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Impact of organic and inorganic nutrient integration on growth and yield performance of cherry tomato (*Solanum lycopersicum* var. *cerasiforme*)

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ABSTRACT

The present investigation was carried out at the College of Horticulture and Forestry, CAU, Pasighat, Arunachal Pradesh during 2023-24 using combination of organic manures and inorganic fertilizers to investigate the impact of organic manures and inorganic fertilizers on growth and yield of cherry tomato. 7 treatments conducted in a Randomized Block Design (RBD) with 3 replications and treatments comprising of combination of FYM, vermicompost, poultry manure and Ghanajeevamrit with inorganic nutrients. Among the treatments, T_3 (75% N from RDF + 25% N from vermicompost) showed the best results, including the tallest plants (318.83 cm), fruits per plant (104.33), the heaviest fruits (7.93 g), polar and equatorial diameter (24.89 mm and 24.17 mm respectively), the highest yield per plant (478.74 g) and per plot (4.96 kg). The second-best performance was observed with T_4 , particularly in terms of fruits per plant (97.20) and yield per plant (469.22 g). In contrast, the lowest values were recorded in the control treatment (T_0), with a yield per plant of 391.30 g and per plot of 3.81 kg. The results emphasize the substantial positive impact of T_3 (75% N from RDF + 25% N from vermicompost) on sustainable cherry tomato production.

Keywords: Organic manures, Inorganic fertilizers, Growth, Yield, Cherry tomato

1. Introduction

Over the past few years, growers in India have been producing a remarkable amount of cherry tomatoes. Multiple factors contribute to this rise, most prominent among them is an increased awareness of the health advantages associated with cherry tomatoes in urban communities. var. *Solanum lycopersicum* var. *cerasiforme* is highly popular as a fresh fruit because it is both delicious and packed with essential minerals (Nie *et al.*, 2023) [1]. As awareness of the benefits of including cherry tomatoes in diets grows, their demand is increasing, prompting farmers to expand production and improve yields (Richardson *et al.*, 2022) [2]. This rising trend in cherry tomato cultivation mirrors a larger shift towards sustainable agriculture and a more varied culinary scene in India.

Organic manures, such as FYM, vermicompost, poultry manure, and ghanajeevamrit, are inexpensive, readily accessible, and effectively contribute to the production of cherry tomatoes in the local conditions. Cattle dung and urine combine to form farm yard manure (FYM), a degraded mixture that includes a fair quantity of vital nutrients. Vermicompost, an organic manure made through earthworm activity, is a rich source of vitamins, growth hormones and both macro and micronutrients (Bhawalker, 1993) [3]. Poultry manure is composed of chicken faeces and urine, along with feathers, cells from the digestive tract lining, indigestible feed remnants and various mineral salts. Jeevamruth, a natural input composed of naturally available organic ingredients, encourages a high level of biological activity in the soil and delivers nutrients for crop utilization (Lakhani, 2024) [4]. Ghanajeevamrit is the solid form of jeevamruth used for soil application.

In recent years, inorganic fertilizers have been applied more frequently to increase yields from hybrids and improved varieties, as the use of organic fertilizers has decreased. Cherry tomatoes, being nutrient-demanding and exhausting crops, respond well to these nutrient applications. While initial yields may rise with the exclusive use of chemical fertilizers, this approach poses challenges for sustainability. Additionally, the increasing cost of chemical fertilizers aggravates the issue. Therefore, reducing dependence on chemical fertilizers and promoting sustainable production is essential. This can be achieved through integrated nutrient management, which combines organic and inorganic nutrient sources to improve soil quality, boost crop yields and provide a nutrient reserve for future crops (Parmar *et al.*, 2019) [5].

2. Materials and methods

The current study was conducted in a naturally ventilated polyhouse at the College of Horticulture and Forestry, CAU, Pasighat, Arunachal Pradesh, situated in the eastern foothills of the Himalayas. Pasighat experiences a subtropical and humid climate with plentiful sunshine and rainfall year-round. The average annual temperature is 22.8 °C (73.1 °F). The region receives its heaviest rainfall from July to September, and the monsoon season often brings continuous rain for four to six weeks. During the monsoon, relative humidity is high, leading to significant downpours. In autumn, strong, drying winds begin and persist through winter. The area is located at an altitude of 155 meters above sea level, with a latitude of 28.07° North and a longitude of 95.33° East. The terrain is moderately elevated and features good drainage.

2.1 Experimental treatments: The experiment was laid out in a randomized block design (RBD) with three replications. The treatments consisted of a combination of organic manures and inorganic fertilizers

including T_0 = Control, T_1 = 75% of RDF (N: P: K = 56.25: 45:45 kg/ha), T_2 = 75% N of RDF + 25% N from FYM, T_3 = 75% N of RDF + 25% N from Vermicompost, T_4 = 75% N of RDF + 25% N from Poultry manure, T_5 = 75% N of RDF + 25% N from Ghanajeevamrit, T_6 = 75% N of RDF + 25% N from (FYM + Vermicompost + Poultry manure + Ghanajeevamrit).

2.2 Observations recorded: Observations on plant height (cm), days to first flowering, number of flowers per cluster, number of fruits per cluster, number of fruits per plant, fruit weight (g), yield per plant (g) and yield per plot (kg) were recorded at various stages of crop growth on randomly selected five labelled plants in each plot and average was calculated.

2.3 Statistical analysis: The collected data was analyzed using the OPSTAT software package (Sheoran, 1998) [6] for conducting analysis of variance (ANOVA) based on a randomized block design (RBD) and SPSS software for finding critical difference (CD) among the treatments.



Figure 2.1. Fertilizers incorporated for inorganic treatment

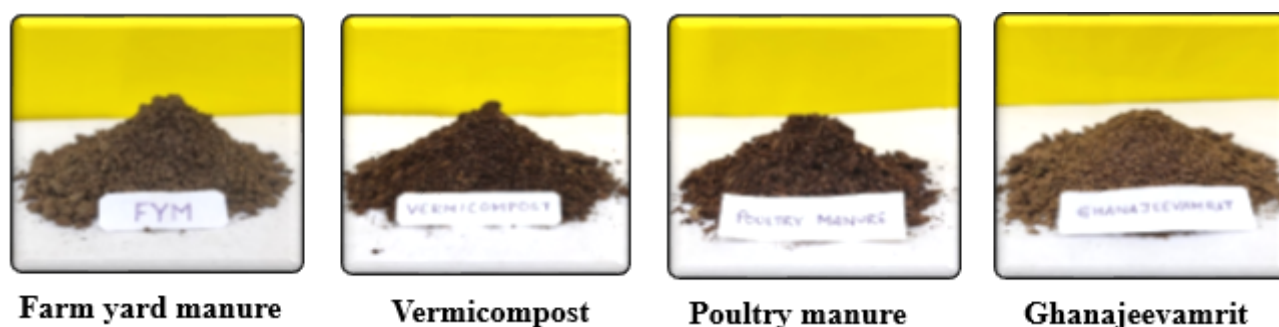


Figure 2.2. Organic manure treatments

3. Results and Discussion

3.1 Growth parameter

3.1 Plant height (cm): The integrated application of organic manures and inorganic fertilizers significantly influenced the height of cherry tomato plants at different growth stages (30, 60, 90, 120 days after transplanting and at harvest). Treatment T_3 , which included 75% N from recommended dosage and 25% from vermicompost, consistently produced the tallest plants (73.40 cm, 170.31 cm, 250.77 cm, 277.62 cm and 318.83 cm respectively) at all growth stages compared to control treatment (T_0) which resulted in the shortest plants at each

stage (Table 1). The increased plant height observed at 30, 60, 90, 120 days after transplanting and at harvest is likely due to the use of organic manures, particularly vermicompost, along with 75% of the recommended dose of inorganic fertilizers (RDF). This combination provided ample nitrogen, which supports improved photosynthetic activity and vigorous vegetative growth. The inorganic fertilizers offered a rapid nutrient boost during early growth stages, while the vermicompost provided a slow, sustained nutrient release later on. In contrast, the limited growth seen in the control group may be a result of inadequate nutrient availability. These results are consistent with findings reported by Singh *et al.* (2018) [7], Prativa and Bhattarai (2011) [8] and Reddy *et al.* (2002) [9] in their studies on tomatoes.

Table 1. Effect of organic manures and inorganic fertilizers on plant height (cm) of cherry tomato

Treatments	30 DAT	60 DAT	90 DAT	120 DAT	AT HARVEST
T ₀	61.77	154.70	232.94	258.40	290.48
T ₁	67.35	163.13	238.46	263.20	292.05
T ₂	67.75	167.77	240.93	270.87	294.88
T ₃	73.40	170.31	250.77	277.62	318.83
T ₄	68.84	168.70	241.51	271.11	297.06
T ₅	68.54	164.80	239.96	266.98	294.00
T ₆	68.93	169.70	241.81	272.04	304.10
SE _M ±	0.65	0.45	0.57	0.44	0.35
CD (<i>P</i> = 0.05)	2.01	1.39	1.76	1.36	1.10

3.2 Yield attributes

3.2.1 Number of fruits per plant: The number of fruits on each cherry tomato plant is crucial for determining its economic yield. 75% nitrogen from RDF plus 25% nitrogen from vermicompost achieved the highest fruit count per plant, with an average of 104.33 fruits, followed by 75% nitrogen from RDF plus 25% nitrogen from poultry manure at 97.20 (Table 2). The higher fruit numbers per plant can be attributed to a well-balanced nutrient supply from both organic and inorganic sources, providing the necessary nourishment to support the development of more fruit clusters. These results align with findings from Bai *et al.* (2024) [10], Sharma *et al.* (2020) [11] and Mohit *et al.* (2019) [12]. The control treatment recorded the lowest number of fruits per plant, averaging 88.60.

3.2.2 Fruit weight: The highest fruit weight recorded was 7.93 g in treatment T₃ followed by 6.32 g in treatment T₄. The control treatment (T₀) had the lowest fruit weight at 4.90 g (Table 2). Both vermicompost and poultry manure contribute organic matter and beneficial microorganisms that improve soil structure and nutrient availability, promoting fruit enlargement. Meanwhile, the recommended dose of fertilizers (RDF) ensures a balanced nutrient supply. Proper nutrition is essential for enhancing productivity and fruit quality, as it increases plant vigor, expands the area for nutrient absorption, and results in larger fruit size, ultimately leading to greater fruit weight. Similar findings were reported by Singh *et al.* (2023) [13] in cherry tomatoes and Naval *et al.* (2012) [14] in tomatoes.

3.2.3 Polar diameter of fruit: With a polar diameter of 24.89 mm, T₃ (75% N from RDF + 25% N from Vermicompost) significantly produced the widest fruit amongst all the treatments. T₄ (75% N from RDF + 25% N from Poultry Manure) came in second with 23.50 mm. Having a length of 20.35 mm, the T₀ control treatment had the smallest polar diameter (Table 2). As stated by Bihari *et al.* (2018), there is favourable effect on tomato fruit length when organic manure is blended with inorganic fertilizers. The positive impacts of organic manure, which upgrades the biological, chemical and physical properties of the soil and provides vital nutrients in a balanced ratio, are responsible for this improvement. These enhancements might have caused the plant to absorb and use nutrients more effectively, thereby increasing diameter of fruit in T₃ and other organic combinations. The outcomes reported by Bai *et al.* (2024) [10] and Mohit *et al.* (2019) [12] in tomato exhibit similar patterns.

3.2.4 Equatorial diameter of fruit: T₃- 75% N of RDF + 25% N from Vermicompost observed the largest equatorial diameter of fruit among the different mixtures involving organic manures and inorganic fertilizers (24.17 mm), followed by T₄-75% N of RDF + 25% N from Poultry manure (22.30 mm). The fruit's smallest equatorial diameter of 20.44 mm was measured by T₀ (control) (Table 2). Higher quantity of food material may have been generated with assistance of higher vegetative growth and later transported into developing fruits, enlarging its fruit diameter. The discoveries of Muthukumar *et al.* (2019) [15] and Tekale *et al.* (2017) [16] in tomato may provide credence to these findings.

3.2.5 Yield per plant: 75% nitrogen from RDF along with 25% nitrogen from vermicompost achieved the highest yield per plant at 478.74 g, closely followed by 75% nitrogen from RDF plus 25% nitrogen from poultry manure at 469.22 g. The control treatment yielded the lowest at 391.30 g per plant (Table 2). Vermicompost not only serves as a rich source of micronutrients but also acts as a chelating agent, regulating the availability of metallic micronutrients to plants. This promotes growth and yield by providing nutrients in a form that is easily accessible and tailored to the crop's needs. The yield per plant of cherry tomatoes was significantly influenced by average fruit weight and the number of fruits per plant, both of which had positive effects. These findings are consistent with those reported by Meena *et al.* (2017) [17] and Kumar *et al.* (2017) [18] in tomato studies.

3.2.6 Yield per plot: The greatest yield of 4.96 kg per plot (75% N from RDF + 25% N from vermicompost) was reported in T₃. The treatments that proceeded were T₄ (75% N of RDF + 25% N from poultry manure), which yielded a yield of 4.69 kg per plot, and T₅-75% N of RDF + 25% N from Ghanajeevamrit, which generated a yield of 4.61 kg per plot, as opposed to a minimal yield of 3.81 kg per plot in treatment T₀-control (Table 2). The combined application resulting in higher tomato yield per plot may be due to their synergistic effects. Better fruit development, optimized nutrient uptake, and up-graded plant growth were all facilitated by this combination. As a result of the above, every plant bears more fruits, increasing the total yield per plot. The boost in cherry tomato yield per plot could be due to the enhanced absorption of N, P, and K, which likely improved chlorophyll content in the leaves of each plant. This increase in chlorophyll would have led to greater carbohydrate synthesis and the formation of new cells (Jagadeesha, 2008) [19]. The present result correlates with the research outcomes of Hui *et al.* (2023) [20] and Laxmi *et al.* (2015) [21].

Table 2. Effect of organic manures and inorganic fertilizers on yield attributes of cherry tomato

Treatments	Number of fruits per plant	Fruit weight (g)	Polar diameter (mm)	Equatorial dia- meter (mm)	Yield per plant (g)	Yield per plot (kg)
T ₀	88.60	4.90	20.35	20.44	391.30	3.81
T ₁	92.53	5.71	21.50	21.10	396.80	4.03
T ₂	95.07	5.70	22.06	21.20	451.93	4.48
T ₃	104.33	7.93	24.89	24.17	478.74	4.96
T ₄	97.20	6.32	23.50	22.30	469.22	4.69
T ₅	94.40	5.76	22.08	21.51	465.50	4.61
T ₆	96.47	6.04	22.09	21.78	460.57	4.58
SE _M ±	0.88	0.20	0.18	0.22	0.77	0.03
CD (P = 0.05)	2.74	0.61	0.58	0.69	2.39	0.11

4. Conclusion

The combined application of 75% nitrogen from RDF with 25% nitrogen from vermicompost (T₃) proved to be the most effective treatment, significantly boosting the growth and yield of cherry tomatoes in polyhouse conditions. While treatments involving poultry manure (T₄) and a mix of organic sources (T₆) also showed positive results, T₃ outperformed them in overall effectiveness. This shows the fact that Vermicompost not only enhanced plant growth but also increased its yield and quality, making it an ideal supplement to inorganic fertilizers for sustainable cherry tomato production. This emphasizes the potential use of vermicompost as an crucial organic component for optimizing tomato production in polyhouse environments, offering a viable alternative to reducing the dependence on chemical fertilizers while promoting soil health and plant productivity.

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