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Influence of organic and inorganic inputs on yield and quality parameters in tomato (*Solanum lycopersicum* L.)

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Abstract

A field experiment was undertaken during the *rabi* season of 2025-2026 to assess the impact of organic and inorganic inputs on tomato output and quality. The experiment included several mixes of farmyard manure (FYM), humic acid, lignite, microbial consortia, and recommended doses of fertilizers (RDF). Average fruit weight, number of fruits per plant, fruit yield per plant, fruit yield per plot, and fruit yield per hectare were among the yield metrics that were noted. Fruit hardness, fruit length, fruit girth, total soluble solids (TSS), pH, and ascorbic acid concentration were among the quality criteria assessed. When compared to applying inorganic fertilizers alone, the findings showed that applying 100% RDF in combination with humic acid (5 L ha⁻¹) and microbial consortia (14 kg ha⁻¹) considerably enhanced yield and quality parameters. Maximum average fruit weight, number, yield, TSS, firmness, and ascorbic acid concentration were all reported by the treatment. According to the study, tomato production and fruit quality may be successfully increased while soil health and nutrient usage efficiency are improved by integrated nutrient management that includes organic amendments and microbial inoculants.

Keywords: Tomato, integrated nutrient management, humic acid, microbial consortium, lignite, yield quality etc...

Introduction

The fruit is particularly rich in lycopene, a powerful antioxidant responsible for its red colour, which helps in reducing oxidative stress, improving cardiovascular health and lowering the risk of certain cancers. In addition, tomato contains dietary fiber and several bioactive compounds that contribute to better digestion and overall health. One of the most extensively grown vegetable crops worldwide is the tomato (*Solanum lycopersicum* L.), which is a member of the solanaceae family. Because of its great market demand and broad range of adaptation, it is widely grown in tropical, subtropical, and temperate locations. A vital part of everyday diets, tomatoes are consumed in a variety of ways, including fresh salads, cooked meals, and processed goods like sauces, juices, soups, and pastes. In terms of nutrition, tomatoes are said to be a good source of important minerals like potassium and phosphorus as well as vitamins A, C, and E. The fruit is especially high in lycopene, a potent antioxidant that gives it its red hue. Lycopene improves cardiovascular health, lowers the risk of some malignancies, and reduces oxidative stress. Furthermore, Organic inputs are critical for sustainable agriculture because they improve soil health, boost nutrient availability, and encourage long-term crop development. Farmyard manure (FYM), humic acid, lignite, and the microbial consortium all play essential roles in boosting soil fertility and crop performance. FYM improves soil structure and water holding capacity, whilst humic acid encourages nutrient absorption and root development. Lignite increases organic matter content and stimulates beneficial microbial activity. Microbial consortiums help the nutrient cycle by promoting nitrogen fixation and phosphorus solubilization. The use of organic sources maintains environmental balance while reducing dependency on chemical fertilizers. According to Sengupta and Samanta (2024) [17], organic additions increase soil biological activity, which improves nutrient transformation and plant development. Humic acid has been identified as an excellent organic supplement for improving nutrient absorption and stimulating plant growth. Humic acid enhances nutrient intake and physiological efficiency, which improves productivity and quality significantly.

It stimulates root activity, resulting in greater absorption of key nutrients needed for fruit growth. According to Thakur *et al.* (2024) ^[20], the use of humic compounds improves yield qualities while also improving quality indicators such as total soluble solids and nutritional content. Lignite's high organic carbon and humic content promotes nutrient retention and progressive nutrient release, which increases crop output. It also helps to increase quality by ensuring a consistent nutrition delivery during important development phases. Microbial consortiums boost productivity by making nutrients available via biological processes such as nitrogen fixation and phosphorus solubilization. These microorganisms also improve quality parameters by promoting nutrient absorption and metabolic activity. According to Yadav *et al.* (2022) ^[22], mixing organic and inorganic nutrition sources improved tomato yield and quality by increasing nutritional availability and physiological efficiency.

Materials and Methods

The investigation was undertaken at Malla Reddy University's School of Agricultural Sciences in Hyderabad, Telangana. The experiment sought to explore the effect of organic and inorganic inputs on the growth, production, and quality of tomato during the *rabi* season period of (20/11/25 to 28/2/26) and the hybrid used is Saaho. The field experiment utilized a Randomized Block Design (RBD) with eight treatments and three replications. This strategy was chosen to decrease the impact of field variability and provide reliable comparisons across different treatment combinations. The experimental area was split into three identical blocks, each representing one replication. Within each block, all eight treatments (T₁ to T₈) were randomly allocated to separate plots, ensuring that each treatment appeared once in each replication. The study included twenty-four experimental plots (8 treatments). Randomization of treatments within each block helped to remove experimental bias, whilst replication allowed for precise calculation of experimental error and increased the dependability of the results. The experiment's data were statistically examined using analysis of variance (ANOVA) suited for Randomized Block Design to establish the significance of treatment effects.

Results and Discussion

Yield Parameters

The incorporation of organic inputs resulted in a gradual rise in fruit number. The treatment T₃ (100% RDF + HA + MC) produced the most fruits per plant (54.39), followed by T₄ (100% RDF + lignite + MC) with 51.62 fruits per plant. Increased microbial activity, faster root growth, and higher nutrient availability all contributed to better flowering and fruit set, which may explain these treatments' superior performance. The use of humic acid, lignite, and a microbial consortia in conjunction with inorganic fertilizers may have improved nutrient absorption efficiency and physiological activities that result in higher fruit output. Similar findings were reported by Meena *et al.* (2021) ^[7] and Yadav *et al.* (2022) ^[22] who have observed that integrated nutrient management significantly enhanced fruit number and yield attributes in tomato through improved nutrient availability and better soil health. The combined application of inorganic fertilizers with organic amendments and microbial inoculants significantly increased the number of fruits per cluster while the highest value was recorded in T₃ (100% RDF + humic acid + microbial consortium) with 6.0 fruits per cluster. This was followed by T₄ (100% RDF + lignite + microbial consortium), which produced (5.8) fruits per

cluster. The improved performance of these treatments may be due to enhanced nutrient availability, better root development, improved microbial activity, and efficient translocation of photosynthates towards reproductive organs. Similar findings were reported by Patil *et al.* (2017) ^[9] and Rajawat *et al.* (2019) ^[14], who observed that integrated nutrient management significantly improved flowering, fruit set, and cluster development in tomato.

The Average fruit weight was significantly influenced by the different nutrient management treatments, indicating the beneficial effect of integrated nutrient management on fruit development and yield attributes in tomato and the maximum average fruit weight was recorded in T₃ (100% RDF + humic acid + microbial consortium) with (98.48 g) fruit⁻¹, followed by T₄ (100% RDF + lignite + microbial consortium) with (95.76 g) fruit⁻¹. The increased fruit weight observed in these treatments may be attributed to improved nutrient availability, enhanced root activity, better translocation of photosynthates, and increased metabolic efficiency resulting from the combined application of organic amendments and microbial inoculants along with inorganic fertilizers. Humic acid and microbial consortium might have enhanced nutrient uptake efficiency and stimulated physiological processes responsible for better fruit growth and development. The minimum average fruit weight was observed in T₁ (100% recommended dose of fertilizers) with (70.53 g) per fruit, suggesting that sole application of inorganic fertilizers was comparatively less effective in improving fruit size and weight (Patel *et al.* 2020) ^[10].

Fruit yield plant⁻¹ was significantly influenced by the different nutrient management treatments. Among the treatments, T₁ (100% recommended dose of fertilizers) recorded the lowest fruit yield per plant (2.01 kg plant⁻¹), indicating that the sole application of inorganic fertilizers was comparatively less effective in enhancing productivity. The integration of organic amendments with inorganic fertilizers significantly improved fruit yield over the control treatment. The highest fruit yield per plant was recorded in T₃ (100% RDF + humic acid + microbial consortium) with (5.35 kg plant⁻¹), followed by T₄ (100% RDF + lignite + microbial consortium) with (4.49 kg plant⁻¹). Ramesh and Sikder (2021) ^[12] indicated that integrated nutrient management strategies greatly increased tomato production and growth characteristics by balancing nutrient delivery and increasing soil microbial activity. Fruit output eventually increased as a result of the treatments using organic amendments, which maintained continuous nutrient release and enhanced nutrient absorption. Saini *et al.* (2022) ^[15] observed similar findings.

Fruit yield plot⁻¹ exhibited significant variation among the nutrient management treatments, demonstrating the beneficial effect of integrated nutrient management practices on crop productivity. The incorporation of organic amendments and microbial inoculants along with inorganic fertilizers substantially enhanced fruit yield. The maximum fruit yield per plot was registered in T₃ (100% RDF + humic acid + microbial consortium) with (107.12 kg plot⁻¹), followed by T₄ (100% RDF + lignite + microbial consortium) with (98.86 kg plot⁻¹). The superior performance of these treatments may be attributed to improved nutrient solubilization, enhanced rhizospheric microbial activity, increased nutrient uptake efficiency, and better physiological utilization of assimilates, which collectively contributed to enhanced fruit production. Similar findings were reported by Kiran *et al.* (2018) ^[5], Naik *et al.* (2019) ^[8], and Bairwa *et al.* (2019) ^[2], who observed that integrated nutrient management practices significantly improved tomato yield and

productivity through balanced nutrient supply and improved soil fertility.

Fruit yield ha^{-1} was significantly influenced by the various nutrient management treatments, indicating the effectiveness of integrated nutrient management practices in enhancing crop productivity. Among all the treatments, T₃ (100% RDF + humic acid + microbial consortium) registered the highest fruit yield of (198.38 q ha^{-1}), followed by T₄ (100% RDF + lignite + microbial consortium) with (183.08 q ha^{-1}). The increased yield in these treatments may be attributed to improved nutrient availability, enhanced microbial proliferation in the rhizosphere, better root growth, and efficient utilization of nutrients, ultimately resulting in increased fruit production. Similar findings were reported by Suryawanshi *et al.* (2021) [18] who stated that the combined use of organic amendments, microbial inoculants, and inorganic fertilizers significantly enhanced tomato productivity by improving soil biological activity, nutrient solubilization, and physiological efficiency of plants. The treatments involving organic inputs alone also performed better than the control treatment due to sustained nutrient release and improved soil health throughout the crop growth period.

Quality Parameters

Fruit length was significantly influenced by the different nutrient management treatments, indicating the beneficial effect of integrated nutrient application on fruit growth and development. An increase in fruit length was observed with the incorporation of organic amendments and microbial inoculants along with inorganic fertilizers. The maximum fruit length was recorded in T₃ (100% RDF + humic acid + microbial consortium) with (4.43 cm), followed by T₄ (100% RDF + lignite + microbial consortium) with (4.37 cm). T₁ (100% recommended dose of fertilizers) recorded the minimum fruit length (3.92 cm), suggesting that the sole application of inorganic fertilizers was comparatively less effective in improving fruit development.

These findings indicate that the supplementation of organic amendments with reduced fertilizer doses effectively maintained better fruit development by improving nutrient uptake efficiency and soil health. Comparable observations were reported by Choudhary *et al.*, (2021) [3]. The maximum fruit girth was recorded in T₃ (100% RDF + humic acid + microbial consortium) with (4.22 cm), followed by T₄ (100% RDF + lignite + microbial consortium) with (4.07 cm). The improved fruit girth observed in these treatments may be attributed to enhanced nutrient availability, increased cell division and enlargement, improved metabolic activity, and efficient translocation of photosynthates towards fruit tissues. Similar findings were reported by Verma *et al.*, (2025) [21] and Parmar *et al.*, (2019) [11] who observed that integrated nutrient management significantly improved fruit growth, yield, and quality parameters in tomato. The maximum ascorbic acid content was recorded in T₃ (100% RDF + humic acid + microbial consortium) with (26.20 mg 100 g⁻¹), followed by T₄ (100% RDF + lignite + microbial consortium) with (26.00 mg 100 g⁻¹). The enhanced ascorbic acid content observed in these treatments may be attributed to improved nutrient availability, enhanced photosynthetic activity, better enzymatic reactions, and increased synthesis and accumulation of vitamin C in fruits. Similar findings were reported by Rai *et al.*, (2018) [13], who observed that integrated nutrient management significantly improved fruit quality and ascorbic acid content in tomato. Comparable results were also reported by Siddaling *et al.*, (2017) [19], who stated that combined application of organic and inorganic nutrient sources enhanced nutritional quality and biochemical characteristics in tomato fruits. Similar observations were also recorded by Verma *et al.*, (2025) [21], who reported that integrated nutrient management improved vitamin C content, fruit quality, and overall biochemical properties of tomato fruits.

Table 1: Effect of different and inorganic inputs on yield parameters

Treatment	Combinations	Number of fruits plant ⁻¹	Number of fruit cluster ⁻¹	Average fruit weight (gms)
T ₁	100% Recommended Dose Fertilizer	28.47	4.0	70.53 g
T ₂	100% RDF + FYM (25 T Ha^{-1})	33.25	4.8	83.25 g
T ₃	100% RDF+ HA (5 L ha^{-1}) + MC (14 Kg ha^{-1})	54.39	6.0	98.48 g
T ₄	100% RDF + Lignite (3 t ha^{-1}) + MC (14 Kg ha^{-1})	51.62	5.8	95.76 g
T ₅	75% RDF + HA (5 L ha^{-1})	43.75	5.4	90.27 g
T ₆	75% RDF + Lignite (3 t ha^{-1})	47.98	5.6	92.56 g
T ₇	FYM (25 T Ha^{-1}) + Lignite (3 t ha^{-1}) + MC (14 Kg ha^{-1})	40.57	5.0	89.56 g
T ₈	FYM (25 T Ha^{-1}) + HA (5 L ha^{-1}) + Lignite (1.5 t ha^{-1})	38.56	5.2	87.96 g
S.Em ($\pm$)		1.42	0.17	2.91
CD (p=0.05)		4.31	0.52	8.84

Table 2: Effect of different and inorganic inputs on fruit yield parameters

Treatment	Combinations	fruit yield plant ⁻¹	fruit yield plot ⁻¹	Yield ha^{-1}
T ₁	100% Recommended Dose Fertilizer	2.01	40.15	74.37
T ₂	100% RDF + FYM (25 T ha^{-1})	2.76	55.36	102.52
T ₃	100% RDF+ HA (5 L ha^{-1}) + MC (14 Kg ha^{-1})	5.35	107.12	198.38
T ₄	100% RDF + Lignite (3 T ha^{-1}) + MC (14 Kg ha^{-1})	4.49	98.86	183.08
T ₅	75% RDF + HA (5 L ha^{-1})	3.94	78.98	146.27
T ₆	75% RDF + Lignite (3 T ha^{-1})	4.44	88.82	164.48
T ₇	FYM (25 T ha^{-1}) + Lignite (3 T ha^{-1}) + MC (14 Kg ha^{-1})	3.63	72.66	134.57
T ₈	FYM (25 T ha^{-1}) + HA (5 L ha^{-1}) + Lignite (1.5 T ha^{-1})	3.39	67.83	125.62
S.Em ($\pm$)		0.13	2.59	4.80
CD (p=0.05)		0.39	7.86	14.56

Table 3: Effect of different and inorganic inputs on fruit yield parameters

Treatment	Combinations	Fruit length (cm)	Fruit girth (cm)	Ascorbic acid (mg/100 g)
T ₁	100% Recommended Dose Fertilizer	3.92	3.17	24.00
T ₂	100% RDF + FYM (25 T Ha ⁻¹)	3.95	3.32	24.50
T ₃	100% RDF+ HA (5 L ha ⁻¹) + MC (14 Kg ha ⁻¹)	4.43	4.22	26.20
T ₄	100% RDF + Lignite (3 t ha ⁻¹) + MC (14 Kg ha ⁻¹)	4.37	4.07	26.00
T ₅	75% RDF + HA (5 L ha ⁻¹)	4.21	3.77	25.30
T ₆	75% RDF + Lignite (3 t ha ⁻¹)	4.27	3.92	25.50
T ₇	FYM (25 T Ha ⁻¹) + Lignite (3 t ha ⁻¹) + MC (14 Kg ha ⁻¹)	4.06	3.62	25.00
T ₈	FYM (25 T Ha ⁻¹) + HA (5 L ha ⁻¹) + Lignite (1.5 T ha ⁻¹)	4.02	3.47	24.80
S.Em (±)		0.14	0.12	0.84
CD (p=0.05)		0.42	0.37	2.54

Table 4: Effect of different and inorganic inputs on TSS, pH and Fruit firmness.

Treatment	Combinations	Total soluble solids (°Brix)	pH	Fruit firmness (mm)
T ₁	100% Recommended Dose Fertilizer	3.60	3.35	2.12
T ₂	100% RDF + FYM (25 T Ha ⁻¹)	3.80	3.36	2.26
T ₃	100% RDF+ HA (5 L ha ⁻¹) + MC (14 Kg ha ⁻¹)	3.90	3.59	3.28
T ₄	100% RDF + Lignite (3 t ha ⁻¹) + MC (14 Kg ha ⁻¹)	3.80	3.58	3.20
T ₅	75% RDF + HA (5 L ha ⁻¹)	3.70	3.43	2.54
T ₆	75% RDF + Lignite (3 t ha ⁻¹)	3.90	3.55	2.78
T ₇	FYM (25 T Ha ⁻¹) + Lignite (3 t ha ⁻¹) + MC (14 Kg ha ⁻¹)	3.80	3.38	2.38
T ₈	FYM (25 T Ha ⁻¹) + HA (5 L ha ⁻¹) + Lignite (1.5 T ha ⁻¹)	3.70	3.36	2.26
S.Em (±)		0.13	0.12	0.09
CD (p=0.05)		0.38	0.35	0.27

Total soluble solids (TSS) of tomato fruits were significantly influenced by the different nutrient management treatments, indicating the positive effect of integrated nutrient management on fruit quality improvement. The highest TSS was recorded in T₃ and T₆ with (3.90 °Brix), followed by T₂, T₄, and T₇ with 3.80 °Brix, while T₅ and T₈ recorded (3.70 °Brix). The lowest TSS value of (3.60 °Brix) was observed in the T₁. The increase in TSS under treatments receiving organic amendments and microbial inoculants along with inorganic fertilizers may be attributed to enhanced nutrient availability, improved photosynthetic efficiency, better carbohydrate metabolism, and increased accumulation of sugars and soluble metabolites in the fruits. Organic inputs such as FYM, humic acid, lignite, and microbial consortium may have improved soil microbial activity and nutrient uptake efficiency, thereby enhancing fruit quality characteristics. Treatments with reduced fertilizer doses supplemented with organic amendments also maintained higher TSS values, suggesting that integrated nutrient management can effectively sustain fruit quality even under reduced chemical fertilizer application. Similar findings were reported by Kumar *et al.* (2020) [4], who observed that integrated nutrient management significantly improved TSS and other quality parameters in tomato fruits. Comparable results were also reported by Agbede *et al.*, (2019) [1], who stated that the combined application of organic manures and inorganic fertilizers significantly improved fruit quality attributes, including TSS, in tomato. The highest pH was recorded in T₃ (100% RDF + humic acid + microbial consortium) with (3.59), followed by T₄ (100% RDF + lignite + microbial consortium) with (3.58). The increased pH observed in these treatments may be attributed to enhanced nutrient availability, improved metabolic activities, and efficient nutrient uptake resulting from the combined application of organic amendments, microbial inoculants, and inorganic fertilizers. Organic inputs such as FYM, humic acid, lignite, and microbial consortium may have improved soil microbial activity and nutrient use efficiency, thereby positively influencing fruit biochemical composition and quality attributes. The highest fruit firmness was recorded in T₃ (100% RDF + humic acid + microbial consortium) with (3.28

mm), followed by T₄ (100% RDF + lignite + microbial consortium) with (3.20 mm). The enhanced firmness observed in these treatments may be attributed to improved nutrient availability, enhanced cell wall development, better calcium uptake, and increased accumulation of structural compounds that strengthened fruit tissues. The application of humic acid, lignite, and microbial consortium might have improved soil microbial activity and nutrient absorption efficiency, thereby contributing to improved fruit texture and firmness.

**Fig 1:** Measuring the TSS through Hand Refractometer**Fig 2:** Measuring the firmness of fruit with Penetrometer**Fig 3:** Measuring the pH level in tomato with pH meter

Conclusion

The current study clearly indicated that integrating organic and inorganic nutrition sources had a substantial impact on tomato output and quality indices. T₃ (100% RDF + humic acid + microbial consortium) was the most successful treatment in terms of increasing average fruit weight, number of fruits per plant, number of fruits per cluster, fruit yield per plant, fruit yield per plot, and fruit output per hectare. The same treatment produced higher quality metrics such as fruit length, girth, total soluble solids, fruit hardness, pH, and ascorbic acid levels. Furthermore, the study found that using only inorganic fertilizers was less beneficial in boosting tomato productivity and quality attributes. Therefore, the combined use of inorganic fertilizers with organic amendments and microbial inoculants can be recommended as an effective and sustainable nutrient management strategy for achieving higher productivity and better quality tomato fruits under field conditions

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