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Efficacy of INM Practices on Growth and Yield of Tomato (*Solanum lycopersicum* L.)

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Abstract

The present research work entitled “Efficacy of INM practices on growth and yield of Tomato (*Solanum lycopersicum* L.)” was carried out at Agricultural Research Farm, IFTM University, Moradabad during summer season of 2020 laid out in randomized block design consisting of fifteen treatment combinations with three replications. The experimental results revealed that treatment T_{10} (100 % RDF + Vermicompost + PSB Root dip) resulted in highest values of growth parameters such as plant height, number of primary branches and plant spread at 30, 45 and 60 days after transplanting. The significantly highest value of weight per fruit was recorded in treatment T_{10} (98.77 g) though it was found to be statistically at par with treatment T_{11} (96.30 g) and statistically superior to all other treatments in the experiment. The treatment T_{10} being at par with treatment T_{11} recorded significantly highest value of number of fruits per plant (29.20 and 28.27, respectively), weight of fruits per plant (2.88 and 2.66 kg/plant, respectively), fruit yield of tomato (78.77 t/ha and 75.80 t/ha, respectively) as compared to all other treatments.

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Tomato (*Solanum lycopersicum* L.), (European Commission Directive 2013/45/ EU) is one of the most common, leading, widely consumed, popular, staple, day neutral, self-pollinated, annual and economically important solanaceous fruit vegetable crops.[1] Tomato occupies a prime position in the list of protective foods since it consists of vitamins, minerals and antioxidants which are essential for human health.[2] In the recent decades, the consumption of tomato has been associated with prevention of several disease *viz*. low-density lipoprotein (LDL) cholesterol, homocysteine, platelet aggregation, and blood pressure[3,4] mainly due to its antioxidant contents including carotenes, (lycopene as well as carotene), ascorbic acid, and phenolic compounds.[5]

The average productivity of tomato in our country is highest (30-35 tonnes/ha) and this is mainly attributed to the favourable environmental condition

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and adoption of high yielding hybrids. However, India is yet to attain the yield potential (80-120t^{-ha}) due to low adoption of poor agronomic practices and incidence of insect, pests, diseases and other abiotic factors.[6] Yield potentiality of tomato largely depends on various agronomical factors. Among these factors, plant nutrition is an important that affects growth and yield of tomato.[7] Tomato is a heavy feeder crop because once the plant has developed sufficient root system, and above-ground biomass, it starts producing flowers, which rapidly develop into the first fruitlets, and they, in turn, start a long process of development and accumulation of sugars, organic acids, vitamins, pigments and anti-oxidants that enrich this fruit with their specific health values and requires large quantities of chemical fertilizers.[8] Since last decade, tomato production has increased due to increased use of fertilizers and use of high yielding varieties. Tomato crop consumes around 280 kg N, 55 kg P_2O_5 and 540 kg K_2O ha^{-1} for producing 30 t ha^{-1} of fruit yield.[9] However, excessive use of chemical fertilizers for tomato production not only pollutes the environment, soil and underground water but also makes the soil acidic and reduces the soil fertility gradient. On the other hand, high cost of chemical fertilizers makes crop production uneconomical for small and marginal farmers.The use of integrated nutrient management practice is mainly concerned towards the protection of soil productivity and to provide essential nutrients to the cultivated plants at a most favourable level for sustaining the desired yield through optimization of the benefits from all probable sources of organic, inorganic and biological ingredients in an integrated way. Keeping these facts in view, the present investigation entitled "Efficacy of INM practices on growth and yield of Tomato (*Solanum lycopersicum* L.)" was carried out.

Materials and Methods

The present research work entitled "Efficacy of INM practices on growth and yield of Tomato (*Solanum lycopersicum* L.)" was carried out at Agricultural Research Farm, School of Agricultural Sciences and Engineering, IFTM University, Lodhipur Rajput, Moradabad during summer season, 2020 with the variety of NBH-333 IMP. It is a short duration variety of tomato, which matures in 70-75 days. The plant habit is semi determinate; fruit shape is square round and weights around 90-100g. NHB-333 is tolerant to tomato yellow leaf curl virus. There were total fifteen treatment combinations i.e. T_1(100%RDF), T_2(75%RDF) T_3(50%RDF), T_4(100%RDF + Vermicompost), T_5(75%RDF + Vermicompost), T_6(50%RDF + Vermicompost), T_7(100%RDF + PSB), T_8(75%RDF + PSB), T_9(50%RDF + PSB), T_{10}(100%RDF + Vermicompost + PSB),T_{11}(75%RDF + Vermicompost + PSB),T_{12}(50%RDF + Vermicompost + PSB), T_{13}(Vermicompost), T_{14}(PSB) and T_{15}(Control), all treatments allocated in field in randomized block design manner and replicated thrice. The seedlings were raised in nursery bed with proper scientific procedure, sowing of seeds in nursery bed in the month of March. The recommended dose of fertilizers (RDF) was applied @150:60:60 (N:P:K) Kg/ha, vermicompost @25 Quintal/ha. The phosphorus solublizing bacteria (PSB) @ 2 ml/litre water was used as the seedling treatments in the experiment. The soil of experimental site was sandy loam having pH -7.3, E.C.- 0.90 ds/m, available N - 87.75 kg/ha, available P - 13.5 kg/ha, available K-198 kg/ha and 0.39 % of organic carbon.

Twenty five days old seedlings were transplanted in well prepared field according to treatment combination at the spacing of 45cm. x 60 cm. To minimize the transplanting shock, transplanting of seedling was done in the evening and light irrigation was done just after transplanting. Gap filling was done within 10 days of transplanting to maintain uniform crop stand in the field.All cultural operations i.e. irrigation, weeding, staking and plant protection measures were performed during the crop period. Growth and yield attributing parameters were recorded and analysed with F-test.

Result and Discussion

Effect of (INM) Practices on Growth Parameters of Tomato

It is evident from Table–1 that treatment T_{10}(100 % RDF + Vermicompost + PSB) has recorded significantly highest value of plant height at 30 DAT (59.17 cm) as compared to all other treatments, but it was found to be statistically at par with treatment T_7(100 % RDF + PSB), T_1(100 % RDF and T_4(RDF+ Vermicompost), where 55.70 cm, 58.50 cm and 56.67 cm plant height, respectively were recorded.Minimum plant height (33.27cm) was recorded under control.

Table 1: Effect of INM practices on growth parameters of tomato

Treatments	Plant height (cm) at 30 DAT	Plant height (cm) at 45 DAT	Plant height (cm) at 60 DAT	Primary branches at 30 DAT	Primary branches at 45 DAT	Primary branches at 60 DAT	Plant spread at 30 DAT (cm)	Plant spread at 45 DAT (cm)	Plant spread at 60 DAT (cm)
T_1 - 100 % RDF	58.50	83.30	93.30	8.70	13.60	18.60	48.67	64.60	69.60
T_2 - 75 % RDF	49.50	75.67	85.67	8.27	13.50	16.50	45.97	64.50	69.50
T_3 - 50 % RDF	45.20	63.67	73.67	7.37	11.20	14.20	40.43	60.63	64.63
T_4 – 100 % RDF + Vermicompost	56.67	87.13	97.13	8.90	15.40	20.40	55.73	72.03	77.03
T_5 - 75 % RDF + Vermicompost	48.27	81.07	91.07	7.63	13.67	18.67	52.43	67.93	72.93
T_6 - 50 % RDF + Vermicompost	41.20	69.27	79.27	7.40	13.03	16.03	42.53	61.97	65.97
T_7 - 100 % RDF + PSB	55.70	86.90	96.90	9.57	14.77	19.77	54.10	69.57	74.57
T_8 - 75 % RDF + PSB	44.90	78.80	88.80	8.03	13.33	16.33	51.47	67.13	68.13
T_9 - 50 % RDF + PSB	40.60	66.47	76.47	6.93	12.53	15.53	42.77	60.47	64.47
T_{10} - 100 % RDF + Vermicompost + PSB	59.17	87.60	97.60	9.63	15.53	20.53	60.30	75.83	80.83
T_{11} - 75 % RDF + Vermicompost + PSB	44.17	80.37	90.37	7.83	15.33	20.33	59.67	73.17	78.17
T_{12} - 50 % RDF + Vermicompost + PSB	38.73	75.90	85.90	6.97	12.60	15.60	43.33	61.10	65.10
T_{13} – Vermicompost	38.80	60.90	71.17	7.03	11.20	14.20	39.43	59.33	63.33
T_{14} – PSB	39.87	61.17	70.93	6.97	10.97	13.97	38.43	56.50	60.50
T_{15} – Control	33.27	60.93	70.90	6.17	10.37	13.37	35.97	54.63	58.63
S.E.(m)±	1.37	1.68	1.68	0.29	0.49	0.49	1.04	1.11	1.12
C.D.	3.99	4.89	4.89	0.86	1.43	1.43	3.04	3.22	3.23

Plant height at 45 days after transplanting, the treatment T_{10} being at par with treatment T_4 and T_7 recorded significantly highest value of plant height (87.60 cm, 87.13 cm, and 86.90 cm, respectively) as compared to all other treatments. The data pertaining to plant height at 60 DAT also followed the similar trend and 97.60 cm, 97.13 cm and 96.90 cm plant height were recorded under the treatment T_{10}(100 % RDF + Vermicompost + PSB), T_4(100 % RDF + Vermicompost) and T_7(100 % RDF + PSB), respectively. The plant height for T_1 was par at 60 DAS and 90 DAS, though at par with treatments reporting highest values. It shows the slow release of nutrients from organic sources and solubilization by PSB. This could be mainly attributed to the beneficial effects of full dose of NPK, application of organic manure i.e. vermicompost and seedling treatment with PSB, which improved the physical, chemical and biological conditions of the soil as well as solubilisation of phosphorus by PSB and thus resulted in better plant height. The similar findings were also reported by[10,11] in tomato.

Data presented in table 1 clearly revealed that no. of primary branches at 30, 45 and 60 days after transplanting significantly influenced by the different integrated nutrient management practices. Maximum numbers of primary branches (9.63) at 30 DAT was recorded under the treatment T_{10} (100 % RDF + Vermicompost + PSB) which was statistically at par with treatment T_7(100 % RDF + PSB), as well as T_1(100 % RDF) where 9.57 primary branches/ plant was recorded. Maximum no. of primary branches per plant at 45 DAT and 60 DAT was recorded under the treatment T_{10} (100 % RDF + Vermicompost + PSB), where 15.53 and 20.53 branches per plant respectively were recorded. However, treatment T_{10} was statistically at par with the treatment T_4, T_7 and T_{11}. Minimum no. of primary branches per plant at i.e. 6.17, 10.37 and 13.37, respectively were recorded at 30, 45 and 60 DATunder the control.This is mainly attributed due to the beneficial effect of chemical fertilizers along with the application of vermicompost and seedling treatment with PSB. Organic fertilizers have capacity to improve water holding capacity of the soil, source of different macro and micro nutrients they improve the availability of different macro and micronutrients to the plants, which in turn improves the growth of plants as well PSB act as catalysis for phosphorus solubilisation. The results obtained are in close conformities with the findings of[12] in INM practices of tomato.

Table 2: Effect of INM practices on growth parameters of tomato

Treatments	Weight per fruit (g)	Number of fruits per plant	Weight of fruits per plant (kg)	Fruit yield (t/ha)
T_1 - 100 % RDF	82.70	22.13	1.83	54.23
T_2 - 75 % RDF	81.40	19.87	1.62	47.92
T_3 - 50 % RDF	66.33	16.27	1.08	34.96
T_4 – 100 % RDF + Vermicompost	90.77	24.13	2.19	64.90
T_5 - 75 % RDF + Vermicompost	87.17	22.93	1.99	59.24
T_6 - 50 % RDF + Vermicompost	71.43	17.07	1.22	36.17
T_7 - 100 % RDF + PSB	89.47	23.60	2.11	62.56
T_8 - 75 % RDF + PSB	82.73	20.80	1.72	50.95
T_9 - 50 % RDF + PSB	67.47	17.33	1.18	38.14
T_{10} - 100 % RDF + Vermicompost + PSB	98.77	29.20	2.88	78.77
T_{11} - 75 % RDF + Vermicompost + PSB	96.30	28.27	2.67	75.80
T_{12} - 50 % RDF + Vermicompost + PSB	78.70	17.73	1.39	41.32
T_{13} – Vermicompost	63.03	16.40	1.03	30.80
T_{14} – PSB	62.60	16.27	1.02	33.18
T_{15} – Control	56.97	15.87	0.90	30.63
S.E.(m)±	1.17	0.77	0.08	2.33
C.D.	3.42	2.24	0.22	6.79

Data pertaining to plant spread (Table-1) at 30, 45 and 60 DAT clearly shows that plant spread statistically influenced by the various integrated nutrient management practices and show the similar trend at 30, 45 and 60 days after transplanting. Maximum plant spread i. e. 60.30 cm, 75.83 cm and 80.30 were recorded 30, 45 and 60 DAT, respectively under the treatment T_{10} (100 % RDF + Vermicompost + PSB) followed by treatment T_{11}(75 % RDF + Vermicompost + PSB), where 59.67 cm, 73.17 cm and 78.17 cm plant spread were recorded at 30, 45 and 60 DAT, respectively. This might also be attributed to the fact that application of Vermicompost and PSB along with chemical fertilizers was beneficial in improving the growth and development of plants. Similar results were also reported by[13] in tomato.

Effect of INM Practices on Yield Parameters of Tomato

Data illustrated in table-2 on different yield attributing parameters i.e., weight/fruits, number of fruits/plant, weight of fruits/plant and fruits yield significantly influenced by the different integrated nutrient management practices. Maximum weight/fruit (98.77g.), maximum no. of fruits/ plant (29.20), weight of fruits/plant (2.88 kg.) and maximum fruits yield (78.77 tonnes/ha) was recorded under the treatment T_{10}(100 % RDF + Vermicompost + PSB) followed by treatment T_{11}(75 % RDF + Vermicompost + PSB), where 96.30g weight/fruit, 28.27 fruits/plant, 2.67 g. fruits/plant and 75.80 t^{-ha} yield was recorded. However, minimum values of yield attributing characters were recorded under the control.It appears from the findings that supply of nutrients from organic and inorganic sources, i.e. vermicompost and chemical fertilizers with PSB improves the partitioning of photo-assimilates from source to sink (leaf to fruit) and thereby increases the fruit weight. These finding are close conformity with the findings of[14] in garlic. Similar findings were also reported by[10,12] in tomato.

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Conflict of Interest

The authors declare no conflicts of interest.

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