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Mohd. Javed

Department of Horticulture
University Teaching
Departments Ch. Charan Singh
University, Meerut,
Uttar Pradesh, India

Har Mohan Singh Yadav

Shri Megh Singh Mahavidyalaya
Abidgarh, Agra, Uttar Pradesh,
India

Jitendra Kumar

Department of Horticulture
University Teaching
Departments Ch. Charan Singh
University, Meerut,
Uttar Pradesh, India

Corresponding Author:**Mohd. Javed**

Department of Horticulture
University Teaching
Departments Ch. Charan Singh
University, Meerut,
Uttar Pradesh, India

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Effect of Azotobacter and nitrogen on growth and yield of Tomatocrop (*Lycopersicum esculantum*) cv. "Pusa Rubby"

Mohd. Javed, Har Mohan Singh Yadav and Jitendra Kumar

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Abstract

The present investigation was carried out at the Horticultural Research farm, Department of Horticulture, Ch. Charan Singh University, Meerut to assess the effect of different treatments of azotobacter culture with different levels of nitrogen on growth and yield parameters. Twenty three days old seedlings were transplanted in experimental field. There were nine treatment combinations consisting two methods of Azotobacter chroococcum application (soil treatment with 2 kg per hectare and Seedling root dip treatment @ 2 kg per 10 liters of water) two levels of nitrogen application 75 kg per hectare and 150 kg per hectare and one control. Result revealed that seedling treatment with Azotobacter performed superior to soil treatment for all growth and yield parameters. The different levels of nitrogen exhibited pronounced effect of improving the various yield contributing traits were recorded maximum at 150 kg. nitrogen in each case. The parameters were recorded maximum under the treatment combination Seedling treatment with Azotobacter culture @ 2 kg+10 liters of water and 150 kg nitrogen/ha. Followed by Soil treatment with Azotobacter @ 2kg / ha. and 150 kg Nitrogen / ha.), Seedling treatment with Azotobacter @ 2 kg +10 liters of water and 75 kg Nitrogen / ha. and Soil treatment with Azotobacter @ 2 kg / ha. and 75 kg Nitrogen/ha.

Keywords: Azotobacter, Tomatocrop, *Lycopersicum esculantum*

Introduction

With the Introduction of green revolution technologies the modern agriculture is getting more and more dependent upon the steady supply of synthetic inputs like fertilizers, pesticides etc, which are generally the products of fossils fuel (Coal +Petroleum). Adverse effects are being noticed due to the excessive and imbalanced use to these synthetic inputs. This situation has leadto identifying harmless inputs like biofertilizers. Use of such natural products like biofertilizers in crop cultivation will help in safe guarding the soil heath and also the quality of crop products.

Bio-fertilizers are ready to use live formulates of such beneficial microorganisms which on application to seed, root or soil mobilize the availability of nutrients by their biological activity and help to build up the micro flora and in turn the soil heath. They Increase crop yield, replace chemical nutrients restore natural soil fertility, provide protection against drought and some soil borne diseases.

Moreover they are cheaper then fertilizers, ecofriendly and reduce the costs towards fertilizers use, especially regarding nitrogen, phosphorus and potash.

Most research conducted elsewhere suggested that the bio-fertilizers are very useful to increase the growth, yield and quality of almost all crops. Horticultural crops are likely to benefit the most from bio-fertilizers inoculation as the production practices of these high value crops are readily amenable to inoculation and vegetable crops like tomato will form a good condition for bio-fertilizers inoculation due to the nature of their root morphology.

As far as the nitrogen is concerned it is very well known to all that the nitrogen play a very important role for the growth and yield parameters of plants.

Materials and Methods

The present investigation was carried out during the springat the Horticultural Research farm, Department of Horticulture, Ch. Charan Singh University, Meerut-Uttar Pradesh (India). The

seeds of tomato variety "Pusa Ruby" was obtained from IARI New Delhi. After sterilization of seed they were sown by broadcasting on well prepared seed bed, covered with the mixture of sieved FYM and soil and lightly sprinkled. The seedling treatment culture was prepared with a carrier base (Charcoal and Soil in 3: 1 Ratio) inoculum of *Azotobacter chroococcum* culture @ 2 kg + 10 liters of water and 10% of gaggari of total volume of water. First of all water and gaggari were boiled together and then after cooling this solution the *Azotobacter* culture was mixed and then the roots of seedlings were dipped in the prepared culture for half an hour and transplanted in the field, for soil treatment the *Azotobacter* culture 2kg per hectare was increased by mixing with farm yard manure 50kg and applied to the plant after 7 days of fertilization.

There were two factors *Azotobacter* and Nitrogen and six treatments A₀ (No *Azotobacter* inoculation), A₁ (Soil treatment with 2 kg per hectare of *Azotobacter chroococcum* culture), A₂ (Seedling root dipping treatment with *Azotobacter chroococcum* culture @ 2kg per 10 liters of water), N₀ (No nitrogen), N₁ (application Nitrogen 75 kg per hectare), N₂ (Nitrogen application 150kg per hectare). The Experiment was conducted in Randomized Block Design. All the treatments were randomly distributed among the plots and replicated three times.

Result and Discussion

Effect of *Azotobacter chroococcum* culture on growth and yield parameters

Application of biofertilizer resulted in better vegetative growth and development of plants. Increased Plant growth was also noticed with significant difference as compared to control. The significantly higher plants were observed by the seedling treatment with *Azotobacter* followed by the soil treatment with *Azotobacter* and control. The improvement in plant height due to *Azotobacter* inoculation may be ascribed to increased nitrogen availability around the rhizosphere and better uptake by the plant due to atmospheric N₂ fixation by *Azotobacter*. Similar results were obtained by Gajbaiye *et al.* (2008) in Tomato.

The diameter of main shoot increased with seedling treatment *Azotobacter* followed by soil treatment. However, the minimum diameter of main shoot was observed under the control. The similar results were obtained by Terry *et al.* (2000) in Tomato.

The number of primary branches per plant increased with the application of *Azotobacter* as seedling treatment followed by soil treatment and control. Similar observation was also reported by Hameedunnisa 1990^[3] in Tomato

The minimum days taken to first flower was obtained by seedling treatment with *Azotobacter* which was at par with the first flowering by soil treatment with *Azotobacter*. However, the maximum days taken to first flowering recorded under the control. Similar results were obtained by Bhadoria and Dwivedi (2007)^[4] in Tomato.

The number of fruit per plant was increased with the addition of *Azotobacter* culture and significantly higher number of fruits was recorded when *Azotobacter* was applied as seedling treatment and it was at par with the number of fruits under the soil treatment. However, the minimum number of fruits was recorded under the control. Similar results were also obtained by Bhadoria and Dwivedi (2007)^[4] in Tomato.

The fruit size was increased with the addition of biofertilizer (*Azotobacter*) culture and the comparatively bigger fruits were recorded under the seedling treatment than the soil

treatment. However, the smallest fruits were obtained under the control.

The average fruit weight and yield per plant were increased by the *Azotobacter* treatments. The comparatively higher fruit weight and yield per plant were obtained with seedling treatment which was at par with soil treatment and the lowest fruit weight and yield were recorded under the control. The possible reasons for increased fruit weight and fruit yield might be associated to better inorganic nitrogen utilization in the presence of biofertilizer, enhanced biological nitrogen fixation. Similar results were also obtained by Kumaraswamy (1990)^[5] in Tomato.

Effect of Nitrogen on growth and yield parameters

The comparatively higher plants were recorded under the treatment N₂ where the Nitrogen was applied @ 150 kg per hectare, while the plant height was minimum under the control. The promotive effect of nitrogen on plant height may be due to the better synthesis of amino acids which helps in cell multiplication and cell elongation. Similar results have also being reported by Rupa *et al.* (2004) in Tomato.

The application of nitrogen @ 150 kg and 75 kg per hectare resulted increased diameter of main stem, and number of primary branches while the minimum were recorded under the control. This may be probably due to the fact that nitrogen is a major constituent of plant protein, amino acids, chlorophyll and protoplasm. It is also constituent of nucleic acid, phospholipids and some vitamins. These observation are in accordance with the findings of Ahmad and Pandita (1983) in Tomato.

The application of nitrogen @ 150 kg and 75 kg per hectare resulted comparatively less days taken to first flower. However, the maximum days taken to first flower were recorded under the control. Increasing levels of nitrogen induced early flowering. The reason for early appearance of the flowers might be due to the fact that the plants fertilized with nitrogen had more flowering and fruiting space. These results are in agreement with the finding of Tonondong, M.V. (1986) in Tomato.

The number of fruits, size of fruits and weight of fruits per plant were also significantly influenced by the nitrogen application. The more number of fruits per plant were recorded by the application of nitrogen @ 150 kg per hectare followed by 75 kg per hectare. The favorable effect of nitrogen in promoting these parameters might be due to the fact that the absorbed nitrogen helped the formation of food reserves due to higher photosynthetic activity and resulted in the maximum number of fruits. The present findings are in agreement with the observation made by Panday *et al.* (1998) in Tomato.

The critical analysis of data reveals that the application of 150 kg and 75 kg Nitrogen per hectare significantly increased the yield. The increasing yield of fruits with nitrogen might be due to the fact that the nitrogen is a major constituent of plant protein, amino acids, chlorophyll and protoplasm all of which play a definite role in the physiology of plant life and synthesizing greater amount of food material. The positive influence of nitrogen on the total yield was also reported by Rupa *et al.* (2004) in Tomato.

Interaction Effect

The interaction effects of *Azotobacter* and Nitrogen were found significant with respect to plant growth parameters (Plant height, Stem diameters and Number of primary branches) which were recorded highest at A₂N₂ treatment

combination (seedling treatment with Azotobacter culture and 150 kg N/ha.) and it was at per with A_1N_2 (soil treatment with Azotobacter culture and 150 kg N/ha.) followed by A_2N_1 (Seedling treatment with Azotobacter culture and 75 kg N/ha.) and A_1N_1 (Soil treatment with Azotobacter and 75 kg N/ha.) while the minimum effect on such parameters were recorded under the control. On the other hand the parameters number of primary of branches and days taken to first flower did not show significant differences.

The interaction effects of Azotobacter and Nitrogen were found significant with respect to all yield parameters like

number of fruits per plant, fruit size, yield per plant, average fruit weight and yield per plot which were recorded highest at the treatment combination A_2N_2 (Seedling treatment with Azotobacter and Nitrogen 150 kg. per hectare) that were significantly superior over rest of the treatment combinations. This might be because of dominance of native microorganisms of Azotobacter. Similar results were obtained by Kumaran *et al.* (1998), Gajbhiye *et al.* (2003) ^[1] Bhadoria and Dwivedi (2007) ^[4] in Tomato.

Table 1a: Effect of Azotobacter and Nitrogen on Plant height and stem diameter.

Treatments	Plant Height (cm.)	Stem Diameter (cm.)	Number of primary branches	Days taken to first flowering	Number of fruits per plant	Fruit size (cm.)	Yield per plant (gm.)	Average fruit weight (gm.)	Yield per plot (Kg.)
Azotobacter									
A_1 (soil treatment with Azotobacter culture @ 2kg/ha.)	79.39	79.39	13.87	44.27	39.84	16.03	2323.93	58.33	20.91
A_2 (Seedling treatment with Azotobacter culture @ 2kg + 10 liters of water)	81.56	81.56	14.20	43.53	42.47	16.36	2511.93	59.14	22.60
Nitrogen							2952.13		26.56
N_1 (75 kg N/ha.)	87.63	87.63	16.07	42.33	44.40	17.41	3740.73	66.49	33.60
N_2 (150 kg N/ha.)	97.85	97.85	18.46	39.27	50.13	19.32	2104.40	74.61	18.93
Control	76.05	76.05	12.87	44.87	37.13	15.61	5.8249	56.67	0.052
SEm±	0.042	0.042	0.0945	0.1295	0.0862	0.0126	17.4651	0.0670	0.1558
CD at 5%	0.1207	0.1207	0.2833	0.3883	0.2583	0.0377		0.2010	

Table 3: b Interaction effect of Azotobacter and Nitrogen on Yield per plant (gm.), Average fruit weight (gm.) and Yield per plot(kg.)

Treatments	Plant Height (cm.)	Stem Diameter (cm.)	Number of primary branches	Days taken to first flowering	Number of fruits per plant	Fruit size (cm.)	Yield per plant (gm.)	Average fruit weight (gm.)	Yield per plot (Kg.)
A_1N_1	88.96	1.97	16.47	41.46	46.13	17.91	3297.27	71.47	29.67
A_2N_1	92.03	2.01	16.93	41.07	47.33	18.21	3424.13	72.23	30.81
A_1N_2	99.99	2.24	18.93	38.07	52.60	19.79	3971.53	75.50	35.74
A_2N_2	102.42	2.36	19.93	37.26	53.83	19.97	4115.60	76.11	37.04
SEm±	0.0697	0.0150	0.1637	0.2243	0.1492	0.0218	10.0890	0.1161	0.0900
CD at 5%	0.209	0.045	N.S.	N.S.	0.447	0.065	30.250	0.348	0.270

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