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Impact of Integrated Nutrient Management on Growth, Yield and Shelf Life of Tomato (*Solanum lycopersicum*) cv. Pusa Ruby

Bronica Victor[1*] and Abhishek Singh[2]

[1]M.Sc. Student, [2]Assistant Professor

Department of Horticulture, Faculty of Agricultural Sciences and Technology

AKS University, Sherganj, Satna (M.P.)

*Corresponding Author E-mail: bronica2@gmail.com

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ABSTRACT

The experiment entitled "Impact of integrated nutrient management on growth, yield and shelf life of Tomato (Solanum lycopersicum) cv. Pusa Ruby" was conducted during Rabi season of the year 2020-2021 on experimental farm of Department of Horticulture, AKS University, Satna (M.P.). The experiment was laid out in a randomized block design with three replicated 13 treatments viz., T_1: Control, T_2: Pseudomonas (50%) + NPK (50%), T_3: Azotobacter (50%) + NPK (50%), T_4: Azospirillium (50%) + NPK (50%), T_5: Pseudomonas (25%) + Azotobactor (25%) + NPK(50%), T_6: Pseudomonas (25%) + Azospirillium (25%) +NPK(50%), T_7: Azotobator (25%) + Azospirillium (25%) + NPK(50%), T_8: Pseudomonas (50%) + Azosirillium (25%) + NPK (50%), T_9: Pseudomonas (50%) + Azotobactor (25%) + NPK (50%), T_{10}: Azotobactor (50%) + Azospirillium (25%) + NPK (50%), T_{11}: Azotobactor (50%) + Pseudomonas (25%) + NPK (50%), T_{12}: Azospirillium (50%) + Azotobactor (25%) + NPK (50%), T_{13}: Azospirillium (50%) + Pseudomonas (25%) + NPK (50%). The results reveal that increase in Composts level had significant response on vegetative growth yield and shelf life of Tomato. The treatment the T_{13}-Azospirillium (50%) + Pseudomonas (25%) + NPK (50%) was found superior in growth yield with quality corrector. In this investigation the treatment T_{13}-Azospirillium (50%) + Pseudomonas (25%) + NPK (50%) was found suitable for cultivation in winter season for better yield (29.76 t/ha) and maximum shelf life (9.93 days).

Keywords: *Tomato, NPK, Pseudomonas, Azotobacter, Azospirillium.*

INTRODUCTION

Tomato (*Lycopersicon esculentum* mill, 2n=24) a member of family Solanaceae and the genus *Lycopersicon*. It is a herbaceous, annual to perennial, prostrate and sexual propagated plant with bisexual flower. Scientific information indicates that cultivated tomato was originated in South Western (tropical) American.

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There are several species of tomato but the fruits are edible only of two species namely (*L. esculantum* and *L. pimpinellifolium*). It has taproot and growth habit of the plant determinate or indeterminate. In indeterminate tomato vegetative growth continuous with flowering and fruiting. Terminal bud is vegetative bud. Plants are tell long with training and stacking hebight. No. of harvesting are more. Tomato is grown in our country in abundance; both in summer and winter season, but those grown in winter are superior in quality because they contain more total solids. It is grown for its edible fruit which can be consumed either fresh or cooked and also in the form of various processed products like juice, ketchup, sauce, puree, powder, essence, cocktail etc. Red colour of tomato is due to the presence of pigment 'Lycopene'. The yellow and orange colour of tomato fruit is due to the presence of carotene and prolycopene pigments, respectively. Besides soil and climatic factors the cultivar itself is very important in respect of its performance regarding earliness, disease resistance and yield. Many cultivars have been developed and recommended by various research institute and State Agricultural Universities. The adoptability and yielding capacity of the cultivars is not the same in all regions. Hence it is important to find out the most suitable cultivar in a particular region and make the farmers aware of it. Nitrogen is one of the most prevalent elements and it is a component of amino acids, proteins, nucleic acids, chlorophyll and many other metabolites, essential for survival of the plant. Numerous field experiments conducted throughout the world has shown that nitrogen is the most important growth limiting factor. It also affects protein content, quality and yield of the bottle gourd and it may increase the plant resistance to diseases. Phosphorus is necessary for cellular preparation and in the metabolism of starch, protein and fats. One of the most important effects of phosphorus on plants is the stimulation of early root formation and growth. A low available phosphorous content in soil means delay in maturity and poor plant growth. Integrated nutrient management plays an important role in improving crop yield and quality. It has been an established fact since long that, amongst the nutrients, nitrogen and phosphorous play an important role in the growth and development of crops plants. Nitrogen is indispensable for increasing crop production as it being a constituent of protoplasm and chlorophyll and is associated with the activity of every living cell. Similarly, phosphorus also plays an important role in storage of energy and transfer of it in plant system. A higher level of phosphorous encourages better fruiting in the bottle gourd. In addition phosphorus is an important structural component of nucleic acid, phytin, phospholipids and enzymes. Azotobacter is an aerobic soil dwelling organism with a wide variety of metabolic capabilities which includes the ability to fix atmospheric nitrogen by converting it to ammonia; it fixes nitrogen in the free living state and does not enter into the symbiosis with plants. In the present day cultivation, continuous use of chemical fertilizers affects soil health and leads to environmental pollution. By using the bio fertilizers to supplement part of the nutrient needs of the plant not only the cost of inputs be brought down, but also the environmental hazards associated with the chemical fertilizers can be avoided. Therefore, the current trends is to explore the possibility of supplementing chemical fertilizers with organic ones more particularly, bio-fertilizers of microbial origin.

MATERIALS AND METHODS

The experiment entitled "Impact of integrated nutrient management on growth, yield and shelf life of Tomato (*Solanum lycopersicum*) cv. Pusa Ruby" was conducted during Rabi season of the year 2020-2021 on experimental farm of Department of Horticulture, AKS University, Satna (M.P.). The experiment was laid out in a randomized block design with three replicated 13 treatments *viz*., T_1: Control, T_2: Pseudomonas (50%) + NPK (50%), T_3: Azotobacter (50%) + NPK (50%), T_4: Azospirillium (50%) + NPK (50%), T_5: Pseudomonas (25%) + Azotobactor (25%) +

NPK(50%), T_6: Pseudomonas (25%) + Azospirillium (25%) +NPK(50%), T_7: Azotobator (25%) + Azospirillium (25%) + NPK(50%), T_8: Pseudomonas (50%) + Azosirillium (25%) + NPK (50%), T_9: Pseudomonas (50%) + Azotobactor (25%) + NPK (50%), T_{10}: Azotobactor (50%) + Azospirillium (25%) + NPK (50%), T_{11}: Azotobactor (50%) + Pseudomonas (25%) + NPK (50%), T_{12}: Azospirillium (50%) + Azotobactor (25%) + NPK (50%), T_{13}: Azospirillium (50%) + Pseudomonas (25%) + NPK (50%). The seeds were sown on 6th November - 2020 germination started and transplanted on 30th November - 2020, the recording of observations was done 20 days after transplanting and subsequent readings were recorded after every 20 days interval. The crop was harvested on 31st March - 2021. Raised nursery beds of 3.0 x 1.0 m were prepared thoroughly. Then the seeds were sown on 30th November 2020 during Rabi season. The nursery beds were maintained systematically upto 30 days till the seedlings were ready for transplanting. The land was brought to a fine tilth by thorough tillage. A spacing of 0.5m between two replications and 0.3m between two plots were maintained for laying of irrigation channels and bunds, respectively. Thirty days old healthy and uniform seedlings of Tomato cv. Pusa Ruby were transplanted in the evening hours in each bed at prescribed with spacing 60 to 50cm on 30th November 2020. Light irrigation was given after transplanting. In order to maintain uniform crop stand in each plot, the dead seedlings were replaced by the new once up to 5 DAT. This gap filling continued till 10th days of transplanting. The first light irrigation is given soon after sowing to ensure proper germination and the subsequent irrigation were given at the interval of 10–20 days. Flood irrigation was given once in week during the entire period of crop growth. Thinning of the plants is done to maintain proper spacing. The experimental plot was kept free from weeds by regular hand weeding. 15 days after germination light irrigation was given to the field. Weeding and hoeing of the field was conducted. After top dressing of rest amount of fertilizer earthing up was done to promote proper development of roots and to provide proper soil aeration. Irrigation was done immediately after the operation. The fruits were harvested at weekly intervals when the fruits were fully mature. The harvesting of the fruits for the purpose of observations on yield component was done early in the morning before 10.0 am at pikes stage. These fruits were harvested from the net plot and used for further observations. The experimental field was prepared and ploughed with a disc harrow by tractor drawn two times with cultivator and well levelled by planker before sowing. After that rocks and debris were removed from the field soil. After field preparation, the area was marked and laid out as per plan. All required Tomato seeds, manures (NPK, Pseudomonas, Azotobacter, Azospirillium.) obtained from department of horticulture, A.K.S. University, Satna (M.P.). Pseudomonas, Azotobacter and Azospirillium were applied after land preparation as for recommendation. As per recommended dose of NPK/ha and Bioinoculant were applied in two splits i.e. 50 percent N and full dose of P and K at the time of transplanting and remaining 50 percent 'N' was applied 40 days after transplanting in the form of urea, super phosphate and muriate of potash, respectively. The data recorded during the course of investigation were subjected to statistical analysis as per method of analysis of variance. The significance and non-significance of the treatment effect were judged with the help of 'F' variance ratio test. Calculated 'F' value (variance ratio) was compared with the table value of 'F' at 5% level of significance. If calculated value exceeded the table value, the effect was considered to be significant. The significant difference between the means was tested against the critical difference at 5% level of significance.

RESULTS AND DISCUSSION

The higher values of growth and yield attribute *viz.,* plant height cm, Number of leaves per plant, Diameter of stem (cm), Leaf area per plant (cm^2), Number of branch per plant, Days required for 50% flower initiation, Days required for 50% fruiting per plant, Number of fruit per plant, Fresh weight of fruit (g), Fruit diameter (cm) and fruit yield. The results of the studies on growth at different stages of the experiment have been given below. The optimum levels of nutrients were found to significantly improve plant height at all the growth stages. The significantly higher plant height of Tomato was recorded under T_{13}-Azospirillium (50%) + Pseudomonas (25%) + NPK (50%) with the respective values of 66.33 cm, 96.00 cm and 121.67 cm at growth stage of 30, 60 and 90 days after transplanting, respectively. The optimum levels of nutrients were found to significantly improve number of leaves per plant. The significantly higher number of leaves per plant of Tomato was recorded under T_{13}-Azospirillium (50%) + Pseudomonas (25%) + NPK (50%) with the respective values of 65.13, 119.25 and 148.21at growth stage of 30, 60 and 90 days after transplanting, respectively. These findings are come in conformity with the findings of Patil et al. (2004), Chumyani et al. (2010), Hoossain et al. (2012), Biswas et al. (2015) and Siddaling et al. (2017). The optimum levels of nutrients were found to significantly improve diameter of stem (cm). The significantly maximum diameter of stem (cm) of Tomato was recorded under T_{13}-Azospirillium (50%) + Pseudomonas (25%) + NPK (50%) with the respective values of 7.09 cm proved significantly superior to rest of the treatments. The optimum levels of nutrients were found to significantly improve leaf area (cm^2). The significantly maximum leaf area (cm^2) of Tomato was recorded under T_{13}-Azospirillium (50%) + Pseudomonas (25%) + NPK (50%) with the respective values of 307.65 cm^2 proved significantly superior to rest of the treatments. Treatment T_{13}-Azospirillium (50%) + Pseudomonas (25%) + NPK (50%) recorded maximum number of branch per plant (15.93) followed by 15.36 with the treatment T_{12}-Azospirillium (50%) + Azotobactor (25%) + NPK (50%) and the minimum number of branch per plant (9.13) was recorded with T_{1}-(Control). These results closely match with the findings of Naidu et al. (2002), Yadav et al. (2004), Akhtar et al. (2010), Dubey et al. (2012), and Parmar et al. (2019). Treatment T_{13}-Azospirillium (50%) + Pseudomonas (25%) + NPK (50%) recorded minimum days required for 50% flower initiation (50.05) followed by 50.33 with the treatment T_{12}-Azospirillium (50%) + Azotobactor (25%) + NPK (50%) and the maximum days required for 50% flower initiation (63.52) was recorded with T_{1}-(Control). Treatment T_{13}-Azospirillium (50%) + Pseudomonas (25%) + NPK (50%) recorded minimum days required for 50% fruiting per plant (71.23) followed by 73.11 with the treatment T_{12}-Azospirillium (50%) + Azotobactor (25%) + NPK (50%) and the maximum days required for 50% fruiting per plant (80.46) was recorded with T_{1}-(Control). Results related to fresh weight of Tomato found to be close agreement with that of Krishana et al. (2002), Singh and Asrey (2005), Gong et al. (2010), Kumar et al. (2014) and Mishra et al. (2019). Treatment T_{13}-Azospirillium (50%) + Pseudomonas (25%) + NPK (50%) recorded maximum number of fruits per plant (36.72) followed by (35.53) with the treatment T_{12}-Azospirillium (50%) + Azotobactor (25%) + NPK (50%) and the minimum number of fruits per plant (23.45) was recorded with T_{1}-(Control).Treatment T_{13}-Azospirillium (50%) + Pseudomonas (25%) + NPK (50%) recorded maximum fruit diameter (18.15 cm) followed by (18.03 cm) with the treatment T_{12}-Azospirillium (50%) + Azotobactor (25%) + NPK (50%) and the minimum fruit diameter (13.23cm) was recorded with T_{1}-(Control).Treatment T_{13}-Azospirillium (50%) + Pseudomonas (25%) + NPK (50%) recorded maximum fresh weight of fruit (65.07g) followed by (61.67kg) with the treatment T_{12}-Azospirillium (50%) + Azotobactor (25%) + NPK (50%) and the minimum fresh weight of fruit (46.30g) was recorded with T_{1}-(Control). The results of present study are almost match with the findings of Kadam and Karthikeyan (2006), Chatterjee et al. (2013), Jat et al. (2018) and

Singh et al. (2021). Treatment T_{13}-Azospirillium (50%) + Pseudomonas (25%) + NPK (50%) recorded maximum yield per plot (5.20 kg) followed by (4.93 kg) with the treatment T_{12}-Azospirillium (50%) + Azotobactor (25%) + NPK (50%) and the minimum yield per plot (3.12kg) was recorded with T_{1}-(Control).Treatment T_{13}-Azospirillium (50%) + Pseudomonas (25%) + NPK (50%) recorded maximum yield (29.76 tonnes/ha) followed by (27.45 tonnes/ha) with the treatment T_{12}-Azospirillium (50%) + Azotobactor (25%) + NPK (50%) and the minimum yield (11.79 tonnes/ha) was recorded with T_{1}-(Control). Treatment T_{13}-Azospirillium (50%) + Pseudomonas (25%) + NPK (50%) recorded maximum shelf life (9.93 days) followed by (9.51 days) with the treatment T_{12}-Azospirillium (50%) + Azotobactor (25%) + NPK (50%) and the minimum shelf life (5.20 days) was recorded with T_{1}-(Control). Treatment T_{13}-Azospirillium (50%) + Pseudomonas (25%) + NPK (50%) was superior over all other treatments of Tomato. The T_{13}-Azospirillium (50%) + Pseudomonas (25%) + NPK (50%) was found superior in growth yield with quality corrector. In this investigation the treatment T_{13}-Azospirillium (50%) + Pseudomonas (25%) + NPK (50%) was found suitable for cultivation in winter season for better yield (29.76 t/ha) and maximum shelf life (9.93 days).

Table 1: Impact of integrated nutrient management on growth, yield and shelf life of Tomato

Treatments	Plant height (cm)	Number of leaves per plant	Diameter of stem (cm)	Leaf area per plant (cm^2)	Number of branch per plant	Days required for 50% flower initiation	Days required for 50% fruiting per plant	Number of fruit per plant	Fruit diameter (cm)	Fresh weight of fruit (g)	Fruit yield per plot (kg)	Fruit yield (tonne/ha)	Shelf Life (days)
T_1	94.67	92.66	3.79	135.29	9.13	63.52	80.46	23.45	13.23	46.30	3.12	11.79	5.20
T_2	101.60	104.70	5.14	160.21	10.85	59.69	78.83	26.54	15.04	51.00	4.08	20.81	6.59
T_3	98.33	100.37	4.71	155.84	10.37	59.12	79.55	25.65	14.69	49.87	3.77	18.48	6.27
T_4	94.93	97.02	4.58	152.67	9.66	61.77	79.72	23.89	14.57	47.17	3.34	16.54	5.32
T_5	104.27	109.38	5.61	181.27	11.40	58.35	77.20	27.87	15.21	52.87	4.23	20.51	6.63
T_6	106.63	113.53	5.87	223.72	12.55	57.90	76.07	29.56	15.45	53.53	4.28	21.27	7.39
T_7	107.53	118.74	5.96	231.08	12.87	57.37	75.34	30.73	16.38	54.73	4.31	21.63	7.48
T_8	108.33	121.80	6.08	249.10	13.13	56.54	75.01	31.89	16.52	55.53	4.49	22.93	7.81
T_9	110.47	125.56	6.20	264.12	13.82	55.81	74.68	32.54	16.80	56.07	4.55	22.59	8.45
T_{10}	111.47	132.77	6.55	279.46	14.24	55.47	72.84	33.66	17.23	57.40	4.63	23.79	8.76
T_{11}	114.47	137.45	6.76	283.57	14.96	53.26	73.46	34.34	17.65	59.70	4.76	25.04	9.04
T_{12}	118.33	143.16	7.01	295.04	15.36	50.33	73.11	35.53	18.03	61.67	4.93	27.45	9.51
T_{13}	121.67	148.21	7.09	307.65	15.93	50.05	71.23	36.72	18.15	65.07	5.20	29.76	9.93
S.Ed(±)	0.04	0.03	0.04	0.22	0.04	0.06	0.47	0.11	0.03	0.05	0.09	0.23	0.05
CD at 5%	0.08	0.07	0.09	0.47	0.10	0.13	0.98	0.24	0.06	0.11	0.18	0.47	0.11

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