Original Research Article

Effect of INM Practices on the Quality Parameters in Tomato (*Lycopersicon esculentum* L.) under Southern Rajasthan Conditions

Abstract

An experiment on Tomato (*Lycopersicon esculentum* L.) was 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 fruit growth, yield and quality of tomato variety Abhilash. The experiment was conducted in Randomized Block design. The nutrient sources applied were Biofertilizer (PSB+Azotobector) @ 5kg each per ha; Vermicompost (VC) @10t/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. It is clear from the results that the maximum specific gravity under the application of 75% RDF + 25% organic (FYM+VC+PM) (T_{11}) was 1.16 and 1.19 g/cm3, the T.S.S content was 5.45 and 5.67^{o}brix, the ascorbic acid content was 25.53 and 25.53 mg/100g, and the acidity was 0.620% and 0.650% in both years, respectively. The lowest values for each attribute were noted when receiving control therapy. According to the results of the current experiment, T_{11} was shown to be the optimum treatment for tomato development and yield, as measured by ascorbic acid, T.S.S., lycopene content, specific gravity, and acidity content among other factors. The investigation's findings support the conclusion that the T_{11} therapy is appropriate for use in tomato growing.

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

1. INTRODUCTION

India is bestowed with a wide range of agro-climatic and soil conditions. Therefore, almost all types of vegetables can be grown in one or other parts of the country. Indian farmers grow an amazing number that is 175 different vegetables but Potato, Onion, Tomato, Okra, and Cauliflower account for 60% of total production.

Tomato (*Lycopersicon esculentum* L.) belongs to the genus Lycopersicon under the solanaceae family. Tomato is an herbaceous sprawling plant growing to 1-3 m in height with a weak woody stem. It is a true diploid with 2n=24.

The cultivation area available to produce tomato across India during the fiscal year 2022 is estimated to have amounted to 841 thousand hectares with a production of 20300 thousand tonnes. This was a slight decrease from the previous fiscal year 2021, which was 845 thousand hectares. India ranked second on the list of nations producing tomatoes during the measured time period (Anonymous, 2022a). Country has achieved the previous year target of production of tomato in 2021, which was 21181 thousand tonnes.

In India, the major production states are Madhya Pradesh, Andhra Pradesh, Karnataka, Tamil Nadu, Orissa, Gujarat, West Bengal, Maharashtra, Chhattisgarh, Maharashtra, and Bihar. Madhya Pradesh has risen as a major tomato producing states in India in 2021 with an average production of 2970 tonnes followed by Andhra Pradesh (2,217 tonnes) which occupies the second position in production (Anonymous, 2022b). Worldwide 177,118,248 tonnes of tomato are produced per year. China is the largest tomato producer in the world with 56,423,811 tonnes production volume per year. India comes second with an average production of 18,399,000 tonnes yearly production.

Rajasthan has achieved the 232.86 thousand tonnes of tomato with a contribution of 1.15% of the total India's production in year 2021-22. Additionally, the state has estimated to increase the production and contribution in upcoming years (Anonymous, 2022b).

Integrated nutrient management like farm yard manure, poultry manure, vermi-compost and urban compost etc. are sustainable manures and are important sources of nutrients. Farm yard manure supplies macro and micronutrients to the soil and improves the physical, chemical and biological properties (Poonkodi *et al*., 2019). Vermicompost could be used as an excellent soil amendment for main field and nursery bed and has been reported to be useful in raising nursery species plant (Chanda *et al*., 2011).

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 constant use of chemical fertilisers raises the level of heavy metals in the soil, disrupts soil health, and renders soil unfit for long-term plant development Chanda *et al*., (2011) and Anonymous (2013).

Large quantities of both organic and inorganic nutrients are required for economic yield and improve quality of tomato. The yield of tomato is low; since plant nutrients are limiting the tomato yield (Mohd *et al.*, 2002). So, must be adding adequate supply of the balanced nutrients to increase yield and improve the fruit quality. Therefore, this study has been conducted to determined adequate amount of NPK, FYM, Vermi-compost and Biofertilizer on tomato crop for its better growth, higher yield and improves fruit quality in tomato.

Therefore, it is need to estimate the accurate amount of organic and inorganic fertilizers to enhance the yield and quality of tomatoes. Keeping these facts in view, the present investigation was conducted to assess the effect of organic manure, chemical fertilizers with bio fertilizers on yield and quality parameters of tomato

2. MATERIALS AND METHODS

At the Agriculture Research Farm, School of Agriculture Science & Technology, Sangam University, Bhilwara, Rajasthan (India), an experiment on tomatoes (*Lycopersicon esculentum* L.) was carried out during the growing seasons of 2020-21 and 2021–22 to better understand the impact of Integrated Nutrient Management at different doses combination on quality of tomato variety Abhilash. The experiment's Randomized Block Design was used. Applying biofertilizer (PSB+Azotobacter) at a rate of 5 kg per ha, vermicompost (VC) at a rate of 10 t/ha (100%), FYM at a rate of 25 t/ha (100%), and PM at a rate of 8 t/ha (100%), were the nutrient sources used. Twelve treatments were created for the current experiment using the various combination doses of integrated nutrient management described in and duplicated three times.

Table 1: Treatments details for tomato given with their notation

Notation	Treatments
T1	100% RDF (Control)
T2	100% RDF+Biofertilizer
T3	75% RDF+Biofertilizer
T4	100% FYM + Biofertilizer
T5	100% VC+ Biofertilizer
T6	100% PM+ Biofertilizer
T7	25%RDF+75%VC+ Biofertilizer
T8	100% organic (33%FYM+33%VC+33%PM)
T9	75% organic (FYM+VC+PM) + Biofertilizer
T10	50% RDF + 50% organic (FYM+VC+PM)
T11	75% RDF + 25% organic (FYM+VC+PM)

T12	25% RDF +25%FYM+25%VC +Biofertilizer

2.1 Experimental site and agro-climatic conditions of Bhilwara

The present field experiment was laid out at Agriculture Research Farm, School of Agriculture Science & Technology, Sangam University, Bhilwara, Rajasthan during the zaid season of 2020-21 and 2021-22. Geographically, 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 millimeters (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 Nursery Techniques

The seeds were purchased from a local Bhilwara distributor. For the first and second years of the experiment, tomato seeds were planted in January 2020 and January 2021, respectively, to develop high-quality seedlings, frequent irrigation and the required plant protection measures were implemented.

2.3 Experimental design, layout and treatments

The experiment was laid out in randomized block design (RBD) having 12 Treatment which were replicated 3 times.

The treatment combinations are as follows: 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)] and T_{12} (25% RDF +25%FYM+25%VC +Biofertilizer).

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

Influence of integrated nutrient management was found to be significant in enhancing quality characters of tomato in both the years. Application of different sources of nutrients significant influence the quality of the fruits in the present investigation as given in the table. The application of 75% RDF + 25% organic (FYM+VC+PM) (T_{11}) gave significantly higher specific gravity 1.16 and 1.19 g/cm3 followed by 50% RDF + 50% organic (FYM+VC+PM) (1.12 and 1.14 g/cm3). The minimum specific gravity (0.99 and 1.02 g/cm3) was noted under RDF i.e., NPK kg. /ha) shown in table 2.The increase in specific gravity at 75% RDF + 25% organic (FYM+VC+PM) might be due to fact that application of nitrogenous fertilizer diluted the juice of the fruits as compared to the application of organics alone. Earlier Gosavi *et al*., (2010) and Howlader *et al*., (2019) also noted similarity with these results.

Applications of different sources of nutrients significantly influence the T.S.S. of the fruits in the present investigation as given in the shown in table 2.The application of 75% RDF + 25% organic (FYM+VC+PM) (T_{11}) gave significantly higher T.S.S content 5.45 and 5.66^{o}brix followed by 50% RDF + 50% organic (FYM+VC+PM) (5.45 and 5.66 ^{O}brix). The minimum T.S.S (4.82 and 5.03 ^{O}brix) was noted under 100% RDF i.e., control as shown in table 2.

Data on ascorbic acid content is as given in table 2 shows that maximum ascorbic acid content was recorded under T_2 (100% RDF+Biofertilizer) i.e., 26.11 and 27.11 mg/100g followed by 75% RDF + 25% organic (FYM+VC+PM) (T11), i.e., 25.53 and 25.53 mg/100g in both the years respectively. Which was noted at par with the T_{10} (50% RDF + 50% organic (FYM+VC+PM). The minimum ascorbic acid content was recorded under 100% VC+ Biofertilizer (T_5) i.e., 19.22 and 19.41 mg/100g. The higher ascorbic content noted by the application of different organic sources might be the same as the T.S.S. of the fruits vary.

The TSS and Ascorbic content was noted higher at less fertilizer levels compared to the higher levels. This is due to the fact that excess moisture content by the presence higher levels of fertilizers. Pal *et al.* (2015), Chopra *et al.* (2017) and Jat *et al.* (2022) are also agreed with the present findings. Manickam *et al.* (2022) revealed that the quality parameters like ascorbic acid content, total soluble solids (TSS), and titrable acidity were higher under the organic source of nutrients than chemical only or integrated nutrient sources.

The lycopene content was significantly influenced by various treatments (Table 2).

In year 2020-21, the treatment T_{11} [75% RDF + 25% organic (FYM+VC+PM)] registered highest lycopene content of 5.53 mg/100g of fresh fruits sample and was significantly superior to all other treatments. The treatment T_{10} [50% RDF + 50% organic (FYM+VC+PM)] and T2 (100% RDF+Biofertilizer) were statistically at par with T_{11} with the lycopene content of 5.03 and 4.53 mg/100g respectively. These treatments are also significantly greater over T_1 (100% RDF) which recorded 4.07 mg/100g lycopene and was the minimum value in first year.

In year 2021-22, the treatment T_{11} [75% RDF + 25% organic (FYM+VC+PM)] registered highest lycopene content of 5.61 mg/100g of fresh fruits sample and was significantly superior to all other treatments. The treatment T_2 (100% RDF+Biofertilizer) and T_{10} [50% RDF + 50% organic (FYM+VC+PM)] were statistically at par with T_{11} with the lycopene content of 5.55 and 5.14 mg/100g respectively. These treatments are also significantly greater over T_1 (100% RDF) which recorded 4.19 mg/100g lycopene and was the minimum value in second year. Similar reports were also observed by Chopra *et al*. (2017) and Jat *et al*. (2018).

Acidity (%) in the fruits as affected by various nutrient management vary significant in both the years as evident from the data depicted in table 2.

The table showed that treatments showed significant response with regards in the total acidity (%). The maximum acidity was recorded under T_{11} [75% RDF + 25% organic (FYM+VC+PM)] i.e., 0.620% and 0.650% in both years followed by T_2 (100%

RDF+Biofertilizer) i.e., 0.600% and 0.612%. Which was noted at par with the T_{11} and statistically significant and greater over control T_1 (100% RDF) i.e., 0.220% and 0.295% in both years respectively. The minimum acidity was observed in case of treatment provided 100% RDF (T_1) i.e., 0.220% and 0.295% in both years respectively. Similar reports were also observed by Pal *et al*. (2015), Chopra *et al*. (2017), Jat *et al*. (2022) and Kushum *et al*. (2022).

Table 2: Impact of integrated nutrient management on quality parameters

Treatments	Specific gravity (g/cm^3)		T.S.S (ºBrix)		Ascorbic acid content(mg/100g)		Lycopene content		Acidity (%)	
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
T1	0.99	1.02	4.82	5.03	22.77	23.05	4.07	4.19	0.220	0.295
T2	1.15	1.18	5.40	5.51	26.74	27.11	4.53	5.55	0.600	0.612
T3	1.08	1.11	5.19	5.21	23.31	23.41	3.93	4.02	0.450	0.480
T4	1.07	1.09	5.16	5.31	24.81	25.32	4.00	4.13	0.410	0.420
T5	1.02	1.05	5.04	5.26	19.22	19.41	3.63	3.71	0.270	0.290
T6	0.97	1.00	5.15	5.22	24.29	24.61	3.80	3.84	0.190	0.200
T7	1.01	1.02	5.25	5.31	20.30	20.31	4.43	4.56	0.250	0.270
T8	1.06	1.07	5.26	5.31	24.23	25.33	4.03	4.13	0.360	0.380
T9	1.04	1.05	5.09	5.19	22.54	22.74	3.47	3.55	0.300	0.310
T10	1.12	1.14	5.45	5.66	25.12	25.13	5.03	5.14	0.550	0.570
T11	1.16	1.19	5.70	5.80	25.53	25.53	5.53	5.61	0.620	0.650
T12	1.10	1.11	4.99	5.12	21.62	21.66	3.80	3.89	0.500	0.510
SE(m) ±	0.03	0.02	0.12	0.11	0.46	0.33	0.10	0.08	0.010	0.011
C.D. at 5%	0.08	0.07	0.34	0.33	1.37	0.98	0.29	0.23	0.031	0.034
C.V. (%)	4.32	3.74	3.88	3.58	3.43	2.43	4.02	3.07	4.57	4.76

CONCLUSION

According to the results of the experiment, T_{11} was the treatment that produced the best tomato growth and yield in terms of total soluble solids, acidity, lycopene, ascorbic acid, specific gravity, and other factors. In comparison to other therapies, it also offered the highest amount of return. The investigation's findings support the conclusion that the T_{11} therapy is appropriate for use in tomato growing. Therefore, it is possible to offer a combination of biofertilizer, vermicompost, azotobacter, etc. for cultivation techniques that would increase crop output. Additionally, it showed to be economical.

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