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Effect of bio-fertilizers growth, physiological parameters, yield and quality of brinjal cv. Surati Ravaiya

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ABSTRACT

The present experiment was carried out on brinjal cv. Surati Ravaiya during *rabi* season 2006-07 with objective to know the effect of bio-fertilizers on growth, yield, quality and physiological parameters. The treatments comprised of bio-fertilizers and chemical fertilizers, *viz*., T1 (100% RDF, control), T2 (100% RDF + *Azospirillum*), T3 (75% RDF + *Azospirillum*), T4 (100% RDF + *Azotobacter*), T5 (75% RDF + *Azotobacter*), T6 (100% RDF + *Azospirillum* + PSB), T7 (75% RDF + *Azospirillum* + PSB), T8 (100% RDF + *Azotobacter* + PSB), T9 (75% RDF + *Azotobacter* + PSB), T10 (100% RDF + *Azospirillum* + *Azotobacter* + PSB) and T11 (75% RDF + *Azospirillum* + *Azotobacter* + PSB) were tested in Randomized Block Design with three replications. The bio-fertilizers @ 2.0 kg ha^{-1} were mixed with fine soil and applied as per treatment. Regarding growth parameters, plant height at 60 DATP and at harvest and number of branches per plant were found maximum with 100% RDF + *Azospirillum* + *Azotobacter* + PSB, which was followed by 75% RDF + bio-fertilizers. An initiation of flowering was not affected by different bio-fertilizers treatment with chemical fertilizers. Like growth parameters, yield attributes and TSS were found superior with same treatment. Fruit weight and crude protein were not affected by these treatments. Maximum range of all physiological parameters like photosynthetic rate, transpiration rate, stomatal resistance, internal CO_2 concentration and leaf temperature at flowering were obtained in treatment of 100% RDF + *Azospirillum* + *Azotobacter* + PSB.

Key words: Brinjal, bio-fertilizers, physiological parameters, quality, yeld.

INTRODUCTION

Brinjal or egg plant (*Solanum melongena* L.) is cultivated as one of the major vegetable crop, next to tomato in India. It covered an area of 6.00 lac ha. in India with a total production of 103.78 lakh tonnes (Anon, 4). Major states growing brinjal are West Bengal, Orissa, Bihar and Gujarat. In Gujarat, it is cultivated in an area of 62,663 ha with the total production of 9,82,623.4 MT (Anon, 4). Maximization of yield of brinjal per unit area is more feasible and desirable solution than that of increasing area under this crop without affecting the physical properties of soil. Nutrient management is one of the most important factors to improve the productivity of brinjal. The continues sole and erratic use of chemical fertilizers in imbalance form leads to decline in soil fertility as well as nutrient uptake efficiency of plants, resulting in either yield stagnation or decrease consequently. In last four decades many microorganisms have been used in the form of bio-fertilizers. The ever increasing costs of chemical fertilizers have also emphasized the need for full exploitation of bio-fertilizers.

Bio-fertilizers are eco-friendly, low cost input and not only improve the crop growth and yield but also improve fruit quality and fertilizer use efficiency. Keeping these facts in view, the present investigation was under taken with objectives to know the effect of bio-fertilizers on growth, yield and quality of brinjal.

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MATERIALS AND METHODS

A field experiment on brinjal cv. Surati Ravaiya was carried out during *rabi* season of 2006-07 at College Farm, Navsari Agricultural University, Navsari. The soil having 7.9 pH, 0.35 EC (dS m^{-1}) and 0.58% organic carbon. The treatments comprised of bio-fertilizers and chemical fertilizers *viz*., T1 (100% RDF, control), T2 (100% RDF + *Azospirillum*), T3 (75% RDF + *Azospirillum*), T4 (100% RDF + *Azotobacter*), T5 (75% RDF + *Azotobacter*), T6 (100% RDF + *Azospirillum* + PSB), T7 (75% RDF + *Azospirillum* + PSB), T8 (100% RDF + *Azotobacter* + PSB), T9 (75% RDF + *Azotobacter* + PSB), T10 (100% RDF + *Azospirillum* + *Azotobacter* + PSB) and T11 (75% RDF + *Azospirillum* + *Azotobacter* + PSB) were tested in Randomized Block Design with three replications. The gross plot size was 5.40 m × 3.00 m with spacing of 90 cm x 75 cm. The brinjal seedlings were transplanted on 26th September, 2006. The bio-fertilizers were mixed @ 2.0 kg ha^{-1} with fine soil and applied as per treatment. Brinjal crop was fertilized with recommended dose, i.e., 20 T FYM, 100 - 37.5 - 37.5 NPK kg ha^{-1}. Nitrogen, phosphorus and potash fertilizer were applied in the form of urea, single super phosphate and muriate of

potash, respectively. Half-dose of nitrogen and whole quantity of phosphorus and potash were applied uniformly to plots as basal dose as per treatments. The remaining half dose of N was applied as top dressing in two equal splits on 30 and 60 days after transplanting. The observations on growth, physiological parameters, flowering characters, yield and quality were recorded during investigation.

RESULTS AND DISCUSSION

The mean data on plant height as influenced by bio-fertilizers and chemical fertilizers recorded at 60 DATP and at harvest are presented in Table 1. The treatment effect was found significant with respect to plant height which measured at 60 DATP and at harvest. Treatment T10, *i.e.*, 100% RDF + *Azospirillum* + *Azotobacter* + PSB each at 2.0 kg/ha was found superior with higher plant height. It was statistically on same bar with T11, T8, T6, T9, T7, and T4. While lower value of plant height was registered with treatment of 75% RDF + *Azospirillum* (T3), which was at par with T1 (control), T2 and T4. In case of number of branches, maximum number was recorded with 100% RDF + *Azospirillum* + *Azotobacter* + PSB (T10), which was similar to T11.

The better plant growth *viz*., plant height and number of branches per plant observed in present investigation may be attributed to the fact that *Azotobacter* is free living bacteria and have specific role in fixing atmospheric N_2 in soil which enhance soil fertility (Subbarow, 9; Vyas *et al*., 11). Likewise, *Azospirillum* produces phytohormone, which stimulate root growth and changes in root morphology affecting the assimilation of nutrients (Summer,10). Phosphobacteria would helped in the conversion of unavailable phosphorous form to available form especially in early crop growth phase. Another mechanism by which phosphobacteria augement the plant growth is due to the biosynthesis of growth promoting substance (Anburani and Manivannan, 2). These results are in conformity with Devi *et al.* (5), and Wange and Kale (24) in brinjal, and Sengupta *et al*. (12) and Gajbhiye *et al*. (7) in tomato. There was no significant effect of different treatments on days to initiation of flowering (Table 1). However, early initiation of flowering was noted in treatment T5 mulching (sugarcane trash @ 10 t/ha).

The response of bio-fertilizers on number of fruits per plant and fruit yield per plant and per hectare differed significantly. However, the fruit weight was found to be non-significant (Table 2). Higher value of number of fruit per plant and fruit yield (kg/plant and t/ha) were obtained with treatment T10 (100% RDF + *Azospirillum* + *Azotobacter* + PSB) and it was at par with T11. Whereas, lower value of above parameters were recorded with treatment T3 (75% RDF + *Azospirillum*) and it was statistically similar to T1, T2, and T5. The increase in fruit yield might have been due to better assimilation of plant nutrients through bio-fertilizers, which enhance biological nitrogen fixation, better development of root system and possible higher synthesis of plant growth hormones (Gajbhiye *et al*., 7). Another workers Anburani and Manivannan (1), Devi *et al.* (5), Wange and Kale (12) in brinjal and Sengupta *et al.* (8) in tomato also reported similar results.

Total soluble solids was significantly affected by

Table 1. Effect of bio-fertilizers with chemical fertilizers on growth and flowering of brinjal cv. Surati Ravaiya.

Treatment	Plant height (cm)		No. of branches/plant	Days to initial flowering
	60 DATP	At harvest		
T1-100% RDF (Control)	47.40	67.60	4.80	37.33
T2-100% RDF + *Azospirillum*	49.93	69.30	5.07	36.00
T3-75% RDF + *Azospirillum*	43.60	64.03	4.13	35.67
T4-100% RDF + *Azotobacter*	50.13	70.13	5.60	36.33
T5-75% RDF + *Azotobacter*	44.80	64.50	4.53	35.00
T6-100% RDF + *Azospirillum* + PSB	53.67	75.83	6.07	37.00
T7-75% RDF + *Azospirillum* + PSB	52.93	75.27	5.33	36.00
T8-100% RDF + *Azotobacter* + PSB	54.00	75.93	6.20	37.67
T9-75% RDF + *Azotobacter* + PSB	52.40	74.20	5.40	35.33
T10-100% RDF + *Azotobacter* + *Azospirillum* + PSB	58.00	81.03	7.53	38.00
T11-75% RDF + *Azotobacter* + *Azospirillum* + PSB	50.73	79.90	7.27	35.67
CD at 5%	8.11	10.48	0.85	NS
CV (%)	9.30	8.49	8.86	5.59

Table 2. Effect of bio-fertilizers with chemical fertilizers on yield and quality of brinjal cv. Surati Ravaiya.

Treatment	Average fruit weight (g)	No. of fruits/plant	Fruit yield		TSS (%)
			kg/plant	t ha^{-1}	
T_1-100% RDF (Control)	55.20	30.60	1.69	25.07	6.90
T_2-100% RDF + *Azospirillum*	56.87	32.07	1.83	27.07	7.07
T_3-75% RDF + *Azospirillum*	56.33	27.67	1.57	23.19	6.73
T_4-100% RDF + *Azotobacter*	57.53	35.13	2.02	29.91	7.03
T_5-75% RDF + *Azotobacter*	55.53	29.60	1.64	24.37	6.27
T_6-100% RDF + *Azospirillum* + PSB	58.00	37.47	2.17	32.21	7.47
T_7-75% RDF + *Azospirillum* + PSB	55.67	33.13	1.85	27.37	7.03
T_8-100% RDF + *Azotobacter* + PSB	57.67	38.40	2.21	32.80	7.30
T_9-75% RDF + *Azotobacter* + PSB	57.20	33.53	1.92	28.43	7.07
T_{10}-100% RDF + *Azotobacter* + *Azospirillum* + PSB	58.33	45.40	2.64	39.18	7.80
T_{11}-75% RDF + *Azotobacter* + *Azospirillum* + PSB	57.00	43.87	2.50	37.06	7.73
CD at 5%	NS	4.91	0.35	5.17	0.81
CV (%)	5.39	8.29	10.22	10.22	6.64

different treatments (Table 2). The maximum TSS (7.80%) content was recorded with treatment of 100% RDF + *Azotobacter* + *Azospirillum* + PSB (T10), which was at par with all treatments except T3 and T5. (Table 2). Increasing TSS content of fruit was also reported by Anburani *et al.* (1) in brinjal.

The physiological parameters *viz*., photosynthetic rate, transpiration rate, stomatal resistance, internal CO_2 concentration and leaf temperature at flowering stage were found statistically significant in different treatments of bio-fertilizers and chemical fertilizers in brinjal (Table 3; Fig. 1). Higher value of above parameters were recorded in treatment T10 (100% RDF + *Azotobacter* + *Azospirillum* + PSB), which was at par with T11. Whereas, lower value was noted in T3 and it was statistically similar to T1 and T5.

The studies with different physiological parameters indicated significantly positive correlation between number of fruits per plant and fruit yield per plant. The regression coefficient equation was also worked out. The full model regression equation of all the physiological parameters *viz*., photosynthetic rate, transpiration rate, stomatal resistance, internal CO_2 concentration and leaf temperature at flowering

Table 3. Effect of bio-fertilizers with chemical fertilizers on physiological parameters at flowering stage of brinjal cv. Surati Ravaiya.

Treatment	Internal CO_2 conc. (ppm)	Leaf temp. (°C)
T_1- 100% RDF (Control)	255.00	32.90
T_2- 100% RDF + *Azospirillum*	259.67	33.47
T_3- 75% RDF + *Azospirillum*	242.00	32.30
T_4- 100% RDF + *Azotobacter*	263.00	34.37
T_5- 75% RDF + *Azotobacter*	252.00	32.90
T_6- 100% RDF + *Azospirillum* + PSB	271.33	34.00
T_7- 75% RDF + *Azospirillum* + PSB	262.00	34.03
T_8- 100% RDF + *Azotobacter* + PSB	271.33	35.20
T_9- 75% RDF + *Azotobacter* + PSB	262.67	34.33
T_{10}- 100% RDF + *Azotobacter* + *Azospirillum* + PSB	282.67	35.53
T_{11}- 75% RDF + *Azotobacter* + *Azospirillum* + PSB	277.33	35.37
CD at 5%	3.02	0.29
CV (%)	0.67	1.59

stage together were highly correlated with number of fruits per plant as well as fruit yield per plant. Multiple correlation coefficient between number of fruits per plant (R = 0.8897) and yield per plant (R = 0.8753) were found significant at 1 per cent level and total contributions of photosynthetic rate, transpiration rate, stomatal resistance, internal CO_2 concentration and leaf temperature at flowering stage on number of fruits per plant and fruit yield per plant were 75.30 and 72.29 per cent, respectively. Higher stomatal conductance rate was not only enhance the CO_2 exchange rate but also results in higher transpiration rate (Farquhar and Sharkey, 1982).

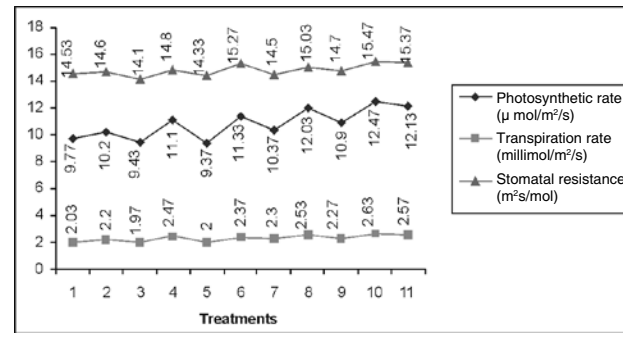

Fig. 1. Effect of bio-fertilizers with chemical fertilizers on different physiological parameters at flowering stage of brinjal cv. Surati Ravaiya.

Parameter	CD at 5%	CV (%)
Photosynthetic rate (μmol/m^2/s)	0.29	1.55
Transpiration rate (millimol/m^2/s)	0.24	6.10
Stomatal resistance (ms/mol)	0.33	1.29

Table 4. Correlation coefficient of different physiological parameters at flowering stage with number of fruits and fruit yield per plant.

Character	Correlation coefficient ('r')		Regression coefficient	
	Number of fruits $plant^{-1}$	Fruit yield $plant^{-1}$	Number of fruits $plant^{-1}$ (b)	Fruit yield $plant^{-1}$ (c)
Photosynthetic rate (x1)	0.8754**	0.8584**	4.15	0.29
Transpiration rate (x2)	0.7217**	0.7146**	-1.68	-0.07
Stomatal resistance (x3)	0.7644**	0.7422**	-3.20	-0.23
Internal CO_2 concentration (x4)	0.8604**	0.8378**	0.29	0.01
Leaf temperature (x5)	0.7740**	0.7357**	0.70	-0.08
Constant value (Intercept) (a)	-12.89	0.20	-	-
R^2	0.7530**	0.7229**	-	-
Variation explained (%)	75.30	72.29	-	-
R	0.8897	0.8753	-	-

Regression equation : ** Significant at 1 per cent

1. Number of fruits $plant^{-1}$

$Y = a + bx1 + bx2 + bx3 + bx4 + bx5$

$= -12.89 + 4.15 \times 0.8754 - 1.68 \times 0.7217 - 3.20 \times 0.7644 + 0.29 \times 0.8604 + 0.70 \times 0.7740$

$= -12.89 - 0.3178$

$R^2 = 0.7530$

2. Fruit yield $plant^{-1}$

$Y = a + cx1 + cx2 + cx3 + cx4 + cx5$

$= 0.20 + 0.29 \times 0.8584 - 0.07 \times 0.7146 - 0.23 \times 0.7422 + 0.01 \times 0.8378 - 0.08 \times 0.7357$

$= 0.20 - 0.0223$

$R^2 = 0.7229$

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