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Response of bio-fertilizers and inorganic fertilizers on growth and yield of tomato cv. PUSA RUBY

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Abstract : The field experiment was conducted at the Horticulture Research Farm, Department of Horticulture, C.C.S. University, Meerut (U.P) during 2007-08. The experiment consisted 9 treatments of inorganic and biofertilizers. Three biofertilizers treatments *i.e.* B_0, B_1, (B_0 = no biofertilizer, B_1 = phosphobacteria) and B_2 = *Azospirillum* and three, inorganic fertilizer treatments *i.e.* I_0, I_1 and I_2 (I_0 = no inorganic fertilizer, I_1= 60kg N+30 kg P/ha), I_2=120 kg N + 60 kg P/ha. The maximum plant height (77.32cm), no. of branches/plant (12.28), diameter of fruits (58.72 cm) average fruit weight (5.06 g) and yield (360.82q/ha), the earliest flowering (43.05days) were noted in the treatment I_2, where nitrogen and phosphorus was applied 120 kg and 60 kg/ha, respectively and diameter of main stem showed non significant effect. But the interaction effect on plant height, number of branches/plant , diameter of main stem , days taken to first flowering, diameter of fruit, average fruit weight and yield gave the better performance at the treatment combination I_2B_2 as compared to other treatments and control.

Key words : Tomato, Nitrogen, Phosphorus, Phosphobacteria, *Azospirillum*

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Tomato (*Lycopersicon esculentum* Mill.) is a member of Solanaceae family and genus *Lycopersicon*. Tomato is one of the most popular and principal vegetable crops grown in India and other parts of the world. It can be grown in almost all parts of the country except higher altitudes. Horticultural crops are likely to benefit the most from bio-fertilizer inoculation as the production practice of these high value crops are readily amenable to inoculation, and vegetable crops like tomato will form a good condition from bio-fertilizers inoculation due to the very nature of its root morphology.

It is known that all the nutrients like nitrogen, phosphorus and potash are very necessary for proper growth and yield of not only tomato but also for all plants because these elopement are the major constituent of plant protein, amino-acids, chlorophyll, protoplasm, nucleic acid, phospholipids and some vitamins which play a definite role in the physiology of plant life. Therefore, the requirement of three elements have to be fulfilled by the use of inorganic manures. Although the successive use of inorganic manures is responsible for deterioration of soil health.

The bio-fertilizer of microbial origin, *i.e. Azospirillum* as a source of nitrogen and phosphobacteria of phosphorus are the most for potential biological systems. For more rational agricultural programme, the economical and eco-friendly use of these nitrogenous and phosphates bio-fertilizers has now become an important issue

RESEARCH METHODS

The present experiment was carried out at the Horticulture Research Farm, Department of Horticulture, Ch. Charan Singh University, Meerut (U.P.) during 2007-2008.The topography of the field on which the experiment was conducted was fairly uniform. The experiment was laid out in Randomized Block Design. The experiment consisted 9 treatments of inorganic and biofertilizers. Three biofertilizers treatments *i.e.* B_0, B_1, (B_0 = no biofertilizer, B_1 = phosphobacteria) and B_2 = *Azospirillum* and three inorganic fertilizer treatments *i.e.* I_0, I_1 and I_2

($I_{0=}$ no inorganic fertilizer, I_1= 60kg N+30 kg P/ha), I_2=120 kg N + 60 kg P/ha. After sowing, seeds were covered with sieved mixture of F.Y.M. and soil. The nursery bed was irrigated immediately after sowing and tender seedlings were protected from direct sun, frost and heavy rains. Treatment plots received nitrogen and/or phosphorus or *Azospirillum* and/or Phosphobacteria and/ or potash or both inorganic and bio-fertilizers depending on the treatment requirement. A common dose of 60 kg/ ha potash was applied to all the treatment plots.A carrier based (charcoal :soil;3 :1) inoculums of *Azospirillum* @ 1kg/ha was dissolved in water to prepare a slurry. Seedlings uprooted from nursery bed and then dipped in the slurry for about 30 minutes were transplanted to the main field.A carrier based Phosphobacterin inoculum @1 kg/ha was dissolved in water to prepare slurry. In all nitrogen treatments, half dose of nitrogen was applied at the time of transplanting and remaining half does was applied in two split doses at 30 and 45 days after trans planting in the form of ammonium nitrate.The full dose of phosphorus and super phosphate as per treatments was applied as basal before the transplanting. Potash @60kg/ ha was applied through murate of potash as basal before planting to all the experimental plots.

RESEARCH FINDINGS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarised under following heads:

Effect of bio-fertilizers:

Application of bio-fertilizers (Table 1) resulted in better vegetative growth and development of plant. Increased plant growth was also noted with significant difference as compared to control (B_0 = no biofertilizers). The maximum plant height (67.64 cm) was observed in the plants treated with *Azospirillum* followed by those treated with Phosphobacteria. The improvement in plant height due to bio fertilizer inoculation may be attributed to increased nitrogen availability around the rhizosphere and better uptake by the plant due to atmospheric N_2 fixation by Azosirillum and also the positive impact of growth substances synthesized by these biofertilizers on cell division and elongation. Similar results were obtained by Subbiah (1990) and Terry *et al.* (2000).

The number of branches per plant increased with the application of biofertilizer cultures and the maximum branches (9.74) were observed under the treatment B_2 (*Azospirillum*) followed by B_1 (Phosphobacteria). The differences were found to be statistically significant between biofertilizer cultures and it was found to be beneficial over control. Similar observations were also reported by Kumaran *et al.* (2003) .

The data with respect to diameter of main shoot did not show significant effect by the application of different biofertilizers. However they gradually showed increasment.

The improvement in days taken to first flowering with biofertilizer treatment is reflected in minimum days to first flowering (46.92) was obtained with B_2 (*Azospirillum*) treatment followed by B_1 (Phosphobacteria). However, the maximum days taken to first flowering was recorded under control (B_0) treatment. The possible reason for decreased days taken to first flowering might be due to increased microbial population which not only fixed atmospheric nitrogen and phosphorus but also produced some growth promoting hormones. Similar results were obtained by Bhatnagar and Pandita (1977) in tomato.

The average fruit weight and average fruit yield were

Table 1 : Response of bio-fertilizers and inorganic fertilizers on growth and yield of tomato cv. PUSA RUBY

Treatments	Growth parameters			Yield parameters			
	Plant height (cm)	Number of branches per plant	Diameter of main stem (cm)	Days taken to first flowering	Diameter of fruit (cm)	Average fruit weight (g)	Yield per hectare (q/ha)
Bio-fertilizers							
B_1(Phosphobacteria)	66.76	9.47	1.62	47.27	46.32	4.43	244.41
B_2 (*Azospirillum*)	67.64	9.74	1.64	46.92	47.25	4.52	25.11
Inorganic manures							
I_1(60kgN+30kgP/ha)	71.16	10.64	1.71	45.51	51.03	4.88	292.91
I_2(120kgN+60kgP/ha)	77.32	12.28	1.82	43.05	58.72	5.06	360.82
Control (B_0)	65.06	9.02	1.59	48.07	44.13	4.25	225.04
S.E. ±	1.107	0.860	0.085	1.034	0.685	0.497	2.183
C.D. (P=0.05)	3.348	1.838	NS	3.126	2.072	NS	6.601

NS=Non-significant

increased by biofertilizers treatment. The maximum fruit weight and fruit yield 4.52g and 25.11q/ha, respectively were obtained with B_2 (*Azospirillum*) followed by B_1 (Phosphobacteria) treatment and lowest fruit weight and fruits yield were recorded when no biofertilizers was applied. The possible reason for increased fruit weight and fruit yield might be associated to better inorganic nitrogen utilization in the presence of biofertilizers, enhanced biological nitrogen fixation, better development of root system and possible synthesis of plant growth hormones which ultimately resulted in better fruit weight and fruit yield. These findings are in consonance with those of Terry *et al.* (2000) in tomato.

Effect of inorganic fertilizers:

The application of nitrogen and phosphorus upto 120 kg N and 60 kg P/ha resulted in the significant increase in plant height. The maximum plant height (77.32cm) was recorded under the treatment I_2, where the nitrogen and phosphorus was applied @120 kg N + 60 kg P/ha., while the minimum plant height was recorded under control. The promotive effect of nitrogen and phosphorus on plant height may be due to the better synthesis of amino acids which help in cell multiplication and elongation. The chlorophyll content in the plants is also directly influenced by the elongations. The chlorophyll content in the plants is also directly influenced by the amount of nitrogen uptake in the plants. Similar findings have also been reproted by Durigan *et al.* (1975) and Ahmed and Pandita (1983),

The perusal of the data indicates that inorganic fertilizers application significantly influenced the number of branches plant in the present study. The application of nitrogen and phosphorus @ 120 kg N and 60 kg P/ha resulted in maximum number of branches (12.28) per plant. Whereas, the minimum number of branches per plant was recorder under the control.

The data with respect of diameter of main shoot did not show significant effect by the application to different levels to inorganic manures. However, they showed gradual increments.

The application of nitrogen and phosphorus @ 120 kg N and 60 kg P/ha resulted in earliest flowering recorder under the treatment I_2. However, the maximum days taken to first flowering (43.05 days) was recorded under the control. Increasing levels of nitrogen and phosphorus application induced early flowering. The reason for early appearance of the flower might be due to the fact that the plants fertilized with nitrogen had more flowering and fruiting space because they remained physiological more active to build up adequate food reserves resulting in better growth and development of the plants. These results are in agreement with the findings of Ahmed and Pandita (1983), Varis and George (1985), Tonondong (1986).

The average fruit weight and average fruit yield were increased by the application of inorganic fertilizers. The maximum fruit weight and fruit yield (5.06 g and 360.82g/ha) were obtained with I_2 followed by I_1 treatment and lowest fruit weight and fruit yield was recorded when no inorganic fertilizers was applied. The possible reason for increased fruit weight and fruit yield might be due to the fact that phosphorus helps in better growth which helps in better absorption of nutrients which ultimately improved the carbohydrate content of plants, synthesizing greater amount of food materials and the photosynthetic translocated into fruit led to an increase in fruit weight which ultimately resulted in better fruit yield. Similar results were obtained by Manang *et al.* (1983).

Interaction effect:

The interaction effect (Table 2) of inorganic and biofertilizers was found significant with respect to plant growth parameters (plant height, number of branches/plant) which were recorded highest at I_2B_2 treatment combination (*Azospirillum* with 120 kg N =60 kg P/ha) followed by I_2 B_1 (Phosphobacteria with 120 kg N+60 kg P/ha). While the minimum effect on such parameters were recorded under the treatment combination B_0 N_0 (no biofertilizers and no inorganic fertilizers).

The data with respect of diameter of main shoot did not show significant effect by the application different

Table 2 : Interaction

Treatments	Growth parameters				Yield parameters		
	Plant height (cm.)	Number of branches per plant	Diameter of main stem (cm)	Days taken to first flowering	Diameter of fruit (cm.)	Average fruit weight (g)	Yield per hectare (q/ha)
I_1B_1	72.92	11.11	1.75	45.16	53.67	5.15	312.31
I_1B_2	73.81	11.34	1.82	44.46	54.38	5.52	322.02
I_2B_1	79.08	12.75	1.88	42.71	60.08	5.71	381.01
I_2B_2	80.02	13.03	1.91	42.02	61.33	5.81	390.06
S.E. ±	65.06	9.02	1.59	48.07	0.685	0.497	2.183
C.D. (P=0.05)	1.107	0.860	0.085	1.034	2.072	NS	6.601

NS=Non-significant

levels of inorganic and biofertilizers. However, they showed gradual incensement.

The interaction effect of inorganic and biofertilizers was found significant with respect to fruit yield per hectare which was recorded highest at a treatment combination of I_1B_2 (*Azospirillum* with 120 kg N + 60 kg P/ha) being significantly superior over rest of the treatment combinations. This might be because of the fact that the time to first flowering and average fruit weight were found to be significantly higher at I_1B_2 (*Azospirillum* with kg N + 60 kg P/ha) of fruit which was greatly influenced by I_1B_2 (Phosphobateria with 120 kg N + 60 kg P/ha). This might be because of dominance of native micro organisms. Similar results were obtained by Barakart and Gabr (1998) and Kumaran *et al.* (2003) in tomato.

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