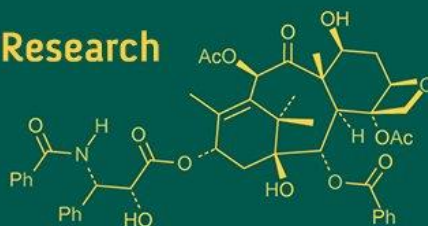


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Amit Kumar
M.Sc. Department of
Horticulture, Institute of
Agricultural Science
Bundelkhand University
Jhansi, Uttar Pradesh, India

Jay Narayan Tiwari
Assistant Professor
Department of Horticulture,
Institute of Agricultural
Science Bundelkhand
University Jhansi, Uttar
Pradesh, India

Karan Singh
Department of Post Harvest
Management: Acharya
Narendra Deva University of
Agriculture & Technology,
Kumarganj, Ayodhya, Uttar
Pradesh, India

Rajeev Kumar
M.Sc. Department of
Horticulture, Institute of
Agricultural Science
Bundelkhand University
Jhansi, Uttar Pradesh, India

Shashi Shekhar Mishra
Department of Vegetable
Science: Acharya Narendra
Deva University of Agriculture
& Technology, Kumarganj,
Ayodhya, Uttar Pradesh, India

Corresponding Author:
Karan Singh
Department of Post Harvest
Management: Acharya
Narendra Deva University of
Agriculture & Technology,
Kumarganj, Ayodhya, Uttar
Pradesh, India

Effect of integrated nutrient management on growth, yield and quality of tomato (*Solanum lycopersicum* L.) in semi-arid condition of Bundelkhand

Amit Kumar, Jay Narayan Tiwari, Karan Singh, Rajeev Kumar and Shashi Shekhar Mishra

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Abstract

A field experiment was conducted during the Rabi season of 2024–25 at the Agriculture Research Farm, near Narayan Bagh, Bundelkhand University, Jhansi, Uttar Pradesh, India, to evaluate the effect of integrated nutrient management on the growth, yield, and quality of tomato (*Solanum lycopersicum* L.) under semi-arid conditions of Bundelkhand. Eight nutrient management treatments, viz., T₀: 100% RDF, T₁: 100% RDF + PSB, T₂: 75% RDF + PSB, T₃: 125% RDF + PSB, T₄: 75% RDF + 25% FYM, T₅: 75% RDF + 25% FYM + PSB, T₆: 75% RDF + 25% Vermicompost, and T₇: 75% RDF + 25% Vermicompost + PSB, were evaluated in a Randomized Block Design with three replications. Among the different treatments, T₇ (75% RDF + 25% Vermicompost + PSB) recorded significantly superior growth, yield, and quality attributes of tomato. The treatment recorded higher plant height, number of branches per plant, days to first flowering, days to 50% flowering, number of fruits per plant, fruit length, fruit diameter, fruit weight, and fruit yield. It also recorded the maximum fruit shelf life and total soluble solids (TSS). The highest fruit weight (89.81 g) and fruit yield (462.83 q ha⁻¹) were recorded under T₇. The superior performance of T₇ may be attributed to the combined and complementary effects of inorganic fertilizer, vermicompost, and PSB, which improved nutrient availability, soil fertility, root development, nutrient uptake, and photosynthetic efficiency, ultimately promoting better fruit development and yield. Thus, the integrated application of 75% RDF + 25% Vermicompost + PSB proved effective for enhancing the growth, yield, and quality of tomato under semi-arid conditions of Bundelkhand.

Keywords: Integrated nutrient management, vermicompost, RDF, FYM, PSB, yield, quality, soil fertility

Introduction

Among the all vegetables, tomato (*Solanum lycopersicum* L.) is one of the most important and widely cultivated vegetable crops in the world. It is valued for its nutritional, medicinal, and economic importance and is consumed fresh as well as processed into products such as sauces, ketchup, paste, puree, soups, and preserves. Tomato fruits are rich in lycopene, β -carotene, vitamin C, vitamin E, potassium, and other bioactive compounds. Lycopene is the major carotenoid responsible for the characteristic red colour of ripe tomato fruits and is also associated with several health-promoting properties (Doniela Erba *et al.*, 2013) [4].

Tomato is cultivated extensively in tropical and subtropical regions. India is the second-largest producer of tomato after China, with 21.32 million tonnes of production from 0.812 million hectares during 2023–24, with an average productivity of 26.09 tonnes ha⁻¹. In Uttar Pradesh, tomato occupied about 0.022 million hectares, producing 0.852 million tonnes with a productivity of 38.72 tonnes ha⁻¹ during 2023–24 (NHB, 2023–24). Despite its importance, sustainable improvement in productivity remains a major challenge due to declining soil fertility, imbalanced nutrient use, increasing fertilizer costs, and adverse environmental effects associated with excessive dependence on inorganic fertilizers.

Integrated nutrient management (INM) is an effective approach for sustainable crop production that involves the balanced and efficient use of inorganic fertilizers, organic manures, and biological nutrient sources. The integrated application of these nutrient sources can improve nutrient availability, soil health, microbial activity, nutrient-use efficiency, and

crop productivity while reducing dependence on chemical fertilizers (Singh *et al.*, 2023) ^[11]. Organic manures such as farmyard manure (FYM) and vermicompost improve soil physical, chemical, and biological properties and provide nutrients gradually throughout the crop growth period. Vermicompost also enhances microbial activity and nutrient availability, thereby promoting plant growth and fruit development (Tetarwal *et al.*, 2011) ^[12]. Biofertilizers such as phosphate-solubilizing bacteria (PSB) play an important role in improving phosphorus availability by converting unavailable forms of phosphorus into forms readily accessible to plants. The combined use of PSB with organic manures and inorganic fertilizers may enhance root development, nutrient uptake, photosynthetic activity, fruit development, and yield. Several studies have reported beneficial effects of integrated nutrient management on growth and yield of tomato (Beura *et al.*, 2017; Siddaling *et al.*, 2017; Meena *et al.*, 2017; Mohit *et al.*, 2019; Ramesh and Sikder, 2021) ^[1, 10, 5, 6, 9].

Materials and Methods

The present experiment was conducted at the Agriculture Research Farm, Narayan Bagh, Bundelkhand University, Jhansi, Uttar Pradesh, India, during the Rabi season of 2024–25. The soil of the experimental site was sandy clay in texture. The field experiment was conducted in a Randomized Block Design (RBD) with three replications to minimize experimental error and ensure the reliability of the results. The experiment consisted of eight nutrient management treatments, namely T₀: 100% RDF (Control), T₁: 100% RDF + PSB, T₂: 75% RDF + PSB, T₃: 125% RDF + PSB, T₄: 75% RDF + 25% FYM, T₅: 75% RDF + 25% FYM + PSB, T₆: 75% RDF + 25% Vermicompost, and T₇: 75% RDF + 25% Vermicompost + PSB. The treatments were randomly assigned within each block. The crop was planted on December 10, 2024, and the first harvesting was carried out on March 10, 2025. The recommended dose of fertilizers (RDF), farmyard manure (FYM), vermicompost, and phosphate-solubilizing bacteria (PSB) were applied according to the respective treatment combinations.

Observations were recorded for various growth, flowering, yield, and quality parameters. Growth parameters included plant height, stem diameter, plant spread, and number of branches per plant, number of leaves per plant, leaf length, and leaf width. Flowering parameters included days to first flowering and days to 50% flowering. Yield and yield-attributing parameters included days to first fruit picking, number of fruits per plant, fruit length, fruit diameter, average fruit weight, and fruit yield. Quality parameters such as total soluble solids (TSS) and fruit shelf life were also evaluated. The observations were recorded at the appropriate growth and harvesting stages using standard procedures. The data obtained from the experiment were subjected to statistical analysis of variance (ANOVA) as per the standard procedure for Randomized Block Design. Treatment means were compared at a 5% level of significance ($p \leq 0.05$) to determine the significance of differences among the treatments.

Results and Discussion

Growth Attributes

The results of the growth parameters of tomato are presented in Table-1. The present investigation revealed that integrated nutrient management (INM) had a significant

influence on the vegetative growth of tomato. Among the different treatments, T₃ (125% RDF + PSB) recorded the maximum plant height of 19.04 cm and 69.27 cm at 30 and 60 days after transplanting (DAT), respectively. The same treatment also recorded the maximum number of branches per plant, with 7.30 branches at 30 DAT. At harvest, T₇ (75% RDF + 25% Vermicompost + PSB) recorded the maximum plant height (89.24 cm) and the highest number of branches per plant (21.97). The superior vegetative growth observed under the integrated application of inorganic fertilizer, vermicompost, and PSB may be attributed to improved nutrient availability, enhanced microbial activity, better root development, and efficient nutrient uptake by the plants. The combined application of organic and inorganic nutrient sources may have provided a balanced supply of essential nutrients throughout the crop growth period, resulting in vigorous plant growth and better canopy development. The higher plant height observed under T₃ at the early growth stages may be attributed to the higher availability of readily soluble nutrients supplied through 125% RDF along with PSB. The application of phosphorus-solubilizing bacteria may have further enhanced phosphorus availability in the soil, thereby promoting root growth, cell division, and overall plant development. At later stages, the superior performance of T₇ may be due to the gradual release of nutrients from vermicompost, combined with the readily available nutrients from RDF and enhanced nutrient availability through PSB. This balanced and sustained nutrient supply may have resulted in better plant growth and increased branching.

The increase in the number of branches per plant under integrated nutrient management may also be associated with improved nutritional status of the plants, enhanced photosynthetic activity, and better vegetative development. Vermicompost additionally improves soil physical and biological properties, thereby creating favourable conditions for root proliferation and nutrient absorption.

Similar findings have been reported by Mohit *et al.* (2019) ^[6], Ramesh and Sikder (2021) ^[9], who observed significant improvement in plant growth and yield attributes of tomato with the integrated application of inorganic fertilizers, organic manures, and biofertilizers.

Table 1: Effect of Integrated Nutrient Management on Plant Height and Number of Branches per Plant of Tomato at Different Growth Stages.

Treatments	Plant height			Number of branches plant ⁻¹		
	30 DAT	60 DAT	At harvest	30 DAT	60 DAT	At harvest
T ₀	17.78	66.11	79.39	6.83	15.26	17.73
T ₁	18.66	68.33	79.72	7.09	15.61	18.58
T ₂	12.50	49.94	70.17	5.58	14.56	16.98
T ₃	19.04	69.27	88.40	7.30	17.52	19.93
T ₄	14.84	59.36	82.41	5.66	16.59	19.54
T ₅	16.08	59.67	86.07	6.16	17.76	21.36
T ₆	17.26	62.22	84.44	5.66	16.88	19.72
T ₇	17.31	64.46	89.24	6.63	18.30	21.93
SEm±	0.19	0.62	0.63	0.10	0.08	0.35
CD	0.57	1.87	1.90	0.31	0.24	1.08

Yield Attributes

The results of the yield attributes of tomato are presented in Table .2. The present investigation revealed that integrated nutrient management (INM) exerted a significant influence on the yield and yield-attributing characters of tomato.

Among the different treatments, T₇ (75% RDF + 25% Vermicompost + PSB) recorded the maximum fruit length, fruit diameter, fruit weight, and fruit yield, with values of 6.20 cm, 5.82 cm, 89.81 g, and 462.83 q/ha, respectively. The increase in fruit size, fruit weight, and fruit yield under T₇ may be attributed to the combined and complementary effects of inorganic fertilizers, vermicompost, and PSB. The application of vermicompost may have improved soil physical and biological properties, enhanced microbial activity, and provided nutrients gradually throughout the crop growth period. The readily available nutrients supplied through RDF, together with the improved nutrient availability facilitated by PSB, might have promoted better root development, nutrient uptake, photosynthetic activity, and translocation of assimilates towards the developing fruits.

Phosphate-solubilizing bacteria (PSB) may also produce small quantities of growth-promoting substances and phytohormones such as indole-3-acetic acid (IAA), gibberellins, and cytokinins. These substances, together with the nutrients supplied through chemical fertilizers and vermicompost might have improved the physiological activities of the plants and promoted the transition from the vegetative to the reproductive phase. The enhanced availability of phosphorus and other essential nutrients may have further contributed to improved fruit development, resulting in greater fruit size, average fruit weight, and overall fruit yield.

The higher fruit yield under T₇ may also be attributed to better canopy development, increased photosynthetic efficiency, and greater accumulation and translocation of photosynthesis towards the fruits. Thus, the combined

application of 75% RDF + 25% Vermicompost + PSB proved more effective in improving the yield attributes and productivity of tomato under the experimental conditions. These findings are in agreement with those reported by Dev *et al.* (2012)^[3] and Kempegowda *et al.* (2017)^[10] in tomato.

Quality Attributes

The results pertaining to the quality attributes of tomato are presented in Table-2. The integrated application of nutrient sources significantly influenced the quality characteristics of tomato fruits. Among the different treatments, T₇ (75% RDF + 25% Vermicompost + PSB) recorded the maximum shelf life of fruit (14.27 days) and total soluble solids (TSS) content (5.07 °Brix). The improvement in fruit shelf life under T₇ may be attributed to balanced and sustained nutrient availability resulting from the combined application of RDF, vermicompost, and PSB. Vermicompost may have improved the nutritional status of the plants and contributed to better fruit development and structural integrity, which could have delayed physiological deterioration during storage. The higher TSS content may be associated with enhanced photosynthetic activity and greater accumulation of soluble sugars and other soluble solids in the fruits. The balanced availability of nitrogen, phosphorus, potassium, and other nutrients may have enhanced the synthesis and translocation of photosynthesis towards the developing fruits, thereby improving fruit quality. The combined application of organic manure, inorganic fertilizer, and PSB may therefore provide a favorable nutritional environment for producing tomato fruits with better keeping quality and higher TSS content. The present findings are in conformity with those reported by Meena *et al.* (2017)^[5] in tomato.

Table 2: Effect of Integrated Nutrient Management on Plant Height and Number of Branches Plant⁻¹ of Tomato at Different Growth Stages

Treatments	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (gm)	Fruit yield (q/ha)	Shelflife of fruit (Days)	TSS (°Brix)
T ₀	4.82	4.84	58.71	408.47	10.17	4.10
T ₁	5.09	5.16	69.66	410.42	10.50	4.23
T ₂	4.59	4.28	45.65	380.42	9.40	3.57
T ₃	5.86	5.61	83.36	418.69	13.00	4.53
T ₄	5.25	5.30	73.67	430.12	11.10	4.33
T ₅	6.15	5.75	86.59	440.89	13.37	4.77
T ₆	5.58	5.48	81.51	451.26	12.77	4.47
T ₇	6.20	5.82	89.81	462.83	14.27	5.07
SEm±	0.06	0.03	1.26	5.37	0.15	0.10
CD	0.19	0.10	3.82	16.28	0.44	0.31

Conclusion

The study concluded that integrated nutrient management significantly improved the growth, yield, and quality of tomato. Among the treatments, T₇ (75% RDF + 25% Vermicompost + PSB) proved superior, recording the highest fruit weight, fruit yield, shelf life, and TSS. Thus, T₇ may be recommended for sustainable tomato production under semi-arid conditions of Bundelkhand.

References

- Beura JK, Monalisa SP, Tarai RK. Impact of integrated nutrient management on the yield performance of winter tomato (*Lycopersicon esculentum* Mill.) cv. Arka Vikas. Asian Journal of Soil Science. 2017;12(1):94-97.
- Chopra AK, Payum T, Srivastava S, Kumar V. Effects of integrated nutrient management on agronomical attributes of tomato (*Lycopersicon esculentum* L.) under field conditions. Archives of Agriculture and Environmental Science. 2017;2(2):86-91.
- Dev P, Singh IP, Satyaparkash, Mohan B, Kumar V, Singh M. Impact of integrated nutrient management on the yield performance of summer tomato (*Lycopersicon esculentum* Mill.) cv. Kanchan Special. International Journal of Agricultural Sciences. 2012;8(1):63-65.
- Erba D, Casiraghi MC, Ribas-Agustí A, Cáceres R, Marfà O, Castellari M. Nutritional value of tomatoes (*Solanum lycopersicum* L.) grown in greenhouse by different agronomic techniques. Journal of Food Composition and Analysis. 2013;31(2):245-251. doi:10.1016/j.jfca.2013.05.014.
- Meena ML, Gehlot VS, Meena DC, Kishor S, Kumar S, Meena JK. Impact of biofertilizers on growth, yield and quality of tomato (*Lycopersicon esculentum* Mill.) cv. Pusa Sheetal. Journal of Pharmacognosy and Phytochemistry. 2017;6(4):1579-1583.

6. Mohit MK, Singh MK, Singh SP, Naresh RK. Effect of integrated use of organic and inorganic sources of nutrients on growth, yield, quality and profitability of tomato (*Lycopersicon esculentum* Mill.) var. Pusa Rohini. International Journal of Agricultural and Statistical Sciences. 2019;15(1):57-66.
7. National Horticulture Board. Second advance estimates of 2023-24 of area and production of horticultural crops. Ministry of Agriculture and Farmers Welfare, Government of India; 2024. Posted June 4, 2024.
8. Pavitra D, Singh IP, Braj M, Vinuj K, Manender S. Impact of integrated nutrient management on the yield performance of summer tomato (*Lycopersicon esculentum* Mill.) cv. Kanchan Special. International Journal of Agricultural Sciences. 2012;8(1):63-65.
9. Ramesh E, Sikder S. Standardization of integrated nutrient management for growth and yield of tomato. International Journal of Environment and Climate Change. 2021;11(11):106-112.
10. Siddaling N, Kempegowda K, Raghavendra H. Effect of integrated nutrient management on growth and yield of tomato (*Solanum lycopersicum* L.) var. Arka Rakshak. International Journal of Plant & Soil Science. 2017;16(2):1-7. doi:10.9734/IJPSS/2017/33280.
11. Singh DP, Maurya BK, Kumari M, Singh RP, Singh DB, Kumar P. Response of integrated nutrient management (INM) on growth and yield attributes in tomato (*Solanum lycopersicum* L.). Annals of Agricultural Research. 2023;44(1):120-126.
12. Tetarwal JP, Ram B, Meena DS. Effect of integrated nutrient management on productivity, profitability, nutrient uptake and soil fertility in rainfed maize (*Zea mays* L.). Indian Journal of Agronomy. 2011;56(4):373-376.