Original Research Article

Effect of integrated nutrient management on the growth, yield and quality in tomato (*Solanum lycopersicum* L.).

ABSTRACT

The present investigation was carried out with title Effect of integrated nutrient managment on the growth, yield and quality in tomato (*Solanum lycopersicum* L.) at the Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, Uttar Pradesh during the Kharif-2021-22 with a view to determine the effect of plant growth regulators application on tomato variety TMTH-2267 for its growth, quality and yield and to work out the economics of various treatments. Under this experiment, overall 10 treatment was taken T_0 (RDF of NPK(150:80:60)Kg/ha +10t FYM), T_1 (75% N through Urea +MOP + SSP +25% through FYM + Boron + Azotobactor +Phosphorous Solubilizing Bacteria), T_2 (75% N through Urea +MOP + SSP +25% through FYM +Zinc+ Azotobactor + Phosphorous Solubilizing Bacteria), T_3 (75% N through Urea + MOP + SSP +25% through FYM + Boron+ Zinc+ Azotobactor + Phosphorous Solubilizing Bacteria), T_4 (75% N through Urea + MOP + SSP + 25% through vermicompost+ B + Azotobactor + Phosphorous Solubilizing Bacteria), T_5 (75% N through Urea + MOP + SSP + 25% through vermicompost + Zinc + Azotobactor + Phosphorous Solubilizing Bacteria), T_6 (75% N through Urea+ MOP + SSP + 25% through vermicompost+ Boron + Zinc + Azotobactor + Phosphorous Solubilizing Bacteria), T_7 (75% N through Urea + MOP + SSP + 25% through poultry manure + Boron + Azotobactor + Phosphorous Solubilizing Bacteria), T_8 (75% N through Urea + MOP + SSP + 25% through poultry manure +Zinc + Azotobactor + Phosphorous Solubilizing Bacteria) and T_9 (75% N through Urea + MOP + SSP + 25% through poultry manure + Boron + Zinc + Azotobactor + Phosphorous Solubilizing Bacteria).. From the present investigation it was concluded that T_1 (75% N through Urea +MOP + SSP +25% through FYM + Boron + Azotobactor +PSB) was found to be best among all treatment in terms of yield and T6 (75% N through Urea+ MOP + SSP + 25% through Vermicompost+ B + Zn + Azotobactor +PSB) in growth and quality of tomato i.e. plant spread, plant height, T.S.S. etc. The highest B:C ratio that is 3.25 was observed for T_6 (75% N through Urea+ MOP + SSP + 25% through Vermicompost+ B + Zn + Azotobactor +PSB).

Keywords: Integrated Nutrient Management, PSB, Azotobactor, Benefit cost ratio.

INTRODUCTION

Tomatoes are horticulture crop belongs to the family Solanaceae bearing chromosome number 2n=2X=24 (Karpechenko, 1925). It originated from South America (Vavilov, 1935). The tomato plants typically grow to 1–3 meters (3–10 ft) in height and have a weak stem that often sprawls over the ground and vines over other plants. Flowers are generally borne in clusters of 4 to 8 but small fruited types may have 30 to 50 flowers per cluster. Tomato plants are dicots, and grow as a series of branching stems, with a terminal bud at the tip that does the actual growing. Tomato plays a major role in human nutrition, fruit contain 93.1% water, 1.9% protein, 0.3 g fat, 0.7% fibre, 3.6%carbohydrates, 23 calorie, 320 I.U vitamin A., 0.07 mg vitamin B1, 0.01 mg vitamin B2, 31 mg vitamin C, 20 mg calcium, 36 mg phosphorus and 0.8 mg iron.

Integrated Nutrient Management (INM):-

Integrated nutrient management (INM) is an approach that involves the management of both organic and inorganic plant nutrients for optimal production of cultivated crops, forage, and tree species, while conserving the natural resource base essential for long-term sustainability. The crop is being cultivated as an important spring summer season vegetable in eastern Uttar Pradesh finding readymade market in plains of northern India fetching very remunerative prices for the farmers.

The growth, yield and fruit quality of tomato largely depend on number of various interacting factors. Among them, INM is the most crucial as well as basic factor. The continuous use of chemical fertilizer increases the concentration of heavy metals in the soil, disturbs soil health and quality which cannot support plant growth in long term basis. Integrated Nutrient Management comprises organic, inorganic component and microorganism that are highly beneficial for sustainable crop production as it ameliorates soil environment, maintains adequate level of nutrients and provides favourable conditions for high tomato yield with desired quality.The integrated use of organic and inorganic fertilizers is the need of hour and is being advocated for sustainable agriculture. When the inorganic fertilizers are not available timely due to higher prices and inadequate supply of it, organic manures can supplement the nutrients.

Nitrogen (N) plays a key role in nutrition of the plants. As a matter of fact, the plant life would not be possible without this element. Adequate amount of nitrogen are also required to

obtain good yield in vegetable crops. Phosphorous and potassium is considered as major nutrient in tomato cultivation which involves in all the metabolic process in the plant and there is considerable evidence to show that, this element plays an important role in photosynthesis and helps in building up of carbohydrate in the plant. The production of dry matter is further affected by the effect of potassium on rate of respiration.

The role of bio-fertilizers in improving soil fertility has long been studied in various crops. The bio-fertilizers such as Azotobactor, Phosphate Solubilising Bacteria and Arbuscular Mycorrhiza (AM fungi) helps to enhance overall soil fertility by modifying soil texture, soil structure integrity, aeration, increased nutrient availability there by greatly influencing plant growth and yield.

Azospirillum a diazotropic bacterium which is widely distributed in soil rhizosphere and roots of a number of plants have ability to fix nitrogen. Many reports have indicated the importance of Azospirillum in vegetable crops.

Bio-fertilizers are involved in symbiotic and associative microbial activities with higher plants. These are natural mini-fertilizer factories that are economical and safer source of plant nutrition for increasing the agricultural production and improving fertility.

MATERIALAND METHODS

The present investigation entitled “Effect of integrated nutrient management on the growth, yield and quality in tomato (Solanum lycopersicum L.)” was done to understand the effect of Integrated nutrient management at different doses combination on fruit growth, yield and quality of tomato variety TMTH-2267. The details of the materials used and the procedures adopted in the investigation, which was carried out at Horticultural Research Farm (HRF), Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj during the Kharif season of 2021 are described under the following heads.

Experimental Site

The present investigation was carried out in the Horticultural Research Farm at Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, U.P during Kharif-2021. The University is situated on the left side of Prayagraj – Rewa National Highway, about 5 km away from Prayagraj City. All types of facilities necessary for cultivation of successful crop including field preparation, inputs, irrigation facilities and labours were provided from the Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, U.P.

Experimental Materials

Variety details: TMTH-2267

VarietySource - Department of Horticulture, NAI, SHUATS

RESULTS AND DISCUSSION

Growth Parameters

Plant height at 30 DAS

The height of plant significantly varied among different treatment combinations. The mean Plant height at 30 DAS was observed to be 32.68 cm. The maximum plant height (35.69 cm) at 30 DAS was observed with treatment T_8 (75% N through Urea + MOP + SSP + 25% through Poultry Manure +Zinc + Azotobactor + Phosphorous Solubilizing Bacteria) followed by T_3 (75% N through Urea + MOP + SSP +25% through FYM + Boron + Zinc+ Azotobactor + Phosphorous Solubilizing Bacteria) with 33.76 cm. Minimum plant height (31.57 cm) was observed in T_5 (75% N through Urea + MOP + SSP + 25% through Vermicompost + Zinc + Azotobactor + Phosphorous Solubilizing Bacteria), while the remaining treatments were moderate in their growth habit.

Plant height at 60 DAS

.The maximum plant height (73.60 cm) at 60 DAS was observed with treatment T_9 (75% N through Urea + MOP + SSP + 25% through Poultry Manure + Boron + Zinc + Azotobactor + Phosphorous Solubilizing Bacteria) followed by T_6 (75% N through Urea+ MOP + SSP + 25% through Vermicompost+ Boron + Zinc + Azotobactor + Phosphorous Solubilizing Bacteria) with 73.36 cm. Minimum plant height (52.85 cm) was observed in T_0 (RDF of NPK(150:80:60)Kg/ha +10t FYM), while the remaining treatments were moderate in their growth habit.

Plant height at 90 DAS

The maximum plant height (101.05 cm) at 90 DAS was observed with treatment T_5 (75% N through Urea + MOP + SSP + 25% through Vermicompost + Zinc + Azotobactor + Phosphorous Solubilizing Bacteria) followed by T_6 (75% N through Urea+ MOP + SSP + 25% through vermicompost+ Boron + Zinc + Azotobactor + Phosphorous Solubilizing Bacteria) with 100.58 cm. Minimum plant height (79.20 cm) was observed

in T_0 (RDF of NPK(150:80:60)Kg/ha +10t FYM), while the remaining treatments were moderate in their growth habit.

Plant height at harvest

The maximum plant height (103.99 cm) at harvest was observed with treatment T_5 (75% N through Urea + MOP + SSP + 25% through vermicompost + Zinc + Azotobactor + Phosphorous Solubilizing Bacteria) followed by T_6 (75% N through Urea+ MOP + SSP + 25% through vermicompost+ Boron + Zinc + Azotobactor + Phosphorous Solubilizing Bacteria) with 103.05 cm. Minimum plant height (82.88 cm) was observed in T_0 (RDF of NPK(150:80:60)Kg/ha +10t FYM), while the remaining treatments were moderate in their growth habit.

Table 1. Effect of integrated nutrient management on plant height (cm) [30 DAS, 30, 45,60 DAT] and at harvest of the tomato.

Treatments	Treatment Combination	30 DAS	60 DAS	90 DAS	At Harvest
T_0	RDF of NPK(150:80:60)Kg/ha +10tn FYM	31.69	52.85	79.20	82.88
T_1	75% N through Urea +MOP + SSP +25% through FYM + Boron + Azotobactor +PSB	33.41	59.91	87.90	91.64
T_2	75% N through Urea +MOP + SSP +25% through FYM +Zn+ Azotobactor +PSB	31.55	59.14	91.41	95.13
T_3	75% N through Urea + MOP + SSP +25% through FYM + B+ Zn+ Azotobactor +PSB	33.76	60.31	91.55	95.60
T_4	75% N through Urea + MOP + SSP + 25% through Vermicompost+ B + Azotobactor +PSB	33.25	73.29	98.69	102.32
T_5	75% N through Urea + MOP + SSP + 25% through Vermicompost+ Zn + Azotobactor + PSB	31.57	72.80	100.58	103.99
T_6	75% N through Urea+ MOP + SSP + 25% through Vermicompost+ B + Zn + Azotobactor +PSB	32.27	73.16	100.58	103.58
T_7	75% N through Urea + MOP + SSP + 25% through PM + B + Azotobactor + PSB	31.88	70.75	97.96	100.78

T_8	75% N through Urea + MOP + SSP + 25% through PM +Zn + Azotobactor + PSB	35.69	71.68	99.55	102.97
T_9	75% N through Urea + MOP + SSP + 25% through PM + B + Zn + Azotobactor +PSB	31.66	73.60	93.25	96.80
	'F' Test	**s**	**s**	**s**	**s**
	C.V.	**2.56**	**5.96**	**8.57**	**9.05**
	S.E. (m)	**0.86**	**2.01**	**2.88**	**3.05**
	C.D. at 5%	**4.57**	**5.21**	**5.31**	**5.41**

Number of branches per plant

The number of branches per plant was influenced by different treatments at all successive stage of growth .It was found that T0 (RDF of NPK(150:80:60)Kg/ha +10tn FYM) with maximum value i.e. 13.71 branches per plant followed by T1 (75% N through Urea +MOP + SSP +25% through FYM + Boron + Azotobactor +PSB) with 12.36 branches per plant whereas the minimum score was observed in treatment T4 (75% N through Urea + MOP + SSP + 25% through Vermicompost + B + Azotobactor +PSB) with 6.82.

Plant Spread (cm)

It is also evident that the plant spread was influenced by different treatments at all successive stage of growth . It was also found that T_6 (75% N through Urea+ MOP + SSP + 25% through Vermicompost + B + Zn + Azotobactor +PSB) with maximum value i.e. 52.30 plant spread followed by T_5 (75% N through Urea + MOP + SSP + 25% through Vermicompost + Zn + Azotobactor + PSB) with 50.94 plant spread whereas the minimum score was observed in treatment T_0 (RDF of NPK(150:80:60)Kg/ha +10tn FYM) with 45.68.

Days to first flowering

The results related to days to first flowering varied significantly among different treatments . Among the application of integrated nutrient management the maximum days to first flowering was seen in T_8 (75% N through Urea + MOP + SSP + 25% through PM +Zn + Azotobactor + PSB) with 42.88 days, followed by T_3 (75% N through Urea + MOP + SSP +25% through FYM + B+ Zn+ Azotobactor +PSB) with 41.31 days whereas minimum days to first flowering 30.65 days was recorded in T_7 (75% N through Urea + MOP + SSP + 25% through PM + B + Azotobactor + PSB).

Days to 1st fruit setting

Among the application of integrated nutrient management the maximum days to first fruit setting was seen in T_8 (75% N through Urea + MOP + SSP + 25% through PM +Zn + Azotobactor + PSB) with 58.59 days, followed by T_3 (75% N through Urea + MOP + SSP +25% through FYM + B+ Zn+ Azotobactor +PSB) with 56.95 days whereas minimum days to first fruit setting 46.02 days was recorded in T_7 (75% N through Urea + MOP + SSP + 25% through PM + B + Azotobactor + PSB).

Number of fruits per plant

The maximum number of fruits per plants 59.22 were recorded in treatment T_0 (RDF of NPK(150:80:60)Kg/ha +10tn FYM) followed by T_1 (75% N through Urea +MOP + SSP +25% through FYM + Boron + Azotobactor +PSB) i.e., 54.82 and the lowest fruits per plant 32.14 were observed in T_9 (75% N through Urea + MOP + SSP + 25% through PM + B + Zn + Azotobactor +PSB).

Days to 1st fruit picking

Among the application of integrated nutrient management the maximum days to first fruit picking was seen in T_8 (75% N through Urea + MOP + SSP + 25% through PM +Zn + Azotobactor + PSB) with 71.37 days, followed by T_3 (75% N through Urea + MOP + SSP +25% through FYM + B+ Zn+ Azotobactor +PSB) with 69.60 days whereas minimum days to first fruit picking 58.75 days was recorded in T_7

Fruit yield per plant (kg/plant)

The maximum fruit yield per plants 3.44 kg/plant were recorded in treatment T_1 (75% N through Urea +MOP + SSP +25% through FYM + Boron + Azotobactor +PSB) followed by T_0 (RDF of NPK(150:80:60)Kg/ha +10tn FYM) i.e., 2.91 kg/plant and the lowest fruits per plant 1.81 were observed in T_9 (75% N through Urea + MOP + SSP + 25% through PM + B + Zn + Azotobactor +PSB).

Table 2 : Effect of integrated nutrient management on fruit yield per plant (Kg/plant) of tomato.

Treatment Notation	Treatment Combination	Fruit yield per plant (kg/plant)
T_0	RDF of NPK(150:80:60)Kg/ha +10tn FYM	2.91
T_1	75% N through Urea +MOP + SSP +25% through FYM + Boron + Azotobactor +PSB	3.44
T_2	75% N through Urea +MOP + SSP +25% through FYM +Zn+ Azotobactor +PSB	1.98
T_3	75% N through Urea + MOP + SSP +25% through FYM + B+ Zn+ Azotobactor +PSB	2.81
T_4	75% N through Urea + MOP + SSP + 25% through Vermicompost + B + Azotobactor +PSB	1.65
T_5	75% N through Urea + MOP + SSP + 25% through Vermicompost + Zn + Azotobactor + PSB	2.83
T_6	75% N through Urea+ MOP + SSP + 25% through Vermicompost + B + Zn + Azotobactor +PSB	2.18
T_7	75% N through Urea + MOP + SSP + 25% through PM + B + Azotobactor + PSB	2.38
T_8	75% N through Urea + MOP + SSP + 25% through PM +Zn + Azotobactor + PSB	2.23
T_9	75% N through Urea + MOP + SSP + 25% through PM + B + Zn + Azotobactor +PSB	1.81
	Mean	**2.43**
	'F' Test	**S**
	C.V.	**6.51**
	S.E. (m)	**0.09**
	C.D. at 5%	**0.27**

Total soluble solid (0Brix)

The maximum T.S.S. (6.04 0Brix) was observed in treatment T6 (75% N through Urea+ MOP + SSP + 25% through Vermicompost + B + Zn + Azotobactor +PSB) followed by T7 (75% N through Urea + MOP + SSP + 25% through PM + B + Azotobactor + PSB) with 5.74 0Brix. The minimum T.S.S. (4.25 0Brix) was noticed in treatment T1 (75% N through Urea +MOP + SSP +25% through FYM + Boron + Azotobactor +PSB).

Acidity (%)

The maximum acidity (15.62%) was observed in treatment T0 (RDF of NPK(150:80:60)Kg/ha +10tn FYM) followed by T3 (75% N through Urea + MOP + SSP +25% through FYM + B+ Zn+ Azotobactor +PSB) with 14.66%. The minimum acidity (9.58%) was noticed in treatment T9 (75% N through Urea + MOP + SSP + 25% through PM + B + Zn + Azotobactor +PSB).

Summery and Conclusion

From the present investigation it was concluded that T_1 (75% N through Urea +MOP + SSP +25% through FYM + Boron + Azotobactor + Phosphorous Solubilizing Bacteria) was found to be best among all treatment in terms of yield and T_6 (75% N through Urea+ MOP + SSP + 25% through vermicompost+ Boron + Zinc + Azotobactor + Phosphorous Solubilizing Bacteria) in growth and quality of tomato i.e. plant spread, plant height, T.S.S. etc. The highest B:C ratio that is 3.25 was observed for T_6 (75% N through Urea+ MOP + SSP + 25% through vermicompost+ Boron + Zinc + Azotobactor + Phosphorous Solubilizing Bacteria).

It is concluded from the investigation that the treatment T_6 (75% N through Urea+ MOP + SSP + 25% through vermicompost+ Boron + Zinc + Azotobactor + Phosphorous Solubilizing Bacteria) was found suitable for application in tomato cultivation.

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