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Research Article

EVALUATION OF FUNGICIDES AGAINST *Fusarium moniliformae* CAUSING POKKAH BOENG OF SUGARCANE

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Abstract

Fungicides play a very important role in disease management as they are easy to handle and appllication, economical, quick acting directly on the diseases. The aim of this study was to assess the *in-vitro* activity of fungicides *viz.*, Amistar (Azoxystrobin), Bayleton (Triademefon), Kavach (Chlorothalonil), Score (Difenaconazole) and Tilt (Propiconazole) were evaluated against the test fungus at the concentration of 5, 10, 20 and 40 ppm. Results indicate that propiconazole, difenaconazole was found to be highly effective showing complete inhibition at all the concentrations i.e. 5ppm, 10ppm, 15ppm, 20ppm whereas, azoxystrobin was next followed by tridemefon while, chlorothalonil was least effective to *Fusarium moniliformae.*

Introduction

Humans are dependent upon plants for their very existence. Most of their food supply worldwide is derived from the crops like wheat, rice, sorghum, barley, sugarcane, banana, apple, mango, citrus, coconut, potato, tomato, onion, oats, peanut, moong, urdbean, soybean etc. Plants not only provide food for humans but also beautify the surrounding, purify the air and protect our natural resources. However, plants also suffer from various pests and diseases which cause losses in yield and in turns could lead to human suffering. The demand for sugar is increasing especially in developing countries. Besides the production of sugar, there are several by product like molasses, presmud, bagasse, flyash etc. Other products produced from molasses are butyl alcohol, lactic acid, citric acid, and glycerin etc. (Paturau, 1982; Harris and Staples, 1998).

Sugarcane crop is infected by both abiotic and biotic stress. In abiotic *viz.* drought, waterlogging, salinity/alkalinity and variations of temperatures, etc., whereas in biotic different groups of organisms and others associated which include fungi, bacteria, phytoplasma, nematodes, phanerogamic plants and viruses etc. Among them red rot, wilt, smut, pokkah boeng, ratoon stunting, wilt, mosaic, leaf spots, YLD and grassy shoot are of great concern and causing losses in yield every year in varying quantity (Singh, *et al.*, 1991). Pokkah boeng disease of sugarcane is one of them which were reported as minor foliar disease caused by *Fusarium moniliformae* in early 1930s. Keeping in view the importance

of sugarcane and its economic value and visualizing the emergence of disease in northern sugarcane growing areas, the present investigations had been carried in order to evaluate the efficacy of different fungicides, so that disease could be controlled effectively.

Sachidananda (2005) reported the systemic fungicides, carbendazim and propiconazole were found effective in inhibiting the growth of *Fusarium chlamydosporum*. Among non-systemic fungicides, chlorothalonil and captan were found to be the best in inhibiting the growth of *Fusarium chlamydosporum*. Kopacki and Wagner (2006) had tested ten fungicides *in-vitro* for their effectiveness to inhibit the linear growth of three isolates of *Fusarium avenaceum* of proven pathogenicity to Chrysanthemum. The result indicates that, the fungicides which containing difenaconazole, carbendazim and flusilazol were most effective while the least effective fungicide were mancozeb, chlorothalonil and captan. Lore, *et al.* (2007) had assumed the efficacy of eight fungicides viz. Tilt 25EC (propiconazole), Bavistin 50 WP (carbendazim), Baycor 25 WP (bitertanol), Contaf 5EC (hexaconazole), Oithane Z-78 (zineb), Kitazin 48 EC (iprobenphos), Saaf 75 WP (carbendazim+rnancozeb) and Rhizocin 3L (validamycin) against *R. solani, F. moniliforme*, and *O. oryzae* using poisoned food technique. Among these, Tilt 25EC (propiconazole) was found most effective fungicide against all the three pathogens, followed by Contaf 5EC (hexaconazole). Shovan, *et al.* (2008) evaluated five fungicides namely Tilt-25 EC, Vitavax-200 75 per cent WP, Rovral 50 WP, Dithane M-45 80 per cent WP and Cupravit 50 per cent WP at 100, 200 and 400 ppm for their efficacy against the radial colony growth and mycelial dry weight of *Fusarium oxysporum* and observed the complete inhibition of radial growth and hyphal dry weight was obtained with Tilt-25 EC at all the selected concentrations.

Materials and Methods

In vitro screening of fungicides against the pathogen

In vitro, efficacy of different fungicides against *F. moniliformae* was studied by poisoned food technique (Sharvelle, 1960). The fungicides *viz.*, Amistar (Azoxystrobin), Bayleton (Triademefon), Kavach (Chlorothalonil), Score (Difenaconazole) and Tilt (Propiconazole) were evaluated against the test fungus at the concentration of 5, 10, 20 and 40 ppm. The colony diameter was measured. Ten mL stock solution of 10000 ppm concentration of each fungicide was prepared in the distilled water in test tube. Required amount of the solution was added into 250 mL flask containing 60 mL of the sterilized melted Oat Meal Agar, so as to get final required concentrations of 5, 10, 15 and 20 ppm. The medium was mixed thoroughly before plating. Each media toxicated with fungicide was poured in three Petri plates. Non toxicated media was poured into Petri plates kept as a check. After solidification of media, a 5 mm mycelia disc of 7 days old culture of the test pathogen was cut with sterile cork borer (with outside/inside diameter of 7/5.5) and placed in centre of each Petri plate. The Petri plates were incubated at 28±1ºC. After 10 days of incubation the radial growth was measured. The per cent inhibition in growth was determined with the help of mean

colony diameter and calculated by using the formula given by McKinney (1923).

$$\text{Percent inhibition} = \frac{X - Y}{X} \times 100$$

Where,
X = colony diameter in control
Y = colony diameter in treated medium

Results and Discussion

The data revealed that at 5 ppm concentration, tilt and score showed complete inhibition of mycelia growth of the test fungus followed by amistar (27.8 %), bayleton (16.8%) and least effective by kavach (6.2%) as compare to control. At 10 ppm concentration, tilt and score complete inhibition of mycelial growth of the test fungus followed by amistar (37.6 %), bayleton (32.16%) while least effective was by kavach (23.14%) as compare to control. At 20 ppm concentration, tilt and score showed complete inhibition of mycelial growth of the test fungus followed by amistar (50.2 %), bayleton (48.23%) while least effective was by kavach (35.69%) as compare to control. At 40 ppm concentration, tilt and score showed complete inhibition of mycelial growth of the test fungus followed by amistar (60.7 %), bayleton (57.2%) while least effective was by kavach (44.6%) as compare to control.

The result showed in Table 1 and Fig 1.

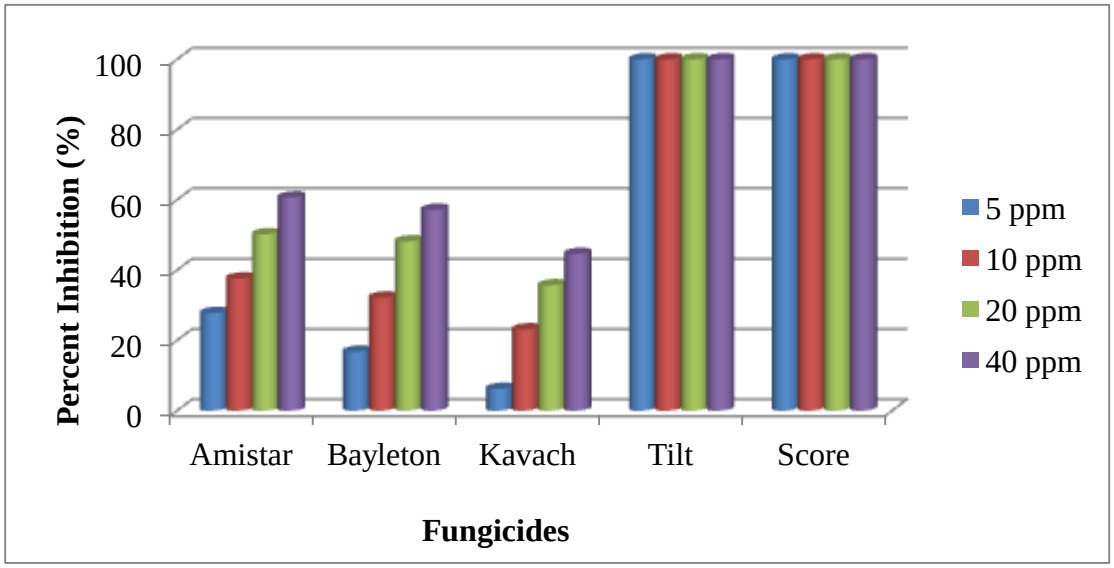

Fig. 1: *In-vitro* effect of fungicides on growth of *Fusarium moniliformae* at 25-28 ± 1°C after 10 days

Table 1: *In-vitro* effect of different Fungicides on the radial growth of *F. moniliformae* at 5, 10, 20 and 40 ppm concentration

S. No.	Fungicides	Concentrations							
		5%		10%		20%		40%	
		G	I	G	I	G	I	G	I
1.	Amistar (Azoxystrobin)	61.33	27.84	53.00	37.64	42.33	50.2	33.33	60.78
2.	Bayleton (Triademefon)	70.66	16.87	57.66	32.16	44.0	48.23	36.38	57.2
3.	Kavach (Chlorothalonil)	79.66	6.28	65.33	23.14	54.66	35.69	47.03	44.67
4.	Score (Difenaconazole)	00.0	100.0	00.0	100.0	00.0	100.0	00.0	100.0
5.	Tilt (Propiconazole)	00.0	100.0	00.0	100.0	00.0	100.0	00.0	100.0
6.	Control	85.00	00.0	85.0	0.00	85.0	0.00	85.0	0.00
	Mean	49.44		43.49		37.66		30.44	
CD. 1 at 5% 2.34		SEM 0.82				For botanicals			
CD. 2 at 5% 1.91		SEM 0.67				For concentrations			
CD. 3 at 5% 4.69		SEM 1.6				For interaction			
G= Radial growth (mm), I= % inhibition in radial growth									

It can be concluded that, Tilt and Score was found to be highly effective showing complete inhibition at all the concentrations. While Amistar and Bayleton gave near about same inhibition at all concentrations. Kavach found very ineffective in all concentrations against *F.moniliformae*. Shovan *et al*. (2008) has also found that the tilt showed complete inhibition against *F. oxysporum*. Sachidananda (2005); Kopacki and Wagner (2006); Lore *et al*. (2007) had also reported that fungicide tilt and score was highly effective at all the concentration.

Conclusion

Out of five fungicides *viz.*, Amistar (Azoxystrobin), Bayleton (Triademefon), Kavach (Chlorothalonil), Score (Difenaconazole) and Tilt (Propiconazole) were tested *in vitro*, propiconazole, difenaconazole was found to be highly effective showing complete inhibition at all the concentrations i.e. 5ppm, 10ppm, 15ppm, 20ppm whereas, azoxystrobin was next followed by tridemefon while, chlorothalonil was least effective to *Fusarium moniliformae*

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Research Article

CORRELATION COEFFICIENTS STUDY ON DIFFERENT QUANTITATIVE CHARACTERS IN FRENCH BEAN (*Phaseolus vulgaris* L.)

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Abstract

In present investigation simple correlation coefficient was calculated for eleven characters in 60 germplasm during January to May, 2009 on Vegetable Research Centre (VRC) of Department of Vegetable Science, G.B.P.U.A.T., Pantnagar. Observations were recorded on plant height, pod length, no. of pods per plant, no. of seeds per pod, days to first flowering, days to 50 per cent flowering, days to 50 per cent pod setting, pod yield per plant, seed yield per plant, 100-seed weight and days to maturity on five random selected plants in each replication for each germplasm. Correlation coefficient studies indicated that pod yield per plant was positively and significantly correlated with seed yield per plant, and days to maturity, but positive and non significant association was found with 100-seed weight.

Key words: French bean (*Phaseolus vulgaris* L.), correlation coefficient, phenotypic correlation, genotypic correlation

Introduction

Common bean (*Phaseolus vulgaris* L.) has many synonyms as Kidney bean, Field bean, Garden bean, *Rajmah* and Snap bean. It is one of the most important food legumes worldwide. It is originated in South Mexico and Central America (Vavilov, 1950). It is grown for dried seeds, green pod vegetable and for processing as a frozen vegetable (Biswas *et al*., 2010 and Singh, 2000). The knowledge of association between yield and its contributing characters is of great value in plant breeding programme. But it does not give the exact picture of relative importance of direct and indirect effects of the various yield attributes. The extent of relationship between yield and its component traits as well as among the component traits is revealed through correlation analysis. A study of correlation between different yield forming quantitative characters provides an idea of association that could be effectively exploited for selecting better plant types in crop improvement programmes (Kumar *et al.,* 2014). Significant increase in yield can be obtained by the improvement of characters with high correlation with yield. A wide range of variability exists among French bean cultivars and there is ample scope for improvement in

marketable yield through selection one or more direct or indirect yield components. Therefore the present study was undertaken to determine the correlation among the economic parameters and their direct and indirect effect on marketable yield of French bean.

The efficiency of selection can be improved by estimating the relative degree of association between different pairs of characters. An increase in production per unit area per unit time is an ultimate aim of most of the breeding programmes. The expression of a complex character like yield is a sum total of the contribution of many simply inherited characters and therefore, direct selection for it may not be their action but are interlinked and in this interlinked complex genetic system, selection practiced for an individual character might subsequently bring about a simultaneous change in other, thus an understanding of the association between the component characters and their relative contribution to yield is essential to bring a rational improvement in their desirable traits.

Materials and Methods

The experiment was conducted on Vegetable Research Centre (VRC) of department of Vegetable Science; G.B.P.U.A.T., Pantnagar during January- May, 2009. The experiment consist of 60 germplasm of French bean was conducted in Randomized Block Design with three replications during Rabi season in open field conditions. Germplasm were sown in third week of January at spacing of 60 cm between rows and 15 cm between plants. Regular irrigation, hoeing, fertilization, stacking for pole type germplasm and crop protection measures were adopted as per recommended practices. Observations were recorded on plant height, pod length, no. of pods per plant, no. of seeds per pod, days to first flowering, days to 50 per cent flowering, days to 50 per cent pod setting, pod yield per plant, seed yield per plant, 100-seed weight and days to maturity on five random selected plants in each replication for each germplasm. Mean values of data were used for statistical analysis. Correlation coefficient was worked out as per Al Jibouri *et al*. (1958).

Results and Discussion

Investigation was carried out to determine simple correlation coefficient of pod yield and yield contributing characters *viz.,* plant height, pod length, no. of pods per plant, no. of seeds per pod, days to first flowering, days to 50 per cent flowering, days to 50 per cent pod setting, pod yield per plant, seed yield per plant, 100-seed weight and days to maturity. The correlation coefficient was calculated to observe direction and magnitude of such association. The results are presented in Table. 1

Days to first flowering exhibited highly significant and positive correlation with days to 50 percent flowering (0.7805**) and days to 50 percent pod setting (0.7610**). It exhibited significant and positive correlation with days to maturity (0.2547*). It exhibited non significant and positive correlation with pod yield per plant (0.0027). Whereas rest of the characters showed negative and non-significant association. Days to 50 percent flowering exhibited highly significant positive correlation with

days to 50 percent pod setting (0.9971**), days to maturity (0.5252**) and pod yield per plant (0.4803**). This character also exhibited non significant and positive correlation with seed yield per plant (0.0647). It exhibited non significant and negative correlation with 100 seed weight (-0.1902). Days to 50 percent pod setting was highly significant and positively correlated with days to maturity (0.5423**) and pod yield per plant (0.4970**). This character exhibited non significant and positive correlation with seed yield per plant (0.0676) and also exhibited non significant and negative correlation with 100-seed weight (-0.1861).

Number of pods per plant exhibited was highly significant and positively correlated with pod yield per plant (0.9376**), seed yield per plant (0.7500**), days to maturity (0.5737**), days to 50 percent pod setting (0.5322**) and days to 50 per cent flowering (0.5266**). This character also exhibited significant and positive correlation with number of seeds per pod (0.2883*).While other characters showed positive and non-significant association. Pod length was highly significant and positively correlated with seed yield per plant (0.7197**) and 100 seed weight (0.3650**). Pod length is highly significant and negatively correlated with 50 per cent pod setting (-0.3328**) and days to 50 per cent flowering (-0.4106**). Pod length is significantly and negatively correlated with days to first flowering (-0.3058*).Whereas other characters showed positive and non-significant association with pod length.

Number of seeds per pod exhibited highly significant and positive correlation with pod yield per plant (0.4501**), days to 50 percent pod setting (0.4094**) and days to 50 percent flowering (0.3855**). This character also exhibited significant and positive correlation with days to maturity (0.2560*) and exhibited non significant and negative correlation with 100- seed weight (-0.2176). Whereas rest of the characters showed positive but non-significant association with number of seeds per pod. Plant height was highly significant and positively correlated with days to 50 percent flowering (0.4527**), days to maturity (0.4410**), number of pods per plant (0.4393**) and days to 50 per cent pod setting (0.4149**). Plant height was significantly and positively correlated with pod yield per plant (0.3265*) and seed yield per plant (0.2559 *). In this study plant height, however, established negative non-Significant association with pod length (-0.2510). Whereas with other characters showed positive and non-significant association. Pod yield per plant exhibited highly significant and positive correlation with seed yield per plant (0.7316**) and days to maturity (0.5320**).This character also exhibited non significant and positive correlated with 100-seed weight (0.0859). 100-seed weight character exhibited non significant and negative correlation with days to maturity (-0.0012). Seed yield per plant exhibited non significant and positive correlation with days to maturity (0.2512) and 100-seed weight (0.1586). In the present experiment, the study of correlation among different characters revealed that, in general, the genotypic correlation coefficients were somewhat greater than the phenotypic correlation coefficient. This indicated little role of environment in the expression of genetic relationship of the characters.

Agarwal and Singh (1973) recorded significant positive correlation of seed yield with number of days to maturity and pods per plant, seed per pod and 100- seed weight. Similar study was made by Singh (1993) for positive and significant correlation of pod length and seed yield per plant. Similar to this investigation Samal *et al.* (1996) showed high positive correlation for seed yield per plant with number of seeds per pod. This was also confirmed by Vasic *et al.* (1997), Chand and Chand (1998) and Berrocal *et al.* (2002).

Pod length has positive and highly significant association with seed yield per plant and 100 seed weight, indicating that increase and decrease in seed yield per plant directly reflected in the length of pod. An inverse relation between pod length and plant height indicated that the increase in length in length of pod, is accompanied by reduction in the plant height would reduce and vice versa. It might be due to the physiological activity, such as the separation of photosynthates from source to sink in determinate and indeterminate type of French bean cultivars (Upadhaya, 2001). Pod length had non-significant correlation with days to maturity in present investigation. This was also confirmed by Narsinghani and Saxena (1991) and Mishra *et al.* (1997). Some bush type genotypes had minimum days (59 days) to 50 per cent flowering as EC-530940 and EC-530954 whereas maximum days were recorded in pole type variety such as Swarnlata (75 days). In present investigation it was observed that days to 50 per cent flowering had positive and highly significant correlation with plant height and days to maturity and negative but significant correlation with pod length, whereas days to maturity had non-significant correlation with seed yield per plant. Plant height had positive and significant correlation with days to maturity and negative and non significant correlation with pod length; it was also confirmed by Narsinghani and Saxena (1991).

Agarwal and Singh (1973) observed positive and significant correlation between 100-seed weight and pod length, similarly in this investigation 100-seed weight had positive and significant correlation with pod length indicated that these characters could be improved simultaneously though selection. The positive association of number of pods per plant with plant height, number of seeds per pod, pod yield per plant and seed yield per plant was found. Similarly positive and significant association of pod length with seed yield per plant and 100-seed weight at genotypic level indicated that these characters could be improved simultaneously through selection. Similar results have been reported by Patil *et al*. (2004), Siroshi (2005), Nahar and Newaz (2005) and Chauhan *et al*. (2007).

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Table: 1. Genotypic correlation coefficients of different quantitative characters in French bean (*Phaseolus vulgaris* L.)

	Plant height (cm)	Pod length (cm)	No. of pods /plant	No. of seeds /pod	Days to first flowering	Days to 50% flowering	Days to 50 per cent pod setting	Pod yield /plant (g)	Seed yield /plant (g)	100-seed weight (g)	Days to Maturity (days)
Plant height (cm)	1.000										
Pod length (cm)	-.2510	1.000									
No. of pods /plant	.4393**	.2440	1.000								
No. of seeds/pod	.0049	.0118	.2883 *	1.000							
Days to first flowering	.2247	-.3058 *	.1371	.0321	1.000						
Days to 50 per cent flowering	.4527**	-.4106**	.5266**	.3855**	.7805**	1.000					
Days to 50 per cent pod setting	.4149**	-.3328**	.5322**	.4094**	.7610**	.9971**	1.000				
Pod yield /plant (g)	.3265 *	.2029	.9376**	.4501**	.0027	.4803**	.4970**	1.000			
Seed yield /plant (g)	.2559 *	.7197**	.7500**	.1569	-.0704	.0647	.0676	.7316**	1.000		
100- seed weight (g)	.1224	.3650**	.1357	-.2176	-.0981	-.1902	-.1861	.0859	.1586	1.000	
Days to Maturity (days)	.4410**	.0291	.5737**	.2560 *	.2547 *	.5252**	.5423**	.5320**	.2512	-.0012	1.000

** Significant at 1% level of significance, * Significant at 5% level of significance

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Table: 2. Phenotypic correlation coefficients of different quantitative characters in French bean (*Phaseolus vulgaris* L.)

	Plant ight (cm)	Pod length (cm)	No. of pods /plant	No. of seeds /pod	Days to first flowering	Days to 50% flowering	Days to 50% pod setting	Pod yield /plant (g)	Seed yield /plant (g)	100 seed weight (g)	Days to Maturity (days)
Plant height (cm)	1.000										
Pod length (cm)	-.0449	1.000									
No. of pods /plant	.3703**	.2047	1.000								
No. of seeds /pod	.0437	-.0408	.1827	1.000							
Days to first flowering	.1600	-.1166	.1269	.0426	1.000						
Days to 50 per cent flowering	.3408**	-.1383	.3952**	.2715 *	.7935**	1.000					
Days to 50 per cent pod setting	.3342**	-.1457	.4001**	.2967 *	.7672**	.9828**	1.000				
Pod yield /plant (g)	.2563 *	.1865	.9219**	.2355	.0219	.3311**	.3394**	1.000			
Seed yield /plant (g)	.1579	.2577 *	.4965**	.0594	-.0135	.0891	.0878	.4295**	1.000		
100 seed weight (g)	.1071	.1322	.1099	-.1357	-.1035	-.1841	-.1789	.0795	.1378	1.000	
Days to Maturity (days)	.2512	-.0032	.3285 *	.1352	.1753	.3593**	.3419**	.2958 *	.1963	-.0253	1.000

** Significant at 1% level of significance, * Significant at 5% level of significance

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Short Communication

MORPHOLOGICAL VARIATION IN FLORAL CHARCTERS ON TUBEROSE (*Polianthes tuberosa* Linn.) CULTIVARS TREATED WITH EMS

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Abstract

Mutagenic effectiveness of EMS was studied on four cultivars of tuberose (*Polianthes tuberosa* Linn.) cv. Kalyani Single, cv. Kalyani Double, cv. Suvasini and cv. Prajwal by treating them with 2 doses of EMS (0.1%, 0.2 %) .The findings indicated that there was significant morphological variation related to floral character in cultivar prajwal and Suvasini treated with EMS (0.1%, 0.2 %). The findings indicated that mutagenic treatments with lower doses EMS lower doses (0.1%,) resulted in increase in floral size of few florets within a spike.

Key words: Tuberose, mutantation, EMS

Introduction

Tuberose (*Polianthus tuberosa* Linn.) is a leading floriculture crope whose flower spikes are used for floral decoration and bouquet whereas individual fragrant florets are used for making artistic garlands, gajras and extraction of essential oil. The delightful aromatic oil extracted from tuberose is quite popularly used in naturapathy for mental healing and rejuvination. Inspite of it is various applicability and acceptablity; there are very few cultivars of tuberose in production worldwide.Another limitation associated with it is that in all its existing varieties, flower colour is limited to white only, although some varieties show pinkish ting at bud stage. It has been reported that self incompatibility exisits in tuberose (Sreethramu *et al*. 2000) so, there is also a limitation of convention breeding methods involving hybridation in it. Mutation breeding appears to be well standardized, efficient and cost-effective breeding techniques that can be exploited for the creation of new and novel ornamental cultivars of commercial importance in tuberose. Furthermore, many ornamental species are heterozygous and are often propagated vegetatively thus allowing the detection, selection and conservation of mutants within M_1 generation (Van Hartan, 2002).

Manychemical mutagens have been employed for obtaining useful mutants in various crop species (Singh and Singh, 2001). Ethyl methane sulphonate (EMS) is one of the common chemical mutagen used by various previous workers to overcome

the limitations of variability in plants. In view of this an experiment was carried out to study effect of different doses of EMS on genetic and morhophological variation on different cultivars of tuberose(*Polianthes tuberosa* Linn.)

Materials and Methods

The experiment was conducted at Model Floriculture Center of Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, district Udham Singh Nagar, Uttarakhand during 2010 and 2011.The experimental material comprised of the four tuberose cultivars named cv. Kalyani Single (V_1), cv. Kalyani Double (V_2), cv. Suvasini (V_3) and cv. Prajwal (V_4). The healthy and uniform bulbs of appropriate size (1.5-2.0 cm in diameter) of different cultivars were obtained from the germplasm being maintained at the Model Floriculture Center, Pantnagar. Bulbs of tuberose were dipped in freshly prepared solution of 0.1 and 0.2 per cent of EMS for 12 hours and dried under shade for 4 hours before planting it in field. The treated bulbs along with the untreated bulbs were planted in open field using factorial randomized block design with three replications. All the recommended package and practices for cultivation were followed throughout the year.

Results and Discussion

It can be depicted from table 1 and fig 1 , fig 2 fig 3 that the effect of EMS was cultivar and dose specific. In case of single cultivars Prajwal which is a single type variety of tuberose was more responsive as compared to cv.Shringa as it was observed that there was no morpholgical change appeard on floral character in cv. Shringar but incase of cv. Prajwal there was increase in number of petals per florets from six to seven and eight.It was seen that it was only few florets among the total number of florets borne on a particular spike which showed such deviation interms of number of petals per floret whereas other floret on the same spike were normal.

Incase of tuberose normally, two floret are borne at one point on a spike but it was observed that in one plant treated with EMS(0.1%) there was merging of two florets into one thus doubling of number of petals per floret from six to tweleve. This variation was also limited to only few florets among the total number of florets borne on a particular spike. It was also reported that although 0.1% EMS treated plants showed such variation but on plant treated with0.2% EMS didn't showed any deviation in these character.

Incase of double type cultivars, cv.Suvasini was observed to be more responsive as compared to cv.Kalyani double. It was observed that in one plant treated with EMS (0.1%) there was merging of two florets into one thus showing prominent increase in flower size and diameter but as in case of cv. Prajwal in cv. Suvasini also this phenomena was limited to only few florets among the total number of florets borne on a particular spike. Again incase of double cultivars selected for this study 0.1% EMS treated plants showed such variation but on plant treated with0.2% EMS didn't showed any deviation in these character. Thus it can be concluded that effect of EMS cultivar and dose specific,where lower dose seems to having more having favourable effect on floral characters.

It seems EMS treatment effected the expression of certain gene related to floral characters in tuberose.It has been reported earlier that floral organ identity gene plays a key role as a regulator of floral size. Mizukami and Fischer . (2000) reported that ectopic expression of *ANT* in Arabidopsis causes increased cell division in all floral whorls. Arabidopsis plant also shows enhanced cell expansion in petals, stamens and pistils but not in sepals (Krizek BA. 1999). In *Antirrhinum majus* larger flowers of *formosa* (*fo*) mutants were reported to be associated with increased expression of *Am-ANT* (Delgado-Benarroch *et al*., 2009; Kim *et al*., 2011).

Conclusion:

From the above experiment it can be concluded that EMS on lower dose (01%) can increase the floret size of tuberose. Whereas on higher dose of EMS there was appearance of floral abnormality and delay in flowering. further studies should be done covering genetic aspect for such mophological variation in tuberose.

Table 1: morphological variation related to floral character in tuberose (*Polianthes tuberosa* L).

Treatment	Mother plant	Characteristics of variants
EMS(0.1%)	Prajwal	Increase in number petals in a florets from 6 to 8
EMS(0.1%)	Prajwal	Merging of two florets(12 petals per floret)
EMS(0.1%)	Suvasini	Merging of two florets

Fig.-1 Merging of two florets (12 petals per floret)

Fig 2: Increase in number petals in a florets from normal 6 petals per floret to to 8 petals per floret in cv. Prajwal

Fig 3: Merging of two florets in cv. Suvasini

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Research Article

STUDIES ON THE PHYTOCHEMICAL AND ANTIMICROBIAL ACTIVITY OF ALLIUM SATIVUM AGAINST MEDICALLY IMPORTANT BACTERIAL STRAINS

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Abstract

Medicinal plants are important substances for the study of their traditional uses through the verification of pharmacological effects and can be natural composite source that act as new anti-infectious agents. Medicinal plants have been a source of novel drug compound. Green pharmacy may become the base for the base of medicine by providing a pharmacophore which could be used for the development new drugs with novel mechanisms of action. A number of medicine plants have been screened for antimicrobial activity in recent years and efforts have been done to identify their active constituents. The extracts possessing bioactivity are essentially evaluated for toxicity and the extracts are usually tested for short or long term toxicity in animal models. Plant derived products have made large contribution to human health and wellbeing. A number of medicine plants have been screened for antimicrobial activity in recent years and efforts have been done to identify their active constituents. Garlic has an important dietary and medicinal role for centuries. Our work was focused on isolation of bioactive compounds from Garlic and evaluation of its antimicrobial activity on pathogenic bacterial strains. Analysis of antimicrobial activity was done by Disc diffusion technique on Mueller Hinton Agar against Proteus vulgaris, Escherichia coli, Streptococcus mutans, Klebsiella pneumonia and Staphylococcus aureus. In our study, the antimicrobial activity of Garlic was found to be highest against Escherichia coli, Proteus vulgaris and Staphylococcus aureus. This study revealed the potential antimicrobial activities of Garlic. We concluded that the Garlic sample have a potential antimicrobial activity which can be used to develop alternate strategies to combat the challenges in pharmaceutical sciences.

Keywords: Antibacterial agents, bioactive compounds, Allicin, Pathogenic microbes.

Introduction:

Medicinal plants are important substances for the study of their traditional uses through the verification of pharmacological effects and can be natural composite source that act as new anti-infectious agents. Garlic has an important dietary and medicinal role for centuries. Its therapeutic uses include beneficial effects on the cardiovascular system, antibiotic, anticancer, anti-inflammatory, hypoglycemic, and hormone-like effects (Hageman, 1999). In traditional eastern medicine, garlic has been

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used in various forms and in the treatment of almost all infections. Garlic is widely used around the world for its pungent flavor as a seasoning or condiment. The garlic plant's bulb is the most commonly used part of the plant. With the exception of the single clove types, garlic bulbs are normally divided into numerous fleshy sections called cloves. Garlic cloves are used for consumption (raw or cooked) or for medicinal purposes. They have a characteristic pungent, spicy flavor that mellows. (Katzer, 2009). It's pointed out that garlic water has been used in typhoid and meningitis, its fume in whooping cough, garlic wicks in yeast infections and garlic soup in pneumonia. Its typical pungent odor and antibacterial activity depend on allicin, which is produced by enzymatic (alliin lyase) hydrolysis of alliin after cutting and crushing of the cloves. Garlic is a plant, which kills bacteria, fungus, parasites and lowers glycaemia and cholesterol and has liver protector property and includes antitumor agents. Treatment of fungal infections are difficult like in viruses and medicines used for this aim are generally toxic and a resistance can develop against the medicine in long term. It's stated that garlic, which consists of allicin being a fungistatic substance, has proved itself against micro-organisms such as Candida, Aspergillus and Cryptococci as an effective anti-fungal substance (Ayaz , 2007). Most of the foods borne bacterial pathogen are sensitive to extract from plant such as garlic, mustard, onion etc, (Chopra,1991). Garlic has antibacterial activity and contains powerful sulfur and numerous phenolic compounds (Benkeblia,2004). Allicin is the key component to which the antimicrobial activity of garlic is attributed; it is a volatile molecule that gives it its characteristics odour. Allicin has also been found to be effective an antifungal, antimicrobial and anti-parasitic agent (Reuter,1996). As an anti-bacterial agent, it is effective against many more gram negative and gram positive bacteria like Helicobacter pylori, E. coli, Lactobacillus casei and that this effect is sourced from allicin inside it (Cellini,1996). Active substances like allistatin I and allistatin II in garlic are powerful agents against Staphylococcus and E. coli bacteria (Hanafy,1994). In traditional eastern medicine, garlic has been used in various forms and in the treatment of almost all infections. It's pointed out that garlic water has been used in typhoid and meningitis, its fume in whooping cough, garlic wicks in yeast infections and garlic soup in pneumonia. Organisms resistant to antibiotics necessitates its more use in standard medicinal applications (Reuter,1996).

Material and Methods:

Sample collection:
Garlic sample were purchased from the local market, Dehradun. These will used in the preparation of extracts.

Preparation of Allium satium (garlic) extract:
Garlic (100gm) was washed first by distilled water and then by 95% ethanol. It was homogenized using sterile mortar and pestle and then sieved through double layer of sterile fine mesh cloth to make 100% extract. About 10gram of peeled garlic cloves were grinded using methanol, distilled water, petroleum ether, chloroform and ethyl acetate. The finely ground paste were soaked in 100ml of each of the solvent separately and wrapped with Para film to prevent the evaporation of volatile compound. The crude extracts were kept in a rotatory shaker for two days at 240-340 rpm. The resultant crude extracts were centrifuged at 8000g for 10 min and the supernatant was collected and stored at -20 degree Celsius.

Phytochemical screening:
The test were done to find the presence of the active chemical constituents such as terpanoids, steroid, flavonoids, reducing sugar, protein, amino acid, phylobatanins and tannins.

Test for phenolic:
Two drops of 5% ferric chloride were added to 5 ml of the crude extracts in a test tube. A greenish precipitate was taken as indication of phenolic.

Flavonoids:
To a volume of three milliliter of the garlic extracts, a volume of 1 ml of 10% sodium hydroxide was added. A yellow coloration indicated the presence of flavonoids.

Tannin:
A volume of 1 ml of freshly prepared 10% potassium hydroxide was added to a volume of 1 ml of the extracts. The presence of a dirty white precipitate was taken as indication of tannins.

Proteins:
Biuret test; to 2ml of the best solution added 5 drops of 1 % copper sulphate solution and 2ml of 10% NaoH. Mix thoroughly. Formation of purple or violet colour confirmed proteins.

Amino acids:
1ml of the extracts was treated with few drops of Ninhydrin reagent. Appearance of purple colour shows the presence of amino acids.

Terpenoids test:
0.2g of the extracts of whole plant sample was mixed with 2ml of chloroform and concentrated H2So4 (3ml) was carefully added to form a layer. A reddish brown coloration of the interface was formed to indicate positive results for the presence of terpenoids.

Reducing Sugar:
The extracts were shaken with distilled water and filtered. The filtrate was boiled with drops of Fehling ‘solution A and B for 5 minutes. An orange red precipitate forms shows positive results.

Phylobatanins:
The extracts (0.5g) were dissolved in diluted water and filtered. The filterate was boiled with 2% HCL solution. Red precipitate shows the presence of phylobatanins.

Bacterial strains used:
MTCC culture of *Escherichia coli*, *Staphylococcus aureus*, *Proteus vulgaris*, *Streptococcus mutans*, *Klebsiella pneumonia* were purchased from Institute of Microbial Technology, Chandigarh. The culture were activated according to the provided guidelines in aseptic conditions.

Antimicrobial activity testing of extracts
Disc diffusion method:
Discs were prepared using Whatman filter paper and were then charged with extracts for 2 hours. Antimicrobial testing was done on Mueller Hinton Agar plates and sensitivity was determined by measuring the zones of inhibition after overnight incubation. Tetracycline was also used as control.

Results and Discussion:

Phytochemical characterization of garlic extracts:
In this work, we have analyzed eight phytochemicals compounds which were proteins, tannins, reducing sugar, flavonoids, phylobatanins, amino acids and terpenoids, phenoids (Table No.1).

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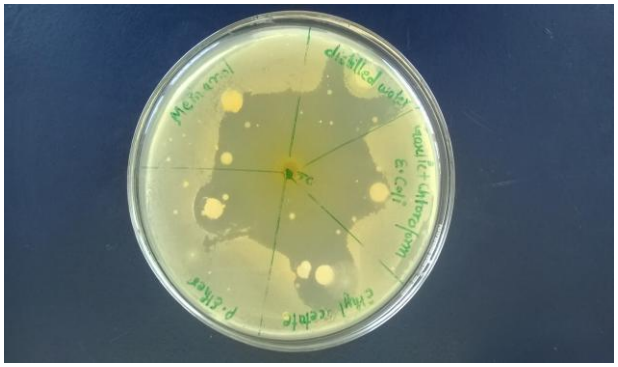
Disc diffusion test:

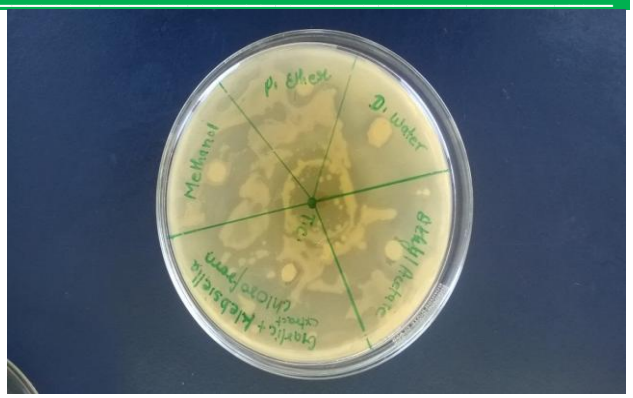
The main objective of the study is to evaluate antimicrobial activities. It was determined by using disc diffusion method. Garlic extracts possessed some antimicrobial activity. Garlic extracts prepared were used to study their inhibitory effects against selected bacterial pathogen namely *Proteus vulgaris, Escherichia coli, Staphylococcus aureus, Streptococcus mutan, Klebsiella pneumonia*. The zone of inhibition shown after 24 hours incubation at 37°C by them was then measured. The results obtained are presented in the forms of tables and figures (fig 1.1) (Table No.2)

Fig: 1.1 (a - e) Disc Diffusion test of Garlic extracts against bacterial strains

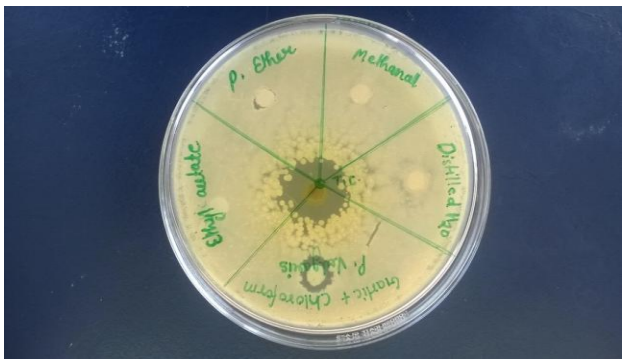


(a) Antimicrobial activity of Garlic extracts against Escherichia coli

(b) Antimicrobial activity of Garlic extracts against Streptococcus mutans.



(c) Antimicrobial activity of Garlic extracts against Klebsiella pneumonia



(d) Antimicrobial activity of Garlic extracts against Proteus vulgaris.

(e) Antimicrobial activity of Garlic extracts against Staphylococcus aureus.

We have analyzed eight phytochemicals compounds which were proteins, tannins, reducing sugar, flavonoids, phylobatanins,

amino acids and terpenoids, phenoids. Garlic extracts prepared were used to study their inhibitory effects against selected bacterial pathogen namely Escherichia coli(I), Staphylococcus aureus (II), Proteus vulgaris(III), Streptococcus mutans (IV), Klebsiella pneumoniae (V). The zone of inhibition shown after 24 hours incubation at 37°C by them were then measured. Phytochemical study indicated the presence of Flavonoids, Tannins, Proteins and Terpenoids in the prepared extracts. The inhibitory effect of Garlic was found to be highest against *Escherichia coli, Proteus vulgaris and Proteus vulgaris.* We concluded that the Garlic sample have a potential antimicrobial activity which can be used to develop alternate strategies to combat the challenges in pharmaceutical sciences.

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Table No. 1: Phytochemical analysis of Garlic extract

Test	Methanol	Chloroform	Ethyl acetate	Petroleum ether	Distilled water
Flavonoids	+	_	_	+	+
Tannins	_	_	_	+	+
Proteins	+	+	+	+	+
Phenolics	_	_	_	_	_
Amino acid	_	_	_	_	_
Terpenoids	+	_	_	_	+
Reducing sugar	_	_	_	_	_
Phylobatanins	_	_	_	_	_

Table No. 2: Zone of inhibition of Garlic extracts against *Proteus vulgaris, Escherichia coli, Streptococcus mutans, Klebsiella pneumoniae, Staphylococcus aureus*

S. N.	Name of bacteria	Time (Hrs)	Methanol	Chloroform	Ethyl acetate	Petroleum ether	Distilled water	Tetracycline
1.	*Escherichia coli*	24	0	0	18 mm	20 mm	0	47 mm
2.	*Staphylococcus aureus*	24	9 mm	11 mm	0	8 mm	10 mm	21 mm
3.	*Proteus vulgaris*	24	10 mm	12 mm	11 mm	0	0	30 mm
4.	*Streptococcus mutans*	24	0	13 mm	9 mm	12 mm	6 mm	37 mm
5.	*Klebsiella pneumoniae*	24	6 mm	6 mm	11 mm	9 mm	8 mm	25 mm

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EFFECT OF BLUE GREEN ALGAE AS BIO-FERTILIZERS ON GROWTH OF MUSTARD PLANT

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Abstract

The use of biofertilizers, in preference to chemical fertilizers, offers economic and ecological benefits by way of soil health and fertility to farmers. Cyanobacteria represent a small taxonomic group of photosynthetic prokaryotes which some of them are able to N2 fixation and also possess a tremendous potential for producing a wide range of secondary metabolites. Cyanobacteria have drawn much attention as prospective and rich sources of biologically active constituents and have been identified as one of the most promising groups of organisms capable of producing bioactive compounds. It showed that, the supply of nitrogenous nutrients to the seeds is important also showed that in addition to N-contributions in bga culture has decreased losses from sulphate reducing processes and this has been attributed to the enhancement of germination and faster seedling growth due to algal exudates Statistical analysis confirm that there is a significant difference in plant height, root length, number of leaf, fresh and dry weight of root, leaf and stem in treated plants as compared to control. The present study was conducted to evaluate the effect of blue green algae as biofertilizers on the growth of Mustard plant (Brassica campestris). Germination percentage was higher in culture treated with the algal suspensions than the controlled one. The enhanced growth of Mustard plants induced by blue green algae inoculation in the present study might have resulted from its liberation of biologically active compounds.

Keywords: Bio fertilizers, Cyanobacteria, exudates, Secondary metabolites.

Introduction

Biofertilizers is defined as a substance, contains living microorganisms which colonizes the rhizosphere or the interior of the plant and promotes growth by increasing the supply or availability of primary nutrient and/or growth stimulus to the target crop, when applied to seed, plant surfaces, or soil (Vessey, 2003). The biofertilizers are natural fertilizes which are living microbial inoculants of bacteria, algae, fungi alone or in combination and they augment the availability of nutrients to the plants. Bio-fertilizers containing beneficial bacteria and fungi improve soil chemical and biological characteristics, phosphate solutions and agricultural production (El-Habbasha, 2007; Yosefi, 2011).

The Biofertilizers includes mainly the nitrogen fixing, phosphate solubilising and plant growth promoting microorganisms (Goel, 1999). Among biofertilizers benefiting the crop production are Azotobacter, Azospirillum, Blue Green Algae, Azolla, P-solubilising microorganisms, Mycorrhizae and Sinorhizobium, there are different types of microorganisms which are used as the biofertilizers. Some are capable of nitrogen fixation such as Azotobacter, blue green

algae, Rhizobium and Azospirillum. Rhizobium is used to increase the capacity of nitrogen fixation in the leguminous plants. Azotobacter is used as biofertilizers for the development of various vegetable plants such as mustard, maize, wheat, cotton etc. Azospirillum is applied in the millets, sorghum, sugarcane, and maize and wheat field. Blue green algae such as Nostoc, Tolypothrix, Anabaena, and Aulosira fix atmospheric nitrogen and enrich the soil fertility (Hegde, 1999).

Blue green algae (bga) are photosynthetic nitrogen fixers and are free living. They are found in abundance in India. They too add growth promoting substances including vitamin B_{12}, improve the soil's aeration and water holding capacity and add to biomass when decomposed after life cycle. Azolla is an aquatic fern found in small and shallow water bodies and in rice fields. It has symbiotic relation with bga and can help rice or other crops through dual cropping or green manuring of soil. They manufacture their food by photosynthesis, as they have chloroplasts. Hence, they can live independently. Heterocystous nitrogen-fixing blue-green algae consist of filaments containing two types of cells: the heterocyst, responsible for ammonia synthesis, and vegetative cells, which exhibit normal photosynthesis and reproductive growth. Cyanobacteria are capable of abating various kinds of pollutants and have advantages as potential biodegrading organisms (Subramanian and Uma, 1996).

In the current scenario therefore, an urgent need has been felt to deploy microbial biofertilizers which are multifaceted such as cyanobacterial biofertilizers. As yet for substitution of chemical fertilizers by microbial biofertilizers many studies have also reported that plant growth was enhanced in the presence of cyanobacterium, even without organic Nitrogen fertilizer application been done. Beneficial effects of cyanobacterial inoculation were reported Mustard plant. (Venkataraman, 1972; Rodgers 1979; Thajuddin & Subramanian, 2005; Saadatnia & Riahi, 2009).

Several reasons have been proposed for beneficial effects of cyanobacteria on the growth of different plants. The capacity for biosynthesis of growth promoting substances such as auxins, amino acids, sugars and vitamins (Vitamin B_{12}, Folic acid, Nicotinic acid and Pantothenic acid) was reported by that can enhance growth of plant. Additionally, cyanobacteria excrete complex organic carbon compounds that bind to the soil particles and improve soil aggregation, hence improve soil structure, soil permeability and water holding capacity of soil .The primary aim of this project was to study the role of cyanobacteria as a biofertilizers in Mustard plants. Blue green algae (bga) are photosynthetic nitrogen fixers and are free living. Cyanobacteria are capable of abating various kinds of pollutants and have advantages as potential biodegrading organisms (Subramanian, 1996).

The objective of application of Bio-fertilizers is that of accelerating microbial processes which augment the availability of nutrients that can be easily absorbed by plants, harvesting the naturally available biological system of nutrient mobilization.

In conclusion, Bio fertilizer help in increasing crop productivity by way of increased biological nitrogen fixation, increased availability or uptake of nutrients through solubilisation or increased absorption stimulation of plant growth. Furthermore, biofertilizers as to replace part of the use of chemical fertilizers reduces amount and cost of chemical – Fertilizer and thus prevents the environment pollution from extensive application of chemical fertilizers. The technology can be easily adopted by farmers for multiplication at their own level. With using the biological and

organic fertilizers, low input system can be carried out, and it can be helped achieving sustainability of farm. Our present study was mainly focused to study the effects of blue green algae over mustard plant growth.

Materials and Methods

Experimental Mustard (Brassica campestris) plants were raised in soil culture under pot culture conditions in the laboratory.

Containers:
Plants were raised in 8.5" plastic flower pots with a central drainage hole. The inner surface of the pots along with 3"of outer rim was lined with acid washed polythene provided with the central hole superimposed on the drainaged hole of the pole.

Water:
Normal tap water was used during the experiment.

Rising of plants:
All the plants were raised in the soil of about 1.5 cm deep hole were made with glass rod of 3mm in diameter and seeds were put in this holes containing seeds loosely with soil of the same pot .After the seeds emergence, plants were thinned to a uniform number of each pot .Subsequent thinning was done whenever needed. The soil was retained in the pots with the help of a pad of broken clay pot pieces, and placed above the drainage hole.

Layout:
For the experiment, six pot were taken and arranged in three blocks i.e., block A, B and C. Each block contain two pots were meant for the controlled (without blue green algae) treatment and other one with blue green treatment. In each block the treatment were completely randomized. The experimental pots were arranged in North-South direction and were kept raised from the ground at a height of one feet avoiding any surface contact of the drainage hole with the ground to eliminate any contamination.

Soil culture:
Experiment present in respective chapter, Mustard (Brassica campestris) plants were raised in soil pot culture

Soil:
Soil samples were collected from nearby field in the clean polythene bags after surface scrapping and brought to the laboratory. Clean polythene lined 13" plastic flower pots were used for soil culture. The soil in pots was retained by putting an inverted clean broken clay pot pieces over the drainage hole.

Watering:
Calculated amount of normal water was given daily to pots provided as far as possible for maintaining uniform soil moisture condition.

Sampling technique:
Sampling was generally started at 10:00 AM and completed in two hours. All samples were drawn at the same time and placed in the shade. The three blocks A, B and C were drawn at same time

Application of biofertilizer:
Soil was separately mixed with required amount of blue green algae. Thereafter it was dried thoroughly, grounded and mixed. For thorough mixing required amount of bga was mixed again and again. Then this amended soil was mixed with bigger amount similarly as above, and finally this soil was mixed with bigger lot of calculated soil required for experiment. Soil mixing was done on separate clean chart to avoid any contamination. Mixed soil was filled in the pots as described earlier. The algal biofertilizers was

purchased from National facility for blue green algal collection IARI, New Delhi.

Analytical:
For analysis, washed, finely chopped and mixed plant material was used. For the determination of fresh matter yield, fresh material was used and for the determination of dry matter yield, dry material was used.

Seed germination:
Ten healthy seeds of Brassica campestris were spread uniformly in each pot with controlled treatment and other with blue green algae treatment. Normal tap water was applied to the two sets of pots. The seeds were allowed to germinate in alternate light and dark conditions.

Height of the plant:
Replicates of 6 plants were for the measurement of height and also for other parameters. Entire plants containing main tap root expressed in centimetre (cm) for all the controlled as well as treated plants was measured by using a ruler. Different measurement of shoot length was taken. Measurement was taken for the shoot from the base of the top of the plant.

Fresh matter yield:
The plants samples were finely chopped blotted and weight for Fresh Matter Yield (FMY).

Dry matter yield:
Dry matter yield was determined by drying the finely chopped and mixed plant samples in a forced drought oven at 70 ^{O} C for 24 hours to constant weight. The samples were taken out from the oven and placed in a desiccator cooled for about an hour and weighed for the determination of yield.

Results and Discussion

Total ten seeds were sown in each of the pots of block A, B and C under controlled and blue green algae treatment conditions the growth parameters which were analysed are described below (Table 1.1).

Height:
After 45 days of starting of experiment, the height of tops of Mustard (Brassica campestris) plant 1.683cm under controlled condition. The height of plants after applying 250gm bga/kg soil was found 4.933cm after 45 days.

Fresh matter yield:
Total fresh matter yield of 45 days old tops of the Mustard (Brassica campestris) plant under controlled condition was found to be 5 gm. whereas the fresh matter yield after days applying 250 bga/kg soils was reported 11.5 gm.

Dry matter yield:
In oven dried condition, Dry Matter Yield of tops of 45 days old plant in controlled condition was reported to be 0.06 gm. On applying 250gm bga/kg soil the Dry Matter Yield was 1.5 gm. of top of the Mustard plant.

Number of leaves:
Total number of leaves in 45 days old top of the Mustard plant under controlled condition was found to be 28 whereas the number of leaves after 45 days on applying 250 gm of bga/kg soil was reported 38. Result of the experiment performed on the Mustard plants is depicted in the following table 1.1:

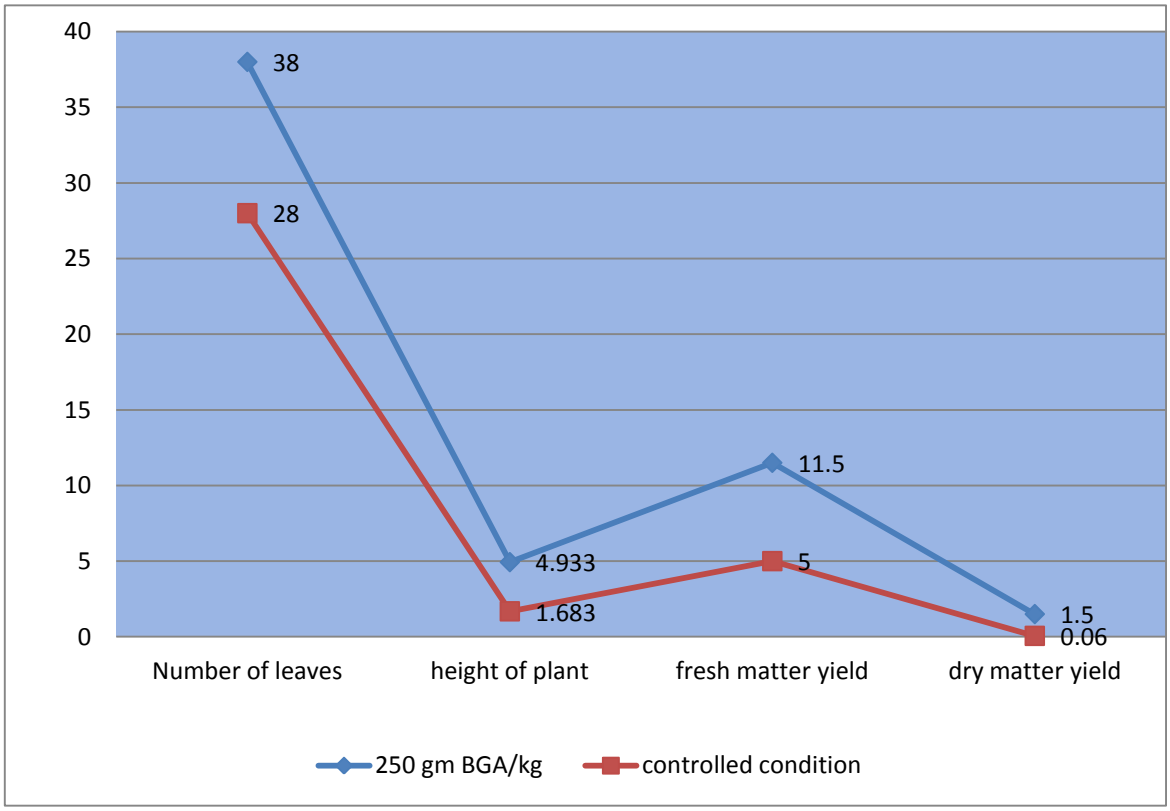
Growth Parameter	Number of leaves	Height of plant (in cm)	Fresh matter yield (in gm)	Dry matter yield (in gm)
Controlled Condition	28	1.683	5	0.06
250 gm bga/kg soil	38	4.933	11.5	1.5

Mustard plants with Blue green algae Treatment

Mustard plants without Blue green algae treatment

A mustard plant without biofertilizer.

A mustard plant with biofertilizer.



The above table shows that there is a significant improvement in various growth parameter i.e., Germination percentage, number of leaves, height of plant, fresh matter yield, dry matter yield.

Algal bio-fertilizers not only provide nutrients to the plants but in fact also help in increasing plant growth and soil fertility. Algal bio-fertilizers play a major role in organic farming. The review of literatures showed that, there are only a few studies on similar subjects, especially on vegetable crops; nevertheless results of other studies on other plants confirm the results of this study. The results obtained in the first part of this work showed that by algal extract accelerates seed height. Application of bga subsequent led to significant increase in growth and development of Mustard plant.

It showed that, the supply of nitrogenous nutrients to the seeds is important (Jacq & Roger .1977) also showed that in addition to N-contributions in bga culture has decreased losses from sulphate reducing processes and this has been attributed to the enhancement of germination and faster seedling growth due to algal exudates Statistical analysis confirm that there is a significant difference in plant height, root length, number of leaf, fresh and dry weight of root, leaf and stem in treated plants as compared to control.

Venkataraman and Neelakantan (1967) showed that the production of growth substances and vitamins by the algae may be partly responsible for the greater plant growth and yield. The capacity for biosynthesis of growth promoting substances such as auxins, amino acids, sugars and vitamins (Vitamin B_{12}, Folic acid, Nicotinic acid and Pantothenic acid) also can enhance plant growth. The other reason that can suggest for increased plant growth by using cyanobacterial extract is that, the growth of bga in soil seems to influence the physical and chemical properties of soil. The water stable aggregate significantly

increase as a result of algal growth and thereby improves the physical environment of the plants. Heterocystous cyanobacteria (Anabaena vaginicola, Nostoc sp. and Nodularia harveyana) have ability to promote vegetable growth and they are appropriate candidate for the formulation of a biofertilizers.

Blue green algae as biofertilizers have several advantages over chemical fertilizers. They are non-polluting, in expensive, utilize renewable resources. In addition to their ability of using free available solar energy, atmospheric nitrogen and water .Beside supplying N_2 to crops, they also supply other nutrients such as vitamins and growth substances (Wagner, 1997).

The seedlings with biofertilizers significantly increase nitrogen and phosphorus content in the soil as a result of N fixation and phosphate dissolving by bacteria and Mycorrhizae. As well as growth promoting substances such as Indole acetic acid and gibberellins produced by all organisms used. Soluble bacteria in the nitrogen biofertilizers by generating soil soluble phosphorus, secretion plant growth hormones, natural enzymes, antibiotics and different compounds such as volatile gasses are capable to develop the aerial parts of plant.

Sharma reported that biofertilizers application increased the biomass and dry material of plants, who believed that the biological fixation of nitrogen and phosphorus is reason of biomass increasing. Many blue green algae have the capacity to manufacture nitrogenase. Because the enzyme complex is anaerobic, significant fixation by unicellular, colonial and some filamentous a species occurs only in the absence of air. Therefore, only heterocystous species are valuable as bio fertilizers. Scientists indicate that the nitrogen produced by free living blue green algae is immediately available to crops.

Blue green algae is cheap source of Nitrogen, which does not because pollution. It improves the organic matter status and water holding capacity. It was observed that the use of nitrogenous fertilizers cause acidification of soil and their long term application significantly reduces the microbial activity of the soil.

The present study was conducted to evaluate the effect of blue green algae as biofertilizers on the growth of Mustard plant (Brassica campestris). Germination percentage was higher in culture treated with the algal suspensions than the controlled one. The enhanced growth of Mustard plants induced by blue green algae inoculation in the present study might have resulted from its liberation of biologically active compounds.

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