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Effect of integrated nutrient management on the growth, yield parameters and economics in tomato (*Lycopersicon esculentum* L.) under Southern Rajasthan conditions

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Abstract
An experiment on Tomato (*Lycopersicon esculentum* L.) was conducted during Z*aid* season of 2020-21 and 2021-22, at Agriculture Research Farm, School of Agriculture Science & Technology, Sangam University, Bhilwara, Rajasthan (India) to understand the effect of integrated nutrient management at different doses combination on plant growth and yield of tomato variety Abhilash. The experiment was conducted in Randomized Block design. The nutrient sources applied were Biofertilizer [Phosphorus solubilizing bacteria (PSB) + Azotobector] @ 5 kg each per ha; Vermicompost (VC) @ 10 t/ha (100%); Farm Yard Manure (FYM) @ 25 t/ha (100%) and Poultry Manure (PM) @ 8 t/ha (100%). Under the present investigation 12 treatments were prepared with different combination doses of integrated nutrient management mentioned in and replicated thrice. Results evident that the maximum fruit yield per hectare was produced by T_{11} [75% RDF + 25% organic (FYM + VC + PM)] (282.98 Qu. in first year and 292.20 Qu. in second year) over control T_1 (100% RDF) which produced 168.10 Qu. and 171.30 Qu. in both years respectively. The fruit yield noted under application of T_{11} were significant and greater over control T_1. The minimum fruit yield of tomato was recorded in case of control i.e., 100% RDF applied, *viz*., 168.10 Qu. and 171.30 Qu. Per hectare in both years respectively. The maximum net profit Rs. 322596 and 356776 along with maximum C: B ratio 2.48 and 2.55 in both the years respectively in 2020-21 and 2021-22 was noted by the treatment T_{11} i.e., application of 75% RDF + 25% organic (FYM + VC + PM). The minimum net profit was noted under T_6 i.e., 100% PM + Biofertilizer, Rs. 173627 with C: B ratio 1.84 in 2020-21; and Rs. 196610 with C: B ratio 1.97 in 2021-22. From the present investigation it was concluded that T_{11} was found to be best among all treatment in terms of growth and yield of tomato i.e., plant height, stem diameter, number of branches, number of fruits, fruit diameter, fruit weight etc. It is concluded from the investigation that the treatment T_{11} was found suitable for application in tomato cultivation.

Keywords: Integrated nutrient management (INM), Lycopersicon esculentum, biofiertlizers, organic manures, vermicompost, yield

1. Introduction
Tomato (*Lycopersicon esculentum* L.) is a annual vegetable crop farmed around the world that ranks second in significance after potato. The tomato is thought to have originated in South America. Tomatoes with the chromosome number 2n=24. It is a herbaceous annual that reproduces sexually by seed. It is used in the production of margarine and as salad oil. Tomato is one of the most extensively farmed vegetables in India, and they have gained popularity in the previous six decades. It is grown in tiny home gardens and market gardens for both fresh consumption and processing. It is eaten raw, cooked, or processed as puree, ketchup, sauce, and so on. Despite having 94% water by weight, ripe tomatoes are a strong source of vitamins A and B as well as an excellent source of vitamin C. They also have a high nutritional value.
Madhya Pradesh, Andhra Pradesh, Karnataka and Tamil Nadu are the states that produce the most tomatoes. The top processed vegetable is the tomato. The income it provides small and marginal farmers is excellent. Fruits include a variety of flavouring chemicals that enhance their flavour. In salads, sandwiches, and other dishes, tomatoes are utilised straight as fresh veggies.
An estimated 841 thousand hectares of land were accessible for tomato cultivation in India in fiscal year 2022, with a production of 20300 thousand tonnes. This was down slightly from the 845 thousand hectares recorded in the preceding fiscal year 2021.

India was the second-largest tomato producer during the time period under study (Anonymous, 2022a) [4]. The nation has met its 2021 goal of producing 21181 thousand tonnes of tomatoes, which it set for that year.

Rajasthan has produced 232.86 thousand tonnes of tomatoes, accounting for 1.15% of all India's production in the years 2021–2022. The state has also predicted that in the following years, production and contribution will increase (Anonymous, 2022b) [5].

The nutrients needed for tomato crop are supplied through organic, inorganic source and through micronutrients and biofertilizer integrated nutrient management (INM) is a holistic, approach that considers all the available farm resources that 3 can be used as plant nutrients. (Jat *et al*., 2018) [10].

To produce a good yield, farmers apply pesticides and inorganic fertilisers in an unbalanced manner. The level of heavy metals in the soil rises with continued usage of chemical fertilisers (Arya and Roy, 2011) [6]

Ruins the health and quality of the soil, making it impossible for plants to flourish on a long-term basis. The tomato is a heavy producer, thus it needs enough fertiliser for growth and a good output. The use of organic and inorganic, in integrated nutrient management improves the soil environment, maintains an acceptable level of nutrients, and creates ideal circumstances for a good growth of high yield tomatoes. (Pandey and Chandra, 2012) [20]

To maximise output and enhance plant growth, it is therefore necessary to offer an adequate amount of balanced nutrients. In order to boost tomato crop growth and fruit yield, this study was done to determine the appropriate amount of NPK (Nitrogen, Phosphorus and Potassium), FYM, VC and biofertilizer to apply to tomato plants.

To increase the yield of tomatoes, it is necessary to accurately determine the amount of organic and inorganic fertilisers to use. In light of these facts, the current experiment was carried out to evaluate the impact of organic manure, chemical fertilisers, and biofertilizers on tomato plant development and yield metrics.

2. Materials and Methods

2.1 Materials

An Experiment on Tomato (*Lycopersicon esculentum* L.) were conducted during *zaid* season of 2020-21 and 2021-22, at Agriculture Research Farm, School of Agriculture Science & Technology, Sangam University, Bhilwara, Rajasthan (India) to understand the effect of integrated nutrient management at different doses combination on growth and yield of tomato variety Abhilash. The experiment was conducted in Randomized Block design. The nutrient sources applied were Biofertilizer (PSB + Azotobector) @ 5kg each per ha; VC @ 10 t/ha (100%); FYM @ 25 t/ha (100%) and PM @ 8 t/ha (100%). Under the present investigation 12 treatments were prepared with different combination doses of integrated nutrient management mentioned in and replicated thrice.

The present field experiment was laid out at Agriculture Research Farm, School of Agriculture Science & Technology, Sangam University, Bhilwara, Rajasthan during the Z*aid* season of 2020-21 and 2021-22. Geographically, Bhilwara district is located at an elevation of 421 metres (1381 feet) above sea level and at 25.359854°N longitude and 74.652791°E latitude. Bhilwara has a subtropical steppe climate (Classification: BSh). The district's yearly temperature is 29.41ºC (84.94ºF) and it is 3.44% higher than India's averages. Bhilwara typically receives about 93.38 millimetres (3.68 inches) of precipitation and has 81.55 rainy days (22.34% of the time) annually. The experimental soil was silty loam in texture, nearly neutral in soil reaction (pH 8.1), low in organic carbon (0.39%), low in available N (228.79 Kg/ha), medium available P (23.00 Kg/ha) and medium available K (270.67 Kg/ha).

2.2 Methods

The seeds were procured from a local distributor of bhilwara. The seeds of tomato were sown during January 2020 and January 2021 respectively for first year and second year. Frequent irrigation and necessary plant protection measures were taken to raise good quality seedlings.

Table 1: Treatments details for tomato given with their notation

Notation	Treatments
T_1	100% RDF (Control)
T_2	100% RDF + Biofertilizer
T_3	75% RDF + Biofertilizer
T_4	100% FYM + Biofertilizer
T_5	100% VC + Biofertilizer
T_6	100% PM + Biofertilizer
T_7	25% RDF + 75% VC + Biofertilizer
T_8	100% Organic (33% FYM + 33% VC + 33% PM)
T_9	75% Organic (FYM + VC + PM) + Biofertilizer
T_{10}	50% RDF + 50% Organic (FYM + VC + PM)
T_{11}	75% RDF + 25% Organic (FYM + VC + PM)
T_{12}	25% RDF + 25% FYM + 25% VC + Biofertilizer

The experiment was laid out in randomized block design (RBD) having 12 Treatment which were replicated 3 times. The treatment combinations are follows: T_1 T_2 T_3 T_4 T_5 T_6 T_7 T_8 T_9 T_{10} T_{11} and T_{12} (Table - 1).

During February the 4-5 weeks old seedlings having 4 leaf stages were transplanted in at a distance of 60 cm between the plants in each row and 45 cm between rows. Staking was done after a month of transplanting. Irrigation was provided frequently and all the recommended cultivation practices were followed.

3. Results and Discussion

3.1 Growth Parameters

3.1.1 Plant Height, Number of Branches Per Plant, Stem Diameter and Days to First Harvest

The observations with regards to the growth parameters i.e., plant height, number of branches per plant, stem diameter, and days to first harvest of tomato are given in table 2 to table 4. The effect of various treatments on plant height of tomato were found to be positively and consistently in both the years. The data obtained at 30, 60, 90 and 120 days after transplanting were subjected to statistical analysis. The height of the plants recorded at 30, 60, 90 and 120 DAT was noted higher by application of recommended dose of 75% RDF + 25% organic (FYM + VC + PM) (T_{11}) i.e., 33.73, 68.17, 102.53 and 125.63 cm respectively compared to the other treatments in 2020-21. A parallel value was also noticed in 2021-22, the maximum plant height at 30, 60, 90 and 120 DAT was under application 75% RDF + 25% organic (FYM + VC + PM) (T_{11}) is 34.50 cm at 30 DAT, 72.51 cm at 60 DAT, 106.53 cm at 90 DAT and 129.05 cm at 120 DAT

respectively followed by recommended dose of 100% RDF + Biofertilizer (T_2) in first and second years of experimentation. The minimum plant height at all the dates of observations was recorded under control. This is because of the availability of more nitrogenous compounds at early growth stages of tomato plants. The increase of plant height, number of branches and stem diameter at recommended dose of fertilizers and T_{11} level is might be due to the availability more nitrogenous compounds to the plant from inorganic sources which increase the foliage of the plant and thereby increases in the photosynthesis rate resulting there is increase in height of the plants (Kumar *et al*., 2014; Adeyeye *et al*., 2018) [11, 3]. It is also due to the cell elongation by the presence of nitrogenous compounds as it is the basic functions of the nitrogen. The present findings are in conformity with the findings of (Abdulmaliq *et al*., 2019; Mohit *et al*., 2019) [1, 18].

The data showed that the maximum number of branches produced were seen under T_{11} i.e., 75% RDF + 25% organic (FYM + VC + PM) at 30, 60, 90 and 120 days in both the years i.e., 9.40 and 9.62 at 30 DAT; 12.37 and 12.44 at 60 DAT; 17.47 and 18.02 at 90 DAT; and 20.28 and 20.68 respectively. These observations were significantly greater over control i.e., T_1 (100% RDF (Control) with 5.47 and 5.55 at 30 DAT; 9.40 and 9.71 at 60 DAT; 13.93 and 14.44 at 90 DAT; and 17.47 and 18.02 at 120 DAT respectively in both the years. The implementation of integrated nutrient management may have improved the physical and chemical characteristics of the soil, resulting in an adequate supply of nutrients to the plants, which may have promoted the maximum vegetative growth while the minimum plant growth was caused by nutrient scarcity. Similar findings were reported by Mahto *et al*. (2009) [15]; Prabhu *et al*. (2010) [21] and Kumar *et al*. (2014) [11] in tomato.

The stem diameter achieved higher values under T_{11} *viz*., 75% RDF + 25% organic (FYM + VC + PM) i.e., 0.700 and 0.740 cm at 30 DAT; 0.967 and 0.997 cm at 60 DAT; 1.377 and 1.407 cm at 90 DAT; and 1.830 and 1.870 cm 120 DAT, followed by T_2 (100% RDF + Biofertilizer) i.e., 0.630 and 0.647 cm at 30 DAT; 0.923 and 0.967 cm at 60 DAT; 1.333 and 1.373 cm at 90 DAT; and 1.690 and 1.710 cm 120 DAT which were statistically significant and greater over control T_1 (100% RDF) in both years 2020-21 and 2021-22. At 30 DAT, the minimum stem diameter obtained under T_1 (control) and T_5 (100% VC + Biofertilizer) in both years, *viz*., in 2020-21, 0.333 cm and 0.333 cm respectively; and in 2021-22, 0.337 cm and 0.340 cm respectively. At 60 and 90 DAT, the minimum stem diameter was observed in case of T_1 (control) in both years as shown in table 4. At 120 DAT of final observation the minimum stem diameter was recorded under the application of T_1 which was control (100% RDF) followed by T_5 (100% VC + Biofertilizer) in both the years of investigation, i.e., 1.160 and 1.150 cm respectively in year 2020-21 and 1.210 and 1.180 cm respectively in year 2021-22.With increasing levels of micronutrients, it was observed that the number of branches per plant grew as plant height climbed sequentially. Combining INM also measured the height of the plant at its tallest point and the number of branches, which aided the plants' vigour by enhancing photosynthesis. The findings of the present investigation are in conformity with the reports of Mahato *et al*. (2009) [15]; Prabhu *et al*. (2010) [21]; and Kumar *et al*. (2014) [11] in tomato.

The days to first fruit harvest were noted higher in 75% organic (FYM + VC + PM) + Biofertilizer (T_9) 81.67 and 82.00 days respectively in 2020-21 and 2021-22 and were recorded minimum in the treatment applied recommended dose of 75% RDF + 25% organic (FYM + VC + PM) (T_{11}) which registered minimum days to first fruit harvest and was noted on par with 50% RDF + 50% organic (FYM + VC + PM) in both the seasons (Table 4). Results on days to first fruit harvest of tomato shows that the application of recommended dose of fertilizer [75% RDF + 25% organic (FYM + VC + PM)] regarded minimum days taken (67.00 and 67.67 days) in both the years compared to the other treatments. This is might be due to the initial growth of tomato and better quality available of nutrients at early stages. The present findings agree with the findings of the Howlader *et al*. (2019) [9] and Dubey and Shukla (2020) [8].

3.2 Yield Parameters

3.2.1 Fruit weight (g), Fruit diameter (cm) and Fruit volume (cc)

The fruit weight of tomato showed significant variation among different treatments over control (T_1) (100% RDF). The maximum fruit weight was recorded under the application of T_{11} [75% RDF + 25% organic (FYM + VC + PM)] i.e., 110.74g cm in 2020-21, and 113.84g in 2021-22. While, the minimum fruit weight was recorded from control T_1 (74.51 in first year and 75.71 in second years). The higher fruit diameter was found with T_{11} [75% RDF + 25% organic (FYM + VC + PM)] in year 2020-21 (6.80 cm) followed by T_{10} [50% RDF + 50% organic (FYM + VC + PM)] (6.66 cm) and T_2 (100% RDF + Biofertilizer) (6.50 cm) which were significantly greater over control T_1 (100% RDF) (5.13 cm). Whereas, in year 2021-22, the higher fruit diameter was noted in case of treatment T_{10} (7.04 cm) followed by T_{11} (6.84 cm) and T_2 (6.71 cm) respectively. The data given in table 5 evident that the maximum fruit volume was produced by T_{11} [75% RDF + 25% organic (FYM + VC + PM)] (179.93 in first year and 182.41 cc in second year) over control T_1 (100% RDF) which produced 135.83 cc and 136.88 cc in both years respectively. The fruit volume noted under application of T_{11} were significant and greater over control T_1. The minimum fruit volume wasseen under control condition as shown in table which might be due to lack of nutrient sources. Incorporating various nutrient management strategies encouraged vigorous growth and increased the production of these hormones in plants, which may have aided in the translocation of more phosphorus through the xylem vessels and its accumulation in the axillary buds, which would have encouraged the plant to enter reproductive phase. Similar results have also been reported by Mahato *et al*. (2009) [15]; Prabhu *et al*. (2010) [21]; and Adeel *et al*. (2017) [2] in tomato.

3.2.2 Number of fruits per plant, Fruit yield per plant (kg) and Fruit yield per hectare (q)

The maximum number of fruits were produced by T_{11} [75% RDF + 25% organic (FYM + VC + PM)] (85.00 in first year and 89.40 in second year) over control T_1 (100% RDF) which produced 74.33 and 76.11 fruits in both years respectively. The number of fruits appeared under application of T_{11} were significant and greater over control T_1. The minimum fruits of tomato were noted in case of 100% RDF applied, *viz*., 74.33 and 76.11 fruits in both years respectively.

Incorporating various nutrient management strategies encouraged vigorous growth and increased the production of

these hormones in plants, which may have aided in the translocation of more phosphorus through the xylem vessels and its accumulation in the axillary buds, which would have encouraged the plant to enter reproductive phase. Similar results have also been reported by Mahato *et al*. (2009) [15]; Prabhu *et al*. (2010) [21]; and Adeel *et al*. (2017) [2] in tomato.

The maximum fruit yield per plant was produced by T_{11} [75% RDF + 25% organic (FYM + VC + PM)] (9.43 kg in first year and 9.74 kg in second year) over control T_1 (100% RDF) which produced 5.60 kg and 5.71 kg which produced minimum fruit yield in both years respectively. The fruit yield noted under application of T_{11} were significant and greater over control T_1. A relatively higher fruit yield per plant was also observed under application of T_2 (100% RDF + Biofertilizer) i.e., 8.31 kg in 2020-21 and 8.40 kg in 2021-22, followed by T_{10} [50% RDF + 50% organic (FYM + VC + PM)] i.e., 7.29 kg in 2020-21 and 7.84 kg in 2021-22, which were statistically at par with T_{11} and significantly greater over control (5.60 kg and 5.71 kg fruits in both years respectively).

The increase in yield may be the result of more vegetative growth, which includes an increase in plant height, the number of branches per plant, the length and diameter of the fruit, and the availability of more nutrients, especially nitrogenous fertiliser, which actively participates in cell division and cell elongation and increases growth parameters that are necessary for photosynthesis and the accumulation of food reserves in the curd farm. The findings of Thakur and Thakur (2012) [23], Manoj (2014) [17], Singh *et al*. (2015) [12], and Musa *et al*. (2020) [19] agree with the findings of the present study.

The data shown in table evident that the maximum fruit yield per hectare was produced by T_{11} [75% RDF + 25% organic (FYM + VC + PM)] (282.98 Qu. in first year and 292.20 Qu. in second year) over control T_1 (100% RDF) which produced 168.10 Qu. and 171.30 Qu. in both years respectively. The fruit yield noted under application of T_{11} were significant and greater over control T_1. The minimum fruit yield of tomato was recorded in case of control i.e., 100% RDF applied, *viz*., 168.10 Qu. and 171.30 Qu. Per hectare in both years respectively.

The possible reason for increase in yield is might be due to better inorganic nitrogen utilization in the presence of organic and biofertilizers, enhanced biological nitrogen fixation, better development of root system and possible synthesis of plant growth hormones, Madalageri and Dharmatti (2006) [14] and Mallika *et al*. (2022) [16] also agreed with the present findings.

3.3 Effect of INM on Economics of fruits

Data related to the economics of the various treatments are clearly given in the table 6. It clearly showed that the maximum net profit Rs. 322596 and 356776 along with maximum C: B ratio 2.48 and 2.55 in both the years respectively in 2020-21 and 2021-22 was noted by the treatment T_{11} i.e., application of 75% RDF + 25% organic (FYM + VC + PM). This is closely followed by the treatment T_2 i.e., 100% RDF + Biofertilizer, where the net profit was Rs. 277988 and 303660 with the cost benefit ratio was 2.30 and 2.43 respectively in both the years. It was significantly greater over control (T_1) which recorded net profit of Rs.183228 and 202991 with C: B ratio 2.14 and 2.30 in both the years respectively. The minimum net profit was noted under T6 i.e., 100% PM + Biofertilizer, Rs. 173627 with C: B ratio 1.84 in 2020-21; and Rs. 196610 with C: B ratio 1.97 in 2021-22. Bairagya *et al*. (2019) [7], Mohit *et al*. (2019) [18] and Kushum *et al*. (2022) [13] also noted the similar finding.

Table 2: Impact of integrated nutrient management on Plant height (cm)

Treatments	Plant height (cm)							
	30 DAT		60 DAT		90 DAT		120 DAT	
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
T_1	26.35	26.55	52.04	54.15	89.24	92.15	114.20	117.25
T_2	32.62	33.12	67.20	71.02	100.77	104.05	125.63	129.05
T_3	31.27	32.41	64.77	67.95	98.75	102.14	119.44	122.84
T_4	28.57	28.90	55.89	59.99	92.93	96.15	115.09	118.41
T_5	28.25	29.02	57.25	61.05	89.82	92.87	117.05	121.41
T_6	28.84	28.84	56.19	60.11	92.33	96.05	120.57	124.02
T_7	31.32	31.41	64.53	68.14	94.38	98.15	121.31	125.01
T_8	28.63	29.10	54.67	59.12	91.09	94.95	116.11	119.41
T_9	27.26	27.32	54.85	60.25	94.13	97.84	121.15	125.04
T_{10}	28.90	29.40	56.25	62.01	92.77	96.05	114.00	117.14
T_{11}	33.73	34.50	68.17	72.51	102.53	106.14	128.81	132.05
T_{12}	31.16	31.45	64.94	67.95	98.37	102.35	123.24	128.41
SE(m) ±	0.78	0.66	1.47	1.44	2.31	2.20	3.05	2.62
C.D. at 5%	2.29	1.96	4.33	4.26	6.81	6.49	9.01	7.74
C.V. (%)	4.52	3.81	4.26	3.92	4.21	3.88	4.42	3.68

Table 3: Impact of integrated nutrient management on number of branches per plant

Treatments	Number of branches							
	30 DAT		60 DAT		90 DAT		120 DAT	
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
T_1	5.47	5.55	9.40	9.71	13.93	14.44	17.47	18.02
T_2	8.50	8.74	11.27	11.55	17.11	17.56	19.02	19.60
T_3	7.87	8.12	9.87	10.12	14.67	15.02	18.80	19.40
T_4	5.87	6.11	9.53	9.84	13.56	14.11	17.47	17.99
T_5	5.90	6.20	9.74	9.99	14.27	14.77	17.53	17.91
T_6	5.73	6.02	9.61	9.74	13.71	14.22	17.60	18.14

T_7	8.24	8.35	11.00	11.40	15.87	16.24	18.42	18.94
T_8	6.20	6.37	9.85	10.12	14.60	15.10	17.47	17.98
T_9	6.12	6.31	9.60	9.84	14.27	14.57	17.53	18.20
T_{10}	6.84	7.11	9.88	10.22	14.60	15.10	18.00	18.44
T_{11}	9.40	9.62	12.37	12.44	17.47	18.02	20.28	20.68
T_{12}	7.47	7.60	10.33	10.41	15.20	15.74	18.13	18.45
SE(m) ±	0.18	0.18	0.21	0.25	0.30	0.39	0.37	0.44
C.D. at 5%	0.54	0.52	0.63	0.73	0.88	1.16	1.10	1.31
C.V. (%)	4.55	4.23	3.61	4.11	3.44	4.42	3.55	4.13

Table 4: Impact of integrated nutrient management on stem diameter (cm) and Days to first harvest

Treatments	Stem diameter (cm)									
	30 DAS		60 DAS		90 DAS		120 DAS		Days to first harvest	
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
T_1	0.333	0.337	0.733	0.770	0.940	0.973	1.160	1.210	71.33	72.33
T_2	0.630	0.647	0.923	0.967	1.333	1.373	1.690	1.710	71.33	72.00
T_3	0.500	0.540	0.867	0.917	1.200	1.257	1.333	1.370	74.00	75.66
T_4	0.433	0.470	0.767	0.817	0.957	1.020	1.170	1.207	73.67	75.01
T_5	0.333	0.340	0.800	0.830	1.007	1.033	1.150	1.180	77.67	78.33
T_6	0.470	0.490	0.767	0.810	1.060	1.107	1.200	1.240	71.33	72.67
T_7	0.533	0.553	0.870	0.913	1.210	1.240	1.367	1.400	78.67	80.00
T_8	0.400	0.430	0.770	0.817	1.100	1.150	1.270	1.310	77.33	79.33
T_9	0.400	0.430	0.667	0.710	0.963	0.993	1.200	1.240	81.67	82.00
T_{10}	0.553	0.570	0.800	0.830	1.140	1.180	1.300	1.337	68.67	69.33
T_{11}	0.700	0.740	0.967	0.997	1.377	1.407	1.830	1.870	67.00	67.67
T_{12}	0.470	0.500	0.733	0.767	1.103	1.147	1.270	1.310	81.33	82.00
SE(m) ±	0.011	0.009	0.016	0.018	0.022	0.016	0.032	0.024	1.70	1.94
C.D. at 5%	0.032	0.028	0.047	0.052	0.066	0.047	0.094	0.072	5.03	5.72
C.V. (%)	3.973	3.249	3.450	3.614	3.489	2.409	4.146	3.104	3.96	4.44

Table 5: Impact of integrated nutrient management on yield attributes

Treatment	Yield attributes											
	Fruit weight (g)		Fruit Diameter (cm)		Number of fruit per plant		Fruit volume (cc)		Total yield per plant (kg)		Yield per ha (Qu.)	
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
T_1	74.51	75.71	5.13	5.21	74.33	76.11	135.83	136.88	5.6	5.71	168.1	171.3
T_2	104.78	106.91	6.5	6.71	79	81.25	171.99	174.51	8.31	8.4	249.32	252
T_3	92.4	95.41	6.13	6.24	71	73.1	162.29	165.31	6.54	6.63	196.14	198.9
T_4	83.61	86.61	5.63	5.71	75	77.15	149.06	152.17	6.2	6.25	186.02	187.5
T_5	77.59	80.05	5.53	5.63	74.67	76.41	146.41	147.55	5.85	6.1	175.59	183
T_6	82.38	86.41	5.63	5.73	68.33	70.81	149.06	151.5	5.58	5.81	167.43	174.3
T_7	93.74	96.74	6.23	6.44	60.67	62.44	164.93	166.81	5.68	5.74	170.31	172.2
T_8	82.89	85.19	5.67	5.8	73	75	149.94	151.35	6.06	6.36	181.73	190.8
T_9	80.73	83.09	5.57	5.71	72	73.51	147.29	150.14	5.9	6.24	177.05	187.2
T_{10}	95.09	98.14	6.66	7.02	76.33	81	176.22	178.31	7.29	7.84	218.83	235.2
T_{11}	110.74	113.84	6.8	6.84	85	89.4	179.93	182.41	9.43	9.74	282.98	292.2
T_{12}	94.74	96.84	5.83	6.13	73.33	74.41	154.35	156.14	6.92	7.12	207.71	213.6
SE(m) ±	2.26	1.99	0.14	0.16	1.59	1.93	3.52	3.91	0.14	0.17	4.97	4.27
C.D. at 5%	6.66	5.89	0.42	0.47	4.69	5.69	10.39	11.54	0.42	0.51	14.67	12.61
C.V. (%)	4.37	3.75	4.17	4.5	3.74	4.4	3.87	4.25	3.76	4.42	4.34	3.61

Table 6: Economics of various integrated nutrient management treatments on tomato

Treatment	Economics							
	Total cost of cultivation (Rs.)		Total income (Rs.)		Net profit (Rs.)		B:C ratio	
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
T_1	85730	88220	268958	291210	183228	202991	2.14	2.30
T_2	120919	124740	398906	428400	277988	303660	2.30	2.43
T_3	106308	109793	313826	338130	207517	228337	1.95	2.08
T_4	89291	90375	297635	318750	208345	228375	2.33	2.53
T_5	94117	100650	280948	311100	186830	210450	1.99	2.09
T_6	94264	99700	267891	296310	173627	196610	1.84	1.97
T_7	87030	90405	272501	292740	185471	202335	2.13	2.24
T_8	95770	102841	290763	324360	194993	221519	2.04	2.15
T_9	95430	104083	283281	318240	187851	214157	1.97	2.06
T_{10}	107665	118541	350131	399840	242466	281299	2.25	2.37
T_{11}	130170	139964	452766	496740	322596	356776	2.48	2.55
T_{12}	108630	114062	332330	363120	223700	249058	2.06	2.18

SE(m) ±	2199.83	2681.04	7111.48	8536.47	4679.73	6397.33	0.04	0.06
C.D. at 5%	6493.51	7913.98	20991.85	25198.17	13813.75	18883.81	0.13	0.17
C.V. (%)	3.76	4.34	3.88	4.25	3.75	4.59	3.61	4.30

4. Conclusion
From the present investigation it was concluded that T11 was found to be best among all treatment in terms of growth and yield of tomato i.e., plant height, stem diameter, number of branches, number of fruits, fruit diameter, fruit weight and economics etc. It also provided highest amount of return as compared to other treatments. It is concluded from the investigation that the treatment T11 was found suitable for application in tomato cultivation. Therefore, combination of biofertilizer, FYM, VC and PM etc. can be suggested for cultivation practices that would enhance crop yield. It also proved to be cost effective.

5. Conflicts of interest
No conflicts.

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