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EFFECT OF ORGANIC SOURCES OF NUTRITION IN PERFORMANCE OF TOMATO AND SOIL PROPERTIES INSIDE PLASTIC HOUSE

Shukra Raj Shrestha[1,*], Kishor Bhandari[2], Manish Kumar Thakur[3], Surendra Prasad Yadav[1], Diagambar Yadav[4], Bikash Dahal[1] and Damali Sherpa[1]

[1] Directorate of Agricultural Research, Koshi Province, Sunsari
[2] Nepal Agricultural Research Council, Singhadurbar plaza
[3] National Commercial Agriculture Research Program
[4] Soil and Fertilizer Testing Laboratory, Koshi Province Sunsari

ABSTRACT

The experiments were conducted during September-March over two years, in 2022-23 and 2023-24 under plastic house at Directorate of Agricultural Research, Tarahara, Sunsari to evaluate the responses of organic sources of nutrition on growth, yield, yield attributes and fruit quality of tomato and to monitor changes in soil properties. Experiments were laid out in a Randomized Complete Block Design (RCBD) with eight treatments comprising organic manures and compost like farmyard manure, vermicompost, poultry manure, goat manure, mustard oil cake, self-prepared compost and Jeevamrut including the control plots without any fertilizers. Each treatment was replicated thrice. The doses of manures and compost were calculated to fulfill the nitrogen requirement recommended for Tomato cv. 'Srijana'. The pooled analysis revealed that the plant height, days to first flower, number of fruits per cluster, number of fruits per plant and fruits yields showed significant variation among the treatments. The highest fruit yield (2.93 kg/plant i.e.74.92 t/ha) was obtained from plants treated with vermicompost followed by the plants receiving farmyard manure (2.88 kg/plant). Treatments did not show significant change in the Total soluble solids (TSS) and titratable acidity (TA) of tomato fruits. The soil samples of each experimental plot were analyzed for chemical and physical properties at the beginning and after the crop's final harvest in both the years. The significant improvement in total nitrogen, available phosphorus, available potassium and soil organic matter was observed in fertilized plots over the control during trial period.

Keywords:

Compost, Fruit quality, Growth, Organic manures, Tomato, Yield

INTRODUCTION

Tomato (*Solanum lycopersicum* L.), the edible berry belonging to Solanaceae family is a popular and commonly used ingredient in cuisines worldwide. It is an essential constituent in Nepalese cooking as well. Tomato is a good source of potassium, folate, vitamin A, C and E and phytochemicals-carotenoids such as lycopene, β Carotene, phytoene and phytofluene (Kirstie

* Corresponding author Email: shukrarajshrestha@gmail.com

et al., 2005). The estimated total production of tomato is about 186 million tonnes in 2022 ranking second after the potato having production of about 375 million tonnes (FAOSTAT, 2024). It is widely cultivated fruit vegetables in different agro-ecological domains of Nepal. It was cultivated in 4,998 hectares of land with an annual production of 1,26,354 mt in 2021/22 in Koshi Province (MoALD, 2023). The national production in the same year was 4,22,703 mt from 22,911 hectares of land.

Excessive and inappropriate use of chemicals has put forth a question on sustainability of agriculture in the long run and concerns have been raised time and again over its adverse effects on soil productivity and environment. The use of chemical fertilizers and pesticides during production can have an impact on the sanitary, organoleptic and nutritional quality of the tomato and even on the health of the consumer (Khan et al., 2008). Continuous use of inorganic fertilizers alone to soils had a deleterious effect on soil productivity and a steady declining trend in crop productivity associated mainly with loss of inherent soil fertility (Bhattacharyya et al., 2015). Alarmingly, about 50 percent of the chemical fertilizers applied to soil remain unused and causes enormous reactions resulting in deterioration in the water conservation and nutrients holding capacity of soil (Reazuddin, 1994). Furthermore, increased use of hybrid seeds of cereals and vegetables has been driven to more demand for pesticides and chemical fertilizers, and Nepal which does not manufacture such fertilizers/pesticides, will become over dependent and rely more on imports. These scenarios have drawn the attention of many agricultural scientists and specialists towards organic farming practices so that the environment friendly and sustainable agriculture can be achieved. Increasing consciousness about ill effects of the chemical pesticides and fertilizers have led to a demand of more policies and agricultural management methods to achieve sustainable agriculture.

IFOAM, 2008 in its definition of organic agriculture has highlighted on health of soils, ecosystems, and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. The trend of organic production of vegetables has emerged these days and many promotional activities were conducted in different parts of Koshi Province. While initiating, practicing and promoting organic agriculture, the use of organic manures/amendments is one of the essential and mandatory components. There is no alternative method of nourishing soil other than organic manures in organic agriculture/farming. Organic manures improve soil physical, chemical and biological properties (Khan et al., 2010) and its regular application improves soil structure and leads to better environment for root development, ultimately increased crops' yield. Application of organic manures are directly associated with bio-chemical properties of tomato fruits as well. Studies have suggested that tomatoes grown with organic manure often exhibit a more balanced sweetness-acidity ratio that provides better taste with slight variations depending on the type of organic manure used. Improved microbial activity and better soil structure associated with organic manure application enhance nutrient cycling, particularly potassium, which plays a crucial role in sugar accumulation (Patil et al., 2004). Hence, to study the response of organic sources of nutrition in growth parameters, yields, yield attributes and bio-chemical properties of tomato and the soil properties dynamics the field experiments were conducted for consecutive two years 2022-23 and 2023-24.

METHODOLOGY

EXPERIMENTAL SITE

The field experiments were conducted at Directorate of Agricultural Research (DoAR), Tarahara, Sunsari (Figure 1) in the predominant plain soil having Silty clay loam texture. The experimental site is situated in Eastern Terai of Nepal at 26°42' North latitude and 87°16' East longitude, located at an elevation of 127 meter above mean sea level.

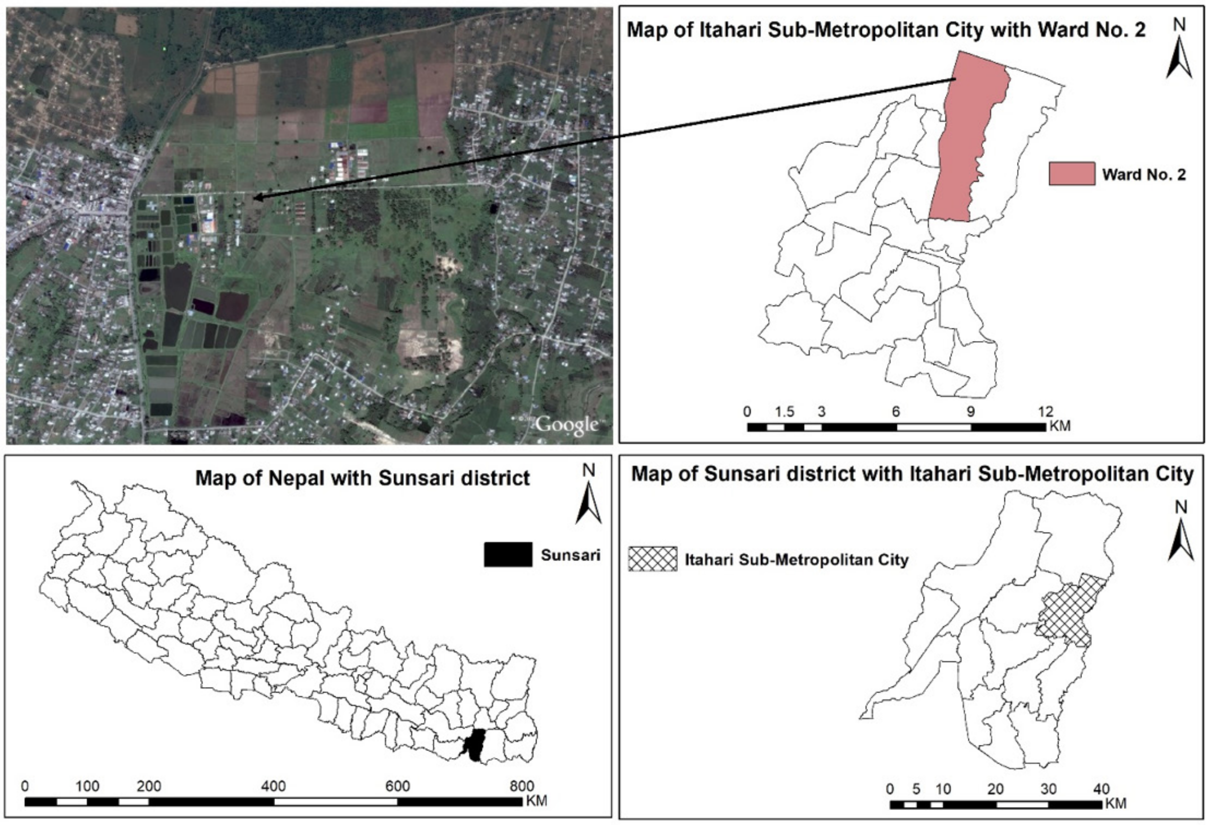

Figure 1. Different maps showing the study district, sub-metropolitan city, ward and experimental site

SOIL SAMPLING AND ANALYSIS

A composite soil sample of experimental plot representing 30 samples of upper layer (0-25 cm depth) was taken before transplanting of the crop to estimate the initial value of soil properties; total nitrogen, available phosphorus, available potassium, soil organic matter, pH, soil texture and bulk density. The samples were analyzed at the soil lab of Directorate of Agricultural Research, Tarahara, Sunsari following standard lab methods of NARC (Table 1). The soil samples of each experimental plot were analyzed for chemical properties and bulk density after the crop's final harvest in both the years.

Table 1. Initial status of soil properties and methods adopted for the laboratory analysis at DoAR, Tarahara, Sunsari, 2022

SN	Parameter	Unit	Method	Analysis status	Ratings/Remarks
1	Total Nitrogen	%	Kjeldahl Digestion (Bremner & Mulvaney, 1982)	0.12	Medium
2	Available P_2O_5	ppm	Olsen (Olsen et al., 1954)	23.6	Low
3	Available K_2O	ppm	Ammonium acetate extraction (Jackson, 1967)	38.5	Very low
4	Soil Organic Matter	%	Walkley-Black wet oxidation (Walkley & Black, 1934)	2.7	Medium
5	pH		Potentiometric 1:2.5 (Jackson, 1973)	6.2	Slightly acidic
6	Sand	%		15.7	
7	Silt	%		50.1	
8	Clay	%		34.2	
9	Soil texture		Hydrometer (Bouyoucos, 1962)	Silty clay loam	
10	Bulk density	g/cm^3		1.48	Moderate (acceptable for many crops)

Note: The status is based on ratings provided by National Soil Science Research Center, Khumaltar, NARC

EXPERIMENTAL SETUP AND CROP VARIETY

The experiments were laid out in Randomized Complete Block Design (RCBD) with eight treatments replicated thrice. The tomato variety 'Srijana' F1 hybrid registered by National Seed Board in 2010 was used in the experiment. The spacings of 70 cm (RR) and 60 cm (PP) were maintained. The individual net plot and gross plot sizes were 1.68 and 3.90 m^2 respectively with 10 observable plant population accommodated in each plot. The seedlings raised in tray with growth media were transplanted after 20 days of seeding.

TREATMENTS' DETAIL

The following 8 treatments shown in table below comprising different organic sources were applied during experiments.

Table 2. Treatments for the field experiments at DoAR, Tarahara, Sunsari (2022-23 and 2023-24).

T/ No.	Treatments	Remarks
T1	Control	No any external inputs were applied as soil amendments and fertilizers
T2	Farmyard manure	A well rotten farmyard manure
T3	Vermicompost	A well rotten vermicompost
T4	Poultry manure	A well rotten poultry manure
T5	Goat manure	A well rotten goat manure
T6	Mustard oil cake	A well powdered mustard oil cake
T7	Compost	Prepared by mixing 10 kg farmyard manure, 10 kg wooden dust, 10 kg fresh banmara (*Eupatorium adenophorum* L.), 10 kg rice bran, 10 kg oil cake, 5 kg ash of rice straw, 2 kg jaggery, 10 liter of buffalo urine and 5 liter of liquid fertilizer containing effective microorganisms and used after 40 days of mixing.
T8	Jeevamrut	Prepared by mixing 1 kg of fresh cow dung, 1 liter of cow urine, 200 g of jaggery, 200 g of chickpea flour and handful of forest soil in 20 liters of water. The solution was mixed well.

After 6 days of storage, Jeevamrut was applied @ 1 liter per plant around the trunk in soil. Jeevamrut was first applied at 15 days of transplanting and thereafter at every interval of 20 days. In total 6 liter of Jeevamrut was applied to each plant.

All the recommended dose of solid manures and compost were placed in pit and mixed with soil before 5 days of transplanting. Intercultural operations like weeding, irrigation, pruning and staking were done as per the necessary. For disease and insect management the organic proven pesticides/insecticides were used.

Estimation of the dose of manures and compost: Nutrient content of well decomposed manure and compost were assessed following the standard methods at DoAR, Tarahara and Soil and Fertilizer Testing Laboratory, Jhumka. The dose of manures and compost were then calculated to fulfill the nitrogen requirement recommended for 'Srijana' variety that comes to be 35 g/plant (Shrestha et al., 2021) on per plant basis (Table 3). The average nitrogen, phosphorus and potassium contents in different manures and compost were shown in table below.

Table 3. Dose of manures and compost with nutrient content provided to plants during the experiments at DoAR, Tarahara, Sunsari (2022-23 and 2023-24).

T/No.	Manures	N content (%)	P_2O_5 content (%)	K_2O content (%)	Amount (g/ plant)
T1	Control	-	-	-	-
T2	Farmyard manure	0.58	0.27	0.54	6034.48
T3	Vermicompost	2.30	1.38	2.17	1521.74
T4	Poultry manure	3.94	2.54	2.15	888.32
T5	Goat manure	1.74	0.58	1.62	2011.49
T6	Mustard oil cake	4.83	0.95	1.05	724.64
T7	Compost	1.69	1.25	0.85	2071.01
T8	Jeevamrut (Soil)	-			-

DATA COLLECTION

The alternate 3 plants from first row and 2 plants from second row were selected and tagged in each plot to measure plant height (cm), days to first flower (DAT), number of fruits per cluster, no. of fruits per plant, fruits yield per plant (kg) and fruits yield per hectare (t/ha). The fruits yields mentioned in table 3 are average value of marketable yield. The plant height was measured once using a measuring scale at the final harvest. Number of fruits from five clusters were counted at each harvest and average value was recorded. For individual fruit weight, five fruits were randomly selected from each treatment/plot, weighed and average value was recorded. The fruits yield per plant was the average yield obtained from five plants. Fruits yield per hectare was calculated on the basis of yield and plant population of net plot area.

Total Soluble Solids (TSS): The sample fruits were harvested at light-red ripe stage. The juice from selected 5 tomatoes from each plot (treatment) was extracted and homogenized for 2 min at high-speed food blender and then filtered using a muslin cloth. TSS were measured by using a digital refractometer. The refractometer was first standardized by adding few drops of water and one to two drops of clear juice were placed on the prism for observation. The resulted value was expressed as ^{o}Brix.

Titratable Acidity (TA): For TA, 5 ml extracted juice was taken and diluted with 95 ml distilled water and phenolphthalein as an indicator. TA was then calculated by titrating 5 ml tomato juice against 0.1 N NaOH. The titratable acidity (TA) of the tomato was determined by the titration method explained by Teka (2013). Titratable acidity was expressed as a percentage of citric acid and it was calculated by using the following equation;

$$\% \text{ Citric acid} = \frac{\text{Volume of NaOH (ml)} * 0.1 \text{ (Normality of NaOH)} * 0.064 * 100}{\text{Volume of juice (ml)}}$$

Where, 0.064 is the citric acid milliequivalent factor.

STATISTICAL ANALYSIS

The collected data were analyzed as per the procedure given in R-STAT software (Version 4.1.1) for the randomized complete block design (R Core Team, 2021). Analysis of variance (ANOVA) was performed and the treatment means were compared by the Least Significant Difference (LSD) test at 5% level (Gomez and Gomez, 1984).

RESULTS

GROWTH ATTRIBUTES

The plots receiving poultry manure recorded significantly ($p<0.05$) higher plant height at harvest (228.47 cm) followed by the plots receiving mustard oil cake (218.43 cm) and Jeevamrut (216.23 cm). The lowest plant height was observed in control plots (196.03 cm). The earliest inflorescence (20 DAT) was reported in control plots while Jeevamrut treated plots experienced first flower at 21 DAT and rest of the treatments resulted first flowers at 22 DAT showing statistical at par (Table 4).

YIELDS AND YIELD ATTRIBUTES

The data obtained from pooled analysis revealed that the number of fruits per cluster, number of fruits per plant and fruits yields varied significantly ($p<0.05$) with different treatments (Table 4). The number of fruits per cluster showed statistically similar results among the treatments with application of vermicompost, poultry manure and Jeevamrut resulting higher number of fruits per cluster (8.7) followed by the plots treated with farmyard manure, goat manure and mustard oil cake (8.0). The plots receiving vermicompost counted significantly higher number of fruits per plant (87) followed by the application of goat manures (85) with an increase in 19.5% and 17.6% over the control respectively. The plots receiving poultry manure and mustard oil cake resulted similar number of fruits per plant (84). A significant variation was observed in fruits yield per plant because of different organic sources of nutrition. In the study, the highest fruit yield (2.93 kg i.e., 74.92 t/ha) was obtained from plants treated with vermicompost followed by the plants receiving farmyard manure (2.88 kg) and self-made compost (2.85 kg). The plots where no external inputs were applied i.e., control plots registered significantly lower number of fruits per cluster (7.3), number of fruits per plant (70), fruits yield per plant (2.04 kg) with 51.83 t/ha fruits yield.

FRUITS CHEMICAL PROPERTIES

Fruits chemical properties like total soluble solid and titratable acidity did not significantly vary among the treatments. The highest TSS was found in fruits treated with vermicompost (5.28 ^{o}Brix) followed by goat manure (5.16 ^{o}Brix) and poultry manure (5.11^{o}Brix) with lowest value in fruits of control plots (4.83 ^{o}Brix). Titratable acidity of fruits treated with different organic manures ranges from 0.23% to 0.25%.

Table 4. Average value of growth parameters, yield, yield attributes and fruit quality of tomato as influenced by organic nutrient management practices at DoAR, Tarahara during 2022-23 and 2023-24.

Treatments (Treatment Code)	Plant height (cm)	Days to first flower (DAT)	No. of fruits per cluster	No. of fruits per plant	Fruits yield per plant (kg)	Fruits yield (t/ha)	Total Soluble Solid (°Brix)	Titratable Acidity (%)
T1 (Control)	196.03[c]	20[c]	7	70[c]	2.04[d]	51.83[d]	4.83	0.23
T2 (FYM)	213.33[b]	22[ab]	8	83[ab]	2.88[ab]	72.25[ab]	4.95	0.23
T3 (Vermi)	209.73[b]	22[a]	9	87[a]	2.93[a]	74.92[a]	5.28	0.24
T4 (Poultry M)	228.47[a]	22[ab]	9	84[ab]	2.79[abc]	69.67[bc]	5.11	0.23
T5 (Goat M)	214.43[b]	22[a]	8	85[ab]	2.68[c]	70.33[abc]	5.16	0.23
T6 (MOC)	218.43[ab]	22[ab]	8	83[ab]	2.73[bc]	66.50[c]	4.98	0.25
T7 (Compost)	214.30[b]	22[a]	8	84[ab]	2.85[abc]	72.17[ab]	5.01	0.24
T8 (Jeevamrut)	216.23[ab]	21[bc]	9	79[b]	2.81[abc]	68.33[bc]	5.07	0.23
P value	0.011	0.002	0.35	0.008	<0.001	<0.001	0.56	0.12
LSD $_{(0.05)}$	13.38	0.72	1.37	7.23	0.20	4.72	1.31	0.01
SEm (±)	1.56	0.08	0.16	0.84	0.02	0.58	0.05	0.002
CV (%)	3.57	1.90	9.64	5.05	4.18	3.96	5.08	3.27

Note-Means in each column with the same superscript are not significantly different by DMRT (p<0.05). CV: Coefficient of Variance, LSD: Least Significant Difference; SEm: Standard Error Mean, MOC: Mustard oil cake, M: Manure

CHANGE IN SOIL PROPERTIES

All the tested soil parameters except the soil pH in second year varied significantly ($p<0.05$) under different treatments (Table 5). The total nitrogen, available phosphorus, available potassium and soil organic matter of control plots declined significantly over the trial period by 50, 45.2, 55.5 and 34.1 percent respectively.

TOTAL NITROGEN

The total nitrogen in soil after first and second harvest varied significantly among the treatments. Application of different organic manures, compost and Jeevamrut significantly increases the total nitrogen content in soil at the end of experiment. After first harvest the highest total nitrogen was revealed in poultry manure treated plots (0.16%) followed by the farmyard manure treated plots (0.15%). The final harvest resulted the highest total nitrogen content in the farmyard manure treated plots (0.19%).

AVAILABLE PHOSPHORUS

In both the years the available phosphorus content in soil varied significantly among the treatments (Table 4) with application of poultry manure resulting significantly higher amount in first (45.5 ppm) and second (51.8 ppm) harvests. The continuous application of manures, compost and Jeevamrut in two years showed ascended content of available phosphorus in soil.

AVAILABLE POTASSIUM

The available potassium was significantly higher in poultry manure treated plots in both the first (49.7 ppm) and second (54.9 ppm) harvests (Table 5). This highest value was followed by vermicompost treated plots, which accorded the available potassium content in soil with 46.1 and 48.9 ppm in first and second harvests respectively.

SOIL ORGANIC MATTER

The farmyard manure treated plots showed significantly higher soil organic matter content over the trial period followed by the compost. The plots treated with farmyard manure and compost treated plots resulted net increment of 35.7% and 30.8% soil organic matter respectively.

SOIL pH

The soil pH was significantly lower in control plots after first harvest (5.5) with highest fluctuation in farmyard manure (6.2-6.9) and poultry manure (6.2-7.0) treated plots (Table 5).

BULK DENSITY

The application of manures and compost significantly lowered the soil bulk density. In first year, the application of vermicompost and goat manure resulted the lowest bulk density (1.44 g/cm^3), while in second year, significantly lower bulk density was observed in poultry manure treated plots (1.42 g/cm^3).

Table 5. Change in soil properties after first (2023) and second (2024) harvest under different practices of organic nutrition in tomato at DoAR, Tarahara.

Treatments	**Total Nitrogen (%)**		**Available P_2O_5 (ppm)**		**Available K_2O (ppm)**		**Soil organic matter (%)**		**pH**		**Bulk Density (g/cm^3)**	
	2023	**2024**	**2023**	**2024**	**2023**	**2024**	**2023**	**2024**	**2023**	**2024**	**2023**	**2024**
T1 (Control)	0.08^{f}	0.06^{c}	16.9^{c}	12.9^{c}	20.8^{c}	17.13^{c}	2.2^{d}	1.8^{e}	5.5^{b}	5.9	1.55^{a}	1.58^{a}
T2 (FYM)	0.15^{ab}	0.19^{a}	41.3^{ab}	42.2^{ab}	38.1^{b}	44.03^{ab}	3.9^{a}	4.2^{ab}	6.8^{a}	6.9	1.45^{b}	1.43^{b}
T3 (Vermi)	0.14^{bc}	0.15^{ab}	37.8^{b}	39.1^{b}	46.1^{ab}	48.9^{ab}	3.3^{bc}	3.6^{bc}	6.3^{a}	6.5	1.44^{b}	1.44^{b}
T4 (Poultry M)	0.16^{a}	0.18^{a}	45.5^{a}	51.8^{a}	49.7^{a}	54.9^{a}	3.0^{c}	3.4^{cd}	6.5^{a}	7.0	1.46^{b}	1.42^{b}
T5 (Goat M)	0.13^{de}	0.14^{ab}	34.2^{b}	38.8^{b}	40.1^{b}	43.3^{ab}	3.0^{c}	3.3^{cd}	6.6^{a}	6.8	1.44^{b}	1.43^{b}
T6 (MOC)	0.14^{bcd}	0.16^{ab}	39.2^{abc}	44.7^{ab}	34.3^{b}	36.6^{b}	3.0^{c}	3.2^{cd}	6.2^{a}	6.5	1.47^{b}	1.45^{b}
T7 (Compost)	0.12^{e}	0.15^{ab}	36.2^{b}	45.3^{ab}	37.4^{b}	42.3^{ab}	3.7^{ab}	3.9^{ab}	6.1^{a}	6.3	1.46^{b}	1.46^{b}
T8 (Jeevamrut)	0.13^{cde}	0.14^{b}	33.9^{b}	40.1^{b}	35.8^{b}	41.7^{ab}	2.8^{c}	3.1^{d}	6.3^{a}	6.4	1.48^{b}	1.44^{b}
P value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.01	0.15	0.006	0.03

LSD $_{(0.05)}$	0.01	0.04	7.15	9.08	9.12	13.07	0.46	0.43	0.75	0.95	0.05	0.06
SEm (±)	0.002	0.004	0.83	1.06	1.06	1.52	0.05	0.05	0.09	0.11	0.006	0.007
CV (%)	5.75	14.53	11.78	13.92	14.18	18.13	8.40	7.48	6.73	8.28	2.01	2.25

Note-Means in each column with the same superscript are not significantly different by DMRT (p<0.05). CV: Coefficient of Variance, LSD: Least Significant Difference; SEm: Standard Error Mean

DISCUSSION

The increase in plant height following the application of different organic manures is consistent with the findings of Laxmi et al., (2015), who reported that organic fertilizers are rich in essential macro and micronutrients that enhance photosynthesis and protein synthesis supporting cell division and elongation. The earlier and forced inflorescence in control plots might be due to the low nitrogen leading to increased synthesis of abscisic acid (ABA) and a reduction in cytokinins, both of which promote earlier flowering. A deficiency in phosphorus can also trigger early flowering as suggested by Grant et al., (2001), as it's a key element in energy transfer during reproduction. Obi & Ebo (1995) observed that the application of organic manures along with compost improved soil water relationship, which affected bulk density and porosity of the soil, made available the moisture contents in proper proportion with required soil nutrients. These factors as justified by them helps to promote the number of fruits per cluster and number of fruits per plant. The significantly higher fruit yield by the application of vermicompost are in close resemblance with Ali et al., (2015), who reported that the vermicompost provides a more balanced and slow-release supply of nutrients, making them more readily available to plants over time and reducing the risk of nutrient leaching with richness in beneficial microbes and enzymes. Despite the higher content of NPK in poultry manure, it releases nutrients too quickly and possess lesser buffering capacity which failed to influence fruits yield as compared to vermicompost. In addition, Akand et al., (2015) advocated that the higher fruits yield by the application of organic fertilizers is due to the promoted vegetative growth and other yield parameters like fruits per cluster and fruits weight. Organic manures have been shown to enhance TSS in tomato compared to unfertilized fruits. This improvement is attributed to the better nutrient availability, including macro and micro-nutrients provided by organic inputs. Decomposition of organic matter improves soil structure and moisture retention, facilitating a steady nutrient supply, which supports sugar accumulation and the development of soluble solids in fruit (Alexander et al., 2006). The narrow range of titratable acidity of fruits treated with different organic manures could be linked to the slow nutrient release from organic sources, which alters the plant's metabolic balance, promoting the synthesis of organic acids. Organic manures also improve soil moisture and reduce plant stress, stabilizing acid production in fruits.

The depletion of primary nutrients in control plots after harvest is due to crop uptake from the soil during the growth and development without replenishment. Decline in soil organic matter is due to null application of organic sources of nutrition in control plots. Organic manures when applied to soil release nitrogen as they decompose, adding both organic and inorganic forms of nitrogen. A study by Mahajan et al., (2019) observed a 15-20% increase in soil nitrogen after three years of continuous organic manure application compared to chemical fertilizers. Sanchez & Leakey (2020) highlighted that the application of composted manures enhances microbial activity, leading to increased nitrogen mineralization rates, which is crucial for the conversion of organic nitrogen to ammonium (NH_4^+) and nitrate (NO_3^-) forms. This contributes to a higher buildup of soil total nitrogen over time. A study conducted by Singh & Singh (2022) also demonstrated that farmyard manure (FYM), vermicompost and poultry manure significantly increased the availability of soil phosphorus in tomato fields. The organic acids released during manure decomposition can chelate Fe and Al ions reducing their interaction with phosphorus and thereby enhancing P availability. This might be the reason behind the unavailable forms of phosphorus in the acidic soil of trial plots got transferred to available forms with enhanced P content as prevailed in the result. Furthermore, organic manures when decompose, release phosphorus in both organic and inorganic forms making it available to plants and also increasing its content in soil. Boraiah et al., (2017) reported that the microbial populations boosted by organic manure applications enhanced phosphorus solubilization through the production of organic acids and enzymes. Organic manures stimulate microbial activities, which aids in the breakdown of potassium-bearing minerals in the soil, releasing potassium into plant-available forms. Also, the addition of organic matter by the continuous application of manures and compost improves the soil's cation exchange capacity (CEC), reducing potassium leaching in soils. Whalen & Chang, after examining long-term impacts of manure application on soil potassium in 2002 revealed that the application of manures including vermicompost improved microbial activity, which contributed to potassium mineralization, increasing its availability by 30-35% compared to control plots. Organic manures stimulate microbial populations (bacteria, fungi and actinomycetes) by providing energy source i.e., carbon and nutrients and their activities enhances the breakdown of organic materials and the formation of stable organic matter. The result is in harmony with the findings of Verma et al., 2024 who revealed the improved organic matter by the application of manures and organic amendments in different solanaceous group of vegetables. The increased soil pH by the application of vermicompost, goat manure and mustard oil cake is due to enriched content of cations like calcium and potassium in it as revealed by Ayeni & Ezeh (2017). Organic manures improve soil structure by binding soil particles into aggregates, creating a more porous structure. These materials add lightweight organic matter, which increases the volume of pores in the soil, reducing its overall density.

CONCLUSION

The application of organic amendments significantly influenced the growth and yield parameters of the crop compared to the control (T1). Among all treatments, vermicompost (T3) consistently resulted in superior performance, with the highest number of fruits per plant maximum fruit yield per plant, and highest total yield, while also recording the highest TSS, indicating better fruit quality. Poultry manure (T4) also showed promising results, particularly in plant height, highlighting its positive impact on vegetative growth. The data demonstrate that organic inputs such as vermicompost and poultry manure can effectively enhance both quantitative and qualitative traits of crop performance, offering sustainable alternatives to conventional practices. The application of organic amendments had a significant positive impact on soil fertility and physical properties. Poultry manure (T4) emerged as the most effective treatment, showing the highest levels of total nitrogen, available phosphorus, and available potassium, indicating enhanced nutrient availability. Farmyard manure (T2) also performed well, especially in increasing soil organic matter and maintaining favorable pH and bulk density. Across treatments, all organic inputs improved soil nutrient status and organic matter content compared to the control (T1), which consistently recorded the lowest values. Moreover, treatments reduced soil bulk density and maintained near-neutral pH levels, contributing to better soil structure and health. These findings highlight the long-term benefits of organic amendments in sustaining soil fertility and improving soil quality. This study clearly indicated the positive influence of manures and compost in soil chemical and physical properties. But to unveil the increment trend of primary nutrients and organic matter with the application of similar dose of organic manures the same experiment needs to be conducted for more than two years.

DECLARATION

The authors declare no conflict of interests.

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