

Original Research Article

Effect of different sources of nitrogen and bio fertilizers on growth, yield and quality of cherry tomato [*Solanum lycopersicum* L.) var. cerasiforme] in polyhouse conditions

Abstract

The present investigation was carried out at Research Farm, Department of Horticulture, Naini Agricultural Institute, SHUATS, Naini, Prayagraj, Uttar Pradesh during the *Kharif-2022* with a view to identify the effect of different sources of nitrogen and bio fertilizers on growth, yield and quality of cherry tomato” [*Solanum lycopersicum* L.) var. cerasiforme] in polyhouse conditions. The experiment was laid in Randomized block design (RBD) with 9 treatments and 3 replications with different combination in RDF and application of organic nutrition. Under this experiment, overall, 10 treatment were taken. From the above experimental finding it may be concluded that the treatment T₉ (75% N through urea + 25% N through FYM + Azotobacter (4 kg ha⁻¹) + PSB (4 Kg ha⁻¹) was found to be best in the terms of growth parameters like highest plant height (283.35 cm) at 120 DAT, maximum number of branches per plant (72.33 branches) at 120 DAT. In terms of earliness, it was found to have minimum days to attain 50% flowering (55.93 DAT). In terms of yield T₉ had highest number of fruits per cluster (5.57 fruits), and fruit yield per hectare (25.88 t ha⁻¹).

Keywords :- Cherry Tomato, FYM, Azotobacter, PSB, Growth, Quality, Yield and Economics

INTRODUCTION

“Cherry tomato (*Solanum lycopersicum* var. *cerasiforme* Mill.) is a highly priced culinary as well as ornamental vegetable. One of the most popular high value exotics, it is a favourite among chef’s who cook for high profile restaurants and hotels. Nevertheless, it is becoming increasingly popular among common people, who are now interested in garnishing their dishes and diversifying their nutritional intake. Cherry tomatoes look not only attractive in kitchen gardens but are commercially valuable horticultural commodity and have impressive nutritional and pharmaceutical properties. According to the USDA nutritional information, one cup of cherry tomatoes (149 g) provides 26.8 calories, 1.3 g protein, 4.5 mg omega-3 fatty acids, 119 mg omega-6 fatty acids, 1241 IU of vitamin A, 18.9 mg vitamin C, 22.3 mcg folic acid, 11.8 mcg vitamin C, 353 mg potassium, 35.8 mg phosphorus and 14.9 mg calcium” (Choudhary, 2013).

“Farm manure is primarily made from cow dung, cow urine, straw, and other milk waste. A small amount of Nitrogen (N) is directly available to plants, but more N becomes available as FYM degrades. Mixing cow dung with urine gives plants a balanced diet. The availability of potassium and phosphorus from FYM is like that from inorganic sources. Applying FYM improves soil fertility. On an average well decomposed farmyard manure contains 0.5 per cent Nitrogen (N), 0.2 per cent Phosphate (P₂O₅) and .0.5 per cent Potassium (K₂O)” (Singh, 2019).

“Azotobacter in plant growth enhancement are as biofertilizer, bio stimulant, and bioprotectant. Nitrogen fixation by Azotobacter is the mechanism to provide available nitrogen for uptake by roots. Azotobacter stimulates plant growth through phytohormones synthesis; indole acetic acid, cytokinin, and gibberellins are detected in the liquid culture of Azotobacter” (Hindersah *et al.*, 2020).

“Urea contains 46.6% nitrogen and is taken up by plants through their roots as ammonium, which can be oxidized to nitrate by bacteria in some soils. Nitrogen (N) is an important macro-nutrient required for crop

production and is considered an important commodity for agricultural systems. Urea is a vital source of N that is used widely across the globe to meet crop N requirements” (Anas *et al.*, 2020). It plays a vital role in forming chlorophyll, proetids and proteins, and other essential compounds like plant hormones; however, plants are inefficient in the acquisition and utilization of applied nitrogen (Tiong *et al.*, 2021).

MATERIALS AND METHODS

This experiment was laid out during the July 2023 to August 2023 at Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.). The horticulture research farm is situated at 25° 39’ 42’’ N latitude, 81° 67’ 56’’ E longitude and at an altitude of 98 m above mean sea level. The treatment consisted of T₀ - Control, T₁ - 100% N through urea+ 25 t ha⁻¹ FYM, T₂ - 75% N through urea + 25% N through FYM, T₃ - 50% N through urea + 50% N through FYM, T₄ - 75%N through urea + 25% N through FYM+ Azotobacter (4 Kg ha⁻¹), T₅ - 50% N through urea + 50% N through FYM + Azotobacter (4 Kg ha⁻¹), T₆ - 75% N through urea +25% N through FYM + PSB (4 Kg ha⁻¹), T₇ - 50% N through urea + 50% N through FYM + PSB (4 Kg ha⁻¹), T₈ -75% N through urea + 25% N through FYM + Azotobacter (4 Kg ha⁻¹) + PSB (4 Kg ha⁻¹), T₉ -50% N through urea + 50% N through FYM + Azotobacter (4 Kg ha⁻¹) + PSB (4 Kg ha⁻¹). The experiment was laid out in a Randomized Block Design with 10 treatments and replicated thrice. Data recorded on different aspects of fruit crop, viz., growth, yield were subjected to statistical analysis by analysis of variance method. (Gomez and Gomez, 1976) and economic data analysis mathematical method.

RESULTS AND DISCUSSION

Growth parameters

The results pertaining to the effect of organic and inorganic fertilizers on growth parameters of Cherry Tomato are presented in table 1

Plant height (cm)

The height of plant at 120 DAT varied significantly among different treatment combinations. The maximum height of plant (283.35 cm) was observed with treatment T₉ (50% N through urea + 50% N through FYM + Azotobacter (4 kg ha⁻¹) + PSB (4 kg ha⁻¹)). Minimum plant height (210.67 cm) was observed in T₀ (Control), while the remaining treatments were moderate in their growth habit.

The treatment combination of 50% N via urea + 50% N through FYM + Azotobacter (4 kg ha⁻¹) + PSB (4 kg ha⁻¹) fosters superior plant height in cherry tomatoes by orchestrating a holistic nutrient symphony. The balanced nitrogen sources fuel robust foliage development, while Azotobacter's symbiotic nitrogen fixation enriches the soil, promoting extensive root growth. In contrast, Control treatment, lacked this synchronized nutrient blend, leading to comparatively limited plant stature. Findings were in accordance with **Baba *et al.*, (2018) and Verma *et al.*, (2020)** in Tomato.

Number of branches per plant

It is evident that the number of branches per plant of plant was influenced by different different sources of nitrogen and biofertilizers applied for growth observed at different stages of growth. There was significant difference present among the treatments applied. The highest number of branches (72.33 branches) at 120 DAT respectively was observed with treatment T₉ (50% N through urea + 50% N through FYM + Azotobacter (4 kg ha⁻¹) + PSB (4 kg ha⁻¹)). Minimum plant height (63.27 branches) was observed in T₀ (Control) at 120 DAT.

The treatment combination of 50% N through urea + 50% N through FYM + Azotobacter (4 kg ha⁻¹) + PSB (4 kg ha⁻¹) orchestrates a thriving environment for cherry tomatoes, manifesting in an augmented number of branches per plant. This combination provides a balanced nitrogen supply for sustained growth, fostering abundant foliage. Azotobacter's nitrogen fixation enriches soil, encouraging robust root development, a precursor to lateral branching. In contrast, control treatment missed this balanced nutrient synergy, resulting in comparatively limited lateral growth and fewer branches per plant in cherry tomatoes. Similar findings were reported by **Khan *et al.*, (2013)** and **Olagunju *et al.*, (2023)** in Cherry Tomato.

PHENOLOGICAL PARAMETERS

The results related to phenological parameters are presented in table 1.

Days to first flowering

Days to first flowering showed significant difference present among the treatments applied. The minimum days to first flowering (34.07 days) was observed with treatment T₉ (50% N through urea + 50% N through FYM + Azotobacter (4 kg ha⁻¹) + PSB (4 kg ha⁻¹)). Maximum days to first flowering (42.90 days) was observed in T₀ (Control).

The treatment mix of 50% N through urea + 50% N through FYM + Azotobacter (4 kg ha⁻¹) + PSB (4 kg ha⁻¹) expedites the days to first flowering in cherry tomatoes by orchestrating an optimal growth environment. This balanced nitrogen blend fuels early vegetative vigour, crucial for triggering flower initiation. This combined approach cultivates an enriched soil ecosystem, fostering expedited vegetative growth stages and consequently, earlier flowering in cherry tomatoes. Conversely, control treatment did not have this balanced nutrient synergy, leading to delayed flowering due to inadequate nutritional support for the plant's early developmental stages. Similar findings were reported by **Shafi *et al.*, (2019)** and **Verma *et al.*, (2020)** in Tomato.

Days to 50% flowering

Days to 50% flowering showed significant difference present among the treatments applied. The minimum days to 50% flowering (55.93 days) was observed with treatment T₉ (50% N through urea + 50% N through FYM + Azotobacter (4 kg ha⁻¹) + PSB (4 kg ha⁻¹)). Maximum days to 50% flowering (64.26 days) was observed in T₀ (Control). The results related to days to 50% flowering are presented in table 1.

The treatment blend of 50% N through urea + 50% N through FYM + Azotobacter (4 kg ha⁻¹) + PSB (4 kg ha⁻¹) accelerates the days to reach 50% flowering in cherry tomatoes by orchestrating an optimal nutrient environment and soil symbiosis. This holistic approach creates a nutrient-rich, symbiotically balanced soil, expediting vegetative growth stages and subsequently hastening the onset of 50% flowering in cherry tomatoes. Conversely, control treatments lacked this synchronized nutrient blend, resulting in delayed flowering due to inadequate nutritional support during critical growth phases. Similar findings were reported by **Nishant *et al.*, (2021)** and **Olagunju *et al.*, (2023)** in Tomato.

YIELD PARAMETERS

The results related to yield parameters are presented in table 2.

Number of flowers per cluster

Number of flowers per cluster showed significant difference present among the treatments applied. The highest number of flowers per cluster (11.33 flowers) was observed with treatment T₉ (50% N through urea + 50% N through FYM + Azotobacter (4 kg ha⁻¹) + PSB (4 kg ha⁻¹)). T₀ (control) had lowest number of flowers per cluster (6.51 flowers). The results related to number of flowers per cluster are presented in table 2.

The treatment blend of 50% N through urea + 50% N through FYM + Azotobacter (4 kg ha⁻¹) + PSB (4 kg ha⁻¹) fosters an increased number of flowers per cluster in cherry tomatoes due to a comprehensive nutrient amalgamation and soil enrichment. This balanced nitrogen composition sustains robust vegetative growth, pivotal for cluster initiation. Azotobacter's nitrogen-fixing ability enriches soil fertility, encouraging extensive root development, a crucial precursor to cluster formation. **Khan *et al.*, (2013) and Reddy *et al.*, (2018)** came up with similar conclusions in Tomato.

Number of fruits per cluster

Number of fruits per cluster showed significant difference present among the treatments applied. The highest number of fruits per cluster (5.57 fruits) was observed with treatment T₉ (50% N through urea + 50% N through FYM + Azotobacter (4 kg ha⁻¹) + PSB (4 kg ha⁻¹)). T₀ (Control) had lowest number of fruits per cluster (3.32 fruits).

The treatment combination of 50% N through urea + 50% N through FYM + Azotobacter (4 kg ha⁻¹) + PSB (4 kg ha⁻¹) fosters an increased number of fruits sets per cluster in cherry tomatoes due to a holistic nutrient synergy and soil enhancement. This balanced nitrogen supply sustains robust vegetative growth, crucial for fruits set initiation within clusters. **Poonia and Dhaka (2012) and Saha *et al.*, (2019)** drew similar inferences in Tomato.

Number of clusters per plant

Number of clusters per plant showed significant difference present among the treatments applied. The highest number of clusters per plant (6.00 clusters) was observed with treatment T₉ (50% N through urea + 50% N through FYM + Azotobacter (4 kg ha⁻¹) + PSB (4 kg ha⁻¹)). T₀ (Control) had lowest number of clusters per plant (2.39 clusters).

Through a balanced nutrient blend and enhanced soil vitality, the treatment mix of 50% N through urea + 50% N through FYM + Azotobacter (4 kg ha⁻¹) + PSB (4 kg ha⁻¹) encourages more clusters per plant in cherry tomatoes. This well-balanced combination of nitrogen maintains strong vegetative growth, which is necessary for copious flower production. Because of its ability to fix nitrogen, Azotobacter improves soil fertility and encourages extensive root development, which is a necessary step before flower initiation. **Poonia and Dhaka (2012); and Shafi *et al.*, (2019)** came up with similar conclusions in Tomato.

Fruit setting percent

Fruit setting percent showed significant difference present among the treatments applied. The highest fruit setting percent (80.59%) was observed with treatment T₉ (50% N through urea + 50% N through FYM + Azotobacter (4 kg ha⁻¹) + PSB (4 kg ha⁻¹)). T₀ (control) had lowest fruit setting percent (51.07%).

The treatment blend of 50% N through urea + 50% N through FYM + Azotobacter (4 kg ha⁻¹) + PSB (4 kg ha⁻¹) fosters an increased number of fruits setting per cent in cherry tomatoes due to a holistic nutrient synergy and soil enhancement. Additionally, PSB's role in enhancing phosphorus uptake facilitates reproductive processes, encouraging multiple flower sets within clusters. This comprehensive approach creates an optimal soil environment, nurturing accelerated vegetative growth and reproductive phases, thereby encouraging more fruits set per cluster in cherry tomatoes. **Saha *et al.*, (2019) and Hariyadi *et al.*, (2020)** drew similar inferences in Tomato.

Fruit yield per hectare

Fruit yield per hectare showed significant difference present among the treatments applied. The maximum fruit yield per hectare (25.88 t ha⁻¹) was observed with treatment T₉ (50% N through urea + 50% N through FYM + Azotobacter (4 kg ha⁻¹) + PSB (4 kg ha⁻¹)). Minimum fruit yield per hectare (11.75 t ha⁻¹) was observed in T₀ (Control).

By coordinating a balanced nutrient amalgamation and enhanced soil biology, the treatment combination 50% N through urea + 50% N through FYM + Azotobacter (4 kg ha⁻¹) + PSB (4 kg ha⁻¹) fosters superior fruit yield per hectare in cherry tomatoes. Strong vegetative growth is maintained by this nutrient synergy, which is essential for the development of flowers and subsequent fruit set. **Bilalis *et al.*, (2018) and Pinkee *et al.*, (2023)** concluded with similar results in Tomato.

Conclusion

From the above experimental finding it may be concluded that the treatment T₉ (50% N through urea + 50% N through FYM + Azotobacter (4 kg ha⁻¹) + PSB (4 kg ha⁻¹)) was found to be best in the terms of growth and yield of Cherry Tomato.

Table 1 Effect of different sources of nitrogen and biofertilizers on growth and phenological of Cherry Tomato

Treatment Symbol	Treatment combinations				
		Plant height 120 DAT	Number of branches/plant	Days to first flowering	Days to 50% flowering
T ₀	Control	210.67	63.27	42.90	64.26
T ₁	100% N through urea+ 25 t ha ⁻¹ FYM	222.47	66.20	40.40	62.93
T ₂	75% N through urea + 25% N through FYM	226.40	65.47	35.73	57.33
T ₃	50% N through urea + 50% N through FYM	218.27	66.20	34.54	57.53
T ₄	75%N through urea + 25% N through FYM+ Azotobacter (4 kg ha ⁻¹)	225.87	71.30	34.30	57.67
T ₅	50% N through urea + 50% N through FYM + Azotobacter (4 kg ha ⁻¹)	226.33	70.80	35.40	57.47
T ₆	75% N through urea +25% N through FYM + PSB (4 kg ha ⁻¹)	231.47	70.07	35.07	58.27
T ₇	50% N through urea + 50% N through FYM + PSB (4 kg ha ⁻¹)	230.51	69.20	35.47	58.13
T ₈	75% N through urea + 25% N through FYM + Azotobacter (4 kg ha ⁻¹) + PSB (4 kg ha ⁻¹)	232.27	71.60	34.14	56.88
T ₉	50% N through urea + 50% N through FYM + Azotobacter (4 kg ha ⁻¹) + PSB (4 kg ha ⁻¹)	283.35	72.33	34.07	55.93
	F-test	S	S	S	S
	SEm(±)	0.82	0.72	0.59	0.98
	CD (p=0.05)	2.41	2.11	1.74	2.88

Table 2 Effect of different sources of nitrogen and biofertilizers on yield of Cherry Tomato

Treatment Symbol	Treatment combinations					
		No of flowers per cluster	No of fruits per cluster	No of clusters per plant	Fruit setting percent (%)	Fruit yield per hectare (t ha ⁻¹)
T ₀	Control	6.51	3.32	2.39	51.07	11.75
T ₁	100% N through urea+ 25 t ha ⁻¹ FYM	8.47	5.00	2.97	59.42	14.22
T ₂	75% N through urea + 25% N through FYM	8.59	4.87	3.40	56.92	17.22
T ₃	50% N through urea + 50% N through FYM	7.00	5.47	3.23	78.06	19.10
T ₄	75%N through urea + 25% N through FYM+ Azotobacter (4 kg ha ⁻¹)	8.07	5.33	2.77	66.14	20.44
T ₅	50% N through urea + 50% N through FYM + Azotobacter (4 kg ha ⁻¹)	8.33	5.33	5.50	64.07	19.10
T ₆	75% N through urea +25% N through FYM + PSB (4 kg ha ⁻¹)	7.67	5.23	5.00	68.87	19.77
T ₇	50% N through urea + 50% N through FYM + PSB (4 kg ha ⁻¹)	7.87	5.13	4.37	65.36	21.77
T ₈	75% N through urea + 25% N through FYM + Azotobacter (4 kg ha ⁻¹) + PSB (4 kg ha ⁻¹)	8.80	5.47	5.60	80.32	21.99
T ₉	50% N through urea + 50% N through FYM + Azotobacter (4 kg ha ⁻¹) + PSB (4 kg ha ⁻¹)	11.33	5.57	6.00	80.59	25.88
	F-test	S	S	S	S	S
	SEm(±)	0.34	0.24	0.14	3.71	0.62
	CD (p=0.05)	0.99	0.69	0.40	10.89	1.82

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