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Effect of integrated nutrient management on growth and yields of tomato (*Solanum lycopersicum* L.) in Dehradun, Uttrakhand

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Abstract
Tomato (*Solanum lycopersicon* L.) is one of the most popular fruit vegetables grown in the world. Tomato is universally treated as a "Protective Food" and is also a very good source of income to small and marginal farmers. It is a rich source of minerals, vitamin and organic acid. A field experiment conducted entitled, "Effect of Integrated Nutrient Management on growth and yields of Tomato (*Solanum lycopersicum* L.) in Dehradun, Uttrakhand*"* at Shivalik Agriculture Research Farm, SIPS, Dehradun during 2021-22. The experiment consisted of 7 treatments with 3 replications. The experiment was plotted according to Randomized Complete Block Design. It concluded from the results that Plant height (cm) 80 DAT, Leaf length (cm) (80 DAT), Leaf area per plant (cm^2) (80 DAT), No. of branches per plant at 80 DAS, No. of leaves per plant at 80 DAT, Fresh weight of leaf (gram), Dry weight of leaf (gram), No. of flower per plant, Minimum days to flowering and Days to 50% flowering were significantly affected by INM. Results revealed that No. of fruits per plants, Days to first fruiting, Weight of fruit (g), Fruit length (cm), Fruit diameter (cm), Number of fruit per cluster and Fruit yield (q/ha) were significantly affected by different INM. It also revealed that maximum Number of fruit per cluster observed in (T6) 50% RDF + 50% vermicompost. It also revealed that maximum Fruit yield (q/ha) observed 348.85 (qtl/ha) T6 (50% RDF + 50% vermicompost).

Keywords: Leaf length, dry weight of leaf, fresh weight of leaf fruit diameter, fruit length, yield etc

Introduction
Tomato (*Solanum lycopersicon* L.) is one of the most popular fruit vegetables grown in the world. It is one of the most widely, grown vegetable in India. It is grown in small home gardens and market gardens for fresh consumption as well as processing purposes. India ranks second in area and production of tomato in the world. The leading tomato growing states in India are Uttar Pradesh, Karnataka, Maharashtra, Haryana, Punjab and Bihar. It is a self-pollinated crop and Peru- Equador region is considered to be the centre of origin. It was introduced by the Portuguese. It is cultivated in tropics and subtropics of the world and it is being cultivated in kitchen gardens, commercial fields under green house and poly house conditions and soil less culture or hydroponic systems. It consist of vitamins, minerals and antioxidants which are essential for human health. It is one of the popular vegetable of great commercial value and used in various forms of salad or cooked and are used in the preparation of products like sauce, pickles, puree, paste, syrup, ketchup, soup and powder. Although, a ripe tomato has 94 percent water, being a good source of vitamin A and B and excellent source of vitamin C and has good nutritive value. It is very appetizing, removes constipation and has a pleasing taste. Tomato is universally treated as a "Protective Food" and is also a very good source of income to small and marginal farmers. It is a rich source of minerals, vitamin and organic acid. 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 nutrient management is helpful in increasing the yields in crops as well as maintains soil fertility. The precise information on integrated nutrient management for the maximum production and better quality will be of immense value to tomato growers.

Material and Methods

A field experiment conducted entitled, "Effect of Integrated Nutrient Management on growth and yields of Tomato (*Solanum lycopersicum* L.) in Dehradun, Uttrakhand*"* at Shivalik Agriculture Research Farm, SIPS, Dehradun during 2021-22. The experiment consisted of 7 treatments with 3 replications. The experiment was plotted according to Randomized Complete Block Design. The details of experimental layout are given below-

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Treatment	Symbol
Control	T_1
100% RDF	T_2
FYM @50 ton/ha	T_3
Vermicompost 10 ton /ha	T_4
50% RDF + 50% FYM	T_5
50% RDF + 50% vermicompost	T_6
50% FYM + 50% vermicompost	T_7

Observations recorded

Growth parameters

Plant height (cm), Number of branches plant^{-1}, Plant fresh weight and Plant dry weight recorded

Yielding parameters

Number of flowers per plant, Number of fruits per plot, Fruit yield (q ha^{-1})

Biological yield (kg/ha)

The whole foliage and fruits received from each plot was weighed and on the basis of biological yield kg/ha was calculated

Harvest index (%)

Harvest index was calculated by using the following formula given by Donald (1962).

$$\text{Harvest index (\%)} = \frac{\text{Economic Yield (kg per ha)}}{\text{Biological Yield (kg per ha)}} \times 100$$

Statistical analysis

The data were statistically analysed by using Randomized Block Design. The significance of difference among treatment means were tested by F-test. Wherever, the F- test was found to be significant, critical difference (C.D.) at 5% level of significance was calculated. The results are presented in the forms of graphs and tables and are given at appropriate place for result interpretation.

Results and Discussion

Plant height (cm) 80 DAT, Leaf length (cm) (80 DAT), Leaf area per plant (cm2) (80 DAT), No. of branches per plant at 80 DAS, No. of leaves per plant at 80 DAT, Fresh weight of leaf (gram), Dry weight of leaf (gram), No. of flower per plant, Minimum days to flowering and Days to 50% flowering were significantly affected by INM.

It depicted from table -1 Maximum 108.30 cm Plant height (cm) 80 DAT observed in T6(50% RDF + 50% vermicompost) followed by T5 and T7. It also revealed that maximum Leaf length(cm) (80 DAT) observed 24.24 cm in 50% FYM + 50% vermicompost (T_7) followed by T_6 and T_4 which was superior over other treatments. Minimum Leaf length (cm) (80 DAT) observed in T1.

Table -1 depicted that Maximum 342.98 cm^2 Leaf area per plant (cm2) (80 DAT) observed in T7 (50% FYM + 50% vermicompost) followed by T6 and T5. It also revealed that maximum No. of branches per plant at 80 DAS observed 69.80 cm in 50% RDF + 50% FYM (T_5) followed by T_2 and T_3 which was superior over other treatments. Minimum Leaf area per plant (cm^2) (80 DAT) observed in T7.

Table -1 clearly stated that Maximum 431.80 No. of leaves per plant at 80 DAT observed in T6 (50% RDF + 50% vermicompost) followed by T5 and T1. It also revealed that maximum Fresh weight of leaf (g) observed 1.63 gram in50% FYM + 50% vermicompost (T_7) followed by T_6 and T_5 which was superior over other treatments while minimum observed in T1. It also revealed that maximum dry weight of leaf (g) observed 0.69 gram in 50% FYM + 50% vermicompost (T_7) followed by T_6 and T_5 which was superior over other treatments while minimum observed in T1

Table -1 revealed that Maximum 53.42 No. of flower per plant observed in T6 (50% RDF + 50% vermicompost) followed by T7 and T4. It also revealed that maximum Minimum days to flowering observed 53.61 in (T_1) control followed by T_5 and T_3 which was superior over other treatments while minimum observed in T7. It also revealed that maximum Days to 50% flowering observed T1 (Control) followed by T_4 and T_3 which was superior over other treatments while minimum observed in T6.

Table-2 depicted that No. of fruits per plants, Days to first fruiting, Weight of fruit (g), Fruit length (cm), Fruit diameter (cm), Number of fruit per cluster and Fruit yield (q/ha) were significantly affected by different INM.

It revealed from table-2 that Maximum 90.40 No. of fruits per plant observed in T6 (50% RDF + 50% vermicompost) followed by T7 and T3. It also revealed that maximum days to first fruiting observed 59.80 in (T_1) control followed by T_3 and T_5 which was superior over other treatments while minimum observed in T7. It also revealed that maximum Weight of fruit (g) observed T2 (100% RDF) followed by T_6 and T_7 which was superior over other treatments while minimum observed in T1.

It revealed from table-2 that Maximum 6.18 fruit length (cm) observed in T2 (100% RDF) followed by T6 and T7. It also revealed that maximum Number of fruit per cluster observed 10.03 in (T6) 50% RDF + 50% vermicompost followed by T_7 and T_4 which was superior over other treatments while minimum observed in T1. It also revealed that maximum Fruit yield (q/ha) observed 348.85 (qtl/ha) T6 (50% RDF + 50% vermicompost) followed by T_7 and T_4 which was superior over other treatments while minimum observed in T1.

Table 1: Effect of Integrated Nutrient Management on growth of Tomato

Treatment	Plant height (cm) 80 DAT	Leaf length(cm) (80 DAT)	Leaf area per plant (cm2) (80 DAT)	No. of branches per plant at 80 DAS	No. of leaves per plant at 80 DAT	Fresh weight of leaf (g)	Dry weight of leaf (g)	No. of flower per plant	Minimum days to flowering	Days to 50% flowering
T1	78.34	13.07	142.38	51.40	333.60	0.72	0.30	29.36	53.61	56.83
T2	88.88	16.67	198.96	63.60	315.00	1.15	0.52	35.77	45.85	48.68
T3	82.20	15.05	156.85	60.00	324.40	1.18	0.43	32.21	49.89	50.74
T4	88.12	19.22	235.56	53.40	289.20	1.20	0.44	45.70	47.43	52.75
T5	99.14	13.93	147.85	69.80	409.00	1.24	0.51	42.12	50.52	44.87
T6	108.30	23.98	317.40	20.40	431.80	1.33	0.50	53.42	41.87	43.93
T7	90.54	24.24	342.98	30.80	278.40	1.63	0.69	46.55	44.09	46.72
CD	9.380	0.27	11.78	16.627	54.079	0.249	0.109	0.56	0.78	0.43
SEm±	3.126	0.79	35.59	5.542	18.026	0.083	0.036	1.72	2.36	1.37

Table 2: Effect of Integrated Nutrient Management on yield and yield attributes of Tomato

Treatment	No. of fruits per plants	Days to first fruiting	Weight of fruit (g)	Fruit length (cm)	Fruit diameter(cm)	Number of fruit per cluster	Fruit yield (q/ha)
T1	16.80	59.80	54.26	4.78	13.30	6.86	170.29
T2	25.20	51.85	89.32	6.18	18.42	8.76	262.99
T3	26.00	56.48	63.68	4.76	14.02	7.01	225.86
T4	25.40	53.76	70.05	5.04	15.63	9.12	297.79
T5	25.60	55.54	58.72	4.71	14.09	8.30	274.89
T6	90.40	47.77	79.10	5.72	17.06	10.03	348.85
T7	81.40	45.70	74.16	5.57	15.74	9.19	323.19
CD	28.312	0.56	0.23	0.22	0.47	0.59	0.71
SEm±	9.437	1.73	0.68	0.64	1.38	1.84	2.26

Conclusion

A field experiment conducted entitled, "Effect of Integrated Nutrient Management on growth and yields of Tomato (*Solanum lycopersicum* L.) in Dehradun, Uttrakhand*"* at Shivalik Agriculture Research Farm, SIPS, Dehradun during 2021-22. The experiment consisted of **7** treatments with **3** replications. The experiment was plotted according to Randomized Complete Block Design.

It concluded from the results that Plant height (cm) 80 DAT, Leaf length (cm) (80 DAT), Leaf area per plant (cm^2) (80 DAT), No. of branches per plant at 80 DAS, No. of leaves per plant at 80 DAT, Fresh weight of leaf (gram), Dry weight of leaf (gram), No. of flower per plant, Minimum days to flowering and Days to 50% flowering were significantly affected by INM. Results revealed that No. of fruits per plants, Days to first fruiting, Weight of fruit (g), Fruit length (cm), Fruit diameter (cm), Number of fruit per cluster and Fruit yield (q/ha) were significantly affected by different INM.

Results revealed that maximum No. of fruits per plant observed in T6 (50% RDF + 50% vermicompost. It also revealed that maximum days to first fruiting observed in (T_1) control. It also revealed that maximum Weight of fruit (g) observed T2 (100% RDF) followed by T_6 and T_7 while minimum observed in T1.

It revealed from results that Maximum fruit length (cm) observed in T2 (100% RDF) followed by T6 and T7. It also revealed that maximum Number of fruit per cluster observed in (T6) 50% RDF + 50% vermicompost. It also revealed that maximum Fruit yield (q/ha) observed 348.85 (qtl/ha) T6 (50% RDF + 50% vermicompost).

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