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Influence of Organics on Physiological and Quality Parameters of Tomato (*Lycopersicon esculentum* Mill.)

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ABSTRACT: The over reliance of conventional agriculture on synthetic chemical inputs such as fertilizers and pesticides has led to environmental degradation, soil erosion and water pollution, posing risks to biodiversity and human health though they increase the crop yield. At present, the use of organic amendments in agriculture has gained considerable attention due to their potential benefits in enhancing soil fertility, crop productivity and sustainability. A field experiment was undertaken to study the effect of organic treatments on physiological and quality parameters of tomato at the Instructional cum Research Farm, Biswanath College of Agriculture, Assam Agricultural University, Biswanath Chariali during 2020-2021. The results revealed that both the parameters were significantly influenced by various treatments. The organic treatment Enriched compost≈@10 t/ha FYM + 10% Cow urine + 10% Dung brew spray recorded the highest total leaf chlorophyll content (1.90 mg g^{-1}fw), chlorophyll stability index (52.30%) and relative leaf water content(79.92 %) at 45 days after transplanting(DAT), fresh and dry weight of leaf at 30 DAT(3.28 and 0.561g) and at harvest(2.29 and 0.496 g), leaf are a per plant(633.34 and 1083.34 cm^2) at 30 and 45 DAT and leaf area index(3.34 and 4.66) at 30 and 45 DAT. This treatment also resulted the highest TSS (6.10 °Brix), lycopene (8.92 mg/100g) and ascorbic acid content (31.92 mg/100g) in the fruit. Hence, in conclusion, it can be suggested that use of organic manure and liquid manure results in production of quality fruits with superior physiological attributes in tomato.

Keywords: Tomato, organic, physiological, quality, production.

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is an important day neutral warm season fruit vegetable belongs to the Solanaceae family with chromosome number 2n=24. Tropical America (Peru) is the origin of tomato. Tomato is considered as protective foods due to its high concentrations of minerals and vitamins as well as healthy organic acids like citric, formic and acetic acids (Hari,1997). Tomato also contains lycopene, β-carotene, phenols and flavonoids. Tomato consumption lowers the risk of different kinds of cancers, osteoporosis and cardiovascular diseases. Some studies show that tomatoes and garlic should be taken together at the same time to have its cancer preventive effects (Bhowmik *et al*., 2012). It is used raw as a salad or cooked, processed products like pickles, ketchup, puree, sauces, and paste. Tomato is a good appetizer and its soup is a good remedy for preventing constipation (Gopalakrishnan, 2007).

Chemical fertilizers are harmful to both humans and the environment, even though their use is increasing day by day because of their higher yield when compared to organic fertilizers. The cost of inorganic fertilizers is also expensive, making them unaffordable for certain small and marginal farmers. The demand for organic food is increasing among consumers since it is better for their health and the environment. However, its production is very low throughout the country.

In Assam, organic farming occupies in a decent amount but people are still dependent on chemical fertilizers. Considering the detrimental effect of chemical fertilizers emphasis is given on organic production of tomato to prevent the hazards of chemical fertilizer. Based on this, the experiment was conducted to determine the best organic treatment on the basis of physiological and quality parameters.

MATERIALS AND METHODS

The study was conducted at the Instructional cum Research farm, Department of Horticulture, Biswanath

College of Agriculture, Assam Agricultural University, Biswanath Chariali during 2021-2022. The experimental site was located at 26.7°40′44″ N latitude and 93.1°98′ 42″E longitude at an elevation of 105 m above mean sea level. The experimental plot has a good slope with proper drainage system. The soil was sandy loam with pH 5.35, organic carbon 0.72% and available N, P and K were 537.60, 46.16 and 204.28 kg ha^{-1}. The experiment was composed of 13 treatments *viz*. T1: RDF (N:P:K @ 75:60:60 kg/ha), T2: FYM @10t/ha, T3: Vermicompost≈@10t/ha FYM, T4: Enriched compost≈@10t/ha FYM, T5: FYM @10t/ha + 10% Cow urine spray, T6: Vermicompost≈@10t/ha FYM + 10% Cow urine spray, T7 : Enriched compost≈@10t/ha FYM + 10% Cow urine spray, T8: FYM@10t/ha + 10% Dung brew spray, T9: Vermicompost≈@10t/ha FYM + 10% Dung brew spray, T10: Enriched compost≈@10t/ha FYM + 10% Dung brew spray, T11: FYM @10t/ha + 10% Cow urine + 10% Dung brew spray, T12: Vermicompost≈@10t/ha FYM +10% Cow urine + 10% Dung brew spray and T13: Enriched compost≈@10t/ha FYM + 10% Cow urine + 10% Dung brew spray. The treatments were laid out in Randomized Block Design with 3 replications. Twelve treatments (T2, T3, T4, T5, T6, T7, T8, T9, T10, T11, T12, T13) were laid in the certified organic block which was certified in the year of 2006 by APOF organic certification agency and was maintained for the last 15 years. The treatment T1 (recommended dose of fertilizer) was laid out outside the organic block. Altogether thirty-nine plots of equal dimension (3.75 m x 1.2 m) were made for the experiment. The seedlings were first raised in nursery which was prepared by sterilizing the soil with the Bio-Veer and well rotten powdered farm yard manure was applied and incorporated into the soil. Healthy, uniform and vigorous 30 days old seedlings of variety 'Pusa Ruby' were selected for transplanting at a spacing of 75 cm × 30 cm incorporating 20 numbers of plant per plot. The experimental plot was thoroughly ploughed by tractor followed by harrowing and brought to a fine tilth by repeated harrowing and levelling. Each plot was broadcasted with the recommended treatments mixed with top soil. Organic manure like FYM, Vermicompost and Enriched compost was incorporated 6-7 days prior to transplanting. FYM was applied in each recommended plot @ 4.5 kg and Vermicompost @ 0.97 kg. Vermicompost is the product of the decomposition process using various species of earthworms, to create a heterogeneous mixture of decomposing vegetable or food wastes, bedding materials and vermicast. Enriched compost was prepared by mixing organic materials of plant-based origin with rock phosphate and in each recommended plot 1.87 kg of enriched compost was applied. Liquid manure used was Cow urine and Dung brew. Cow urine is a unique product of dairy compared to other organic sources with extensive manure, antimicrobial and disinfectant properties. Ten percent (10%) cow urine spray was done 3 times at 10 days interval from 20 days after transplanting in each recommended plot.

Dung brew is a fermented solution of cow dung that provides nutrition to the plant. It was prepared by adding 5 kg of cattle dung and 15 litres of cattle urine in a 20 litres plastic bucket and mixed well. After that, covered the bucket with a gunny sack for providing sufficient aeration and stirred the materials every alternate day for 15 days. The dung brew was ready for spray after 15 days. In each recommended plot 10 percent of dung brew was sprayed 3 times at 10 days intervals from 20 days after transplanting on the foliage of the crop. Also, each 10 per cent cow urine spray and 10 per cent dung brew spray were done 3 times alternately at 10 days intervals from 20 days after transplanting in every recommended plot. The recommended dose of inorganic fertilizer for tomato in Assam condition *i.e*., N:P:K @ 75:60:60 kg/ha in the form of Urea, SSP and MOP, respectively were applied along with the FYM @ 10 t/ha. FYM was applied as basal and half of N and full doses of P_2O_5 and K_2O were applied at the time of final land preparation. The remaining dose of N was top dressed at 30 days after transplanting. Timely intercultural operations were performed as per package of practice. Neem oil, bio-meta and tobacco-garlic extract were sprayed to control insect pests and to protect the crop from viral infection in the organic plot. Also, the Bordeaux mixture was applied to protect the crop from infection of Late blight. In inorganic plot, Blitox and neem oil was sprayed to control the diseases and pest. Observation on different physiological and quality parameters were taken as per the procedure mentioned below.

A. Physiological parameters

Total leaf chlorophyll content (mg g^{-1}fw). Photosynthetically active green leaves were selected at 45 days after transplanting from each replication to measure the chlorophyll content. After washing and blotting, the leaves were cut into small pieces avoiding mid ribs and big ribs. Weighed 0.1 g of leaf samples and incubated in 5 ml DMSO (Dimethyl sulfoxide). At the end of the incubation period, the supernatant was collected and the volume was made up to 10 ml by using DMSO. The O.D (Optical density) readings were recorded in a spectrophotometer at 645nm and 663nm by using DMSO as a blank. Total chlorophyll content as mg in 1 gram of plant tissue was calculated as:

Total chlorophyll= [20.2(A645) + 8.02(A663)] ×V / (1000 × W) mg g^{-1} fw

Where, A645 and A663= Optical density value at 645 nm and 663 nm wavelength of light, respectively and

W = Fresh weight of leaf sample (g)

V = Final volume of chlorophyll extract in DMSO (ml)

Chlorophyll Stability Index (%). After 45 days of transplanting the leaf samples are prepared as mentioned in chlorophyll content Weighed 0.50 g of leaf samples, homogenized with 10 ml of 80% acetone in a pestle and mortar and centrifuged at 3000 rpm for 10 minutes and the supernatant was collected. The final volume of the supernatant was made up to 25 ml with 80% acetone and O.D. readings were recorded in a spectrophotometer at 645 nm and 663 nm. The chlorophyll contents of normal leaf samples were

calculated using the formulae. Another set of leaf samples of 0.50 g was taken in a test tube, added to 10 ml distilled water, and put in a hot water bath at 56-60°C for 30 minutes. The chlorophyll content of normal and heat treated leaf was determined by using the following formula and expressed as mg g^{-1} fresh weight of leaf.

Total chlorophyll= [20.2(A645) + 8.02(A663)] ×V / (1000 × W) mg g^{-1} fw

Where, A645 and A663 = Optical density value at 645 nm and 663 nm wavelength of light, respectively and

W = Fresh weight of leaf sample (g)

V = Final volume of chlorophyll extract in DMSO (ml)

Then the CSI of the leaf was calculated by using the following formula and were expressed as percentage.

CSI= Chlorophyll content of heat treated leaf × 100/ Chlorophyll content of normal leaf

Relative leaf water content (RLWC in %). Relative leaf water content was calculated at 45 days after transplanting. Actively growing, green healthy representative leaves free from disease and pest attacks were taken and the fresh weight was recorded. Selected leaves were cut into small, uniform segments and placed in glass Petri dishes filled with distilled water and kept for about 3-4 hours. After that, the leaf segments were taken out and the excess surface water was removed by using blotting paper and their turgid weight was recorded. The leaves were then completely dried in a hot air oven at 80°C and the dry weight was recorded. RLWC was calculated by using the following formula and expressed as a percentage.

RLWC = Fresh weight- Dry weight/ Turgid weight – Dry weight x100

Fresh and dry weight of leaf (g). The weight of five randomly selected uniform-sized leaves from each treatment in each replication was taken and measured 30 days after transplanting and at first harvest in an electronic balance and the mean was calculated to estimate the average leaf weight and was expressed in grams (g).

After measuring the fresh weight, the leaves were oven dried and the dry weight was taken periodically until the constant value of dry weight was obtained and the mean was calculated to estimate the average dry weight of the leaf and was expressed in grams (g).

Leaf area (cm^2). Uniform sized green, photo synthetically active leaves were taken at 30 and 45 days after transplanting and the leaf area was measured with the help of a Leaf Area Meter (Model: BIONICS, An ISO 9001-2000) and was expressed in cm^2. To calculate the total leaf area per plant, the leaf area of the representative leaf was multiplied by the number of functional leaves present in the plant at the time of observation.

Leaf area index. The leaf area index was calculated at 30 and 45 days after transplanting by using the formula suggested by Evans (1972). It expresses the ratio of the total leaf area to the ground area occupied by the plant.

LAI =Total leaf area of the plant/Ground area covered by the plant

B. Quality parameters

Total soluble solid content of fruit (TSS in °Brix). The total soluble solid content of the fruit was recorded by using Pocket Refractometer PAL-1 and the result was expressed in °Brix.

Lycopene content of fruit (mg/100g). The fully ripend tomato was used to estimate the lycopene content of the fruit. Lycopene content was estimated by using acetone and petroleum ether as suggested by Ranganna (1976) and expressed in mg/100 g.

Estimation. Five gram of fresh pulp tomato samples was extracted repeatedly with acetone by using mortar and pestle until the residue is colourless. The acetone extract was then transferred to a separatory funnel containing 20 ml of petroleum ether and mixed gently. 20 ml of sodium sulphate solution (5%) was added and the separating funnel was shaked gently. 20 ml more of petroleum ether was added to the separating funnel for clear separation of two layers. The two phases were separated and the lower aqueous phase was re-extracted with additional 20ml petroleum ether until the aqueous phase is colourless. The petroleum ether extract containing carotenoids was poured into a brown bottle containing about 10 g of anhydrous sodium sulphate. It was kept aside for 30 minutes. The petroleum ether extract was transferred into a 100 ml flask through a funnel containing cotton wool. The sodium sulphate slurry was washed with petroleum ether until it was colourless. It was then transferred to the volumetric flask. The volume was made up to 100 ml with petroleum ether and the absorbance was measured in a spectrophotometer at 503 nm using petroleum ether as a blank.

The lycopene content of the sample was calculated by using the following formula,

Lycopene (mg/100g) = 31.206 × Absorbance / weight of the sample (g) Where,

Absorbance (1 unit) = 3.1206 µg of lycopene/ml

Ascorbic acid content of fruit(mg/100g). Full ripened fruit was taken to estimate the ascorbic acid of fruit. Ascorbic acid content was estimated by using 2, 6-Dichlorophenol-indophenols dye visual titration method as suggested by Ranganna (1986) and expressed in mg 100 g^{-1}.

Indophenols dye preparation. For preparing the dye 42 g of sodium bicarbonate and 52 mg of 2,6-dichlorophenol-indophenols were added to 250 ml of distilled water and boiled gently to dissolve. This reagent was kept in an amber colour bottle and stored in a refrigerator and used within a week of its preparation.

Standard Ascorbic Acid Preparation. For preparing the standard solution, 2.5 ml of L-Ascorbic acid was taken in 25 ml of volumetric flask and volume made up of 4 percent oxalic acid. 5 ml of the above solution and 5 ml of 4 percent oxalic acid were taken in a 100 ml conical flask and titrated against dye until the solution changed to pink colour.

Estimation. Five grams of fresh fruit sample was grinded in a mortar and pestle in 50 ml of 4 percent oxalic acid was added and filtered. 5 ml of filtered solution was taken and titrated against the dye solution. The amount of ascorbic acid was calculated with the

formula below using the dye factor and expressed as mg/100 g.

Ascorbic acid (mg/100g) = Titre value × dye factor × volume made up × 100/ Aliquot of extract taken for estimation × weight or volume of the sample taken for estimation

*Dye factor = 0.5/Titre value

The significance of the variance due to treatments was determined by calculating the respective 'F' values by following the method described by Panse and Sukhatme (1985). The significance of the difference between mean values of the character of the treatment was tested by computing critical difference (CD) estimates.

RESULTS AND DISCUSSION

Effect of organics on physiological parameters. The physiological parameters such as total leaf chlorophyll content, chlorophyll stability index, relative leaf water content, fresh and dry weight of leaf, leaf area per plant and leaf area index (Table 1& 2) were significantly influenced by different treatments. At 45 DAT, the highest total leaf chlorophyll content (1.98 mg g^{-1} fw), chlorophyll stability index (53.29 %) and the relative leaf water content (80.79 %) was recorded in T1which was followed by T13 (1.90 mg g^{-1} fw, 52.30 % and 79.92 %) and T12 (1.86 mg g^{-1} fw, 51.16 % and 78.71%) while the lowest was recorded in T2.Fresh and dry weight of leaf were recorded at 30 DAT at 1st harvest. Data revealed that there was a significant difference among all the treatments. At 30 DAT, the maximum fresh weight and dry weight was recorded in T1 (3.51g and 0.609 g) which was followed by T13 (3.28 g and 0.561g) and T12 (3.06 g and 0.469 g).The minimum fresh weight and dry weight were recorded in T2 (1.03 and 0.158 g, respectively). Similarly, at 1st harvest the maximum fresh weight was recorded in T1 (2.59 g) followed by T13 (2.29 g). The maximum dry weight was also recorded in T1 (0.517 g) which was at par with T13 (0.496 g). Whereas, fresh weight and dry weight were found to be minimum in T2(1.00 and 0.130 g, respectively).Similar trend was noticed at 1st harvest also. The maximum fresh weight was recorded in T1 (2.59 g) followed by T13 (2.29 g). The maximum dry weight was also recorded in T1 (0.517 g) which was at par with T13 (0.496 g). Whereas, fresh weight and dry weight were found to be minimum in T2 (1.00 and 0.130 g, respectively).

The maximum leaf area per plant was achieved at T1 (718.85 and 1197.85 cm2 at 30 and 45 DAT, respectively), while the minimum was recorded in T2 (347.29 and 534.94 cm2 at 30 and 45 DAT, respectively). The maximum leaf area index was found in T1 (3.40 at 30 DAT) which was at par with T13 (3.34 at 30 DAT). Similarly, at 45 DAT maximum was recorded in T1 (4.94) which was followed by T13 (4.66). Whereas, the minimum was recorded in T2 (1.70 and 2.70 at 30 and 45 DAT).

Increased value for this parameters in treatment T1 (recommended doses of fertilizer) might be due to plants uptake of more nitrogen. Nitrogen is the key component of protein, amino acids and chlorophyll and the proper supply of nutrients in the soil accelerated their synthesis. Chlorophyll is produced from photosynthates in the presence of sufficient nitrogen and favourable environmental condition for growth. Leaf area index and chlorophyll content increased as the nitrogen rate increased (Pyne *et al*. 2022). The results are in conformity with Boroujerdnia and Ansari (2007) who obtained increased fresh and dry weight of leaves, leaf area and leaf area index with the increased nitrogen fertilizer rate in lettuce.

Comparing all the organic treatments, physiological parameters were found to be significantly increased by the application of enriched compost @10t/ha FYM + 10% Cow urine + 10% Dung brew spray (T13). Since in T13 in addition to soil application of enriched compost, 10% cow urine and 10% dung brew were sprayed so due to positive combined effect of all three components the superiority was noticed. Also, enriched compost contains more nutrients and microbes compared to vermicompost and FYM. The application of compost increased the nutrient availability such as N, P and K contents and soil microbial activity which resulted in more nutrient uptake by the plant as reported by Khan *et al*. (2017). According to Arivazhagan *et al*. (2019), organic manures enhance the physical properties of the soil and promotes microbial and soil organic matter, which in turn produces organic acids and inhibits enzymes, particularly IAA oxidase, to increase the promotion of auxin-IAA, which directly affects plant growth. The findings of the current study showed that applying organic manure increased the availability of micro and macro nutrients which might have contributed to stimulating various physiological processes within the plant. The increase in leaf weight might be due to increase in leaf area.

Effect of organics on quality parameters. Perusal of Data revealed that total soluble solid content (TSS), lycopene content and ascorbic acid content of fruit exhibited significant differences due to the influence of organic treatments (Table 3). The maximum TSS(6.10°Brix) and ascorbic acid content (31.92 mg/100g) was recorded in T13 followed by T12 (5.82°Brix and 29.71 mg/100g), while the minimum was recorded in T1 (3.51° Brix and 20.26 mg/100g). Again, the maximum lycopene content was found in T13 (8.92 mg/100g) followed by T11 (8.61 mg/100g) and minimum was recorded in T1 (5.51 mg/100g).Total soluble solids content is of considerable economic importance for the processing tomato industry, because even a small increase in its values can significantly increase the product yield and decrease the cost of dehydration of puree into sauce and paste (Young *et al*., 1993). In the present study, total soluble solids (TSS) was found higher in the fruits produced under organic manure treatments which might be attributed to optimum availability of all the micronutrients to plant contributing to better fruit quality. These results are inconsonance with the results of Chassy *et al*. (2006); Rickman and Barrett (2008) who opined that tomatoes grown under organic production systems contain higher total soluble solids compared to chemically fertilized crops. Similar finding was also observed by Singh *et al.* (2017).

Pigment synthesis in tomato is closely related to the initiation and progress to ripening and red colour of the fruit results from the accumulation of lycopene (Helyes and Pek 2006), so lycopene is considered as a good indicator of the level of ripening. The colour of the fruits is an important consumer quality parameter. The typical colour changes during tomato ripening from green to red are associated with chlorophyll breakdown and the synthesis of carotenoid pigments due to the transformation of chloroplasts to chromoplasts (Serrano *et al*., 2008). Tomatoes grown organically contained substantial amounts of lycopene when ripened to firm red or soft red stages. In the present study, lycopene content was found maximum in the fruits produced under the treatment of T13 (Enriched compost≈@10t/ha FYM + 10% Cow urine + 10% Dung brew spray). Of course, signification variations in lycopene content in tomatoes were observed among the organic treatments which might be due to the effect of different treatments formulated with different organic sources.

The analysis of tomato fruits produced with different treatments revealed that ascorbic acid content was higher in fruits produced by applying only organic manures as compared to treatment with only inorganic fertilizer. Among all the treatments, T13(Enriched compost≈@10t/ha FYM + 10% Cow urine + 10% Dung brew spray) recorded the highest ascorbic acid treatment. Rajawat *et al*. (2019) reported maximum ascorbic acid content with 100 per cent organic management and justified that higher level of ascorbic acid in tomato fruit was due to accomplishment of major and minor nutrients through application of organic manures and reduction in the ascorbic acid oxidase enzyme which was responsible for annihilation of ascorbic acid content in the plants.

The lowest content of ascorbic acid in the fruits produced with recommended doses of inorganic fertilizers might be due to fertilizer that was rich in soluble nitrogen (N) which might have caused a decrease in the ascorbic acid content, probably for indirect reasons, since the nitrogen supply increased the leaf density in plants, which promoted shading effect over the fruits. Increase in quality parameters might be due to increased availability of major as well as minor nutrients especially nitrogen and potassium obtained from different organic sources, as they play vital role in enhancing the fruit quality (Krishna and Krishnappa, 2002).

Table 1: Influence of organics on the physiological parameters of tomato.

Treatment	Total leaf Chlorophyll Content (mg/g^{-1} fw)	Chlorophyll stability index (%)	Relative leaf water content (%)	Fresh weight of leaf (g)	
	45DAT	45DAT	45DAT	30 DAT	At harvest
T1	1.98	53.29	80.79	3.51	2.59
T2	1.12	44.25	70.95	1.03	1.00
T3	1.24	45.36	71.36	1.23	1.17
T4	1.37	45.50	72.72	1.40	1.33
T5	1.73	48.16	74.66	2.32	1.71
T6	1.74	48.35	75.77	2.83	1.75
T7	1.75	50.57	76.85	2.84	1.82
T8	1.43	47.48	72.95	1.51	1.43
T9	1.57	47.69	73.56	1.85	1.49
T10	1.67	47.84	73.87	2.12	1.58
T11	1.78	50.63	77.56	2.85	2.00
T12	1.86	51.16	78.71	3.06	2.16
T13	1.90	52.30	79.92	3.28	2.29
SEd ±	0.02	0.03	0.01	0.03	0.02
CD (P=0.05	0.05	0.06	0.02	0.07	0.04

Table 2: Influence of organics on the physiological parameters of tomato.

Treatments	Dry weight of leaf (g)		Leaf area per plant (cm^2)		Leaf area index	
	30 DAT	At harvest	30 DAT	45 DAT	30 DAT	45 DAT
T1	0.609	0.517	718.85	1197.85	3.40	4.94
T2	0.158	0.130	347.29	534.94	1.70	2.70
T3	0.218	0.188	369.64	597.92	1.85	2.92
T4	0.227	0.254	480.23	634.22	2.01	3.01
T5	0.376	0.361	594.28	815.28	2.65	3.66
T6	0.393	0.374	597.39	870.38	2.77	3.76
T7	0.425	0.407	602.01	930.01	2.92	3.92
T8	0.266	0.261	530.05	688.37	2.10	3.25
T9	0.317	0.311	541.86	731.21	2.42	3.36
T10	0.358	0.350	563.69	775.68	2.64	3.49
T11	0.445	0.417	605.59	954.58	3.11	4.01
T12	0.469	0.437	609.29	989.44	3.15	4.45
T13	0.561	0.496	633.34	1083.34	3.34	4.66
SEd ±	0.01	0.01	0.80	0.53	0.03	0.03
CD(P=0.05)	0.03	0.02	1.65	1.09	0.07	0.06

Table 3: Influence of organics on quality of tomato fruits.

Treatments	TSS (°Brix)	Lycopene(mg/100g)	Ascorbic acid(mg/100g)
T1	3.51	5.51	20.26
T2	4.85	5.82	25.90
T3	4.92	6.11	26.82
T4	5.03	7.23	26.32
T5	5.14	5.73	21.02
T6	5.23	6.52	22.78
T7	5.32	8.54	30.22
T8	5.51	6.83	23.46
T9	5.03	6.02	21.93
T10	5.71	7.53	24.96
T11	5.71	8.61	28.92
T12	5.82	7.74	29.71
T13	6.10	8.92	31.92
SEd ±	0.01	0.01	0.02
CD(P=0.05)	0.02	0.03	0.05

CONCLUSIONS

It has been observed from the present investigation the inorganic treatment T1 with recommended dose of fertilizers performed best for physiological characters among all the treatments. But among the organic treatments the treatment T13 with Enriched compost ≈ @10 t/ha FYM + 10% Cow urine + 10% Dung brew spray performed best. For quality parameter T13 showed superiority among all the treatments. Therefore it can be concluded that Enriched compost≈@10 t/ha FYM + 10% Cow urine + 10% Dung brew can be used for production of quality fruits with superior physiological and quality attributes of tomato plants under organic production in Assam condition.

FUTURE SCOPE

Further studies are required to understand the long-term effect of organic manures and liquid manure on tomato production, soil microbiological status and investigating other crops that could benefit with similar practices. This study contributes to the knowledge base in the field of organic vegetable cultivation and provides valuable insights for both researchers and practitioners in agriculture.

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Conflict of Interest. None.

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