JSST-RL

Journal of Sustainable Science and Transformative Research – Reviews & Letters, Vol 4 (1), 272-274 (2025)

Response of Growth and Yield Parameters of Brinjal (*Solanum melongena* L.) as Influenced by Different Doses of Zinc Fertilizer and Method of Application in Araria District of Bihar

ISSN: 2583-4118
doi:https://doi.org/10.56703/OKGY7002/Fibg8949/Mcqx3194
www.jsst.uk

Anil Kumar[1], Shashi Prakash Vishwakarma[2], and Pankaj Kumar Yadav[3]

[1],[2] & [3] Assistant Professors-cum-Junior Scientists, Bihar Agricultural University

Corresponding author: shashisp76@gmail.com

Abstract: Zinc deficiency is a major constraint in brinjal cultivation in the sandy loam soils of Araria district. An on-farm trial was conducted during August–October 2016 using three treatments: T_1 (farmers' practice): 12 kg Zn ha^{-1} basal, T_2 (recommended): 25 kg Zn ha^{-1} basal, and T_3 (new technology): 12 kg Zn ha^{-1} basal + two foliar sprays of 0.5 % $ZnSO_4 \cdot 7H_2O$ at vegetative and flowering stages with 0.25 % lime. Results showed that T_3 recorded the highest values for flowering percentage (78.6 %), fruit set (70.2 %), and yield (279.8 q ha^{-1}), followed by T_2 and T_1. The benefit–cost ratio was also highest in T_3 (2.62). The study concludes that combined basal + foliar zinc application is more efficient than basal Zn alone, improving flowering, fruit set, and yield in brinjal (*Smith & Combrink, 2005; Ali et al., 2013; Chaudhary et al., 2019*).

Key words: Brinjal, zinc sulphate, foliar spray, yield, micronutrient

1 Introduction

Brinjal (*Solanum melongena L.*) is an important vegetable crop in India, ranking third in area and production. India contributes about 13.44 million tonnes of brinjal annually (NHB, 2015). Productivity of the crop is limited by micronutrient deficiencies, particularly zinc, which is deficient in nearly 49 % of Indian soils and up to 70 % of soils in Bihar (Singh, 2008; Shukla et al., 2020). Zinc plays an essential role in enzyme activation, auxin metabolism, pollen formation, fruit set, and yield (Takkar & Mann, 1975; Meena et al., 2021).

In the Araria district of Bihar, sandy-loam soils with low organic carbon and high pH frequently show zinc deficiency, resulting in poor flowering, low fruit setting, and reduced yield in brinjal. Although farmers commonly apply only basal zinc, research suggests that foliar application along with basal dose may improve nutrient-use efficiency (Chaudhary et al., 2019).

The present study was therefore conducted to evaluate the response of brinjal to different zinc application methods under farmer-field conditions, with emphasis on growth, flowering, fruiting, yield, and economic return.

2 Materials & Methods

The on-farm trial (OFT) was conducted by Krishi Vigyan Kendra, Araria (Bihar) during August–October 2016 in the adopted village Tekhpura (Raniganj block) on sandy-loam soil. The experiment followed a Randomized Complete Block Design with ten farmer replications and three treatments:

Treatment	Description
T_1 – Farmers' Practice	12 kg Zn ha^{-1} as basal ($ZnSO_4 \cdot 7H_2O$)
T_2 – Recommended Practice	25 kg Zn ha^{-1} as basal

Treatment	Description
T_3 – New Technology	12 kg Zn ha^{-1} basal + two foliar sprays of 0.5 % $ZnSO_4 \cdot 7H_2O$ + 0.25 % lime at vegetative and flowering stages

Crop details: Variety Devgiri (Venol); spacing 75 × 60 cm; seedling age 30 days; irrigation as per farmer practice.

Summary table 1. Effect of Zinc Application Methods on Growth, Yield and Economics of Brinjal (Mean of 10 Farmers)

Parameter	T1 (12 kg Zn/ha basal)	T2 (25 kg Zn/ha basal)	T3 (12 kg Zn/ha basal + 2 foliar sprays)
Plant height (cm)	50.2	54.5	67.2
% Flower set	53.5	62.6	78.6
% Fruit set	50.7	58.7	70.2
Fruits per plant	14.9	17.3	20.6
Yield (q/ha)	221.8	253.9	279.8
Cost of cultivation (₹/ha)	50,300	54,620	53,500
Gross return (₹/ha)	1,10,925	1,26,950	1,39,900
Net return (₹/ha)	60,625	72,330	86,400
B:C Ratio	2.20	2.32	**2.62**

3 Results & Discussion

Application of zinc significantly improved growth and yield parameters of brinjal. The combined basal + foliar application (T_3) recorded the highest plant height (67.2 cm), flower set (78.6 %), fruit set (70.2 %) and yield (279.8 q ha^{-1}), followed by T_2 and T_1. The yield increase under T_3 was 26.1 % higher than T_1 and 10.2 % higher than T_2.

The superior performance of T_3 may be attributed to the dual supply of zinc through soil and foliar route. Foliar-applied zinc is rapidly absorbed and enhances auxin synthesis, pollen viability, carbohydrate translocation, and fruit setting (*Smith & Combrink, 2005; Ali et al., 2013; Chaudhary et al., 2019*). Similar results were reported in tomato and eggplant by *Meena et al. (2021)* and *Kiran et al. (2010)*.

Economically, T_3 recorded the highest net return (₹ 86,400 ha^{-1}) and B:C ratio (2.62), followed by T_2 (2.32) and T_1 (2.20). These results align with *Chaudhary et al. (2019)* and *Meena et al. (2021)*, who observed that foliar zinc sprays improve nutrient efficiency and profitability in solanaceous crops.

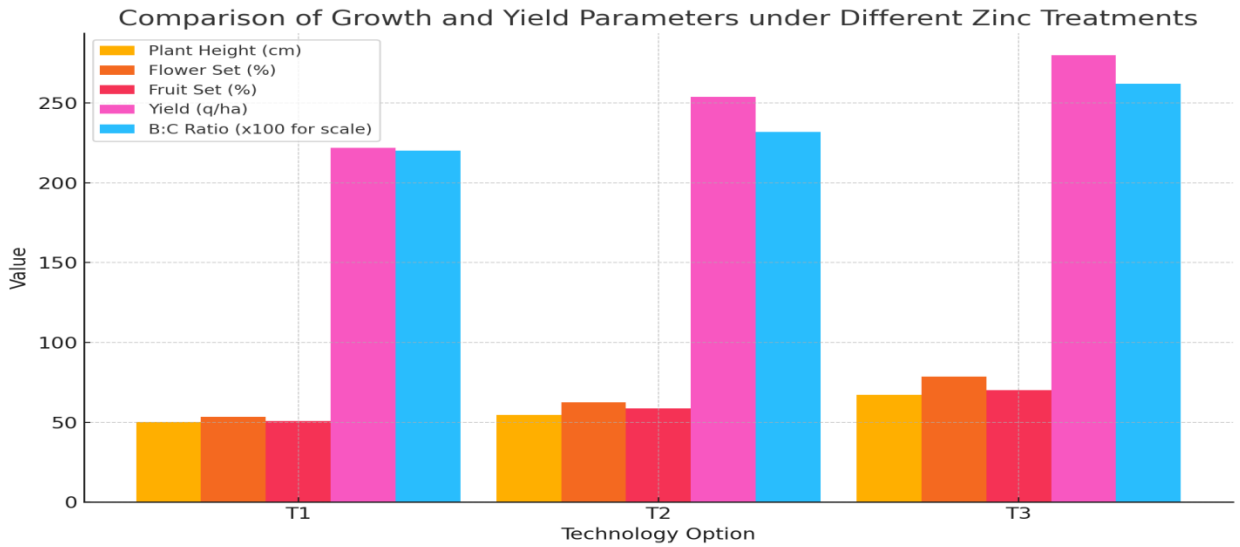

Fig 1 Comparison of growth and yield parameters under different zinc treatments

4 Conclusion

- Zinc application significantly improved flowering, fruit setting, yield, and profitability of brinjal under farmer-field conditions.
- The treatment T_3 (12 kg Zn ha^{-1} basal + two foliar sprays of 0.5 % $ZnSO_4 \cdot 7H_2O$ + 0.25 % lime) proved most effective, recording 33 % increase in plant height, 46.9 % higher flower set, 38.4 % higher fruit set, and 26.1 % increase in yield over farmers' practice.
- T_3 also recorded the highest net return (₹ 86,400 ha^{-1}) and B:C ratio (2.62).
- Combined basal + foliar zinc application is thus recommended over basal application alone for brinjal in zinc-deficient sandy-loam soils of Bihar.

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