E-ISSN: 2618-0618
P-ISSN: 2618-060X

NAAS Rating (2025): 5.20
www.agronomyjournals.com
2025; SP-8(11): 122-124
Received: 05-09-2025
Accepted: 07-10-2025

Anil Kumar
Irrigation Research Station, Madhepura, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Pankaj Kumar Yadav
Regional Research Sub Station, Jalalgarh, Purnea, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Shashi Prakash Vishwkarma
Regional Research Sub Station, Jalalgarh, Purnea, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Diwakar Paswan
Jute Research Station-Katihar, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Birendra Kumar
Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Neha Pareek
Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Corresponding Author:
Shashi Prakash Vishwkarma
Regional Research Sub Station, Jalalgarh, Purnea, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Enhancing brinjal productivity through optimized zinc fertilizer doses and application techniques in north east alluvial plain zone of Bihar

Anil Kumar, Pankaj Kumar Yadav, Shashi Prakash Vishwkarma, Diwakar Paswan, Birendra Kumar and Neha Pareek

DOI: https://www.doi.org/10.33545/2618060X.2025.v8.i11Sb.4205

Abstract
The present investigation was carried out by Krishi Vigyan Kendra, Araria in its adopted village Tekhpura and Sangrampur to evaluate the effect of different doses and methods of zinc fertilizer application on brinjal (*Solanum melongena* L.). On-Farm Trials (OFTs) were conducted during August to October 2016 using the variety Degiri -1. The study comprised three treatments: T_1 (Farmer's Practice)-12.0 kg Zn/ha as a basal dose, T_2 (Assessed Recommended Practice) -25.0 kg Zn/ha as a basal dose, and T_3 (New Technology) -12.0 kg Zn/ha as a basal dose along with two foliar sprays of 0.5% $ZnSO_4 \cdot 7H_2O$ (the first at maximum vegetative growth stage and the second at flower initiation stage) with 0.25% lime added to neutralize the residual acidity of $ZnSO_4 \cdot 7H_2O$. The results revealed that T_3 recorded the highest improvement in growth and yield parameters (91.4%), followed by T_2 (82.4%) and T_1 (62.77%). It is concluded that the application of 12.0 kg Zn/ha as a basal dose combined with two foliar sprays of 0.5% $ZnSO_4 \cdot 7H_2O$ significantly enhanced flowering, fruit setting, and fruit yield per plant in brinjal under field conditions.

Keywords: Brinjal, micronutrient, on-farm trials, zinc, borax

Introduction
Brinjal (*Solanum melongena* L.), commonly known as eggplant, is one of the most important and widely cultivated vegetable crops in India and several other countries across Asia and the world. It plays a significant role in the warm regions of India and other Asian countries, including Pakistan, Bangladesh, the Philippines, China, Turkey, Japan, and Iraq. India produces around 12.9 million tonnes of brinjal annually, accounting for roughly one-third of the global production. This makes it not just the largest producer but also one of the biggest consumers. Brinjal is sold in fresh markets, used in home cooking, and also processed into pickles, frozen vegetables, and ready-to-cook meals (NHB,2024) [1]. Among vegetable crops grown in India, brinjal occupies the third position, covering an area of 680 thousand hectares with an average productivity of 18.70 t/ha.

Soil analysis in the Araria district indicates that 49% of soils in India are potentially deficient in zinc (Zn), 12% in iron (Fe), 5% in manganese (Mn), 3% in copper (Cu), 33% in boron (B), and 11% in molybdenum (Mo) (Singh, 2008) [2]. In Bihar, micronutrient deficiencies are more pronounced, with Zn deficiency at 70%, B at 60%, and Mo at 25%. Basal application of Zn, B, and Mo to the soil, along with foliar sprays of Fe and Mn, has been recommended as the most effective method to correct such deficiencies (Singh, 2008) [2]. The integrated application of micronutrients along with judicious use of recommended doses of fertilizers (RDF) not only enhances crop productivity but also improves the total production and fertilizer use efficiency in brinjal.

Materials and Methods
The present investigation was conducted by Krishi Vigyan Kendra (KVK), Araria, in its adopted villages Tekhpura and Sangrampur to evaluate the effect of different doses and methods of zinc

fertilizer application on brinjal (*Solanum melongena* L.). The On-Farm Trial (OFT) was carried out during August to October 2016 on sandy soils across 10 farmers' fields in the selected villages. The experimental sites had almost uniform land topography with adequate surface drainage (Table 1). The OFT was laid out in a Randomized Completely Block Design (RCBD) with three treatments and ten replications. Prior to the initiation of the trials, farmers were briefed through meetings and training sessions about the latest recommended package of practices for zinc fertilization in brinjal. Regular monitoring of the OFT plots was carried out by KVK scientists, and farmers were advised on the timely execution of various agronomic operations. Data on growth, flowering, fruit set, and yield were collected through personal visits and direct observations. The observed data were then calculated, tabulated, and statistically analysed to assess the effects of different zinc doses and application methods on crop performance.

Detail of Treatments used in the OFT

T_1-(Farmers practices)-12.0 kg Zn /ha as basal dose T_2-(Recommended practices)-25.0 kg/ha as basal dose, T_3- (New Technology)- 12.0 kg Zn /ha as basal dose +Foliar spray of Zn twice @0.5% ZnSo4.$7H_2O$ solution one at maximum vegetative growth stage and other at flower initiation stage (0.25% lime as neutralized residual activity caused by the application of ZnSO4.H2O). 30 days old seedling of brinjal (c.v -Degiri -1 with spacing of 75cm row to row and 60 cm plant to plant transplanted in the plots in the afternoon hour immediately followed by irrigation for proper establishment of the seedlings. Observation was recorded on growth and phenological parameter. The data generated and analysed.

Table 1: Soil fertility status of farmer's field at different villages

S.N.	Farmer	Village	pH	Organic carbon%	Ec dS/m	Available N Kg/ha	Available P_20_5 Kg/ha	Available K_20 Kg/ha	Zn ppm
1	Jeevas Mishra	Tekhpura	6.65	0.52	0.23	263.5	32.4	132.5	0.65
2	Permod Mishra	Tekhpura	6.90	0.42	0.42	254.6	30.5	140.6	0.68
3	Jagdish Mishra	Tekhpura	5.95	0.68	0.54	263.4	32.4	142.3	0.56
4	Lalbhadur Mishra	Tekhpura	5.75	0.55	0.56	255.6	30.1	145.6	0.59
5	Rajesh Mishra	Tekhpura	5.70	0.62	0.35	244.5	32.7	155.6	0.58
6	Herdai Nath Mishra	Sangrampur	5.60	0.46	0.30	260.8	32.5	161.2	0.65
7	Vidya lal Mishra	Sangrampur	6.84	0.52	0.56	302.5	32.5	150.2	0.75
8	Shyam sunder Mishra	sangrampur	6.50	0.43	0.45	256.5	34.5	145.3	0.59
9	Vishnu Mehta	Sangrampur	6.8	0.62	0.26	285.6	32.5	160.3	0.58
10	Ohm Parkash Mehta	Sangrampur	6.75	0.55	0.36	320.2	35.6	16.8	0.85

Results and Discussion

Effect of different technology option on growth parameters of brinjal on different farmer's field.

Table 3 shows that the maximum percentage of flower set (78.6%) was recorded with T_3 (New Technology) 12.0 kg Zn/ha as a basal dose, along with two foliar sprays of Zn at 0.5% $ZnSO_4 \cdot 7H_2O$ solution, one applied at the maximum vegetative growth stage and the other at the flowering initiation stage (0.25% lime was used to neutralize the residual activity of $ZnSO_4 \cdot 7H_2O$). This was followed by T_2 and T_1. It is evident that plants treated with zinc along with foliar application exhibited a higher percentage of flower set than those receiving only the basal dose. This effect is attributed to zinc's role in stimulating phosphorus uptake, which directly promotes flowering. These results are in agreement with Smit and Combrink (2005) [4].

The percentage of fruit set is presented in Table 3. The maximum fruit set (70.2%) was recorded with T_3 (New Technology)- 12.0 kg Zn/ha as a basal dose, along with two foliar sprays of Zn at 0.5% $ZnSO_4 \cdot 7H_2O$ solution, one applied at the maximum vegetative growth stage and the other at the flowering initiation stage (0.25% lime was used to neutralize the residual activity of $ZnSO_4 \cdot 7H_2O$), followed by T_2 and T_1, respectively. This effect may be attributed to the vital role of zinc in maintaining cell integrity, enhancing respiration rate, increasing the uptake of certain nutrients, and promoting metabolic activities such as IAA synthesis, which collectively contributed to an increased fruit set.

The maximum yield (301 qt/ha), net return (Rs. 86,400/ha), and B:C ratio (2.62) was attained with T_3-12.0 kg Zn/ha as a basal dose, along with two foliar sprays of Zn at 0.5% $ZnSO_4 \cdot 7H_2O$ (0.25% lime was used to neutralize the residual activity of $ZnSO_4 \cdot 7H_2O$), followed by T_2 and T_1. This was observed by farmer Jagdish Mishra and is attributed to the effect of zinc in stimulating phosphate uptake, which directly promotes flowering when applied as 0.5% $ZnSO_4 \cdot 7H_2O$ at two different stages: maximum vegetative growth and flowering initiation. The combined effect of zinc and boron on IAA metabolism increases the number of flowers and enhances phosphate uptake by plant roots, thereby promoting the development of flower clusters (Day, 2000) [3]. This was followed by Shyam Sunder Mehta, who recorded a yield of 298 qt/ha.

Table 2: Effect of Different Zinc Fertilizer Doses and Methods of Application on Growth and Yield Parameters of Brinjal.

S.N.	Farmers name	Technology option	Plant height (cm)	% of flower set	% of fruit set	No. of fruit/plant	Yield/plant) (gm)	Total Yield (Qt/ha)	B:C ratio
1	Jagdish Mishra	T_1	53.2	50	45	12	1585	198.5	1.90
		T_2	51.8	55	55	17	1445	225	2.04
		T_3	55.8	70	65	20	2100	301	2.89
2	Pramod Mishra	T_1	52.5	60	52	18.6	1395	201.5	1.90
		T_2	53.4	61	42	15	1275	250	2.31
		T_3	60.2	75	70	22	2000	272	2.56
3.	Jagdish Yadav	T_1	48.6	45	55	16.3	1222.5	232.5	2.23
		T_2	50.7	62	65	16.3	1385.5	260	2.38

		T_3	62.8	76	60	18.6	1953.0	262	2.40
4.	Lal Bhadur Mishra	T_1	48.7	55	54	16.6	1245	240	2.66
		T_2	49.8	65	62	18.6	1581	240	2.18
		T_3	65.6	78	65	20.0	2000	290	2.9
5.	Rajesh Kumar Mehta	T_1	45.7	56	56	12	1560	212	2.25
		T_2	52.8	62	61	17.3	1470	257	2.33
		T_3	67.8	81	73	22	2100	258	2.34
6.	Hirdya Nath Mehta	T_1	45.8	50	57	15	1470	210	2.05
		T_2	52.9	59	60	18.6	1900	282	2.57
		T_3	69.7	82	65	23	2100	256	2.46
7.	Vidya Lal Mehta	T_1	51.0	51	42	16	1600	220	2.1
		T_2	60.0	62	65	20	2350	225	2.08
		T_3	70.5	85	76	16.3	1800	270	2.54
8.	Shyam Sunder Mehta	T_1	52	52	56	16.3	1222.5	232	2.36
		T_2	62	65	64	16.3	2350	260	2.26
		T_3	71.5	84	61	18.6	1222.5	298	2.32
9.	Vishnu Mehta	T_1	50.7	55	48	14	1470.5	242	2.52
		T_2	60.2	66	58	18.6	2000	260	2.64
		T_3	77	75	78	23	2300	300	2.72
10.	Omprakash Mehta	T_1	50.5	61	42	12	1395	230	2.30
		T_2	61.5	69	55	15	1500	280	2.35
		T_3	66.2	80	79	22	1560	301	2.78

Foliar sprays of zinc increased the nitrogen content of the leaves. Number of the leaves increase may be due to promotive effects of micro and macro nutrients on vegetative growths which ultimately leads to more photosynthesis activities. Similar results have been reported by Kiran *et al*., (2010) [6], Ali *et al*., (2013) [5]. Table -3 showed that Maximum yield (279.8 qt/ha), net return (86400 Rs/ha) and B:C ratio(2.62) was attained with foliar application of 12.0 kg/ha as basal dose & foliar spray of Zn twice @0.5% ZnSO4.7H_2O (0.25% lime as neutralizes of residual activity caused by the application of ZnSO4.7H_2O), followed by T_2 and T_1.This is due to effect of Zn that stimulate phosphate uptake which promote flowering directly when used as 0.5% ZnSO4.7H2O as foliar application at two different stag i,e maximum vegetative growth stage and other at flower ignition stage. Effect of Zinc & Boron in IAA metabolism which increases number of flower and stimulate the phosphate uptake by roots of plants help in development of flower and stimulate the phosphate uptake by roots of plants that in turn promoted development of flower cluster (Day,2000) [3]

Table 3: Effect of different technology option on growth parameters of brinjal

S.N.	Technology option	Plant height (cm)	% of flower set	% of fruit set	No. of fruit/plant	Yield/plant) (gm)	Total Yield/ (Qt/ha)	Cost of cultivation (Rs. /ha)	Gross/ return (Rs/ha)	Net return Rs/ha	B:C ratio
1	T_1	50.2	53.5	50.7	14.88	1416.55	221.85	50300	110925	60625	2.20
2	T_2	54.49	62.6	58.7	17.27	1725.7	253.9	54620	126950	72330	2.32
3	T_3	67.2	78.6	70.2	20.55	1904.7	279.8	53500	139900	86400	2.62

Conclusion

Based on the findings of the present study, it is concluded that zinc application had a significant impact on the growth and yield of brinjal. The treatment T_3 (12.0 kg Zn/ha as basal dose + two foliar sprays of 0.5% $ZnSO_4 \cdot 7H_2O$) performed best among all treatments. Foliar sprays were applied at the maximum vegetative and flowering initiation stages with 0.25% lime to neutralize residual Zn activity. T_3 recorded the highest plant height (67.2 cm), flower set (78.6%), and fruit set (70.2%). It also produced the maximum number of fruits per plant (20.55), yield per plant (1904.7 g), and total yield (279.8 q/ha). Compared to control, plant height increased by 33%, flower set by 46.91%, and fruit set by 38.46%. Similarly, yield per hectare increased by 26.12%, while the cost of cultivation was reduced by 6.36%. Gross income increased by 10.78%, resulting in a net return of Rs. 86,400/ha and a B:C ratio of 2.62. These findings clearly indicate the economic and agronomic superiority of the T_3 treatment. Hence, this technology is recommended for brinjal cultivation in Araria district (Agro-Climatic Zone II) of Bihar to enhance productivity and profitability.

References

1. National Horticulture Board (NHB). Horticulture at a Glance 2024. Gurugram: National Horticulture Board; 2024. https://nhb.gov.in/
2. Singh MV. Micronutrient deficiencies in crops and soils in India. In: Alloway BJ, editor. Micronutrient Deficiencies in Global Crop Production. Dordrecht: Springer; 2008. p. 93-125.
3. Day SC. Tomato Crop in Vegetable Growing. New Delhi: Agrobios; 2000. p. 59-61.
4. Smit JN, Combrink NJJ. Pollination and yield of winter-grown greenhouse tomato as affected by boron and zinc nutrition, cluster vibration, and relative humidity. South African Journal of Plant and Soil. 2005;22(2):110-115.
5. Ali S, Javed H, Umar R, Rehman H. Foliar application of some macro and micro nutrients improves tomato growth, flowering, and yield. International Journal of Biosciences. 2013;3(10):280-287.
6. Kiran J, Vjankarana BS, Raikar VK. Seed yield and quality of brinjal as influenced by crop nutrients. Indian Journal of Agricultural Research. 2010;44(1):1-7.