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Effect of biofertilizers on the growth of *Vicia faba* cv. T-41

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SUMMARY

A pot experiment was conducted during the *Rabi* season of session 2006-2007 in G.F. (P.G.) College Shahjahanpur on *Vicia faba* cv. T-41 in order to study the effect of biofertilizers *i.e. Azospirillum* and *Rhizobium* in various concentrations (0.1, 0.25, 0.50, 0.75, 1.0 per cent) on different growth parameters (shoot length, root length, shoot fresh weight, root fresh weight, shoot dry weight, root dry weight and fruits per plant). A maintenance dose of N P K was also given at the rate of 50:100:50 kg/ha to maintain the growth of plants. Seed inoculation with both the bacteria *Azospirillum* and *Rhizobium* showed the considerable increase in all the growth parameters over the uninoculated control. In case of *Azospirillum,* seeds treated with 0.50 per cent bacterial culture showed the best results while in seeds treated with *Rhizobium* 0.25 per cent bacterial culture showed better results with respect to all growth parameters *i.e.* shoot length, root length, shoot fresh weight, root fresh weight, shoot dry weight, root dry weight and fruits per plant. Among both the bacterial treatments *Rhizobium* was better than *Azospirillum* because *Rhizobium* showed the better results with less amount of its culture. Thus *Rhizobium* is strongly recommended as suitable biofertilizer in improving growth parameters of *Vicia faba* cv. T-41.

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Modern agriculture is heavily dependent on the fossil fuel based inputs such as inorganic fertilizers, pesticides, herbicides and energy intensive machinery. Large-scale use of chemical fertilizers causes various problems. Continuous and unbalanced use of chemical fertilizers is leading to decrease in crop yield. Frequent use of chemical fertilizers at a higher rate also causes problems lie soil health deterioration, ground water pollution and atmospheric pollution etc. The problems like leaching, volatilization, denitrification of nitrogen and deposition of non-available phosphorus in soil are also the resultants of heavy use of chemical fertilizers. Moreover, the nitrogenous fertilizers are already in short supply and expensive because industrial fixation of nitrogen is an energy intensive process, is solely based on mineral oils *i.e.* petroleum products which are non-renewable resources.

Biofertilizers, being natural products an eco friendly in nature, assume great significance in organic farming. In India, majority of the farmers are small and marginal. Therefore, use of biofertilizers in conjunction with organic and inorganic fertilizers offers a great opportunity for sustainable crop production. Biofertilizers are cost effective and inexpensive source of plant nutrients do not require non-renewable source of energy during their production. They improve crop growth and quality of the product by producing plant hormones and also help in sustainable crop production through maintenance of soil productivity. They are useful as biocontrol agents, since they control many plant pathogens and harmful microorganism.

Azospirillum and *Rhizobium* are important microorganisms widely distributed in agricultural lands as well as in the rhizosphere of the plants also. They are found as free living, symbiotic, heterotrophic, aerobic bacteria and may also grow under reduced conditions. *Azospirillum* has ability to fix molecular nitrogen (5-20 kg/hectare) from atmosphere independently without association, with roots, called asymbiotic/free living nitrogen fixers, while *Rhizobium* fixes atmospheric nitrogen by living in symbiotic relationship with the roots of leguminous plants. Thus most of the biofertilizers fix nitrogen and increase plant yield up to 80-90 per cent (Gahukar,2005).It is with this aim an attempt has been made in present work to study the effect of biofertilizers on the growth of *Vicia faba* cv. T-41.

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MATERIALS AND METHODS

A pot experiment was conducted during *Rabi* season of 2006-2007 in G.F. College, Shahjahanpur. The pots were filled with 3 kg soil consisting of farm soil, compost and sand in the ratio of 3:1:1. Seeds of *Vicia faba* cv. T-41 were treated with 0.1, 0.25, 0.50, 0.75 and 1.0 per cent aqueous solutions of *Azospirillum* and *Rhizobium* cultures along with 5 per cent jaggery to allow fixing of bacteria on the seed surface. The seeds were dipped in the solutions for 3-4 hours. The treated seeds were sown immediately after soaking treatments. Five seeds were sown in each pot and each treatment was replicated thrice. After 15 days of germination of seeds thinning was done in each pot and only three healthy seedling approximately of the same height were left in each pot. A constant dose of N, P and K @ of 50:100:50 kg/ha was also applied at 30 days stage of plants in each pot to maintain the growth of the plants.

The experiment was terminated after 90 days of sowing. Plants were uprooted carefully from rat pot. They were tagged separately and washed thoroughly under running tap water to remove the soil attached with the roots. Plants were brought to the laboratory for taking different parameters. Plants were dried between two fold of blotting paper to measure their length and fresh weight. All the growth parameters *viz.*, shoot length, root length, shoot fresh weight, root fresh weight, shoot dry weight, root dry weight and fruits per plants was recorded. For taking dry weights, plants were kept in oven for 7-8 days at 50 –60^{0}C. Mean values of all the parameters were calculated and statistical analysis was done to compare the results.

RESULTS AND DISCUSSION

The data presented in the Table 1 and 2 show that there was considerable increase in all the growth parameters when plants were treated with different concentrations of *Azospirillum* and *Rhizobium* cultures.

The plants receiving different concentration of *Azospirillum* showed a direct correlation between the increase in the concentrations and increase in the growth parameters but 0.50 per cent bacterial culture showed maximum. Statistical analysis of data shows that the concentrations of bacteria above 0.5 per cent were at par with the 0.5 per cent concentration. Therefore, they are not recommended for increasing the growth parameters. Table 3 reveals the per cent increase in different growth parameters in plants receiving different concentrations of the *Azospirillum.* The per cent increase in different concentrations of *Azospirillum* was 16.65,

Table 1 : Showing the effect of *Azotobacter* on root length, shoot length, shoot fresh weight, root fresh weight, shoot dry weight, root dry weight and fruits

Treatments	Shoot length (cm)	Root length (cm)	Shoot fresh weight (g)	Root fresh weight (g)	Shoot dry weight (g)	Root dry weight (g)	No. of fruits per plant
Control	20.00	10.83	11.10	2.80	2.17	0.56	4
0.1%	23.33	13.66	14.32	3.54	2.80	0.70	5
0.25%	28.26	15.33	15.80	4.02	3.23	0.80	6
0.50%	33.33	17.66	18.22	4.73	3.63	0.90	8
0.75%	33.60	18.07	18.60	4.76	3.73	0.94	8
1.0%	33.80	18.32	18.80	4.78	3.78	0.96	8
C.D. (P=0.05)	03.46	02.15	02.25	0.35	0.21	0.06	1.50

N.B. Each value is mean of three replicates.

Table 2 : Showing the effect of *Rhizobium* on root length, shoot length, shoot fresh weight, root fresh weight, shoot dry weight, root dry weight and fruits

Treatments	Shoot length (cm)	Root length (cm)	Shoot fresh weight (g)	Root fresh weight (g)	Shoot dry weight (g)	Root dry weight (g)	No. of fruits per plant
Control	29.66	12.43	15.48	4.36	2.45	0.66	3
0.1%	48.12	19.90	25.95	7.18	4.22	1.04	9
0.25%	50.70	21.60	26.61	7.76	4.48	1.19	9
0.50%	51.50	21.71	26.89	7.84	4.49	1.20	8
0.75%	51.95	21.76	26.96	7.94	4.53	1.21	8
1.0%	52.13	21.83	27.13	7.96	4.63	1.23	8
C.D. (P=0.05)	02.33	01.68	01.63	0.37	0.25	0.08	2.50

N.B. Each value is mean of three replicates

Table 3 : Showing the per cent increase in shoot length, root length, shoot fresh weight, root fresh weight, shoot dry weight, root dry weight and fruits due to *Azospirillum*

Treatments	Shoot length (cm)	Root length (cm)	Shoot fresh weight (g)	Root fresh weight (g)	Shoot dry weight (g)	Root dry weight (g)	No. of fruits per plant
0.1%	16.65	26.13	29.01	26.43	29.03	25.00	25.00
0.25%	41.30	41.55	42.34	43.57	48.85	42.66	50.00
0.50%	66.65	63.07	64.14	68.93	67.28	60.71	100.00
0.75%	68.00	66.85	67.57	70.00	71.89	67.86	100.00
1.0%	69.00	69.16	69.37	70.71	74.19	71.43	100.00
C.D. (P=0.05)	05.88	05.93	04.63	04.37	05.25	06.58	12.50

N.B. Each value is mean of three replicates

Table 4 : Showing the per cent increase in shoot length, root length, shoot fresh weight, root fresh weight, shoot dry weight, root dry weight and fruits due to *Rhizobium*

Treatments	Shoot length (cm)	Root length (cm)	Shoot fresh weight (g)	Root fresh weight (g)	Shoot dry weight (g)	Root dry weight (g)	No. of fruits per plant
0.1%	62.24	60.10	67.64	64.68	72.24	57.58	33.33
0.25%	70.94	73.77	71.90	73.39	78.78	80.30	200.00
0.50%	73.63	74.66	73.71	79.82	83.27	81.82	200.00
0.75%	75.15	75.06	74.16	82.11	84.90	83.33	166.67
1.00%	75.76	75.62	77.20	87.16	88.98	86.36	166.67
C.D. (P=0.05)	05.15	05.28	04.12	04.13	02.35	05.45	10.42

N.B. Each value is mean of three replicates

41.30, 66.65, 68 and 69 per cent in shoot length; 26.13, 41.55, 63.07, 66.85 and 69.16 per cent in root length; 29.01, 42.34, 64.14, 67.57 and 69.37 in shoot fresh weight; 26.43, 43.57, 68.93, 70.00 and 70.71 in root fresh weight; 29.03, 48.85, 67.28, 71.89 and 74.19 in shoot dry weight; 25.00, 42.66, 60.71, 67.86 and 71.43 in root dry weight and 25, 50, 100, 100 and 100 per cent in number of fruits per plant in plants receiving 0.1, 0.25, 0.5, 0.75 and 1.00 per cent concentrations of *Azospirillum*, respectively. The increase in growth parameters receiving *Azospirillum* fertilizer beyond 0.5 per cent concentration was at par with the results shown by plants receiving 0.5 per cent bacterial concentration of *Azospirillum.* Thus 0.5 per cent concentration of *Azospirillum* seems to be optimum for increasing different growth parameters in plants.

Data presented in Table 4 revealed the per cent increase in different growth parameters in plants receiving different concentrations of the *Rhizobium.* The per cent increase in different concentrations of *Rhizobium* was 62.24, 70.94, 73.63, 75.15 and 75.76 in shoot length; 60.10, 73.77, 74.66, 75.06 and 75.62 in root length; 67.64, 71.90, 73.71, 74.16 and 77.20 in shoot fresh weight; 64.68, 73.39, 79.82, 82.11 and 87.16 in root fresh weight; 72.24, 78.78, 83.27, 84.90 and 88.98 in shoot dry weight; 57.58, 80.30, 81.82, 83.33 and 86.36 in root dry weight and 33.33, 200.00, 200.00, 166.67 and 166.67 in number of fruits per plant in plants receiving 0.1, 0.25, 0.5, 0.75 and 1.00 per cent concentrations of *Rhizobium*, respectively. The increase in growth parameters receiving *Rhizobium* fertilizer beyond 0.25 per cent concentration was at par with the results shown by plants receiving 0.25 per cent bacterial concentration of *Rhizobium.* Thus 0.25 per cent concentration of *Rhizobium* seems to be optimum for increasing different growth parameters in *Vicia faba* cv.T-41 plants.

Among both the bacterial treatments *Rhizobium* is proved better than *Azospirillum* because *Rhizobium* shows the better results with less amount of its culture.

Rhizobium resulted in more accumulation of nitrogen ultimately resulting into more plant height, along with this *Rhizobium* produces some growth promoting substances like NAA, GA, B-Vitamins which might have increased the number of branches per plant. These substances are inhibitory to certain root pathogens. Addition to all these factors, biomass and N-content is increased that results in better plant growth (Thosar *et al*., 2005, Gahukar, 2005).

On the other hand, *Azospirillum* can fix 40-200 kg/ha nitrogen, which is able to meet 80-90% of nitrogen need of the crop that increases the yield upto 10-35 %. (Gahukar, 2005, Sharma *et al*., 1998, Ingle *et al*., 2001). *Rhizobium* and *Azospirillum* increases the growth parameters because they also control certain diseases that occur frequently in faba bean. Diseases like root rot

and wilt disease are controlled by co-inoculation of both the bacteria or all alone (Fayez *et al.*, 2004). The findings of this experiment are also found similar to the findings of Khoja *et al.* (2002), Singh *et al.* (2005), Behl (2003).

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