2	AV-7	Dark green, Linear Lanceolate	Pantnagar
8	Pant-3	AV-8	Green, Linear Lanceolate	Pantnagar
9	Pant-4	AV-9	Light green, Linear Lanceolate	Pantnagar
10	Pant-5	AV-10	Light green, Linear ovate	Pantnagar
11	Sahjahanpur Aleo-1	AV-11	Dark green, Linear Lanceolate	Sahjahanpur
12	Sahjahanpur Aleo-2	AV-12	Dark green, Linear ovate	Sahjahanpur
13	Sahjahanpur Aleo-3	AV-13	Green, Linear Lanceolate	Sahjahanpur
14	Bikaner Sweet Aleo	AV-14	Light green, Linear Lanceolate	Bikaner
15	Bikaner Bitter Aleo-1	AV-15	Dark green, Linear Lanceolate	Bikaner

16	Bikaner Bitter Aleo-2	AV-16	Dark green, Linear ovate	Bikaner
17	Meerut Aleo-1	AV-17	Green, Linear ovate	Meerut
18	Meerut Aleo-2	AV-18	Dark green, Linear ovate	Meerut
19	Meerut Aleo-3	AV-19	Dark green, Linear Lanceolate	Meerut
20	Meerut Aleo-4	AV-20	Green, Linear Lanceolate	Meerut

Table2. Details of RAPD primers along with sequences used for the analysis of twenty *Aloe vera* genotypes.

S. No.	Primer Code	Sequence
1.	MAP-1	GCACGCCGGA
2.	MAP-2	CACCCTGCGC
3.	MAP-3	CTATCGCCGC
4.	MAP-4	GTGCAATGAG
5.	MAP-5	AAGATAGCGG
6.	MAP-6	GGATCTGAAC
7.	MAP-7	CATCCCGAAC
8.	MAP-8	GCGAATTCCG
9.	MAP-9	GACCCTAGTC
10.	MAP-10	AACCCGGGAA

Table3. Polymorphism Information Content (PIC) of RAPD Loci across different genotypes analyzed in current investigation.

SN	Name of Primers	Annealing temp.	Molecular wt. range (bp)	Total no. of alleles	No. of polymorphic alleles	No. of Monomorphic alleles	% polymorphism	PIC value
1.	MAP-1	32	200-800	6	6	0	100	.89
2.	MAP-2	32	250-800	4	4	0	100	.87
3.	MAP-3	32	200-450	4	4	0	100	.81
4.	MAP-4	32	200-350	2	2	0	100	.96
5.	MAP-5	32	200-500	3	3	0	100	.67
6.	MAP-6	32	200-400	3	3	0	100	.86
7.	MAP-7	32	200-900	5	5	0	100	.78
8.	MAP-8	32	200-700	3	3	0	100	.57
9.	MAP-9	32	200-1000	4	4	0	100	.88
10	MAP-10	32	200-600	3	3	0	100	.52

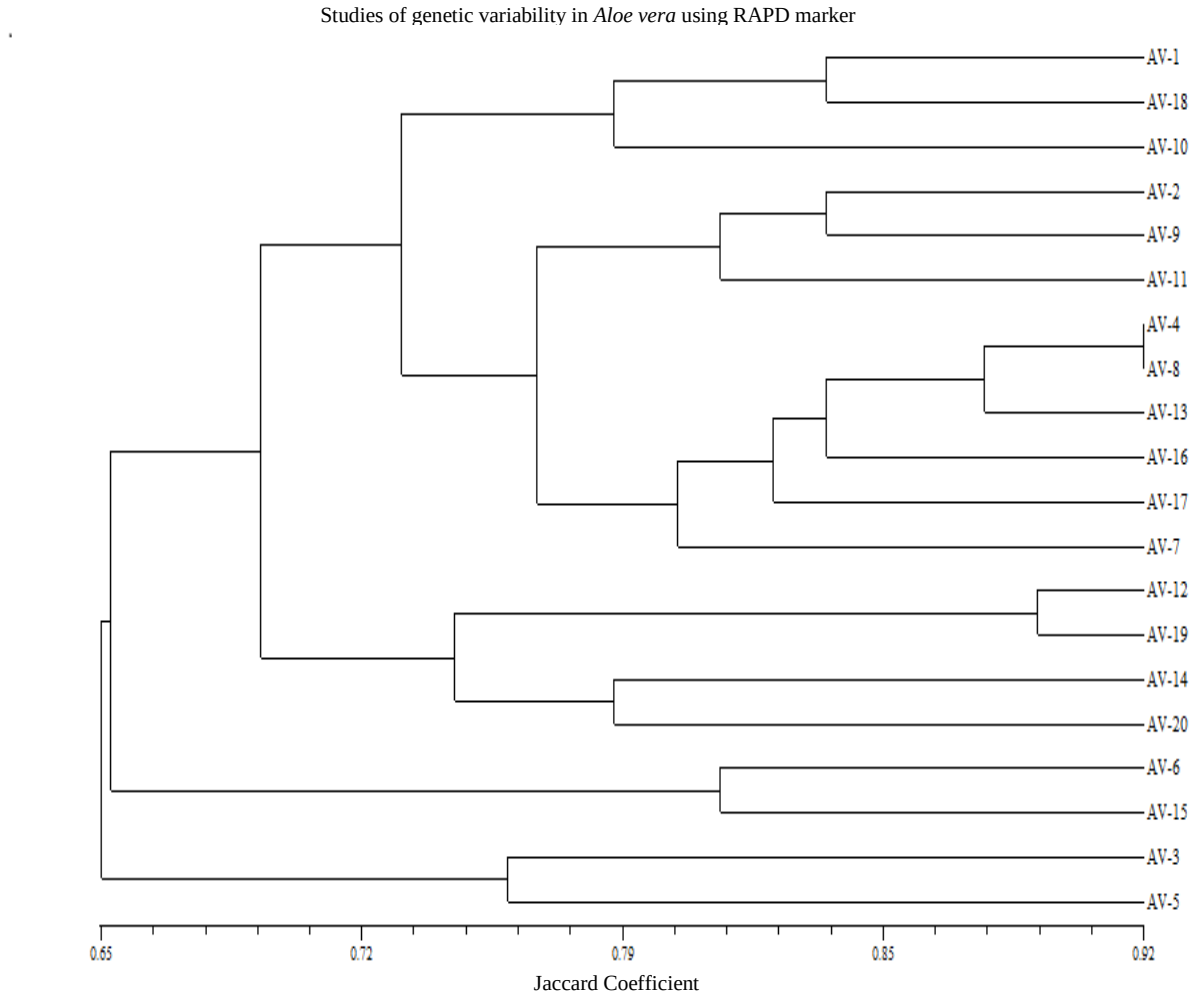


Figure 1. Dendrogram showing clustering of 20 genotypes of *Aloe vera* based on RAPD data

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TEMPERATURE STRESS AT DIFFERENT STAGES OF GROWTH AND ITS EFFECT ON PHENOPHASE IN TWO VARIETIES OF MUNG BEAN GROWN DURING SUMMER SEASON

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Abstract: Two varieties of mung beansvizPusa 9531 and Pusa Vishal were used in the present investigation under pot culture conditions.The plants were grown under natural and temperature elevated conditions throughout the season.To know the critical stage, plants were exposed for 15 days at elevated temperature at early vegetative stage (0-15) days, (15-30)days ,(30-45) days , and (45-60)days stage. For the rest of the period, plants were grown under natural conditions. The results revealed that phenophase was altered due to elevated temperature.It enhanced flower initiation but decreased total number of flowers, pod numbers and pod setting percentage. The seed number per pod and seed weight decreased affecting the grain yield of the plant in both the varieties. The critical stage was found during pod development stage (45-60) days followed by flower initiation and grain development stage (30-45)days .However the plants exposed to high temperature (15-30)days stage showed the recovery after exposure to natural conditions.

Keywords: Phenophase**,** elevated temperature,Summer mung bean, pod setting, grain yield

INTRODUCTION

The temperature is of key importance for plant development, influencing the rate of photosynthesis, flowering and even pod setting or grain filling. The summer mungis being grown in Delhi and adjacent area as a catch crop between rabi and kharif season, in an area of assured irrigation facility. During its growth and development phases, plant faces the rising temperature particularly during grain development phase. High temperature stress during germination and flowering, and drought and salinity stresses during the entire life cycle of the crop cause considerable yield losses in mungbean, Singh and Singh (2011).Exposure to extreme temperature during flowering may have a damaging effect on fertilization and grain development leading to lower yield (Porter,2005). The high temperature also affect the total dry matter production leading to poor pod set and grain yield, Panwar and Srivastava, 2012, Srestha *et al.*,2006.The temperature variations during the plant growth and development disturbs the plant metabolism that consequently affect the dry matter production and productivity of the plant crops, (Farooq *et al.*, 2009a).

Elevating air temperature stress during critical growth stages may be the key driver for maximum yielding potential in mung bean and other crops, (Oweis and Hachum, 2001).In response tohigher temperatures flowering and ripening are accelerated, with a significant reduction in the number of days to the flowering and maturity (Rahaman*et al*., 2009).The weight of mature grains was found to be most sensitive to heat stress occurring early in the grain-filling period. Stress may also be critical when it occurs during grain filling, as it may result not only in a reduction in the extent of grain filling (Wardlaw and Moncur 1995), but also in more rapid cell death and in the earlier occurrence of harvest ripeness.

The global climatic change may affect through various abiotic stresses, but fluctuation in temperature during summer may affect the yield potential in summer mung bean. The selection of temperature tolerant types and to know the critical phase as affected by high temperature was the main aim of this experiment.

MATERIAL AND METHODOLOGY

In the experiment two cultivars Pusa Vishal and Pusa 9531 of mung bean were used. The seeds of both cultivars were obtained from Indian Agricultural Research Institute (I.A.R.I) Pusa, New Delhi.The earthen pot experiment was conducted during summer on 28thMarch onwards in year 2012.12'' earthen pots were divided into two sets.The first set plants were grown under prevailing environmental conditions at the experimental site whereas the elevated conditions work artificially made by covering the plants under the transparent polythene sheet, so that the light may not be curtailed. To know the critical stage, the plants were exposed to high temperature by putting the plants under coverage for a period of 15 days. After exposing the plants in high temperature they were transferred to natural conditions as per the given lay out.

Experimental varieties: Two varieties of mung bean Pusa Vishal and Pusa 9531 were selected. During presentation of experimental details, Pusa 9531 is represented as V1 and Pusa Vishal as V2.

Experimental treatments

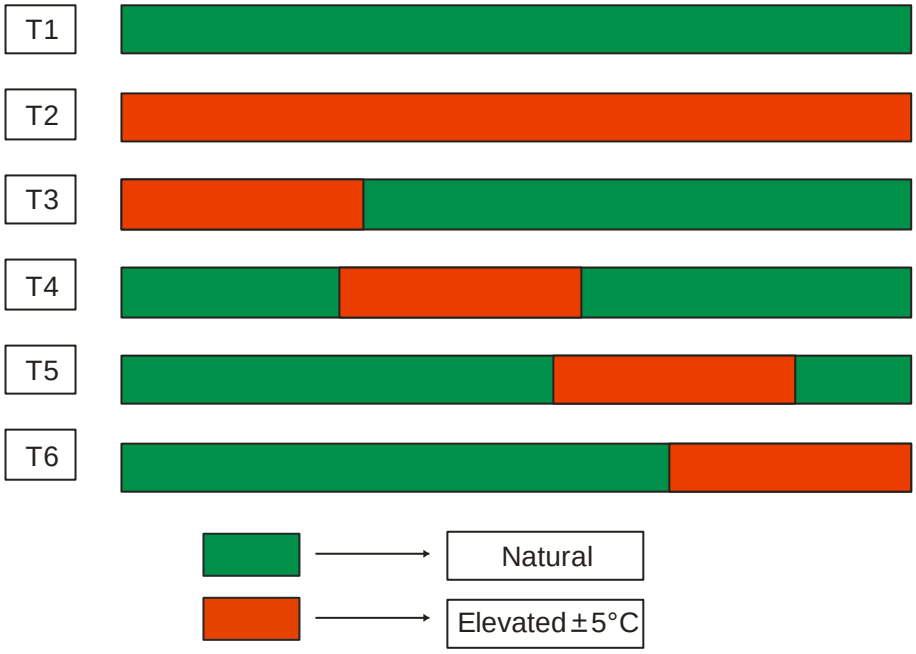
The treatments of the plants during experiments were divided into 6 treatments.

T1-Under natural condition throughout the growing season (0-60 days)

T2-Under elevated condition throughout the growing season (0-60 days)

*Ph.D. Scholar

T3-Upto 15 days under elevated temperature then shifted to natural conditions
T4–Upto 15 days under natural, 16-30 days under elevated temperature, then shifted to natural conditions
T5-Upto 30 days under natural conditions and 31-45 days under elevated temperature, then shifted to natural conditions.
T6-Upto 45 days under natural conditions and then shifted to elevated condition



After the exposure , the effect was noticed in the phenophases, including flower initiation, total number flowers, total number of pods noted per plant, pod setting percentage. Whereas the number of seed per pod , 100 seed weight and grain yield per plant was noted after the post harvest stages in both the varieties in a replicated trial.

RESULT AND DISCUSSION

The plants were raised during the summer season with the maximum temperature range (32 -42 °C) and minimum (15-30 °C) under natural conditions,butas a result of climatic change, the maximum temperature has grown upto 45 °C for1 or 2 days in May and June. 2012 summer was hottest in decades in Delhi.The average maximum temperature in Delhi for May and June was 41.57°C , the highest since 1980.(Refer TOI Report ,July 3,2012).It is estimated that this temperature may further rise in the coming future. The sudden variation in temperature may hamper the growth and yield of the plants due to the metabolic changes brought about and also changes in the phenophases.High temperatures caused significant declines in shoot dry mass, relative growth rate (RGR) and net assimilation rate (NAR) in pearl millet, maize, and sugarcane, though leaf expansion was minimally affected (Ashraf and Hafeez, 2004, and Wahid, 2007).During the vegetative stage, high day temperature can cause damage to compensated leaf photosynthesis, reducing CO_2 assimilation rates reported by Hall (1992).Increase in temperature within optimal ranges shortens time to flowering in cowpea (Craufurd*et al.*, 1996), soybean (Baker *et al*., 1989) and peanut (Awal and Ikeda, 2002).Lower seed yields at super-optimal temperatures are due mainly to a decreased number of fruits and a smaller seed size ,(Prasad *et al.*, 2002).

The Table -1 and 2 shows that Pusa 9531 flowered late than Pusa Vishal, whereas the exposure to high temperature either throughout or early phase(0-15) days hastened the flower initiation,with adverse effect on total number of flowers and pod numbers. When the plants were exposed to high temperature at later stage did not affect the total number of flowers produced (T5 and T6), but drastically reduced the pod setting percentage, resulting in poor pod number per plant. The adverse effect of elevated temperature was noted on the seed number per pod. When exposed to high temperature on the later phase of growth and development (T5 and T6), were at par with T2,T5 and T6, whereas the early exposure(0—15) days did not affect the seed number per pod and seed size.The grain yield per plant showed that variety Pusa 9531 had higher pod number than Pusa Vishal, whereas Pusa Vishal had more number of seeds per pod along with 100 seed weight. The variety Pusa 9531 was found relatively tolerant to pusa Vishal. The most critical stage was found the pod development to maturity stage (T6) followed by (T5).

Table 1. Effect of temperature stress on various stages of phenophasein Pusa 9531 variety.

Treatments	Number of days, taken for flowering	Total Number of flowers	Pod setting percentage	Number of pods/plant	Number of seeds per pod	100 seed weight	Yield /plant(g)
T1	36	46	60.58	27	9.06	4.02	7.04
T2	31	42	57.95	24	7.90	3.26	5.21
T3	30	42	60.51	26	9.02	4.25	5.76
T4	34	45	62.71	28	8.79	4.05	5.19
T5	32	46	55.05	25	7.82	3.75	4.25
T6	34	45	55.27	24	8.11	3.22	4.92

Table 2. Effect of temperature stress on various stages of phenophaseinPusa Vishal variety.

Treatments	Number of days, taken for flowering	Total Number of flowers	Pod setting percentage	Number of pods/plant	Number of seeds per pod	100 seed weight	Yield /plant(g)
T1	34	45	52.33	22	10.04	4.76	6.42
T2	30	39	50.28	20	8.53	4.0	4.32
T3	29	40	57.13	23	9.21	4.78	5.54
T4	31	43	51.51	22	8.88	4.65	5.04
T5	31	42	49.05	20	8.87	3.92	4.23
T6	30	45	48.56	19	8.90	3.76	4.87

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HETEROSIS AND GENETIC VARIABILITY FOR 6-PARENT HALF DIALLEL CROSS IN LATHYRUS

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Abstract: Fifteen F_1 hybrids of grasspea and their parents were evaluated in randomized complete block design to estimate heterosis and variability of seed yield and neurotoxin content. The magnitude of heterosis varied significantly between hybrids. Heterosis over mid parent in seed yield per plant and neurotoxin content ranged from 6.95% to 161.33% and 1.47% to 41.10% respectively. Heterotic effect for 100 seed weight, protein content, and biological yield per plant respectively varied from 0.86% to 24.05%, 10.36% to 93.14% and 3.33% to 87.85%. Pusa-24 x Ratan exhibited maximum heterosis and heterobeltiosis for seed yield per plant, whereas, Mahateora x RLS-3004 expressed maximum heterobeltiosis and heterosis for ODAP content. Analysis of variance indicated significant differences due to genotypes for all the characters except plant height (cm), pod length (cm), no. of seeds pod^{-1}, biological yield plant^{-1} and harvest index (%). High heritability coupled with high genetic advance was observed for only protein content.

Keywords: Heterosis, *Lathyrus*, genetic variability, grasspea

INTRODUCTION

Grasspea (*Lathyrus sativus* L.) locally called '*Khesari*', '*Teora*', '*Lakh*'/'*Lakhdi*' is an important rabi pulse crop of the Chhattisgarh region. In India it occupies an area of about 1.6 million ha. *Lathyrus* belongs to family Leguminosae, and sub family Poaceae a grain legume with high nutritional profile having diploid chromosome 2n=14. Manifestations, suitable for comprehensive genetic studies and breeding for high yield and low neurotoxin content coupled with resistance for biotic stresses will be land mark on this poormans' crop. *Lathyrus* proved to be a most economical pulse for human food and animal feed in rice fields during the cool winter period. Because of its drought tolerance, it is only potential crop in chhattisgarh under rice based relay (*Utera*) cropping system. *Lathyrus* contain very high protein, but has *a* neurotoxic principle *i.e.,* β-N-oxalyl-L-α, β- diamino propionic acid (ODAP), present in seed and plant of grasspea. If consumed in excess quantity may cause the irreversible crippling disease known as lathyrism. Advancements in the development of crop varieties greatly depend upon genetic variability. The study of genetic variability with the estimates of phenotypic and genotypic variance along with heritability and genetic advance using methods of analysis of variance and computation of heritability are necessary to start crop development programme. These simple statistical derivations give knowledge of mean, variance, standard deviation present in the population. The ultimate aim of a farmer or breeder is to get high quality yield. Yield is a complex character and is the multiplicative end product of many yield components and hence knowledge of the existing genetic variations between various yields traits and their heritability assumes importance. Heritability (h^2) is an approximate measure of the expression of a character.

Heterotic response of progenies further helps the breeders to isolate desirable segregates in subsequent generations. Association and contribution of component characters on yield and quality parameters like ODAP content in present reference also helpful in evolving high yielding genotype with better nutritional qualities.

MATERIAL AND METHOD

Fifteen F_1 hybrids and their parents constituted the experimental material of this study. The hybridization between pure lines was performed under field conditions following emasculation and pollination simultaneously in morning. The list of F_1 hybrid and their parents is given bellow:

Parents: Pusa-24, Prateek, Ratan, Mahateora, RLS-3004 and Siraha Local.

F_1 hybrids: Pusa-24 x Prateek, Pusa-24 x Ratan, Pusa-24 x Mahateora, Pusa-24 x RLS-3004, Pusa-24 x Siraha Local, Prateek x Ratan, Prateek x Mahateora, Prateek x RLS-3004, Prateek x Siraha Local, Ratan x Mahateora, Ratan x RLS-3004, Ratan x Siraha Local, Mahateora x RLS-3004, Mahateora x Siraha Local and RLS-3004 x Siraha Local.

The experiment was laid out in a Randomized Complete Block Design (RBD) with three replications. Each genotype was grown in a row of 2 meter length. The row to row distance was 30 cm and 20 cm between plants. All the recommended package of practices was followed to facilitate good crop growth and development. Five competitive plants were randomly selected from each genotype of each replication to record data on seventeen characters *viz.* days to flower initiation, days to 50 % flowering, days to pod initiation, days to 50 % pod formation, days to maturity, plant height (cm), number of primary branches plant^{-1}, number of pods plant^{-1}, pod length (cm), number of seeds pod^{-1}, number of seeds plant^{-1}, seed yield plant^{-1}, biological yield plant^{-1}, harvest index (%), 100 seed weight (g), protein

content (%) and ODAP content (%). The data were statically analyzed to determine the significance of difference between genotypes for parameters under consideration. Heterosis was calculated by following formulae:

$$\text{Heterosis} = \frac{\text{F1} - \text{mid parent value}}{\text{mid parent value}} \times 100$$

$$\text{Heterobeltiosis} = \frac{\text{F1} - \text{better parent value}}{\text{better parent value}} \times 100$$

RESULT AND DISCUSSION

Heterosis: The hybrid with high heterotic effects may offer better chances of identification of desirable pure lines in the following advance generations as compared to hybrid with low heterosis. The results of present study revealed significant differences among various hybrids. The heterosis and heterobeltiosis estimates indicated both negative and positive heterosis for all the traits in different cross combination. The heterotic effects in 15 F_1 hybrids their mid parental value and their negative heterosis ranged from 4.23% (Pusa-24 x Ratan) to 6.04% (Pusa-24 x Siraha Local) in days to flower initiation, 3.75% (Pusa-24 x Ratan) to 7.19% (Pusa-24 x Siraha Local) in 50% flowering, 3.68% (Pusa-24 x Ratan) to 5.29% (Pusa-24 x Siraha Local) in pod initiation, 2.76% (Pusa-24 x Prateek) to 6.63% (Pusa-24 x Siraha Local) in 50% pod formation, 2.93% (Pusa-24 x RLS-3004) in days to maturity, 0.87% (Prateek x RLS-3004) to 40.58% (Pusa-24 x Ratan) in ODAP content, whereas, the positive heterosis ranged from 61.91% (Prateek x Mahateora) to 185.47% (Pusa-24 x Ratan) in number of pods per plant, 48.16% (Prateek x Mahateora) to 157.24% (Pusa-24 x Ratan) in seeds per plant, 17.64% (Prateek x Ratan) to 138.08% (Pusa-24 x Ratan) in seeds yield per plant, 55.48% (Pusa-24 x Ratan) to 101.41% (Ratan x RLS-3004) in biological yield per plant, 6.57% (Prateek x Mahateora) to 8.38% (RLS-3004 x Siraha Local) in 100 seed weight and 10.78% (Mahateora x RLS-3004) to 37.89% (Pusa-24 x Ratan) in protein content. As for as heterobeltiosis was exhibited negative value ranging from 0.71% (Pusa-24 x Siraha Local) to 3.55% (Pusa-24 x Ratan) in days to flower initiation, 2.52% (Pusa-24 x Siraha Local) to 3.14% (Pusa-24 x Ratan) in 50% flowering, 0.62% (Pusa-24 x Siraha Local) to 3.09% (Pusa-24 x Ratan) in pod initiation, 2.76% (Pusa-24 x Prateek) to 3.31% (Pusa-24 x Ratan) in 50% pod formation, 0.90% (Prateek x Ratan) to 3.07% (Ratan x Mahateora) in days to maturity and 2.13% (RLS-3004 x Siraha Local) to 41.89% (Mahateora x RLS-3004). The positive values ranging from 74.03% (Prateek x Siraha Local) to 193.64% (Ratan x RLS-3004) in number of pods per plant, 49.36% (Prateek x Siraha Local) to 150.63% (Ratan x RLS-3004) in seeds per plant, 71.94% (Ratan x RLS-3004) to 161.33% (Pusa-24 x Ratan) in seeds yield per plant, 87.85% (Ratan x RLS-3004)) in biological yield per plant, 1.60% (Prateek x Ratan) to 22.64% (Prateek x RLS-3004) and 9.88% (Prateek x Siraha Local) to 93.14% (Pusa-24 x Prateek). The similar result was also reported by Dahiya and Jeswani (1974), Dahiya (1986), Mourya (1998), Kumari and Prasad (2003).

Table 1. Heterosis over superior parent for seed yield, its components and Neurotoxin (ODAP) content in grasspea

Hybrids	Characters								
	Days to flower initiation			Days to 50% flowering			Days to pod initiation		
	MP	BP	SV	MP	BP	SV	MP	BP	SV
Pusa-24 x Prateek	-2.14	-2.84*	0.75	-1.90	-2.52	0.66	-1.86	-2.47**	0.65
Pusa-24 x Ratan	-4.23**	-3.55**	0.00	-3.75**	-3.14**	0.00	-3.68**	-3.09**	0.00
Pusa-24 x Mahateora	0.36	-1.42	2.21	1.60	0.00	3.25*	0.31	-1.23	1.91
Pusa-24 x RLS-3004	10.18**	11.35**	15.44**	7.69**	10.06**	13.64**	8.54**	9.88**	13.38**
Pusa-24 x Siraha Local	-6.04**	-0.71**	2.96**	-7.19**	-2.52**	0.66	-5.29**	-0.62**	2.56*
Prateek x Ratan	11.35**	12.95**	15.44**	10.06*	11.46**	13.64**	9.88**	11.25**	13.38**
Prateek x Mahateora	1.82	0.72	2.96*	2.89**	1.91	3.90**	1.58	0.62	2.56*
Prateek x RLS-3004	10.95**	12.95**	15.44**	8.36**	11.46**	13.64**	9.20**	11.25**	13.38**
Prateek x Siraha Local	4.73**	11.51	13.99**	2.41*	8.28*	10.40**	4.14**	10.00	12.12**
Ratan x Mahateora	13.26**	10.49**	16.19**	11.11**	8.70**	13.64**	11.53**	9.15**	14.03**
Ratan x RLS-3004	-0.35	0.00	5.16**	-1.53	0.00*	4.56**	-0.61	0.00	4.47**
Ratan x Siraha Local	4.67**	9.79	15.44**	2.98**	7.45	12.35**	4.09**	8.54	13.38**
Mahateora x RLS-3004	1.43	4.41	4.41**	0.00	3.90**	3.90**	0.93	3.82	3.82**

Mahateora x Siraha Local	7.85**	16.18	16.19**	6.99**	14.29	14.30**	6.87**	14.01	14.03**
RLS-3004 x Siraha Local	18.94**	24.31**	31.63**	15.54**	18.67**	27.94**	16.28**	20.48**	27.40**

Hybrids	**Characters**								
	Days to 50% pod formation			**Days to maturity**			**Plant height (cm)**		
	MP	**BP**	**SV**	**MP**	**BP**	**SV**	**MP**	**BP**	**SV**
Pusa-24 x Prateek	-2.76**	-2.76**	-1.11	0.62	3.16**	10.13**	7.85	6.75	4.03
Pusa-24 x Ratan	-4.37**	-3.31**	-1.69	-1.25	0.32	7.09**	10.67	11.00	8.17
Pusa-24 x Mahateora	0.36**	2.21**	3.94**	-0.65	-3.80**	2.70**	2.42	3.76	1.11
Pusa-24 x RLS-3004	6.52**	8.29**	10.11**	-2.93**	-5.70	0.67	-20.09	-20.70	-22.72
Pusa-24 x Siraha Local	-6.63**	-2.76	-1.11	1.95**	-0.95**	5.74**	-22.40	-21.68	-23.68
Prateek x Ratan	7.10**	8.29**	10.11**	0.00	-0.90**	11.15**	-14.86	-13.72	-17.63
Prateek x Mahateora	2.51**	1.66**	3.37**	5.73**	0.00**	12.16**	-10.13	-8.01	-12.17
Prateek x RLS-3004	7.61**	9.39**	11.24**	5.40**	0.00**	12.16**	9.46	9.74	4.78
Prateek x Siraha Local	1.86	6.08**	7.87**	5.40**	0.00**	12.16**	2.32	4.35	-0.37
Ratan x Mahateora	9.64**	7.57**	11.80**	1.61*	-3.07**	6.75**	6.46	7.53	5.41
Ratan x RLS-3004	-0.54	0.00**	3.94**	4.49**	0.00**	10.13**	5.50	4.39	2.34
Ratan x Siraha Local	2.89**	5.95**	10.11**	5.45**	0.92**	11.15**	-17.78	-17.27	-18.90
Mahateora x RLS-3004	-0.82	1.69	1.69	11.11**	11.49**	11.48**	-21.99	-23.57	-23.57
Mahateora x Siraha Local	5.88**	11.24**	11.24**	6.06**	6.42**	6.42**	-5.91	-6.26	-6.26
RLS-3004 x Siraha Local	13.84**	16.58**	22.48**	9.40**	9.40**	10.13**	-19.41	-18.03	-21.34

Hybrids	**Number of seeds pod^{-1}**			**Number of seeds plant^{-1}**			**Seed yield plant^{-1} (g)**			**Biological yield plant^{-1}**		
	MP	**BP**	**SV**	**MP**	**BP**	**SV**	**MP**	**BP**	**SV**	**MP**	**BP**	**SV**
Pusa-24 x Prateek	-2.17	-6.25	-13.54	4.61	14.13	32.90	5.09	12.39	6.39	-31.19	-33.90	-2.64
Pusa-24 x Ratan	-4.00	0.00	-7.78	157.24**	122.93**	159.61**	138.08**	161.33**	147.25**	55.48*	27.83	88.33*
Pusa-24 x Mahateora	-20.00	-16.67*	-14.41*	59.28**	48.03*	72.39**	91.72*	97.12*	86.50	43.23	20.24	77.14*
Pusa-24 x RLS-3004	-19.15	-20.83	-27.09*	12.60	22.40	42.55	34.49	50.81	42.63*	3.29	-19.56	18.49
Pusa-24 x Siraha Local	-6.93	-2.08	-9.80	29.81	34.63	56.78**	-2.33	-8.26	-13.14	-9.54	-26.48	8.34
Prateek x Ratan	-14.58	-6.82*	-21.33*	28.71	4.28	43.54	17.64**	20.55	29.84	43.04	21.54	64.98
Prateek x Mahateora	-2.08	6.82	-9.80	48.16**	27.90	76.06**	68.76*	62.64	75.31*	59.76*	38.74	88.33*
Prateek x RLS-3004	0.00	2.27	-13.54	18.68	18.29	62.83**	28.32	34.18	44.58	74.78*	40.27	90.41*
Prateek x Siraha Local	15.46	27.27	7.49	56.49**	49.36**	105.59**	137.47**	110.33**	126.64**	73.53*	45.67	97.71*
Ratan x Mahateora	1.92	1.92	1.73	79.20**	94.53**	66.11**	28.85	21.36	37.30	27.38	30.80	24.18
Ratan x RLS-3004	-8.16	-13.46	-13.54	92.70**	150.63**	114.01**	68.58**	71.94*	94.49*	101.41**	87.85**	78.32**
Ratan x Siraha Local	-18.10	-17.31	-17.29	60.74**	98.12	69.17**	82.02**	57.91	78.51*	59.14	56.81	48.85
Mahateora x RLS-3004	-2.04	-7.69	-7.78	-5.62	11.71	11.71	39.79	52.13	52.04	-2.80	-11.49	-11.47
Mahateora x Siraha Local	-10.48	-9.62	-9.80	12.78	26.93	26.94	31.82	20.73	20.60	7.57	3.33	3.34
RLS-3004 x Siraha Local	1.01	8.70	-4.03	-6.37	-10.35	22.58	9.03	-6.95	9.41	27.38	35.14	10.98

Hybrids	**Number of primary branches plant^{-1}**			**Number of pods plant^{-1}**			**Pod length (cm)**		
	MP	**BP**	**SV**	**MP**	**BP**	**SV**	**MP**	**BP**	**SV**
Pusa-24 x Prateek	-6.63**	-11.00	-38.01**	18.68	38.82	46.74	0.21	5.03	6.67
Pusa-24 x Ratan	1.55**	1.55	-35.89**	185.47**	155.97**	170.53**	-2.83	-2.41	-1.00
Pusa-24 x Mahateora	-16.00**	-31.48**	-31.48**	147.32**	140.67**	154.38**	-0.77	-1.53	0.00
Pusa-24 x RLS-3004	-12.59**	-14.74	-43.39**	32.67	34.79	42.47	-2.92	1.97	3.67
Pusa-24 x Siraha Local	-12.83**	-13.95	-45.68**	40.86	35.29	43.01	-4.94	-3.06	-1.67
Prateek x Ratan	-6.63**	-11.00	-38.01**	47.83	17.69	66.61	-4.99	-8.78	1.67
Prateek x Mahateora	-35.96**	-45.67**	-45.68**	61.91*	38.14	95.58*	-6.41	-11.18*	-1.00
Prateek x RLS-3004	-10.55**	-12.64	-39.15**	67.54*	48.31	109.97**	-3.98	-3.79	7.00
Prateek x Siraha Local	-9.70**	-14.98	-40.78**	106.25**	74.03**	146.39**	-0.20	-2.79	8.33
Ratan x Mahateora	-32.60**	-45.02**	-45.02**	67.54	83.69	54.01	7.14	5.86	8.33

Ratan x RLS-3004	-9.32**	-11.54	-41.27**	155.25**	193.64**	146.20**	1.24	5.86	8.33
Ratan x Siraha Local	4.71	3.35	-34.75**	140.20**	159.53**	117.61**	0.64	2.17	4.67
Mahateora x RLS-3004	-23.53**	-36.37**	-36.38**	14.02	19.18	19.18	0.73	6.67	6.67
Mahateora x Siraha Local	-24.65**	-39.15**	-39.15**	41.13	39.25	39.28	0.54	3.33	3.33
RLS-3004 x Siraha Local	-9.95**	-13.26	-42.41**	43.03	35.34	47.62	-1.23	-3.98**	7.33

	Characters											
Hybrids	**Harvest index (%)**			**100 seed weight (g)**			**Protein content (%)**			**ODAP content (%)**		
	MP	**BP**	**SV**	**MP**	**BP**	**SV**	**MP**	**BP**	**SV**	**MP**	**BP**	**SV**
Pusa-24 x Prateek	43.99	59.87	3.13	-10.40**	-14.76**	-6.60**	21.44**	93.14**	-1.31	-20.31**	-15.00**	0.00
Pusa-24 x Ratan	25.51	94.68	25.58	-7.73**	-5.11**	3.87	37.89**	118.15	11.47*	-40.58**	-31.67**	-50.00**
Pusa-24 x Mahateora	19.01	51.75	-2.12	-0.32	-4.67*	4.45**	-24.19**	12.09**	-42.70**	-7.46**	3.33**	0.00
Pusa-24 x RLS-3004	-4.49	72.28	11.14	-13.24**	-17.34**	-9.47**	33.16**	107.81	6.21	-0.93**	-11.67**	0.00
Pusa-24 x Siraha Local	-13.13	16.17	-25.07	-13.05**	-12.27**	-3.87	-19.55**	20.70**	-38.30**	-4.76**	16.67**	0.00
Prateek x Ratan	-23.97	3.48	-18.51	-6.40**	1.60**	0.43	5.17	4.76	16.77**	-10.96**	-4.41**	0.00
Prateek x Mahateora	-4.24	8.69	-14.42	6.57**	7.16**	5.88**	-20.83**	-24.89**	-16.27**	-2.82**	1.47**	0.00
Prateek x RLS-3004	-40.39	-6.53**	-26.40	22.43**	22.64**	21.23**	-4.19	-5.50	5.30	-0.87**	-16.18**	0.00
Prateek x Siraha Local	25.85	49.25	17.53	-13.46**	-7.93**	-9.04**	14.62**	9.88**	22.48**	-14.84**	-2.94**	0.00
Ratan x Mahateora	-10.58	-22.32	5.33	-8.43**	-14.67**	-1.29	-5.85	-10.36*	-0.86	-11.84**	-14.10**	0.00
Ratan x RLS-3004	-30.98	-22.69	4.85	-3.60	-10.50**	3.59**	3.35	2.32	13.15**	-2.40**	-21.79**	0.00
Ratan x Siraha Local	-6.92	-16.38	13.38	-22.63**	-24.05**	-12.05*	1.44	-2.39	7.93	-17.58**	-12.82**	0.00
Mahateora x RLS-3004	13.92	52.76	52.77	-3.46	-3.83	-3.87	10.78**	15.43	15.46**	-28.93**	-41.89**	-50.00**
Mahateora x Siraha Local	3.91	8.08	8.08	-6.27**	-0.86**	-0.86	-1.10	0.00	0.00	-13.04**	-5.41**	0.00
RLS-3004 x Siraha Local	-27.01	-40.06	0.82	8.38**	15.09	14.20**	-41.85**	-43.50**	-38.76**	-31.34**	-2.13**	0.00

Genetic variability: The mean values, coefficient of variability are presented in Table 1. Number of pods per plant showed the maximum genotypic variability and Pod length showed the minimum genotypic variability. For all traits, phenotypic coefficients of variation were higher than the genotypic coefficient of variation. Coefficients of genotypic and phenotypic variation suggest that there is good scope for yield improvement through selection for pods per plant, seeds per plant and yield per plant.

Table 2. Genetic parameters of variation for seed yield, its components and Neurotoxin (ODAP) content in grasspea

S. No.	**Characters**	**Mean**	**Range**		**Coefficient of variation**		**h^2_{bs}(%)**	**Genetic advance (GA)**	**Genetic advance as % of mean**
			Minimum	**Maximum**	**Genotypic**	**Phenotypic**			
1.	Days to flower initiation	48.71	45	59.66	7.54	7.69	96.12	7.38	15.15
2.	Days to 50% flowering.	55.42	51.33	65.67	6.47	6.64	94.84	7.17	12.93
3.	Days to pod initiation	56.46	52.33	66.67	6.49	6.62	96.16	7.35	13.03
4.	Days to 50% pod formation	62.90	58.33	72.67	5.54	5.69	94.66	6.99	11.11
5.	Days to maturity	106.15	98.67	110.67	4.02	4.12	94.98	8.65	8.15
6.	Plant height (cm)	58.77	47.93	67.93	4.59	18.61	6.09	1.35	2.30
7.	Number of primary branches $plant^{-1}$	3.87	3.33	6.13	11.71	20.10	33.92	0.54	14.16
8.	Number of pods $plant^{-1}$	60.59	31.47	101.53	27.78	46.94	35.02	21.79	35.96
9.	Pod length (cm)	3.08	2.95	3.35	2.28	5.96	14.70	0.06	2.01
10.	Number of seeds pod^{-1}	3.07	2.53	3.73	5.80	15.05	14.88	0.14	4.64
11.	Number of seeds $plant^{-1}$	129.54	74.40	226.20	23.16	34.24	45.77	43.60	33.65
12.	Seed yield $plant^{-1}$ (g)	7.81	4.68	13.92	22.46	47.15	22.70	1.83	23.46
13.	Biological yield $plant^{-1}$ (g)	19.10	11.82	28.45	18.34	44.60	16.91	3.06	16.03
14.	Harvest index (%)	43.17	26.76	63.37	11.17	39.65	7.94	2.79	6.47
15.	100 seed weight (g)	6.99	6.13	8.45	8.52	8.96	90.49	1.16	16.59
16.	Protein content (%)	21.12	11.27	27.02	22.04	22.66	94.58	9.26	43.85
17.	ODAP content (%)	0.02	0.01	0.03	18.19	22.02	68.28	0.006	31.28

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EFFECTS OF HEAVY METAL (Cd) STRESS ON ENZYME ACTIVITY OF *VIGNA RADIATA* L. SEEDLINGS

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Abstract: An experiment was conducted to see the impacts of heavy metal stress as it is main cause in soil and water disorders in agricultural field crops, specially *Vigna radiata* L. cv. MH98-6 on enzyme activity and yield attributes. Surface sterilized seeds of *Vigna radiata* L. cv. MH98-6 L. were exposed to various concentrations of cadmium chloride solution (10^{-2} M, 10^{-4} M, 10^{-5} M, 10^{-8} M and control) at room temperature and these seeds were transferred to petriplates and polythene bags in triplicate. Increase in heavy metal stress (10^{-2} M) conc. was found to have deleterious effects on pollen growth, plant height, phytomass, number of branches, leaf area, chlorophyll contents and yield attiributes while 10^{-8} M revealed slightly promotory effects. Nitrate and nitrite reductase activity was markedly inhibited at higher conc. and same trend was observed in amylase activity. Low dose of cadmium (10^{-8} M) did not affect soluble sugar contents of seeds but it induced a significant increase at higher conc (10^{-2} M). It however, did not affect protein contents of seeds, catalase (CAT) and peroxidase(POD) activity of 15 days old seedlings except at higher concentration.

Keywords: *Vigna radiata*, Cadmium, enzyme activity, sugar, yield attributes

INTRODUCTION

Heavy metal toxicity is one of the major abiotic stress which leads to hazardous effects in plants because of their high reactivity, they can directly influence growth, senescence and energy synthesis processes. Heavy metals could interact with metabolic functions of plants. For instance; inhibition of growth processes or decrease in activity of photosynthetic apparatus offen correlated with progression of senescence processes etc. (Ouzounidou *et al*.,1995; Sharma and Agrawal, 2010) as well as shortened and poorly developed roots (Khudsar *et al.,* 2004*).* Growth inhibition and senescence stimulation caused by heavy metals in excess are intriguing effects, more so, as the knowledge of their mechanisms can have a great significance in ecophysiology and medicine (Waldemar, 2007; Amat *et al*., 2010).

Cadmium is classified among the most dangerous groups of anthropogenic environmental pollutants due to their toxicity and persistence in the environment. Consequently, the evaluation of the level of metal deposition is of vital importance for assessment of plant exposure (Ahmed *et al*., 2010). Cadmium is multitarget toxicant for most organisms, and well established carcinogen. Cd^{2+} also reduced the absorption of nitrate and its transport from roots to shoots by inhibiting nitrate reductase activity in the shoots (Hernandez *et al.,* 1996). The inhibition of root Fe (III) reductase induced by Cd led to Fe (II) deficiency and it seriously affected photosynthesis (Alcantara *et al.,* 1994).

Adid and Okamato (1992) observed that decrease in growth of roots and shoots was due to the suppression of the elongation growth rate of cells, specially in the stem, because of an irreversible inhibition exerted by cadmium on the proton pump responsible for the process. Inhibiting effects of cadmium stress on reproductive attributes (Pollen viability & germination) of *Vigna radiata* L. have been observed by Kumar and Dhingra (2005). Cadmium most severely inhibits plant growth and even cause plant death by disturbing the uptake of nutrients and inhibiting photosynthesis via degradation of chlorophyll (Somashekaraiah *et al.*, 1992) and also acts as inhibitor of nitrate reductase enzyme (Keshan and Mukherjee, 1994). Cadmium accumulation in the plants causes disturbance in membrane function, enzyme activity (Tamas *et al.*, 2006) cell division (Fojtova *et al*., 2002). Cadmium is a non-redox metal but has been found to induce oxidative stress in plant cells. In some plants, cadmium induced changes in the activities of ROS scavenging enzymes including superoxide dismutase(SOD), catalase (CAT) and ascorbate peroxidase (APX) have been demonstrated(Dixit *et al*., 2001)

Present study was therefore undertaken to evaluate the effects of cadmium on different reproductive components and activity of some enzymes-N.R, Catalase, Peroxidase and Amylase in *Vigna radiata* cadmium contaminated soil.

MATERIAL AND METHOD

Uniform healthy seeds of *Vigna radiata* L. cv. MH98-6 were obtained from Indian Agricultural Research Institute, New Delhi-12 and were made surface sterilized with 0.1 % $HgCl_2$ solution. Cadmium solution was prepared by dissolving the molecular weight of cadmium chloride (228.35) in one liter of Hoagland's nutrient solution. This solution was known as 1M solution of cadmium and served as a stock solution (S.S.), other molar conc. were prepared from this 1M (one molar) solution. Metal was given to soil in the form of different molar conc. of cadmium viz. (10^{-2}M, 10^{-4}M, 10^{-5}M, 10^{-8}M & control). Surface sterilized seeds were sown in cement pots lined with polythene bags in triplicate

having central drainage hole. Each bag has 10kg of sandy loam soil pH (7.45). Intermittent canal water irrigation was given whenever needed. The experiment was conducted at Environmental Science Laboratory during the year 2006, 2007 and 2008.

Observations on pollen viability, germination, biochemical attributes, enzyme activity and yield attributes were recorded. Number of flowers produced/plant was recorded on alternate days until the flowering was completed. Floral buds were collected a day before anthesis and pollen from these flower buds were mixed thoroughly on a glazed paper. Pollen were germinated on semisolid medium (sucrose 35%, boric acid and calcium nitrate 100 ppm each and agar 8%) contained in petridishes supplemented with different molar conc. of cadmium. Petriplates were incubated at 30±2^{o}C for 3 hours in dark in a BOD incubator. After incubation, the pollen activity was terminated by flooding the surface of the media with killing and fixing solution (Sass,1951). Pollen producing tube length of a size greater than its diameter was designated as germinated. Ten reading for pollen germination from different microscopic fields of each petriplate were made.

Chlorophyll contents were estimated by adopting the method of Smith and Benetiez (1955). Nitrate and nitrite reductase activity, catalase, proxidase, amylase of seedlings, soluble sugar and protein contents of seeds were estimated the method given by Sadasivum and Manickam (1992). The plant attributes ie- plant height, dry matter, leaf area, No. of braches and pod, No. of seed pod^{-1}, test weight of 100 seeds, seeds weight plant-^{1} were observed at harvest. Data were statistically analysed by analysis of variance (ANOVA) following the method of Panse and Sukhatme (1961). The MSTATC Software & Microsoft Excel sheets were used to assess the critical difference and ±SD.

RESULT AND DISCUSSION

Results on Pollen growth show that cadmium treatment did not bring about significant change in pollen viability of V*igna radiata* L. CV. MH98-6. Manisha and Dhingra (2003) reported that cadmium did not affect pollen viability significantly in pea cultivar except at higher concentration 7.5 mM. Pollen from plants grown under 10^{-8} M cadmium level did not exhibit any significant change in germination, while at higher levels it reduced pollen germination. Cadmium mediated stimulation in pollen germination by lower cadmium stress has been reported in *Catharanthus roseus* (Salgare and Pathak, 2001). Chlorophyl contents are suggested as a very useful in vivo indicator of heavy metal toxicity for calculating upper critical tissue concentrations. Accordingly, we studed the effects of cadmium on chl. a, chl.b and total chlorophyll contents in V*igna radiata* L. seedlings growing in cadmium contaminated soils (Table 2). Due to cadmium toxicity, a maximum reduction was noticed in chl. a, chl. b and total chlorophyll contents in 10^{-2} M in Cd contaminated soil. Our observation is in the conformity with that of Siddhu *et al*., (2012). Cadmium is known to inhibit chlorophyll synthesis eiether due to impaired uptake of Mg and Fe by plants because of increased chlorophyllase activity (Drazkiewicz, 1994).

Cadmium stress or toxicity decreased the antioxidative enzyme activity of peroxidase (POD) and catalase (CAT). These are important antioxidative enzymes that function in cells to prevent the buildup reactive oxygen species ROS (Halliwell and Gutteridge, 1999). The activity of POD and CAT increased in V*igna radiata* L. CV. MH98-6 at lower exposure 10^{-8} M conc. but subsequently declined at conc. higher than 10^{-4} M. This lowering in activity may be due to enzyme inhibition, since Cd, is known to be a potential enzyme inhibitor (Das *et al.*, 1997; Schutzendubel *et al.*, 2001). Contrasting results such as fluctuation in the activities of these enzyemes under Cd stress have also been found (Dixit *et al*., 2001 and Zhang *et al*., 2007) accompanied by a weaking of ROS detoxification system. Peroxidase takes part in the defense mechanism against the HMs toxicity through lignifications of cell walls (Diaz *et al*., 2001) that confer rigidity and prevent growth. Peroxidase acts as an efficient H_2O_2 scavenger in a process that involves phenolic compounds as an electron doners in the apoplast and plant vacuoles (Morina *et al., 2008).* Increase in POD activity suggests that antioxidative machinery induced by Cd was involved in detoxification of H_2O_2.

Catalase represents a primary enzymatic mechanism which is used by arobic organisms for the decomposition of toxic H_2O_2 generated during oxygen metabolism Havir and Mchale, (1987). In the leaf calls CAT is exclusively located in the peroxisomes while H_2O_2 mainly accumulates in the chloroplast. It appears that CAT was not markedly mobilized for protection against the oxidative injury possibly because the excess accumulation of H_2O_2 inactivated CAT (Wang *et al*., 2004). Data on catalase activity showed the same trend as in POD activity in response to Cd exposure. CAT is another important antioxidant enzyme that converts H_2O_2 to water in the peroxisomes. In this organelle, H_2O_2 is produced from β-oxidation of falty acids and photorespiration (Morita *et al.*, 1994). Higher activites of catalase decreased H_2O_2 level in cell and increase the stability of membranes and CO_2 fixation because many enzymes of the calvin cycle within the chloroplast are extremely sensitive to H_2O_2.

A decrease in the level of antioxidants was observed with increase in Cd stress intensity in V*igna radiata* L. The amylase activity in seedlings under the influence of high level of $CdCl_2$ was found to be decreased in comparison to control. Enzyme activities showed great variation with increasing level of Cd stress. Maximum enzyme activity was recorded in 10^{-8} M conc. while minimum in 10^{-2} M concentration. Decrease activity of amylase could be explained decreased moisture and reserved materials in the treated plants. Amylase and its

important role during seed germination through hydrolysis of reserve starch and release in energy has been worked out by Nauriere *et al. (*1992*).*

Present investigation revealed that lower conc. 10^{-8} M showed increase in plant height No. of branches and dry matter. However higher conc. 10^{-2} M hampered the plant height and dry matter significantly. These observations are in the agreement with those of Mehindirata *et al.* (2000) and Ali Khan & Siddhu (2006). Leaves became curled and tended to abscise easily in the higher conc. 10^{-2} M of Cd^{2+}. Number of leaves, branches and leaf area decreased as the conc. of metal increased. Strong decrease in leaf area was correlated to accumulation of chlorophyll pigments as disturb integration of chlorophyll molecules into stable complex (Skkorzynska Polit and Baszynski, (1997). Similar findings have been reported by Siddhu *et al.* (2012) (Table 2).

NiR (Nitrite reductase), the second enzyme of nitrate assimilation pathway that reduce nitrite to ammonia is also deleteriously affected by higher dose of cadmium chloride (10^{-2} M) concentration. Nitrate reductase activity also diminished markedly in the same concentration. Data also tend to suggest that lower conc. (10^{-8} M) found to augment the activity both nitrite and nitrate reductase enzyme. Our results are in close conformity with that Solanki *et al.* (2011) and Siddhu *et al*. (2012). N.R is a complex enzyme and is constituted of two distinct catalytic component viz-NADH-dehydrogenase and terminal nitrate reducatase. It has been reported that NR activity depends upon active photosynthesis or production of photosynthesis as it requires photosynthetically generated reductant energy. Hence reduction in NR activity could be due to reduced photosynthesis as a result of inhibition of chlorophyll biosynthesis (Rai *et al*., 2004).

In *vivo* production of NADH can be inhibited due to reduced rates of photosynthesis. Moreover, Cd may stimulate reduced nicotinamide adenine dinucleotide (NADH) oxidation and subsequent decline in NADH pool available to the enzyme. Reduction in nitrate reductase activity due to stress might be a result of a reduced uptake of nitrogen (Bhandal and Kaur, 1992). Low dose of Cd^{2+} (10^{-8}M) did not affect soluble sugar contents but higher conc. induced a significant increase at (10^{-2}M), which remained nearly unchanged with further increase in dose of cadmium chloride (Table 1). Manisha and Dhingra (2004) reported the similar observations while working on pea. Inhibition in protein contents at higher conc. (10^{-2}M) were observed while lower conc. (10^{-8}M) was found to elevate the protein contents. Cadmium treatment decreased the protein contents of seeds at higher conc., which was further confirmed by Rolli *et* al. (2010). (Table 1).

Significant decline in total number of flowers pod^{-1} due to Cd^{2+} stress was observed even in the lowest dose. Similar inhibitory effects of cadmium on flower production have been reported by (Siddhu *et* al., 2008). Data on pod setting revealed that Cd decreased the number of pods significantly in 10^{-2} M conc**.** Such a reduction in pod setting may be ascribed to formation of non functional flowers possibly at the far end of flowering, which abscised without being converted into pods (Dhingra, 2002). A similar observation has been reported by Kumar and Dhingra (2005) in mungbean and Siddhu *et al.* (2012) in *Vigna mungo* (Table 3). Number of seeds/pod and seed weight and test wt. of 100 seeds decreased with the increasing conc. of $CdCl_2$. Delterious effects of Cd on these parameters have also been reported in mungbean by Kumar and Dhingra (2005) and Ali khan and Siddhu (2006). Reduction in seed weight may be associated with decline in number of flowers, number of seeds and seed size.

Table 1. Effect of cadmium chloride on enzyme activity at 15th day old seedlings and sugar and protein contents of seed (mg/gm. f.w.t) of *Vigna radiata* L.

treatment	Catalase activity	Peroxidase Activity	Amylase activity	Nitrate reductase activity	Nitrite reductase activity	Sugar (seed)	Amylase	Protein(seed)
Control	12.024±2.30.	4.525±0.033	2.68±0.345	8.801±0.011	6.624±0.625	345.40±0.003	2.68±0.110	252.30±0.110
10^{-2} M	150.642±1.145	9.754±1.011	2.546±0.140	5.840±0.003	3.145±1.11	470.54±1.001	2.546±0.140	340.43±1.002
10^{-4} M	125.506±2.202	4.856±1.22	2.435±0.027	6.423±1.012	4.252±1.003	430.45±0.222	2.435±0.027	332.28±0.640
10^{-5} M	116.455±1.075	4.235±2.61	2.355±1.011	7.024±0.810	5.325±1.012	355.64±0.003	2.355±1.011	282.32±0.033
10^{-8} M	65.842±2.110	4.455±1.45	2.231±0.027	7.524±2.110	6.525±0.640	338.32±0.222	2.231±0.027	234.45±1.001

Values are the mean of three replicates. ± SD.

Peroxidase- in Δ O.D.D. g^{-1} fresh tissue. w.t.
Catalse- in ml H_2O_2 hydrolysed g^{-1} fresh tissue. w.t.
Amylase – mg starch hydrolysed g^{-1} fresh tissue. w.t.
Nitrate reductase- µg. NO_2^-prod/min/gm f.w.t.
Nitrite reducatase- µg. NO_2^- red/min/gm f.w.t.

Table 2. Effects of cadmium chloride on chlorophyll contents(mg/g f.w.t) of *Vigna radiata* L.

At 48 hours			
Treatment	**Chl. a**	**Chl. b**	**Total chl.**
Control	**6.85. ±0.410**	**7.45±0.64**	**14.30±0.74**
10^{-2} M	**4.84±0.321**	**4.12±0.35**	**8.96±0.56**
10^{-4} M	**5.24±0.321**	**5.45±0.35**	**10.69±0.75**
10^{-5} M	**6.54±0.55**	**6.82±0.55**	**13.36±0.82**
10^{-8} M	**7.65±0.78**	**8.38±0.55**	**16.03±0.94**
At 72 hours			
C	**7.45±0.54**	**8.56±.62**	**16.01±1.02**
10^{-2} M	**4.90±.35**	**4.68±.32**	**9.58±.54**
10^{-4} M	**5.45±.45**	**5.92±.75**	**11.37±.67**
10^{-5} M	**6.85±.55**	**7.45±.82**	**14.20±1.00**
10^{-8} M	**8.95±.65**	**9.54±.75**	**18.49±1.11**
At 96 hours			
C	**8.96±.65**	**9.45±.74**	**18.41±1.11**
10^{-2} M	**5.36±.75**	**6.45±.32**	**11.81±.62**
10^{-4} M	**6.75±.35**	**7.36±.32**	**14.11±.85**
10^{-5} M	**7.48±.52**	**8.45±.65**	**15.93±1.12**
10^{-8} M	**9.78±.84**	**10.68±.82**	**20.46±1.24**

Values are the mean of three replicates. ± SD.

Table 3. Effect of $CdCl_2$ on pollen growth and yield attributes of *Vigna radiata* L.

Characters	**C**	**10^{-2} M**	**10^{-4} M**	**10^{-5} M**	**10^{-8} M**
Pollen viability %	**94.344**	**90.0**	**90.71**	**93.55**	**93.85**
Pollen germination %	**83.55**	**70.66**	**70.0**	**80.25**	**82.25**
No of flower Plant^{-1}	**17.56±.001**	**10.65±.004**	**13.45±.041**	**15.40±.001**	**16.66±.002**
No. of seed pod^{-1}	**9.35±.296**	**7.61±.205**	**8.22±.211**	**9.022±.102**	**9.211±.212**
Seed wt(gm) Plant^{-1}	**2.95±.002**	**1.38±.001**	**2.15±0.003**	**2.43±.006**	**2.87±.006**
Total wt of 100 seeds	**3.12±0.061**	**2.76±.012**	**2.95±0.013**	**3.00±.060**	**3.25±.060**
Plant height(cm)	**46.56±.324**	**42.35±.246**	**45.00±.021**	**45.89±.324**	**47.23±.220**
No. of branches Plant^{-1}	**5.68±.16**	**4.12±.125**	**4.35±.021**	**5.55±.16**	**5.72±.002**
leaf area (cm)^2 Plant^{-1}	**525.45±0.032**	**421.28±0.16**	**465.45±.022**	**490.10±.032**	**531.25±.004**
Dry matter accumulation (gm Plant^{-1})	**38.05±.082**	**25.644±.012**	**28.55±.085**	**32.42±0.125**	**38.65±.125**

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CONCLUDING THOUGHT

It can be concluded from present investigation that higher conc. of cadmium is toxic for *Vigna radiata* L. (Mung bean) while lower conc. is promotory (tolerance level) to all plant attributes which might be used as phytoremediation in 'green cure' technology in anthropogenic ecosystem. Physiological effects of cadmium has been identified and cagtegorized into three groups, viz. cadmium tolerant (10^{-8}M), moderatively sensitive (10^{-4}M and 10^{-5}M) and highly sensitive (10^{-2}M). Therefore, lower concentration has been recommended to grow for *Vigna radiata* L. so that pulse/pod enhanced with seed production for 'Green revolution' and sustainable agriculture.

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QUALITY AND COST ANALYSIS OF COMPOST UNDER DIFFERENT COMPOSTING TECHNIQUE

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Abstract: The experiment was carried out during the December 2007 to March 2008, at instructional farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur. Different composting techniques are used. Treatment under aerobic decomposition of paddy straw, soybean straw and fresh cow dung and soil were taken into 5:2 ratios for each pit. The progressive decrease in total organic carbon, and C/N ratio, cellulose, were found under the NADEP method of composting. Ash percent increased with days of decomposition progresses and maximum increase was found at 120 days. The significant increase in CEC was observed in all the methods under aeration and it was maximum [90.66 C mol (p+) kg^{-1}] under NADEP method of composting followed by turning method and three perforated pipe method of composting. The highest L/N ratio was recorded in NADEP method of composting (T_7) (6.95, 11.43, 12.56 and 14.64) at progressive days. While lowest ratio was recorded in traditional method (T_6) (7.10, 8.86, 10.66 and 10.78) at progressive days, respectively. The maximum CEC/TOC ratio was observed (2.55) in NADEP method of composting at 120 days. The maximum cost of production (553.75 Rs/pit) with NADEP method and minimum (212.00 Rs/pit) with traditional method of composting were estimated the frequency of NADEP method was recorded highest with preparation of composting within 4 months followed by turning method of composting.

Keywords: Cellulose %, nitrogen, organic carbon, lignin%

INTRODUCTION

In India food production through use of chemical fertilizers alone cannot sustain high growth rate in agriculture sector. Availability of organic sources of nutrients has to be augmented substantially in order to enhance nutrients supply for attaining 301 MT of food grain production by 2050 to feed 1.4 billion populations. Bio-solids generation in urban/rural sectors is increasing day by day. Production compost from biodegradable wastes would help in increasing the availability of manure and supply of nutrients to bridge the gaps between nutrient demands and supply in agriculture. There is a need to increase production of quality compost at minimum cost through adoption of appropriate technologies. The quality of compost prepared from different waste will need to be assessed through physical chemical and biological assays minimum content of phytotoxic compound and heavy metal content. However, the direct application of crop residue is possible in the presence of sufficient amount of soil moisture and direction for rapid decomposition. Therefore compositing is an alternative to direct incorporation in soil in semi arid sub humid regions. Hence, it is important to develop a suitable technique for preparation of minerals enriched compost by using low cost amendments in the shortest possibilities and evaluate its quality and maturity. Evidence suggests that the use of enriched compost may help in maintaining proper soil quality and crop productivity.

Traditional method take 6 month to 2 years, the processes of composting are mainly anaerobic decomposition results partial breakdown of organic matter and produces several obnoxious gases due to predominant of anaerobic organisms and traditionally no control, undoubtedly such practices for dealing with organic waste have a bad impact on quality of final product and leads to loss of nutrients through volatilization. Traditional methods in comparison with modern techniques relies an anaerobic decomposition with insufficient aeration. Hence it is important to develop a suitable technique for preparation of manures enriched compost by using low cost amendments and alternated perforated aeration technique in shortest possible time. Therefore an attempt has been made to find out the alternative composting technique for early and quality compost production

MATERIAL AND METHOD

The present experiment was conducted during the December 2007 to March 2008. Research farm of Indra Gandhi Krishi Vishwavidyalaya, Raipur. The experimental design included seven distinct experimental groups (T_1 One perforated pipe of 29.5 cm diameter, T_2 Two perforated pipe of 29.5 cm diameter, T_3 Three perforated pipe of 29.5 cm diameter, T_4 U shape perforated pipe of 29.5 cm diameter T_5 Manual turning of compost 15 day, T_6 Traditional way compost preparation and T_7 NADEP method of compost preparation). Each group is having three replications

Size of pits -The size of pits was 1x1x1 m length, width and height respectively. The pit was layered with the polythene sheet. Firstly 15 cm chopped paddy straw spread at bottom of pits. Then after this layer was moisten with 15-20 liter of water. Later 5 cm and 1 cm layer of cow dung and soil was spread over it. This sequence of layer was continued till its height reaches 15 cm above ground level. Finally this 15 cm raised layer was covered with5-10 cm thick soil.

Paddy straw, soybean straw, (126 kg of each, 5-6 cm long residue) were chopped with thresher / chaff cutter into small pieces (5-6 cm long) fielding up of the pits. 35 kg fresh cow dung and soil were taken into 5:2 ratio respectively for each pits.

Perforated Pipes- To enhance the aeration into the pits. 29.5 cm of diameter polyvinyl chloride pips were used. The hole were (2.5 cm diameter) made in the pipes for aeration. The number of holes varied according to treatments. A bulk composite sample 0.5 kg (moist) was collected for physical and chemical analysis. Randomly five samples were collected from each pit and then mixed together as a composite sample (0.5 kg from each pits). Collected samples were kept at room temperature for four weeks then analysis was carried out.

Compost sampling - The composite sample were collected at interval of 30, 60, 90 and 120 days of composting period

Estimation of total ash content

Ash contents were measured by the ignition method (Black,1965). Known quantity of compost samples were taken in previously weighed silica crucibles and burnt over an electric heater to remove the smoke. Then, the crucibles were kept inside the muffle furnace and ignited at 550°C for 4 hours. The loss of weight of the sample after ignition in the muffle furnace gave the weight of the total ash and was expressed as % on dry matter basis.

$$\% \text{ Ash } = \frac{\text{Weight of ash + crucible – weight of empty crucible}}{\text{Weight of sample}} \text{ x } 100$$

Total organic carbon

Total organic carbon was determined by dry combustion method at 55 ^{0}C for 5 h. loss on ignition is an indicator of organic carbon content

$$\% C = (\% VS) / 1.8$$

Where,

% Volatile Solids =100- % Ash

Lignin percent

Determination of lignin percentage was done as suggested by Goering and Van Soest, (1975). Refluxing the sample material with acid detergent solution remove the water soluble and material other than the fibrous component and left out material was weighed after filtration, dried then treated with 72% H_2SO_4 and filtered, dried then kept inside the muffle furnace and ignited at 550°C for 3 hours. Cool the crucible in desiccators. Calculate the ash content in the sample.

Given formula

$$\% \text{ Acid Detergent Lignin} = \frac{\text{Weight of 72 \% H2SO4 washed fiber} - \text{Ash}}{\text{Weight of sample}} \text{ x } 100$$

Cellulose percent

Determination of cellulose was done as described by Rowland and Roberts (1994)

RESULT AND DISCUSSON

Colour was observed at end of the composting period. Dark brown colour was found one perforated pipe (T_1), two perforated pipe (T_2), three perforated pipe (T_3) and U shape perforated pipe (T_4) method of compost. While, the brown colour was found under NADEP (T_7), turning (T_5) and traditional (T_6) method of compost.

Dark brown colour was found which might due sun shine did not come directly because of pit was covered by thin layer of soil. However, result are supported by the Hug (1993) and Vuorinen (1999) suggested that the compost stabilizes it darkens to a dark brown or black colour.

Brown colour was comes which might due to pit was not covered and sun-shine come directly.

Total Organic Carbon Percent

the total organic carbon has significantly affected by different composting method at all the three stages *ie.* 60, 90 and 120 days with composting and 30 DAF of all the treatment showed non significant for total organic carbon percent. The highest total organic carbon percent was recorded (46.75, 42.30, 40.13 and 39.56) in the traditional (T_6) method of compost and lowest in NADEP (T_7) method of composting (46.73, 37.69, 36.41 and 35.55) which was at par with turning (T_5) method of compost (46.42, 38.90, 37.60 and 35.77) and three perforated pipe (T_3) method of compost (46.00, 39.22, 38.40 and 36.97) at 30, 60, 90 and 120 DAF, respectively.

Loss in carbon content might be due to decomposition of organic matter because in decomposition process the carbon of organic compound is oxidized to CO_2. These results are confirmed by Harada et al (1998) also.

Ash content

Percent ash content of different technique was observed at 30, 60, 90 and 120 days Percent ash content significantly affected by different composting method at all the three stages *ie.* 60, 90 and 120 DAF, respectively and 30 DAF of all the treatment showed non significant performance for ash content. Highest ash content percent was recorded in NADEP (T_7) method of compost (16.13, 32.03, 34.13 and 36.06) it was at par with the turning method (T_5) of compost (16.23, 29.96, 32.13 and 35.60) and three perforated pipe method (T_3) of composting (16.00, 23.73, 26.66 and 28.80), while the lowest ash content was recorded with traditional method (T_6) of composting (16.40, 23.73, 26.66 and 28.80) at 30, 60, 90 and 120 DAF, respectively.

The ash content kept increasing along with the composting process in all of the methods, owing to

the loss of organic matter (OM) through microbial degradation. The highest ash content might be due to high aeration would have higher degradation rates. It provides the proper oxygen for the microorganism to aerobically decompose which results to higher loss of organic matter resulted to higher bulk density of material. Similar, finding also reported by Harada *et al.*(1998).

Total Nitrogen Percent

Total nitrogen of different composting technique was significantly affected by different composting method at 30, 60, 90 and 120 days. Table 4.6 shows that total nitrogen content was increases with days of interval. Highest nitrogen content was recorded in NADEP (T_7) method of compost (2.23, 2.33, 2.38 and 2.39 %) followed by turning (T_5) method of compost (2.17, 2.22, 2.27 and 2.27 %) at 30, 60, 90 and 120 days respectively. While, the lowest nitrogen content was observed in traditional (T_6) method of compost (2.0, 2.06, 2.10 and 2.13 %). Gotaas, (1956) reported the composting process fall of C/N ratio because the microorganism activities the conservation of nitrogen and transformation of carbon to CO_2 humic substance. At the end of the composting process, total nitrogen content would slightly increase. Since the rate of weight loss was increased. Higher nitrogen content in NADEP (T_7) method which, might due the proper aeration for the microorganism to aerobically decompose. Results in higher degradation rate. Further, Harada *et al.* (1998) also reported that the composting process total nitrogen content increases. Our results are same as above reports.

C/N Ratio

the carbon (C) and nitrogen (N) ratio calculated at the four stages of observation and it was noticed that lowest C/N ratio was recorded in the NADEP (T_7) method of composting (20.95, 16.17, 15.29 and 14.87) while, the highest C/N ratio was recorded in traditional (T_6) method of compost (23.37, 20.53, 19.10 and 18.57) at 30, 60, 90 and 120 DAF, respectively. The C/N ratio is considered to determine the degree of maturity of compost and to define agronomic quality of compost. Poincelot (1974) and Golueke (1981) reported that C/N ratio below 20 is indicative of acceptable maturity a ratio of (Juste, 1980). However, Hira *at al.* (1993) stated that C/N ratio cannot be used as an indicator of compost maturity. Since, it values show great variation due to the characteristics of composting techniques. Our results were in agreement with the above reports. Analysis showed that NADEP (T_5) method of compost had a lowest C/N of 15.12 followed by turning (T_5) method of compost.

Cellulose content (%)

Cellulose content was also observed at 30, 60, 90 and 120 DAF. The Cellulose % decreases with the time interval. Cellulose % significantly affected by different composting method at all the four stages *i e.* 30, 60, 90 and 120 days of observation. The lowest cellulose content was recorded (14.33, 13.66, 11.0 and 9.66) on the NADEP method (T_7) of compost. However, it was at par with turning method of compost (16.66, 14.00, 11.66, and 10.0) at 30, 60, 90 and DAF, respectively. While the highest cellulose content % was found in traditional method (T_6) of composting (19.0, 18.0, 15.3 and 13.33 %).High temperature favors cellulose degradation and growth of cellulolytic bacteria (Stutz *et al.* 1970 and Gazi *et al.*, 2007).

Lignin Per cent

Lignin content was recorded at 30, 60, 90 and DAF. Lignin content increased with day of composting period .Different composting technique significantly affected the per cent lignin content at all the three stages of in observation except 30 DAF showed no significant performance for lignin per cent. The highest lignin content was recorded (15.50, 26.66, 30.00 and 35.0 %) in the NADEP (T_7) method of composting. It was at par with the turning method of compost (14.50, 22.7, 29.6 and 33.0 %) while, the lowest lignin content was recorded in traditional method (T_6) of composting (14.20, 18.33, 22.40 and 23.0 %) at 30, 60, 90 and 120 DAF, respectively. the average value of lignin had increased due to aeration rate. Freeman *et al.* (2001) reported that the important enzymes in the process of lignin ion polyphenolic decomposition and contribute to the enzymes letch concept in which phenon oxide ions other hydrolytic enzymes are inhibited by low o_2 level, slowing carbon mineralization. Howevere, Van Soest, (1994) suggested lignin degradation is primarily an aerobic process, and in and anaerobic environment lignin can persist for very long period result in slow microbial degradation further Manna *et al.* (2000), and Harada *et al.* (1998) reported that the lignin content increased with maturation of composting time. Our results were in agreement with the above reports.

Lignin /nitrogen ratio

The Lignin /Nitrogen (L/N) ratio was calculated at all the four stages of observation and it was noticed that highest L/N ratio was recorded in NADEP method of composting (T_7) (9.95, 11.43, 12.56 and 14.64). While, lowest ratio was recorded in traditional method (T_6) (7.10, 8.86, 10.66 and 10.78) at 30, 60, 90 and 120 DAF, respectively.

Cation Exchange Capacity

Cation exchange capacity (CEC) of different composting technique was observed at 30, 60, 90 and 120 days after pit filling. The average values of CEC of these composting materials increased with time and different method of composting. The CEC has significantly affected by different composting

method at all the three stages *ie.* 60, 90 and 120 days of composting, while 30 DAF showed no significant performance for Cation exchange capacity. The highest CEC was observed in NADEP (T_7) method of compost (41.00, 51.00, 67.00 and 90.66 C mol (p^+) kg $^{-1}$) and it was at par with the turning (T_5) method of compost (40.00, 47.00, 60.33 and 88.33 C mol (p^+) kg $^{-1}$). While the lowest CEC was recorded in traditional (T_6) method of compost (33.00, 40.00, 50.33, and 64.00 C mol (p^+) kg $^{-1}$) at 30, 60, 90 and 120 days after composting, respectively.

At the end of maturation that is at the completion of decomposition process the compost become fully matured this is evident from the increase in values of CEC. The results are in conformity with those of Mathur *et al.* (1993).

The high CEC in NADEP (T_7) method which might be due to aerobically microbiological decomposition due to proper aeration results in the greater loss of weight and greater increase of humic substances yielding greater CEC similar founding also reported by Lux *et al.* (1986).

CEC/ TOC Ratio

The cation exchange capacity (CEC) and Total organic carbon ratio (TOC) calculated at all the four (30, 60, 90 and 120 days) stages of observation and it was noticed that highest CEC/TOC ratio was recorded on the NADEP(T_7) method of composting (0.87, 1.35, 1.84 and 2.55). While the lowest ratio was recorded in traditional (T_6) method of compost (0.70, 0.94, 1.25 and 1.61) at 30, 60, 90 and 120 DAF, respectively. The CEC/TOC ratio can be useful as an index of maturity. This observation is in accordance with those of Lux *et al.* (1986).

Cost Economics of Different Composting Technique

As evident from the results obtained the maximum cost of production (553.75 Rs/pits) was calculated with NADEP method and minimum cost of production (212.00 Rs/pits) with traditional method of composting were estimated. In between the two cost of production followed with turning method , three perforated pipe method, U shape perforated pipe method, two perforated pipe method, and One perforated pipe method with (470.5 Rs/pit), (508.00 Rs/pit), (459.5 Rs/pit), (407.5 Rs/pit) and (310.00 Rs/pit), with cost of production, respectively. However, the frequency of NADEP method was recorded highest with preparation of composting within 4 months followed by turning method of composting.

The highest duration for composting was recorded 8-10 month with traditional method of composting as far as preference of the method for composting was recorded, it was concluded that NADEP method (T_7) should be preferred over traditional method (T_6) and all other methods of composting as it gives earliness and bulk composting can be obtained as the composting method of only 4 months duration which will enable to get 3 composting annually compared to others which facilitates only one or twice composting annually.

Cost benefit analysis does not show positive result with current year analysis as in pre investment stage infrastructure investment is included which is much higher than production profit / benefit so with long term production it may be mitigate with benefits pre-investment is recovered and after some stage it will show purely benefit projection.

Table 1. Effect of total nitrogen content on different composting techniques at 30, 60, 90 and 120 days

Treatment	**Total nitrogen percent**			
	30	**60**	**90**	**120**
I perforated pipe method	2.02	2.12	2.17	2.18
II perforated pipe method	2.11	2.17	2.19	2.21
III perforated pipe method	2.07	2.18	2.21	2.22
U Shape perforated pipe method	2.14	2.18	2.20	2.20
Turning method	2.17	2.22	2.27	2.27
Deshi method	2.00	2.06	2.10	2.13
NADEP method	2.23	2.33	2.38	2.39
SEm ±	**0.03**	**0.05**	**0.02**	**0.02**
CD	**0.11**	**0.17**	**0.08**	**0.08**

Table 2. Effect of cellulose content with day of intervals at 30, 60 90 and 120 days

Treatment	**Cellulose percent**			
	30	**60**	**90**	**120**
I perforated pipe method	17.66	16.33	13.00	11.00
II perforated pipe method	17.00	15.33	12.66	11.33
III perforated pipe method	16.66	14.33	11.66	10.73

U Shape perforated pipe method	17.00	14.66	12.00	10.90
Turning method	16.66	14.00	11.66	10.00
Deshi method	19.00	18.00	15.33	13.33
NADEP method	14.33	13.66	11.00	9.66
SEm ±	**0.73**	**0.86**	**0.66**	**0.62**
CD	**2.22**	**2.61**	**2.02**	**1.88**

Table 3. Changing of CEC/TOC ratio with day of interval at 30, 60, 90 and 120 days of composting period

Treatment	**CEC/TOC**			
	30	**60**	**90**	**120**
I perforated pipe method	0.79	1.02	1.33	1.95
II perforated pipe method	0.81	1.07	1.38	2.12
III perforated pipe method	0.84	1.15	1.52	2.36
U Shape perforated pipe method	0.83	1.16	1.45	2.25
Turning method	0.86	1.20	1.60	2.46
Deshi method	0.70	0.94	1.25	1.61
NADEP method	0.87	1.35	1.84	2.55

Table 4. Effect of total nitrogen content on different composting techniques at 30, 60, 90 and 120 days

Treatment	**Total nitrogen percent**			
	30	**60**	**90**	**120**
I perforated pipe method	2.02	2.12	2.17	2.18
II perforated pipe method	2.11	2.17	2.19	2.21
III perforated pipe method	2.07	2.18	2.21	2.22
U Shape perforated pipe method	2.14	2.18	2.20	2.20
Turning method	2.17	2.22	2.27	2.27
Deshi method	2.00	2.06	2.10	2.13
NADEP method	2.23	2.33	2.38	2.39
SEm ±	**0.03**	**0.05**	**0.02**	**0.02**
CD	**0.11**	**0.17**	**0.08**	**0.08**

Table 5. Effect of lignin content at 30, 60, 90 and 120 days of composting period

Treatment	**Lignin percent**			
	30	**60**	**90**	**120**
I perforated pipe method	14.23	19.83	22.83	28.33
II perforated pipe method	14.76	21.00	24.66	29.00

III perforated pipe method	15.06	21.70	26.53	30.66
U Shape perforated pipe method	14.50	21.40	25.56	29.33
Turning method	14.50	22.76	29.6	33.00
Deshi method	14.20	18.33	22.40	23.00
NADEP method	15.50	26.66	30.00	35.00
SEm ±	**-**	**1.02**	**1.69**	**0.89**
CD	**NS**	**3.10**	**5.13**	**2.72**

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ASSESSMENT OF GENETIC DIVERSITY IN GARLIC (*ALLIUM SATIVUM* L.) GERMPLASM

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Abstract: An investigation was carried out to identify the extent of genetic divergence that exist for the yield and yield contributing characters of fifteen genotypes of garlic using Mahalanobis D^2 analysis. All the 15 genotypes of garlic (*Allium sativum* L.) were grouped into three clusters on the basis of the morphological diversity. Maximum intra-cluster distance was observed in cluster III (5.654) whereas, maximum inter-cluster distance was observed between cluster II and I (6.294). The analysis of divergence indicated significant differences among parental lines for all the agro-morphological characters. On the basis of results obtained in the present investigation, it was concluded that the allelic diversity can be used for future breeding program. The traits under study are also major yield contributing traits and are largely associated with each other. Therefore, these traits should be taken into consideration either simultaneously or alone for selecting a high yielding garlic genotype.

Keywords: Garlic, investigation, plant, *Allium*

INTRODUCTION

Garlic is grown world- wide but China is the leading producer and having 75% of world production. Panse *et al.* (2013). In our country, the average productivity of garlic is 5 ton /ha which is very quit low as compared to the other garlic growing countries Singh *et al.* (2012). To increase the production of this crop for domestic as well as international market, there is urgent need to screen the germplasm to get more divergent cultivars for qualitative traits. Since the crop is propagated by vegetative methods, the clonal selection is an important breeding method this situation adds complexity to the chracterization of garlic clones (Bradley *et al.*, 1996, Al-Zahim *et al.*, 1997). Through collection and selection program, a number of strains have been introduced and acclimatized in various parts of the world, but evaluation studies of yield and its contributing quantitative and qualitative traits are scarce. The multivariate analysis has been established by several investigators for measuring the degree of divergence and for ascertaining the relative contribution of different characters to the total divergence (Singh *et al*., 2002). Such a study also permits to select the genetically divergent parents to obtain the desirable recombinants in the segregating generations. Moreover, precise information about the extent of genetic divergence and characters used for discrimination among the population is crucial in any crop improvement program Ashana and Pandey, (1980) and Pandey (2009). Therefore, the present investigation was designed to provide information on genetic divergence of 15 garlic genotypes collected from different sources. The diverse parents belonging to different distant clusters would provide an opportunity for bringing together gene constellations of diverse nature promising hybrid derivatives result probably due to complementary interaction of divergent in parent (Murthy, 1965) and Anand and Murthy, 1968.

MATERIAL AND METHOD

A total of 15 cultivars of garlic were used in the present study (Table 1). Plant material collected from different parts of the country. The experimental field is situated at 29º 01 latitude in the North and 77 º43 longitudes in the Eastern elevation of about 219.75 meters above sea level. The experimental trials were laid out in randomized block design with three replications. Each genotype was assigned to six rows per plot with a distance of 20 cm line to line and 15 cm plant to plant. Data were recorded on 14 different quantitative traits namely plant height (cm), stem diameter (cm), stem internode length (cm), number of primary branches per plant, plant spread (cm), leaf length (cm), leaf width (cm), leaf length-width ratio, length of lower lobe of leaf (cm), peduncle thickness of terminal flower (cm), peduncle length of terminal flower (cm), length of outer ray florets (cm), flower diameter (cm) and number of flowers per plant. The five randomly selected plants in each genotypes of all replication were utilized for taking the observation at appropriate stage. The mean values of the genotypes in each replication for quantitative characters were used for statistical analysis (Table 2). The data were processed with the help of the software programme SPAR-1 Doshi and Gupta, (1991) utilizing various standard statistical procedures. The data recorded on nine different quantitative traits was subjected to the D^2 statistic of Mahalanobis Rao, (1952) and average intra- and - inter cluster distances were calculated (Table.3).

RESULT AND DISCUSSION

The analysis of variance revealed a significant difference among the 15 genotypes for all the 16 characters indicating the existence of high genetic diversity. Cluster formation based on Tocher analysis of field data of morphological traits generated three clusters (Table-3). Maximum inter cluster D^2 value

(6.294) was recorded between cluster II and I. whereas the minimum average inter cluster D^2 value (3.250) was recorded between clusters I and I. The intra cluster divergence were found to range between 3.250 for cluster I, 4.254 for cluster II, 5.654 for cluster III.,. Singh et al. (2012) formed 10 clusters in 32 genotypes of garlic on the basis of 14 morphological characters.

Combined analysis of variance indicated that the magnitude of mean sum of square for maximum leaf width (228.51cm) and plant height (203.11) at 90 days stage after planting of cloves followed by number of cloves per bulb (152.38g) and weight of bulb (142.70g) and these traits are also correlated with bulb yield. (Table 2).

The distribution of genotypes belonging to same geographical region in different cluster and grouping of genotypes collected from different location in one cluster is common. This grouping pattern of genoptypes suggested no parallelism between genetic divergence and geographical distribution of genotypes. Lokhande *et al*. (1987), Lee *et al.* (1996), Mohanti, (2001), Mohanti and Prusti (2002), Sheikh and Khandy, (2008) Swaroop (2010), Singh and Duvey (2011) and Singh *et al*. (2012) also reported that genotypes diversity was independent of geographically region. Murthy and Arunachalam (1966) stated that genetic drift and selection in different environment could cause greater diversity environment could cause greater diversity than geographic distance. Similarly maximum intra-cluster (D^2= 5.654) was observed in cluster II (representing 4 genoypes of the 15 genotypes), (Table. 4) followed by cluster I (D^2 = 4.254) and minimum intra-cluster distance (D^2=3.250) was found in cluster I. Singh *et al.* (2012) has also reported the similar findings.

Cluster means are concerned different clusters have higher mean values for different traits, indicating that few of cluster contained genotypes with most of the desirable characters (Table. 5). It was observed that cluster II included the genotypes with higher bulb weight and maximum diameter of bulb and maximum weight of bulb. Similar observations had been earlier reported by Swaroop and Janakiram, (2010) in gladiolus. The characters showed in terms superior characters i.e qualitative charectars deserve to be considered as potent parents for further utilization in garlic breeding programme. Therefore, based on D^2 analysis, it has been understood that characters need to be given more weightage, while selecting parents for improvement programme.

Cluster analysis based on Euclidean coefficient values obtained from morphological data showed that four genotypes namely CL Lamba, Roshni Mota, Cheeniaa, Desi Lasan found to be present separately from other 15 genotypes that were found to be largely aggregated.

Table 1. List of Indian garlic genotypes and their origin.

Sr. No.	Germplasm	Source
1	CL Lamba	Bareilly/Uttar Pradesh
2	Roshnee mota	Bareilly/Uttar Pradesh
3	Cheeniaa	Bareilly/Uttar Pradesh
4	Sukha 44	Bareilly/Uttar Pradesh
5	Desi lasan	Bareilly/Uttar Pradesh
6	G 50	National Horticulture Research Development Foundation (NHRDF) Karnal Haryana
7	GG 1	National Research Centre For Onion & Garlic Pune
8	Bhima purpule	National Research Centre For Onion & Garlic Pune
9	Phule basant	National Research Centre For Onion & Garlic Pune
10	Godawari	National Research Centre For Onion & Garlic Pune
11	PG -9	Panjabi Agriculture University(PAU) Ludhiana
12	PG-17	Punjab Agriculture University(PAU) Ludhiana
13	PG-35	Punjab Agriculture University(PAU) Ludhiana
14	BG-108	Punjab Agriculture University(PAU) Ludhiana
15	AVTG-1	Panjab Agricuture University(PAU) Ludhiana

Table 2. Analysis of variance (ANOVA) for sixteen characters of Indian garlic.

Source	d.f	**PH 30 DAS (cm)**	PH 60 DAS (cm)	**PH 90 DAS (cm)**	NLPP 30 DAS	**NLPP 60 DAS**	NLPP 90 DAS	**LL 30 DAS (cm)**	LL 60 DAS (cm)
REP	2	15.85	2.21	2.51	2.60	0.42	0.49	0.28	0.79
TRET	14	49.20**	65.50**	203.21**	5.44**	2.80**	1.98**	38.46**	87.33**
EROR	28	8.83	6.95	1.42	0.41	0.49	0.47	0.30	0.67

Source	d.f	**LL 90 DAS (cm)**	LW 30 DAS (cm)	**LW 60 DAS (cm)**	LW 90 DAS (cm)	**BW (gm)**	B.D (mm)	**WOC (gm)**	NCPB
REP	2	0.09	0.00	0.00	3.42	1.66	0.09	1.69	0.02
TRET	14	0.04**	0.15**	0.22**	228.51**	142.70**	0.20**	69.90**	152.38**
EROR	28	0.02	0.04	0.02	1.23	0.79	0.02	0.97	0.34

** significant at 5% and 1% level, respectively

Table 3. Average intra and inter cluster (D^2 value) distance in Indian garlic

Cluster	I	II	III
I	3.250	6.294	3.379
II		4.254	4.450
III			5.654

Table 4. Distribution of 15 genotypes of Indian garlic.

Clusters number	No. of genotypes	Genotypes
I	4	GG- 1 , PG -9, Phule Basant , Godawari
II	4	Cl Lamba, Roshni Mota , Cheeniaa , Desi Lasan
III	7	Sukha -44 , G -50 , Bhima Purpule , PG- 17 , PG -35 , BG-108 , AVTG -1

Table 5. Cluster means values of different traits

Character / Cluster	**Plant Height at 30 DAS (cm)**	**Plant Height at 60 DAS (cm)**	**Plant Height at 90 DAS (cm)**	**Leaves/Plant at 30 DAS**	**Leaves/Plant at 60 DAS**	**Leaves/Plant at 90 DAS**	**Leaf Length at 30 DAS (cm)**	**Leaf Length at 60 DAS (cm)**	**Leaf Length at 90 DAS (cm)**	**Leaf Width at 30 DAS (cm)**	**Leaf Width at 60 DAS (cm)**	**Leaf Width at 90 DAS (cm)**	**Bulb Weight (gm)**	**Bulb Diameter (mm)**	**Single Clove Weight (gm)**	**Cloves/ Bulb**
1	-0.91	-0.93	0.28	-0.63	-0.82	0.38	-1.16	-1.23	-0.67	-0.67	-0.18	0.16	-0.98	-0.79	-0.58	-0.82
2	1.44**	1.03**	0.93**	0.79**	0.48	-0.03	0.36	0.75**	1.42**	1.31**	0.14	0.61	1.10**	0.54**	1.16**	0.01
3	0.30	0.05	-0.37	0.09	0.19	-0.20	0.46**	0.28	0.43**	0.36	0.18	-0.26	0.07	0.14	0.33	0.47**

**Significant at 5% and 1% level, respectively

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GENETIC EVALUATION OF QTLS AND CORRELATION STUDIES FOR YIELD AND RELATED TRAITS IN RICE (*ORYZA SATIVA* L.) FOR IRRIGATED AND DROUGHT CONDITION

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Abstract: Drought stress is the predominant cause for rice yield reduction and production stability in rain fed and poorly irrigated rice ecosystems. Development of cultivars with improved drought tolerance is thus an important element in increasing productivity and alleviating poverty of communities depends on rain fed ecosystem. Identification of QTLs and molecular markers linked to drought tolerance can substantially improve selection efficiency. 45 lines of F_3 population of two *indica* genotypes, SWARNA and IR86931-B-6 were evaluated under Irrigated, Rainout shelter I and Rainout shelter II condition at Research cum Instructional Farm of College of Agriculture, IGKV, Raipur, to generate phenotypic data and SSR and HvSSR based genotypic data of population was generated. The phenotypic and genotypic data was analyzed for genetic evaluation of QTLs and correlation studies for yield and related traits in rice for irrigated and drought condition. The yield under irrigated condition exhibited non significant weak correlation with grain yield under both rainout shelter I as well as rainout shelter II, 100 SSR and HvSSR primers were screened for detecting parental polymorphism, out of which 37 showed polymorphisms. 37 SSR and HvSSR markers were further used for developing genotypic data. QTLs for DSI were identified on chromosome 3 and chromosome 5 under rain out shelter II condition.

Keywords: Rice, DSI, QTLs, SSR, ROSI, ROSII, Correlation

INTRODUCTION

Rice (*Oryza sativa* L.) is the world's most important wetland food crop. Rice is central to the lives of billions of people around the world. A part from food rice is intimately involved in the culture as well as economy of many societies. Rice is an integral part of creation myth and remains today as leading crop and most preferred food (Huke and Huke, 1997). Drought stress is a major constraint to rice production and yield stability in rainfed region (Evenson *et al.,* 1996). The multifaceted nature and complexity of drought and insufficient knowledge on its interactive responses with other biotic/abiotic stress have stalled breeding progress (O'Toole 1982). Drought resistance appears to be the most important single factor in increasing and stabilizing of rice production in rainfed areas. Genetic studies show that adaptive mechanisms to drought in rice are heritable and are controlled by complex quantitative characters (Chaudhary and Rao 1982). QTLs are marvelous genetic entities demonstrating great utility in genetic understanding of complex traits and promise greater impact in crop improvement endeavors they have given as a clearer view of the genetics of agronomically important and several other traits too. The distinction and clarity between monogenic and polygenic traits is blurred with the increase in power and precision of methods to detect and map QTLs (Shashidhar, 2005). Therefore, the present study was undertaken to correlation and QTLS identification for drought susceptibility index in rice under irrigated and drought condition.

MATERIAL AND METHOD

The planting materials were 45 F_3 progenies of a cross between Swarna and IR86931-B-6 (derived from Nagina22). Each F_3 progeny had 10 plants / lines. The F_3 lines derived from a cross between Swarna X IR86931-B-6 were evaluated in the field during *Kharif* season 2012 at Research cum Instructional Farm of College of Agriculture, IGKV, Raipur. The field trials were conducted under irrigated and drought conditions (rain out shelter). The planting material was shown on raised bed nursery and transplanted after 15 days of sowing under puddled irrigated field condition. After 25 days of transplanting tillers from individual plants were separated and transplanted under rain out shelter. Under irrigated condition normal package of practices was followed while under rain out shelter plants were exposed to water stress after 30 days of transplanting. Genotypic data was generated in Plant Molecular Biology Laboratory of Genetics and Plant Breeding Department, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) using rice microsatellite markers for the identification of QTLs for Drought susceptibility index in rice under irrigated and ROS I and ROS II conditions. The data was analyzed using composite interval mapping method for identification of QTLs.

RESULT AND DISCUSSION

Correlation Studies

One of the major problems for direct selection under drought condition is the repeatable imposition of water stress of similar severity. Under these conditions it is highly desirable to understand the

association of yield under stress. The data on various traits recorded during *Kharif* 2012 under irrigated, ROS I and ROS II condition, are presented in table1.

Yield under rainout shelter II (0.531) with yield under rainout shelter I, DSI of ROS I (0.417) exhibited positive correlation with yield under irrigated and negative correlation (-0.658) with yield under ROS I condition. DSI of ROS II condition reported negative correlation with yield (ROS II) (-0.579) and positive correlation with DSI ROS I (0.682) condition.

Another significant point is that yield under irrigated condition exhibited non significant weak correlation with grain yield under both rainout shelter 1 as well as rainout shelter 2. This also indicates that breeding varieties for stress condition should screen the test genotypes under stress as well as non stress condition then only one can identify a genotype performing well under all sets of condition can be identified.

The grain yield under rainout shelter exhibited negative correlation with DSI, This is expected as susceptible lines produced less yield. This DSI under both the stress condition had significant positive correlation, this indicates that imposition of stress and other agronomic condition were almost similar. Imposition of similar stress level is essential for proper selection both has been observed to be different by other worker.

QTL analysis

Extraction of genomic DNA and quantification

Total genomic DNA was extracted from 45 lines of rice along with both the parents using miniprep method (Doyle and Doyle, 1978). Fresh and healthy leaves were used for extraction of DNA. The DNA samples were then subjected to quantification on Nanodrop Spectroscopy. The quantity of the samples ranged from 100-700 ηg / µl. DNA samples were then diluted with sterile water such that the final concentration of DNA becomes 40 ηg / µl.

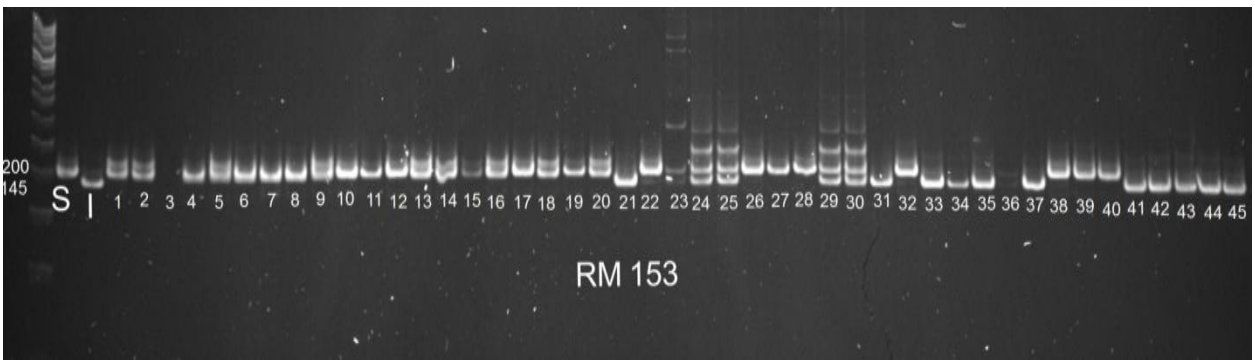
Parental polymorphism analysis using SSR and HvSSR primers

After standardization of the PCR protocol for SSR assay, it was used for all subsequent studies. The DNA of selected lines along with the parents was subjected to PCR based simple sequence repeat (SSR) technique to generate genotypic data using rice SSR and HvSSR primers.

A set of 100 microsattelite markers were used in this study for amplification of genomic DNA of mapping population through PCR. The PCR products were loaded on PAGE gel electrophoresis was done at 180 volts for 1 hour. The DNA was stained with ethidium bromide (10 mg / µl). Gels were visualized and photographed by using Gel Doc Unit. Out of 100 SSR and HvSSR primers, 37 primers showed parental polymorphism and were then subjected to generate genotypic data. The relatively low recovery of parental polymorphism under this study was attributable to the narrow genetic variation between the parents as both of these were *indica* type and adopted to grow in the same rice ecosystem.

Days to flowering, Difference of flowering between irrigated and rain out shelter, plant height, panicle length, grain yield, drought susceptibility index were used for QTLs analysis through composite interval mapping method. QTL analysis was employed by use of QTL Cartographer, version 2.5. The threshold LOD of 3.0 was used. However, only those QTL with LOD above 3.0 were treated as significant.

Overall on 12 chromosomes, only 3, 4, 5, 6 and 9 had QTLs for various traits under study. However among these five chromosomes, chromosome 3 showed maximum no. of QTLs (15) followed by chromosome 5 showing (6) QTLs, chromosome 9 had 3 QTLs and chromosome 4 and chromosome 6 showed only 2 QTLs. Under irrigated condition, chromosome 3, 5, and 9 reported 2 QTLs each. The markers which exhibited significant association were presented in Figure 1. Molecular linkage map with position of QTLs for all traits presented in Figure 2 and Molecular linkage map with position of QTLs for some traits under irrigated and rain out shelter condition were presented in Figure 3.



L= Ladder, S= Swarna, I= IR86931-B-6

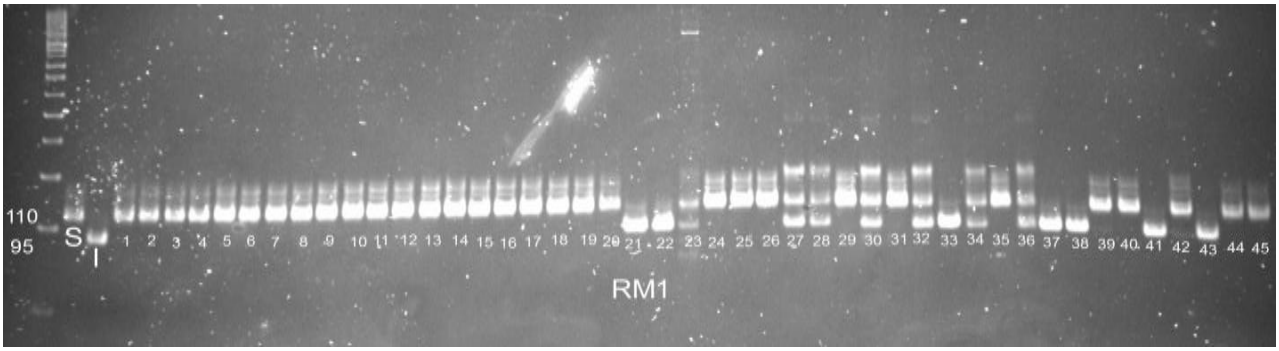


Fig. 1. Banding pattern of SSR primer RM 153 and RM 1 in parents & F_3 segregating progeny

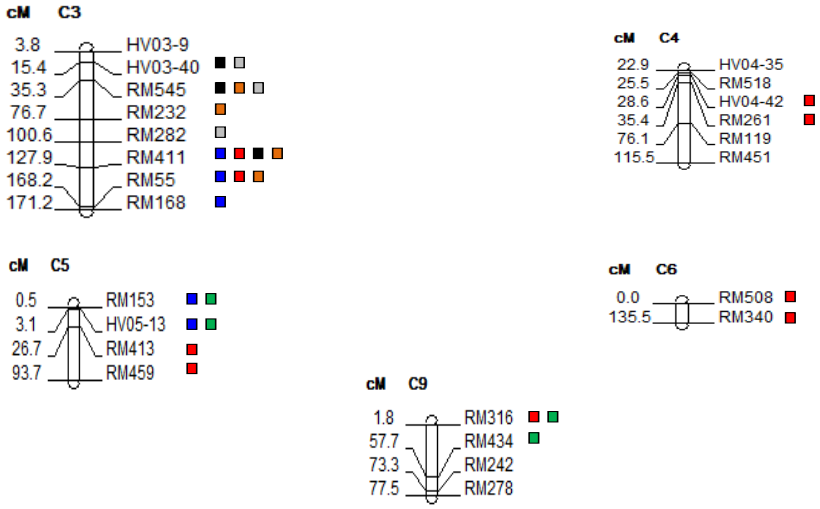
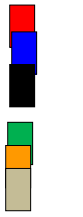


Fig. 2. Molecular linkage map with position of QTLs for all traits under all sets of conditions



Difference of flowering
DSI
Plant Height
Panicle length
Grain yield irrigated
Grain yield ROS I

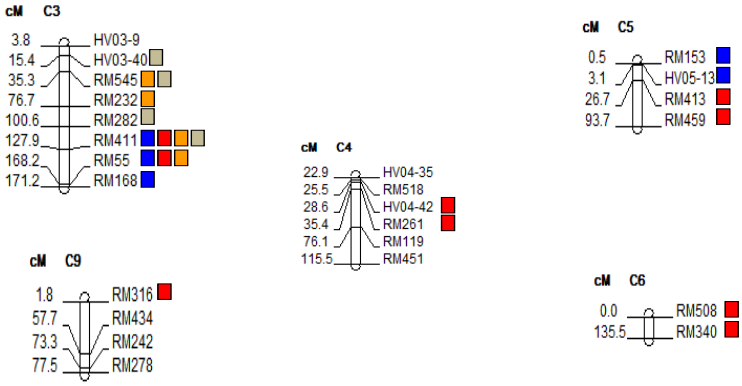


Fig. 3. Molecular linkage map with position of QTLs for some traits under irrigated and rain out shelter condition.

Characters	Irrigated	ROS I	ROS II
DSI			
Grain yield			
Difference of flowering	Irri - ROS II	Irri - ROS II	ROS I – ROS II

For drought susceptibility index (DSI) trait, QTL was identified on chromosome 3 with the LOD of 3.2 under rain out I condition, similarly, on chromosome 5 also are QTL was identified with the LOD value of 4.7 under rain out shelter I.

QTLs for difference of flowering identified on chromosome 9 with the LOD value of 3.2, chromosome 6 with the LOD value of 3.6, chromosome 5 with the LOD value of 4.9, chromosome 4 with the LOD value of 6.8, and chromosome 3 with the LOD value of 6 under ROS I - ROS II condition.

QTLs for panicle length was found on chromosome 5 with LOD value of 3.2 and 9 with LOD value of 3 under irrigated condition QTLs for plant height was found on chromosome 3 with LOD value of 6 under irrigated condition.

QTLs for grain yield was found on chromosome 3 with LOD value of 3.2 under irrigated condition. Similarly on chromosome 3 also are QTL was identified with the LOD value of 4.5 under ROS I.

Within 45 line number 29, 4, and 10 gave highest grain yield under irrigated, ROS I and ROS II condition respectively. So these can be used for further breeding programme. Within 45 line number 4, 5, 7, 23, 26, and 39 showed negative DSI under ROS I and line number 1, 39 shows negative DSI under ROS II condition. Present results suggested the possibilities of use of these markers for subsequent marker assisted selection and the selected genotypes should extensively be tested under multi-location trials So, these genotypes can be used as donors in hybridization programme for improving the drought tolerance of existing rice cultivars.

Table 1. Association among six characters of 45 lines of Swarna x IR 86931 - B-6 F3 generation under all sets of condition

	DTF	Difference in flowering		ROS I - ROS II	PH (cm)	PL (cm)	Y (g) (I)	Y (g) (ROS I)	Y (g) (ROS II)	DSI ROS 1	DSI ROS II
		I - ROS I	I - ROS II								
DTF	1.000										
ROS I	0.193	1.000									
ROS II	-0.114	0.238	1.000								
ROS I – ROS II	-0.066	-0.176	0.429**	1.000							
PH	-0.205	0.276	0.328*	-0.047	1.000						
PL	-0.024	0.398**	-0.045	-0.319*	0.496**	1.000					
Y(I)	-0.195	0.002	0.225	0.342*	-0.068	-0.339*	1.000				
Y(ROS I)	0.213	0.043	-0.027	0.078	-0.049	-0.142	0.229	1.000			
Y(ROS II)	0.075	0.276	0.235	0.201	0.107	0.073	0.274	0.531**	1.000		
DSI ROS I	-0.360*	0.080	0.226	0.221	0.112	-0.041	0.417**	-0.658**	-0.272	1.000	
DSI ROS II	-0.286	-0.055	0.082	0.152	-0.028	-0.179	0.488**	-0.285	-0.579**	0.682**	1.000

DTF = Days to flowering; PH = Plant height (cm); PL = Panicle length (cm); GY = Grain yield (g); ROS I = Rain out shelter I; ROS II = Rain out shelter II; I = Irrigated and DSI = Drought susceptibility index

** and ** significant at 0.05 and 0.01 probability level*

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PHYSIOLOGICAL AND BIOCHEMICAL MANIFESTATIONS OF SALICYLIC ACID IN RICE UNDER WATER STRESS CONDITION

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Abstract: Salicylic acid (SA) is a naturally occurring plant hormone of phenolic nature that has diverse effects on tolerance to abiotic stresses. It may act as endogenous signal molecule responsible for inducing abiotic stress tolerance in plants, especially water stress. An experiment was therefore, conducted with an aim to assess the role of exogenously applied SA in water stress tolerance of four different rice varieties. The pot culture was laid out in a completely randomized design (CRD) with three replications. Varieties were subjected to water stress at vegetative stage by withholding water application. The study revealed that moisture stress at vegetative stage is highly detrimental to most of the physiological and biochemical traits investigated in the current research. Drought caused a massive reduction in the basic physiological processes measured in terms of photosynthetic rate, stomatal conductance, transpiration rate, and chlorophyll stability index, but contrastingly, caused noticeable increase in proline accumulation. Foliar application of 100 ppm SA improved the plant growth by increasing the above stated parameters which were reduced due to moisture stress and helped the plants to overcome the adverse effects of water stress. The present finding envisaged that SA improved the drought tolerance of all the four rice cultivars particularly the sensitive ones. Therefore, it may be used as an ameliorant to alleviate the negative effect of drought injury in rice.

Key words: Rice, vegetative stage, water stress, physiological and biochemical traits

INTRODUCTION

Rice (*Oryza sativa* L.) is the staple food for more than two-third of the world's population (Dowling *et al.,* 1998). Though the constraints of rice production are many, the most predominant is drought, as more than 70 percent of rice grown in India is rainfed. Productivity of rice in rainfed conditions is around 60-75 percent lower than that of in irrigated conditions (Rao and Venkateswarlu, 1998). It is a world wide spread problem seriously influencing grain production and quality and with increasing population and global climate change making the situation more serious. Water stress frequently occurs, either at one or more phenological stages of the upland rice crop raised under rainfed condition due to the erratic and unevenly distributed rains during the growing season. Water stress at vegetative stage causes irreparable loss of canopy, which leads to a series of morphological, physiological and molecular changes and that adversely affect the plant growth. Salicylic acid (SA) is an important signaling molecule with ubiquitous distribution in plants, and participates in plant physiological processes. It plays an important role in abiotic stress tolerance (Raskin, 1992). It has diverse effect on tolerance to abiotic stress. SA has been demonstrated to be messenger involved in signal transduction in response to biotic and abiotic stresses (Clarke *et al*., 2000). Exogenous application of SA may participate in the regulation of physiological processes in plants, such as stomatal closure, ion uptake and transport (Gunes *et al.*, 2007). Therefore, objectives of the current study were to study the effect of induced water stress on morpho-physiological and biochemical traits vis à-vis variability among the rice varieties and to study the effect of salicylic acid in mitigation of drought injury. Analyzing these responses can be useful in understanding the physiological and biochemical mechanisms of this compound by which it cope up to drought stress in rice.

MATERIAL AND METHOD

A pot culture experiment was conducted during summer 2012-13 at the wire netting house of Department of Plant Physiology, OUAT, Bhubaneswar, Odisha, India. Four rice varieties namely; Subhadra (DR-92), Mandakini (OR-20774/IET 17847), Kalinga III (CR-237-1) and Khandagiri (IET 10396) were subjected to three treatments viz., control (normal irrigation), drought, drought + salicylic acid in the present experiment. Earthen pots of 10 inch diameter were used for raising the crop. The soil used for filling the pots was sandy loam type having a pH of 6.8 and the native available N, P and K contents were 100, 17.8 and 110.3 kg ha^{-1}, respectively. Seeds were first sown in the nursery and then 25 days old seedlings were transplanted in the earthen pots using two seedlings per hill and three hills per pot. N, P and K were applied @ 80:40:40 kg ha^{-1} · Half of the N and full dose of P and K were mixed in the soil before filling the pots. Remaining half of the nitrogen was added in two equal split doses, one at tillering and other at the time of panicle emergence. The experiment was replicated thrice with completely randomized design

(CRD). Moisture stress treatment was imposed at the vegetative stage (40 days crop age) by withholding irrigation till temporary wilting appeared. 100 ppm salicylic acid was applied as foliar spray at the beginning of the water stress. A water stress treatment without salicylic acid and a control set (irrigated normally) was also maintained for the study. The plants were irrigated at the end of water stress treatment. The different physiological and biochemical parameters were recorded by using methods as follows.

Photosynthesis and ancillary parameters

Photosynthetic rate and other gas exchange parameters viz. transpiration rate and stomatal conductance were measured on the second fully expanded leaf of three representative plants per genotype with a portable photosynthesis system (CIRAS-2 of version 2.02, USA).

Root : shoot ratio

After destructive sampling of plants, the root and stem were separated and kept in an oven for 48 hours at 80^0C. After 48 hours, dry weight was taken. Root:shoot ratio was calculated as the ratio between root dry weight and shoot dry weight.

Chlorophyll stability index (CSI)

Chlorophyll stability index (CSI) was calculated by following methodology outlined by Kar *et al*. (2005) as follows: CSI = (Total chlorophyll content in stressed plant/ Total chlorophyll content in control plants) x 100. Total chlorophyll content in leaf sample was estimated according to method of Arnon (1949) and expressed as mg g^{-1} fresh weight of leaves. In this method, chlorophyll was extracted in the 80% acetone. 100 mg of fresh leaves were taken from the middle portion of the leaves and were cut into small pieces. The leaf discs were then put in 80% v/v acetone solution and kept in dark for 24 hours. Then they were filtered by Whatman No. 1 filter paper and the filtrate was used to record the absorbance (OD) at 645 nm and 663 nm. The amount of chlorophyll was calculated as, total Chl = $(20.2 \times OD_{645} + 8.02 \times OD_{663}) \times V / (1000 \times W_F)$; Where, OD = Optical density of the chlorophyll extract at a specific wave length and W_F is Fresh weight of leaf in gram.

Proline content

Proline estimation was done as per the protocol described by Gilmour *et al.* (2005) and Sadasivam & Manickam (1996). Fresh leaves (0.5 g) were ground in mortar and pestle with 10 ml of 3% sulpho-salicylic acid and the homogenate was centrifuged at 18000 rpm. The homogenate was filtered. 2 ml of filtrate was added to 2 ml of glacial acetic acid and 2 ml of acid ninhydrin and test tubes were kept for 1 hour at 100^0C in water bath, followed by ice bath. The reaction mixture was vortexed with 4 ml of toluene. Toluene layer was separated & OD was read at 520 nm. A standard curve of proline was used for calibration & expressed as mg g^{-1} FW.

Statistical analysis

Statistical analyses were done in analysis of variance (ANOVA) technique following the methodologies outlined by Panse and Sukhatme (1985).

RESULT AND DISCUSSION

Photosynthesis and ancillary parameters

Results showed that due to imposition of water stress at vegetative stage, there was significant decrease in photosynthetic rate in all the varieties tested in the current experiment, whereas treatment with 100 ppm salicylic acid reduced the impact of stress and increased the photosynthesis. Photosynthetic rate, irrespective of varieties, decreased significantly by 35% under water stress over control. SA application improved photosynthetic rate in stressed plants and the decrement was to the tune of 14% in stressed plants compared to control. The reduction in photosynthesis under stress and stress plus salicylic acid relative to control was minimum in Subhadra (26 and 4%, respectively) and maximum in Kalinga-III (56% and 38%, respectively). The mean effect of stress, variety and their interaction effect were found to be significant. This enhancement in photosynthetic rate due to exogenously applied SA under drought condition was in agreement with A. R. Mohammed (2011) in rice plants. It has been reported that SA protects the chloroplast and the photosynthetic enzymes from the stress injury which in turn maintains the photosynthesis and its related process much higher than that of lone stressed plants (Marschner, 1995). The decrease in net photosynthetic rate under drought stress observed in many studies is often explained by the lower internal CO_2 concentration, which result in a limitation of photosynthesis at the acceptor site of Rubisco (Ribulose-1,5-biphosphate carboxylase /oxygenase) (Cornic *et. al.*, 1992) or by the direct inhibition of photosynthetic enzymes like Rubisco (Haupt-Herting and Fock, 2000) or ATP synthase (Tezara *et. al.*, 1999; Nogues and Baker, 2000). Drought injury is manifested both at zone of cell turgor and zone of cell flaccidity. This is mainly attributed to stomatal closure, increased mesophyll resistance, decreased diffusion and metabolic shift, which concomitantly inhibit growth and development of plant leading to its productivity (Levitt, 1980).

It was observed that drought significantly decreased stomatal conductance (Gs) of all rice varieties over control, wherein SA application increased Gs in the water stress condition. Application of SA as compared to no application, increased stomatal conductance by 31% under drought condition. The highest Gs (across the treatments) was found in Subhadra (40.87 µmol CO_2 m^{-2} S^{-1}), while minimum

Gs was observed in Kalinga-III (29.34 µmol CO_2 m^{-2} S^{-1}) (table 1). According to Cornic (1994), plants react to water deficit with a rapid closure of stomata to avoid further water loss via transpiration. The varieties having higher Gs are supposed to maintain higher photosynthetic rate as compared to other varieties. In the present study, stomatal conductance and transpiration rate were increased with increase in photosynthetic rate due to exogenously applied SA through foliar application, which suggests that this increase in photosynthesis might have been due to stomatal factors (Athar & Ashraf, 2005).

Table 1. Effect of imposed moisture stress and salicylic acid application at vegetative stages on photosynthetic parameters like (a) Photosynthetic rate (µmol CO_2 m^{-2} s^{-1}), (b) Stomatal conductance (µmol CO_2 m^{-2} s^{-1}), (c) Transpiration rate (µmol CO_2 m^{-2} s^{-1}) in rice varieties.

Varieties		Control	Stress	Stress + SA	Mean
Subhadra	(a)	9.11	6.70	8.73	8.18
	(b)	47.50	31.95	43.16	40.87
	(c)	8.55	7.25	8.17	7.99
Mandakini	(a)	7.26	5.01	6.17	6.15
	(b)	39.81	24.97	32.06	32.28
	(c)	8.39	5.46	6.33	6.73
Kalinga III	(a)	6.49	2.86	4.01	4.45
	(b)	40.64	17.17	30.21	29.34
	(c)	7.53	3.78	5.22	5.51
Khandagiri	(a)	8.87	5.94	8.37	7.73
	(b)	46.20	34.57	36.59	39.12
	(c)	8.97	5.09	8.23	7.43
		V	T		V x T
SEm(±)	(a)	0.16	0.14		0.27
	(b)	1.04	0.90		1.80
	(c)	0.15	0.13		0.26
C.D. at 5%	(a)	0.46	0.40		0.80
	(b)	3.03	2.63		5.25
	(c)	0.43	0.37		0.75

Results pertaining to transpiration rate showed that transpiration rate of all the four varieties decreased under drought conditions (35% as compared to control). On the other hand SA treatment increased it and a reduction of 17% was found under stress treated with 100 ppm salicylic acid as compared to control (table 1). Irrespective of stress treatment, lowest transpiration was found in Kalinga III followed by Mandakini, Khandagiri and Subhadra. On exposure to water stress, plants close their stomata more rapidly to avoid drought injury. Early stomatal closure in response to water stress helps to reduce water loss. But it reduces the gas exchange between the plant and the ambient air also, which results in reduced CO_2 intake and reduced photosynthesis (Sharkey *et. al.*, 1989 and Chaves *et. al.*, 2002). Transpiration rate reduced markedly by water stress (Cabuslay *et. al.*, 1999; Wade *et. al.*, 2000; Ravindrakumar *et. al.*, 2003). Waseem *et. al.*, (2006) reported that with the application of 100 ppm SA in wheat under drought through foliar spray, transpiration rate (E) increased, which is in consonance with the present findings.

Root : shoot ratio

Moisture stress was found to significantly increase the root: shoot ratio in rice (Table 2). On an average, root: shoot ratio increased by 13.9% due to the moisture stress. Among the cultivars, root: shoot was highest in Subhadra followed by Khandagiri, Mandakini and lowest in Kalinga III. Application of SA had increased the ratio by 4.3% as compared to

control. In this case, root : shoot ratios were found to increase compared to control in almost all the varieties (except Kalinga III), when salicylic acid was applied in stress condition. This means root dry weights increased more over shoot dry weight due to SA application. It indicates that rice varieties diverted more of their dry matter to the root than the shoot, when SA was applied at stress condition. Acceleration of root growth in the plants cause rapid establishment of seedlings and helps to avoid moisture stress. The above result corroborates with the results of Chang *et al.* (1972) in rice and Levitt (1980).

Chlorophyll stability index

It was noticed that CSI significantly decreased with increase in moisture stress irrespective of varieties (Table 2). The decrease was 42% in stress and 18% in stress with SA treatment as compared to control. The mean CSI computed was in order of: 72.9% < 80.2% < 82.3% < 83.8% in Kalinga III, Mandakini, Khandagiri and Subhadra, respectively. Application of SA significantly increased the CSI over the stressed plants (table 2). Agarie *et al.*, (1995) reported about decrease in CSI in rice genotypes under drought stress condition. Yildirim *et al*., (2008) found that 100 ppm SA significantly increased chlorophyll stability index, which corroborate with our results.

Proline content

Higher proline accumulation in plants during stress is credited to maintenance of high turgor and continuous growth even under stress condition. A spurt in proline content was found in plants grown under stress-prone environment irrespective of cultivars. Application of SA showed further significant increase of proline accumulation (26%) over the stressed plants. Mean proline content (across treatments) was highest in Subhadra (302.66 µg g^{-1} FW leaf) followed by Mandakini (269.8 µg g^{-1} FW leaf), Khandagiri (243.4 µg g^{-1} FW leaf) and the lowest value was found in Kalinga III (150.17 µg g^{-1} FW leaf) (table 2). Under SA treatment, Mandakini registered the highest increase in proline accumulation (47%) followed by Subhadra (26%), Khandagiri (14%) and Kalinga III accumulated the least (10%) over their respective values under stress. The interaction effect on proline accumulation was significant between variety and the treatments. Increased trend of proline content with moisture stress suggest its protective and stabilized role. These results were in conformity with the earlier findings of Mafakeri *et. al.*, (2010); Maggio *et. al.* (2002), and Baruah *et. al.*, (1998). Azooz and Youssef (2010) and Demiralay *et. al.*, (2012) reported that proline content increased with application of SA under drought stress in wheat and roscoe respectively, which are in consonance with our present findings.

Table 2. Effect of imposed moisture stress and salicylic acid application at vegetative stages on (a) Root: Shoot ratio (b) Chlorophyll stability index (%), (c) Proline content (µg proline g^{-1} fresh weight leaf) in rice varieties.

Varieties		Control	Stress	Stress + SA	Mean
Subhadra	(a)	0.200	0.198	0.240	0.213
	(b)	100.00	66.28	84.96	83.75
	(c)	93.15	359.91	454.92	302.66
Mandakini	(a)	0.215	0.171	0.232	0.206
	(b)	100.00	59.31	81.37	80.23
	(c)	91.72	290.11	427.61	269.81
Kalinga III	(a)	0.226	0.160	0.153	0.180
	(b)	100.00	42.07	76.56	72.88
	(c)	66.93	182.02	201.55	150.17
Khandagiri	(a)	0.190	0.188	0.242	0.207
	(b)	100.00	63.15	83.76	82.30
	(c)	82.71	302.57	344.82	243.37
		V	T	V x T	
SEm(±)	(a)	0.006	0.005	0.011	
	(b)	1.51	1.31	2.62	
	(c)	12.28	10.63	21.27	

C.D. at 5%	(a)	0.018	0.015	0.031
	(b)	4.41	3.82	7.63
	(c)	35.84	31.03	62.07

CONCLUSION

Analyzing the findings of the present investigation, it was concluded drought caused a severe reduction in photosynthetic rate, stomatal conductance, transpiration rate, chlorophyll stability index and root:shoot ratio, but contrastingly, caused noticeable increase in proline accumulation in rice. Foliar application of 100 ppm increased the drought tolerance of rice by overcoming the adverse effect of stress on stated parameters. The beneficial response of salicylic acid in ameliorating the adverse effect of water stress was more in sensitive genotype Kalinga III. Therefore, it may be used as an ameliorant to alleviate the negative effect of drought injury in rice.

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GENETIC VARIABILITY AND COMBINING ABILITY ANALYSIS FOR 6-PARENT HALF DIALLEL CROSS IN LATHYRUS

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Abstract: Fifteen F_1 hybrids of grasspea and their parents were evaluated in randomized complete block design to estimate variability and combining ability of seed yield and neurotoxin content. Analysis of variance indicated significant differences due to genotypes for all the characters except plant height (cm), pod length (cm), no. of seeds pod^{-1}, biological yield plant^{-1} and harvest index (%). High heritability coupled with high genetic advance was observed for only protein content. Analysis of combining ability revealed the existence of highly significant variation among crosses for all characters in F_1 generation. Combining ability analysis indicating predominance of additive gene action in the expression of pod length (cm) and harvest index (%). The parent Mahateora, Pusa-24, RLS-3004 and Siraha Local appeared to be good general combiners. The cross Pusa-24 x RLS-3004 proves the best combination for early maturity; Prateek x Siraha Local and Pusa-24 x Ratan proves the best combination for seed yield plant^{-1}; Pusa-24 x Ratan and Mahateora x RLS-3004 proves the best specific combination for ODAP content.

Keywords: Grasspea, hybrid, seed, *Lathyrus*

INTRODUCTION

Grasspea (*Lathyrus sativus* L.) locally called '*Khesari*', '*Teora*', '*Lakh*'/'*Lakhdi*' is an important rabi pulse crop of the Chhattisgarh region. In India it occupies an area of about 1.6 million ha. *Lathyrus* belongs to family Leguminosae, and sub family Poaceae a grain legume with high nutritional profile having diploid chromosome 2n=14. Advancements in the development of crop varieties greatly depend upon genetic variability. The study of genetic variability with the estimates of phenotypic and genotypic variance along with heritability and genetic advance using methods of analysis of variance and computation of heritability are necessary to start crop development programme. These simple statistical derivations give knowledge of mean, variance, standard deviation present in the population. The ultimate aim of a farmer or breeder is to get high quality yield. Yield is a complex character and is the multiplicative end product of many yield components and hence knowledge of the existing genetic variations between various yields traits and their heritability assumes importance. Heritability (h^2) is an approximate measure of the expression of a character.

Lathyrus being an essentially self pollinated crop requires strategies to allow accumulation of fixable gene effects in a homozygous line. In order to exploit gene actions operating in the population, information pertaining to magnitude of genetic variances, combining ability for different traits is essential. Identifying suitable parents is another pre-requisite in self pollinated crops. Under such circumstances combining ability helps in evaluation of parents in terms of their genetic value. In addition to this it also provides nature and magnitude of gene effects involved in the expression of targeted traits.

MATERIAL AND METHOD

Fifteen F_1 hybrids and their parents constituted the experimental material of this study. The hybridization between pure lines was performed under field conditions following emasculation and pollination simultaneously in morning. The experiment was laid out in a Randomized Complete Block Design (RBD) with three replications. Each genotype was grown in a row of 2 meter length. The row to row distance was 30 cm and 20 cm between plants. All the recommended package of practices was followed to facilitate good crop growth and development. Five competitive plants were randomly selected from each genotype of each replication to record data on 17 characters.

Combining ability analysis was carried out by the procedure giving by Griffing (1956) as per the method II (Model II). This is applied for the set of data involving parents and F_1's excluding reciprocals. Components of variance estimates of genotypic and phenotypic coefficient of variation (GCV and PCV) were evaluated as per Burton (1952). Heritability in the broad sense was calculated following Hanson (1963) and expected genetic advance was estimated as per Johnson *et al.* (1955) and Kempthorne (1957).

RESULT AND DISCUSSION

Genetic variability

The mean values, coefficient of variability are presented in Table 1. Number of pods plant^{-1} showed the maximum genotypic variability and Pod length showed the minimum genotypic variability. For all traits, phenotypic coefficient of variation was higher than the genotypic coefficient of variation. Coefficients of genotypic and phenotypic variation suggest that there is good scope for yield

improvement through selection for pods plant^{-1}, seeds plant^{-1} and yield plant^{-1}.

Combining ability

The table showing estimates of gca effects revealed that parent Ratan besides being the best general combiner for 100 seed weight and protein content. Mahateora being the best general combiner for no. of primary branches per plant and good for days to flower initiation, days to 50 % flowering, days to pod initiation, days to 50 % pod formation and days to maturity. RLS-3004 being the best general combiner for pod length and days to maturity and good general combiner for harvest index, 100 seed weight and protein content. Siraha Local being the best general combiner for days to maturity and good general combiner for no. of seeds pod^{-1}. Prateek being best general combiner for days to flower initiation, days to 50 % flowering, days to pod initiation and days to 50 % pod formation and good general combiner for biological yield plant^{-1} and protein content. Pusa-24 being good general combiner for days to flower initiation, days to 50 % flowering, days to pod initiation, days to 50 % pod formation and days to maturity.

The cross Pusa-24 x Ratan proved to be the best specific combiner for no. of seeds plant^{-1} and ODAP content. Pusa-24 x Mahateora proved to be the best specific combiner for no. of pods plant^{-1}. Pusa-24 x RLS-3004 proved to be the best specific combiner for protein content. Prateek x RLS-3004 proved to be the best specific combiner for 100 seed weight. Prateek x Siraha Local proved to be the best specific combiner for no. of seeds pod^{-1} and seed yield plant^{-1}. Ratan x Mahateora proved to be the best specific combiner for pod length.

Table 1. Genetic parameters of variation for seed yield, its components and Neurotoxin (ODAP) content in grasspea

S. No.	Characters	Mean	Range		Coefficient of variation		h^2_{bs}(%)	Genetic advance (GA)	Genetic advance as % of mean
			Minimum	Maximum	Genotypic	Phenotypic			
1.	Days to flower initiation	48.71	45	59.66	7.54	7.69	96.12	7.38	15.15
2.	Days to 50% flowering.	55.42	51.33	65.67	6.47	6.64	94.84	7.17	12.93
3.	Days to pod initiation	56.46	52.33	66.67	6.49	6.62	96.16	7.35	13.03
4.	Days to 50% pod formation	62.90	58.33	72.67	5.54	5.69	94.66	6.99	11.11
5.	Days to maturity	106.15	98.67	110.67	4.02	4.12	94.98	8.65	8.15
6.	Plant height (cm)	58.77	47.93	67.93	4.59	18.61	6.09	1.35	2.30
7.	Number of primary branches plant^{-1}	3.87	3.33	6.13	11.71	20.10	33.92	0.54	14.16
8.	Number of pods plant^{-1}	60.59	31.47	101.53	27.78	46.94	35.02	21.79	35.96
9.	Pod length (cm)	3.08	2.95	3.35	2.28	5.96	14.70	0.06	2.01
10.	Number of seeds pod^{-1}	3.07	2.53	3.73	5.80	15.05	14.88	0.14	4.64
11.	Number of seeds plant^{-1}	129.54	74.40	226.20	23.16	34.24	45.77	43.60	33.65
12.	Seed yield plant^{-1} (g)	7.81	4.68	13.92	22.46	47.15	22.70	1.83	23.46
13.	Biological yield plant^{-1} (g)	19.10	11.82	28.45	18.34	44.60	16.91	3.06	16.03
14.	Harvest index (%)	43.17	26.76	63.37	11.17	39.65	7.94	2.79	6.47
15.	100 seed weight (g)	6.99	6.13	8.45	8.52	8.96	90.49	1.16	16.59
16.	Protein content (%)	21.12	11.27	27.02	22.04	22.66	94.58	9.26	43.85
17.	ODAP content (%)	0.02	0.01	0.03	18.19	22.02	68.28	0.006	31.28

Table 2. Estimates of General Combing ability effect (GCA) for seed yield, its components and Neurotoxin (ODAP) content in 6-parent half diallel genotypes of grasspea

Characters	Parents					
	Pusa-24	Prateek	Ratan	Mahateora	RLS-3004	Siraha-Local
Days to flower initiation	-1.97**	-0.60**	-0.06	-1.22**	1.15**	2.69*
Days to 50% flowering	-2.00**	-0.62**	-0.17	-1.08**	1.50**	2.38**
Days to pod initiation	-1.99**	-0.61**	-0.07	-1.24**	1.22**	2.68**
Days to 50% pod formation	-2.13**	-0.54**	0.00	-0.75**	1.29**	2.13**
Days to maturity	-1.68**	3.53**	1.61**	-1.72**	-0.93**	-0.81**
Plant height (cm)	0.53	1.14	1.60	0.74	-1.86	-2.13
Number of primary branches plant^{-1}	-0.08	-0.03	-0.08	0.46**	-0.09	-0.17
Number of pods plant^{-1}	1.07	4.82	3.61	-3.91	-2.91	-2.68
Pod length (cm)	-0.08*	0.05	-0.02	-0.05	0.09**	0.01
Number of seeds pod^{-1}	-0.13	-0.06	0.04	0.08	-0.09	0.16*
Number of seeds plant^{-1}	4.62	4.52	7.46	-11.05	-3.00	-2.55
Seed yield plant^{-1} (g)	-0.18	0.09	0.91	-0.09	-0.05	-0.68
Biological yield plant^{-1}	0.69	2.96*	0.87	-1.16	-1.71	-1.66
Harvest index (%)	-4.94	-6.13	3.36	0.65	7.39*	-0.32
100 seed weight (g)	-0.06	-0.04	0.11**	-0.08*	0.09*	-0.02
Protein content (%)	-3.97**	1.89**	2.43**	-0.17**	1.01**	-0.65**
ODAP content (%)	0.00	0.00	0.00	0.00	0.00	0.00

*, ** significant at 5% and 1% levels, respectively

Table 3. Estimates of Specific Combing ability effects (SCA) for seed yield, its components and Neurotoxin (ODAP) content in 6-parent half diallel genotypes of grasspea

Characters / Crosses	Days to flower initiation	Days to 50% flowering	Days to pod initiation	Days to 50% pod formation	Days to maturity	Plant height (cm)	No. of primary branches plant^{-1}	Number of pods plant^{-1}
Pusa-24 x Prateek	-1.21**	-1.14**	-1.20**	-1.57**	0.61	4.90	0.04	-12.25
Pusa-24 x Ratan	-2.08**	-1.93**	-2.07**	-2.45**	-0.47	7.04	0.23	35.43**
Pusa-24 x Mahateora	0.08	0.65	0.10	1.64**	-1.47**	3.46	-0.05	36.88**
Pusa-24 x RLS-3004	3.71**	3.40**	3.64**	3.26**	-4.26**	-8.91	-0.23	-6.11
Pusa-24 x Siraha Local	-3.50**	-4.14**	-3.49**	-4.24**	0.61	-9.24	-0.29	-6.15
Prateek x Ratan	3.54**	3.70**	3.55**	2.97**	-1.68**	-9.77	0.05	-7.32
Prateek x Mahateora	-0.96**	-0.39	-0.95*	-0.28	2.65**	-5.49	-0.97**	11.06
Prateek x RLS-3004	2.33**	2.03**	2.26**	2.35**	1.86**	7.75	-0.01	15.47
Prateek x Siraha Local	0.13	-0.51	0.14	-0.49	1.74**	4.79	-0.04	28.90*
Ratan x Mahateora	4.50**	4.15**	4.51**	4.18**	-0.76	5.09	-0.88**	-3.33
Ratan x RLS-3004	-2.87**	-3.10**	-2.95**	-2.53**	1.78**	5.76	-0.10	30.28*
Ratan x Siraha Local	0.25	0.03	0.26	0.30	2.65**	-7.31	0.38	19.31
Mahateora x RLS-3004	-2.04**	-2.51**	-2.11**	-3.11**	6.45**	-9.65	-0.34	-9.87
Mahateora x Siraha Local	1.75**	1.95**	1.76**	1.72**	1.32*	1.49	-0.43	-2.57
RLS-3004 x Siraha Local	6.38**	6.36**	6.30**	6.35**	4.20**	-5.38	-0.08	-0.43

*, ** significant at 5% and 1% levels, respectively

Table 4.

Characters / Crosses	Pod length (cm)	Number of seeds pod^{-1}	Number of seeds plant^{-1}	Seed yield plant^{-1}(g)	Biological yield plant^{-1}	Harvest index (%)	100 seed weight (g)	Protein content (%)	ODAP content (%)
Pusa-24 x Prateek	0.09	0.05	-24.62	-1.85	-9.08*	10.18	-0.51**	2.38**	0.00
Pusa-24 x Ratan	-0.07	0.15	82.83**	5.28**	6.09	10.00	0.09	4.65**	-0.01**
Pusa-24 x Mahateora	0.00	-0.42	25.35	2.86	6.51	1.22	0.31**	-4.16**	0.00
Pusa-24 x RLS-3004	-0.04	-0.38	-8.70	0.34	-1.38	-0.02	-0.83**	4.91**	0.00
Pusa-24 x Siraha Local	-0.11	-0.04	3.25	-2.17	-2.89	-7.32	-0.33**	-3.25**	0.00
Prateek x Ratan	-0.12	-0.38	-18.20	-1.61	0.46	-7.10	-0.18	-0.04	0.00
Prateek x Mahateora	-0.17*	-0.02	28.65	1.94	5.85	-2.70	0.40**	-4.18**	0.00
Prateek x RLS-3004	-0.07	0.02	9.07	0.17	6.70	-14.40	1.29**	-1.14**	0.00
Prateek x Siraha Local	0.06	0.49*	45.88**	5.42**	7.71	11.53	-0.71**	4.31**	0.00
Ratan x Mahateora	0.19*	0.28	17.04	-1.01	-1.30	-3.99	-0.25*	-1.33**	0.00
Ratan x RLS-3004	0.04	-0.08	50.73**	2.17	7.05	-10.93	-0.08	0.04	0.00
Ratan x Siraha Local	0.02	-0.47*	11.21	1.91	2.76	0.32	-1.07**	0.56	0.00
Mahateora x RLS-3004	0.02	0.08	-19.89	0.78	-3.84	11.65	-0.41**	3.69**	0.00
Mahateora x Siraha Local	0.01	-0.25	-7.07	-0.36	-1.75	0.83	-0.09	1.95**	0.00
RLS-3004 x Siraha Local	-0.01	0.13	-18.92	-1.88	-0.10	-8.92	0.78**	-8.33**	0.00

*, ** significant at 5% and 1% level, respectively

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IMPACT OF ELEVATED TEMPERATURE ON GROWTH, YIELD, GRAIN QUALITY IN SUMMER MUNG BEAN AND ITS MITIGATION THROUGH USE OF BIOFERTILSERS

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Abstract: Two varieties of mung bean *viz.* Pusa 9531 and Pusa Vishal were raised under pot culture conditions during summer season.These plants were grown under natural and elevated temperature(normal±5°C)conditions.The result revealed that the elevated temperature had the adverse effect on nodulation,leaf area,total dry matter and grain yield as compared to natural conditions.The use of *Rhizobium*and AM fungi either alone or in combination had mitigated the adverse effect of elevated temperature in both the varieties.The dual inoculation was found better than individual application in terms of dry matter production, pod number, seed number, seed size, grain yield and quality. VarietyPusa 9531 proved better than Pusa Vishal.

Keywords: Elevated temperature, Summer mungbean, AM Fungi, *Rhizobium*, nodulation, grain yield, quality

INTRODUCTION

Growth performance of a plant is a result of its genetic makeup and environment to which it has been exposed (G x E) interaction.The pulses play a very important role in Indian agriculture as they are rich source of proteins. It also contains low fat,low sodium, and no cholesterol and high fibre. The mung beans are grown in kharif as well as summer with assured irrigative area, as a catch crop between kharif and rabi season. The varieties are preferred having short duration and tolerant to high temperature particularly during the flowering and grain development. The high temperature affect adversely grain yield and quality as reported earlier by Panwar *et al.* (1988), Nanda and Saini (1987), Panwar and Srivastava (2012). The exposure to excessively high temperature delayed seed initiation in soybean and peanut (Wheeler *et al.*, 1997) and soybean (Pan.1996).

However the use of *Rhizobium* and AM fungi has been reported to mitigate the effects on yield, quality of grain (Thakur and Panwar, 1997). The dual inoculation has been reported to amelioratethe grain yield and quality. The use of *Rhizobium* has affected the nodulation and N_2 fixation through nodule development, more chlorophyll content and better photosynthetic rate. AM Fungi induced phosphorus nutrition to the host plant (Sanders, 1971), Smith and Smith 2011. The dead material of hyphae also make successful contribution to soil organic matter pool.(Verbrugen *et al.*, 2012a) and other nutrients (Zansa 2013,Sharif *et al*, 2010.,Abd *et al*, 2013).

In present investigation, during growing summer season, how does the use of biofertilizersunder high temperature affect the yield and grain quality was our main objective.

MATERIAL AND METHODOLOGY

In the experiment two cultivars Pusa Vishal and Pusa 9531 of mung bean were raised under pot culture conditions in 2012. The pots were filled with soiland FYM (Farm yard manure) in 3:1 ratio. The pots were irrigated regularly and divided into two groups. In one group , the plants were grown throughout natural conditions where as another set were raised under elevated temperature conditions.(normal±5°**C**).These pots were kept under raised structure covered by transparent plastic sheet.All the package of practices were followed. The seeds of both the cultivars were inoculated with *Rhizobium* (Cowpea miscellaneous group) whereas the AM fungi (*Glomusfasciculatum, G x T*) were applied through layering techniques as per the following treatments.

T1- Natural condition, normal

T2- Elevated temperature condition (normal ±5°C)

T3- Seed inoculated with *Rhizobium* at elevated temperature.

T4-Inoculated with *AM fungi* at elevated temperature.

T5-Dual inoculation of *Rhizobium* and AM fungi at high temperature in a replicated trial.

The plants were uprooted and sampled at different stages of growth and separated into different parts to note the dry weights of these parts. The leaf area was measured by tracing the leaves on graph paper. The nodules were separated from plant roots and dried in envelopes in the cover and dry weight was noticed.The N_2content was estimated in the grains using the microkjeldahl method. The fat was estimated using the cold percolation method (Kartha and Sethi 1957). Carbohydrate content Anthrone method (Dubois *et al.*, 1956).

All biochemical tests were done in M.M.H college, Ghaziabad and the seed quality and related estimations were done at Indian Agricultural Research Institute,Pusa, New Delhi.

*Ph.D. Scholar

RESULT AND DISCUSSION

The plants were raised during the crop season with the maximum temperature range (32 -42 °C) and minimum (15-30 °C) Fig-1.But an increase of ±5°C over normal was maintained under the plastic covered structure. The genotypic differences were observed in terms of nodulation, leaf area, and total dry matter production, as shown in Table -1.The nodule dry weight decreased drastically in the plants grown under elevated temperature. It was compensated with the application of *Rhizobium* and AM fungi. The dual inoculation showed the better results as compared to any other inoculation, as reported earlier, Thakur and Panwar 1995, Panwar and Thakur 1997 and Smith and Smith 2011.

The leaf area and the total dry matter production also noted to have the same trend as recorded in case of nodulation. The variety Pusa 9531, attained higher total dry matter as compared to PusaVishal.This better effect of combined inoculation has been reported for higher total dry matter production by different workers in different crops. (Azcon 1979, Bagyaraj 1979, Young *et al*. and Panwar *et al*. 1995).

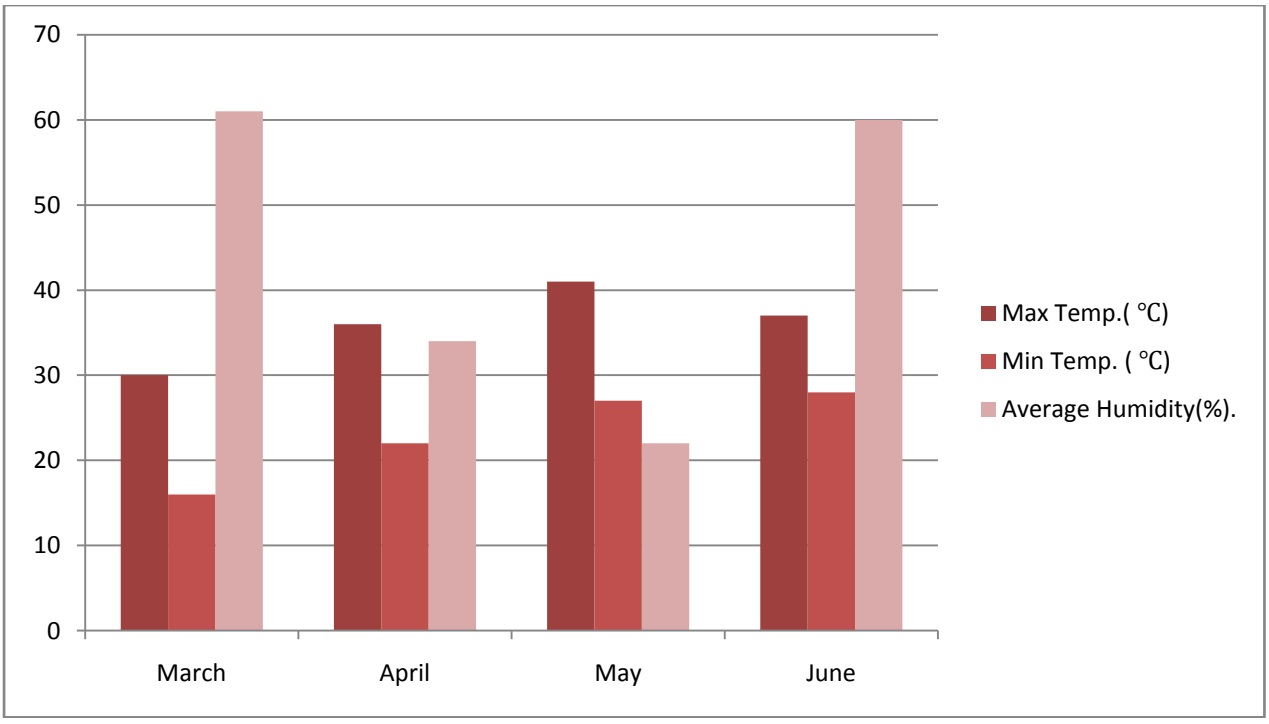
Use of *Rhizobium* and AM fungi under under high temperature work at par to the plants grown under natural conditions.(Manke*et al* 2008, Prasad *et al.*, 1982, Singh *et al.*, 1983, Young *et al.*, 1988, Preeti *et al.*, 2013).

The high temperature exposure decreased the grain yield as compared to plants grown under natural conditions.(Control).The loss in grain yield was attributed properly to less pod number and partly due to reduction in grain number per pod and seed size. The loss under high temperature in grain yield was due to disturbed source sink relationship. The recovery due to application of *Rhizobium or* AM Fungi might have improved the source sink relationship (Rao and Ghildiyal, 1985). The genotypic variations were observed in yielding potential under natural and elevated temperature conditions. Pusa 9531 yielded better than PusaVishal.

The grain quality as affected by the (G X E) interaction., revealed that PusaVishal had relatively more carbohydrate ,proteins and fat as compared to Pusa 9531.The quality was drastically reduced in both the varieties under high temperature conditions, that reduction was compensated by the use of *Rhizobium* and AM fungi (dual inoculation). That was at par with the plants grown under natural conditions. However the protein recovery due to inoculation did not show any significant improvement. The effect of grain quality raised under different sets of environment has been reported by Shrestha *et al.*, 2006 b in lentil.

However beneficial effect of *Rhizobium* and AM fungi, have been reported by many workers. Our results also showed the beneficial effects of AM fungi and *Rhizobium* in compensating the dry matter and yield due to elevated temperature.

Fig. 1. Meteorological data for the summer season of the year 2012



#Data obtained from Climate Chart for temperature and Humidity, New Delhi

Table 1. (Effect of *Rhizobium* and /or AM Fungi under elevated temperature on nodule, leaf area, yield and yield contributing characters in Pusa 9531)

Treatments	**Nodule wt(mg)at 30 DAS**	**Leaf Area(cm^2) at 45 DAS**	**Total dry matter (g)at 45 DAS**	**Pod no. per plant**	**No. of seeds per pod**	**100 seed weight(g)**	**Yield (g)/plant**
Normal temp.(Control)	0.108	303.12	20.25	27.87	9.06	4.02	7.04
El.Temp.	0.092	266.65	18.72	24.31	7.90	3.26	5.21
El. Temp. + *Rhizobium*	0.095	292.12	19.23	25.32	7.23	3.83	6.17
El. Temp. + AM Fungi	0.093	275.66	19.11	26.14	7.34	3.70	6.08
El. Temp. + AM Fungi+ *Rhizobium*	0.098	301.15	20.54	26.86	8.12	4.22	7.23

Table 2. (Effect of *Rhizobium* and /or AM Fungi under elevated temperature on nodule, leaf area, yield and yield contributing characters in PusaVishal)

Treatments	**Nodule wt(mg)at 30 DAS**	**Leaf Area(cm^2) at 45 DAS**	**Total dry matter (g)at 45 DAS**	**Pod no. per plant**	**No. of seeds per pod**	**100 seed weight(g)**	**Yield (g)/plant**
Normal temp.(Control)	0.112	208.12	18.56	22.65	10.04	4.76	6.42
El. Temp.	0.085	200.40	16.05	20.11	8.53	3.81	4.35
El. Temp. + *Rhizobium*	0.090	203.64	17.19	22.12	8.90	4.11	4.90
El. Temp. + AM Fungi	0.093	202.43	17.12	22.45	8.78	4.07	4.75
El. Temp. + AM Fungi+ *Rhizobium*	0.099	205.41	18.06	23.05	9.02	4.46	5.12

Table 3. Grain quality as affected by bio fertilizers (alone or in combination) under elevated temperature in two cultivars of mung bean.

Treatments	**Pusa 9531**			**Pusa Vishal**		
	Carbohydrate(%)	**Protein(%)**	**Fat(%)**	**Carbohydrate(%)**	**Protein(%)**	**Fat(%)**
Normal temp.(Control)	54.02	20.91	0.84	56.15	21.50	0.93
El. Temp.	52.63	16.42	0.86	54.62	17.05	0.88
El. Temp. + *Rhizobium*	53.12	17.02	0.92	55.35	18.03	0.92
El. Temp. + AM Fungi	53.01	16.59	0.88	55.71	17.65	0.91
El. Temp. + AM Fungi+ *Rhizobium*	54.10	17.79	0.93	56.12	19.11	0.95

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NEED OF AGROFORESTRY AND IMPACT ON ECOSYSTEM

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Abstract: Agroforestry is a modern and scientific farming practice. It is a sustainable land use system under which food crops (annuals) with tree crops (perennials) and/or livestock are maintain simultaneously on the same piece of land to increase the total yield and this management practices are economically and ecologically sound. It is just a compromise between these two resources of forest trees and agricultural crops to maintain the need of forest cover upto 33% as per given national forest policy. Agroforestry has the potential to alter the microclimate under the tree canopy. It plays a major role in enhancement of overall farm productivity, soil fertility through addition of litter and organic matter, climate change mitigation through carbon sequestration, phytoremediation, watershed protection and biodiversity conservation. Upto some extent biodrainage plantation might have improve the soil aeration, sulphide toxicity and nutrient use efficiency. Moreover, it reduces the water logging condition and maintains the soil aeration property. Under the agroforestry system multipurpose and N_2-fixing trees are played a valuable and significant role for upliftment of productivity and combating the soil health problem. Generally, farmers are used N_2-fixing trees like some leguminosae family comprises *Acacia spp., Dalbergia sissoo* etc. on their farmland for enhancement productivity with better soil health and generating incomes through employment. Therefore, scope and potential of agroforestry are envitable.

Keywords: Agroforestry, biodrainage, biodiversity, carbon-sequestration, farming system.

INTRODUCTION

Agroforestry may be defined as an efficient and integrated land use management system by raising of certain agricultural crops, forest tree species and or animals simultaneously or sequentially on the same unit of land with appropriate management practices which result in overall increase in the production under a particular set of climatic and edaphic conditions and socio-economic status of local people (King, 1969). It involves interaction of woody perennial ecologically and economically with the crop and or livestock. According to Dhyani *et al.* (2013) in India the current area under agroforestry is estimated at 25.32 Mha, or 8.2% of total geographical area of the country. This includes 20.0 Mha in cultivated lands (7.0 Mha in irrigated and 13.0 Mha in rainfed areas) and 5.32 Mha in other areas such as shifting cultivation (2.28 Mha), home gardens and rehabilitation of problem soils (2.93 Mha). Traditionally, farmers allow growing *Acacia nilotica* naturally at irregular spacing on the bunds of paddy fields or in combination with *Butea monosperma* and *Terminalia arjuna* etc. *Acacia nilotica*, being a multipurpose and nitrogen fixer species, is highly preferred by farmers and as a result, it is widely distributed in the field. Similarly, Jhariya *et al.* (2013) has concluded a large scale plantation of neem trees helps to combat desertification, deforestation, soil erosion and to reduce excessive global temperature. Tree species viz. *Dalbergia sissoo, Azadirachta indica, Acacia nilotica, Grewia optiva, Morus alba, Ficus* spp. etc are grown on the borders of fields for meeting demand of timber, fodder, fuel etc is common practices throughout the country (Singh, 1993).

Management practices are played a major role in maintaining the identity and sustainability of agroforestry system. As per Manna *et al*. (2008) management practices for agroforestry are more complex because multiple species has varied phonological, physiological and agronomic requirements. Agroforestry provides great opportunities to link water conservation with soil conservation; hence, the major focus has to be on this aspect (Dhyani *et al.*, 2003). It is also noted that stainable agroforestry can upsurge resilience against environmental change, to enhance carbon sequestration and also to generate income, which will result in improved livelihood of small and subsistence farmers (Buchman, 2008). Moreover, the role and scope of agroforestry are also studied in way of biodiversity conservation, yield of goods and services to society, augmentation of the carbon storages in agroecosystems, enhancing the fertility of the soil and providing social and economic well-being to people (Pandey, 2007). Therefore, agroforestry if properly developed, have the potential to improve socio-economically more sustainable and make the landscape more better (Kittur and Bargali, 2013).

Scope and Potential

The scope and potential of agroforestry is envitable. Tree species are adopted in a large hectare of boundaries, bunds, wastelands area and permits in the field where most annual crops are growing well. As per Fanish and Priya (2013) agroforestry has many potential, such as enhance the overall (biomass) productivity, soil fertility improvement,

soil conservation, nutrient cycling, micro-climate improvement, carbon sequestration, bio drainage, bio-energy and biofuel etc. Moreover, the important elements of agroforestry systems that can play a significant role in the adaptation to climate change include changes in the microclimate, protection through provision of permanent cover, opportunities for diversification of the agricultural systems, improving efficiency of use of soil, water and climatic resources, contribution to soil fertility improvement, reducing carbon emissions and increasing sequestration, and promoting gender equity (Rao *et al.*, 2007).

Tree crop interaction

Under the agroforestry system the interaction between tree and crop are studied in positive, negative and neutral way. This interaction are depends upon the type of model including varying species, their nature and composition. Further, interaction is defined as the effect of one component of a system on the performance of another component and/or the overall system (Nair, 1993). Various interactions take place between the tree and herbaceous plants (crops and pasture), which are referred to as the tree-crop interface. Studying tree-crop interaction in agroforestry would help to devise appropriate ways to increase overall productivity of land. Increased productivity, improved soil fertility, nutrient cycling, soil conservation are the major positive effects of interactions and competition is the main negative effect of interaction, which substantially reduces the crop yield. It may be for space, light, nutrients and moisture. Ecological sustainability and success of any agroforestry system depends on the inter-play and complementarily between negative & positive interactions. It can yield positive results only if positive interactions outweigh the negative interactions (Singh *et al*., 2013).

Agroforestry and soil health

The property of soil under agroforestry practices is depend on tree species and their intercropping pattern, management practices, arrangement direction and the quantity and quality of litter and their decay rate. Trees are simultaneously planted in rows sparsely in crop field and/or along the alies (bunds). These trees provide food, timber, fuel, fodder, construction materials, raw materials for forest-based small-scale enterprises and other cottage industries and in some cases, enrich soil with essential nutrients (Ghosh *et al.,* 2011). According to Torquebiau and Kwesiga (1996) in agroforestry fallows with *Sesbania sesban*, decreased soil bulk density and improved water infiltration explain better early growth of the subsequent crop. Tree roots can reach 7 m deep in 2 years and represent 1.7 to 2.9 Mg ha^{-1} after 2 years, i.e. about 0.6 to 1 Mg C ha^{-1}. Plantation of tree and crops are a boost to increase or sequester the carbon content of the soil which helps to beat the problem of climate change and global warming. As per Kumar *et al.* (2006) increase in soil carbon through plantations may also act as an important carbon sink. Biodrainage tree including eucalyptus played a major role to combating the water logging condition. Chowdhury *et al.* (2011) has reported that biodrainage plantation might have improved the soil aeration, nutrient use efficiency and reduce sulphide toxicity. Agroforestry models are also helps in reclamation of salt affected soil. As per Ram *et al.,* (2011) lowering of water table and associated soil improvement by *Eucalyptus* plantations increased the wheat grain yield by 3.4 times and resulted in reclamation of waterlogged areas. Generally, agroforestry practices increases the soil organic matter through leaf litter addition. It maintains the population dynamics of beneficial microorganism and improves biological nitrogen fixation in soil. All microbiological activity in soil contributes to cycling of nutrient and other ecosystem functions and all soil functions contributes to ecosystem services. Recycling in natural system is one of the many ecosystem services that sustain and contribute to the well being of human society (Jhariya and Raj, 2014).

Agroforestry for CO_2 mitigation

Climate change is a burning issue of the world. Rise in CO_2 level accelerate the global warming which necessitated the sink and sequestration of carbon. These problems are mitigated through plantation of valuable tree and crop either singly or simultaneously on same piece of land through agroforestry system. As per Nair *et al.* (2009) under the agroforestry system carbon sequestration has potential to mitigate the green house gases because of greater efficiency of resource (nutrients light and water) capture and utilization. Moreover, reforestation and agro-forestry systems offer perhaps the greatest potential to remove large quantities of carbon from the atmosphere. However, as per Sudha *et al*. (2007) agroforestry is an attractive option for climate change mitigation as it sequesters carbon in vegetation and soil, produces wood, serving as substitute for similar products that are unsustainably harvested from natural forests, and also contributes to farmers' income. Similarly, according to Kursten (2000) agroforestry can, arguably, increase the amount of C stored in lands devoted to agriculture, while still allowing for the growing of food crops. According per given report of FAO (2007) and Rawat (2010) the total C content of forests has been estimated at 638 Gt for 2005, which is more that the amount of carbon in the entire atmosphere. In India total carbon storage (tC/ha) of different agroforestry systems including Silvi-pastoral system (age 5 years), Silvipastoral system (age 6 years), Block plantation (age 6 years), Agri- silvicultural system (age 8 years) and Agri-silvicultural system (age 11 years) are varies from 9.5-19.7, 1.5-18.5, 24.1-31.1, 4.7-

13.0 and 26.0 respectively in different region of semi-arid (Rai *et al.*, 2001), north western India (Kaur *et al*., 2002), central-India (Swamy *et al*., 2003), arid (Singh, 2005) and semi-arid region (NRCAF, 2005). As per Yadava (2010) C sequestration ranged from 4.66 to 18.53 t C ha^{-1} in different agroforestry systems in Tarai region of Central Himalaya. Maximum value was recorded in systems S1 (*Populus deltoides* 'G-48' + wheat) as 18.53 t C ha^{-1}, which was followed, by systems S4 (*P. deltoides* + Lemon grass). Minimum C sequestration was recorded in System S3 (P. deltoids + wheat boundary plantation). Further, Verma *et al.* (2008) studied soil organic carbon and sequestration potential of agroforestry Systems in Himachal Pradesh and found average carbon stocks (t ha^{-1}) in the decreasing order as Silvipasture (31.71), Natural grassland (19.2), Agrihorti silviculture (18.81), Horti-pastoral (17.16), Agri-silviculture (13.37) and Agri-horticulture (12.28). Thus the importance of agroforestry are not only studied in the way of sustainable productivity but also in issue related the carbon mitigation in global view.

Agroforestry and microclimate amelioration

Trees on farm bring about favourable changes in the microclimatic conditions by influencing radiation flux, air temperature, wind speed, saturation deficit of understory crops all of which will have a significant impact on modifying the rate and duration of photosynthesis and subsequent plant growth, transpiration, and soil water use (Monteith *et al*., 1991). Shade tree performs a good role to moderating the temperature, humidity, evapotranspiration of that locality on which either tree are scattered or on bund of agricultural crops under the agroforestry system. As per Beer *et al.* (1998) shade management in coffee and cacao plantations have buffer high and low temperature extremes by as much as 5^0C. According to Steffan-Dewenter *et al.* (2007) the removal of shade trees increased soil surface temperature by about 4^0C and reduced relative air humidity at 2 m above ground by about 12%. Soil temperature under the baobab and *Acacia tortilis* trees in the semi-arid regions of Kenya at 5-10 cm depth were found to be 6^0C lower than those recorded in open areas (Belsky *et al*., 1993). In the Sahel, where soil temperatures often go beyond 50^0C to 60^0C, a major constraint to establish a good crop, *Faidherbia* trees lowered soil temperature at 2-cm depth by 5^0C to 10^0C depending on the movement of shade (Vandenbeldt and Williams, 1992). As per Mukherjee *et al.* (2008) tea under plantation of alley of seven shade tree species including *Acacia auriculiformis, Casuarina equisetifolia, Dalbergia sissoo, Gliricidia sepium, Albizia lebbeck, Gmelina arborea* and *Eucalyptus hybrid* and reported that both atmospheric temperature and Soil temperature were lowered by 2-3 ^{0}C compared to a non-shaded open condition, whereas relative humidity values increased by 3-9% within the shade. The shade provided by *Acacia auriculiformis* and *D. sissoo* seemed to be beneficial for tea yield. Shelterbelt and windbreak are also perform protecting function in term of beneficial aspects of microclimate change are extensively used. Based on the response of crops to shade, Brenner (1996) has classified leafy horticultural crops (e.g., alfalfa, cliver) as the most responsive crops and cereals as moderately responsive (e.g., barley and millet) or less responsive (e.g., maize, and wheat)**.** The net shade effect was reported to be more positive when the annual crop is a C3 plant which is normally light saturated in the open (Ong, 1996).

Socioeconomic development

Agro-forestry as a land use system that integrates trees, crops and animals in a way that is scientifically sound, ecologically desirable, practically feasible and socially acceptable to the farmers (Nair, 1979). It can improve the livelihoods of smallholder farmers as by providing fruit and nuts, fuel wood, timber, medicine, fodder for livestock, green fertilizers, additional / diversified income (WAC, 2010). Agroforestry models for different site conditions have to be developed and demonstrated under different agro-ecological regions in the country. In Chhattisgarh state, Agri-horticulture model comprises combination of horticulture tree (Aonla) and field crops (groundnut and gram) and their different parameter of economic analysis (input/output) including total expense (tree+crops) per ha (86,494 Rs.), total benefits per ha (93,903 Rs.), net Benefit per ha. (7,410 Rs.), B: C ratio (1.09). Similarly, Agri-silviculture system comprises combination of tree species (*Gmelina arborea*) and field crop (paddy and linseed) and their economic parameters are total expense (tree+crops) per ha (69139 Rs.), total benefits per ha (119,997 Rs.), net benefit per ha. (50,858 Rs.), B: C ratio (1.74). These economic analysis are sufficient to measure socio-economic potential of different agroforestry models and gives idea about whether this model be accepted or not (GoI, 2001).

CONCLUSION

Agroforestry is not a something new. It is a relatively new name for a set of old farming practices. Agricultural crops (herbaceous plants), woody perennials (tree crops/ forest plants) and animals are the component of Agroforestry. Under the agroforestry model, a suitable combination of nitrogen fixing and multipurpose trees with field crops are played a major role in enhancement of better yield productivity, soil nutrient status and microbial population dynamics which plays a major role in nutrient cycling to maintain ecosystem. In developing countries forests and agroforestry provide substantial benefits to rural dwellers, national

economies, and the environment. Therefore, Agroforestry system gives diversification, creates green cover for carbon sequestration and increases the nutrient uptake and their utilization management practices that lead to improved organic matter status of the soil will lead inevitably to improved nutrient cycling and better soil productivity.

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DIVERGENCE STUDIES IN GLADIOLUS (*GLADIOLUS HYBRIDUS* L.) GERMPLASM

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Abstract: An investigation was carried out to identify the extent of genetic divergence that exist for the flower yield and yield contributing characters of fifteen genotypes of gladiolus. Multivariate analysis was performed on field data using Mahalanobis's D^2-statistics, Tochers method of clustering and combined analysis of variance. Analysis of variance revealed considerable differences among the genotypes for all the morphological traits studied. All the 15 genotypes of gladiolus (*Gladiolus hybridus* L.**)** were grouped into three clusters on the basis of the morphological diversity. Maximum intra-cluster distance was observed in cluster III (4.544) was recorded between cluster III and I. whereas the minimum average inter cluster D^2 value (3.699) was recorded between clusters III and II. The analysis of divergence indicated significant differences among parental lines for all the agro-morphological characters. On the basis of results obtained in the present investigation, it was concluded that the allelic diversity can be used for future breeding program. The traits under study are also major flower and corm yield contributing traits and are largely associated with each other. Therefore, these traits should be taken into consideration either simultaneously or alone for selecting a high yielding gladiolus genotype.

Keywords: Gladiolus, investigation, germplasm, Iridaceae

INTRODUCTION

Gladiolus (*Gladiolus hybridus* L.), a member of family Iridaceae. It occupies 4th place in international cut flower trade after Rose, Carnation and Chrysanthemum (Farhat, 2004). It is one of the leading cutflower crops grown in our countries, known for its majestic spikes which contain attractive, elegant and delicate florets. With over 260 accepted species, Gladiolus is the second largest genus of Iridaceae family after Iris L. itself (Goldblatt and Manning, 2008). A huge quantum of diversity exists in this crop with respect to shape, growth habit, flowering behaviour, vase life, etc. Inspite of such variability, very few are having desirable characters in terms of yield and quality. Knowledge of divergence studies helps the plant breeder to ascertain the real components of yield and provide an effective basis of selection. The characters contributing significantly to desirable traits can be significantly identified, and can be used as alternate selection criteria in crop improvement programmes. Through collection and selection program, a number of strains have been introduced and acclimatized in various parts of the world, but evaluation studies of yield and its contributing quantitative and qualitative traits are scarce. The multivariate analysis has been established by several investigators for measuring the degree of divergence and for ascertaining the relative contribution of different characters to the total divergence (Singh *et. al*.,2002). Such a study also permits to select the genetically divergent parents to obtain the desirable recombinants in the segregating generations. Moreover, precise information about the extent of genetic divergence and characters used for discrimination among the population is crucial in any crop improvement program (Ashana and Pandey, 1980; Pandey, 2009). Therefore, the present investigation was designed to provide information on genetic divergence of 15 garlic genotypes collected from different sources. The diverse parents belonging to different distant clusters would provide an opportunity for bringing together gene constellations of diverse nature promising hybrid derivatives result probably due to complementary interaction of divergent in parent (Murthy, 1965) and Anand and Murthy, 1968.

MATERIAL AND METHOD

Plant materials

A total of 15 cultivars of gladiolus collected from different parts of the country were used in the present study (Table 1). The experimental field is situated at 29º 01 latitude in the North and 77 º43 longitudes in the Eastern elevation of about 219.75 meters above sea level. The experimental trials were laid out in randomized block design with three replications. Each genotype was assigned to six rows per plot with a distance of 30 cm line to line and 25 cm plant to plant. Data were recorded on five vegetative characters, namely, plant height (PH), number of leaves/plant (NLPP), length of the longest leaf (LLL), width of longest leaf (WLL) and number of suckers/plant (NSPC), nine flowering characters namely, length of spike (LS), length of rachis (LR), spike diameter (SD), spikes per corm (SPC), number of florets per spike (NFPS), flower diameter (FD), visibility of first spike in days (VSD), opening of first flower in days (OFFD), longevity of spike in days(LSD) and four corm chracters i.e. diameter of corm (DC), weight of corm (WC), number of corms/plant (NCPP), cormels per plant (CPP) respectively. The five randomly selected plants in each genotypes of all replication were utilized for taking the observation at appropriate stage. The mean values of the genotypes in each replication for

quantitative characters were used for statistical analysis (Table 2). The data were processed with the help of the software programme SPAR-1 (Doshi and Gupta, 1991) utilizing various standard statistical procedures. The data recorded on nine different quantitative traits was subjected to the D^2 statistic of Mahalanobis (Rao, 1952) and average intra- and - inter cluster distances were calculated (Table. 2).

RESULT AND DISCUSSION

The analysis of variance revealed a significant difference among the 15 genotypes for all the 16 characters indicating the existence of high genetic diversity. Cluster formation based on Tocher analysis of field data of morphological traits generated three clusters (Table-2). Maximum inter cluster D^2 value (4.544) was recorded between cluster III and I. whereas the minimum average inter cluster D^2 value (3.699) was recorded between clusters III and II. The intra cluster divergence were found to range between 3.022 for cluster III, 3.987 for cluster I and 4.217 for cluster II. Singh et al. (2012) formed 10 clusters in 32 genotypes of garlic on the basis of 14 morphological characters.

Combined analysis of variance indicated that the magnitude of mean sum of square for maximum weight of corm followed by length of rachis and length of spike and these traits are also known as qualitative traits of gladiolus (Table 3).

The distribution of genotypes belonging to same geographical region in different cluster and grouping of genotypes collected from different location in one cluster is common. This grouping pattern of genoptypes suggested no parallelism between genetic divergence and geographical distribution of genotypes. Sheikh and Khandy, (2008) Swaroop (2010), Singh and Duvey (2011) and Singh *et al.* (2012) also reported that genotypes diversity was independent of geographically region. Murthy and Arunachalam (1966) stated that genetic drift and selection in different environment could cause greater diversity environment could cause greater diversity than geographic distance. Similarly maximum intra- cluster (D^2= 4.217) was observed in cluster II (representing 3 genoypes of the 15 genotypes), (Table.4), followed by, cluster I (D^2 = 3.987) and minimum intra-cluster distance (D^2=3.022) was found in cluster III. Singh et al.,(2012) who had also observed the similar findings.

Cluster means are concerned different clusters have higher mean values for different traits, indicating that few of cluster contained genotypes with most of the desirable characters. It was observed that cluster I included the genotypes with highest length of spike, higher corm weigh, maximum diameter of corm, maximum number of cormlets (Table.5). Similar observations had been earlier reported by Swaroop and Janakiram (2010) in gladiolus. The characters showed in terms superior characters i.e qualitative charectars deserve to be considered as potent parents for further utilization in garlic breeding programme. Therefore, based on D^2 analysis, it has been understood that characters need to be given more weightage, while selecting parents for improvement programme.

Cluster analysis based on Euclidean coefficient values obtained from morphological data showed that four genotypes namely Punjab Glace , Pacific , Orange Ginger , Aldebaran , Arka Kesher found to be present separately from other 15 genotypes that were found to be largely aggregated. These genotypes could be a good alternative for fruitful gladiolus breeding program.

Table 1. List of genotypes with their origin

1	Punjab Pink	PAU, Ludhiana, Punjab
2	Punjab Glace	PAU, Ludhiana, Punjab
3	Pacific	NBRI, Lucknow, Uttar Pradesh
4	Orange Ginger	NBRI, Lucknow, Uttar Pradesh
5	Prabha	NBRI, Lucknow, Uttar Pradesh
6	Sylvia	NBRI, Lucknow, Uttar Pradesh
7	Aldebaran	NBRI, Lucknow, Uttar Pradesh
8	Pricilla	IARI, New Delhi
9	Navalux	IARI, New Delhi
10	Gold Field	IARI, New Delhi
11	Ocilla	IARI, New Delhi
12	Kum-Kum	IIHR, Bangalore, Karnataka
13	Arka Kesher	IIHR, Bangalore, Karnataka
14	Arka Gold	IIHR, Bangalore, Karnataka
15	American Beauty	Meerut, Uttar Pradesh

Table 2. Average intra and inter cluster (D^2 value) distance in gladiolus cultivars

Cluster	I	II	III
I	3.987	4.485	4.544
II		4.217	3.669
III			3.022

Table 3. Combined analysis of variance of 16 morpho-agronomic traits

Source	d.f	PH (cm)	NLPP	LL(cm)	LW (cm)	NSPC	LS (cm)	LR (cm)	SPC	DS (cm)	NFPS
REP	2	0.35	0.01	3.27	0.04	0.00	9.09	17.02	0.00	0.00	2.11
TRET	14	98.28**	0.28**	91.68**	1.27**	1.15**	303.59**	314.59**	0.15**	0.04**	21.81**
EROR	28	6.72	0.09	4.90	0.02	0.01	9.06	4.16	0.00	0.00	0.46

Source	d.f	FD (cm)	VSD	OFFD	LSD	DC (mm)	WC (gm)	NCPP	CPP
REP	2	0.01	2.00	20.30	0.84	0.12	7.95	0.00	0.03
TRET	14	1.96**	187.78**	264.05**	37.07**	2.23**	2421.36**	0.31**	10.60**
EROR	28	0.24	17.14	27.46	2.56	0.10	13.70	0.01	0.51

Table 4. Distribution of 15 genotypes of Indian gladiolus

Clusters number	No. of genotypes	Genotypes
I	5	Punjab Glace , Pacific , Orange Ginger , Aldebaran , Arka Kesher
II	3	Punjab Pink, Prabha , Sylvia
III	7	Pricilla , Navalux , Gold Field , Ocilla , Kum-Kum, Arka Gold, American Beauty

Table 5. Clusters mean values of different traits

Character / Cluster	PH (cm)	NLPP	LL(cm)	LW (cm)	NSPC	LS (cm)	LR (cm)	SPC	DSPC (cm)	NFPS	FD (cm)	VSD	OFFD	LSD	DC (mm)	WC (gm)	NCPP	CPP
1	-0.80	-0.95	--0.94	-0.76	0.32	--0.77	-0.72	--0.33	-0.68	0.84	-0.57	-0.56	-0.52	0.86	0.39	0.26	0.14	0.59
2	1.50	0.81	1.57	0.09	-0.89	0.08	--0.43	-0.65	-0.41	-0.24	-0.35	0.00	-0.13	-0.18	0.14	0.16	0.07	0.12
3	-0.07	0.33	0.00	0.51	0.15	0.52	0.70	0.51	0.66	0.70	0.56	0.40	0.43	-0.53	-0.34	-0.25	-0. 13	-0.47

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SOIL FERTILITY STATUS OF MAJOR NUTRIENT IN *VERTISOL* OF DHAMTARI BLOCK

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Abstract: The present investigation entitled "Evaluation of soil fertility status in *Vertisol* of Dhamtari block, under Dhamtari district in chhattisgarh." was carried out for soil fertility evaluation during 2009-10 and analyzed for nitrogen, phosphorus and potassium content for delineation the fertility status in *Vertisols* in relation to salient physicochemical characteristics. There was Grid based surface (0-15 cm) soil samples by systematic survey were collected from 69 villages in Dhamtari block where 516 samples were identified from *Vertisol.* The available phosphorus and potassium was negative but non-significant correlation showed with soil pH and the positive but no significant correlation with nitrogen, the pH was positively and significant correlated with electrical conductivity. The positive and significant correlation observed between organic carbon and nitrogen. The organic carbon showed the negative and non–significant correlation with phosphorus and potassium. The nitrogen, phosphorus and potassium showed no significant correlation among them. After evaluation found as the status of available nitrogen in *Vertisols* were found to be low nitrogen status, available phosphorus found low to high and available potassium content generally found medium to high and only 1.75 percent soil samples tested low in available potassium. The nutrient index with respect to available nitrogen, phosphorus and potassium were also calculated on village basis. Four categories of soil fertility viz. Low- Low- Low (LLL), Low-Low-Medium (LLM), Low-Medium-Medium (LMM) and Low-Medium-High (LMH) were observed in *Vertisol* of Dhamtari Block.

Keywords: fertility status, major nutrients, *Vertisol*

INTRODUCTION

Macronutrients (N, P and K) are important soil elements that control its fertility. Soil fertility is one of the important factors controlling yield of the crops. Soil characterization in relation to evaluation of fertility status of the soils of an area or region is an important aspect in context of sustainable agriculture production. Because of imbalanced and adequate fertilizer use coupled with low efficiency of other inputs, the response (production) efficiency of chemical fertilizer nutrients has declined tremendously under intensive agriculture in recent years. The results of numerous field experiments in different parts of India have, therefore indicated "fertilizer-induced un-sustainability of crop productivity". Variation in nutrient supply is a natural phenomena and some of them may be sufficient where others deficient. The stagnation in crop productivity can not be boosted without judicious use of macro and micronutrient fertilizers to overcome existing deficiencies/imbalances.

Soil fertility is an important factor which determines the growth of plant. Soil fertility is the inherent ability of soils to supply nutrient elements to the plants. Soil Fertility is related to the amount of available nutrients, which measure it by the yield capacity, and still others look it to be a function of organic matter or even soil texture. The use of plant nutrients in a balanced manner is the prime factor for efficient fertilizer program. Balanced nutrient use ensures high production level and helps to maintain the soil health.

Study Area

Dhamtari is a block comes under Dhamtari district in the state of Chhattisgarh. This district is situated between 20°40' North, 81°33' East longitude. The total area of district is 2029 Sq. Km. and 305 meter above the mean sea level. The *Vertisols* group of the soil covered under the different village of the Dhamtari block in Dhamtari district of Chhattisgarh has been taken for fertility evaluation of various aspects and sixty-nine villages comes under *Vertisols.*

MATERIAL AND METHOD

Collection of soil samples

The soil sample was collected from representative area. A field can be treated as a single sampling unit only if it is appreciably uniform in all respect variation in slope, texture, color, crops grown and management levels fallowed should be taken into amount. Separate sets of composite samples need to be collected from each such area. Recently fertilized plot, bunds, channels, marshy tracts and spots near trees, wells, compost piles or other non-representative locations must be avoided during sampling. The soil samples should be taken in a zigzag pattern. The collected soil sample thoroughly mixed on a clean piece of cloth, polythene sheet or thick paper and kept it in with suitable description and identification marks.

Analysis of Samples

Soil samples collected from the study area, after air drying soil samples are crushed gently in pestle and mortar and sieved through a 2 mm sieve. The

material larger than 2 mm is discarded and then used for the determination of soil pH, organic matter, macronutrients and micronutrients content by adopting standard laboratory methods.

The pH was determined by glass electrode pH meter in soil water suspension (1**:**2.5) (Piper, 1950). Electrical Conductivity with Solu-bridge method which is reciprocal of resistance, thus, increases with increases in salt concentration described by Black (1965), Organic Carbon by wet digestion method (Walkley and Black's rapid titration method, 1934), Available nitrogen was estimated by alkaline $KMnO_4$ method (Subbiah and Asija, 1956), Available phosphorus was extracted by 0.5M $NaHCO_3$ solution buffer at pH 8.5 (Olsen *et al.,*1954) is used for neutral- alkaline soils while the Bray and Kurtz P1 methods (Bray and Kurtz 1945) is used for acid soils. Available potassium is estimated through neutral normal ammonium acetate by using a flame-photometer described by Jackson (1967). The samples were categorized as per the rating limit given in Table 1.

Table 1. Limits for the soil test values used for rating the soil

Classification for pH values			
Strongly acid	**Moderately acid**	**Slightly acid**	**Neutral**
<5.5	5.5-6.0	6.0-6.5	6.5-7.5
Classification for total soluble salt content (EC as dS m^{-1})			
No deleterious effect on crop	**Critical for germination**	**Critical for salt sensitive crop**	**Injurious to most crops**
<1.0	1.0-2.0	2.0-3.0	>3.0
Parameters	**Low**	**Medium**	**High**
O.C. (%)	0.25-0.50	0.50-0.75	>0.75
	Macronutrients		
Av. N (kg ha^{-1})	<280	280-560	>560
Av. P (kg ha^{-1})	<12.5	12.5-25	>25
Av. K (kg ha^{-1})	<135	135-335	>335

RESULT AND DISCUSSION

Soil reaction (pH)

The *Vertisols* samples of the study area were determined for pH (Table 2) and observed in the range of 4.7 – 8.2 with the mean value of 7.01.

pH estimation from total 516 soil samples of Dhamtari block and it was observed that nearly 5.24% samples under moderately acidic (5.5-6.0), 8.13 % under slightly acidic (6.0-6.5), 0.39 % under strongly acidic (<5.5) and only 77.32 % samples were categorized under neutral in reaction (Table 3). The tables revealed that the surface soils studied were strongly acidic (4.7) to slightly alkaline (8.2) in reaction and appeared to be influenced by rainfall and topography (Thangaswami *et al* 2005, Rajeshwar *et al.,* 2009). This wide variation in soil pH of *Vertisols* may be attributed to be injudicious use of irrigation water imbalance and continued use of nitrogenous fertilizers and continuous rice-rice cropping system prevailing in the area under study.

Table 2. Salient soil properties of study area

Soil characteristics	**Range**	**Mean**	**S.D**
pH (1:2.5, Soil water)	4.7-8.2	7.01	$\pm$0.5
E.C. (dS m^{-1})	0.01-0.89	0.22	$\pm$0.11
O.C. (%)	0.15-0.91	0.54	$\pm$0.14
Available N (kg ha^{-1})	100.35-451.58	219.48	$\pm$63.52
Available P (kg ha^{-1})	0.35-51.96	8.13	$\pm$6.79
Available K (kg ha^{-1})	23.52-566.04	262.11	$\pm$73.42
Available Fe (mg kg^{-1})	0.22-6.52	2.46	$\pm$1.02

Available Mn (mg kg^{-1})	3.66-95.0	21.99	±8.17
Available Cu (mg kg^{-1})	6.36-97.02	38.61	±14.39
Available Zn (mg kg^{-1})	0.04-3.66	0.82	±0.57

Table 3. Limits for the soil test values used for rating the soil

Classification for pH values			
Strongly acid	**Moderately acid**	**Slightly acid**	**Neutral**
0.39	5.24	8.13	77.32
Classification for total soluble salt content (EC as dS m^{-1})			
No deleterious effect on crop	**Critical for germination**	**Critical for salt sensitive crop**	**Injurious to most crops**
5.23	44.28	31.10	19.19
Parameters	**Low**	**Medium**	**High**
O.C. (%)	32.95	56.59	8.33
	Macronutrients		
Av. N (kg ha^{-1})	75	25	0
Av. P (kg ha^{-1})	81.40	15.50	3.10
Av. K (kg ha^{-1})	1.75	81.38	16.87

Salt concentration (EC)

The total soluble salt content expressed as electrical conductivity (EC), varied from 0.01 to 0.89 dS m^{-1} with a mean value of 0.22 dS m^{-1} at 25°C (Table 2) and 44.28% samples have found that critical for germination (Table 3). The total soluble salts observed under studied samples were safe for germination and growth of plants.

Organic Carbon

The organic carbon analyzed in all sampled *Vertisol* exhibited in the range of 0.15 to 0.91 with a mean value of 0.54 % (Table 2). Thus, the *Vertisol* of Dhamtari block is medium in Organic Carbon content. Distribution of soil samples with respect to organic Carbon content indicates (Table 3) that about 32.95 % samples had low (<0.50 %) organic C, 56.59 % in medium (0.50-0.75%) and only 8.33 % samples had higher organic Carbon (>0.75%). Most of the soils found under medium organic carbon status,

Available N

The available N content (Table 2) of *Vertisol* ranged from 100.35 to 441.58 kg ha^{-1} with an average value of 219.48 kg ha^{-1}. The majority of the sampled area (75 %) covering in *Vertisol* of Dhamtari block fall under low status (<280 kg ha^{-1}) in available N content (Table 3). Only 25% soil samples were categorized under medium (280-560 kg ha^{-1}) status. In this way, almost all the soil samples tested were found to be deficient in N. It is fact that the available N analyzed by alkaline $KMnO_4$ method as suggested by Subbiah and Asija (1956) do not exhibit the exact availability of N in dry soil. It is the measure of the oxidisable N in dry soil. It is quite obvious that efficiency of applied nitrogen is very low due to the fact that nitrogen is lost through various mechanisms like ammonia volatilization, nitrification, succeeding denitrification, chemical and microbial fixation, leaching and runoff (De Datta and Buresh, 1989) which resulted in low amount of nitrogen in soil. These results are in conformity with the findings of Sharma *et al*. (2008), Kumar *et al.* (2009) and Rajeshwar *et al.* (2009).

Available P

The available P varied from 0.35 to 51.96 kg ha^{-1} with a mean value 8.13 kg ha^{-1} in *Vertisol* (Table 2). The study indicates that about 2/3rd of the sampled area exhibited low and 1/3rd under medium range of phosphorus content (Table 3). or the available phosphorus content in larger area is generally low, Phosphorus is present in soil as solid phase with varying degree of solubility. When water soluble P is added to the soil, it is converted very quickly to insoluble solid phase by reacting with soil constituents and the farmers are producing higher yields with intensive cropping associated with imbalance use of fertilizers leading to higher Phosphorus P-uptake. Moreover, the farmer's are applying higher doses of nitrogenous fertilizers leading to soil reaction towards acidic range as also evident from soil pH from this study. Phosphorus fixation may occur due to acidity and high amount of clay in *Vertisol* attributing low level of phosphorus in these soils. Similar results were also reported by Sood *et al*. (2003), Kumar *et al*. (2009) and Kumar *et al.* (1995).

Available K

The available Potassium content in *Vertisol* ranged from 23.52 to 566.04 kg $ha^{-1}$with an average value 262.11 kg ha^{-1} (Table 2). The data reveals that 81.38 % soil samples tested were in medium level of available Potassium and only 1.75 % samples were tested under low range and 16.87 % samples were tested were in high level of available Potassium (Table 3). Adequate level of available Potassium in *Vertisol* of the study area may be attributed to the prevalence of K-rich clay minerals like *illite* and *kaolinite.*

Relationship between soil properties and available macronutrients

The correlation studies presented in table 4, indicated that pH showed positive and non significant correlation with available nitrogen (r = 0.016), organic carbon (r = 0.028). These findings are in conformity with the results of Sharma *et al* (2008).

The soil reaction (pH) showed significant and positive correlation (r = 0.119**) with electrical conductivity. The soil pH showed non significant and negative correlation (r = -0.015) with phosphorus. These results are in agreement with Kumar *et al.* (2009), because at higher pH, phosphorus is precipitated as Ca-phosphate and reduced phosphorus availability. However, potassium showed a negative and non significant correlation (r = -0.009) with soil reaction.

The electrical conductivity of *Vertisols* showed positive and non significant correlation (r = 0.065) with nitrogen, r = 0.085 with phosphorus, (Table 4). Sharma *et al.* (2008) also observed positive relationship between electrical conductivity and available nitrogen and phosphorus in the soils of Amritsar, Punjab. However, available potassium showed negative and non significant relationship (r = -0.062) and organic carbon showed positive and non significant relationship (r = 0.048). Almost similar results were also reported by Sharma *et al*. (2008).

The correlation studies presented in table 4 revealed that there was a significant and positive relationship (r =0.123**) between available nitrogen and organic carbon. These findings are in conformity with the results reported by Sharma *et al.* (2008). This relationship was found because most of the soil nitrogen is in organic forms. There is a definite relation of organic carbon with available nitrogen because organic matter can release the mineral soluble nitrogen in the soil. Hence, organic carbon status of the soil can predict the available nitrogen which shows positive relationship. Whereas, available phosphorus and potassium showed negative and non significant relation (r = -0.061) and (r = -0.001) with organic carbon, It may be attributed due to the presence of calcium ions in *Vertisols* of Dhamtari Block, which may lead to phosphate fixation and thus showing the inverse relationship while forming the complex with organic matter.

The correlation studies presented in table 4 and revealed that available potassium had non-significant and negative relation (r = -0.067) with available nitrogen and (r = -0.008) with available phosphorus, respectively. Similarly, available nitrogen showed non-significant and negative relation (r = -0.076) with available phosphorous.

Table 4. Correlation coefficients (r) between physico-chemical properties and available N, P and K in *Vertisol* of Dhamtari block.

	PH	**EC**	**OC**	**N**	**P**	**K**
pH						
EC.	0.119**					
OC.	0.028	0.048				
N	0.016	0.065	0.123**			
P	-0.015	0.085	-0.061	-0.076		
K	-0.009	-0.062	-0.001	-0.067	-0.008	

*Significant at 5% level **Significant at 1% level

Thus, it can be concluded from the present study that the *Vertisols* of Dhamtari Block were indicated slightly acidic to neutral in reaction. However, all soil samples were in safe limit of electrical conductivity and majority of the soil samples represented low to medium in organic carbon. These soils are low in available nitrogen and available phosphorus content. However, available potassium is low to medium in these soils, hence, the *Vertisols* needs regular attention regarding nutrient management practices and regular monitoring of soil health for better crop production.

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REPORT

URGINEA INDICA – IMPORTANCE AND NEED FOR AWARENESS

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Abstract: *Urginea indica* (Roxb.) Kunth. is a bulbous perennial herb belonging to family Liliaceae. The species is distributed abundantly on Rocky Mountains and on dry sandy soils near the sea. It is also found growing in J & K in different habitats. The bulbs are of immense medicinal importance and used in the treatments of many ailments, though locals of J & K consider them as a best remedy for joint pains and for removing thorns. While extensive literature is available on its phytochemistry, tissue culture, taxonomy and systematic, little is known about its cytology, reproductive biology, breeding system and genetics. The species is increasingly becoming threatened in few regions due to non-awareness and habitat degradation. The present communication attempts to bring forth the amount of work already done on the species and its importance. It is aimed to motivate the researchers and explorers to undertake more work on the species before it is lost to ruthless traders and urbanization.

Keywords: Bulbs, Diploid, Morphological variants, Phytochemicals, Polyploidy, *Urginea indica*

INTRODUCTION

Urginea Steinhill belonging to family Liliaceae is a large polytypic genus of bulbous herbs. Represented by about 100 species, it is endemic to India, Africa and Mediterranean region (Airy Shaw, 1993). Of the 100, 9 species are found in India (Hamidri and Sasibhushan, 1982), two of which namely *U. maritima* Baker (European or Red squill) and *U. indica* (Roxb.) Kunth (Indian or White squill) are medicinally important (Anonymous, 1976). *U. indica*, a native of India and Burma (Singh and Dey, 2005), is distributed abundantly in north-western Himalayas upto 2000 ft and extends to South-India, Konkan, Coromandal and Bihar (Jain, 1968). Also found in Western Peninsula and Tropical Africa (Kritikar and Basu, 1935), it frequently grows in dry sandy soils near the sea (Anonymous, 1976). In J&K, the authors have located populations of this species in Kalakupar (near Nandini tunnel, District Jammu) as reported by Sharma and Kachroo (1981) and villages Galakh and Lakhri of Tehsil Billawar (District Kathua).

Drimia indica (Roxb.) Jessop has been regarded as its synonym (Jadhav, 2008). The species under consideration i.e., *Urginea indica* is also known by different regional names like 'Jangli piyaz' (Hindi), 'Banpiyaaj' (Bengali), 'Janglikando' (Gujrati), 'Rankando' (Marathi), 'Kolokanda' (Sanskrit), 'Narivengayam' (Tamil), 'Nakkavalligadda' (Telugu) and 'Banganda' in Dogri (Jain, 1968; Sharma and Kachroo, 1981). Maximum published work on this species pertains to phytochemistry, cytology, tissue culture, taxonomy and systematics. Major contributors from across the world are: Raghavan and Venkatasubban, 1940a,b; Jha and Sen along with their co-workers (1981, 1982, 1983, 1984, 1987 and 1990); Shivakameshwari with her co-workers (1999, 2004, 2011, 2012); Oyewole and Mustapha (2000). Of these, two Indian groups have substantial contributions and deserve special mention. These are Jha (1989), Jha and Sen (1981, 1982, 1983, 1984, 1987 and 1990) and Shivakameshwari with her associates (1999, 2004, 2011 and 2012). These works largely pertain to cytology, phytochemical analysis, tissue culture and systematics. Reproductive biology of the species is neither known nor worked out in detail except for a single report of the species being self-compatible and cross pollinated by insects (Shivakameshwari *et al*, 2012).

The bulbs of *U. indica* are of immense medicinal importance. Known to possess anthelmintic, stimulant, deobstruent, digestive, diuretic, emmenagogue, expectorant and laxative properties (http://www.impgc.com), these are used for curing snake bites, goitre in cattle, relieving pain after delivery (Singh and Khan, 1989), removing warts and corns, treating chronic Bright's disease (a typical degeneration of kidneys), scabies, rheumatism (http://www.divineremedies.com), skin ailments (Sultana *et. al*, 2010), psoriasis (Shivakameshwari *et al.*, 2012), strangury and fever in horses, burning sensation in soles of feet (Drury, 1978), parched tongue, fevered lips and contraction of features (Shivakameshwari, 2013). The plant is also known to possess cardio-tonic, anti-tumor and anti-cancer properties (Deepak and Salimath, 2006; http://www.ewtc.cn). The alcohol extracts of the bulbs have high anti-inflammatory, good anti-arthritic activity and moderately good analgesic effects (Rahman *et al.*, 2011). Different solvent extracts have antimicrobial activity against the bacterial strains and fungus (Rathabai *et al.*, 2012). The locals of J&K (India) consider it to be the best remedy for joint pains and for removing thorns. In large doses, it acts as an acrid poison inducing nausea and active movement of bowels (http://www.divineremedies.com) and a narcotic (http://www.ewtc.cn).

Detailed phytochemical analyses have been conducted on the bulbs of *U. indica* by many workers (Table 1). Time and quantity of production of some of these phytochemicals vary with the ploidy

level and developmental stages of the plants. Some also show seasonal variation (Jha and Sen, 1981a, b; Jha and Sen, 1982; Patil and Torne, 1980). For example, stigmasterol, the principal sterol, is found in all the organs (root, leaves and bulbs) of all the cytotypes. Bufadienolides like proscillaridin A and scillaren A, on the other hand, are found only in roots of all the cytotypes. Tetraploids, in addition to these, also contain scilliphaeoside and anhydroscilliphaeosidin, and triploids, scilliphaeoside. Proscillaridin A and scillaren A show seasonal variation reaching a maximum twice in the annual cycle, once at the peak of their vegetative phase and second at the end of dormancy phase (Jha and Sen, 1982). Similar is the case of scilliphaeoside in tetraploids. This decrease prior, during and after flowering has been attributed to its gradual utilization (Jha and Sen, 1982). Kopp *et al.* (1996) isolated 13 bufadienolides from *U. indica* and 41 from *U. maritima*.

The cardioactive glycoside present in squill (Lewis and Lewis, 1977) resembles that of *Digitalis*. This cardioactive is recommended only in those patients who need to be treated with *Digitalis* but are hypersensitive to that drug (Jain, 1968; Anonymous, 1976). Found to vary seasonally, these compounds also reach a maximum at the start of the dormancy period i.e., in October (Patil and Torne, 1980).

A 29 KDa glycoprotein isolated from the bulbs of *U. indica* has antifungal (Deepak *et al.*, 2003; Shenoy *et al.*, 2006) and anti-tumor activities (Deepak and Salimath, 2006). Possessing a significant homology to class II chitinases of glycoside hydrolase family 19, it gives tolerance against fungal pathogens such as *Fusarium oxysporum* and *Rhizoctonia solanii* (Shenoy *et al.*, 2006). Three novel flavonoid glycosides also isolated from the bulbs (Sultana *et al.*, 2010) have been added to the existing list. *U. maritima* also contain three bitter glucosidal substances Scillitoxin, Scillipicrin and Scillin; Sinistrin, an inulin-like substance; mucilaginous and saccharine matter and calcium oxalate crystals (http://www.botanical.com). Raphids (calcium oxalate crystals) are also present in vegetative and reproductive parts of *U. indica* and play a vital role in protecting plants from herbivore attack. The bundle size of raphids varies considerably within the species which suggests their potential to be used as a taxonomic tool (Prathima Rao *et al.*, 2012).

Voluminous literature is available on the cytology of *U. indica* (Fedorov, 1969; Raghavan and Venkatasubban, 1940a, b; Sen, 1974; Jha and Sen, 1983a,b; Shivakameshwari and Muniyamma, 2004). With its diploid number being 2n=20 (Fedorov, 1969; Raghavan and Venkatasubban, 1940a; Sen, 1974; Jha and Sen, 1983a), the species is known to exist in several cytotypes. Tripolids, tetraploids, hexaploids and aneuploids (Raghavan and Venkatasubban, 1940b; Jha and Sen, 1983b; Shivakameshwari and Muniyamma, 2004) along with B-chromosomes in some diploid races (Sen, 1974) are on record.

In diploid plants, chromosomal fragments varying in number are found in the somatic and meiotic cells of the same individual (Raghavan and Venkatasubban, 1940a). The somatic complement is characterized by two typical chromosomes; C_1 and C_2. The former bears a secondary constriction at its distal end while the latter has a terminal constriction and a satellite at its proximal end. The two are distinct from the rest and break easily; their satellites forming persistent fragments. Fusion of gametes with such fragments leads to the formation of individuals with varying number of these bodies. Further work by Raghavan and Venkatasubban (1940b) led to the isolation of triploids from a heterogenous population which differ from diploids in having much longer scapes.

Of the 20 populations collected by Jha and Sen (1983a), nine turned out diploid and rest polyploid (Jha and Sen, 1983b). Plants of all the diploid populations uniformly had 2n = 20 chromosomes. Only one carried B-chromosomes in addition to the normal 20 (Jha and Sen, 1983a). Interestingly however, all polyploid populations were devoid of B-chromosomes (Jha and Sen, 1983b). On the whole, karyotypic variation is quite high at the inter-population level. On the basis of their relative length and position of primary and secondary constrictions chromosomes were divided into different groups. Present in different combinations in different cytotypes (Jha and Sen, 1983a, b), the plants were collected from various areas within a broad climatic zone. Inter-population karyotypic variation was, therefore, attributed largely to the presence of cytotypes in different microclimatic conditions. Role of structural alterations was also not ruled out. Surprisingly, heteromorphicity prevalent in non-nucleolar chromosomes does not manifest in their pairing ability during meiosis (Jha and Sen, 1983a, b).

These cytotypes of *U. indica* enjoy wide distribution in India; diploids found throughout, triploids restricted to the peninsular part including the southern and western belt, and tetraploids in the southern coast. The cytological races across this distributional range are maintained by extensive vegetative reproduction (Jha and Sen, 1983b).

As mentioned before, only diploids of *U. indica* are known to have B-chromosomes in their cells (Sen, 1974). Their presence in all the individuals of a population is indicative of some adaptive advantage being provided to the population concerned. B-chromosomes are absent in tetraploids probably because they have a high tolerance range on account of higher ploidy and therefore donot require any accessories. It is worthwhile to mention that cytotypes with B-chromosomes also exhibited polysomaty (Jha and Sen, 1984). That is, cells with different ploidy levels (diploid, hyperdiploid, hypertriploid and hypertetraploid) are noticed in a

single root tip, but the B-chromosomes are invariably recorded only in those with 2n = 20. Their number varies from cell to cell with 6 being the modal number. Notwithstanding this numerical variation, B-chromosomes are uniformly metacentric and small with subterminal primary constriction.

Plants of *U. indica* with varied ploidy states have also been reported by Shivakameshwari and Muniyamma (1999a, 2004). Diploid (2n=20), triploid (2n=30), tetraploid (2n=40), hexaploid (2n=60) and aneuploid populations have been recorded with plants having 2n=32, 34, 36, 38 and 46 chromosomes. Aneuploidy in *U. indica* as per Shivakameshwari (2004) might have originated as a result of hybridization between polyploid taxa and, the individuals formed must have perpetuated through efficient vegetative propagation. An aneuploid of the sister species, *U. polyphylla* having 2n=54 is also on record (Shivakameshwari and Muniyamma, 1999b). Its bulbs are found to have a number of bulbils adhered to them; each giving rise to a new plant.

Jha *et al.* (1984) tried *in-vitro* regeneration of *U. indica* on modified MS basal medium using 3-5 scales joined at the base by a small piece of disc, individual scales and axial discs as explants. Of the three, only the first responded to culture conditions and formed bulblets. These *in-vitro* regenerated bulblets were then used as a source of secondary explants. Approximately 400 bulblets formed in liquid culture exhibited 90% survival when transferred to potted soil. This method of regenerating plants from secondary explants proved advantageous and rapid. Calli obtained from bulb scales showed significant cytological changes during regeneration (Jha and Sen, 1987). Organogenesis like formation of shoots and roots occurred when the calli were 8-10 week old. Cytological analysis of the calli revealed the cells to be normal diploids. But with the increasing age of calli, polyploidy increased, and increasing cytological abnormality led to a drastic decline and finally loss in their potential to undergo organogenesis (Jha and Sen, 1987). Bulb scale explants from diploid plants formed friable calli which gave rise to embryonic calli when allowed to remain on 2, 4-D for a prolonged period (Jha, 1989). Calli obtained from explants raised on different media show different levels of karyological heterogeneity, being lowest with NAA and highest with 2, 4-D alone (Jha and Sen, 1990). Bulblets regenerated *in-vitro* produce bufadienolides-Proscillaridin A and Scillarin A, characteristic of the parent plant (Jha *et al.*, 1991).

Systematics of the species has been worked out by different workers (Oyewole, 1987a,b; Mustapha, 1996, 1997, 1999, 2000a,b; Oyewole and Mustapha, 2000). According to them, *U. indica* is a species complex comprising of different morphological variants which are reproductively isolated from each other (Oyewole, 1987a,b). The forms which vary in vegetative and floral morphology as well as anatomy occur in different ecological niches and their distribution is affected by three important factors of the environment-weather, temperature and soil (Mustapha, 1996, 1997). Chromosome morphometry of these forms also differs but differentiation at the morphological level is pronounced than that at the cytological level suggesting that chromosome repatterning may have been mild. This taxon, therefore, comprises a stable polymorphism in which different forms have attained genetic stability and each form has retained its morphological identity (Mustapha, 2000b). Hybridization between groups of the complex was unsuccessful indicating their reproductive and genetic isolation from one another. These results, further, established the fact that each form is a distinct genetic system related to but different from the other (Mustapha, 2009). This indicates that the complex comprising normal plants and variants is in a dynamic state of evolution. The taxon, thus, represents a stable polymorphism in which different forms have attained some amount of genetic stability and each form has retained its morphological identity (Mustapha, 2000b). Based on their detailed morphological, ecological and cytological analyses, therefore, Oyewole and Mustapha (2000) proposed the division of *U. indica* complex into three subspecies- *U. indica indica*, *U. indica augustifolia* and *U. indica tenuifolia*.

A new species of *Urginea*, *U. nana* from Nigeria (Oyewole, 1989) differs considerably from *U. indica* in morphology and meiotic behaviour. In *U. nana* a dicentric bridge is formed at anaphase-II. It is probably on account of this difference that Mustapha (1999) speculates *U. nana* to be a hybrid, parents of which have not been identified.

Differences in micromorphological features of the epidermis have been reported and considered taxonomic in significance (Shivakameshwari, 2011). These features may help in according a sub-specific status to the populations of *U. indica*.

U. indica is threatened in few regions due to non-awareness and habitat degradation (Shivakameshwari *et al.*, 2012). One of the populations of J&K growing in Kalakupar has also been completely destroyed due to NSEW corridor project under National Highway Development Programme which involves widening of NH-1A from Jammu to Srinagar. Not only the natural habitat but the germplasm as well is lost forever. Whatever could be saved has been saved by the authors and is safe in the Botanical Garden of University of Jammu. But this is in no way a substitution for the natural populations.

The bulbs found in coastal sand dunes are enriched with arbuscular mycorrhizal fungal species. These arbuscular mycorrhizal fungal species have the potential to stabilize the disturbed habitats and help in conservation of vulnerable species of *U. indica* (Kamble *et al.*, 2012). Studies of this sort are not available for J & K. This calls for an indepth study

and a means to regenerate the species in habitats similar to Kalakupar in J. & K. We, therefore, through this communication wish to motivate researchers and explorers to undertake more work on the species before it is lost to ruthless traders and urbanization.

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SHORT COMMUNICATION

CORRELATION AND PATH ANALYSIS FOR YIELD AND YIELD ATTRIBUTING CHARACTERS IN SOYBEAN (*GLYCINE MAX* L.)

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Abstract: A study was conducted atfield experimentcenter of department of Genetics and Plant Breeding, Allahabad School of Agricultural, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad, U.P. during kharif 2010 on 42 genotypes of soybean to determine the correlation and path analysis of yield and its components. Genotypic correlations were higher than the phenotypic and environmental ones for most of the characters exhibiting high degrees of genetic association among traits under consideration. Correlation coefficient for plant height, number of pods/plant, number of branches/ plant, biological yield /plant, seed index, harvest index and days to 50 % flowering showing positive significant correlation with grains yield per plant whereas days to maturity and number of grains per pod showing positive non-significant correlation with grain yield per plant at genotypic level.

Path coefficient analysis revealed that biological yield had maximum positive direct effect on grains yield per plant followed by harvest index, pod length, plant height, days to maturity and number of branches per plant.

Keywords: Soybean,correlation coefficient, path analysis

INTRODUCTION

Soybean (2n = 40), is a very important leguminous seed crop; known for its highly valued protein and oil owing to its use in food, feed, and industrial applications. It enriches the soil by fixing nitrogen in symbiosis with bacteria. In the international world trade markets, soybean is ranked number one in world among the major oil crops such as rapeseed, groundnut, cottonseed, sunflower, linseed, sesame and safflower.

The use of correlation coefficient is to establish the extent of association between yield and yield attributing traits, which are having decisive role in influencing the yield and determined the component characters in which selection can be based for genetic improvement in yield. However, it is only genetic variation which is heritable and hence important in any selection programme.

Path analysis provides information about the cause and effect situation in understanding the cause of association between two variables. It is quite possible that a trait showing positive direct effect on yield may have a negative indirect effect via other component traits. Path analysis permits the examination of direct effect of various characters on yield as well as their indirect effect via other component traits. Thus through the estimates of direct and indirect effects, it determines the yield components. Yield is complex character governed by a large number of quantitative characters, which are especially important in breeding programme.

MATERIAL AND METHOD

Forty two diverse genotypes of soybean RKS 63, PS 1476, JS 2030, NSO 81, VLS 77, KSO 245, PS 1477, US (SH) 2003.8, DS 15-2, MAUS 449, SL 778, PS 1480, VLS 76, JS 20-34, AMS-MB-5-18, MACS 1311, DSb – 20, KS 203, CSB 08-08, MAUS 453, NRC-86, AMS-MB-5-19, MACS 1336, RKS 61, US 20-29, NRC 85, TS 10, Dsb 18, SL 871, CSB 08-09, DS 27-11, NRC 87, Himso 1680, AMS 243, MACS 1201, BAUS 40, KDS 344, KBS 8, NRC 88, Bragg (check), SL – 525 (check) were grown in *kharif*2010 season at field experimentcenter of department of Genetics and Plant Breeding, Allahabad School of Agricultural, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad, U.P. These forty two genotypes included two checks were grown in RBD with three replication and with a plot size of 3 rows of 3m long. Each genotype was planted in plot consisting of row of 3m long with spacing of 45x10 m between rows and plants. Average data recorded on five randomly selected plants from each treatments in every replication for these characters plant height, number of branches per plant, days to 50% flowering, number of pod per plant, days to maturity, number of grain per pod, grain yield per plant, biological yield per plant and 100 seeds weight were used for statistical analysis.Correlation coefficient was computed at genotypic and phenotypic levels between pair of characters adopting following method by Johnson *et al.* (1955). Path coefficient analysis technique performed according to the method suggested by Dewey and Lu (1959).

RESULT

Correlation coefficient analysis

The total correlation coefficients with respect to various characters under study are presented in Table 1. The results regarding genotypic and phenotypic coefficients of correlation showed that the genotypic correlations were higher than the phenotypic for most of the characters exhibiting high degree of genetic association among traits under consideration. The environmental correlation coefficients were not very important in most of the cases indicating low

environmental influence in the experiment. Chand (1999) performed experiments on different varieties of soybean and revealed that the genotypic correlation coefficients for all characters studied were higher than the phenotypic and environmental correlation coefficients.

Grain yield per plant had significant positive association with biological yield per plant, number of branches per plant, harvest index (%), number of pod per plant, plant height, seed index, days to 50% flowering, , and pod length whereas grain yield per plant showed positive non-significant association with days to maturity and grains per pod at phenotypic level. Similar results were also reported by Harer and Deshmukh (1992).

Days to 50% flowering showed positive and significant correlation with days to maturity, plant height, number of pods per plant, biological yield per plant, grain yield per plant. While, it showed positive non- significant correlation of seed index and number of branches per plant, number of grain per pods, harvest index and pod length showed negative non-significant association with days to 50% flowering. Number of pods per plant showed positive and significant correlation with number of branches per plant, biological yield per plant, plant height and grains yield per plant. While number of grains per pod has positive non- significant association with number of pods per plant.

The trait pod length, number of grains per pod and grains yield per plant showed positive significant correlation while seed index, harvest index, number of branches per plant, biological yield per plant and number of branches per plant found the positive non-significant correlation. Positive and significant association of plant height was observed for biological yield per plant and grains yield per plantwhile, it has positive non- significant correlation of seed index, number of grains per pod and days to maturity. In case of days to maturity seed index showed significant and positive correlation while biological yield per plant, grains yield per plant and harvest index showed positive non-significant correlation with days to maturity.

However, the number of grains per pod showed positive non- significant correlation with harvest index and grains yield per plant. Seed index showed positive significant association with grains yield per plant and showed positive association with harvest index and biological yield per plant. Biological yield per plant as well as harvest index showed positive significant correlation with grains yield per plant.

Path coefficient analysis

Path analysis provides an aid for sorting out the total correlation into direct and indirect effect of different traits on yield. The result of path analysis (Table 2) revealed the highest direct positive effect on grain yield was expressed by biological yield per plant followed by number of branches per plant, harvest index (%), plant height, number of pod per plant, pod length, seed index, days to 50% flowering and grains per pod. Similar findings were reported by Srinives *et al*. (1986) and Arshad *et al*. (2006). Result of present study thus indicated that selection based on number of branches per plant plant height, number of pod per plant, pod length, seed index, days to 50% flowering and grains per pod can bring out grain yield improvement in soybean.

Table 1: Estimation of phenotypic correlation of different quantitative character with seed yield per plant in soybean

Character	Days to 50% flowering	No. of pods /plant	Pod length	Number of branches / plant	Plant height	Days to maturity	Number of grains / pod	Seed index	Biological yield /plant (g)	Harvest Index %	Grain yield per plant
Days to 50% flowering	1.000	0.282**	-0.050	0.139	0.331**	0.518**	-0.114	0.021	0.240**	-0.051	0.181*
Number of pods / plant		1.000	-0.006	0.476**	0.300**	-0.043	0.079	-0.093	0.432**	-0.172	0.236**
Pod length			1.000	0.057	-0.025	-0.011	0.246**	0.134	0.048	0.071	0.197*
Number of branches / plant				1.000	0.307**	0.119	0.245**	-0.060	0.552**	0.014	0.541**
Plant height					1.000	0.014	0.050	0.065	0.383**	-0.156	0.277**
Days to maturity						1.000	-0.129	0.297**	0.108	0.018	0.097
Grains / pod							1.000	-0.162	-0.045	0.170	0.108
Seed index								1.000	0.103	0.174	0.193*

Biological yield / plant									1.000	-0.321**	0.681**
Harvest index %										1.000	0.430**

*, ** are significant at 5% and 1% level respectively.

Table 2. Direct and indirect effect of yield component traits attributing seed yield in soybean at phenotypic level.

Character	Days to 50% flowering	No. of pods /plant	Pod length	Number of branches / plant	Plant height	Days to maturity	Number of grains / pod	Seed index	Biological yield /plant (g)	Harvest Index %	Grain yield per plant
Days to 50% flowering	**0.017**	0.005	-0.001	0.003	0.006	0.009	-0.002	0.001	0.004	-0.001	0.181
Number of pods / plant	-0.022	**-0.077**	0.001	-0.037	-0.023	0.004	-0.006	0.007	-0.032	0.014	0.236
Pod length	-0.006	-0.001	**0.114**	0.007	-0.003	-0.002	0.028	0.015	0.005	0.008	0.196
Number of branches / plant	0.009	0.029	0.004	**0.061**	0.019	0.007	0.015	-0.004	0.033	0.001	0.541
Plant height	0.019	0.017	-0.002	0.017	**0.056**	0.001	0.003	0.004	0.022	-0.009	0.277
Days to maturity	-0.011	0.001	0.001	-0.003	-0.001	**-0.020**	0.003	-0.006	-0.002	-0.001	0.097
Grains / pod	0.003	-0.002	-0.005	-0.005	-0.001	0.003	**-0.021**	0.003	0.001	-0.004	0.108
Seed index	-0.004	0.004	-0.006	0.003	-0.003	-0.013	0.007	**-0.042**	-0.005	-0.008	0.192
Biological yield / plant	0.212	0.382	0.042	0.487	0.338	0.095	-0.040	0.090	**0.884**	-0.283	0.680
Harvest Index (%)	-0.036	-0.122	0.051	0.010	-0.111	0.013	0.120	0.123	-0.228	**0.712**	**0.429**

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SHORT COMMUNICATION

KNOWLEDGE LEVEL OF SYSTEM OF RICE INTENSIFICATION (SRI) TECHNOLOGY AMONG FARMERS OF DHAMTARI DISTRICT OF CHHATTISGARH

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Abstract: Efficient transfer of innovation and their practical application to the field situation is the key to economic development of Chhattisgarh and India also. Still there is a wide gap between the development of innovation and their application at field level or farmers level. An attempt has been made to know the knowledge level of SRI technology. The present study was conducted in Dhamtari district of Chhattisgarh. The study revealed that majority of the respondents (80.16%) had high level of knowledge followed by 17.46 per cent of the respondents who have medium level of knowledge. Only 2.38 per cent of the respondents had low knowledge level. Out of eighteen recommended practices of SRI technology, maximum knowledge level was found towards Seeds soaked for 24 hours before raising nursery and minimum knowledge level was found towards No inundation to be done, field should be at saturation level.

Keywords: SRI technology, Knowledge and Paddy crop nutrients

INTRODUCTION

SRI technology is a civil society innovation occurred outside the formal research system that was first developed accidentally in Madagascar by Father Henri de Laulanié, in 1980, who combined field observations of rice plant performance with a series of experiments over a decade (Laulanié, 1993). SRI technology involves the transplanting of young seedlings, one per hill instead of a clump of several seedlings and 8-12 days old instead of the usual 3-4 weeks; very carefully but quickly, taking special care to protect the young roots; with wider spacing and in a square pattern to give both roots and canopy more room to grow, for taking up nutrients and capturing sunlight; maintaining the soil in mostly aerobic condition, not suffocating the plant roots or beneficial soil organisms; controlling weeds with a simple mechanical hand weeder that also actively aerates the soil; and enhancing the soil organic matter as much as possible with compost or mulch to 'feed the soil' so that the life within it will help feed and protect the growing plants.

The story SRI technology in India indicates the complex evolution process of innovation and development. Today, India has one of the largest numbers of SRI farmers in the world. Official record indicates that SRI diffused first to Tamil Nadu State, followed by Andhra Pradesh in India (Prasad, 2006). However, there is a need to study how SRI was diffused and adopted across the States of Tamil Nadu and Andhra Pradesh (Krishnan, 2008). In Chhattisgarh, the area under SRI technology in 2010-11 was 1317 hectares. In the year 2011-12, the area under SRI technology was 20,000 hectares. The average yield through SRI technology was recorded 5313 kg ha^{-1} (www.Cgagri.net). The area under SRI technology in current year (2013) in Kurud block is 400 hectares. (www.Cgagri.net). The knowledge of SRI technology adopters about recommended practices of SRI technology has a critical role in adoption of recommended practices to make rice farming more profitable and economical to farmers.

MATERIAL AND METHOD

The present study was conducted in 10 selected villages of Dhamtari district of Chhattisgarh, because productivity of rice is quite high and majority of rice area is under assured irrigation. The respondents were selected from Kurud block by the help of proportionate random sampling procedure. Thus a total of 126 respondents were selected as a sample for the study. Ex Post-facto design was followed in this study. The data were collected with the help of well structured and pre-tested interview schedule. The findings are presented here under:

RESULT AND DISCUSSION

The results of the investigation are being presented in subsequent Tables. The distribution of respondents according to the knowledge level of respondents on recommended practices of SRI technology is presented in Table 1.

Table 1. Distribution of respondents according to their overall level of knowledge about System of Rice Intensification (SRI) technology (n=126)

S. No	Level of knowledge	Frequency	Percentage
1	Low (Up to 33.33%)	03	02.38
2	Medium (33.34% – 66.66%)	22	17.46

3	High (Above 66.66%)	101	80.16
	Total	**126**	**100**

The result in the table 1 indicate that majority of the respondents (80.16%) had high level of knowledge about SRI technology followed by 17.46 per cent and 2.38 per cent of the respondents with medium and low level of knowledge, respectively. As majority of the respondents possessed high level of innovativeness, mass media exposure and information source utilization, they would have gain high level of knowledge on SRI cultivation. This is in agreement with the findings pertaining to the knowledge level of farmers in general reported by Vedpathak (2001) and Johnson and Vijayaragavan (2011).

Practice-wise knowledge of respondents on recommended practices of SRI technology

The result on knowledge level of respondents on selected practices of SRI technology are furnished in Table 2.

Table 2. Distribution of respondents according to practice wise level of knowledge about SRI technology (n=126)

S.No	Recommended practice	Level of knowledge		
		Low (Up to 3.33%)	Medium (33.34-6.66)	High (Above 66.66%)
1	Only 6 kg seed to be used for nursery	01 (0.79)	06 (04.76)	119 (94.45)
2	Seeds soaked for 24 hours before raising nursery	04 (03.17)	20 (15.87)	102 (80.96)
3	Seed treatment with fungicides	0 (0.00)	01 (0.79)	125 (99.21)
4	Raised beds to be used for raising nursery	10 (07.93)	30 (23.81)	86 (68.26)
5	Well decomposed manure to be applied to nursery	01 (0.79)	01 (0.79)	124 (98.42)
6	Seeds to be broadcast uniformly on the nursery bed	03 (02.38)	03 (02.38)	120 (95.24)
7	Transplanting with 8-12 day old nursery	08 (06.34)	20 (15.87)	98 (77.78)
8	Nursery to be removed along with soil without causing damage to nursery	03 (02.38)	03 (02.38)	120 (95.24)
9	Marker to be used for marking the main field	06 (04.76)	05 (03.97)	115 (91.27)
10	Transplanting to be done at field saturation condition	02 (01.58)	02 (01.58)	122 (96.84)
11	Drainage channels to be dug for every 2 meters in the main field	123 (97.62)	03 (02.38)	0.00 (0.00)
12	Spacing to be adopted is 25X25 cm	02 (01.58)	04 (03.18)	120 (95.24)
13	Only 16 plants to be transplanted m^{-2}	0 (0.00)	06 (04.76)	120 (95.24)
14	Only one plant to be raised $hill^{-1}$	0 (0.00)	06 (04.76)	1120 (95.24)
15	Nutrients to be provided through organic source	06 (04.76)	30 (23.81)	90 (71.43)
16	No inundation to be done , field should be at saturation level	0 (0.00)	03 (02.38)	123 (97.62)
17	Weedicides not to be applied for weeding	76 (60.31)	50 (39.69)	0.00 (0.00)
18	Cono weeder to be used for weeding	07 (05.55)	30 (23.81)	89 (70.64)

*Data are based on multiple responses

The result indicate that the majority of the respondents (94.45%) were having high level of knowledge about only 6 kg seed should be used for nursery, followed by 4.76 per cent of them were having medium level of knowledge and only 0.79 per cent of them were having low level of knowledge. Regarding seeds soaked for 24 hours before raising nursery, the majority of (80.96%) the respondents were having high level of knowledge followed by 15.87 per cent of the respondents were having medium level of knowledge and 3.17 per cent of them were having low level of knowledge. Regarding seed treatment with fungicides, the majority (99.21%) of the respondents was having

high level of knowledge and only 0.79 per cent of them were having medium level of knowledge. Regarding raised bed to be used for nursery, majority (68.26%) of the respondents were having high level of knowledge followed by 23.81 per cent of the respondents were having medium level of knowledge and 7.93 per cent of them were having low level of knowledge. Regarding well decomposed manure to be applied to nursery, the majority (98.42%) of the respondents was having high level of knowledge and similar percentage of respondents i.e. 0.79 per cent were having medium and low level of knowledge. Regarding seeds to be broadcast uniformly on the nursery bed the majority (95.24%) of the respondents were having high level of knowledge and similar percentage of respondents i.e. 2.38 per cent were having medium and low level of knowledge. Regarding transplanting with 8-12 days old nursery the majority (77.78%) of the respondents were having high level of knowledge followed by 15.87 per cent of the respondents were having medium level of knowledge and 6.34 per cent of them were having low level of knowledge. Regarding nursery to be removed with soil without causing damage to nursery the majority (95.24%) of the respondents were having high level of knowledge and similar percentage of respondents i.e. 2.38 per cent were having medium and low level of knowledge. Regarding marker to be used for marking the main field, the majority (91.27%) of the respondents were having high level of knowledge followed by 4.76 per cent were having low level of knowledge and 3.97 per cent of them were having medium level of knowledge. Regarding transplanting to be done at field saturation condition, the majority (96.84%) of the respondents were having high level of knowledge and equal percentage of respondents i.e. 1.58 per cent were having medium and low level of knowledge. Regarding drainage channels to be dug at every 2 metre in the main field, the majority (97.62%) of the respondents were having low level of knowledge and 2.38 per of them were having medium level of knowledge. Regarding spacing to be adopted 25X25 cm, the majority (95.24%) of the respondents were having high level of knowledge followed by 3.18 per cent of the respondents were having medium level of knowledge and 1.58 per cent of them were having low level of knowledge. Regarding only 16 plants to be raised m^{-2}, the majorities (95.24%) of the respondents were having high level of knowledge and 4.76 of them were having medium level of knowledge. Regarding only one plant to be raised $hill^{-1}$, the majorities (95.24%) of the respondents were having high level of knowledge and 4.76 of them were having medium level of knowledge. Regarding nutrients to be provided through organic source, the majority (71.43%) of the respondents were having high level of knowledge followed by 23.81 per cent of the respondents were having medium level of knowledge and 4.76 per cent of them were having low level of knowledge. Regarding no inundation to be done, field should be at saturation level, the majority (97.62%) of the respondents was having high level of knowledge and 2.38 per cent of them were having medium level of knowledge. Regarding weedicides not to be applied for weeding, the majority (60.31%) of respondents was having low level of knowledge and 39.69 per cent of them were having medium level of knowledge. Regarding con-weeder to be used for weeding, the majority (70.64%) of the respondents were having high level of knowledge followed by 23.81 per cent of the respondents were having medium level of knowledge and 5.55 per cent of them were having low level of knowledge.

CONCLUSION

It can be concluded that respondents belonged to high level of knowledge on SRI technology followed by medium and low level of knowledge. As SRI has been introduced to enhance yield level in paddy crops, the extension officials have been taking intensive efforts to fully popularize the technology. The knowledge was impacted by training programmes, field demonstration, study tours, personal visit and by publicity through mass media.

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SHORT COMMUNICATION

ECONOMICS OF OKRA CULTIVATION IN KORBA DISTRICT OF CHHATTISGARH

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Abstract: An attempt has been made in this study to examine the economics of okra cultivation in korba district of Chhattisgarh. The presented study was conducted in the korba district of Chhattisgarh. Hundred twenty (120) farmers were selected randomly from six villages of two selected blocks of the district. Primary were collected through well prepared personal interview methods with the help of pretested questionnaire and schedule for the year 2013-14. The sample mean and average method was adopted to calculate of the cost of cultivation. The major findings relevant that the average cost of cultivation were estimated as Rs. 34701.49 per ha. and it was found highest at large farms (Rs. 40197.25/ha) at the sample farms in the district. Cost of manure, fertilizer and seed was observed to be highest 43.61 per cent and 35.57 per cent respectively of the total input cost of okra calculated. The average yield was observed to be 98.45 qt/ha and varied from 123.39 qt/ha at large farms to 90.20 qt/ha at marginal farms. The average net income was calculated as Rs. 36379.41/ha while the figure was observed as Rs. 39640.11/ha and Rs. 44152.93 /ha for family labour income and family business income from okra cultivation. The input output ratio varied from 1:1.99 at marginal farms to 1:2.22 at large farms along with an average of 1:2.05 at different farms. Study suggested that the horticultural crop producer's co-operative societies should be formed for better performance and achievement of assured prices to vegetable growers. It is also suggested that varieties capable for resisting insect pest and disease should be provided and to be grown by the vegetable growers of the study area.

Keywords: Cultivation, economics, cost concepts, Chhattisgarh

INTRODUCTION

Vegetables are of much importance in the human nutrition. Also, the farmers could improve their economic position by growing vegetables. The vegetable business in recent years has been highly commercialized and consequently the business of growing vegetables was an important place. The per capita availability of vegetables per day in our country is less i.e. 180 gm/day which is far below the minimum for dietary requirement of 280 gm/day/person (Indian council of medical research). India is a second largest producer of vegetables next to china third in fruits after Brazil and USA. At present country is producing about 50.99 million tones of horticultural products per annum. The total area under vegetable cultivation is 6.25 million hectare in the country during 2012-13 which is 2.71 per cent of total gross cropped area. The total production of vegetable is 67.00 million ton in the country.

The total area under and the production of vegetable is 0.59 m. ha and 5.94 m MT in the state of Chhattisgarh during 2011-12. Okra is one among these different vegetables which is grown in Korba district while the agro-climate conditions are also favorable in other districts of the region. Topographically this district is covered under the industrialization and due to these; area under cultivation is very less in the district.

In this context, a study was conducted to provide the basic information viz., way of cultivation, economics crop and utilization of resources in the right way so that farmers can produces more quantity of crop and can take the profit of less distance of market to sell timely and realize the better price of their produce. Therefore, an attempt has been made in order to analyze the economics of okra cultivation in Korba district of Chhattisgarh.

MATERIAL AND METHOD

Out of 27 district of Chhattisgarh, Korba district was selected purposely for the study. Korba district having 5 blocks Korba, Kartala, Katghora, Pali and Pondiuproda. Out of 5 blocks of Korba district, 3 blocks namely Kartala, Katghora and Pali were selected due to more or less similar socio-economic condition of the district. Out of these selected blocks, six villages namely, Patiyapali, Barpali, Pandaripani, Jhora, Podilapa, and Podi were selected randomly for the study purpose. A sample of 120 respondents is selected by using probability proportional to size techniques method subject to condition that at least 10 respondents would be included on sample from each of four categories' of farms i. e. marginal (0 to 1ha.), small (up to2 ha.), medium (>2 to 4 ha.) and large farmer (above 4 ha.).

Cost of cultivation of okra at sample farms

The cost of cultivation of okra is given in table 01 which clearly shows that the cost of cultivation per hectare of okra was higher on large farms as compared to marginal farms and small farms. The average per hectare cost of cultivation of okra was estimated as Rs. 34701.49/ha. The cost of cultivation in case of large farm was estimated higher i.e. (Rs. 40197.25/ha) as compared to marginal farms (Rs. 32656.93/ha), small farms (Rs. 33713.87/ha) and medium farms (Rs.

37997.80/ha) respectively at sample farms.

Among different inputs in the cultivation of okra, manure, fertilizer, seed and total labour cost together constituted about more than 90 per cent of the total cost of cultivation among different farms. Out of the total cost of cultivation, cost incurred on manure and fertilizer was estimated on average Rs. 15655.24 (43.61 per cent) per ha which varied from Rs. 15655.11 at large farms to Rs. 15340.11/ha at small farms. This wide variation is mainly due to higher price and more quality of fertilizer used by the farmers. The next major cost was observed as Rs. 12343.07 (35.57 per cent) per ha of seed at these farms. Farmers generally produce high quality of seed due to rainy season of crop seems an important reason behind this high cost on seed. Due to rainy season and picking operations in this crop, cost of total labour (both family and human labour) together constituted about 14 per cent of total cost. The total cost was estimated as Rs. 4931.07/ha at the sample farms. The show of total variable cost was estimated at 98.49 per cent which the figure of total fixed cost was observed 1.51 per cent of total cost of cultivation of okra crop in the district.

Yield, value of output and cost of production per quintal

The yield, value of output per hectare and cost of production per quintal of okra on the sample farms is presented in Table 02: Table clearly shows that the average yield was observed 98.45 qt/ha in the district. The farmers of large and medium are realized more yield i.e. 123.39qt/ha and 111.76 qt/ha as compared to be farms of marginal 90.20 qt/ha and small 96.09 qt/ha in the district. Trend was observed in the total value of production of this crop across. the.

Table 1. Cost of cultivation of Okra on different size groups of farms (Rs./ha)

S.No.	**Particulars**	**Marginal**	**Small**	**Medium**	**Large**	**Overall**
1	Family human labour	3998.47	3733.72	1538.05	1130.42	3260.7
		(12.24)	(11.07)	(4.05)	(2.81)	(9.40)
2	Hired human labour	641.58	1031.41	3703.04	4704.48	1670.32
		(1.96)	(3.06)	(9.74)	(11.70)	(4.81)
	Total	4640.05	4765.13	5241.09	5834.9	4931.07
		(14.21)	(14.13)	(13.79)	(14.51)	(14.21)
3	Bullock labour	533.46	557.29	251.52	303.44	594.57
		(1.63)	(1.65)	(0.66)	(0.75)	(1.71)
4	Machine power	0.00	0.00	1750.00	1903.85	468.47
		(0.00)	(0.00)	(4.60)	(4.74)	(1.35)
5	Seed cost	11556.07	11897.42	13868.57	14851.07	12343.07
		(35.39)	(35.30)	(36.50)	(36.94)	(35.57)
6	Manure & Fertilizer	14834.54	15340.11	15455.45	15655.11	15134.24
		(45.42)	(45.50)	(40.67)	(38.94)	(43.61)
7	Plant protection	98.53	134.85	168.5	236.77	132.82
		(0.30)	(0.40)	(0.44)	(0.60)	(0.38)
8	Irrigation charges	501.71	510.83	691.12	808.06	574.41
		(1.54)	(1.51)	(1.82)	(2.01)	(1.65)
9	Land revenue	10.00	10.00	10.00	10.00	10.00
		(0.03)	(0.03)	(0.03)	(0.03)	(0.03)

10	Interest on working Capital (@ 3%)	482.61	498.23	561.54	594.05	512.82
		(1.48)	(1.48)	(1.48)	(1.48)	(1.48)
	Total Input cost	32656.93	33713.87	37997.80	40197.25	34701.49
		(100.00)	(100.00)	(100.00)	(100.00)	(100.00)

Note: Figures in parenthesis indicate per cent of total input cost.

farms. The average value of production was observed as Rs. 71080.90/ha in the district, while the figure was estimated as Rs. 352.48 to produce the quintal of okra crop in the district

Table 2. Per hectare yield, value of output and cost of production per quintal of Okra (Rs./ha)

S.No.	Particulars	Marginal	Small	Medium	Large	Overall
1.	Input cost (Rs.)	32656.93	33713.87	37997.80	40197.25	34701.49
2.	Yield (Qtl)	90.20	96.09	111.76	123.39	98.45
3.	Value of production (Rs.)	65124.40	69376.98	80690.72	89087.58	71080.9
4.	Cost of production (Rs/qt)	362.05	350.86	340.00	325.77	352.48

Cost and return of okra at sample farms:

Table 3 clearly indicates that, on average farmers received a total net income of Rs. 36379.41/ha from okra cultivation to spent the total cost of Rs. 34701.49/ha total family labour income from okra cultivation was estimated as Rs. 39640.11 /ha while the figure was observed as Rs. 44152.93/ha for farm business income in the cultivation of okra crop in the district. The input-output ratio was observed 1:1.99, 1:2.05, 1:2.12 and 1:2.22 at marginal, small, medium and large farms with an average of 1:2.05 in the district which shows the cultivation of okra is profitable to the farms of district.

Table 3. Cost and return of Okra on the sample farms for different group of farms (Rs./ha). Cost and returns on the basis of cost concept

			Farm size			
S.No.	**Particulars**	**Marginal**	**Small**	**Medium**	**Large**	**Overall**
1.	Input cost	32656.93	33713.87	37997.80	40197.25	34701.49
2.	Output value	65124.40	69376.98	80690.72	89087.58	71080.90
3.	Net income	32467.47	35663.11	42692.92	48890.33	36379.41
4.	Family labour income(Rs./qtl)	36465.94	39396.83	44230.97	50020.75	39640.11
5.	Family business income	40948.55	43895.06	87924.51	54614.80	44152.93
6.	Input output ratio	1:1.99	1:2.05	1:2.12	1:2.22	1:2.05

The Cost and returns on the basis of cost concept in the production of okra have been presented in the Table 04. Table portrays that, on an average cost-A, cost-B and cost-C were worked out to Rs. 31441.49, Rs. 35441.49 and 38702.19 per hectare respectively at the sample farms. It was noted that rupees 4000.00 were considered as imputed rental value of owned land for each crop season. The incomes over different costs were also worked out. The average income over cost-A, cost-B and cost-C were calculated as Rs. 39640.11, Rs. 35640.11 and Rs. 32379.41 per hectare, respectively.

Table 4. Economics of Okra on different size groups of farms (Rs./ha)

S. No.	Particulars	Marginal	Small	Medium	Large	Overall
A.	**Break-up of cost**					
	a. Cost A	28658.46	29980.15	36459.75	39066.83	31441.49

	b. Cost A_1	28658.46	29980.15	36459.75	39066.83	31441.49
	c. Cost B	32658.46	33980.15	40459.75	43066.83	35441.49
	d. Cost C	36656.93	37714.44	41997.80	44197.25	38702.19
B.	**Income over different**					
	a. a. Income over cost A	36465.94	39396.83	44230.97	50020.75	39640.11
	b. b. Income over cost A_1	36465.94	39396.83	44230.97	50020.75	39640.11
	c. Income over cost B	32465.94	35396.83	40230.97	46020.75	35640.11
	d. Income over cost C	28467.47	31663.11	38692.92	44890.33	32379.41

CONCLUSION

The foregoing analysis concludes that the manure and fertilizer and seed are the important inputs in the cultivation of okra crop constituted about more than 43 percent and 35 percent of the total cost of cultivation. Across the different from size, the total cost of cultivation was observed highest at large farm i.e. Rs. 40197.25 per hectare followed by medium farm Rs. 37997.80 per hectare, small Rs. 33713.87 per hectare and marginal Rs. 32656.93 per hectare along with an average of Rs. 34701.49 per hectare due to this, the trend of yield of realization was observed as the highest cost incurred by the farms. The highest yield was observed 123.39 qt/ha at large farms while it was lowest at marginal farms i.e. 90.20 qt/ha in the district. The average gross return from okra cultivation was estimated as Rs. 71080.90 per ha while per quintal cost of production was observed Rs. 352.48 at farms. Net income from okra cultivation was observed as Rs. 36379.41/ha. The input output ratio was observed as 1:2.05 across the farms in the district.

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SHORT COMMUNICATION

EVALUATION OF SWEET POTATO (*IPOMOEA BATATAS* (L.) LAM.) GENOTYPES FOR YIELD AND YIELD ATTRIBUTING CHARACTERS UNDER AGRO-CLIMATIC CONDITION OF CHHATTISGARH

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Abstract: An experiment was conducted at Research and Instructional Farm of Department of Horticulture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during the *rabi* season of 2013-2014 with an objective to find out sweet potato genotypes suitable for Chhattisgarh plains. The experiment was laid out in randomized block design in three replications with twelve genotypes of sweet potato. Observations in respect of growth yield and quality parameters were recorded on five competitive random plants from each replication. According to mean performance of the sweet potato genotypes in respect to tuber yield per hectare, IGSP-20 (37.33 t/ha) was found significantly superior than the other genotypes evaluated.

Keywords: Sweet potato, genotypes, yield, characters

INTRODUCTION

Sweet potato [*Ipomoea batatas* (L.) Lam.] locally known as Shakarkand is one of the most popular tuber crops in India and abroad because of its yield potential and high calorific value. It is mainly cultivated almost in all the tropical and subtropical countries as well as in the warmer region of temperate countries. Sweet potato is the world's seventh most important food crop other than wheat, rice, maize, barley, potato and cassava. Among the major tuber crops cultivated in India, sweet potato ranks third next to potato and cassava in area and production. In India, it is grown in an area of 1.12 Lakh ha and produces 11.57 Lakh MT with a productivity of 10.33 t/ha (Anon., 2013). Odisha is leading state in area and production of sweet potato, whereas, productivity is highest in Andhra Pradesh. In Chhattisgarh state, it is cultivated in an area of 3.71 thousand hectare area with production of 37.8 thousand tonnes and productivity of 10.189 t/ha. (Anon, 2013). In spite of climatic suitability the area, of sweet potato in Chhattisgarh state is very low as compared to other state and the national acreage. Although the crop is very popular in urban as well as rural area of the state but it is cultivated in limited area. Unavailability of planting material as early bulking, high yielding and better quality varieties is one of the major factor for limit the area and production of this crop. However, to improve the tuber yield in Chhattisgarh, this study was conducted to evaluate the performance of sweet potato genotypes during *rabi* season.

MATERIAL AND METHOD

The present study was conducted at Research and Instructional Farm, Department of Horticulture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during the *rabi* season of 2013-2014. The experimental material comprised of twelve genotypes (Indira Madhur, Indira Naveen, Indira Nandini, Sree Rethna, IGSP.C-15, Gauri, IGSP-20, IGSP-21, IGSP-39, IGSP-36, IGSP-24 and IGSP-25) of sweet potato and the experiment was laid out in a randomized block design with three replications at the spacing of 60 cm between rows and 20 cm between plants to plant. A plot size of 1.8 m x 2 m was kept for each genotype. All the recommended cultural practices were taken to grow a healthy crop. Data were recorded on five randomly selected plants for fourteen characters *viz*., vine length (cm), inter node length (cm), vine diameter (cm), vine weight (g), number of tubers per plant, neck length (cm), tuber length (cm), tuber diameter (cm), tuber yield per plant (g), marketable tuber yield per plant (g), weevil tuber yield per plant (g), biological yield per plant (g), harvest index (%), dry matter percentage of tuber, dry matter percentage of vine and TSS (%). Three characters *viz*., tuber yield (t/ha), marketable tuber yield (t/ha) and weevil infested tuber yield (t/ha) were calculated on the basis of observed yield data.
The data were subjected to statistical and biometrical analysis (Singh and Chaudhary, 1985).

RESULT AND DISCUSSION

The mean values of different growth parameters with respect to genotypes are presented in table 1. Wide range of variation was found for vine length, vine weight, neck length, tuber yield, biological yield per plant, harvest index and narrow range for vine diameter, tuber length, tuber diameter, dry matter percentage of both vine and tuber and TSS.
Maximum vine length was recorded in Sree Rethna (183.7 cm) followed by Gauri (132.8 cm), Indira Nandini (108.70cm) and IGSP-20 (104.93 cm) whereas, the highest inter node length recorded in Sree Rethna (5.47 cm) followed by Indira Nandini (4.63 cm) and Indira Naveen (4.30 cm). Mean performance of vine diameter was recorded maximum in IGSP-25 (0.47 cm) followed by IGSP-20 (0.46), IGSP-39 (0.45), IGSP-36 (0.45) and

maximum vine weight was recorded in Indira Naveen (555.33 g) followed by Sree Rethna (543.80 g), IGSP-25 (533.33 g) and IGSP-20 (532.43 g).

The number of tubers per plant found maximum in Gauri (5.57) which was followed by Indira Naveen (4.83) and Indira Nandini (4.70), whereas, largest neck length observed in IGSP-25 (8.61 cm) followed by IGSP-20 (7.39 cm), Indira Madhur (5.67 cm) and maximum tuber length was found in IGSP-25 (19.06 cm) followed by Indira Naveen (18.67 cm) and IGSP-20 (18.51 cm). IGSP-20 was showed maximum tuber diameter (4.15 cm) and maximum tuber yield per plant (487.3 g). The significantly highest total yield per hectare was recorded in genotype IGSP-20 (37.33 t/ha) followed by Indira Naveen (23.15 t/ha) and Sree Rethna (23.01 t/ha). The marketable tuber yield was same as total tuber yield because weevil infested tuber yield was only seen in one genotype (Indira Naveen). Whereas, lowest tuber yield was obtained in genotype IGSP-36 (10.11 t/ha). Similar findings were also reported earlier by Goswami (1990), Kamalam (1990), Tirkey (2006), Saikia *et al.* (2009) and Mhaskar *et al.* (2013). The maximum biological yield per plant was obtained by the genotype IGSP-20 (1030.2 g) which was significantly superior to all the genotypes. The maximum harvest index was obtained in IGSP-C-15 (65.50%) which was statistically similar with IGSP-24 (58.73%), IGSP-20 (48.3%), Indira Nandini (41.1%). The maximum dry matter per cent of foliage was obtained in Gauri (27.13%) and maximum dry matter per cent of tuber was obtained in IGSP-39 (36.6%). Maximum TSS recorded IGSP.C-15 (16.87%) followed by IGSP-25 (13.43%), IGSP-20 (11.1%), IGSP-24 (10.83%) and Gauri (10.67%).

Table 1. Mean performance of tuber yield and its components in sweet potato

Treatment/character	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Indira Madhur	67.40	2.90	0.41	235.77	4.17	5.67	15.98	2.10	171.3	171.3	0	12.85	12.85	0	407.1	42.13	22.97	24.43	9.5
Indira Naveen	86.13	4.30	0.41	555.33	4.83	4.54	18.67	2.33	308.7	291.7	17.3	23.15	21.87	1.28	864	35.4	22.47	26.67	7.5
Sree Rethna	183.70	5.47	0.44	543.80	3.93	5.21	14.19	3.14	306.7	306.6	0	23.01	23.01	0	838.67	36.43	23.01	32.03	8.43
Indira Nandini	108.70	4.63	0.43	343.10	4.70	5.50	16.44	2.83	239.3	239.3	0	17.96	17.96	0	582.63	41.1	22.8	31.53	9.2
IGSP.C-15	49.87	2.03	0.41	138.40	1.93	3.37	12.34	2.74	277.7	277.6	0	20.83	20.83	0	416.17	65.5	22.13	28.4	16.87
Gauri	132.80	3.70	0.37	491.33	5.57	4.01	15.26	2.71	239.7	239.6	0	20.48	20.48	0	764.43	35.6	27.13	36.57	10.67
IGSP-20	104.93	3.40	0.46	532.43	3.37	7.39	18.51	4.15	487.3	487.3	0	37.33	37.33	0	1030.2	48.3	20.11	27.13	11.1
IGSP-39	89.03	3.90	0.45	405.10	4.40	4.22	14.27	3.15	284.3	284.3	0	21.33	21.33	0	689.53	41.3	22.11	36.6	8.33
IGSP-21	61.77	2.17	0.29	427.53	3.93	4.27	15.73	2.76	260	260	0	19.51	19.51	0	687.73	37.67	23.43	28.47	8.97
IGSP-25	53.07	2.03	0.47	533.33	3.27	8.61	19.06	2.21	228.3	228.3	0	17.13	17.13	0	761.77	29.97	25.4	35.23	13.43
IGSP-24	39.30	1.47	0.40	107.43	4.13	3.54	15.41	2.87	153.3	153.3	0	11.51	11.51	0	260.77	58.73	22.1	32.03	10.83
IGSP-36	91.13	2.70	0.45	446.10	4.00	1.84	16.21	3.00	145.3	145.3	0	10.11	10.11	0	580.3	23.33	19.27	21.53	7.27
Mean	**88.98**	**3.22**	**0.41**	**396.63**	**4.01**	**4.84**	**16.0**	**2.83**	**258.5**	**257.0**	**1.4**	**19.59**	**19.49**	**0.1**	**656.94**	**41.28**	**22.74**	**30.05**	**10.17**
SEm	**4.2**	**0.23**	**0.03**	**29.8**	**0.30**	**0.38**	**0.69**	**0.26**	**25.9**	**24.9**	**4.89**	**1.7**	**1.7**	**0.3**	**42.83**	**2.62**	**0.76**	**0.76**	**0.26**
CD	**12.67**	**0.73**	**0.10**	**89.65**	**0.91**	**1.16**	**2.07**	**0.78**	**77.9**	**74.9**	**14.67**	**5.3**	**5.3**	**1.0**	**128.5**	**7.88**	**2.28**	**2.28**	**0.80**
CV (%)	**8.42**	**13.32**	**16.35**	**13.34**	**13.57**	**14.81**	**7.70**	**16.66**	**17.80**	**17.22**	**600**	**16.49**	**17.21**	**600**	**11.58**	**11.4**	**6.26**	**4.81**	**4.8**

1. Vine length (cm), 2. Inter node length (cm), 3. Vine diameter (cm), 4. Vine weight (g), 5. Number of tubers per plant, 6. Neck length, (cm), 7. Tuber length (cm), 8. Tuber diameter (cm), 9. Tuber yield (g/plant) 10. Marketable tuber yield (g/plant), 11. Weevils infested tuber yield (g/plant), 12. Tuber yield (t/ha) 13. Marketable tuber yield (t/ha), 14. Weevil infested tuber yield (t/ha), 15. Biological yield (g/plant), 16. Harvest index (%), 17. Dry matter % of foliage, 18. Dry matter % of tuber and 19. TSS (%)

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SHORT COMMUNICATION

ADOPTION OF PLANT PROTECTION MEASURES BY GROUNDNUT GROWERS

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Abstract: The study was conducted in 20 selected villages of four blocks of Raigarh district of Chhattisgarh with sample size of 160 respondents to assess the extent of adoption of plant protection measures in groundnut crop and farmers perception regarding yield losses due to various insect pests and diseases in groundnut crop. The finding revealed that majority of the groundnut growers fell under medium adoption category (59.37 %). In case of practice wise level of adoption none of the groundnut growers adopted the insect tolerant variety, whereas 63.12 per cent of the groundnut growers were partial adopted the 'use of insecticides', while 49.38 per cent growers were complete adopted the crop rotation for control of insect pests and diseases in the crop. The study indicated that among the selected independents variables, eight variables i.e. education, caste, land holding, annual income, source of information, knowledge about plant protection measures, attitude and scientific orientation were found significant and positively correlated with extent of adoption of plant protection measures and in multiple regression analysis only 4 variables i.e. land holding, annual income, knowledge and scientific orientation had significantly contributed in adoption of plant protection measures in groundnut crop.

Keyword: Adoption, Plant protection measures, Groundnut and Groundnut growers

INTRODUCTION

The groundnut (*Arachis hypogaea* Linn.) is the most popular oilseed crop in India. Our country is the second largest producer of groundnut after China and has an area of over 5.31million hectare with production of 6.93 million ton with average yield 1305 kg /hectare. Major groundnut growing states are Gujarat, Tamil Nadu, Andhra Pradesh, Rajasthan and Karnataka which cover the 85 % of the area and 84 % of the groundnut production and minor producing states are Maharashtra, Madhya Pradesh, Uttar Pradesh, Orissa and Chhattisgarh etc (Anonymous, 2012). In Chhattisgarh groundnut covers an area around 29397 hectare with the production of 40504 MT, among the all districts of Chhattisgarh state, Raigarh district is higher in both area and production which covers an area 7572 hectare and production 9930 MT (Anonymous, 2013-14). However, the production of groundnut of Raigarh district is very low, this might be due to losses caused by insect pests and diseases is one of the reason. The most serious insect pest of groundnut is white grub (Arun katyayan 2008). In addition, bihar, red hairy and tobacco caterpillars, leaf minor, aphid, thrips and termite etc are the important pest of the crop. Among diseases, leaf spot, rust, root rot, stem rot and bud necrosis are serious.

Late leaf spot caused by *Phaeoisariopsis personata* [(Berk and Curt) v. Arx = *Cercosporidium personatum* (Berk. & Curt.) Deighton] and rust caused by *Puccinia arachidis* (Speg.) are the two most destructive fungal foliar diseases of groundnut worldwide. Together, these two diseases can cause more than 50 per cent yield loss in groundnut in many countries (Pande *et al*. 2001). The present study was taken up with the objectives to assess the extent of adoption of plant protection measures in groundnut crop by the groundnut growers and to assess the farmers perception regarding yield losses due to various insect pests and diseases of groundnut crop.

RESEARCH METHODOLOGY

The present study was conducted in Raigarh district of Chhattisgarh state during the year 2013-14. Raigarh district has 9 blocks, out of which only four blocks i.e. Baramkela, Pussor, Sarangarh and Raigarh were selected purposively for this study because of maximum area under groundnut cultivation. Out of the total villages of Baramkela, Pussor, Sarangarh, and Raigarh blocks, five villages from each block were selected purposively, thus the total 20 villages from four blocks were selected. Eight groundnut growers were selected randomly from each selected village. Thus the total 160 groundnut growers (8X20=160) were considered as respondent for this study and the data were collected personally through pre-tested interview schedule. The collected data were tabulated and analysed by using appropriate statistical tools i.e. mean, standard deviation, frequency, per cent, range, coefficient of correlation and multiple regression etc.

To measure the extent of adoption of plant protection measures in groundnut crop. The important practices (9 items) were listed and responses for each practice was given score 3, 2 and 1 for complete adoption, partial adoption and not adoption, respectively. The adoption index score of each grower was then worked out using the formula; total score obtained by the respondent divided by maximum score that could be obtained multiplied by 100. Further the respondents were classified into three categories:

a) Low level adoption: < $\overline{X}$ – S.D.

b) Medium level adoption: in between $\overline{X}$ ± S.D.

c) High level of adoption: > $\overline{X}$ + S.D.

RESULT AND DISCUSSION

Table 1. Distribution of respondents according to over all adoption level regarding plant protection measures in groundnut crop n=160

S.No.	Extent of adoption	Frequency	Per cent
1.	Low (up to 10 score)	30	18.75
2.	Medium (11-15 score)	95	59.37
3.	High (16 and above score)	35	21.88
	Total	**160**	**100.00**

$\overline{X}$ = 13.23 S.D. = 2.83

The findings on overall extent of adoption of plant protection measures in groundnut crop by the groundnut growers are presented in Table 1. The finding reveals that 59.37 per cent of the respondents were having medium level of adoption of plant protection measures in groundnut crop. Whereas 21.88 and 18.75 per cent of them had high and low level of adoption of plant protection measures in groundnut crop, respectively. Jondhale *et al.* (2003) and Ram *et al.* (2012) also reported almost similar findings in their studies.

Table 2. Practice wise level of adoption of the respondents regarding plant protection measures in groundnut crop n=160

S.N.	Plant protection measures in groundnut	Level of adoption		
		Not adoption f (%)	Partial adoption f (%)	Complete adoption f (%)
1.	Insect tolerant variety	160 (100.00)	00 (00.00)	00 (00.00)
2.	Use of light trap/pheromone trap	153 (95.62)	02 (01.25)	05 (03.13)
3.	Crop rotation	61 (38.12)	20 (12.50)	79 (49.38)
4.	Use of beneficial insect	155 (96.88)	04 (02.50)	02 (01.25)
5.	Use of insecticide	26 (16.25)	101 (63.13)	33 (20.62)
6.	Seed treatment	92 (57.50)	55 (34.38)	13 (08.12)
7.	Disease resistance/tolerant variety	98 (61.25)	10 (06.25)	52 (32.50)
8.	Use of bio fungicide	143 (89.38)	16 (10.00)	01 (00.62)
9.	Use of fungicide	60 (37.50)	76 (47.50)	24 (15.00)

f (Frequency), % (Per cent)

The data presented in Table 2 reveals that the respondents had complete adoption regarding selected practices of plant protection measures in groundnut crop i.e. crop rotation (49.38%), use of disease resistance/tolerant variety (32.50%), use of insecticide (20.62%), use of fungicide (15.00%), seed treatment (8.12%), use of light trap/pheromone trap (3.13%), use of beneficial insect (1.25%), use of bio fungicide (0.62%) and none of the respondents had high level of adoption regarding insect tolerant variety. In case of partial level of adoption, highest percentage of respondents had observed in use of

insecticide (63.13%), use of fungicide (47.50%), seed treatment (34.38%), crop rotation (12.50%), use of bio fungicide (10.00%), use of disease resistance/tolerant variety (6.25%), use of beneficial insect (2.50%), use of light trap/pheromone trap (1.25%) and none of the respondents had partial level of adoption regarding insect tolerant variety. While in case of not adoption of selected practices of plant protection measures in groundnut crop, cent per cent of the respondents (100.00%) had not adopted insect tolerant variety, use of beneficial insect (96.88%), use of light trap/pheromone trap (95.62%), followed by use of bio fungicide (89.38%), use of disease resistance/tolerant variety (61.25%), seed treatment (57.50%), crop rotation (38.12%), use of fungicide (37.50%) and use of insecticide (16.25%).

Table 3. Farmers perception regarding yield losses due to various insect pest and diseases in groundnut crop

S.N.	Name of the insect pest and diseases	Yield losses in kg/hectare	Frequency	Per cent
1.	Aphid	10 - 49	78	48.75
2.	Thrips	10 - 37	50	31.25
3.	White grub	20 – 123	99	61.87
4.	Leaf minor	12– 74	68	42.50
5.	Bihar, Red hairy and Tobacco caterpillars	37– 99	100	62.50
6.	Leaf spot	25 – 74	97	60.62
7.	Root rot	16– 111	75	46.87
8.	Rust	20 – 66	79	49.37

*Frequency based on Multiple Responses

The data presented in Table 3 indicates that majority of the respondents (62.50%) were reported that Bihar, Red hairy and Tobacco caterpillars were the most serious insect pests in groundnut crop. It causes 37 – 99 kg/ha yield losses, followed by 61.87 per cent of the respondents were reported 20 – 123 kg/ha yield losses due to White grub, 48.75 per cent of the respondents were reported 10 – 49 kg/ha yield losses due to Aphid, 42.50 per cent of the respondents were reported 12 – 74 kg/ha due to Leaf minor and 31.25 per cent of the respondents were reported 10 – 37 kg/ha losses due to Thrips.

Whereas in case of yield losses due to diseases majority of the respondents (60.62%) were reported 25-74 kg/ha yield losses due to leaf spot, followed by 49.37 per cent of the respondents were 20-66 kg/ha. yield losses due to Rust and 46.87 per cent of the respondents were reported 16-111 kg/ha. yield losses due to Root rot.

Table 4. Correlation analysis of independent variables with adoption of plant protection measures in groundnut crop

S.N.	Independent variables	Coefficient of correlation "r" value
01.	Education	0.602**
02.	caste	0.200*
03.	Social participation	0.132NS
04.	Land Holding	0.412**
05.	Occupation	0.107NS
06.	Annual income	0.348**
07.	Credit acquisition	0.114NS
08.	Contact with extension agencies	0.102NS
09.	Source of information	0.460**
10.	Knowledge	0.889**

11.	attitude	0.198*
12.	Scientific orientation	0.485**

** Significant at 0.01 level of probability
* Significant at 0.05 level of probability
NS = Non significant

It is clear from the data in Table 4 that the variables education, land holding, annual income, sources of information, knowledge and scientific orientation were found positively and highly significantly related with adoption at 0.01 per cent level of significance, whereas caste and attitude had positively and significantly related with adoption at 0.05 per cent level of significance, it's means when the level of the above variables *viz.* education, land holding, annual income, sources of information, knowledge and scientific orientation increases then the adoption of the respondents will increase. Whereas other variables like social participation, occupation, credit acquisition and contact with extension agencies showed statistically non significant correlation with adoption of plant protection measures in groundnut crop.

Table 5. Multiple regression analysis of independent variables with adoption of plant protection measures in groundnut crop

S.N.	**Independent variables**	**Regression Coefficient "b" value**	**"t" value**
01.	Education	0.133	1.261
02.	caste	0.009	0.077
03.	Social participation	-0.204	-1.531
04.	Land Holding	0.091*	2.508
05.	Occupation	-0.011	-0.162
06.	Annual income	0.276*	2.329
07.	Credit acquisition	0.023	0.099
08.	Contact with extension agencies	0.002	0.021
09.	Source of information	0.082	0.759
10.	Knowledge	0.801**	13.524
11.	attitude	0.091	1.619
12.	Scientific orientation	0.119*	2.313

** Significant at 0.01 level of probability
* Significant at 0.05 level of probability

R^2= 0.69
F value of r = 46.30

Multiple regression analysis of independent variables with the adoption of plant protection measures in groundnut crop is compiled in Table 5. It revealed that out of the twelve variables under study only one variable knowledge had highly significant and positive contribution towards adoption at 0.01 per cent level of significance and three variables namely land holding, annual income, and scientific orientation had significant and positive contribution towards adoption at 0.05 per cent level of significance. The remaining eight variables viz. education, caste, social participation, occupation, credit acquisition, contact with extension agencies, attitude and scientific orientation had no significant contribution towards adoption of plant protection measures in groundnut crop. However, all the selected 12 variables in the model show 69 percent contribution in the adoption of plant protection measures in groundnut crop.

CONCLUSION

From the findings, it can be concluded that majority of the groundnut growers were in medium range category. In case of practice wise level of adoption, most of the groundnut growers had complete adoption of crop rotation and use of diseases resistance/tolerant variety, whereas partial adoption, majority of the groundnut growers had partial adoption of insecticide use, use of fungicide and seed

treatment, while in case of not adoption, cent per cent of the groundnut growers had not adopted insect tolerant variety, use of beneficial insect and use of light trap/ pheromone trap. It's may be due to lack of technical knowledge and non availability of insect tolerant variety, beneficial insect and light trap/ pheromone trap etc at local market. The majority of groundnut growers were reported that Bihar, Red hairy and Tobacco caterpillars and leaf spot were the most serious insect pests and diseases in groundnut crop. Out of selected 12 independent variables, eight variables i.e. education, caste, land holding, annual income, source of information, knowledge about plant protection measures, attitude and scientific orientation were found significant and positively correlated with extent of adoption of plant protection measures in groundnut crop. In regression analysis only 4 variables i.e. land holding, annual income, knowledge and scientific orientation had significantly contributed in adoption of plant protection measures in groundnut crop.

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SHORT COMMUNICATION

EFFECT OF DRIP FERTIGATION ON QUALITY OF GUAVA (*PSIDIUM GUAJAVA* L.)

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Abstract: The study on 'Effect of drip fertigation was conducted in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during 2009-2010 with Split – Split – Plot Design. The quality parameters were significantly influenced by varieties, drip level and fertigation level. The highest TSS (11.210Brix), total sugar (11.03%), pectin (3.56%) were recorded in T_{17} ($V_2D_2F_1$) and highest ascorbic acid (196.55 mg/100g pulp) was recorded in T_1 ($V_1D_1F_1$). Considering the positive effect on quality parameters, T_{17} ($V_2D_2F_1$) is considered to be the best, but from economic point of view T_{19} ($V_2D_2F_3$) is preferable.

Keywords: Drip fertigation, quality, Guava

INTRODUCTION

Guava (*Psidium guajava* L.) is one of the most important and extensively cultivated fruit crops of India. It is very rich and cheap source of vitamin C and also contains a fair amount of calcium. Important guava growing states in the country are Uttar Pradesh, Bihar, Madhya Pradesh and Maharashtra. Allahabad district of Uttar Pradesh has the reputation of growing the best quality of gauva fruits in the world (Mitra and Bose, 1990). The importance of gauva is due to fact that it is the hardy fruit which can be grown in alkaline and poorly drained soil. This fruit crop has immense potential in increasing productivity and yield sustainability in Assam. But under North East condition, the crop faces water shortage during winter and the rainfall in this region is also not well distributed. A distinct dry spell starts from November and extends to March and sometimes up to April-May. The limited water resource is a constraint in increasing area under guava (Sharma, 2009). Drip irrigation is an advanced irrigation method that permits application of precise and measured quantity of water directly to the plant root zone slowly and frequently through emitters. Application of fertilizer along with irrigation water in a technology of distributing fertilizers to the root zone of the fruit crops. It increases nutrient use efficiency and provides ecological safety by avoiding ground water pollution, saving of fertilizers to an extent of 20 to 40 percent. There is lack of information about the schedule of drip and fertigation on growth, productivity and quality of guava in this region. Therefore, the present investigation was undertaken to study the 'Effect of drip fertigation on quality of guava (*Psidium guajava* L.

MATERIALS AND METHODS

The present investigation entitled 'Effect of drip fertigation on quality of guava (*Psidium guajava* L.)' was conducted in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during 2009-2010. The experiment was laid out in Split – Split – Plot Design with 3 replication comprising 24 (twenty four) treatments. There were 72 plots each having 1 plant with the spacing of 6 m x 6 m. The varieties (main plot treatments) were L-49 (V_1) and Allahabad Safeda (V_2). Drip (sub-plot treatments) and fertigation levels (sub-plot treatments) were D1= 1.00EpR, D2=0.75 EpR, D3=0.50 EpR and F1= 120% of RDF, F2=100% of RDF, F3= 75% of RDF and F4=50% of RDF, respectively. The treatments were T_1= $V_1D_1F_1$, T_2= $V_1D_1F_2$, T_3= $V_1D_1F_3$, T_4= $V_1D_1F_4$, T_5= $V_1D_2F_1$, T_6= $V_1D_2F_2$, T_7= $V_1D_2F_3$, T_8= $V_1D_2F_4$, T_9= $V_1D_3F_1$, T_{10}= $V_1D_3F_2$, T_{11}= $V_1D_3F_3$, T_{12}= $V_1D_3F_4$, T_{13}= $V_2D_1F_1$, T_{14}= $V_2D_1F_2$, T_{15}= $V_2D_1F_3$, T_{16}= $V_2D_1F_4$, T_{17}= $V_2D_2F_1$, T_{18}= $V_2D_2F_2$, T_{19}= $V_2D_2F_3$, T_{20}= $V_2D_2F_4$, T_{21}= $V_2D_3F_1$, T_{22}= $V_2D_3F_2$, T_{23}= $V_2D_3F_3$, T_{24}= $V_2D_3F_4$.

Irrespective of treatments on uniform dose of nitrogenous, phosphatic and potasic fertilizer @ 260 g N, 360 g P_2O_5 and 260 g K_2O per plant in the form of urea, SSP and MOP were applied. Urea and MOP were splited into 12 equal doses and were applied through drip from October to March at an interval of 15 days. The whole of SSP were applied in soil after installation of drip system in the month of October. In case of fertigation the amount of fertilizer was applied for individual treatment was calculated out on the basis of the percent recommended dose of the fertilizer along with the required irrigation levels and was applied in the root zone through the drippers. The intercultural operation like weeding, earthing up, pruning, removal of water sprouts were undertaken uniformly in all the treatments and economics of cultivation was calculated. TSS was determined by Zeiss Hand Brick, Total sugar was estimated by AOAC (1975) method, ascorbic acid was determined by 2, 6-Dichlorophenol Indophenol visual titration method and Pectin was estimated by the method described by Ruck (1963).

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DISCUSSION

The highest benefit cost ratio (4.26) was obtained in the treatment $V_2D_2F_3$, which was closely followed by the treatment $V_2D_2F_2$ (4.13), while the lowest benefit cost ratio (1.47) was recorded under $V_1D_3F_4$.

There was a non significant difference in TSS due to the interaction effect of varieties, drip level and fertigation level. Among the treatments $V_2D_2F_2$ recorded highest TSS (11.21 ^{o}Brix) followed by $V_2D_2F_2$ (10.30 ^{o}Brix) and lowest was recorded in $V_1D_3F_4$ (7.10 ^{o}Brix). The difference in total sugar content, ascorbic acid and pectin content of guava due to varieties, drip irrigation level and fertigation level was significant. The $V_2D_2F_1$ recorded highest total sugar (11.03%) followed by $V_1D_2F_1$ (10.67%) and lowest was recorded in $V_1D_3F_4$ (4.99%) and $V_1D_1F_1$ recorded highest ascorbic acid (196.55 mg) followed by $V_1D_1F_2$ (192.51 mg) and $V_2D_3F_4$ recorded lowest (98.03 mg). Pectin content was highest in treatments $V_2D_2F_1$ (3.56%) followed by $V_2D_2F_2$ (3.24%) and lowest was recorded in $V_1D_3F_4$ (1.42%). Drip irrigation with increasing level resulted in the production of fruits with lower values of TSS and sugar and higher values of ascorbic acid. The decrease in TSS and sugar content might be due to frequent application of water (Hedges and Srinivas, 1990). The reduction of TSS and sugar content under higher level of drip irrigation might also be due to dilution effect with the increasing moisture content. Bhattacharyya (1982) and Deka (2003) also recorded the decrease in TSS and sugar and increased ascorbic acid under higher level of soil moisture. Superior quality under higher doses of N & K through drip might be due to involvement of K in carbohydrate synthesis, breakdown and translocation of starch, synthesis of protein and neutralization of physiologically important organic acids (Twyford, 1967). The beneficial effect of nitrogen stimulated the functioning of a number of enzymes in physiological process, which in turn hydrolyzed starch and phosphate help in metabolic activity during the change of available starch into sugar.

On the basis of growth, yield and quality parameters, Allahabad Safeda at 0.75 EpR and 75% recommended dose of N & K through drip can be adopted for increase yield and low cost of cultivation.

Table1. Effect of drip fertigation on fruit quality of guava

Treatments	TSS (^{0}Brix)	Ascorbic acid (mg/100g pulp)	Total sugar (%)	Pectin (%)
T_1= $V_1D_1F_1$	9.40	196.55	7.66	2.71
T_2= $V_1D_1F_2$	9.20	192.51	7.12	2.63
T_3= $V_1D_1F_3$	9.00	187.01	6.57	2.54
T_4= $V_1D_1F_4$	7.50	183.75	6.23	2.13
T_5= $V_1D_2F_1$	10.20	178.64	10.67	3.17
T_6= $V_1D_2F_2$	9.90	170.33	9.33	3.07
T_7= $V_1D_2F_3$	9.60	167.30	8.56	2.91
T_8= $V_1D_2F_4$	8.60	162.00	8.12	2.33
T_9= $V_1D_3F_1$	8.60	158.12	5.98	2.01
T_{10}= $V_1D_3F_2$	8.30	143.15	5.53	1.97
T_{11}= $V_1D_3F_3$	7.80	137.00	5.27	1.73
T_{12}= $V_1D_3F_4$	7.10	121.21	4.99	1.42
T_{13}= $V_2D_1F_1$	9.60	166.16	8.76	2.89
T_{14}= $V_2D_1F_2$	9.30	159.17	8.50	2.67
T_{15}= $V_2D_1F_3$	8.90	153.00	7.67	2.54
T_{16}= $V_2D_1F_4$	7.50	148.23	7.28	2.35
T_{17}= $V_2D_2F_1$	11.21	137.79	11.03	3.56
T_{18}= $V_2D_2F_2$	10.30	129.83	10.05	3.24
T_{19}= $V_2D_2F_3$	9.80	123.00	9.43	3.01
T_{20}= $V_2D_2F_4$	8.60	119.00	8.40	2.41
T_{21}= $V_2D_3F_1$	8.30	115.04	6.93	2.15
T_{22}= $V_2D_3F_2$	7.85	107.98	6.44	2.01
T_{23}= $V_2D_3F_3$	7.60	103.32	5.84	1.98
T_{24}= $V_2D_3F_4$	7.33	98.03	5.34	1.63
S. Ed.±	0.30	1.43	0.20	0.019
CD at 5%	NS	2.90	0.41	0.039

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SHORT COMMUNICATION

DISTRIBUTION OF DTPA-EXTRACTABLE MICRONUTRINENT IN *VERTISOL* OF DHAMTARI BLOCK UNDER DHAMTARI DISTRICT IN CHHATTISGARH

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Abstract: Evaluation of the soil fertility status of *Vertisol* group of Dhamtari block of Dhamtari district in Chhattisgarh was undertaken during 2009-10. Grid based (GPS) surface (0-15 cm) soil samples by systematic survey were collected from 69 villages in Dhamtari block in such that each 10 ha area represented one sampling point and total 1450 soil samples covering all soil types out of this, 516 samples were identified from *Vertisol.* These samples were analyzed for pH, EC, organic C and DTPA-extractable Zn, Cu, Fe, Mn. The pH (soil reaction) varied from 4.70 to 7.50 with the mean value 5.89, EC ranged from 0.05 to 0.37 with the mean value 0.13 dS m^{-1}. The variation in organic C content in sampled soils was from 0.23 to 0.83 with the mean value 0.44 %. DTPA-extractable Fe, Mn, Cu and Zn status were recorded as 4.54 to 68.70 (30.18 mg Fe kg^{-1}), 3.72 to 59.58 (26.08 mg Mn kg^{-1}), 0.2 to 8.78 (2.79 mg Cu kg^{-1}) and 0.06 to 3.34 (0.68 mg Zn kg^{-1}), respectively. Soil pH showed significant and negative correlations with DTPA-extractable Fe, Mn, Cu and Zn. EC exhibited significant and negative correlated with DTPA-extractable Mn, Cu and Zn. The organic C showed negative relationship with DTPA-extractable Fe, Mn, Cu and Zn.

Keyword: DTPA-Extractable Micronutrient, *Vertisol* and Fertility status

INTRODUCTION

In view of the finite nature of natural resources, their management in a sustained fashion has become an issue of primary concern. Sustainability of the agricultural production systems is the most crucial issue in this part of the green revolution. A system is sustainable when it improves or at least maintains the quality of soil, water and atmosphere. Application of chemical fertilizers has been rated as one of the most important production factor affecting the sustainability. The increasing population has forced farmers to make use of high doses of chemical fertilizers. Its unscientific use (nutrient imbalances, incorrect amounts) is a serious threat to sustainable agricultural production system.

Micronutrients are important for maintaining soil health and also increasing productivity of crops. These are needed in very small amounts. The soil must supply micronutrients for desired growth of plants and synthesis of human food. Increased removal of micronutrients as a consequence of adoption of HYVs and intensive cropping together with shift towards high analysis NPK fertilizers has caused decline in the level of micronutrients in the soil to below normal at which productivity of crops can not be sustained. The deficiencies of micronutrients have become major constraints to productivity, stability and sustainability of soils. Availability of micronutrients is influenced by their distribution in soil and other physico-chemical properties of the soil (Sharma and Chaudhary, 2007). Thus, knowledge of status of micronutrients and their interrelationship with soil characteristics is helpful in understanding the inherent capacity of soil to supply these nutrients to plants. Besides soil characteristics, land use pattern also plays a vital role in governing the nutrient dynamics and fertility of soils (Venkatesh *et al*. 2003). Due to continuous cultivation, soils under a particular land use system may affect physico-chemical properties which may modify DTPA-extractable micronutrients content and their availability to crops. So, analysis of these properties along with micronutrient status of different land use systems may have significant importance. Soil test-based fertility management is an effective tool for increasing productivity of agricultural soils that have high degree of spatial variability resulting from the combined effects of physical, chemical or biological processes (Goovaerts, 1998). However, major constraints impede wide scale adoption of soil testing in most developing countries. In India, these include the prevalence of small holding systems of farming as well as lack of infrastructural facilities for extensive soil testing (Sen *et al.,* 2008). Soil testing provides information regarding nutrient availability in soils which forms the basis for the fertilizer recommendations for maximizing crop yields. Soil testing program is beneficial to formulated specific fertilizer recommendations.

MATERIAL AND METHOD

Study area

Dhamtari is a block comes under Dhamtari district in the state of Chhattisgarh. This district is situated between 20°40’ North, 81°33’ East longitude. The total area of district is 2029 Sq. Km. and 305 meter above the mean sea level. The *Vertisols* group of the soil covered under the different village of the Dhamtari block in Dhamtari district of Chhattisgarh has been taken for fertility evaluation of various aspects and sixty-nine villages comes under *Vertisols.*

One thousand three (0-15 cm depth) soil samples were collected from Dhamtari block using GPS marked. The scale of 1:4000 has been used as the cadastral map for conducting the field survey works. Prior to the actual fieldwork, tentative sampling sites were fixed on the cadastral maps. The sampling points were taken from the cadastral map of different villages by locating in such that from each 10 hectare area may represent one grid based soil sample. Sampling points were pre-determined across a field at fixed intervals such as one sample from each 10 hectare area. Following the sampling sites fixed in the cadastral map, soil samples (15 cm) were collected from each grid point using soil auger and local spade with proper labels. Soil samples collected from the study area were dried and crushed with the help of wooden rod and passed through 2 mm sieve and stored in properly labeled plastic bags for analysis by adopting standard laboratory methods.

Methods of analysis

The pH was determined by glass electrode pH meter in soil water suspension (Piper, 1950), Electrical Conductivity with Solu-bridge method (Black, 1965), Organic C by wet digestion method (Walkley and Black's rapid titration method, 1934). The micronutrients Zn, Cu, Fe and Mn were extracted by using 0.005M diethylene triamine penta acetic acid (DTPA), 0.01M calcium chloride dehydrate and 0.1M triethanol amine buffered at pH 7.3 (Lindsay and Norvell, 1978) and their concentrations were analyzed by atomic absorption spectrophotometer 4129. The data on available Fe, Cu, Mn and Zn of soils were characterized for deficient and adequate status using the threshold values 4.5 mg kg^{-1} for Fe, 0.2 mg kg^{-1} for Cu, (Katyal and Randhawa, 1983), 3.5 mg kg^{-1} for Mn (Shukla and Gupta,1975) and 0.6 mg kg^{-1} for Zn (Katyal,1985). The samples were categorized as per the rating limit given in Table 2.

Table 1. Salient soil properties of study area

Soil characteristics	Range	Mean	S.D
pH (1:2.5, Soil water)	4.7-8.2	7.01	±0.5
E.C. (dS m^{-1})	0.01-0.89	0.22	±0.11
O.C. (%)	0.15-0.91	0.54	±0.14
Available N (kg ha^{-1})	100.35-451.58	219.48	±63.52
Available P (kg ha^{-1})	0.35-51.96	8.13	±6.79
Available K (kg ha^{-1})	23.52-566.04	262.11	±73.42
Available Fe (mg kg^{-1})	0.22-6.52	2.46	±1.02
Available Mn (mg kg^{-1})	3.66-95.0	21.99	±8.17
Available Cu (mg kg^{-1})	6.36-97.02	38.61	±14.39
Available Zn (mg kg^{-1})	0.04-3.66	0.82	±0.57

Table 2. Limits for the soil test values used for rating the soil

Classification for pH values			
Strongly acid	**Moderately acid**	**Slightly acid**	**Neutral**
<5.5	5.5-6.0	6.0-6.5	6.5-7.5
Classification for total soluble salt content (EC as dS m^{-1})			
No deleterious effect on crop	**Critical for germination**	**Critical for salt sensitive crop**	**Injurious to most crops**
<1.0	1.0-2.0	2.0-3.0	>3.0
Parameters	**Low**	**Medium**	**High**
O.C. (%)	0.25-0.50	0.50-0.75	>0.75
Micronutrients			
	Deficient	**Sufficient**	**High level**
Av. Fe (mg kg^{-1})	<4.50	>4.50	>9.00
Av. Mn (mg kg^{-1})	<3.50	>3.50	>7.00
Av. Cu (mg kg^{-1})	<0.20	>0.20	>0.40
Av. Zn (mg kg^{-1})	<0.60	>0.60	>1.20

Table 3. Limits for the soil test values used for rating the soil

Classification for pH values			
Strongly acid	**Moderately acid**	**Slightly acid**	**Neutral**
0.39	5.24	8.13	77.32
Classification for total soluble salt content (EC as dS m^{-1})			
No deleterious effect on crop	**Critical for germination**	**Critical for salt sensitive crop**	**Injurious to most crops**
5.23	44.28	31.10	19.19
Parameters	**Low**	**Medium**	**High**
O.C. (%)	32.95	56.59	8.33
	Micronutrient		
	Deficient	**Sufficient**	
Av. Cu (mg kg^{-1})	0	100	
Av. Mn(mg kg^{-1})	0	100	
Av.Fe (mg kg^{-1})	0	100	
Av. Zn(mg kg^{-1})	49.03	50.97	

Table 4. Correlation coefficient (r) between physico-chemial properties and DTPA-extractable Fe, Mn, Cu, and Zn of *Vertisol* of Dhamtari block.

	Available micronutrient content (mg/kg)			
Soil properties	**Cu**	**Mn**	**Fe**	**Zn**
pH	0.042	-0.111**	-0.060	-0.069
EC	0.008	0.011	0.012	0.028
OC	0.047	0.009	-0.121**	-0.001

* Significant at 5% level ** Significant at 1% level

RESULT AND DISCUSSION

Physico-chemical characteristics of soils

The results of soils analysis pertaining to some salient properties under study are presented in summarized in Table 1. The mean values of different parameters indicate that *Vertisol* of the area under study was strongly acidic to slightly alkaline in nature, normal in soluble salts, normal in organic carbon, available nitrogen is low and medium in available phosphorous and available potassium. The mean values on micronutrient status (Zn, Fe, Mn and Cu) of the soil had sufficient level.

Available Cu

The DTPA-extractable Cu content of soils under study varied from 6.36 to 97.02 mg kg^{-1} with an average content of available Cu was 38.61 mg kg^{-1} (Table 1). All the soil samples of *Vertisols* were found sufficient in available Cu content with a model class of 0.2 to 0.40 mg.kg^{-1} DTPA-extractable copper, (Table 2). Kumar *et al* (2009), Rajeshwar *et al*. (2009), Meena *et al.* (2006) and several other workers reported available copper with similar range. A non significant positive correlation (r = 0.042) was observed between soil pH and available Cu (Table 4). Kumar *et al*. (2009) reported the similar findings in soils of Santhal Parganas region of Jhakhand. The electrical conductivity of soils exercised non significant and positive correlation (r = 0.008) with available copper, the result was in contradicted with the findings of Yadav and Meena *et al*. (2009). The organic carbon content of the soils was found positive and none significantly correlated with available copper (r = 0.047), Similar observation was found by Yadav and Meena *et al.* (2009) and Kumar *et al*. (2009).

Available Mn

The DTPA-extractable Mn content of *Vertisol* soils under study varied from 3.66 to 95. 00 mg kg^{-1} with an average content of available Mn was 21.99 mgkg^{-1} (Table 1). Considering less than 3.50 mg kg^{-1} DTPA-extractable manganese as critical limit (Table 2). All the 100 percent soil samples of *Vertisols* were found to have sufficient status, (Table 3). Similar results were also reported by Yadav *et al*. (2008), Meena *et al*. (2006) and Sharma *et al*. (2001).

The DTPA- Mn showed a, negative and significant correlation with pH (r = -0.111**) (Table 4). The similar findings were also reported by Kumar *et al* (2009). The EC was positive and non significantly correlated (r = 0.011), The organic carbon content of the soils was found positive and none significantly

correlated with available manganese (r = 0.009), this result was agreement with the findings of Yadav and Meena *et al.* (2009) and Kumar *et al.* (2009).

Available Fe

The DTPA-extractable Fe content of *Vertisol* under study varied from 0.22 to 6.52 mg kg^{-1} with an average content of available Fe was 2.46 mg kg^{-1} (Table 1). Considering less than 4.5 mg Fe kg^{-1} as critical limit of (Table 2) DTPA-extractable Fe (Lindsay and Norvell 1978), and data revealed that all soil samples of these soils observed sufficient status of DTPA- extractable available Fe content, (Table 3).

The DTPA-Fe showed a negative and non significant correlation (r = -0.060) with pH (Table 4), these results are in conformity with the findings of Yadav and Meena *et al*. (2009). The correlation of Fe level with EC showed a negative and non significant result (r = 0.012), these results are in contradicted with the findings of Yadav and Meena *et al*. (2009), the organic carbon was negative and significantly correlated (r = -0.121**) with available iron. This may be attributed to the presence of higher level of inherent iron under prolonged submerged conditions and increased organic matter content might have induced buffering effect on the availability of available iron. Similar observation was found by Mogia and Bandyopadhyay (1993) in South Andaman.

Available Zn

The DTPA-extractable Zn content of soils under study varied from 0.04 to 3.66 mg kg^{-1} with an average content of available Zn was 0.82 mg kg^{-1} (Table 1). The critical limit (Table 2) of Zn in soil has been marked as 0.6 mg kg^{-1} (Lindsay and Norvell, 1978).

The available zinc content found deficient in 49.03 per cent samples and 50.97 per cent soil samples exhibited sufficient level of zinc. These results are in conformity with the findings of Rathore *et al.* (1995), Sharma *et al.* (2001) and Nazif *et al*. (2006).

Inverse and non-significant correlation (r = -0.060) was reported with available zinc (Table 4). The result was conformity with the findings of Yadav and Meena *et al*. (2009). The electrical conductivity of soils exercised non significant and positive correlation (r = 0.028) with available content of zinc, Similar result observed by Yadav and Meena *et al*. (2009). Organic carbon is negative and none significantly correlated (r = -0.001) with available content of zinc. Rajeshwar *et al* (2009) confirmed the findings for relationship between organic carbon and available zinc.

CONCLUSION

It can be concluded from the results under study that the *Vertisol* group of Dhamtari block of Dhamtari district in Chhattisgarh is characterized under strongly acid to slightly alkaline in soil reaction, less than one dS m^{-1} soluble salt content comes under safe limit for all crops. The total soluble salts observed under studied samples were safe for germination and growth of plants.

The organic carbon level exhibited low to medium. The *Vertisol* of the area showed low in available N and P, and medium level in available K. In general, the soil samples were tested sufficient in DTPA-extractable Fe, Mn and Cu. Whereas, Zn deficiency was observed in study area. The Soil pH is the main soil characteristics which control micronutrient availability in *Vertisol* of Dhamtari block. Hence, the soils require attention regarding nutrient management practices and regular monitoring of soil health for better crop production.

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SHORT COMMUNICATION

ASSESSMENT OF FLORAL DIVERSITY IN DHAMTARI DISTRICT OF CHHATTISGARH

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Abstract: The central India forms one of the major ecosystems of the Indian subcontinent and constitutes a large tract of tropical dry deciduous and tropical moist deciduous forest type. The Dugali and Nagari is a small patch of forest which is near the Dhamtari district and exists in Chhattisgarh a newly formed state. These forest areas conserve a variety of flora and fauna. The present paper gives an account of assessing the floral diversity in the vicinity of Dhamtari district. A study of the floristic composition and its use by the rural people is also in corporate. The present articles describe the species diversity and structural variation of a tropical dry deciduous and tropical moist deciduous forest type of central India. In the present study 7 climber species, 3 shrubs, 4 herbs species and 40 trees are reported.

Keywords: Biodiversity, ecosystem, endangered, flora, sanctuary

INTRODUCTION

Indian subcontinent represents a very rich wealth of diversified flora and fauna. Plant diversity assessment and documentation is the first step ahead before the next step of conservation of these biological resources. As per Heywood (1995) plant diversity documentation requires surveying, sorting, cataloguing and quantifying. Without documenting of these biodiversity there is a no means of conservation. Good biodiversity is always making the good environments which are helpful for people for many purposes. Biodiversity balance the food chain, food web, CO_2 sequestration, nutrient cycling and livelihood of human being (Jhariya and Raj, 2014). Myers *et al*. (2000) have identified 25 terrestrial biodiversity hot spot and also recognized 9 leading hot spots. The leading hot spot are richer in endemics than other hot spots. Forest is world's most valuable natural resource which is a store house of biological diversity. Trees played and will play a major role to check and stop soil erosion, floods and drought and mitigate the climate change. As per Seth (2004) and Panna *et al.* (2009) tree meets the need of timber, fuel, medicine and other commercial products, which are indispensable requirement of human being. The total forest cover, which includes dense forest, open forest and mangroves, is estimated to be 692,027 km^2. This constitutes 21.05% of the country's geographic area (FSI, 2011). The state Chhattisgarh having 44% of forest cover of the total geographical area, and forest type of Chhattisgarh is tropical moist and tropical dry deciduous which bears a lot of ground flora and fauna too.

MATERIAL AND METHOD

The present study was conducted during summer season during 2013-2014 in the Nagari and Dugali forest area in Chhattisgarh. These forest areas are 55 km far away from Dhamtari district of southern region of Chhattisgarh and situated between 20°42' N latitude and 81°33' longitude. It has an average elevation of 305 m above sea level. The climate of the area is tropical with temperature is ranging from 35^0 C to 12.4^0 C and annual rainfall is 1372.5 mm. The total area of forest is 8760 ha which is 2.14% of total geographical area of Dhamtari (408190 ha). The forest area topography is almost level. The species were observed and identified with the help of local of villages in the forest area and forest guards. Quadrates of 10m x 10m for trees and 5m x 5m for shrubs were laid. The un-identified plants were collected and a herbarium sheet was prepared and identified with the help of local floras. Finally, plants were documented by following their botanical name, family, habits, local name, parts use and uses of the individual plants.

RESULT

The study area did not show uniform distribution of tree, shrubs, herbs and climbers. A total number of 54 plant species belonging to varied families (24) with different habits were recorded (Table 1). Out of these plants species, herbs (4), shrubs (3), climbers (7) and trees (40) were noticed. Maximum plant species were recorded for Leguminosae family. Observed plant species with their local name, botanical name, family, habit, part use and their uses are listed in Table 1. Table 2 shows the family wise distributions of plants and Table 3, the number of different habits is given.

Table: 1. floral diversity in the forest area

Local Name	Plant Species	Family	Habit	Parts Used	Uses
Sal	*Shorea robusta*	Dipterocarpaceae	Tree	Bark, resin	Useful in cough and pitta, ulcers, seminal weakness and burning of eyes.
Pula	*Kydia calyicina*	Dipterocarpaceae	Tree	Leaves	Skin diseases
Semal	*Bombox cieda*	Bombacaceae	Tree	Bark	Treatment of skin eruptions and ulceration.
Bhilma	*Semecarpus anacardium*	Anacardiaceae	Tree	Fruits	Digestive, purgative, liver tonic stimulant.
Dhaman	*Grewia tiliifolia*	Rutaceae	Tree	Leaves , fruits	Useful in diarrhea and dysentery.
Bael	*Aegle mormelos*	Rutaceae	Tree	Leaves, fruits	Useful in diarrhea, dysentery, seminal weakness etc.
Saliha	*Boswella serrate*	Burseraceae	Tree	Roots	Treatment of syphilitic diseases and jaundice.
Chare	*Buchanania lanzam*	Anacardiaceae	Tree	Leaves	Used as cardiac tonic for cardiac disorder.
Aam	*Mangifera indica*	Anacardiaceae	Tree	Fruits and Woods	Useful for syphilis, wounds, ulcers and diphtheria.
Palas	*Butea monosperma*	Leguminosae	Tree	Bark, Leaves, Flower	Useful in cure of intestinal worms, bone fractures and rectal diseases.
Shisham	*Dalbergia sissoo*	Leguminosae	Tree	Leaves Wood	useful in the treatment of skin diseases, leucoderma
Bija	*Pterocarpus marsupium*	Leguminosae	Tree	Stems	Treatment for diabetes
Amaltas	*Cassia fistula*	Leguminosae	Tree	Leaves Roots seeds	Useful in the treatment of skin diseases, leprosy, tuberculosis.
Imli	*Tamarindus indica*	Leguminosae	Tree	Fruits	Fruit is edible
Babool	*Acacia nilotica*	Leguminosae	Tree	Bark, roots Leaves	Used for haemostatic, asthma and diarrhea.
Siris	*Albizia lebbeck*	Leguminosae	Tree	Seeds	Used in asthma, leprosy, leucoderma, sprain and wounds
Chichwa	*Albizia odoratissima*	Leguminosae	Tree	Wood Leaves	Timber and fodder
Safed siris	*Albizia Procera*	Leguminosae	Tree	Wood	Agricultural implements
Dhaora	*Anogesssus latifolia*	Combretaceae	Tree	Whole plant	Useful in cough and vata, skin disease, diarrhea and dysentery
Arjun	*Terminalia arjuna*	Combretaceae	Tree	Bark , Leaves	Useful in fractures, ulcers, diabetes, internal and external hemorrhages.
Bahera	*Terminalia bellirica*	Combretaceae	Tree	Fruits	Useful in anemia, leucoderma, narcotic and digestive.
Harra	*Terminalia chebula*	Combretaceae	Tree	Bark, Fruits	Useful in tridosa, neuropathy and general debility.
Jamun	*Syzygium cumini*	Myrtaceae	Tree	Seeds	Useful in diabetes and strengthening the teeth.
Kumbhi	*Coreya arborea*	Lecythidaceae	Tree	Bark	Treatment of diarrhea
Seja	*Lagerstroemia parviflora*	Lythraceae	Tree	Bark	Treatment of snake –bite
Haldu	*Adina cardifolia*	Lythraceae	Tree	Bark	Used for skin diseases
Mundi	*Mitragyna parvifolia*	Lythraceae	Tree	Bark	Contraceptive
Tendu	*Diospyros melonoxylon*	Ebenaceae	Tree	Seeds	Spermatorrhoea and urinary disorders
Gamari	*Gmelina arborea*	Verbenaceae	Tree	Fruits Wood	Useful in fever, dyspepsia, skin disease and promoting the growth of hair
Kasai	*Bridelia retusa*	Euphorbiaceae	Tree	Fruits Wood	Edible and agricultural implements.

Garari	*Cleistanthus collinus*	Euphorbiaceae	Tree	Leaves	Use for fish Poison
Bargad	*Ficus benghalensis*	Moraceae	Tree	Bark	Useful in the treatment of diarrhea, dysentery and diabetes
Peepal	*Ficus religiosa*	Moraceae	Tree	Fruits	Used as aphrodisiac, antibacterial and purgative.
Mahua	*Madhuca indica*	Sapotaceae	Tree	Bark, Heartwood, Fl owers, Fruits, Seeds.	Used in cooking, adulteration of Ghee, manufacturing chocolates and even soaps
Pakar	*Ficus cunia*	Moraceae	Tree	Seed and fruit	Edable fruits
Sinduri, Roli	*Mallotus phillippensis*	Euphorbiaceae	Tree	Capsules or fruits	Used in colouring silk and wool.
Kullu	*Sterculia urens*	Malvaceae	Tree	Whole tree	Used in foodstuffs as emulsifiers, stabilizers and thickeners.
Lasura	*Cordia dichotoma*	Boraginaceae	Tree	Fruits and leaves	Prickle, timber, fodder.
Tinsa, Sandan	*Ougeinia oojeinsis*	Leguminosae	Tree	Bark	Medicinal use and timber
Saja	*Terminalia tomentosa*	Combretaceae	Tree	Bark	Medicinal use, fodder and timber
Charota	*cassia tora/ Sena tora*	Leguminosae	Herb	Roots, Leaves, and Seeds	Treatment of Constipation, cough, bronchitis, cardiac disorders.
Satavar	*Asparagus racemosus*	Liliaceae	Climber	Whole plants	Treatment of gastric ulcers, dyspepsia, nervous disorder
Gudmar	*Gymnema sylvestre*	Asclepiadoideae	Herb	Whole plants, root	Treatment of diabetes, antidote for snake bite.
Raimunia	*Lantana camara*	Verbenaceae	Shrub	Leaves	Ornamental, Fever,antiseptic,antispasmodic,a ntipyretic
Malkangni	*Celastrus paniculatus*	Celastraceae	Climber	Bark,roots	Used for abortion
Chirchita	Achyranthus aspera	Amaranthaceae	Herb	Leaves,roots	Treatment for Stomach disorders, diarrhea and dysentery
Bantulsi	*Ocimum camum*	Labiatae	Herb	Leaves, whole plant	Treatment for cough, diarrhea, convulsions, fever and cold
Dhawi	*Woodfordia fruticosa*	Lythraceae	Shrub	Flowers	Used in wound healing
Gunja	*Abrus precatorius*	Leguminosae	Climber	Root, leaves and seeds	Treatment for colds, cough, convulsion and rheumatism
Baichnadi	*Dioscorea hispida*	Dioscoreace	Climber	Tuber and leaves	Treatment for Arthritis, rheumatism, vomiting and malaria.
Ramdaton	*Smilax microphylla*	Liliaceae	Climber	Tuber and leaf	Medicinal use, mouth brush
Mahul	*Bauhinia vahlli*	Leguminosae	Climber	All parts	Used for fodder to make mats and containers for food stuffs
Phetra	*Gardenia turgid*	Rubiaceae	Shrub	Fruit and root	Skin disease
Gunja	*Abrus pulchellus*	Leguminosae	Climber	leaves, Root	Treatment for cough and gonorrhea

Table 2. Plant species distribution according to their families

S/N	Family	Number of species
1	Malvaceae	1
2	Moraceae	3
3	Euphorbiaceae	3
4	Verbenaceae	2
5	Ebenaceae	1
6	Lythraceae	4
7	Lecythidaceae	1
8	Myrtaceae	1

9	Combretaceae	5
10	Sapotaceae	1
11	Boraginaceae	1
12	Leguminosae	14
13	Anacardiaceae	3
14	Labiatae	1
15	Burseraceae	1
16	Rutaceae	2
17	Bombaceae	1
18	Dipterocarpaceae	2
19	Liliaceae	2
20	Asclepiadoideae	1
21	Celastraceae	1
22	Amaranthaceae	1
23	Dioscoreace	1
24	Rubiaceae	1

Table 3. Distribution of plants as per their habit

S/N	Habit	Number of plant species	Distribution (%)
1	Tree	40	74.07
2	Herb	4	7.40
3	Shrub	3	5.55
4	Climber	7	12.96
5	Total	54	100.00

DISCUSSION

On the basis of the present finding, it is concluded that the forest area is enriched with various plants of different habits including herbs, shrubs, trees and climbers. This diversity shows the variability among flora and it is essential to get knowledge about the plant species for assessment, though further strategy is needed to conserve them. This study indicates their rich diversity, followed by various habits (herbs, shrubs, climbers and trees) due to suitable climatic condition as well as their survival capacity in this forest area. In the forest area, tree species are mostly seen as they cover a larger part of the area (40 species of 74.07%), and are closely followed by climber species (7 species of 12.96%) and herb species (4 species of 7.40%) but shrubs (3 species of 5.55%) are least of them all.

Further, the trees like *Shorea robusta*, *Terminalia arjuna*, *Terminalia tomentosa*, *Anogeissus latifolia* and *Diospyros melonoxylon* were found dominant in forest area. Climber like *Bauhinia vahlii*, *Asparagus racaemosus*, *Gardinia tergida*, *Woodfordia fruiticosa* etc. trees like *Terminalia tomentosa*, *Terminalia arjuna*, *Terminalia chebula*, *Shorea robusta*, *Ougenia oojensis*, *Syzigum cumini*, *Diospyrus melonoxylon*, *Pterocarpus marsupium*, *Semecarpus anacardium* etc. indicates moist deciduous habitat.

Such economically important trees are also grouped under different categories as below based on their uses.

Wild-edible fruits: *Diospyros melonoxylon* Roxb., *Buchanania lanzan Spreng.*, *Madhuca indica*, *Mangifera indica L.*, *Syzygium cumini*, *Tamarindus indica L.*, *Aegle mormelos*, *Ficus benghalensis*, *Ficus religiosa* and *Ficus conia*.

Tannin yielding trees: *Careya* arborea, Diospyros *melonoxylon* Roxb., *Terminalia bellirica*, *Terminalia chebula*, *Acacia nilotica*, *Anogesssus latifolia*, *Cassia fistula*, *Lagerstroemia parviflora Roxb.*, *Semecarpus anacardium* and *Mallotus phillippensis.*

Gum-yielding trees: *Acacia nilotica*, *Boswella serrate Roxb.*, *Butea monosperma*, *Sterculia urens*, *Anogesssus latifolia Roxb.*, *Buchanania lanzam Spreng.*, *Terminalia bellirica*, *Lavea grantis* and *Careya* arborea.

Timber yielding trees: *Acacia nilotica*, *Albizia lebbeck*, *Albizia odoratissima*, *Albizia Procera*, *Anogesssus latifolia*, *Bombax ceiba*, *Cordia dichotoma*, *Dalbergia sissoo*, *Gmelina arborea*, *Ougeinia oojeinsis*, *Terminalia arjuna*, *Terminalia tomentosa*, *Shorea robusta*, *Adina cardifolia*, *Boswella serrate* and *Pterocarpus marsupium*.

CONCLUSION

Assessment of floral diversity is very important step for need of conservation of that resource. Without assessment and documentation there is a no means of conserving the biological resources including flora and fauna. Due to increasing population pressure with increasing need of food and shelter are necessitates the deforestation. It is time to conserve this forest treasure through assessment of unknown flora, which is an important part of humankind by giving all tangible and intangible products. Further, information of plant diversity is needed for the study

of dynamic nature of vegetation under specific eco-environment situation.

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SHORT COMMUNICATION

STUDY OF ALLELOCHEMICALS AND ALLELOPATHY EFFECT OF WEED AND RICE EXTRACTS ON RICE GENOTYPES

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Abstract: The present investigation was carried out during kharif 2006-07 at instructional farm of indira Gandhi krishi vishwavidalaya,Raipur .The experiment was conducted in split plot design in field and CRD in laboratory condition replication in twice. The stem extract was of *Echinochloa colona* was most effective and root extract in least effective on germination and seedling growth of rice genotype. Maximum reduction in seedlings growth was observed in R-1060-1674-1-1 ,Danteshwari and R-1037-649-1-1.While minimum impact was observed on R-548-89-6,Safri-17 and Dubraj.The minimum chlorophyll content in *Echinochloa colona* was observed in Dubraj.In Ischaemum rugosum maximum chlorophyll was observed in Danteshwari. Overall more phenol content was estimated in vasumati ,dubraj and Safri 17 .Minimum phenol content was observed in R-1182-167-2-157-1 and danteshwari.Minimum adverse effect on ∝ amylase activity was observed in *Echinochloa colona* was due to shoot extract of rice genotypes Vasumati followed by R-548-89-6 and Safri-17 and maximum adverse effect was due to indira sugandhit dhan .

Keywords: Allelopathy, ∝ amylase,Phenol content, Rice extract, Weed extract

INTRODUCTION

Allelopathy is an important mechanism of plant interference mediated by the addition of plant produced phototoxin to the plant environment. Chemicals with allelopathy potential are present virtually in all plants and in the most tissue, including leaves, Stems, flowers, roots, seeds and buds. The Rice crop is generally infected with different weed. Some weeds are emerging from non cropped area to cropped areas but their allelopathy impact on crops is not fully known. Moreover allelopathy based technology is also more easily transferable to farmers in low input management system ,than those of high input management system which entail have use herbicide their there's one excellent review on this subject on strategies to enhance weed control by engineered allelochemicals production on rice allelopathy. Allelopathy refers to the beneficial or harmful effect on of on plant another plant both weed species by the release of chemicals from plants parts by leaching, root exulation, volatilization, reduce decomposition and other process in both nature and agriculture system.

MATERIAL AND METHOD

The present investigation was conducted at the Instructional farm, Indira Gandhi Krishi Viswavidyalya,Raipur(C.G.) during the Kharif season (July to October) 2007-08. The investigation aimed the study of allelochemicals and allelopathic effect of weed extracts on rice genotypes. The experiment was laid out in factorial complete randomized design with two replication .The treatment were given to different petridishes by using random method (Gomez & Gomez, 1987) the experiment of 4 treatments (leaf extract, shoot extract, root extract and control (distil water) and 12 genotype.
The weed – *Echinochloa colona*

Mythology for allelopathy studies
Effect of weed extract on rice genotype – First of all in all each sterilized 9 cm petridish whatman filter paper no 1 was filled after this definite number of healthy seeds (i.e.) 50 seed of rice for Petridis was placed there after 10 ml of aqueous extract of different parts of weed and control (distil water) was added to each petridish as per treatment percent germination was determined after 5 days and seedlings root and shoot length were measure after 9 days seedlings were separated and oven dried at 65 c for 4 hours and measured dry weight . The germination percentage, seedlings growth, fresh weight and dry weight were recorded.
Effect of rice extract on weed growth - petridish of 9 cm size were taken and whatman filter paper no 1 was placed inside the petridish for germination study 50 weeds seeds of *Echinochloa colona* were used for germination study and used 10 ml rice extract in each petridish.The imitation of germination and seedling growth were recorded up to 9 days.The germination percentage, seedling growth, fresh weight and dry weight were recorded.

Mythology for biochemical studies
Chlorophyll content- was measured spade unit (modal no SPSD-502) from the electronic instruments or device called chlorophyll meter the chlorophyll content was measured with the help of this instruments by from weed leaf the observation were recorded between 12 –2.0 PM of sun shine hours.
Phenol content – phenol content estimated in mg/g unit. Phenols the aromatic compounds with hydroxyl groups are weed spread in plant kingdom .The phenol can be carried out with folin cioculteau reagent by Malrck,C.P. Sing 1980.
Alfa amylase activity - Alfa amylase activity was determined by the method of Chrispeels and Varner (1967).

RESULT AND DISCUSSION

Effect of root extract of rice genotype on germination % and seedling length of *Echinochioa colona*

Root extract of all twelve rice genotypes were significant reduce the germination persent of *Echinochioa colona* and maximum reduction was observed in Vasumati (19.53) followed by Safri 17(21.50) and Dubraj (22.40).Whereas minimum reduction was observed in R-1037-649-1-1(53.85) followed by *Danteshwari* (52.29) and R 1182 – 167-2-157 (52.14) as compare to control (88.30)

The seedling length was also significantly reduced due to application of root extract of rice genotypes as compare to control .Maximum Significant adverse effect was observed in the sample when used the extract of rice genotypes R-1037-649-1-1(3.15) followed by Safri 17(3.20) and R-1072-360-1(3.35) .Minimum significant adverse effect was observed in Danteshwari(4.40) followed by Vasumati(4.35) and R-979-1528-2-1 (4.15)as compare to control(6.55) were only distil water was used for germination percentage and seedling length of *Echinochioa colona* .

Effect of leaf extract of rice genotype on germination % and seedling length of *Echinochioa colona*

Leaf extract of all twelve rice genotypes were used for the study of germination % and seedling length of *Echinochioa colona* it was observed that the extract of all experimental genotype were significantaly reduced the germination % and seedling length of *Echinochioa colona* maximum significant adverse effect was observed in germination percent in vasumati (20.51) followed by Safri 17 (22.85) .Whereas minimum reduction was observed in R-1037-649-1-1 (61.1) followed by Indira Sugandhit Dhan (54.14) .Seedling length was maximum adversely affected by Vasumati (2.60) and followed by Dubraj (2.65) while minimum adverse effect was observed due to application of leaf extract of R-1182-167-2-157 (3.70) followed by R-1249-1196-2-1(3.65).

Effect of leaf extract of rice genotypes on fresh and dry weight of *Echinochloa colona*

Significant adverse impact was observed on fresh and dry weight of seedling of *Echinochloa colona* deu to application of leaf extract of rice genotypes .Maximum significant adverse effect was observed in fresh and dry weight in the sample where leaf extract of rice genotype was used in R-1073-649-1-1(0.73 &0.28) and followed by R-1072-360-1(0.88 & 0.35) .Minimum adverse effect was observed in genotype R-1249-1196-2-1(1.36&0.36) followed by R-548-89-6(1.29 & 0.54) .

Effect of stem extract of rice genotypes on Germination % and Seedling length of *Echinochloa colona*

Weed germination percent was significantly reduced due to application of stem extract of rice genotype and minimum adverse impact was observed in Vasumati (22.50)followed by Dubraj(26.68) .Whereas minimum adverse impact was observed in R-1073-649-1-1(66.85) followed by R-1182-167-2-157 (57.14) over control (88.28)

The seedling length was also significantly reduced due to application of stem extract of rice genotype and minimum adverse impact was observed in genotype Dubraj (2.4) followed by R-1037-649-1-1 (2.85) .Whears minimum adverse effect was observed in Danteshwari (4.40) and followed by R-1072-360-1 (4.35) over control (5.5).

Effect of stem extract of rice genotypes on fresh and dry weight of of *Echinochloa colona*

Fresh and dry weight of seedlings of *Echinochloa colona* was significantly and adversely affected by the use of stem extract of rice genoytupe R-1037-649-1-1 (0.84 & 0.33) and followed by R-1249-1196-2-1 .Minimum impact was observed due to application of stem extract of rice genotype R-548-89-6 (1.18 & 0.54) fresh and dry weight respectively.

Impact of *Echinochloa colona* on germination behaviour of rice genotype

Extract of weed species of *Echinochloa colona* was used for germination study of rice genotype leaf, stem, and root were used separately for the study purpose and their extract was used to find out their impact on

- fresh weight of rice Seedlings
- dry weight of rice Seedlings
- length of rice genotype seedlings (cm)

Effect of extract of *Echinochloa colona* on Germination behavior of rice genotype on Seedling fresh weight.

It was observed that stem extract was most effective and significantly reduced the fresh weight of seedlings as compared to control .Whereas the root extract of *Echinochloa colona* was found least effective on fresh weight of young seedling of rice genotype .fresh weight of young seedlings of rice genotypes R-548-89-6(2.36) possessed maximum weight followed by Indira Sugandhit Dhan(2.19) and R-1060-1674-1-1 (2.15) while minimum weight of rice seedlings were observed in genotypes R-1182-167-2-157 (1.63)followed by R-1072-360-1 (1.74)and R 1037-649-1-1 (1.88)

The significant maximum adverse effect was noted in rice genotype R-1072-360- 1 (1.57) followed by R-1182-167-2-157 and Vasumati in leaf extract of *Echinochloa colona*. Whereas signififant maximum seedling weight was observed R-1249-1196-2-1(2.38) followed by R-548-89-6 (2.31) and Safri -17 (2.22)

Genotype R-548-89-6 possessed maximum seedlings weight in leaf stem and root extract .While genotype R-1182-167-2-157 was adversely affected through leaf, stem and root extract of *Echinochloa colona* in relation to seedling growth.

Effect of extract of *Echinochloa colona* on Germination behavior of rice genotype on Seedling dry weight.

Extract of weed species of *Echinochloa colona* was used for germination study of rice genotype leaf ,stem and root were used separately for the study purpose and there extract was used to find out there impact on dry weight of seedling of rice genotype and germination behavior .it was observed that stem extract was most effective and significantly reduced the dry weight as compared to control .Root extract of *Echinochloa colona* was found least effective on dry weight of seedling of rice genotypes.

Dry weight of seedling of rice genotype R-548-89-6(0.955) have sown maximum weight followed by R-1249-1196-2-1(0.88) and while minimum dry weight of rice seedlings observed in genotrype R 1182-167-2-157 (0.62)followed by R-1072-360- 1(0.71) and R 1037-649-1-1(0.74) .The significant maximum reduction was observed when used leaf,stem ,and root extract of *Echinochloa colona* in rice genotype R-1182-167-2-157 and minimum adverse effect was observed in R-548-89-6 .

Effect of extract of *Echinochloa colona* on Germination behavior of rice genotype on Seedling length.

It was observed that stem extract was most effective and significantly reduced the seedling length as compared to control .Leaf extract of *Echinochloa colona* was found least effective on seedling length of young seedlings of rice genotypes . The maximum seedling length was observed in rice genotype R-548-89-6(7.55) followed by Safri (6.60) and Dubraj (6.45).minimum seedling length was observed in R-1060-1674-1-1(4.70) ,Danteshwari(5.25) and R-1037-649-1-1 (5.25).

Observation for biochemical estimation

Chlorophyll content

Chlorophyll content of leaves of major weeds species was estimated at the time of sixty days after transplanting the crop maximum Chlorophyll content was observed in *Cyprus rotundus*(46.00) followed by *Croton banplandianum* (43.53) and *Borreria hispida* (40.85) Minimum Chlorophyll content was observed in *Ischaemum rugosum* (36.30)and followed by *Echinochloa colona* (36.58) and *Eclipta alba*(39.45) .Maximum Chlorophyll cointent was observed in leaves of *cyperus rotundus* R-1072-360- 1(78.1) while minimum Chlorophyll content was observed in *Indira sugandhit dhan* .(32.9) Leaves of *Echinochloa colona* contain maxiumum Chlorophyll content in R-1060-1674-1-1(43.8) and minimum in Dubraj(30.2) .Maximum chlorophyll content in leaves of *Croton banplandianum* was observed in dubraj (49.8) and minimum Chlorophyll content was observed in R-1072-360- 1(38.2) while in this genotype in leaves of cyperus rotundus possessed maximum chlorophyll content and minimum was observed in R-1182-167-2-157 Eclipta alba leaves possessed maximum chlorophyll content in genotrype Danteshwari (19.02) and minimum in R-979-1528-2-1 .In Ischaemum rugosum leaves maximum chlorophyll content was observed in Danteshwari (39.2) and minimum in Indira Sugandhit dhan (34.6) *Eclipta albaleaved* possessed maximum chlorophyll content in *Dubraj* (47.5) and minimum chlorophyll content was observed in genotype R-1182-167-2-157 (30.3) in transplanted situation .The similar trend of maximum and minimum chlorophyll content of leaves of *cyperus rotundus* and *Borreria hispida* was observed in same genotype in SRI method .

While the *Echinochloa colona* leaves the maximum chlorophyll content was observed in same genotypy R-1060-1674-1-1 as recorded in transplanted situation .but minimum content was observed in R-548-89-6 and followed same genotype Dubraj (43.2) as mentioned transplanted situation. In *Croton banplandianum* safri 17 ,Dubraj genotype possessed high chlorophyll content in transplanting situation and SRI also similae trend was observed for maximum as well as for minimum un genotype R-1072-360-1(40.6) chlorophyll content in *Ischaemum rugosum* maximum was observed in same genotype Danteshwari (42.1) as recorded in transplanting and minimum was observed in R-1037-649-1-1 (35.3) and fallowed by same as mentioned as transplanted in Indira sugandhit Dhan . Similarly, *Eclipta alba* leaves possessed maximum chlorophyll content in Dubraj (49.4) mentioned in transplanting and minimum was recorded in Safri 17 (35.5) at 60 DAT.

Phenol content –Phenol content of root, stem, and leaves in rice genotype was estimated at the time of physiological maturity. It was observed that all the genotype possessed significant variation in relation to phenol content and it was significantlay varied in root stem and leaves .However stem portion possessed significantaly maximum phenol content content and root possessed minimum phenol content .The over all phenol content in all plant part was maximum in Vasumati followed by Dubraj and Safri 17 where as minimum phenol content was estimated in R-1182-167-2-157 followed by Danteshwari and R-1249-1196-2-1. In the leave of rice genotype maximum phenol content was estimated in Vasumati followed by Safri 17 and R-548-89-6 .Minimum phenol content was estimated in leaves of R-979-1528-2-1 followed by Indira sugandhit dhan and Danteshwari.

Effect of rice genotype on Germination behavior of *Echinochloa colona*(allelopathy) ∝ amylase activity.

Shoot straw of matured plant of all twelve rice genotypy was used for the the study of germination behaviour of *Echinochloa colona* and ∝ amylase activity of *Echinochloa colona* seedling was estimated at room temperature 33.4℃ .

It was observed that ∝ amylase activity was significantaly varied due to application of extract of twelve rice genotypes seedlings extract of Indira sugandhit dhan possessed significantaly maximum

adverse impact on germination of *Echinochloa colona* followed by R-1249-1196-2-1 and R-979-1528-2-1. Minimum adverse effect on ∝ amylase activity was observed due to the application of extract of rice genotype Basumati followed by R-548-89-6,R-1037-649-1-1 and safri -17 as compare to control.

Table 1. Impact of root, leaf and stem extract of rice genotypes of *Echinochloa colona*.

S. N	Rice genotype	Effect of root Extract		impact of root extract		Effect of leaf extract		Impact of leaf extract		Effect of stem Extract		Impact of stem extract	
		Germination %	*Seedling length*	*Fresh weight*	*Dry weight*	*Germination %*	*Seedling length*	*Fresh weight*	*Dry weight*	*Germina tion %*	*Seedling length*	*Fresh weight*	*Dry weight*
01	R-1037-649-1-1	53.85	3.15	1.13	0.47	61.1	3.6	0.7335	0.28	66.85	2.785	0.844	0.334
02	Danteshwari	52.29	4.40	1.09	0.43	51.82	3.35	1.0365	0.40	55.85	4.4	0.0355	0.3975
03	R-979-1528-2-1	50.17	4.15	1.13	0.49	53.16	3.45	1.1255	0.43	54.12	3.35	0.167	0.4345
04	Vasumati.	19.53	4.35	0.98	0.38	20.515	2.6	0.9855	0.38	22.505	2.75	0.8755	0.377
05	R-1182-167-2-157-1	52.14	3.50	0.94	0.36	50.47	3.7	0.9535	0.38	54.17	3.65	0.807	0.3835
06	*R-1072-360-1*	47.64	3.35	1.04	0.44	45.68	2.75	0.885	0.35	43.05	4.35	0.8245	0.3555
07	Indira sughandhit dhan	43.14	3.7	1.15	0.47	54.14	3.4	1.1445	0.48	48.35	3.65	1.037	0.478
08	*R-548-89-6*	47.51	4.20	1.32	0.51	50.66	3.35	1.297	0.54	52.34	3.75	0.1825	0.544
09	Safri 17	21.5	3.20	1.24	0.48	22.85	3.3	1.247	0.52	28.335	3.54	0.911	0.5235
10	Dubraj	22.4	3.40	1.17	0.45	28.85	2.65	1.133	0.44	26.68	2.4	0.665	0.386
11	R-1249-1196-2-1	47.99	3.65	1.46	0.58	47.855	3.65	1.365	0.36	55.46	3.4	0.9665	0.3645
12	R1060-1674-1-1	49.01	3.70	1.31	0.51	53.175	3.45	1.257	0.50	47.545	3.6	0.576	0.5055
13	**control**	88.30	6.55	1.96	0.71	88.29	6.55	1.962	0.71	88.28	5.5	1.1045	0.705
	Sem+-	1.1447	0.2175	0.00509	0.00231	0.970422	0.232048	0.002166	0.002052	1.12191	0.239792	0.002919	0.013558
	CD at 5 %	3.4973	0.66452	0.01554	0.00705	2.96486	0.70896	0.006618	0.00627	3.427686	0.73261	0.008917	0.041424

Table 2. Chlorophyll content present in leaf of major weed species under transplanting **&** SRI condition

S.N	Rice genotype	Chlorophyll content in SPAD major weed species											
		Cyperus rotundus		***Borreria hispida***		***Echinochoa colona***		***Croton banplandianum***		***Ischaemum rugosum***		**Eclipta alba**	
		Transplanted	***SRI***	***Transplanted***	***SRI***	***Trans planted***	***SRI***	***Transplanted***	***SRI***	***Trans Planted***	***SRI***	***Trans planted***	***SRI***
1	R-1037-649-1-1	46.5	47.3	43.9	45.2	41.2	42.3	40.6	42.3	34.3	35.3	44.0	42.5
2	Danteshwari	52.8	52.9	33.4	34.6	31.5	33.5	46.8	47.8	39.2	42.1	38.4	39.8
3	R-979-1528-2-1	39.4	40.1	41.9	42.3	30.6	32.3	43.2	44.3	36.3	38.2	36.8	38.4
4	Vasumati.	44.2	46.3	46.8	47.9	40.9	42.9	44.5	47.3	36.8	37.4	39.8	42.1
5	R-1182-167-2-157-1	51.3	53.2	44.0	46.3	39.9	40.2	40.5	43.2	36.3	37.2	30.3	36.2

6	*R-1072-360-1*	58.2	61.3	47.7	48.2	42.2	43.2	38.7	40.6	37.2	38.2	33.9	35.7
7	Indira sughandhit dhan	32.9	34.8	40.6	42.3	32.9	34.6	39.5	40.9	34.6	36.3	44.3	46.3
8	*R-548-89-6*	43.7	45.6	37.7	38.6	31.1	32.2	42.6	43.6	35.5	37.2	41.0	43.6
9	Safri 17	43.7	44.6	38.2	39.3	32.9	34.6	48.3	49.2	37.2	39.1	36.8	35.5
10	Dubraj	44.2	46.3	32.2	34.2	30.2	33.2	49.8	42.3	35.7	38.3	47.5	49.4
11	R-1249-1196-2-1	45.0	46.2	43.8	44.3	41.8	42.6	41.2	48.2	36.4	38.6	39.9	39.9
12	R1060-1674-1-1	50.2	42.2	40.1	42.1	43.8	46.8	47.2	48.6	36.2	40.2	40.8	42.6
	Total	**552.1**	**570.8**	**490.3**	**505.4**	**439.0**	**458.4**	**522.4**	**538.3**	**435.7**	**458.2**	**473.5**	**492.0**
	Avarage	**46.00**	**47.56**	**40.85**	**42.11**	**36.85**	**38.2**	**43.53**	**44.85**	**36.30**	**38.18**	**39.45**	**41.0**

Table 3. Total phenol content present in rice genotype (mg/g) of sample

S.N	**Rice genotype**	**Phenol content mg / g of sample**				
		Root	**Stem**	**Leaf**	**Total**	**Mean**
1	R-1037-649-1-1	0.328	0.543	0.632	1.502	0.501
2	Danteshwari	0.229	0.574	0.453	1.256	0.418
3	R-979-1528-2-1	0.388	0.728	0.372	1.488	0.496
4	Vasumati.	1.222	1.401	1.454	4.077	1.359
5	R-1182-167-2-157-1	0.419	0.328	0.453	1.200	0.400
6	*R-1072-360-1*	0.389	0.585	0.602	1.576	0.525
7	Indira sughandhit dhan	0.466	0.874	0.376	1.716	0.572
8	*R-548-89-6*	0.564	0.438	0.911	1.913	0.736
9	Safri 17	0.791	1.08	0.94	2.811	0.937
10	Dubraj	0.817	1.647	0.604	3.068	1.022
11	R-1249-1196-2-1	0.273	0.437	0.604	1.314	0.438
12	R1060-1674-1-1	0.375	0.505	0.888	1.768	0.589
	SEm-+	**0.00363**	**0.00129**	**0.02456**		
	CD at 1 %	**0.01119**	**0.00398**	**0.07568**		

Table 4. Impact of rice genotypes (whole plant extract) on ∝ amylase activity of *Echinochloa colona* seedlings.

S.N	**Rice genotype**	**O.d at 620 w.l. in /g of fresh weight**
		Treatment effect
1	R-1037-649-1-1	1.16
2	Danteshwari	1.11
3	R-979-1528-2-1	0.29
4	Vasumati.	1.18
5	R-1182-167-2-157-1	0.34
6	R-1072-360-1	0.85
7	Indira sughandhit dhan	0.14
8	R-548-89-6	1.16
9	Safri 17	1.12
10	Dubraj	0.37
11	R-1249-1196-2-1	0.28
12	R1060-1674-1-1	1.00
	Control	**1.04**
	SEm-+	**0.00339**
	CD at 1 %	**0.01034**

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SHORT COMMUNICATION

NIGER (*GUIZOTIA ABYSSINICA* CASS.): A HIGH QUALITY OILSEED CROP FOR TRIBAL & HILLY AREAS OF INDIA

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Abstracts: Niger is the most important oilseed crop in Ethiopia and a minor crop in India that has been cultivated for approximately 5000 years which is not involved in the world wide oilseed trade. India is considered to be the chief niger producing country in the world with an area of 5 lakh hectares. It is cultivated mainly in the states of Orissa, Maharashtra, Madhya Pradesh, Bihar, Karnataka and Andhra Pradesh and to some extent in hilly areas of Rajasthan, Uttar Pradesh, Gujarat, Tamilnadu, Assam, and also in some parts of North Eastern Hills states of the Country. Niger seed belongs to the same botanical family as sunflower and safflower (*Compositae*). There are six species of *Guizotia* with *G. abyssinica* being the only the cultivated species It is a dicotyledonous herb, moderately to well branched, and grows up to 2 meter in height. The crop grows best on poorly drained, heavy clay soils without much more irrigation.

Keywords: Tribal, oil, health, fatty acid, Niger

INTRODUCTION

Niger is a neglected minor oilseed crop of India, which plays significant role in the food and nutritional security of the poorest of the poor tribal segment of Indian population, hence known as lifeline of tribal agriculture and economy[1]. Niger yields high quality edible oil with pleasant nutty sweet taste. Niger is mainly used for oil extraction (about 70 per cent) for culinary and anointing purposes. Its oil is bluish white in colour and is a good absorbent of fragrance of flowers and thereby it is used as base oil in perfume industry. Niger oil is very much beneficial to human being. Hence, this paper intends to highlight the importance of neglected and underutilized niger crop in relation to its chemical and health care properties as discuss below.

Protein and its byproduct

Niger meal, remaining after oil extraction, contains approximately 30% protein and 23% crude fiber. In general, Ethiopian niger meal contains less protein and more crude fiber than the niger meal from seeds grown in India[2]. The protein, and crude fiber contents of niger are affected by the hull thickness. Thick-hulled seeds tend to have less protein and more crude fiber. The protein content of the dehulled flour increased from 44–63%. The meal was reported to be free from any toxic substance but contains more crude fiber than most oilseed meals. The utilization of niger seed proteins in human food is very limited due to the presence of a high fiber content and a dark color of the cake. The oil extracted from dehulled seeds was of good quality and the cake was high in protein and low in fiber. The amino acid composition of niger protein was deficient in tryptophan. The lipoprotein contained 4% moisture, 12% ash, 46% protein, 20% fat, 7% crude fiber, and 11% soluble carbohydrate[3].

Oil content and its processing

The oil content of niger varied form 30-50% as per genotype and environment. Niger seeds were also reported to contain 483 calories, 2.8–7.8% moisture, 17–30% protein, 34–39% total carbohydrate, 9–13% fiber, 1.8–9.9 g ash, 50–587 mg/100 g calcium, 180–800 mg/100 g phosphorus, 0.43 mg/100 g thiamine, 0.22–0.55 mg/100 g riboflavin, and 3.66 mg/100 g niacin[4]. The oil has an attractive pale yellow color and a nutty taste. With high levels of linoleic acid, it is very similar to sunflower and safflower oils. In India the oil is extracted by bullock-powered local *'ghanis'* and rotary mills (cottage expellers) or in mechanized expellers and hydraulic presses in large industrial areas. The oil content of niger is also influenced by the hull thickness hence, dehulling is now days practiced in niger seeds for increase of both oil and protein contents[3].

Edible and non edible uses

Niger seeds are used fried, milled into flour, pressed with honey into cakes, and for livestock feed after oil extraction while the plants are used as green manure as a type of cover crop grown primarily to add nutrients and organic matter to the soil. Niger seed is also a good bird feed. The oil can be used as a substitute for olive oil and a substitute for sesame oil for pharmaceutical purposes. In India, Niger seeds are also fried, used as a condiment or consumed about 18 % in certain regions as food in the form of chutney mixed with chilly and spices[5]. Niger seed oil can also be used in the manufacture of soap and as a lubricant or lighting fuel. The oil is also used to a limited extent in paints (being slow-drying), for which the Ethiopian seed is superior to the Indian seed as it has higher linoleic acid content. It is also used in perfumes as a carrier of the scents and fragrances[6].

Fatty acid composition

Niger seed oil has a fatty acid composition typical for seed oils of the *Compositae* family *viz*., safflower and sunflower with linoleic acid being the dominant fatty acid. The fatty acid composition of the seed is made of 7–8% palmitic and stearic acids, 5–25% oleic acid, and 55–80% linoleic acid[7]. This fatty acid composition is comparable to those of safflower (*Carthamus tinctorius*) and sunflower (*Helianthus annus*) oils, which are low in saturated acids, contains virtually no n-3 acids, and rich in linoleic acid (up to 70%). The Indian varieties of niger seed contains 25% oleic and 55% linoleic acids, with the linoleic acid percent being lower than in seeds grown in Ethiopia (75%)[8]. Niger seed oil contained much higher levels of tocopherol (660–850 μg tocopherol/g oil) than sunflower and safflower oil, belonging to the *Compositae* family (510 and 400 μg tocopherol/g oil), which may have resulted in great stability of the oil toward oxidation in spite of higher linoleic acid content than sunflower and safflower oils. Niger seed oil was characterized by extremely high level of vitamin K1 (more than 0.2% of TL) and β-carotene (*ca*. 0.06% of TL). The vitamin K1 level is very low in most foods (<10 mg/100 g), and the majority of the vitamin is obtained from a few green and leafy vegetables like spinach and broccoli. Low levels of phenolic compounds (5 mg/Kg oil) were determined in the crude niger seed oil[6].

Niger oil in health care

The high level of vitamin K1 may be the most unique health promoting characteristic of Niger seed oil. The significance of dietary vitamin K has recently increased. Vitamin K is a fat soluble vitamin that functions as a coenzyme and is involved in the synthesis of a number of proteins participating in blood clotting and bone metabolism. The importance of vitamin K as a blood-clotting agent is well known. Moreover, it is demonstrated that vitamin K may play a variety of health-promoting roles. Vitamin K reduces the risk of heart disease, kills cancer cells, and enhances skin health and may have antioxidant properties[6]. Niger seed oil appears to be nutritionally valuable, as the high content of linoleic acid is known to prevent cardiovascular diseases and to be the precursor of structural components of plasma membranes and of some metabolic regulatory compounds. Linoleic acid may also decrease arrhythmias[9] and improve insulin sensitivity. The oil can also be used in rheumatism. A niger-based agar medium can be used to distinguish *Cryptococcus neoformans* (Sant) Vaill, a fungus that causes a serious brain ailment, from other fungi[10]. There are reports that Niger oil is used for birth control and for the treatment of syphilis. In addition, Niger sprouts mixed with garlic are also used to treat coughs

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SHORT COMMUNICATION

STUDY THE DECOMPOSITION RATE OF COMPOST UNDER DIFFERENT COMPOSTING TECHNIQUE

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Abstract: The experiment was carried out during the December 2007 to March 2008, at instructional farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur.Different composting techniques were used - 1, one perforated pipe method 2. two perforated pipe method 3. Three perforated pipe method. 4. U shape perforated pipe method 5, turning method 6, traditional method 7. NADEP method, the changes in different physical, chemical and biological parameters was studied at 30, 60, 90 and 120 days after filling. Treatment under aerobic decomposition of paddy straw, soybean straw and fresh cow dung and soil were taken into5:2 ratios for each pit. EC and moisture content were found under the NADEP method of composting. The bulk density, ash percent increased with days of decomposition progresses and maximum increase was found at 120 days. The highest pH recorded in NADEP method of compost (7.0, 9.0, 8.2 and 7.7) at 30, 60, 90, and 120 days respectively, while the lowest pH was recorded on the traditional method of composting (5.56, 7.1, 6.7 and 7.0). The highest EC was recorded in traditional method of compost (1.4 dS m^{-1}) at 120 days.

Keywords: Bulk density, EC, moisture, pH, temperature

INTRODUCTION

India has vast potential of organic matter and FYM occupies a prominent position among the different organic material available in the country. In India, solid waste generation is estimated as, 25-39 million MT/annum of municipal solid waste (MSW), 320 million MT/annum of crop residues, 210 million MT/annum of cattle manure, 6.0 million MT/annum of sugarcane press mud and 3.3 million MT/annum of poultry manure (Singh, 2004). In addition, 10-15% of 75 million tones/annum of fruits and vegetables produced in the country are also available as by-products for recycling in agriculture. Food processing industry alone produces around 5.0 million MT/ annum of bio-solids. Management of such an enormous amount of bio-solids and recycling of nutrients and organic matter embedded in these resources has become an important environmental issue and economic necessity

Production compost from biodegradable wastes would help in increasing the availability of manure and supply of nutrients to bridge the gaps between nutrient demands and supply in agriculture. There is a need to increase production of quality compost at minimum cost through adoption of appropriate technologies. The quality of compost prepared from different waste will need to be assessed through physical chemical and biological assays minimum content of phytotoxic compound and heavy metal content. However, the direct application of crop residue is possible in the presence of sufficient amount of soil moisture and direction for rapid decomposition. Therefore compositing is an alternative to direct incorporation in soil in semi arid sub humid regions. Hence, it is important to develop a suitable technique for preparation of minerals enriched compost by using low cost amendments in the shortest possibilities and evaluate its quality and maturity.

MATERIAL AND METHOD

The study was conducted during the December 2007 to March 2008 research farm of Indra Gandhi Krishi Vishwavidyalaya, Raipur. Experimental completely randomized design (CRD). With 7 treatments 3 Replication Size of pit1× 1× $1m^2$ treatments are

Treatments No.	Treatment	No.of holes in Tube	Size of hole in tube (diameter)
T_1	One perforated pipe of 29.5cm diameter	193	2.5 cm
T_2	Two perforated pipe of 29.5 cm diameter	386	2.5 cm
T_3	Three perforated pipe of 29.5 cm diameter	579	2.5 cm
T_4	U shape perforated pipe of 29.5 cm diameter	519	2.5 cm
T_5	Manual turning of compost 15 day		-
T_6	Traditional way compost preparation		-
T_7	NADEP method of compost preparation	111	$10X10^2$

Preparation and Filling of Pits

The size of pits was 1x1x1 m length, width and height respectively. The pit was layered with the polythene sheet. Firstly 15 cm chopped paddy straw spread at bottom of pits. Then after this layer was moisten with 15-20 liter of water. Later 5 cm and 1 cm layer of cow dung and soil was spread over it. This sequence of layer was continued till its height reaches 15 cm above ground level. Finally this 15 cm raised layer was covered with 5-10 cm thick soil.

Raw Material

Paddy straw, soybean straw, (126 kg of each, 5-6 cm long residue) were chopped with thresher / chaff cutter into small pieces (5-6 cm long) fielding up of the pits. 35 kg fresh cow dung and soil were taken into 5:2 ratios respectively for each pit.

Perforated Pipes

To enhance the aeration into the pits, 29.5 cm of diameter polyvinyl chloride pips were used. The hole were (2.5 cm diameter) made in the pipes for aeration. The number of holes varied according to treatments.

RESULT AND DISCUSSION

The highest temperature was recorded in NADEP method of compost followed by treatment turning method of compost and three perforated pipe method of compost. While, the lowest temperature was recorded in traditional method of compost. The temperature of the different compost method ranges from ambient to thermophilic (higher than 45^0C) within a month. In the compost pit initially temperature increase due to presence of mesophilic microorganisms and were overcome the thermophilic ones, which resulted to increase in temperature up to 70 ^{0}C. However, a temperature drop was observed in first 15 days in all method of compost. This early temperature drop could results due to the retardation of composting caused by organic acid formation at the early stage the increase temperature in NADEP method of compost might do better aeration which resulted better growth of microorganism.

In the physical properties moisture content of different samples was recorded among all the techniques, NADEP method of compost showed low moisture content (58.80, 48.3, 53.44 and 40.66 %) followed by turning method (59.30., 52.2, 56.7, and 53.7 %) at 30, 60, 90 and 120 days respectively. While highest moisture content was recorded on one perforated pipe method of compost. In NADEP method of composting there was sharply decrease in moisture content from its initial stage, which might due to better aeration achieves.

Bulk density of different composting techniques showed that highest bulk density (0.47, 0.61, 0.66 and 0.74 Mg/m^3) found on NADEP method of compost and it was at par with the turning method of compost (0.49, 0.58, 0.60 and 0.70 Mg/m^3) at 30, 60, 90 and 120 days respectively. However, lowest bulk density (0.47, 0.47, 0.51 and 0.56 Mg/m^3) showed by the traditional method of compost. The highest bulk density of NADEP method might be due to higher aerobically microbiological decomposition due to proper aeration results in higher degree of biodegradation.

The pH of compost pit was significantly affected by different composting technique at all the four stages of observation. that the highest pH recorded in NADEP (T_7) method of compost (7.0, 9.0, 8.2 and 7.7) at all the stages followed by turning method of compost (T_5) (6.0, 8.4, 7.7, and 7.3) and three perforated pipe method of compost (T_3) (5.5, 8.3, 7.7 and 7.4). While the lowest pH was recorded on the traditional method (T_6) of compost (5.56, 7.1, 6.7 and 7.0). In the mesophilic stage *ie.* at 30 days after pi filling, pH was acidic in all method of compost. Whereas, at thermophilic stage *ie.* at 60 DAF. The pH rose to 8 to 8.6 which might be due to release of NH_4 gas at this stage. Latter again pH come down to neutral *i e* around pH 7.5. Similar finding also reported by Golueke (1972). A high pH level can favor nitrogen loss through ammonia volatilization in conjunction with high temperature and low C/N ratio (Ekinci *et al.,* 2000) Initial stage of microbial degradation, organic acid are frequently produced, which can lead to a reduction of pH. Similar results also reported by Eklind *et al.* (1997).

Electrical conductivity (EC) was recorded at 30, 60, 90 and 120 DAF. That the lowest EC was recorded on NADEP (T_7) method of compost (1.06 dS m^{-1}) at 120 days after decomposition period, which was at par with turning method of compost (1.33 dS m^{-1}) and three perforated pipe method of compost (1.33 dS m^{-1}), while the highest EC was recorded in traditional method (T_6) of compost (1.4 dS m^{-1}). A low electrical conductivity could be an indicator of complex nutrients and therefore desirable. The decrease of EC in the NADEP composting process might be due to direct consequence of the increased concentration of nutrients, such as nitrate and nitrite.

CO_2 evaluation rate was observed at 20, 40, 60, 80, 100 and 120 days after filling. The highest CO_2 was recorded in NADEP (T_7) method of compost at 20, 40and 60 days followed by turning (T_5) method of compost and three perforated pipe (T_3) method of compost, while the lowest CO_2 was recorded on the traditional (T_6) method of compost. The respiration rate evaluation was faster during initial period of composting and later slowed down with time. Availability of easily decomposable organic compounds seems to induce rapid microbial growth in initial period and decreased in later periods may be attributed to the exhaustion of those substances these results are in agreement with those reported by Mishra *et al.* (2001).

Respiration intensity is directly related to the speed of microbic metabolism and therefore it is inversely

related to compost maturity. Consequently in the early composting phases, corresponding to a fast microbic multiplication due to the most readily fermentable organic fraction, respiration intensity is very high. Later on, after a decrease in biologic activity, respiration intensity too decreases strongly until it reaches low values that remain constant in a stable product.

At 60 days after composting the respiration rate was slow down which indicates that the low level biological metabolism result are in confirmed those of Epstein (1996). However, respiration rate decreased with increase in composting time this may be due to the reduction of volatile solids, which in turn affected microbial activity. Our result also supported by Changa *et al.* (2003).

Table 1. Effect of moisture content during composting at 30, 60, 90 and 120 days

Treatment	**Moisture percent**			
	30	**60**	**90**	**120**
I perforated pipe method	60.84	58.91	67.94	61.59
II perforated pipe method	60.96	56.07	64.26	59.57
III perforated pipe method	60.70	55.24	60.22	56.34
U Shape perforated pipe method	59.35	54.50	63.21	57.84
Turning method	59.30	51.40	57.77	48.27
Deshi method	59.33	54.79	57.33	55.13
NADEP method	58.80	43.80	52.11	42.43
SEm ±	**-**	**2.09**	**2.55**	**2.79**
CD	**NS**	**6.35**	**7.74**	**8.46**

Table 2. Effect of Bulk density (Mg/m^3) on different composting techniques at 30, 60, 90 and120 days

Treatment	**Bulk density (** Mg/m^3)			
	30	**60**	**90**	**120**
I perforated pipe method	0.480	0.49	0.55	0.61
II perforated pipe method	0.480	0.54	0.57	0.64
III perforated pipe method	0.483	0.57	0.59	0.66
U Shape perforated pipe method	0.470	0.56	0.58	0.65
Turning method	0.493	0.58	0.60	0.70
Deshi method	0.470	0.47	0.51	0.56
NADEP method	0.470	0.61	0.66	0.74
SEm ±	**-**	**0.02**	**0.02**	**0.02**
CD	**NS**	**0.07**	**0.07**	**0.08**

Table 3. Effect of pH level on 30, 60, 90 and 120 days of composting

Treatment	**pH**			
	30	**60**	**90**	**120**
I perforated pipe method	5.93	7.80	7.60	7.10
II perforated pipe method	6.00	8.18	7.80	6.80
III perforated pipe method	6.51	8.39	7.75	7.43

U Shape perforated pipe method	6.33	8.15	7.80	7.21
Turning method	6.60	8.41	7.73	7.36
Deshi method	5.56	7.16	6.70	7.03
NADEP method	7.05	9.00	8.29	7.73
SEm ±	**0.23**	**0.30**	**0.35**	**0.12**
CD	**0.71**	**0.92**	**1.07**	**0.37**

Table 4. Effect of electrical conductivity (dS m^{-1}) at 30, 60, 90 and 120 days of composting period

Treatment	**Electrical conductivity (**dS m^{-1})			
	30	**60**	**90**	**120**
I perforated pipe method	1.67	1.64	1.68	1.06
II perforated pipe method	1.60	1.60	1.76	1.40
III perforated pipe method	1.58	1.58	1.49	1.13
U Shape perforated pipe method	1.68	1.62	1.84	1.26
Turning method	1.54	1.42	1.20	1.13
Deshi method	1.62	1.63	1.50	1.40
NADEP method	1.62	1.58	1.43	1.06
SEm ±	-	-	**-**	**0.07**
CD	NS	NS	**NS**	**0.21**

Table 5. Effect of CO_2 evolution rate (mg $CO_2/m^2/hr$) on different composting techniques at various time intervals

Composting technique	**20 days**	**40 days**	**60 days**	**80 days**	**100 days**	**120 days**
I perforated pipe method	526.883	587.420	351.847	243.690	93.380	42.327
II perforated pipe method	5551.247	639.570	349.063	272.300	79.983	40.033
III perforated pipe method	562.607	654.230	360.050	218.887	75.773	34.827
U Shape perforated pipe method	557.970	644.093	358.307	216.003	71.393	36.273
Turning method	570.457	640.970	381.927	224.840	75.147	32.337
Deshi method	512.047	582.427	353.107	200.053	81.517	46.807
NADEP method	624.907	730.477	412.460	226.790	64.053	30.290
SEm±	**10.64**	**3.71**	**4.005**	**5.49**	**2.56**	**1.28**
CD at 5%	**32.27**	**11.26**	**12.14**	**16.66**	**7.78**	**3.89**

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SHORT COMMUNICATION

STUDY OF WEED SPECIES AND ITS GROWTH ON DIFFERENT STAGES OF PADDY UNDER TRANSPLANTING AND SRI METHODS

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Abstract: The present investigation was carried out during kharif 2006-07 at instructional farm of indira Gandhi Krishi Vishwavidalaya,Raipur .The experiment was conducted in split plot design in field and CRD in laboratory condition replication in twice. It was observed that the rice genotypes Dubraj ,indira sugandhit dhan and R- 1182-167-2-157 -1 possessed minimum weed densities of major weed species (*cyperus rotundus, Borreria hispida ,Echinochoa colona* **,***Croton banplandianum, ischaemum rugosum* **,***Eclipta alba***)** in both transplanted and SRI method ,while R-548-89-6 and safri -17 and Danteshwari possessed more weeds. The number of leaves were maximum in *Eclipta alba* followed by *Borreria hispida,* **,***Croton banplandianum, ischaemum rugosum* **,** *Echinochoa colona* and *cyperus rotundus* in both transplanted and SRI condition.The number of leaves in all the weed species was slightly higher in SRI method as compared to transplanting .

Keyword: Leaves, Plant height SRI, Transplanting

INTRODUCTION

Chhattisgarh state is regarded as the "Rice bowl" and about 82% population of the state is depending on agriculture for their livelihood. Weed management during a crop season has been a several problems for many years. Worldwide a 10 % loss of agriculture production can be attributed to the competitive effect of weed despite their intensive control potential yield reduction caused by un controlled weed growth out crop season have an estimated range of 45-95 % depending on ecological and climatic condition therefore the identification of rice genotypes exhibiting allelopathic/weed suppression potential against the weed growth may be an important tool to developed genetically allelopathic potential crop weed cause serious problem in cultivation of rice which affect the growth and development and yield of rice .

MATERIAL AND METHOD

The present investigation was conducted at the instructional farm, indira Gandhi krishi vishwavidalaya Raipur (C.G) during the kharif season 2007-2008.Raipur is situated in the central part of the Chhattisgarh and lies at 21.16N latitude and 81.26E longitude with an altitude of 28.56 meters above the mean sea level. the place of investigation comes under sub –humid to semi humid agro climatic region, the average rainfall of the region range from 1200-1400 mm , out of which 80-85 %rains are usually received from third week of June to end of September and very less during October to February . The maximum temperature goes to high as 46.C during the May and minimum as low as 6.C during December months. The experiment is spilit plot design 2 replication and 12 rice genotypes *i.e* (1) R-1037-649-1-1 (2) Danteshwari (3) R-979-1528-2-1 (4) Vasmati (5)R-1182-167-157-1 (6) R 1072-360-1 (7) indira sugandhit dhan (8)R 548-89-6 (9) Safri- 17 (10) Dubraj (11) R 1249-1196-2-1 (12) R1060-1674-1-1 plant height of weed and number of leaves per plant measured in centimeter and inches at 60 DAT ,80 DAT and at the time of physiological maturity of the crop.

RESULT AND DISCUSSION

The plant height of major weeds species was measured at 30, 60 DAT and at the time of physiological maturity of the crop. In general average maximum plant height was observed in *cyperus rotundus* at 30 DAT 60 DAT and at physiological maturity of crop in transplanting and SRI method and followed by *Borreria hispida* and *croton banplandianum* in almost all the stages of observation and experimental condition minimum plant height was observed in the weed spp.*Eclipta alba* and followed by *Ischaemum rugosum* and *Echinochloa colona at* 30,60 DAT and at physiological maturity of crop in transplanting and SRI method.

The maximum plant height of *cyperus rotundus* was observed in Indira sughandhit dhan (medium duration) at 30 DAT,60DAT and at physiological maturity in transplanted as well as SRI method and followed by R-1249-1196-2-1 (long duration) at 30 DAT,60DAT and at physiological maturity in transplanted condition ,while in SRI method it is followed by R-548-89-6 (medium duration) at 30 DAT,60DAT and at physiological maturity.

The minimum plant height of *cyperus rotundus* was observed in R-1182-167-2-157 at 30 DAT,60DAT and at physiological maturity of crop in transplanted and SRI method .However the plant height of *Borreria hispida* was maximum in rice genotype Danteshwari at 30,60,DAT and at physiological maturity situation in rice genotype Danteshwari followed by R-979-1528-2-1 and R-1072-360-1 where as minimum plant height was observed in vasumati followed by R-1060-1674-1-1 in

transplanted condition .while in SRI it was maximum e in R-1037-649-1-1 and minimum in at 30 DAT,60DAT and at physiological maturity Vasumati.

Croton banplandianum possessed *maximum plant height in* rice genotype R-1249-1196-2-1 and fallowed by Safri 17. Minimum plant height *croton banplandianum* was observed in 1037-649-1-1 followed by Indira sugandhit dhan in transplanted condition. In SRI it was maximum in Dubraj fallowed by Vasumati at physiological maturity the minimum plant height was observed in Dubraj and followed by Indira sugandhit Dhan. *Echinochoa colona* stand in fourth rank among the weed species present in rice field .The average plant height was observed in transplanted condition and in SRI method , Maximum plant height of *Echinochoa colona* was observed in R-548-89-6 and fallowed by R-1072-360-1 transplanted condition and in SRI the same genotype were possess similar trend in maximum and minimum .Minimum plant height was observed in R-1060-1674-1-1followed by R-1249-1196-2-1 in transplanted and SRI it was also minimum in R- 1060-1674-1-1.

Ischaemum rugosum was having average plant height in transplanted and in SRI condition .maximum plant height of weed species *ischaemum rugosum* was observed in transplanted and SRI and respectively in genotype R-1060-1674-1-1 where as minimum in R-1182-167-2-157-1 in both transplanted and SRI respectively .

Eclipta alba possessed average plant height in transplanted and SRI *i.e*. 32.80 and 35.68 respectively .The maximum plant height in *R-1072-360-1* transplanted and SRI respectively, where as minimum plant height in observed in R -1037-649-1-1 in transplanted and in R-979-1528-2-1 in SRI.

The number of leaves per plant on major weed species was also measured at 30, 60, DAT and at physiological maturity in transplanted and SRI condition .Number of leaves per plant was maximum at 60 DAT in almost all species of weeds in both the situation .no any specific trend or relation in number of leaves was observed in both the condition.

The numbers of leaves were maximum in *Eclipta alba* followed by *Borreria hispida, Croton banplandianum, Ischaemum rugosum* , *Echinochoa colona* ,and *Cyperus rotundus,* in both transplanting and SRI condition .The number of leaves in all the weed species was slightly higher in SRI method as compared to transplanting .In general the number of leaves on all the weed species were more in rice genotype R-1072-360-1 at almost all the stages of observation and both the situation *i,e* transplanting and SRI condition.

Table 1. Plant height of major weed species in different stages (DAT) under transplanting condition

S.N.	Rice genotype	Plant height of major weed species (cm)																	
		Cyperus rotundus			***Borreria hispida***			***Echinochoa colona***			***Croton banplandianum***			***Ischaemum rugosum***			**Eclipta alba**		
		30	***60***	***Maturity***	***30***	***60***	***Maturity***	***30***	***60***	***Maturity***	**30**	**60**	***Maturity***	***30***	***60***	***Maturity***	**30**	**60**	***Maturity***
1	R-1037-649-1-1	30.8	41.3	60.2	24.2	33.5	47.8	16.7	20.5	36.3	18.1	26.4	38.5	16.4	21.6	35.4	16.5	22.2	26.7
2	Danteshwari	32.5	43.5	65.3	26.6	35.4	52.5	18.2	21.4	32.1	16.0	27.4	41.1	15.9	21.2	31.8	19.2	25.6	38.5
3	R-979-1528-2-1	31.5	40.1	60.6	23.5	31.8	50.3	19.6	24.2	30.8	15.4	25.6	39.6	17.7	23.6	32.4	13.3	17.8	31.1
4	Vasumati.	32.5	43.4	65.2	20.7	25.6	38.4	19.5	25.4	38.2	19.1	26.3	39.5	17.3	23.0	34.6	16.1	21.5	32.3
5	R-1182-167-2-157-1	29.5	38.8	58.3	24.5	33.0	49.6	17.5	23.7	35.6	18.3	28.1	42.2	14.9	19.86	29.8	14.1	18.8	28.2
6	*R-1072-360-1*	31.0	41.4	62.1	24.6	33.5	50.3	19.5	25.9	38.9	19.6	25.5	38.3	15.5	20.7	31.1	19.2	25.6	38.5
7	Indira sughandhit dhan	32.5	47.5	71.3	23.5	31.4	47.2	15.8	20.4	30.6	16.7	25.6	38.4	16.7	22.3	33.5	17.3	23.0	34.6
8	*R-548-89-6*	34.5	45.4	68.2	21.6	27.2	40.9	19.6	26.0	39.1	19.5	26.6	39.9	15.15	20.2	30.2	14.8	19.8	29.7
9	Safri 17	34.5	45.5	68.3	20.5	27.8	41.7	21.2	21.7	32.6	16.3	28.7	43.1	15.7	20.9	31.4	18.6	24.8	37.2
10	Dubraj	32.8	44.2	66.5	21.5	29.1	43.7	21.8	21.2	31.8	15.9	26.4	39.6	15.2	20.3	30.5	14.7	19.6	29.2
11	R-1249-1196-2-1	34.5	45.8	68.8	22.6	26.8	40.2	27.6	20.1	30.2	16.6	28.8	43.2	16.3	21.4	32.2	15.5	20.7	31.1
12	R1060-1674-1-1	31.3	42.6	63.9	19.6	25.7	38.6	18.3	18.8	28.3	14.15	28.5	42.8	21.6	28.1	42.2	17.1	22.8	34.3
	Total	**390.0**	**519.5**	**778.7**	**273.4**	**360.8**	**541.2**	**235.3**	**269.3**	**404.5**	**205.65**	**323.9**	**486.2**	**198.35**	**263.16**	**395.2**	**196.4**	**262.2**	**393.6**
	Avarage	**32.5**	**43.29**	**64.89**	**22.78**	**30.06**	**45.12**	**19.60**	**22.44**	**33.7**	**17.13**	**26.9**	**40.5**	**16.52**	**21.93**	**32.93**	**16.36**	**21.5**	**32.8**

Table 2. Plant height of major weed species in different stages (DAT) under SRI condition

S.N	Rice genotype	Plant height of major weed species (cm)																	
		Cyperus rotundus			***Borreria hispida***			***Echinochoa colona***			***Croton banplandianum***			***Ischaemum rugosum***			**Eclipta alba**		
		30	***60***	***Maturity***	***30***	***60***	***Maturity***	***30***	***60***	***Maturity***	***30***	***60***	***Maturity***	***30***	***60***	***Maturity***	***30***	***60***	***Maturity***
1	R-1037-649-1-1	31.6	42.1	63.8	24.9	33.2	55.8	19.4	25.9	33.6	20.1	26.8	40.8	19.2	25.6	33.6	14.3	19.1	35.2
2	Danteshwari	33.1	45.6	68.4	27.3	36.4	54.6	17.1	22.8	34.3	21.7	29.1	43.5	18.6	24.8	37.3	20.2	27.1	40.5
3	R-979-1528-2-1	31.9	42.5	63.2	27.9	37.2	49.9	16.8	22.4	38.9	20.5	27.2	40.3	15.6	22.4	38.5	17.1	23.4	28.7
4	Vasumati.	33.7	44.93	67.4	20.4	27.2	40.9	16.4	21.9	32.9	23.7	30.8	46.2	18.2	24.2	36.4	19.2	24.0	36.1
5	R-1182-167-2-157-1	31.1	41.5	62.3	25.1	33.5	50.3	18.9	25.2	37.8	22.6	29.5	44.3	15.2	20.2	30.4	15.2	20.2	30.4
6	*R-1072-360-1*	32.1	42.8	64.3	26.3	35.0	52.6	20.2	27.2	40.5	20.6	27.8	40.5	18.9	25.2	37.8	20.1	26.8	40.3
7	Indira sughandhit dhan	37.1	49.46	74.2	25.6	34.2	51.3	17.3	23.0	34.3	21.2	26.8	40.3	18.3	24.1	36.2	19.8	25.9	38.9
8	*R-548-89-6*	35.6	47.53	71.3	22.4	29.8	44.8	21.2	28.2	42.4	22.3	28.3	42.5	19.4	25.9	38.9	18.2	21.8	32.7
9	Safri 17	35.1	46.8	70.2	22.6	30.2	45.3	17.9	23.8	35.8	22.5	30.2	45.3	17.3	23.0	34.6	19.6	25.6	38.5
10	Dubraj	33.9	45.2	67.8	23.4	31.2	46.8	16.9	22.5	33.8	24.6	32.2	48.3	19.6	26.1	39.2	16.7	22.2	33.4
11	R-1249-1196-2-1	35.1	43.8	70.2	21.4	28.53	42.8	18.6	24.4	36.6	21.1	26.8	40.2	16.8	23.5	33.6	17.3	22.4	34.6
12	R1060-1674-1-1	32.4	42.2	64.8	22.9	30.53	45.8	16.2	21.8	32.5	21.2	28.3	42.5	21.2	25.9	42.5	19.45	28.3	38.9
	Total	**402.7**	**534.42**	**807.9**	**290.2**	**386.96**	**580.9**	**216.9**	**289.1**	**433.8**	**261.8**	**343.8**	**514.7**	**218.1**	**290.9**	**439.0**	**217.15**	**286.8**	**428.2**
	Avarage	**3.5**	**44.535**	**67.32**	**24.18**	**32.24**	**48.40**	**18.075**	**24.09**	**36.15**	**21.81**	**28.65**	**42.89**	**18.17**	**24.24**	**36.58**	**18.09**	**23.9**	**35.68**

Table 3. No. of leaf / plant on major weed species in different stages (DAT) under transplanting condition

S.N.	Rice genotype	Number of weeds species 100 cm^2																	
		Cyperus rotundus			***Borreria hispida***			***Echinochoa colona***			***Croton banplandianum***			***Ischaemum rugosum***			**Eclipta alba**		
		30	***60***	***Maturity***	***30***	***60***	***Maturity***	***30***	***60***	***Maturity***	**30**	**60**	***Maturity***	***30***	***60***	***Maturity***	**30**	**60**	***Maturity***
1	R-1037-649-1-1	15	13	15	23	20	22	12	14	15	12	14	16	19	18	18	18	28	28
2	Danteshwari	16	18	16	20	24	22	16	14	16	18	14	16	14	20	22	14	20	20
3	R-979-1528-2-1	12	15	18	18	22	20	12	18	20	13	20	22	17	16	20	26	16	18
4	Vasumati.	15	16	14	24	26	28	13	14	16	13	15	16	18	20	22	26	28	28
5	R-1182-167-2-157-1	13	14	15	19	20	20	14	16	16	20	22	22	18	20	20	25	26	26
6	*R-1072-360-1*	14	16	13	22	24	24	14	16	20	20	22	20	12	15	16	28	30	30
7	Indira sughandhit dhan	12	15	15	20	23	22	12	14	16	18	20	20	14	14	15	27	30	28
8	*R-548-89-6*	16	18	20	22	24	24	08	16	16	12	14	16	12	14	18	23	24	24
9	Safri 17	13	15	15	18	20	20	10	12	12	18	20	22	15	14	16	24	26	24
10	Dubraj	12	14	15	25	26	24	10	12	15	12	15	16	17	18	18	21	22	22
11	R-1249-1196-2-1	16	18	14	16	18	22	12	14	14	13	14	18	14	16	16	22	24	26
12	R1060-1674-1-1	11	14	10	21	22	20	12	12	16	20	22	22	18	16	16	24	24	26
	Total	**165**	**186**	**180**	**284**	**269**	**268**	**145**	**172**	**192**	**189**	**212**	**226**	**188**	**201**	**217**	**278**	**298**	**300**
	Avarage	**13.75**	**15.5**	**15**	**20.66**	**22.4**	**22.33**	**20.8**	**14.3**	**16**	**15.75**	**17.6**	**18.8**	**15.66**	**16.75**	**18.0**	**23.16**	**24.8**	**25**

Table 4. No. of leaf / plant on major weed species in different stages (DAT) under SRI condition

S.N.	Rice genotype	Number of weeds species 100 cm^2																	
		Cyperus rotundus			***Borreria hispida***			***Echinochoa colona***			***Croton banplandianum***			***Ischaemum rugosum***			**Eclipta alba**		
		30	***60***	***Maturity***	***30***	***60***	***Maturity***	***30***	***60***	***Maturity***	**30**	**60**	***Maturity***	***30***	***60***	***Maturity***	**30**	**60**	***Maturity***
1	R-1037-649-1-1	18	20	16	26	24	24	14	14	18	15	14	18	12	20	22	19	22	22

2	Danteshwari	17	20	18	25	20	20	18	18	22	20	16	20	16	18	22	16	18	18
3	R-979-1528-2-1	14	18	16	22	22	24	14	16	16	15	16	18	19	16	20	28	24	24
4	Vasumati.	18	20	15	28	20	26	14	14	14	18	16	18	24	20	24	26	26	28
5	R-1182-167-2-157-1	15	18	16	24	20	22	16	16	18	22	20	20	20	22	20	27	26	28
6	*R-1072-360-1*	16	18	14	26	22	22	18	18	22	24	22	22	15	16	18	29	30	26
7	Indira sughandhit dhan	14	16	18	22	24	20	16	14	18	20	22	20	16	14	18	28	28	28
8	*R-548-89-6*	18	20	20	25	23	23	12	16	18	15	16	18	14	16	16	29	24	24
9	Safri 17	16	18	16	20	27	24	12	14	18	22	20	20	18	16	18	22	28	26
10	Dubraj	14	18	16	28	20	28	15	14	14	18	16	22	19	18	18	26	24	28
11	R-1249-1196-2-1	20	22	15	20	22	24	14	12	18	16	16	18	20	18	16	28	26	24
12	R1060-1674-1-1	13	15	20	24	18	22	14	12	16	24	20	18	23	16	18	24	30	22
	Total	**193**	**223**	**200**	**290**	**262**	**279**	**177**	**178**	**212**	**229**	**214**	**232**	**216**	**210**	**230**	**302**	**306**	**298**
	Avarage	**16**	**18.58**	**16.6**	**24.16**	**21.83**	**23.25**	**14.75**	**14.83**	**17.66**	**19**	**17.83**	**19.33**	**18**	**17.5**	**19.16**	**25.16**	**25.5**	**24.83**

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SHORT COMMUNICATION

STUDY THE IMPACT OF WEED ON RICE GENOTYPES YIELD UNDER TRANSPLANTING AND SRI CONDITION

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Abstract: The present investigation was carried out during kharif 2006-07 at instructional farm of indira Gandhi krishi vishwavidalaya,Raipur .The experiment was conducted in split plot design in field and CRD in laboratory condition replication in twice. It was observed that the yield was higher in SRI method in almost all genotypes of rice as compared to control. The higher yield was recorded in R-548-89-6 followed by Safri-17 and Vasumati.While genotype safri -17, R-1060-1674-1-1 and R-1072-360-1, were found suitable in SRI method .While, Dubraj , Danteshwari,and indira sugandhit dhan were found more suitable for transplanted situation for yield improvement . Indira sugandhit dhan ,Dubraj and R-1182-167-2-157-1 have shown allelopathy potential less difference in yield under unweeded and hand weeding twice condition. Maximum loss due to weed was observed in R-548-89-6 followed by R-1060-1674-1-1 R-1249-1196-2-1 and R-979-1528-2-1.

Keyword: Rice genotype, SRI, transplanting, yield

INTRODUCTION

Rice *(Oryza sativa)* is the most important staple food grain crop of the world .Which constitutes the principles food for about 60 % of population .In India rice is grown on 38.2 millions hectare with annual production of 87.8 millions tones. (Anonymous, 2005). Weed management during a crop season has been a several problems. The weed shared not only the plant nutrients but transpire a lot of valuable conserved water from the soil .The weed also sometimes serve as host for breeding and development of certain disease and pest .The delay in first weeding beyond 15-25 days after seeding sharply reduces the rice yield. The estimated yield losses in rice caused by weeds are as reported in rice (transplanted) 30-40 % (Bhan 1994). SRI (system of rice intensification) has been proved to the one of the best set of agronomic practices which reduces the all losses due to weed in paddy crop.

MATERIAL AND METHOD

The present investigation was conducted at the instructional farm, indira Gandhi krishi vishwavidalaya Raipur (C.G) during the kharif season 2007-2008.Raipur is situated in the central part of the Chhattisgarh and lies at 21.16N latitude and 81.26E longitude with an altitude of 28.56 meters above the mean sea level. the place of investigation comes under sub –humid to semi humid agro climatic region, the average rainfall of the region range from 1200-1400 mm , out of which 80-85 %rains are usually received from third week of june to end of September and very less during October to February . The maximum temperature goes to high as 46.C during the May and minimum as low as 6.C during December months. The experiment is spilit plot design 2 replication and 12 rice genotypes *i.e* (1) R-1037-649-1-1 (2) Danteshwari (3) R-979-1528-2-1 (4) Vasumati (5) R-1182-167-157-1 (6) R 1072-360-1 (7) indira sugandhit dhan (8) R 548-89-6 (9) Safri- 17 (10) Dubraj (11) R 1249-1196-2-1 (12) R1060-1674-1- Weed associated with the crop in experimental area were recorded at 60 DAT, 80 DAT and at the time of physiological maturity of the crop. Species wise weed count was made in randomly selected 2 quadrates of 100 ^{2} from each plot.

RESULT AND DISCUSSION

The grain yield was measured at harvest in transplanted and SRI method, in weedy check (un weeded) and Hand weeding twice to find out the impact of weed flora on their two system of rice cultivation and their impact on economic yield .In general the yield was higher in SRI method in almost all genotype of rice as compared to control. The higher yield was recorded in 548-89-6 (537.52) followed by Safri-17 (517.52) and Vasumati (394.97) and minimum yield was recorded in Danteshwari (227.52) followed by Indira sugandhit dhan (270.04)and R-979-1528-2-1 (327.52) in SRI .While in transplanted situation rice genotype R1249-1196-2-1 possessed maximum yield (472.00) followed by R 1060-1674-1-1 (428.60) and R-1182-167-2-157-1 (377.50) Minimum yield was observed in Dubraj followed by Vasumati (268.60) and Indira sugandhit dhan (278.78).

These is less difference in yield in weedy check (un weeded) and hand weeding twice in rice genotype Indira sugandhit dhan ,Dubraj and R-1182-167-2-157-1 and there genotype also have less weed densities in field situation under transplanting .However,rice genotype R548-89-6 possessed more difference due to more weed densities in field condition .Therefore , more reduction in yield was observed more loss due to this genotype in unweeded condition more loss due to weed was observed in R-1060-1674-1-1-, R1249-1196-2-1 and R -979-1528-2-1.

Safri 17, Indira sugandhit dhan ,Danteshwari, R-1060-1674-1-1 possessed less difference in weedy check and hand weeding twice in SRI .Such type of genotypes possessed the potential to suppress the weed and have shown the less loss due to weed.

Choi *et al*. (1995) also reported the loss in rice yield due to pre dominant weed of kharif season *Echinochloa colona* ,it reduce rice yield 25-30 % in mechanical transplanting and 10-20 % in hand transplanting.

Impact of weeds on rice genotypes yield under transplanting and SRI condition

S.N.	Rice genotype	Yield of rice of 100 cm^2 area in (g) under transplanting condition		Yield of rice of 100 cm^2 area in (g) under SRI condition		Weed dry weight of 100 cm2 area in (g)	
		Weedy check	Hand weeding	Weedy check	Hand weeding	under transplanting condition	under SRI condition
1	R-1037-649-1-1	296.36	360.00	337.52	407.36	3222.24	33.57
2	Danteshwari	314.90	352.12	255.00	227.52	25.96	27.20
3	R-979-1528-2-1	274.54	323.03	431 .52	327.52	70.07	72.36
4	Vasumati.	266.42	268.60	315.04	394.97	58.64	59.03
5	R-1182-167-2-157-1	337.69	377.50	424.96	340.00	52.77	55.76
6	R-1072-360-1	320.72	364.12	334.88	512.48	55.91	60.00
7	Indira sughandhit dhan	257.45	278.78	227.52	270.04	54.12	56.73
8	R-548-89-6	255.27	326.30	230.08	537.52	28.96	31.27
9	Safri 17	340.24	341.33	517.44	517.52	24.40	26.20
10	Dubraj	255.03	255.75	342.4	281.04	22.00	23.99
11	R-1249-1196-2-1	375.75	422.00	327.52	387.52	42.00	47.67
12	R1060-1674-1-1	343.63	428.60	480.0	510.00	54.66	58.33
	Total	**3328.37**	**3731.53**	**4041.88**	**4713.49**	**521.73**	**551.38**
	Avarage	**277.36**	**310.96**	**336.82**	**392.79**	**43.47**	**45.94**

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SHORT COMMUNICATION

SIGNIFICANCE OF PLANT BASED PHYTOEXTRACTS AGAINST SOFT ROT BACTERIA OF POTATO CAUSED BY *ERWINIA CAROTOVORA* SUBSP. *CAROTOVORA* UNDER *IN VITRO* TEST

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Abstract: Potato (*Solanum tuberosum* L.) is one of the most nutritious sources of food in the world. It has been recognized as a wholesome food and the richest source of energy in most of the countries of the world where, it forms an important part of the human diet. Among the various diseases of potato, soft rot caused by *Erwinia carotovora* subsp. *carotovora* is the major potato tuber rot disease. Result revealed against *Erwinia carotovora*, that the extract of Garlic bulb @ 10 per cent produced maximum growth inhibition (60.60%) followed by Mahendi (54.54%) and Lantana leaf extracts (48.10%) respectively.

Keywords: Potato, bacteria, seed

INTRODUCTION

Potato (*Solanum tuberosum* L.) is one of the most nutritious sources of food in the world. Besides cereals, potato is one of the crops, which can supplement food needs of a country. Soft rot is a bacterial disease caused by *Erwinia carotovora* subsp. *carotovora*. Pathogen remains in the soil or in decaying plant debris and in the seed tubers. Bacteria either enter the seed potatoes and lower stems through wounds and injuries, or move directly from contaminated seeds pieces to lower stems. Abundant moisture at the surface of the wound tissue is needed for infection and continued high humidity after infection favors spread of the disease in the plant. The decay of seed pieces in the soil by fungi and other organisms may also provide conditions for blackleg disease to develop. Tubers harvested from plants which were infected during the growing season may develop a soft rot in storage. Looking to the importance and need, different phytoextracts have been studied under *in vitro* condition for the effective management of the soft rot disease of potato. Phytosanitary issues and biosecurity and strategic prevention of deliberate release of crop pests and pathogens are national security priority, which also demands a rapid and efficient diagnostic technology (Schaad *et al.*, 2003).

MATERIAL AND METHOD

Bioefficacy of phytoextracts of eleven plant species having medicinal values was tested *in vitro* by poisoned food technique against soft rot disease of potato.

Fresh and healthy 100g plant parts of each plant species as mentioned in Table - 1 were thoroughly washed with tap water and then with sterile distilled water. These were crushed in grinder mixer by adding 100 ml distilled water to obtain 1:1 extract. The phytoextracts thus obtained were then filtered through double layered sterile muslin cloth in conical flasks and were used without sterilization. The flasks were labelled and stored in the refrigerator for further use. 100 ml of Nutrient Agar (NA) medium was taken for bacterial isolates in flasks of 150 ml capacity, plugged and sterilized by autoclaving at 1.045 kg /cm^2 for 20 minutes. After autoclaving and cooling to about 45 ^{o}C, 10 ml of the respective extracts was mixed thoroughly in the flasks containing 100 ml of NA medium. Medium without respective phytoextracts served as control. All these were poured aseptically into sterile Petri plates replicating four times per treatment. After solidification, the plates were inoculated with 5 mm discs of *E. carotovora* from seven days old culture, which was placed in the centre with the help of sterilized 5 mm cork borer and was incubated at 28 ± 2 ^{o}C temperature for seven days. Observations on radial growth of *E. carotovora* pathogen was measured by averaging two diameters of colony at right angle to one another and the per cent growth inhibition (PGI) was calculated by the following equation (Asalmol *et al.*, 1990).

$$PGI = \frac{C - T}{C} \times 100$$

Where,

P G I	-	Per cent Growth Inhibition
C	-	Growth in control (mm)
T	-	Growth in treatment (mm)

RESULT AND DISCUSSION

Soft rot (*Erwinia carotovora* subsp. *carotovora*)

The results presented in Table-1 revealed that all the phytoextracts inhibited the growth of soft rot pathogen (*Erwinia carotovora* subsp. *carotovora*) significantly as compared to control. The extract of Garlic bulb produced significantly maximum growth inhibition (60.60%) over rest of the phytoextracts tested. The next effective phytoextracts in order of inhibition were extract of Mahendi leaves (54.54%), Lantana leaves (48.10%), Eucalyptus leaves

(45.07%) and Bhoyringni leaves (44.69%). Rest of the phytoextracts exhibited little inhibition on the growth of the pathogen and differed significantly among each other.

Research results corroborate with the report shown by Skinner (1955) found that allicin, a major constituent of *A. sativum* containing sulphur, has strong toxic properties against several bacteria and fungi. Ark and Thompson (1959) showed that aqueous extract and organic solvent extract of garlic (*Allium sativum*) produced zone of inhibition on seeded plates of *Glomerella cingulata, Cladosporium cucumerinum, Erwinia amylovora* and *Xanthomonas vesicatoria.* Alice and Sivaprakasam (1995) showed that garlic clove extracts found equally effective in inhibiting the growth and enzyme production of *Erwinia carotovora*, the causal agent of soft rot of onion. Thus, the present findings are in confirmation with the work of above research workers.

Table 1. Effect of unsterilized extract of different plant species on growth of *Erwinia carotovora* subsp. *carotovora in vitro* test

Sr.No	Phytoextract	Plant part used	Per cent inhibition over control*
			E. carotovora
I	Ardusi	Leaves	34.31(31.35)**
II	Bhoyringni	Leaves	42.22(44.69)
III	Datura	Leaves	14.71(06.00)
IV	Eucalyptus	Leaves	42.43(45.07)
V	Garlic	Bulb	51.39(60.60)
VI	Ginger	Rhizome	10.46(03.01)
VII	Karanj	Leaves	26.38(19.31)
VIII	Mahendi	Leaves	47.87(54.54)
IX	Onion	Bulb	38.48(38.25)
X	Lantana	Leaves	44.17(48.10)
XI	Neem	Leaves	36.90(35.10)
XII	Control (Sterile distilled water)	-	4.05(00.00)
	S.Em. ±	-	0.813
	C.D. at 5%	-	2.319
	C.V. %	-	4.96

* Average of four replications

** Figures in the parenthesis are retransformed values

CONCLUSION

From this experiment it can be concluded that extract of Garlic bulb produced significantly maximum growth inhibition of *Erwinia* bacteria over rest of the phytoextracts tested. Further this extract can be effectively incorporated in different forms for the control the bacteria in the field condition.

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SHORT COMMUNICATION

ECONOMICS OF FISH PRODUCTION UNDER DIFFERENT MANAGEMENT REGIMES IN VILLAGE POND OF DHAMTARI DISTRICT OF CHHATTISGARH

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Abstract: The present study is based on sample unit was 2, 2 and 2 individual, self help group and fish co-operative society management regimes, respectively selected from four village of Kurud block namely, Marod, Nawagaon, Bagdehi and G.Jamgaon The study revealed that among different management regimes of fish production and marketing. The extent of material input use and the efforts for pond preparation and production package received significant attention in the case of fish co-operative society and self help group fishermen. The cost, returns and yield level were found highest in case of fish co-operative regimes and lowest for individual fishermen. Total cost of individual fisherman is 18379.16 Rs./ha., fish co-operative is 24997.56 Rs./ha. and self-help group is 20076.24 Rs./ha. Total cost of individual fisherman is 18379.16 Rs./ha., fish co-operative is 24997.56 Rs./ha. And self-help group is 20076.24 Rs./ha. Table reveals that the highest fish yield level was achieved by the fish co-operative fish farmer to the level of 28.80 quintal per hectare and lowest (20.59 quintal) while the figure of gross return from fish were estimated as Rs.61755.15, Rs.86400.00 and Rs.68326.27, respectively at these regims. Net return per hectare was Rs.43375.98 in case of individual fisherman as against Rs.48250.03 and 61402.44 earned by fish co-operative, which was much higher, then the individual fisherman and self help group regimes. The benefit-cost ratio ranged from 2.36 to 2.46 under the case of all the regimes.

Keywords: Fish, pond, Chhattishgarh

INTRODUCTION

Fish is one of the important items of food all over the world. Due to the steady growth of the Indian population and increasing problems of malnutrition, considerable attention need to be given to enrich the biological value of different food item. Indian fisheries constitute on important sector of our national economics. Government of India and Chhattisgarh Government have implemented various scheme/programs to minimize the gap between and actual productivity of fish especially with reference to inland aquaculture. This most valuable input in fish production was collected earlier, through natural breeding coupled with infrastructure facilities for spawning hatching; nursing was developed during late fifties which reached to perfection during seventies with the assistance from World Bank. National Fish Seed Programme was launched and a number of fish seed farms/hatcheries were established in the country. Through to increase the production of fish is quite important looking to the high risk with its production due to its perishable in nature, marketing is also equally important as production of the fish as the development of any such produce depend on efficient marketing.

MATERIAL AND METHOD

The study is confined to Dhamtari district of Chhattisgarh. Dhamtari district has four blocks namely, Dhamtari, Kurud, Nagari and Magarlod. Kurud block is selected purposively because the below has highest water spread area (village pond) as compared to other block of district. Kurud block comprises of 134 villages. Four village i.e. Marod, Nawagaon, Bagdehi and G.Jamgaon selected purposively. The primary data will be collected from different management regimes of village pond fish culture. For these purpose 2 individual fish farmers, 2 fisheries co-operative society and 2 Self-Help Groups (fish culture) will be selected purposively for the study. These selected ponds are perennial in nature and suitable for fish cultivation of different management regimes. The required primary data were collected from the sample respondents by survey method in the year 2006-07.

RESULT AND DISCUSSION

Economics of village pond fish culture

Economics of cost of fish production was worked out separately for different management regimes i.e. individual, fish co-operative and self help group are presented in the Table 1. The total cost of cultivation of fish production were grouped in to variable cost and fixed cost per hectare of water spread area. It was observed from the table that the total operational expenses alone accounted for more than three fourth (64.98 to 72.14 per cent) of the total cost in fish production for each category of management regimes. It absolute term it was highest in case of fish co-operatives society (Rs.16244.03) fishermen followed by self help groups (Rs.14482.17) and lowest in individuals (Rs.13254.34). The fixed cost accounted for nearly 27.86 per cent of total cost in case of fishermen self help group to 35.02 per cent in fish co-operative society which should be reduced by the adoption of improved technology resulting into higher level of production per unit of area and by readjusting the fixed costs.

A perusal of this table reveals that fish produced under different management regimes require labour

in varying magnitude. Though, family labour is the main source of total human labour requirements some hired human labour is also required as many of the operations are to be finished in stipulated time hence, it can be inferred that human labour shared about one forth (16.21 per cent) of the total cost in case of self help group followed by fish cooperative society (13.26 per cent) and individual (15.83 per cent). Thus, fish culture under self help group management regimes requires more number of human labour days (272) costing Rs.3255.30 followed by co-operative society (Rs.3313.26). The variation in total human labour requirement among different management regimes is due to difference in the style of culture practices. The highest material cost is incurred by the fish co-operative fish farmers with an investment of Rs.11190.11 followed by SHG (Rs. 9672.21) and individual (Rs.8925.25).

Table 1. Economics of fish production under different management regimes (Rs/ha)

S. No.	Particulars	Different Management Regimes		
		Individual Fisherman	**Fish Co-operative**	**Self-Help Group**
1	**Variable cost**			
	a. Labour cost			
	Family labour	341.28 (1.86)	1260.20 (5.04)	1045.55 (5.21)
	Hired labour	2567.71 (13.97)	2053.29 (8.21)	2209.75 (11.01)
	Total	2908.99 (15.83)	3313.49 (13.26)	3255.30 (16.21)
	b. Material cost			
	Seed/Fingerlings	2031.42 (11.05)	2340.37 (9.36)	2118.64 (10.55)
	Manure & fertilizer	4878.66 (26.54)	6266.92 (25.07)	5388.14 (26.84)
	Lime	920.91 (5.01)	1104.18 (4.42)	979.87 (4.88)
	Medicine	119.18 (0.65)	230.44 (0.92)	158.90 (0.79)
	Silt removal	216.68 (1.18)	336.05 (1.34)	264.83 (1.32)
	c. Miscellaneous expenses	758.40 (4.13)	912.15 (3.65)	764.83 (3.81)
	d. Interest on working capital @12% P.A.	1420.11 (7.73)	1740.43 (6.96)	1551.66 (7.73)
	Sub-total	**13254.34(72.12)**	**16244.03** (64.98)	**14482.17** (72.14)
2	**Fixed cost**			
	a. Lease rent	1162.95 (6.33)	1382.62 5.53)	1287.08 (6.41)
	b. Net	3412.78 (18.57)	5040.81 (20.17)	3707.63 (18.47)
	c. Depreciation of boat	-	576.09 (2.30)	0.00 -
	d. Depreciation of building	-	816.13 (3.26)	-
	e. Interest on fixed capital @12% P.A.	549.09 (2.99)	937.88 (3.75)	599.36 (2.99)
	Sub-total	5124.82 (27.88	8753.53 (35.02)	5594.07 (27.86)
3	**Total cost (1+2)**	18379.16 (100.00)	24997.56 (100.00)	20076.24 (100.00)

Note: Figures in parentheses indicate percentage to total cost

Among material cost, seed cost alone shared 9.36 to 11.55 per cent of total material cost followed by manure and fertilizer 25.07 to 26.54 per cent of material cost and lime (4.42 to 5.01 per cent). All fish producers under different management regimes do use non-conventional medicine inputs to protect the fish from diseases.

Operation wise cost of production

Table 2 gives the necessary information of operation wise cost of production under different management regimes.

Table 2. Operation-wise cost incurred in fish in different management regimes (Rs/ha)

S. No.	Particulars	Different Management Regimes		
		Individual Fisherman	Fish Co-operative	Self-Help Group
1.	Pond preparation	1721.56 (12.99)	2831.49 (17.43)	2305.08 (15.92)
2.	Seed stocking	2031.42 (15.33)	2340.37 (14.41)	2118.64 (14.63)
3.	Manuring	4878.66 (36.81)	6266.92 (38.58)	5388.14 (37.21)
4.	Watchman	1430.12 (10.79)	1008.16 (6.21)	1408.90 (9.73)
5.	Medicine expenses	119.18 (0.90)	230.44(1.42)	158.90(1.10)
6.	Miscellaneous	758.40(5.72)	912.15(5.62)	764.83(5.28)
7.	Netting	894.91 (6.75)	914.07 (5.63)	786.02 (5.43)
8.	Interest on working capital @12 P.A.	1420.11 (10.71)	1740.43 (10.71)	1551.66 (10.71)
	Total cost	**13254.34 (100.00)**	**16244.03 (100.00)**	**14482.17 (100.00)**

Note: Figures in parentheses indicate percentage to total cost

It may be noted from the table in all the management regimes, expenditure on manuring and fertilizers was the major item accounted (36.58 per cent to 38.58 per cent) of the total cost followed by seed stocking (14.41 per cent to 15.33 per cent), pond preparation (12.99 per cent to 17.43 per cent), watchman (6.21 per cent to 10.79 per cent). It is understandable from the table that the fish farmers of individual fish co-operative and self help groups management regimes invest amount on medicine (0.90 per cent to 1.42 per cent) and watching (6.21 per cent to 10.79 per cent). Operation thus, conclusion may be drawn that there is variation in operation wise investment and total investment from various management regimes, due to variation in style of operation and quality and cost of material inputs used. This trend is true where new technology of fish cultivation have not taken root in the study area. Thus, it is suggested that a planned impetus be given to extension agencies involved in the field of aquaculture to introduce the new technology of fish production in the area and also the whole state of Chhattisgarh.

Gross return, net return and benefit-cost ratio of fish production

Per quintal per hectare costs, returns and benefit-cost ratio of fish production has been computed on prevailing market rates in the study area. The gross

and net returns of fish production under different management regimes is presented in Table 03. Table reveals that the highest fish yield level was achieved by the fish co-operative fish farmer to the level of 28.80 quintal per hectare and lowest (20.59 quintal) being in individual property regimes, indicating the intensive cultivation practices used by fish co-operative fish farmers. The yield per hectare was 22.78 quintal in case of self help group regime which was quite reasonable.

Table 3. Gross return, net return and benefit-cost ratio of village pond fish production in different management regime

S. No.	Particulars	Different Management Regimes		
		Individual Fisherman	Fish Co-operative	Self-Help Group
1.	Total fish production (qt/ha)	20.59	28.80	22.78
2.	Average selling price (Rs./qt)	3000.00	3000.00	3000.00
3.	Gross return (Rs./ha)	61755.15	86400.00	68326.27
4.	Total cost (Rs./ha)	18379.16	24997.56	20076.24
5.	Net return (Rs./ha)	43375.98	61402.44	48250.03
6.	Benefit-cost ratio	2.36	2.46	2.40
7.	Cost of production	892.84	867.97	881.49

When physical output are converted into monetary terms, the gross return from fish under individual, fish co-operative and self help group regimes are Rs.61755.15, Rs.86400.00 and Rs.68326.27, respectively. The share of gross return Rs./ha from fish production is highest in case of fish co-operative and lowest from individual management regimes. Net return per hectare was Rs.43375.98 in case of individual fisherman as against Rs.48250.03 and 61402.44 earned by fish co-operative, which was much higher, then the individual fisherman and self help group regimes. The benefit-cost ratio ranged from 2.36 to 2.46 under the case of all the regimes. It shows that all the management regimes incurred sufficient amount of input resources for the production of fish cultivation and also received a good selling price in the different marketing channel. The cost of fish production per quintal per hectare varied from Rs.867.77 to 892.84 from various management regimes. It can be said that the difference was not quite extra-ordinary between the different regimes.

CONCLUSION

The present study concluded that the the cost, returns and yield level were found higher in case of fish co-operative regimes and l
the level of 28.80 quintal per hectare and lowest (20.59 quintal). The gross return from fish under individual, fish co-operative and self help group regimes were estimated as Rs.61755.15, Rs.86400.00 and Rs.68326.27, respectively. Net return per hectare was Rs.43375.98 in case of individual fisherman as against Rs.48250.03 and 61402.44 earned by fish co-operative, which was much higher, then the individual fisherman and self help group regimes. The benefit-cost ratio ranged from 2.36 to 2.46 under the case of all the regimes.

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SHORT COMMUNICATION

WEED INTENSITY AND ONION BULB YIELD AS INFLUENCED BY DIFFERENT WEED MANAGEMENT PRACTICES

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Abstract: Weeds are serious problem in all vegetable crops but they are even more so in *kharif* season crops. The problem of controlling weeds has been taken by studying various cultural and chemical method to the extent of different degrees of success by workers all over the world. In this chapter, a brief review of various experimental findings of different experiments covering important aspect of weed flora, losses caused by weeds and effect of weed management practices on crops, yield and yield attributes, use of chemical and cultural methods of weed management and economics is given below.

Keywords: Weed management practices, oxyfluorfen, pendimethalin, Onion

INTRODUCTION

Onion, botanically known as *Allium cepa* L. is one of the most important vegetable crops, native of Central Asia and Mediterranean region and belongs to the family Alliaceae. The second largest producer of onion in the world and occupies 1087.20 thousand ha area with a production of 17511.10 thousand tonnes and productivity 16.10 t/ha (Anon., 2013). Onion is slow growing, shallow rooted crop with narrow, upright leaves and non branching habit. Due to this type of growing habit, onion is used as raw, vegetable and spice all over the world. It is a bulbous annual and biennial herb. Onion bulb and greens both are rich in vitamin C, potassium, dietary fibers, minerals and folic acid. The pungency of onion is due to volatile oil known as allyl- propyl disulphide. The colour of outer skin of onion bulbs is due to quercetin. The productivity of *Kharif* onion is very low as compared to other seasons, because it is affected by diseases, pests and weeds. The chemical and conventional methods of weed control offer the possibilities of increasing crop production. Keeping abreast with the above facts, the present investigation was undertaken to evaluate the different weedicides for controlling weeds in *Kharif* onion. Onion crop cannot compete well with weeds. In addition to this, frequent irrigation water and fertilizer application allows for successive flushes of weeds in onion. Yield loss due to weed infestation in onion has been recorded to the tune of 40 to 80% (Channappagoudar and Biradar, 2007).

Weed flora composition and degree of their population

The composition of weed flora and degree of their population in onion fields has been found to vary from place to place and even at the same place from year to year depending upon the agro climatic conditions and cultural practices. Pandey (2000) reported that the major weed flora in onion *consisted Galinsoga parviflora, Brachiaria ramosa, Cyperus rotundus, Cannabis sativa, Polygonum plebeium, Fumaria parviflora, Phalaris minor and Oxalis latifolia.* Amrutkar *et al*. (2002) recorded that the major weed flora in onion consisted *Cyperus rotundus, Cynodon dactylon, Dinebra retroflexa, Parthemium hysterophorus, Chenopodium album, Anagallis arvensis, Argemone maxicana, Physalis minima, Euphorbia geniculata, Lagasca mollis* and *Portulacea oleracea*. Syed and Malik (2001) reported that the major weed flora in onion consisted *Amaranthu shybridus, convolvusarvensis, Cyprusrotundus Chenopodium album, Echinochola spp., Sophora alopecuroides* were the most damaging. Sukhadia *et al.* (2002) recorded that the major weed flora in percentage at Junagarh during *kharif* season were *Echinochloa colonum*, (31%), *Eluropus villosus*(10%), *Dactyloctenium aegytium* (3%), *Digera arvensis* (16%), *Phyllanthus nirusi* (8%), *Cyperu rotundus* (14%) and *Cyperus iria* (2%). Ahuja *et al.* (2003) observed that the dominant weed species in the experimental field was *Poa annua* in both cabbage and onion crops and *Cyperus rotundus* in onion among the narrow-leaf weeds. *Trianthema portulacastrum, Chenopodium spp., Trigonella polycerta [T. polyceratia], Medicago denticulata, Lepidium sativum and Anagallis arvensis* in both cabbage and onion crops, *Amaranthus spp. and Tribulus terrestris* in onion among the broad-leaf weeds.

Losses caused by weeds

Onion being the poor competitor crops, especially the *kharif* season crop suffers severely from weeds, which usually compete with crop plants for moisture, light, nutrients and space. Weeds also interfere with the development of onion bulbs and decrease the yield upto the extent of 40-80 per cent (Singh *et al*., 1992). Verma and Singh (1996) observed that due to long crop duration, slow initial growth, poor canopy cover and short spaced

crop, onion is seriously affected by weeds. Weed competition reduces bulb yield upto 57 per cent in *kharif* season. Ved *et al.* (2000) reported that season- long crop –weed competition reduced the bulb yield by 81.2 per cent as compared with weed free condition. Kolhe (2001) recorded reduction in bulb yield to the extent of 78.63 per cent due to weed competition under weedy control. Qasem (2005) observed that weed competition reduced average onion fresh yield by 62 per cent as compared with the weed- free control. Sangeeta *et al.* (2008) reported that critical period of crop-weed competition in onion. The result showed that weed population count decreased with increase in weed free environment in both the years. The loss of yield under un-weeded control over weed free environment maintained up to harvest was 84.71 per cent.

Effect of weed management practices

Crop growth and development

Weed is very dangerous for crop growth and development. Singh and Singh (1993) showed that weed free treatment produced the maximum plant height, numbers of leaves plant^{-1}, bulb diameter, fresh weight of bulb, dry weight of leaves, bulb and bulbs yield was however at par with pendimethalin and oxadiazon @1.5 kg ha^{-1} with one HW. Minimum value of crops parameters were recorded under weedy check control. Saikia *et al.* (1997) indicated that Fluchloralin (0.5 or 1.0 kg ha^{-1}) alone or in combination with one HW (after 60 days) or HW (after 40 and 60 days) reduced weed dry weight significantly and improved onion plant growth and bulb development. Ved *et al.* (2000) observed that Alachlor at @ 2.0 kg ha^{-1} + HW at 45 DAT being at par with pendimethalin at @ 1.5 kg ha^{-1} + HW at 45 DAT and weed- free, proved to be the superior integrated weed control approach to control weeds and increased the plant height, bulb diameter and bulb weight. Nandal and Singh (2002) also reported that fluchloralin @ 1.0 kg in combination with one HW at 45 DAT proved to be the significantly superior in increasing the plant height and number of leaves per plant and remained at par with Oxyfluorfen @ 0.15 kg ha^{-1} with one HW at 45 DAT.

Yield and yield attributes

There are many literatures on the effects on yield and their attributes due to weed population and intensity. Sandhu *et al*. (1993) observed that all weed control treatments reduced weed DW from untreated control values of 3350-4030 kg ha^{-1} to 330-1240 kg ha^{-1} and increased onion bulb yields from 3030-8570 kg ha^{-1} to 14760-22460 kg ha^{-1}. Pendimethalin at 0.75 kg resulted in the greatest crop yields, Singh and Singh (1993) observed that Oxyfluorfen @ 1.0 kg ha^{-1} with one HW at 50 DAT (295.70 q ha^{-1}) when applied at higher rate gave significantly better yield than applied at lower rate but this is not true in case of trifuralin and alachlor where, non significant increase was observed. Porwal (1995) reported that superiority of Pendimethalin in controlling weeds in onion resulting in increased yield of bulbs. Similarly, Sandhu *et al.* (1993) also opined out similar results of pendimethalin and fluchloralin in onion and garlic.Saikia *et al.* (1997) screened that Fluchloralin (1.0 kg ha^{-1}) + one HW at 40 DAT resulted in the greatest bulb yield (16.9 t ha^{-1}), followed by the weed- free treatment (16.0 t ha^{-1}). Verma and Singh (1997) found that weed population and weed dry weight m^{-2} were lowest in plot treated with @ 1.5 kg ha^{-1} pendimethalin in onion. Yadiraju and Ahuja (1999) showed that post-emergence application of fluchloralin @ 0.9 kg ha^{-1}, oxadiazon @ 0.75 kg ha^{-1} and oxyfluorfen @ 0.24 kg ha^{-1} at 25 DAT gave lower bulb yield and remained at par with unweeded control. Pandey (2000) also recorded the maximum yield of bulb (227.76 q ha^{-1}) with application of pendimethalin @ 1.0 kg ha^{-1} which was significantly higher as compared to the yield obtained under weed check (163.22 q ha^{-1}).Yadav *et al.* (2000) reported from Hisar that weed free treatment recorded the higher bulb yield of 323.45 q ha^{-1} which was statistically at par with Pendimethalin @ 1.5 kg ha^{-1}. However, the highest net income and yield of bulbs was recorded with the application of oxyfluorfen @ 0.15 kg ha^{-1} closely followed by pendimethalin @ 1.5 kg ha^{-1} due to effective control of weeds during critical period of crop-weed competition. Kolhe (2009) recorded that Pre-emergence application of Oxyfluorfen @ 0.15 kg ha^{-1} supplemented with one HW at 35 DAT was equally effective to that of two HW at 20 and 35 DAT in alleviating weed competition and bulb yield in the range of 159.36-447.25 per cent was observed due to adoption of weed management practices. Nandal and Singh (2002) recorded the highest bulb yield (304.43 q ha^{-1}) and net returns (Rs 60 196 ha^{-1}) with the application of oxyfluorfen (0.25 a.i. kg ha^{-1}) + HW at 40 DAT. The lowest weed density at all the stages of crop growth was observed under oxyfluorfen (0.37 a.i. kg ha^{-1}). Ramachandraprasad *et al.* (2002) reported the highest bulb yield in the weed free plot

(15.4 t ha^{-1}), which was equivalent with those in the herbicide treatments, except fluchloralin. Ghaffoor (2004) observed that plots treated with pendimethalin at 3 liters/ha gave the highest yield (40.28 t ha^{-1}) and weight of bulbs (127.9 g). Rathore and Shekhawat (2004) reported that fluchloralin applied @1.0 kg ha^{-1} as pre-planting incorporation in combination with one HW at 45 DAT proved to be most effective to control the weeds giving maximum weed control efficiency (92.56%) and bulb yield (121.42 q ha^{-1}) of *kharif* onion.

Use of chemical and cultural methods of weed management

A good and proper method for applying chemicals and cultural practices are very necessary for weed management. Sandhu *et al*. (1997) reported that pendimethalin 30 EC @ 2.5 kg and 1.87 kg ha^{-1} and fluchloralin 45 EC @ 2.5 kg and 1.87 kg ha^{-1} supplemented with one hoeing conducted after 105 days of sowing resulted in significant increase in bulb yield comparable to weed control. Singh *et al*. (1997) screened that 0.37 kg Oxyfluorfen was the most effective treatment for reducing population of *Poa annua, Coronopus didymus, Rumex acetosella* and *Medicago denticulate*, with 0.25 kg Oxyfluorfen + hand weeding next best. None of the treatments gave season-long reductions in *Cyperus rotundus* populations. Vanhala *et al.* (1998) studied the effects of physical weed control measures (hoeing, flaming once or 3 times, and hand weeding) on carrot (cv. Fontana) and onion (cv. Sturon) quality during 1992-94 at 2 locations in Finland. Weed free plots were maintained with prometryn 1 kg ha^{-1} + hand weeding. In onion, weedy plots resulted in the lowest marketable yield. However, repeated flaming, although providing the best weed control, inhibited onion development resulting in poorer quality onion as compared with a single flaming treatment and hand weeding.Singh *et al*. (1998) studied the efficacy of oxyfluorfen, fluchloralin and pendimethalin applied alone and with one HW at 40 DAT and two HW at 40 and 60 DAT against *Cyperus rotundus, Medicago denticulate, Coronous didymus, Poa annum, Rumex acetosella, Cynodon dactylon*. Oxyfluofen applied @ 0.25 kg ha^{-1} with one HW at 40 DAT gave the maximum net return followed by oxyfluofen @ 0.37 kg ha^{-1}.

Weed control efficiency

Weed control effiency is very important method for controlling of weed growth. Mishra and Sharma (1992) obtained the maximum weed control efficiency (79%) and minimum weed index (2%) has been observed with fluchloralin @ 1.5 kg ha^{-1} applied pre-planting incorporating and super-imposed with one HW at 45 DAT in onion. Singh *et al*. (1997) reported that weed control efficiency computed for pre-plant incorporation of pendimethalin @ 1.0 kg ha^{-1}, fluchloralin @ 1.5 kg ha^{-1} PPI with one HW at 30 DAT was found most effective in reducing the weed population in onion. Ved *et al*. (2000) reported that Alachlor @ 2.0 kg ha^{-1} +HW at 45 DAT, being at par with pendimethalin at 1.5 kg ha^{-1} + HW at 45 DAT and weed- free, proved to be the superior integrated weed control approach to control weeds and increased the plant height, bulb weight and weed control efficiency. Ramachndraprasad *et al*. (2002) observed the highest weed control efficacy with Oxyfluorfen @ 0.06 kg ha^{-1} + HW, followed by metolachlor + HW. Rathore and Shekhawat (2004) reported that fluchloralin applied @ 1.0 kg ha^{-1} as pre-planting incorporation in combination with one HW at 45 DAT proved to be the most effective to control the weeds, giving maximum weed control efficiency (92.56%) and bulb yield (121.42 q ha^{-1}) of *kharif* onion at Ajmer.

Economics

Weed control mechanism is a very effective to maintain economics parameter regarding cost-benefit ratio, internal net return etc. Saikia *et al.* (1997) observed the maximum cost-benefit ratio (1:1.27) was obtained with Fluchloralin (1.0 kg ha^{-1}) + HW, Fluchloralin (0.5 kg ha^{-1}) + HW was more cost-effective than the weed-free treatment, due to reduced production costs. Unweeded plots led to a loss of 1662.97 Rs ha^{-1}. Nadagonda *et al.* (1998) also noted that pendimethalin @ 0.75 and 1.0 kg ha^{-1} resulted in higher benefit: cost ratio than the unweeded control in onion. Singh and Singh (2000) obtained the maximum net profit with treatments pendimethalin @ 1.5 kg ha^{-1} and pendimethalin @ 1.5 kg ha^{-1} with one HW at 45 DAT in onion. Ved *et al*. (2000) reported that alachlor at 2.0 kg ha^{-1} + HW at 45 DAT being at par with pendimethalin at 1.5 kg ha^{-1} + HW at 45 DAT and weed-free, proved to be the superior integrated weed control approach to control weeds and also recorded high additional net returns. However, the highest additional returns per rupee invested were obtained with alachlor at 2.0 kg ha^{-1}.

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SHORT COMMUNICATION

STUDY ON BIO-EFFICACY OF NEW POST EMERGENCE HERBICIDES FOR ENERGETICS AND GRAIN YIELD IN TRANSPLANTED RICE (*ORYZA SATIVA* L.)

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Abstract : The present investigation was carried out during *kharif*, of 2011 at the research-cum-instructional farm, indira gandhi krishi vishwavidyalaya, raipur (c.g.). Results revealed that higher plant height, total tillers, dry matter accumulation, yield attributes, grain yield and straw yield, crop growth rate, leaf area index were obtained under two hand weedings (20 and 40 dat) (t_{11}), followed by ae 1887196+aef 095404 @ 45 + 22.5 g ha^{-1} (t_3) and minimum was obtained under unweeded check (t_{12}). The maximum energy input and output were obtained under two hand weedings (20 and 40 dat) whereas energy use efficiency and energy output-input ratio were noted under ae 1887196+aef 095404 @ 45 + 22.5 g ha^{-1}(t_3) followed by bispyribac sodium @ 20 g ha^{-1} (t_{10}). The lowest energy parameters were obtained with unweeded check (t_{12}).

Keywords: Bio-efficacy, post emergence herbicides, energetics

INTRODUCTION

Chhattisgarh state is popularly known as "Rice bowl" because of maximum area covered during *kharif* under rice contributing major share in national rice production. However, the production and productivity of rice per unit area is very low due to limited irrigation, lack of improved varieties suitable to different ecosystems, low and imbalance use of fertilizer and improper weed management. The area, production and productivity of rice in Chhattisgarh is 3.57 million ha, 5.85 million tonne and 1.52 t ha^{-1}, respectively (Anonymous 2010).

Rice growing ecologies are divided into rainfed uplands, rainfed low land and irrigated land. The various crop stand establishment methods followed for rice include; direct-seeded-dry, direct-seeded-wet and transplanting. These stand establishment practices and ecologies influence the intensity and nature of weed problem.

MATERIAL AND METHOD

Grain yield (t ha^{-1})

The crop from each net plot was harvested separately. The grains were separated from straw by threshing. After threshing winnowing was done. The weight of grains was recorded and expressed in t ha^{-1} by multiplying the factor (0.595). The no. of hills uprooted for dry matter accumulation were also included in the calculation of yield.

Straw yield (t ha^{-1})

The straw yield was worked out by subtracting the weight of grains from the bundle weight of the produce it was expressed in t ha^{-1} by multiplying the factor (0.595).

Harvest Index (HI)

Harvest index was computed as the ratio of economic yield *i.e.* grain yield to the total biomass *i.e.* biological yield (grain and straw) from same area and expressed in percent. (Donald, 1962)

$$\text{Harvest Index} = \frac{\text{Economic yield}}{\text{Biological yield}} \times 100$$

Where, Economical yield = Grain yield and Biological yield = Grain yield + Straw yield

Weed Index (WI)

Weed index was calculated by the formula mentioned under; it is expressed in per cent.

$$WI = \frac{\text{Maximum grain yield in treated plot} - \text{Grain yield in other treatments}}{\text{Maximum grain yield in treated plot}} \times 100$$

Energetics

Energy input and output was calculated from sowing to harvest of all the treatments. it was estimated in Mega Joules (MJ) ha^{-1} with reference to the standard values. Energy use efficiency and output/ input ratio were calculated by using the following formulae: (Mittal *et al*., 1985).

$$\text{Energy use efficiency (kg MJx10}^3\text{ ha}^{-1}) = \frac{\text{Total produce (q)}}{\text{Energy input (MJx10}-3)}$$

$$\text{Energy output-input ratio} = \frac{\text{Energy output}}{\text{Energy input}}$$

RESULT AND DISCUSSION

Grain yield (t ha^{-1})

Data related to grain yield (Table 4.5) revealed that two hand weedings (20 and 40 DAT) (T_{11}) registered significantly highest grain yield (4.63 t ha^{-1}) over rest of the treatments except, treatments AE 1887196 + AEF 095404 @ 35+17.5 g ha^{-1} (T_1), AE 1887196 + AEF 095404 @ 40 +20 g ha^{-1} (T_2), AE 1887196+AE F 095404 @ 45 + 22.5 g ha^{-1} (T_3), fenoxaprop p-ethyl + (chlorimuron-ethyl+

metsulfuron-methyl) @ 60+4 g ha $^{-1}$ (T_9) and bispyribac sodium @ 20 g ha^{-1} (T_{10}) which were at par with two hand weedings (20 and 40 DAT) (T_{11}) . The lowest grain yield was recorded under unweeded check (T_{12}). Similar results were also reported by Ghosh and Mitra (1992), Nandlal *et al.* (1994)., Bhattacharya *et al.* (2001), Choubey *et al.* (1998), Tiwari (2002), Halder and Patra (2007) and Yadav *et al.* (2009).

Grain production, which is the final product of growth and development, is controlled by growth and yield attributing characters such as effective tillers, dry matter accumulation and test weight etc. Growth and all yield attributing characters are more in two hand weedings (20 and 40 DAT) (T_{11}) because of less crop-weed competition, Similarly environmental conditions were favorable for better crop growth resulted in higher photosynthesis and ultimately higher grain yield in this treatment. The lower grain yield under unweeded check (T_{12}) may be due to the high weed interference and less yield attributing characters (Behera and Jha, 1992).

Straw yield (t ha^{-1})

The straw yield was significantly influenced by different treatments (Table 4.5). The highest straw yield was produced under two hand weedings (20 and 40 DAT) (T_{11}), it was at par with all the treatments except butachlor @ 1250 g ha $^{-1}$ (T_6) and pretilachlor @ 625 g ha^{-1} (T_8). Higher straw yield in these treatments is because of higher plant height, dry matter accumulation. The lowest straw yield was noted under unweeded check (T_{12}). Similar results have been also reported by Choubey *et al.* (1998), Tiwari (2002), Kathirvelan and Vijyapuri (2003), Sori (2008) and Devi (2011).

Harvest index (%)

The data on harvest index for different treatments failed to show their significant impact (Table 4.5)

Weed index (%)

Data on weed index are presented in table 4.5. It was remarkably influenced by post emergence application of herbicides. The lowest WI was obtained with AE 1887196+AEF 095404 @ 45 +22.5 g ha^{-1} (T_3) followed by bispyribac sodium @ 20 g ha^{-1} (T_{10}).It might be due to less density and dry matter production of weeds, the yield reduction was minimum in these treatments. Whereas, maximum was found in unweeded check (T_{12}).

Energetic

The data pertaining to energetic of rice are presented in Table 4.11. Maximum energy input and output was noted under two hand weeding (20 and 40 DAT), though the highest energy output-input ratio and energy use efficiency was observed under AE 1887196+AEF 095404 @ 45 +22.5 g ha^{-1} (T_3) followed by bispyribac sodium @ 20 g ha^{-1} (T_{10}). The above energy parameters were found lowest in unweeded check (T_{12}).This was due to higher biological yield coupled with low energy input. Similar results were also reported by Jain *et al.* (1998) and Billore *et al.* (1999).

Table 1. Grain yield, straw yield, harvest and weed index of transplanted rice as affected by weed management practices

Weed management Practices		Dose (g ha^{-1})	Grain yield (t ha-1)	Straw yield (t ha-1)	HI (%)	WI (%)
T_1	AE 1887196-20% +AE F 095404-10%-30%WG	35+17.5	3.90	5.08	43.17	15.77
T_2	AE 1887196-20% +AE F 095404-10%-30%WG	40+20	4.13	5.16	44.38	10.80
T_3	AE 1887196-20% +AE F 095404-10%-30%WG	45+22.5	4.59	5.74	44.67	0.86
T_4	AE 1887196-20% SC	45	3.76	4.95	43.13	18.79
T_5	AE F 095404-15% WG	22.5	3.70	4.88	43.07	20.09
T_6	Butachlor 50% EC	1250	3.61	4.50	42.02	22.03
T_7	Pyrazosulfuran ethyl 10 %WP	15	3.70	4.87	43.07	20.09
T_8	Pretilachlor 50 % EC	625	3.65	4.82	42.87	21.17
T_9	Fenoxaprop p-ethyl 9.3% EC + (chlorimuron-ethyl + metsulfuron-methyl 20% WP	60+4	4.06	5.15	44.38	12.31
T_{10}	Bispyribac sodium 10 % SL	20	4.46	5.58	44.39	3.67

T_{11}	Two hand weeding	-	4.63	5.74	44.90	0
T_{12}	Unweeded check	-	2.86	3.76	41.71	38.23
SEm±					**0.27**	**0.31**
CD (P=0.05) **NS**					**0.78**	**0.91**

Table 2. Energetic of transplanted rice as affected by weed management practices

Weed management Practices		**Dose (g ha^{-1})**	**Time of application (DAT)**	**Energy input (MJ× 10 ha^{-3})**	**Energy output (MJ × 10 ha^{-3})**	**Energy output-Input ratio**	**Energy use efficiency (kg ×10^{-3} ha^{-1})**
T_1	AE 1887196-20% +AE F 095404-10%-30%WG	35+17.5	10	9.61	111.12	11.57	9.34
T_2	AE 1887196-20% +AE F 095404-10%-30%WG	40+20	10	9.62	115.59	12.02	9.66
T_3	AE 1887196-20% +AE F 095404-10%-30%WG	45+22.5	10	9.62	129.60	13.47	10.74
T_4	AE 1887196-20% SC	45	10	9.62	107.53	11.18	9.05
T_5	AE F 095404-15% WG	22.5	10	9.61	105.78	11.01	8.93
T_6	Butachlor 50% EC	1250	3	9.89	99.43	10.5	8.20
T_7	Pyrazosulfuran ethyl 10 %WP	15	15	9.61	105.53	10.98	8.91
T_8	Pretilachlor 50 % EC	625	3	9.74	104.17	10.69	8.70
T_9	Fenoxaprop p-ethyl 9.3% EC + (chlorimuron-ethyl + metsulfuron-methyl 20% WP	60+4	20	9.67	114.39	11.83	9.52
T_{10}	Bispyribac sodium 10 % SL	20	20	9.62	125.69	13.07	10.44
T_{11}	Two hand weeding	-	20 ,40	9.99	129.82	13.00	10.38
T_{12}	Unweeded check		-	9.58	79.46	8.29	6.91

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