Int.J.Curr.Microbiol.App.Sci (2018) *7*(2): 2542-2545

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 7 Number 02 (2018)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2018.702.309

Effect of Biofertilizers on Growth and Yield of Tomato (*Lycopersicon esculentum* Mill)

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Keywords

Tomato, Biofertilizers, Growth and Yield

Article Info

Accepted:
24 January 2018
Available Online:
10 February 2018

A B S T R A C T

The experiment was conducted during summer season of 2005-06 at GBPUA&T, Pantnagar to study the effect of biofertilizers (*Azotobacter*, *Azospirillum*, PSB and VAM) on growth and yield attributes of tomato. Significant difference was found for plant fresh weight, plant dry weight, stem diameter, fruits per plant and yield while plant height, days to first harvest, days to final harvest and number of primary branches was showed non-significant difference. Maximum plant height (121.0cm) at final harvest and days to first harvest (69.67) was observed with treatment T_2 (*Azospirillum* + 75% N + recommended dose of P and K) whereas, maximum Leaf Area Index (3.41), number of fruits per plant (48.23), number of primary branches (11.99) and fruit yield (693.32q/ha) was found with treatment T_5 having *Azotobacter* and recommended dose of fertilizers (RDF). Higher plant fresh weight (639.33g) and dry (129.00g) per plant was recoded with treatment having phosphorus solublizing bacteria (PSB) and recommended dose of fertilizers, however, total crop duration (115) was longest with treatment T_3 (*Azospirillum* + RDF). VAM treated plot with recommended dose of NPK showed maximum stem diameter (15.89mm).

Introduction

Tomato (*Lycopersicon esculentum* Mill) is one of the most popular and widely grown vegetable in India. It covers 7.9% of total area grown under vegetable crops and 9% of total vegetable production. The average yield of tomato in India is not according to the crop potential. Various factors are responsible for its low yield, inadequate use of fertilizers is one of them. The crop particularly hybrids have higher requirements of nutrients. Low use of fertilizers and imbalance in NPK application ratio is partially responsible for the low yield. Moreover, complete dependence on chemical fertilizers is not sufficient to sustain the higher yields. Also, due to high cost of inorganic fertilizers, sometimes the margin of profit remains poor. The use of biofertilizers along with inorganic fertilizers may be the right answer to above mention problems. Biofertilizers, which are eco-friendly and more economic, can play an important role in reducing the dependence on chemical fertilizers. Biofertilizers fix appreciable amount of atmospheric nitrogen in soil, enhance plant growth by production of organic acid and growth hormones and make available

the complex phosphorus to the plant, which may cause an appreciable reduction in consumption of inorganic fertilizers. Keeping these in view, response of inoculation of biofertilizers on growth and yield of tomato were carried out under field condition.

Materials and Methods

The field experiment was carried out with nine treatments, which includes two levels of nitrogen and phosphorus (75% and 100% of recommended dose i.e., 120:100:100 kg NPK per hectare) with N-fixing bacteria (*Azospirillum* and *Azotobacter*) and phosphorus solublizing bacteria (PSB and VAM) along with control (only chemical fertilizers). The experiment was laid out in randomized block design with three replications. Thirty eight days old seedlings were transplanted (after biofertilizers treatment) in respective experimental plots of 3X3 m^2 size at 60 X 50 cm spacing in last week of February, 2006. Full dose of phosphorus and potassium in the form of single super phosphate and murate of potash, respectively, and half dose of nitrogen in the form of urea per treatment were applied before transplanting and rest half dose of nitrogen applied as top dressing after a month of transplanting.

All cultural operation was done as per the need of crop in all the plots. Plant height was measured at 30, 45, 60, 75, 90 days after transplanting and at final harvest with meter scale. Days to first harvest was recorded as days taken from transplanting to the stage when total yield from one plot weighed at least 500g and the stage when remaining yield from one plot weighed at least 500g was record as days to final harvest. Plants were cut at the time of final harvest from the ground level and weighed to get plant fresh weight. These cut plants kept for sun drying for 3-4 days and then in oven at 55^0 C for 6-8 days after that plant dry weight was recorded. Number of primary branches, stem diameter (cm) and number of fruits per plant were observed at final harvest. Leaf Area Index was calculated with help of leaf area meter. Total fruit yield (q/ha) was computed on the basis of per plot yield.

Results and Discussion

It can be observed from table 1 and 2 that significant difference was seen for plant fresh weight, plant dry weight, stem diameter, fruits per plant and yield whereas, plant height, days to first harvest, days to final harvest and number of primary branches was not found to differ significantly. There was continuous increase in the plant height right from the transplanting to the day of harvesting but there was no significant difference among the treatments at all the stages. At 30, 45 and 60 days after transplanting (DAT) treatment T_7 showed maximum plant height (49.33, 71.60 and 85.00cm, respectively) but at 75 DAT treatment T_3 showed maximum plant height (96.93cm). However, at 90 DAT and at final harvest treatment T_2 gave maximum plant height (115.73 and 121.07cm, respectively). *Azospirillum* inoculated tomato plants showed increase plant height than uninoculated ones (Terry *et al.*, 2000). It was observed that biofertilizers marginally increase the Leaf Area Index of tomato plant over control in all treatments except treatment T_6 (PSB + 75% P + full N and K of recommended dose). The highest Leaf Area Index was recorded in treatment T_5 (*Azotobacter* + recommended dose of NPK) and treatment T_8 (VAM + 75% P + full N and K of recommended dose). The application of *Azotobacter* increases the number of leaves in tomato (Mamatha and Bagyaraj, 2003). Application of *Azotobacter* and *Azospirillum* with 100 % N reduced the days taken to first harvest and increased the total crop duration in comparison to when these applied with 75 % N.

Table.1 Effect of biofertilizers on plant height (cm) at various stages of crop growth

Treatments	Plant height (cm)					
	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT	At final harvest
T1-Recommended N,P and K through chemical fertilizers (Control)	48.7	68.2	81.9	93.7	112.2	114.7
T2-*Azospirillum* + 75% N and recommended P and K through chemical fertilizers	48.2	68.9	83.8	93.8	115.7	121.0
T3- *Azospirillum* + recommended N,P and K through chemical fertilizers	47.4	68.5	86.7	96.9	115.0	120.2
T4-*Azotobacter* +75% N and recommended P and K through chemical fertilizers	45.0	64.0	80.8	92.8	107.9	114.3
T5 *Azotobacter* + recommended N,P and K through chemical fertilizers	47.1	69.5	83.4	94.4	113.6	119.3
T6- PSB + 75% P and recommended N and K through chemical fertilizers	42.5	64.4	82.8	93.3	105.6	115.2
T7-PSB + recommended N,P and K through chemical fertilizers	49.3	71.6	85.0	94.5	110.0	116.9
T8- VAM +75% P and recommended N and K through chemical fertilizers	48.0	70.6	84.4	94.0	110.3	114.3
T9- VAM + recommended N,P and K through chemical fertilizers	45.4	69.5	82.5	92.5	107.0	112.0
CD at 5 %	NS	NS	NS	NS	NS	NS

Table.2 Effect of biofertilizers on growth and yield of tomato

Treatments	Leaf Area Index	Days to first harvest	Total crop duration	Fresh weight/plant (g)	Dry weight/plant (g)	No. of primary branches/plant	Stem diameter (mm)	Number of fruits/plant	Yield (q/ha)
T1-Recommended N,P and K through chemical fertilizers (Control)	2.76	66.67	105.66	495.33	96.67	10.77	13.22	44.86	**643.32**
T2-*Azospirillum* + 75% N andrecommended P and K through chemical fertilizers	2.82	69.67	112.33	544.67	123.00	11.88	12.67	44.47	**669.99**
T3- *Azospirillum* + recommended N,P and K through chemical fertilizers	3.03	68.00	115.00	478.67	106.00	10.32	14.28	46.95	**690.00**
T4-*Azotobacter* +75% N and recommended P and K through chemical fertilizers	2.87	68.00	107.00	409.00	92.00	10.22	14.14	47.15	**660.00**
T5 *Azotobacter* + recommended N,P and K through chemical fertilizers	3.41	66.33	112.33	515.00	106.33	11.99	14.91	48.23	**693.32**
T6- PSB + 75% P and recommended N and K through chemical fertilizers	2.75	67.33	107.00	442.00	86.33	10.99	14.04	41.99	**573.48**
T7-PSB + recommended N,P and K through chemical fertilizers	3.05	67.33	105.00	639.33	129.00	11.33	13.66	44.82	**640.00**
T8- VAM +75% P and recommended N and K through chemical fertilizers	3.26	64.33	103.00	505.00	117.33	10.99	14.13	41.15	**620.00**
T9- VAM + recommended N,P and K through chemical fertilizers	3.27	67.00	100.33	381.67	84.33	10.55	15.89	39.74	**556.60**
CD at 5 %	**NS**	**NS**	**NS**	**82.57**	**19.83**	**NS**	**1.31**	**1.81**	**25.84**

The least number of first harvest days was found in treatment T_8 (VAM + 75 % P + full N and K of recommended dose).

Treatment T_7 (PSB + RDF) was found superior for per plant fresh weight (639.33g) and per plant dry weight (129g). However, treatment T_9 (VAM + RDF) exhibited lowest fresh weight (381.67g) per plant and dry weight (84.33g) per plant. The application of biofertilizers with chemical fertilizers increased the fresh and dry weight of tomato shoot (Singh *et al.*, 2004). Highest number of primary branches (12.00) was observed with treatment T_5. However, treatment T_4 recorded least number of primary branches (10.22) per plant. Here, *Azotobacter* and PSB was found to increase number of primary branches when applied with 100 % NPK dose while such an effect was not observed in *Azospirillum* and VAM. Similar results were also obtained by other scientist (Gajbhiye *et al.*, 2003). Stem diameter showed wide range *i.e.*, from 12.77 to 15.89 mm. As compared to control (13.22mm), treatment T_9 recorded highest stem diameter (15.89mm *i.e.*, 15.65 % increase) followed by treatment T_5 (14.91 mm *i.e.*, 12.78 % increase). Interestingly, all biofertilizers except PSB was found to increase stem diameter when applied with full recommended dose.

Highest number of fruits per plant (48.23) was recorded with treatment T_5. Application of PSB and VAM with RDF increased the fruits per plant but there was no effect when applied with 75 % phosphorus. While application of *Azotobacter* and *Azospirillum* was showed positive effect on fruits per plant. Highest yield (693.32 q/ha) was recorded with treatment T_5 (*Azotobacter* + RDF) followed by treatment T_3 (690.00 q/ha) and T_2 (669.99 q/ha). Treatment T_9 (VAM + RDF) gave lowest yield (556.60 q/ha). It was reported that when tomato seedlings inoculated with *Azotobacter* and *Azospirillum* improved crop growth and yield as compared to uninoculated ones (Sengupta *et al.*, 2002). Increase in the growth attributes and yield may be due to slow but steady effect of biofertilizers, which fix some nutrients and make it available to the plant.

On the basis of the experimental findings, application of *Azotobacter* + recommended dose of NPK and *Azospirillum* + recommended dose of NPK (160:90:90 kg/ha) through chemical fertilizers gave better plant growth and fruit yield.

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How to cite this article:

Shashi Kamal, Mohit Kumar, Rajkumar and Manoj Raghav. 2018. Effect of Biofertilizers on Growth and Yield of Tomato (*Lycopersicon esculentum* Mill). *Int.J.Curr.Microbiol.App.Sci.* 7(02): 2542-2545. doi: https://doi.org/10.20546/ijcmas.2018.702.309