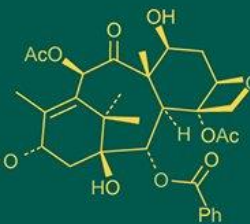
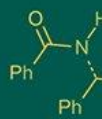


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; SP-10(5): 635-643
www.biochemjournal.com
Received: 10-02-2026
Accepted: 15-03-2026

Dharmendra Vijayvergiya
Department of Horticulture,
Jawaharlal Nehru Krishi
Vishwa Vidyalaya, Jabalpur,
Madhya Pradesh, India

Akhilesh Tiwari
Department of Horticulture,
Jawaharlal Nehru Krishi
Vishwa Vidyalaya, Jabalpur,
Madhya Pradesh, India

Swati Barche
Department of Horticulture,
Jawaharlal Nehru Krishi
Vishwa Vidyalaya, Jabalpur,
Madhya Pradesh, India

Vikas Gupta
Department of Agronomy,
Jawaharlal Nehru Krishi
Vishwa Vidyalaya, Jabalpur,
Madhya Pradesh, India

Gopal Singh Tagore
Department of Soil Science and
Agricultural Chemistry,
Jawaharlal Nehru Krishi
Vishwa Vidyalaya, Jabalpur,
Madhya Pradesh, India

Umesh Singh
Department of Mathematics &
Statistics, Jawaharlal Nehru
Krishi Vishwa Vidyalaya,
Jabalpur, Madhya Pradesh,
India

Shubham Ahirwar
Department of Horticulture,
Jawaharlal Nehru Krishi
Vishwa Vidyalaya, Jabalpur,
Madhya Pradesh, India

Corresponding Author:
Dharmendra Vijayvergiya
Department of Horticulture,
Jawaharlal Nehru Krishi
Vishwa Vidyalaya, Jabalpur,
Madhya Pradesh, India

Assessment of natural farming inputs for improving fruit quality of tomato (*Solanum lycopersicum* L.)

Dharmendra Vijayvergiya, Akhilesh Tiwari, Swati Barche, Vikas Gupta, Gopal Singh Tagore, Umesh Singh and Shubham Ahirwar

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i5Sh.8441>

Abstract

The present investigation was conducted during 2024-25 to evaluate the effect of different source of nutrients including natural farming inputs on quality parameters of Tomato fruits. The experiment comprised eleven treatments including vermicompost, *Jeevaamrit*, *GhanJeevamrit*, mulching and different levels of recommended dose of nutrients. The experiment was laid out in Randomized Block Design with three replications. Observations were recorded on total soluble solids, ascorbic acid, lycopene, total sugar, reducing sugar, non-reducing sugar, titratable acidity, pH and pericarp thickness. The results revealed significant influence of natural farming treatments on fruit quality parameters of tomato. Application of vermicompost @ 7.5 t ha⁻¹ along with 50 per cent recommended dose of nutrients (T₆) recorded maximum total soluble solids (3.73 °Brix), total sugar (5.21%) and reducing sugar (3.62%), along with minimum titratable acidity (0.25%). *Jeevaamrit* @ 500 L ha⁻¹ applied at 15-day interval (T₈) produced highest ascorbic acid content (22.77 mg/100 g), whereas maximum lycopene content (2.82 mg/100 g) was recorded under treatment T₃ receiving 50 per cent recommended dose of nutrients. Highest non-reducing sugar (1.68%) was observed under treatment T₁₁, while maximum pericarp thickness (7.30 mm) was recorded under treatment T₁₀ comprising *GhanJeevamrit* @ 2.0 t ha⁻¹ + *Jeevaamrit* @ 500 L ha⁻¹ at 15-day interval. Integrated application of vermicompost and *Jeevaamrit* proved effective in improving biochemical and physical quality attributes of tomato fruits through enhanced nutrient availability and better physiological activity. The study indicated that natural farming inputs can be successfully utilized as a sustainable and eco-friendly approach for improving fruit quality of tomato under natural farming conditions.

Keywords: Tomato, natural farming, *Jeevaamrit*, vermicompost, *Ghanjeevamrit*, total soluble solids, ascorbic acid, lycopene, sustainable agriculture

Introduction

Tomato is regarded as one of the most important vegetable crops due to its superior nutritional and quality attributes. The fruits are rich in vitamins, minerals, organic acids, antioxidants and health-promoting compounds such as lycopene, ascorbic acid and β-carotene, which contribute significantly to human nutrition and protection against various chronic diseases (Dorais *et al.*, 2001; Shi and Le Maguer, 2000) [5, 22]. Fruit quality in tomato is mainly determined by biochemical parameters including total soluble solids, acidity, sugars, vitamin C and lycopene content, which directly influence consumer acceptability, processing suitability and market value (Amr and Raie, 2022) [1]. These quality traits are greatly affected by nutrient management practices and growing conditions. Application of natural farming inputs has been reported to improve nutrient assimilation, microbial activity and plant metabolism, resulting in enhanced nutritional quality and biochemical composition of tomato fruits (Lee and Kader, 2000; Romdhane *et al.*, 2023) [11, 17]. Natural formulations such as *Jeevamrit*, *Panchagavya* and vermicompost also promote better soil biological activity and balanced nutrient availability, which positively influence fruit quality parameters. Therefore, adoption of suitable natural farming practices may serve as an effective and sustainable approach for improving quality characteristics of tomato fruits. Keeping these facts in view, the present investigation entitled “Assessment of Natural Farming Inputs for Improving Fruit Quality of Tomato (*Solanum lycopersicum* L.)” was undertaken to evaluate the effect of different source of nutrients including natural farming inputs on quality attributes of tomato fruits.

Materials and Methods: The present investigation entitled “Assessment of Natural Farming Inputs for Improving Fruit Quality of Tomato (*Solanum lycopersicum* L.)” was conducted during the Rabi seasons of 2024-25 at the Vegetable Research Farm, Department of Horticulture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Maharajpur, Jabalpur, Madhya Pradesh, India. The experimental site is situated under semi-arid climatic conditions characterized by moderate rainfall and distinct winter season. The soil of the experimental field was sandy clay loam in texture with good drainage facility and medium fertility status. The experiment was laid out in a Randomized Block Design (RBD) with three replications comprising different natural farming input treatments. The treatments consisted of different combinations of recommended dose of nutrients (RDN), vermicompost, Jeevamrit, Ghanjeevamrit, and crop residue mulching. Healthy and uniform seedlings of tomato were transplanted at recommended spacing following standard agronomic practices. All cultural operations were carried out uniformly in all the experimental plots during the

crop growth period. Irrigation, intercultural operations, staking and plant protection measures were carried out uniformly in all treatments whenever required. For the present investigation, tomato variety ‘Kashi Aman’ was used as the experimental crop. The seedlings were transplanted on 08 October 2024 by maintaining a spacing of 60 × 60 cm between rows and plants. Each experimental plot measured 3.0 × 3.6 m². The recommended dose of fertilizer for tomato was applied at the rate of 150:80:60 kg N: P₂O₅: K₂O ha⁻¹. Vermicompost was incorporated into the soil before transplanting as per treatment specifications. Jeevamrit was prepared using cow dung, cow urine, jaggery, pulse flour, and soil collected from the rhizosphere area and applied as foliar spray at 15-day intervals. Ghanjeevamrit was applied in solid form near the root zone of plants according to treatment requirements. Crop residue mulching was applied uniformly after transplanting in designated plots to conserve soil moisture and suppress weed growth. The treatment details used in the experiment are presented below:

Table 1: Treatment details

Treatment	Details
T ₁	Control
T ₂	100% RDN (150:80:60 kg N:P ₂ O ₅ :K ₂ O ha ⁻¹)
T ₃	50% RDN (75:40:30 kg N:P ₂ O ₅ :K ₂ O ha ⁻¹)
T ₄	Vermicompost @ 15 t ha ⁻¹
T ₅	Vermicompost @ 7.5 t ha ⁻¹
T ₆	Vermicompost @ 7.5 t ha ⁻¹ + 50% RDN
T ₇	Vermicompost @ 7.5 t ha ⁻¹ + Jeevamrit 500 L ha ⁻¹
T ₈	Jeevamrit 500 L ha ⁻¹
T ₉	Jeevamrit 500 L ha ⁻¹ + crop residue mulching
T ₁₀	Ghanjeevamrit @ 2.0 t ha ⁻¹ + Jeevamrit 500 L ha ⁻¹
T ₁₁	Ghanjeevamrit @ 2.0 t ha ⁻¹ + Jeevamrit 500 L ha ⁻¹ + mulching

Ripe and healthy tomato fruits from each treatment plot were harvested at proper maturity stage and utilized for quality analysis. Observations pertaining to fruit quality parameters were recorded using standard laboratory procedures.

Quality parameters

Total soluble solids (°Brix): Total soluble solids content of tomato fruits was determined using a digital refractometer. Fresh juice extracted from randomly selected fruits was placed on the prism surface of the refractometer and the readings were recorded directly. The observations were expressed in °Brix.

Ascorbic acid content (mg 100 g⁻¹ FW)

Ascorbic acid content in tomato fruits was estimated by the 2,6-dichlorophenol indophenol visual titration method following AOAC (2016) [2]. Fruit extract prepared in Meta phosphoric acid solution was titrated against standardized dye solution until a light pink endpoint appeared. The results were expressed as mg per 100 g fresh weight.

Lycopene content (mg 100 g⁻¹ FW)

Lycopene content was estimated by spectrophotometric method as described by Anthon and Barrett (2007). Tomato juice was extracted using hexane, ethanol and acetone solvent mixture and absorbance was measured at 503 nm. Lycopene concentration was calculated using the standard formula and expressed as mg per 100 g fresh weight.

Reducing sugar (%)

Reducing sugar content was estimated by Nelson’s method (1944) using Fehling’s solution. The fruit juice sample was titrated against mixed Fehling’s solution in the presence of methylene blue indicator until brick-red precipitate formation. The reducing sugar percentage was calculated using the standard procedure.

Total sugar (%)

Total sugar content was determined after hydrolysis of non-reducing sugars into reducing sugars using hydrochloric acid. The hydrolyzed sample was titrated against Fehling’s solution following the standard titration procedure. The results were expressed as percentage total sugars.

Non-reducing sugar (%)

Non-reducing sugar content was calculated by subtracting reducing sugar percentage from total sugar percentage. The values obtained from reducing and total sugar estimations were used for calculation. The results were expressed in percentage.

Titrateable acidity (%)

Titrateable acidity of tomato fruits was estimated by AOAC (1999) [2] method using standard NaOH titration. Fruit juice extract was diluted and titrated against 0.1 N sodium hydroxide using phenolphthalein as indicator until a light pink endpoint appeared. Acidity was expressed as percentage citric acid.

pH: The pH of tomato juice was measured using a calibrated digital pH meter. Fresh juice extracted from tomato fruits was filtered and used for analysis after standardization of the instrument with buffer solutions. The observations were recorded directly from the pH meter.

Pericarp thickness (mm)

Pericarp thickness was measured using a vernier caliper. Tomato fruits were cut horizontally at the equatorial region and the thickness of the fruit wall was recorded from randomly selected fruits. The average value was expressed in millimetres.

Statistical analysis

The experimental data recorded for various quality parameters were statistically analyzed by applying the analysis of variance (ANOVA) technique appropriate to Randomized Block Design as described by Gomez and Gomez (1984)^[7]. The significance of treatment differences was tested at 5 per cent level of significance.

Results and Discussion

Total soluble solids (°Brix)

The data pertaining to total soluble solids (TSS) and ascorbic acid content of tomato fruits as influenced by different source of nutrients including natural farming inputs are presented in Table 2 and illustrated in Fig.1 respectively. A critical examination of the data presented in Table 2 revealed that various natural farming treatments significantly influenced total soluble solids content of tomato fruits during 2024-25. Among the different treatments, application of vermicompost @ 7.5 t ha⁻¹ along with 50 per cent recommended dose of nutrients (T₆) recorded the highest TSS content (3.73 °Brix), which was found significantly superior over most of the treatments. Treatment T₇ [Vermicompost @ 7.5 t ha⁻¹ + Jeevaamrit @ 500 L ha⁻¹ applied at 15-day interval] also produced comparatively higher TSS content (3.63 °Brix) and remained statistically at par with T₆. The lowest TSS content (3.17 °Brix) was recorded under control treatment (T₁). The increase in TSS content under integrated application of vermicompost and Jeevaamrit might be due to enhanced microbial activity, gradual nutrient release and improved synthesis and translocation of carbohydrates towards fruits. Better nutrient uptake under natural farming treatments possibly enhanced photosynthetic efficiency, resulting in greater accumulation of soluble sugars and dissolved solids in fruits. Improved soil aeration and moisture retention under vermicompost application may also have favoured metabolic activities associated with sugar synthesis. The present findings are in conformity with those of Kaur *et al.* (2018)^[8], who reported increased TSS content in tomato fruits under organic nutrient management practices. Similar observations were also recorded by Dinu *et al.* (2023)^[4], who observed improved soluble solids and fruit quality in organically cultivated tomato. Kumawat *et al.* (2025)^[10] further reported enhancement in biochemical quality parameters of tomato under natural farming systems due to improved nutrient assimilation and microbial activity.

Ascorbic acid content (mg/100 g)

The data presented in Table 2 and illustrated in Fig. 2 further indicated significant variation in ascorbic acid content of tomato fruits due to different natural farming

treatments during 2024-25. Among all the treatments, application of Jeevaamrit @ 500 L ha⁻¹ at 15-day interval (T₈) recorded the highest ascorbic acid content (22.77 mg/100 g), which was significantly superior over all other treatments. The lowest ascorbic acid content (14.30 mg/100 g) was observed under control treatment (T₁). The enhancement in ascorbic acid content under Jeevaamrit treatment may be attributed to improved microbial activity and better availability of essential nutrients involved in enzymatic reactions responsible for biosynthesis of ascorbic acid. Jeevaamrit contains beneficial microorganisms, vitamins, enzymes and growth-promoting substances which may have stimulated physiological and metabolic activities in plants, ultimately increasing vitamin C accumulation in fruits. Enhanced photosynthetic activity and efficient translocation of assimilates under natural farming practices might have also contributed towards higher synthesis of ascorbic acid. The results of the present investigation are in close agreement with the findings of Lee and Kader (2000)^[11], who reported that nutrient management practices markedly influence vitamin C content in horticultural crops. Similar results were also reported by Motthalamme *et al.* (2025)^[12], who observed increased ascorbic acid concentration in tomato fruits under biologically enhanced nutrient management conditions. Dinu *et al.* (2023)^[4] also reported superior antioxidant and nutritional quality in organic cultivated tomato fruits compared to conventional production systems.

Lycopene content (mg/100 g)

The data related to lycopene content of tomato fruits as influenced by different source of nutrients including natural farming inputs are presented in Table 2 and depicted in Fig. 3. A perusal of the data revealed that different natural farming treatments exerted significant influence on lycopene content of tomato fruits during 2024-25. Among the various treatments, application of 50 per cent recommended dose of nutrients (T₃) recorded the highest lycopene content (2.82 mg/100 g), which was closely followed by treatment T₇ comprising vermicompost @ 7.5 t ha⁻¹ + Jeevaamrit @ 500 L ha⁻¹ at 15-day interval (2.60 mg/100 g). Both treatments remained significantly superior over most of the other treatments. The minimum lycopene content (1.34 mg/100 g) was recorded under treatment T₈ comprising Jeevaamrit @ 500 L ha⁻¹ at 15-day interval. The increase in lycopene content under integrated nutrient and natural farming treatments may be attributed to improved nutrient availability, enhanced metabolic activity and better synthesis of carotenoid pigments during fruit ripening. Adequate supply of nutrients, particularly potassium and micronutrients, might have favoured enzymatic activities associated with lycopene biosynthesis and pigment accumulation in fruits. Application of vermicompost and Jeevaamrit possibly improved soil biological activity and nutrient uptake efficiency, thereby promoting synthesis of antioxidant compounds in tomato fruits. The findings of the present investigation are in close conformity with those reported by Shi and Le Maguer (2000)^[20], who observed that nutrient management practices and growing conditions strongly influence lycopene accumulation in tomato fruits. Similar observations were also reported by Romdhane *et al.* (2023)^[17], who recorded enhanced nutraceutical quality and carotenoid content in tomato under improved nutrient management practices. Motthalamme *et al.* (2025)^[13]

further reported significant improvement in lycopene content of tomato fruits under biologically enhanced nutrient treatments.

Total sugar (%)

A critical analysis of data presented in Table 2 and illustrated in Fig. 4 indicated that different natural farming treatments significantly influenced total sugar content of tomato fruits during 2024-25. Among all the treatments, application of vermicompost @ 7.5 t ha⁻¹ along with 50 per cent recommended dose of nutrients (T₆) recorded the maximum total sugar content (5.21%), which was found significantly superior over all other treatments. Treatment T₇ comprising vermicompost @ 7.5 t ha⁻¹ + Jeevaamrit @ 500 L ha⁻¹ at 15-day interval ranked second with total sugar content of 5.03 per cent. The minimum total sugar content (3.22%) was recorded under control treatment (T₁). The increased total sugar content under integrated application of vermicompost and Jeevaamrit may be attributed to enhanced nutrient availability and improved physiological activities in plants. Better microbial activity and gradual release of nutrients under organic and natural farming treatments might have enhanced photosynthesis and carbohydrate synthesis, leading to greater accumulation of sugars in fruits. The findings of the present investigation are in agreement with those of Davies and Hobson (1981) [21], who reported that nutrient availability and physiological efficiency greatly influence sugar accumulation in tomato fruits. Similar observations were also recorded by Dinu *et al.* (2023) [4], who found higher sugar content and improved fruit quality in organically cultivated tomato.

Reducing sugar (%)

The data presented in Table 2 and illustrated in Fig. 5 further revealed significant variation in reducing sugar content of tomato fruits due to different natural farming treatments during 2024-25. Among the treatments, T₆ (Vermicompost @ 7.5 t ha⁻¹ + 50% RDN) recorded the highest reducing sugar content (3.62%), followed by treatment T₇ (3.43%). The lowest reducing sugar content (2.11%) was observed under control treatment (T₁). Higher reducing sugar content under integrated nutrient management involving vermicompost and inorganic fertilizers may be due to enhanced carbohydrate metabolism and efficient conversion of complex carbohydrates into simple sugars. Vermicompost and Jeevaamrit possibly improved enzymatic activities and nutrient uptake, which in turn stimulated synthesis and accumulation of reducing sugars in fruits. The present findings are in close conformity with the results of Kaur *et al.* (2018) [8], who observed increased reducing sugar content in tomato fruits under organic nutrient management practices. Similar results were also reported by Romdhane *et al.* (2023) [17], who found enhanced nutraceutical quality and sugar accumulation in tomato fruits under improved nutrient management conditions.

Non-reducing sugar (%)

The data regarding non-reducing sugar content presented in Table 2 and illustrated in Fig. 6 indicated significant differences among various treatments during 2024-25. Among all treatments, T₁₁ comprising GhanJeevaamrit @ 2.0 t ha⁻¹ + Jeevaamrit @ 500 L ha⁻¹ at 15-day interval along with mulching recorded the highest non-reducing sugar

content (1.68%), followed by treatment T₇ (1.60%) and T₆ (1.59%). The lowest non-reducing sugar content (1.11%) was recorded under control treatment (T₁). The improvement in non-reducing sugar content under Jeevaamrit and mulching treatments might be due to enhanced metabolic activities, better moisture conservation and favourable soil environment created under mulched conditions. Mulching possibly maintained optimum soil moisture and temperature, thereby improving nutrient absorption and carbohydrate translocation within plants. These findings are supported by the observations of Dinu *et al.* (2023) [4], who reported superior biochemical quality of tomato fruits under organic cultivation systems. Kumawat *et al.* (2025) [10] also observed significant improvement in sugar fractions of tomato fruits under natural farming treatments owing to better nutrient assimilation and microbial activity.

Titrateable acidity (%)

A perusal of data presented in Table 2 and illustrated in Fig. 7 revealed that titrateable acidity of Tomato fruits was significantly influenced by different natural farming treatments during 2024-25. Among various treatments, application of vermicompost @ 7.5 t ha⁻¹ + 50 per cent recommended dose of nutrients (T₆) recorded the minimum titrateable acidity (0.25%), which remained significantly lower than most of the treatments. Treatment T₃ and T₇ also recorded comparatively lower acidity values of 0.29 per cent. The highest acidity (0.36%) was observed under treatment T₂ receiving 100 per cent recommended dose of nutrients, followed by treatments T₈ and T₉ (0.34%). The reduction in acidity under integrated application of vermicompost and inorganic nutrients may be attributed to enhanced conversion of organic acids into sugars during fruit ripening and improved metabolic activity within fruits. Balanced nutrient availability under integrated nutrient management might have accelerated physiological processes and carbohydrate accumulation, thereby reducing the concentration of organic acids in fruits. Improved microbial activity and nutrient assimilation under natural farming treatments may also have influenced acid metabolism and fruit biochemical composition. The present findings are in accordance with the observations of Kaur *et al.* (2018) [8], who reported significant variation in acidity of tomato fruits under different nutrient management practices. Similar findings were also reported by Dinu *et al.* (2023) [4], who observed that organically managed tomato fruits exhibited desirable biochemical quality attributes including balanced acidity levels.

pH

The data regarding pH of tomato fruits presented in Table 2 and illustrated in Fig. 8 indicated significant differences among various treatments during 2024-25. The maximum pH value (4.53) was recorded under treatment T₂ comprising 100 per cent recommended dose of nutrients, followed by T₁ and T₄ with pH values of 4.51 and 4.50, respectively. The minimum pH value (4.31) was observed under treatment T₉ comprising Jeevaamrit @ 500 L ha⁻¹ at 15-day interval along with crop residue mulching. The variation in fruit pH under different treatments may be due to changes in organic acid concentration and biochemical composition of tomato fruits under varying nutrient availability. Improved nutrient uptake and enhanced metabolic activity under integrated and

natural farming treatments may have influenced acid-sugar balance in fruits, thereby affecting pH values. The relatively lower pH observed under Jeevaamrit-based treatments might be associated with higher accumulation of organic acids and improved biochemical activity during fruit development. These findings are in close agreement with those of Amr and Raie (2022) ^[1], who reported that nutrient management and cultivation practices significantly influence chemical quality parameters including pH and acidity of tomato fruits. Similar results were also observed by Romdhane *et al.* (2023) ^[17], who noted considerable variation in biochemical quality traits of tomato under different crop management practices.

Pericarp thickness (mm)

The data presented in Table 2 and illustrated in Fig. 9 further revealed significant influence of natural farming inputs on pericarp thickness of tomato fruits during 2024-25. Among the treatments, T₁₀ comprising GhanJeevamrit @ 2.0 t ha⁻¹ + Jeevaamrit @ 500 L ha⁻¹ at 15-day interval recorded the highest pericarp thickness (7.30 mm), which was significantly superior over all other treatments. Treatment T₂ (6.62 mm), T₈ (6.41 mm) and T₁₁ (6.36 mm) also recorded comparatively higher pericarp thickness values. The minimum pericarp thickness (5.29 mm) was observed under control treatment (T₁). The increase in pericarp thickness under Jeevaamrit and GhanJeevamrit treatments may be attributed to improved nutrient availability, enhanced cell division and better development of fruit tissues. Presence of beneficial microorganisms, growth-promoting substances and micronutrients in Jeevaamrit formulations might have stimulated physiological processes responsible for cell enlargement and tissue development. Improved soil health and balanced nutrient supply under natural farming treatments may also have contributed towards enhanced fruit firmness and thicker pericarp. The present findings corroborate the results of Gautier *et al.* (2008) ^[6], who reported that improved

nutrient availability and crop management practices positively influence fruit firmness and pericarp development in tomato. Similar observations were also reported by Kumawat *et al.* (2025) ^[10], who observed improvement in physical and biochemical quality traits of tomato fruits under natural farming systems.

Conclusion: The present investigation demonstrated that different source of nutrients including natural farming inputs significantly influenced the biochemical and physical quality parameters of Tomato fruits under natural farming conditions. Among the various treatments, application of vermicompost @ 7.5 t ha⁻¹ along with 50 per cent recommended dose of nutrients (T₆) proved most effective in improving important quality traits such as total soluble solids (3.73 °Brix), total sugar (5.21%), reducing sugar (3.62%) and also recorded minimum titratable acidity (0.25%). Treatment T₇ comprising vermicompost @ 7.5 t ha⁻¹ + Jeevaamrit @ 500 L ha⁻¹ at 15-day interval also showed superior performance with higher TSS (3.63 °Brix), lycopene (2.60 mg/100 g), total sugar (5.03%) and reducing sugar (3.43%). Application of Jeevaamrit @ 500 L ha⁻¹ at 15-day interval (T₈) recorded the highest ascorbic acid content (22.77 mg/100 g), indicating its beneficial effect on antioxidant quality of tomato fruits. The maximum lycopene content (2.82 mg/100 g) was observed under treatment T₃ receiving 50 per cent recommended dose of nutrients. Treatment T₁₁ recorded highest non-reducing sugar content (1.68%), whereas maximum pericarp thickness (7.30 mm) was obtained under T₁₀ comprising GhanJeevamrit @ 2.0 t ha⁻¹ + Jeevaamrit @ 500 L ha⁻¹ at 15-day interval. The study indicated that integrated use of vermicompost, Jeevaamrit and reduced chemical fertilizers improved fruit quality through better nutrient availability, enhanced microbial activity and improved physiological functioning of plants. Therefore, integrated application of vermicompost and Jeevaamrit may be recommended as a sustainable and eco-friendly nutrient management approach for improving quality attributes of tomato fruits under natural farming systems.

Table 2: Effect of treatments on total soluble solids (°Brix), ascorbic acid, lycopene content, total sugar, reducing sugar, non-reducing sugar, titratable acidity, pH and pericarp thickness of tomato

Treatment Notation	Total soluble solids (°Brix)	Ascorbic acid content (mg/100 g)	Lycopene content (mg/100g)	Total sugar (%)	Reducing sugar (%)	Non Reducing sugar (%)	Titrable acidity (%)	pH	Pericarp thickness (mm)
T ₁	3.17	14.30	2.43	3.22	2.11	1.11	0.31	4.51	5.29
T ₂	3.40	15.18	2.50	4.14	2.79	1.35	0.36	4.53	6.62
T ₃	3.33	14.80	2.82	3.58	2.40	1.17	0.29	4.39	5.94
T ₄	3.27	17.79	1.55	4.61	3.13	1.48	0.30	4.50	5.59
T ₅	3.20	16.07	1.61	4.20	2.90	1.30	0.33	4.43	5.48
T ₆	3.73	16.50	1.89	5.21	3.62	1.59	0.25	4.43	6.29
T ₇	3.63	15.60	2.60	5.03	3.43	1.60	0.29	4.39	6.28
T ₈	3.60	22.77	1.34	4.05	2.70	1.35	0.34	4.33	6.41
T ₉	3.57	20.60	2.34	4.50	3.03	1.47	0.34	4.31	5.89
T ₁₀	3.50	16.60	1.46	4.68	3.22	1.46	0.33	4.35	7.30
T ₁₁	3.47	16.23	2.06	4.91	3.24	1.68	0.30	4.35	6.36
SEm±	0.05	0.37	0.20	0.05	0.07	0.06	0.05	0.005	0.10
CD at 5%	0.13	1.08	0.58	0.14	0.21	0.17	0.15	0.015	NS



Fig 1: Effect of treatments on total soluble solids (°Brix) of tomato

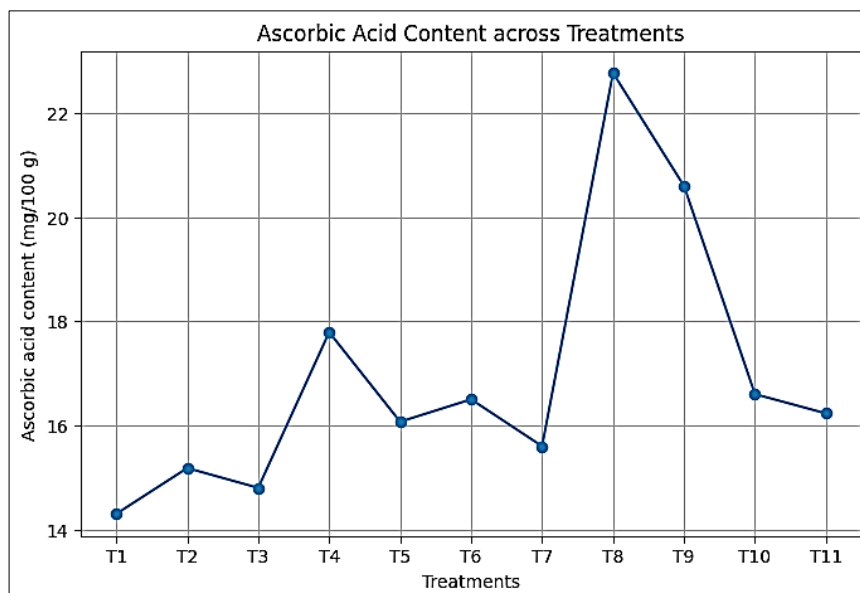


Fig 2: Effect of treatments on ascorbic acid content (mg/100 g) of tomato

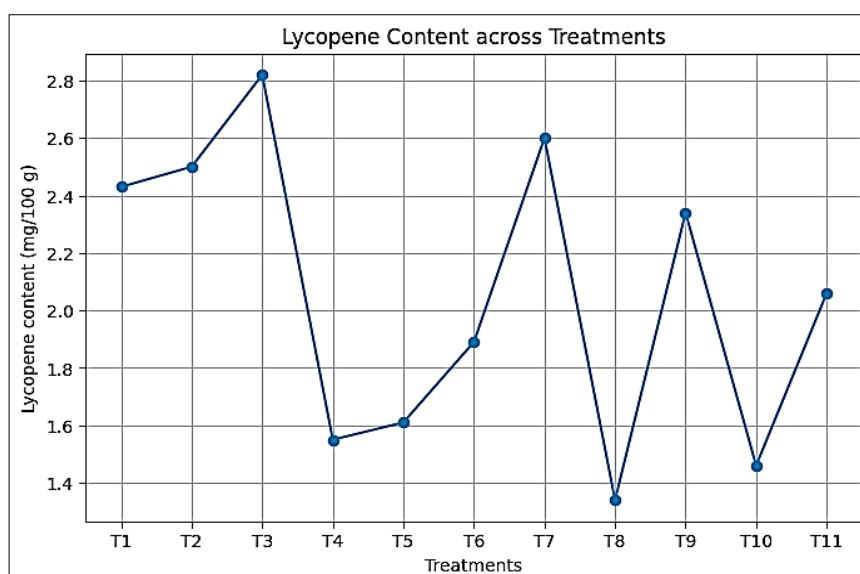
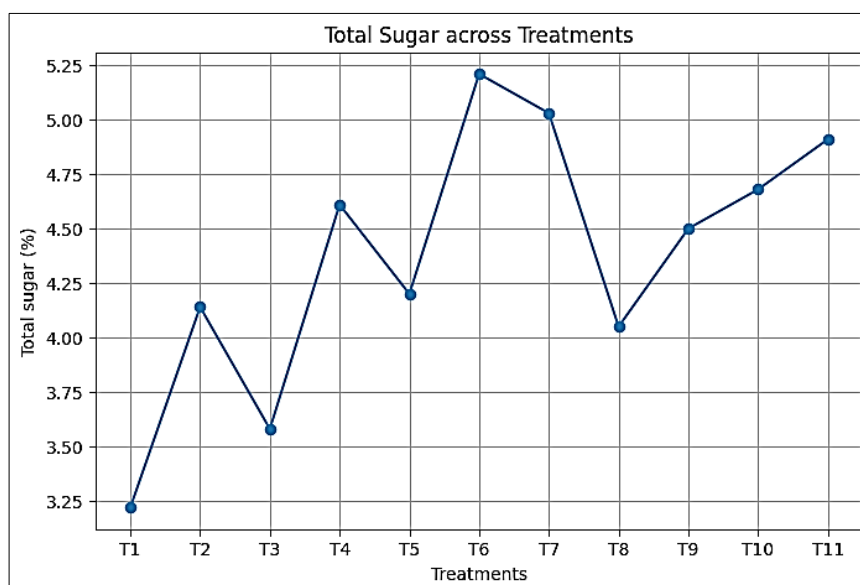
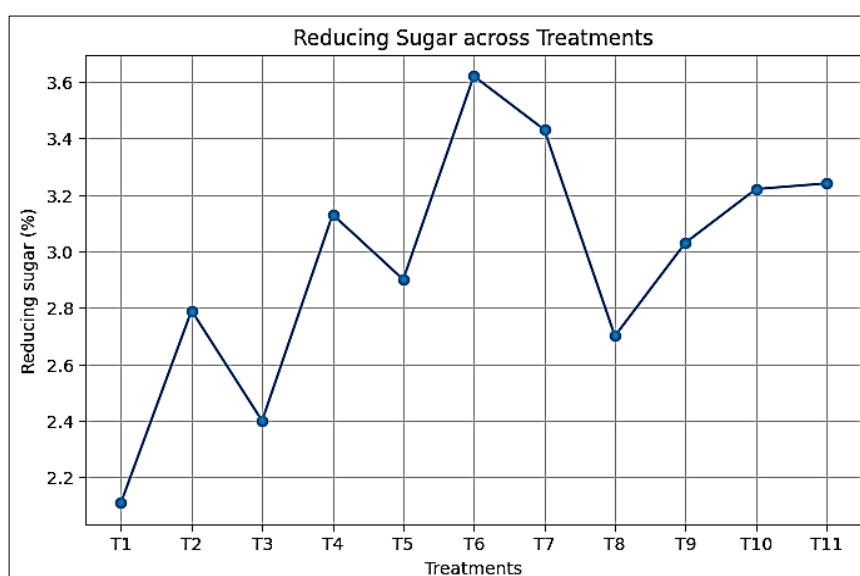
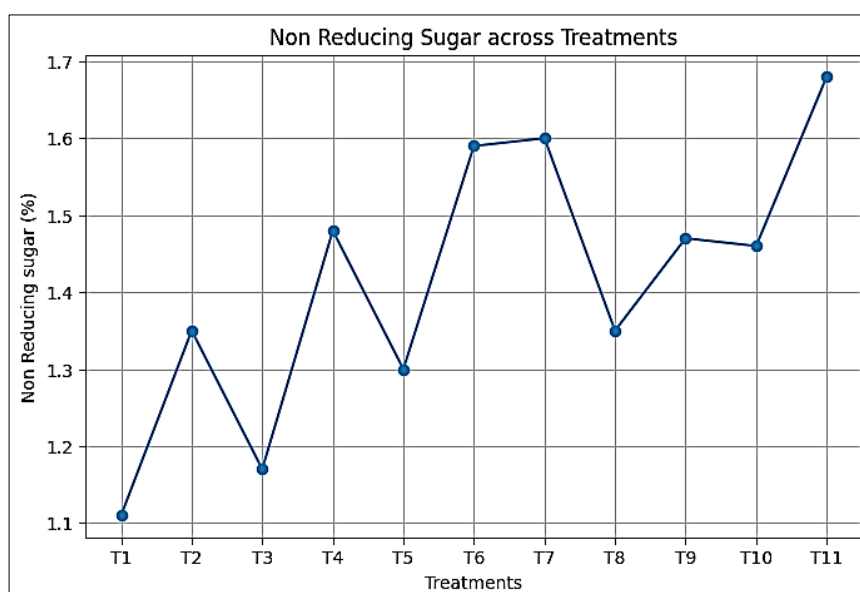


Fig 3: Effect of treatments on lycopene content (mg/100g) of tomato

**Fig 4:** Effect of treatments on total sugar (%) of tomato**Fig 5:** Effect of treatments on reducing sugar (%) of tomato**Fig 6:** Effect of treatments on non-reducing sugar (%) of tomato

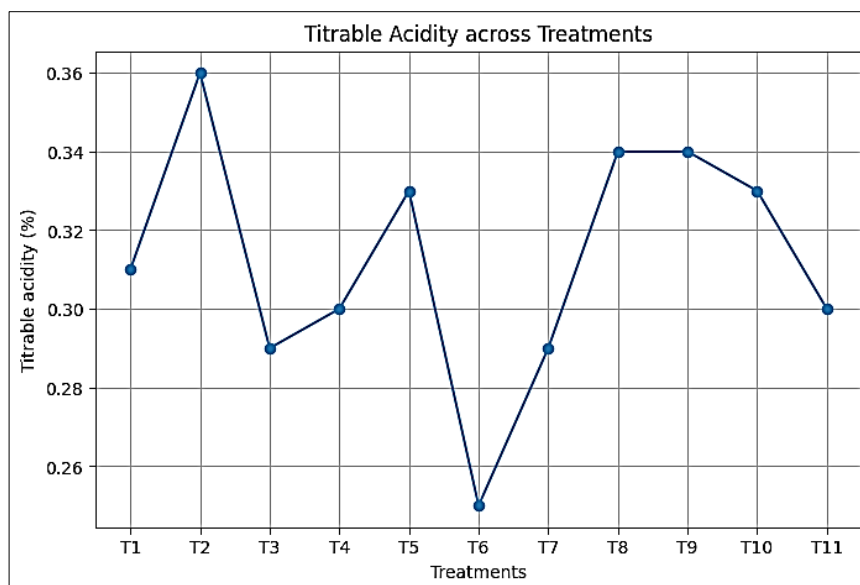


Fig 7: Effect of treatments on titration acidity (%) of tomato

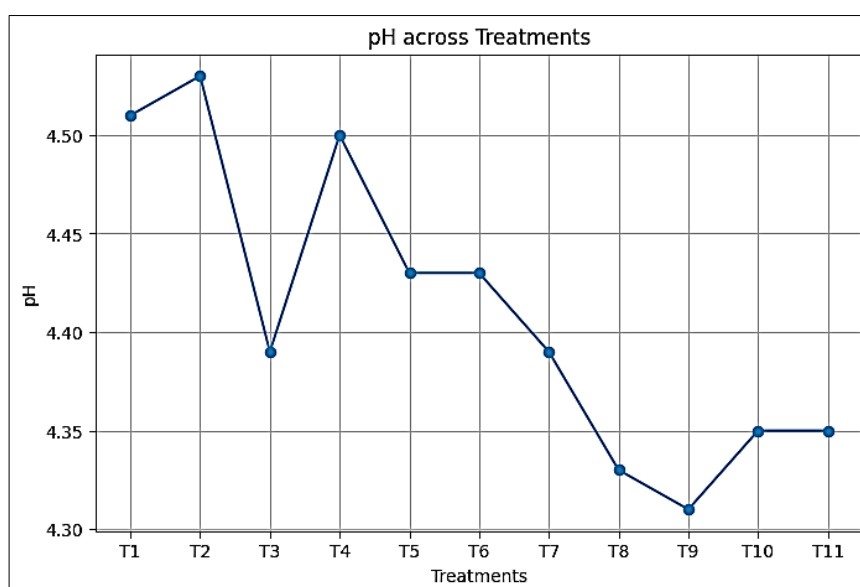


Fig 8: Effect of treatments on fruit pH of tomato

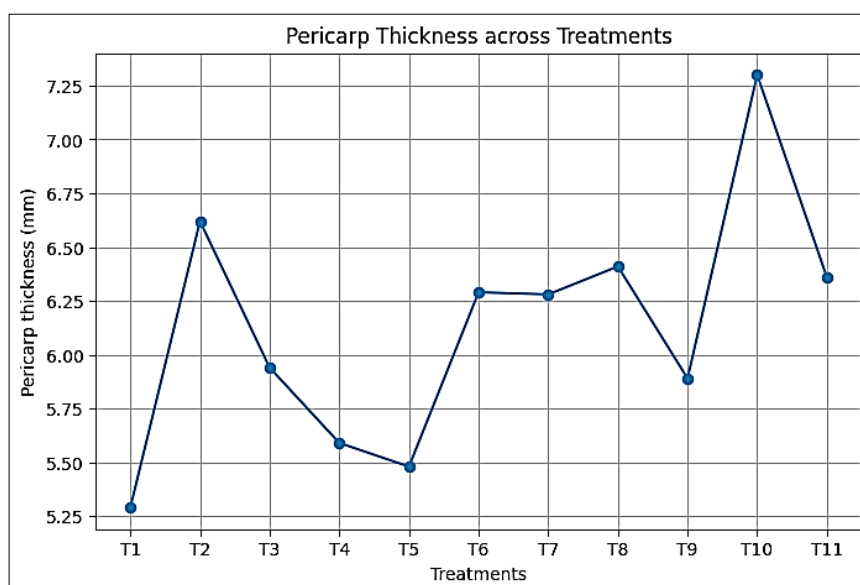


Fig 9: Effect of treatments on pericarp thickness (mm) of tomato

References

1. Amr A, Raie WY. Tomato components and quality parameters: a review. *Jordan J Agric Sci.* 2022;18(3):199-230.
2. AOAC. Official methods of analysis. 17th ed. Washington (DC): Association of Official Analytical Chemists; 2000.
3. Bose TK, Som MG. Vegetable crops of India. Calcutta, India: Naya Prakash; 1990. p. 408-441.
4. Dinu M, Stan T, Petici   A. Effects of organic farming system on some nutritional quality parameters of tomato fruits. *Chil J Agric Res.* 2023;83(3):293-304.
5. Dorais M, Papadopoulos AP, Gosselin A. Greenhouse tomato fruit quality. *Hortic Rev.* 2002;26:239-319.
6. Gautier H, Diakou-Verdin V, B  nard C, Reich M, Buret M, Bourgaud F, *et al.* How does tomato quality depend on ripening stage, temperature and irradiance? *J Sci Food Agric.* 2008;88(7):1235-1243.
7. Gomez KA, Gomez AA. Statistical procedures for agricultural research. 2nd ed. New York: John Wiley and Sons; 1984.
8. Kaur P, Saini S, Malhi GS. Influence of organic nutrient sources on quality attributes of tomato (*Solanum lycopersicum* L.). *Int J Chem Stud.* 2018;6(2):220-224.
9. Kumar M, Chaudhary V, Naresh RK, Maurya OP, Pal SL. Does integrated sources of nutrients enhance growth, yield, quality and soil fertility of vegetable crops. *Int J Curr Microbiol App Sci.* 2018;7(6):125-155.
10. Kumawat N, Giri MD, Soneji IB, Ingle YV, Patke NK, Kale VS, *et al.* Comparative assessment of cleaner production pathways (natural and organic) for tomato cultivation: evaluating yield, quality, and resource efficiency in urban rooftop systems. 2025.
11. Lee SK, Kader AA. Preharvest and postharvest factors influencing vitamin C content of horticultural crops. *Postharvest Biol Technol.* 2000;20(3):207-220.
12. Motlhalamme T, Kaningini AG, Maropeng R, Thema FT, Mohale KC, Maaza M. Tomato lycopene, total flavonoids, vitamin C content and mineral composition as affected by biosynthesized calcium carbonate nanoparticles foliar application. *J Food Compos Anal.* 2025;136:107173.
13. Motlhalamme T, Kaningini AG, Maropeng R, Thema FT, Mohale KC, Maaza M. Tomato lycopene, total flavonoids, vitamin C content and mineral composition as affected by biosynthesized calcium carbonate nanoparticles foliar application. *J Food Compos Anal.* 2025;139:107173.
14. Ranganna S. Manual of analysis of fruit and vegetable products. New Delhi, India: Tata McGraw-Hill Publishing Company Limited; 1976.
15. Ranganna S. Handbook of analysis and quality control for fruit and vegetable products. 2nd ed. New Delhi, India: Tata McGraw-Hill Publishing Company Limited; 1986. p. 122.
16. Raza B, Hameed A, Saleem MY. Fruit nutritional composition, antioxidant and biochemical profiling of diverse tomato (*Solanum lycopersicum* L.) genetic resource. *Front Plant Sci.* 2022;13:1035163.
17. Romdhane A, Riahi A, Piro G, Lenucci MS, Hdider C. Agronomic performance and nutraceutical quality of a tomato germplasm line selected under organic production system. *Horticulturae.* 2023;9(4):490.
18. Romdhane A, Sdiri S, Tlili I. Agronomic performance and nutraceutical quality of tomato germplasm. *Horticulturae.* 2023;9(4):490.
19. Sharma SD, Bhardwaj SK, Kumar P, Chandel A, Kashyap B, Sharma VK. Impact assessment of integrated walnut fruit sequencing in exposed subsoil on vegetative growth traits, soil quality indicators and biological diversity in rainfed ecological system. *Indian J Agric Sci.* 2017;87(11):1487-1498.
20. Shi J, Maguer ML. Lycopene in tomatoes: chemical and physical properties affected by food processing. *Crit Rev Food Sci Nutr.* 2000;40(1):1-42.
21. Davies JN, Hobson GE, McGlasson WB. The constituents of tomato fruit the influence of environment, nutrition, and genotype. *Crit Rev Food Sci Nutr.* 1981;15(3):205-280. DOI:10.1080/10408398109527317. (SCIRP)
22. Dorais M, Papadopoulos AP, Gosselin A. Greenhouse tomato fruit quality. *Hortic Rev.* 2001;26:239-319.