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Pallavi Soni
Ph.D., Research Scholar, Department of Horticulture, Vegetable Science, College of Agriculture, IGKV, Raipur, Chhattisgarh, India

Dr. Rajshree Gayen
Professor, Department of Vegetable Science, College of Agriculture, IGKV, Raipur, Chhattisgarh, India

Dr. Neeraj Shukla
Professor & Head, Department of Vegetable Science, College of Agriculture, IGKV, Raipur, Chhattisgarh, India

Dr. Vijay Kumar
Professor & Head, Department of Floriculture, College of Agriculture, IGKV, Raipur, Chhattisgarh, India

Dr. RR Saxena
Associate Professor, Department of Agriculture Statistics and Social Science, IGKV, Raipur, Chhattisgarh, India

Manoj Kumar Sahu
Subject Matter Specialist, KVK, IGKV, Raipur, Chhattisgarh, India

Corresponding Author:
Pallavi Soni
Ph.D., Research Scholar, Department of Horticulture, Vegetable Science, College of Agriculture, IGKV, Raipur, Chhattisgarh, India

Studies on the effect of micronutrients and biofertilizers on seed production of brinjal (*Solanum melongena* L.) var. Kashi Taru under Chhattisgarh plain condition

Pallavi Soni, Dr. Rajshree Gayen, Dr. Neeraj Shukla, Dr. Vijay Kumar, Dr. RR Saxena and Manoj Kumar Sahu

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Abstract
The present investigation "Studies on the effects of micronutrients and bio-fertilizers on seed production of Brinjal (*Solanum melongena* L.) var. Kashi Taru under Chhattisgarh Plain condition," was conducted at Indira Gandhi Krishi Vishwavidyalaya, Krishi Vigyan Kendra, Raipur farm, C.G. during the year of 2022-23 and 2023-24. A randomised complete block design with three replications was used to set up this experiment. Thirteen treatments combination of three micronutrients $ZnSO_4$, $FeSO_4$ and Borax *via* foliar application at 30, 40, 50 days after transplanting and two biofertilizers *i.e.* PSB, *Azotobacter* @ 2 l/acre through soil drenching technique, including control (RDF 100%) had designed. The experiment was comprised of thirteen treatment *i.e.*, micronutrients sole with 100% RDF and biofertilizers and micronutrients in different combination with 75% RDF. According to the study, application of treatment T_{13} ($ZnSO_4$ 0.2% + Borax 0.1% PSB + AZ + RDF 75%) was found highly significant on yield attributes and seed yield and its quality traits *viz.*, no. of fruits per plant, average fruit weight (g), fruit length (cm), fruit girth (cm), number of seeds per fruit, seed yield per fruit (g), seed yield per plant (kg), seed yield per hectare (kg ha^{-1}), 1000 seed weight (g), germination %, seedling length (cm), radicle length (cm), plumule length (cm), and seedling vigour index-I during the year of 2022-23 and 2023-24. Where seedling dry weight (mg) and seedling vigour index-II was recorded non-significant during both the season. The findings showed that yield attributes and seed yield and its quality parameters of brinjal var. Kashi Taru were found to be significantly increased with the application of T_{13} ($ZnSO_4$ 0.2% + Borax 0.1% + PSB + AZ + 75% RDF) followed by T_{12} ($FeSO_4$ 0.2% + Borax 0.1% PSB + AZ + RDF 75%). Whereas the minimum values for above parameters were recorded under T_1 (control).

Keywords: Micronutrients, biofertilizers, foliar spray, yield, seed, brinjal

Introduction
Brinjal is a popular and principle vegetable crop widely grown in tropics and subtropics (Rao, 2011) [22]. It belongs to the family “solanaceae” and botanically it is known as (*Solanum melongena* L.). It is popularly known as Eggplant, Guinea squash, Aubergine and Poor man’s crop. The centre of origin is Indo Burma region. It was first domesticated in India (Polunin, 1987) [20]. It is an annual herbaceous plant with erect, semi-erect or semi-spreading growth habit (Hazra *et al*., 2003) [10]. According to the report of National Horticulture Board, 2021-22 (Final estimates) brinjal accounting 675 thousand hectares area with total production in India is 12,765 million tonnes (MT). In Chhattisgarh state brinjal cultivation covers an area of 38.97 hectare with a production of 729.13 MT. (Anonymous, 2022-2023.) [3] The nutritional value of eggplant per 100 g according to the United States Department of Agriculture (USDA) include Carbohydrates (5.88 g), Protein (0.98g), fat (0.18 g), Vitamin C (2.2 mg), Vitamin K (3.5 µg), Potassium (229 mg), Phosphorus (24 mg), Magnesium (14 mg), Sodium (2 mg), Calcium (9 mg), Iron (0.23 mg), and Zinc (0.16 mg). Eggplants are either solitary or in groups of two to five flowers.
Seed is the basic and crucial input in agriculture on which the expected dividends from all other inputs depend. The availability of quality seeds in time and at affordable price is prime factor which enable the vegetable growers to produce uniform, healthy and vigorous

seedlings with greater yield. Production of quality seeds is an important factor for obtaining high yield from the crops. Superior quality seeds in terms of viability and vigour are essential factors which determine the seedling development in nursery and plant establishment in the field in order to get higher yield of quality seeds (Doijode, 1988) [6].

Plant nutrition is an important factor for enhancing yield and quality in brinjal. The practice of chemical farming has also put the long-run sustainability of Indian agriculture at risk (Ramya *et al*., 2015) [21]. The problem of the nutrient drain from the soil is becoming so acute and is beyond the capacity of any single fertilizer to accept the challenge of appropriate nutrient supply (Khan *et al*., 2008) [11]. Micronutrients and bio-fertilizers are affordable input that provide highly economic assurance, an eco-friendly atmosphere, support soil health and plant growth by putting organic materials into the soil. Although brinjal is an exhaustive or long duration crop which requires plenty of nutrition for its optimum growth and development from seedling stage till maturity, therefore to reduce the dependency of chemical fertilizers additional nutrition in the form of biofertilizers and micronutrients is practically a paying proposal.

Biofertilizers stimulate plant growth either by increasing nutrient availability, releasing hormones that accelerate plant growth, minimising pathogen/pest damage, or developing tolerance to environmental stressors/pollutants (Pathak *et al.*, 2017) [18]. While *Azotobacter* is an aerobic, free-living species of soil microorganisms that is crucial for nitrogen fixation. They can fix nitrogen equivalent to 60 kg ha^{-1} $year^{-1}$ (Bhhattacharyya and Jha, 2012) [4]. Phosphate solubilizing bacteria (PSB) belongs to a class of beneficial microbes that can hydrolyse both organic and inorganic phosphorus from insoluble substances. About 15-25% of insoluble phosphate can be solubilized saving chemical fertilizers significantly. The foliar application of micronutrients especially boron not only have major effects upon flower formation, carbohydrate and protein metabolism, but also increase pollen germination, pollen tube growth, seed production and yield. Numerous enzymes, including proteinase, peptidase, aldolase, dehydrogenase, and phosphohydrolase all require zinc to function. (Mousavi, 2011) [16].

Recent years have seen an increase in awareness of the value of using biofertilizers and micronutrients in combination, particularly in brinjal to increase plant growth, productivity and quality characteristics. The information on these aspects on brinjal seed production is meagre and scanty. Hence, an investigation on the effect of micronutrients and biofertilizers on plant growth, yield attributes and quality production of brinjal seed was initiated.

Materials and Methods

The present investigation was carried out during the *rabi* season of 2022-23 and 2023-24 at Krishi Vigyan Kendra, Raipur farm, Indira Gandhi Krishi Vishwavidyalaya (C.G.). The soil of experimental field is clayey loam with good drainage and uniform texture along with low in availability of phosphorus, high in potassium and in nitrogen status. The experiment was laid out in a Randomized complete block design (RCBD) and was replicated thrice. Each replication consisted of thirteen treatments along with single variety of brinjal. There were thirteen treatments combination of three micronutrients ($ZnSO_4$, $FeSO_4$, Borax) and two biofertilizers (PSB, *Azotobacter*) including control (RDF 100%) were designed. Foliar spray treatment of micronutrients was applied at 30, 40 and 50 Days after transplanting using a hand held sprayer. Bio-fertilizers like phosphorous solubilizing bacteria (PSB) and *Azotobacter* were treated @ 2 l $acre^{-1}$ through soil drenching technique. Transplanting was done on second week of November. The seedlings of height around 12-15cm were transplanted to the main field after 4-5 weeks. Transplanting was preferably being done in the evening. For yields attributes sampling was performed at maturity. Seed extraction was performed through wet method then seeds were shade dried on the wire mesh up to moisture content of 8.0 percent. The seed quality tests were carried out as per the ISTA procedure (Anonymous, 1999) [1]. Seeds were analysed for quality traits. In order to get representative samples, five plants were randomly selected and tagged. Mean values were worked out for the following observation.

Results and Discussion

Yield attributes

Significant difference was noticed in yield attributes and seed yield and its quality characteristics during both the season of experiment due to different treatments. Statistically analysed data on yield attributes are presented here in Table 1. The pooled analysis revealed that the maximum number of fruits per plant was recorded with treatment T_{13} (30.68) which were statistically at par with treatment T_{12} (29.15). It was further followed by T_{11} (27.12), T_{10} (27.03), and T6 (26.62). However, the minimum number of fruits per plant was recorded under the treatment T_1 (24.05), which were statistically inferior to all other treatments. Maximum average fruit weight was recorded with treatment T_{13} (298.38 g) which is statistically at par with treatment T_{12} (294.49 g), T_{11} (282.09 g) and T_{10} (279.47 g). However, the minimum average fruit weight was recorded under the treatment T_1 (249.85 g). The pooled analysis revealed that the maximum fruit length was recorded with treatment T_{13} (27.80 cm) followed by treatment T_{12} (27.68 cm), T_{11} (26.51 cm) and T_{10} (26.37 cm) which was statistically at par with treatment T_{13}. However, the minimum fruit length was recorded under the treatment T_1 (23.99cm), which was statistically inferior to all other treatments. Maximum fruit girth was recorded with treatment T_{13} (5.98 cm) followed by treatment T_{12} (5.91 cm) which was statistically at par with each other and the minimum fruit girth was recorded under the treatment T_1 (4.87 cm).

Plant's ability to generate a greater quantity of carbohydrates and function as an effective photosynthetic structure may be the cause of the rise of fruits per plant. Boron plays prominent role in the development and growth of new cell in the plant meristem, improve fruit quality and fruit set. Zinc contributes to the synthesis of IAA and a variety of enzymatic processes that boost fruit set and flower in large quantities (Mousavi, 2011) [16]. Zinc has their significant role in increasing fruit weight due to accumulation of high dry matter content. The probable cause for increase in fruit length and girth might be that the supply of boron led to absorption of water, synthesis and translocation of more metabolites, which resulted in increased fruit length. These findings are in agreement with the results reported by Ahirwar *et al*., (2019) [2] in tomato, Kiran *et al*., 2010 [12] in brinjal and Karthick *et al*., (2018) [11] in bitter gourd, Dixit *et al*., (2018) [5], Sathiyamurthy *et al*., (2017) [25], Hamsaveni *et al*., (2003) [9].

Seed yield and its quality traits

Foliar application of micronutrients and biofertilizers showed a significant result in seed yield and its quality attributes. Statistically analysed data on yield attributes are presented here in Table 2. The pooled analysis revealed that the maximum total number of seeds per fruit was recorded with treatment T_{13} (1495.06) which was statistically at par with T_{12} (1489.80), T_{11} (1479.67) and T_{10} (1440.79). However, the minimum total number of seeds per fruit was recorded under the treatment T_1 (1338.73), which were statistically inferior to all other treatments. Analysis revealed that the maximum seed yield per fruit was recorded with treatment T_{13} (9.37 g) which is statistically at par with T_{12} (9.29 g), T_{11} (8.81 g) and T_{10} (8.68 g). However, the minimum seed yield per fruit was recorded under the treatment T_1 (6.97 g). Maximum seed yield per plant was recorded with treatment T_{13} (205.44 g) followed by treatment T_{12} (198.85 g) which is statistically at par with T_{13}. The minimum seed yield per plant was recorded under the treatment T_1 (150.27 g). Analysis revealed that the maximum seed yield per hectare was recorded with treatment T_{13} (999.72 kg ha^{-1}) which is statistically at par with treatment T_{12} (980.86 kg ha^{-1}), T_{11} (959.51 kg ha^{-1}) and T_{10} (913.09 kg ha^{-1}). However, the minimum seed yield per hectare was recorded under the treatment T_1 (772.48 kg ha^{-1}), which were statistically inferior to all other treatments (Table 3).

The pooled analysis revealed that the maximum test weight was recorded with treatment T_{13} (6.91 g) followed by treatment T_{12} (6.85 g), T_{11} (6.70) and T_{10} (6.52). However, the minimum test weight was recorded under the treatment T_1 (5.93 g), which was statistically inferior to all other treatments. Maximum germination percentage was recorded with treatment T_{13} (95.16%) followed by treatment T_{12} (92.54%). Minimum germination percentage was recorded under the treatment T_1 (88.41%). Maximum seedling length was recorded with treatment T_{13} (13.61 g) followed by T_{12} (12.89 g). Minimum seedling length was recorded under the treatment T_1 (10.32 g). The pooled analysis revealed that the maximum radicle length was recorded with treatment T_{13} (5.94 cm) followed by treatment T_{12} (5.89 cm), T_{11} (5.73 cm) and T_{10} (5.64 cm) which was statistically at par with each other. However, the minimum radicle length was recorded under the treatment T_1 (4.74 cm), which was statistically inferior to all other treatments. Maximum plumule length was recorded with treatment T_{13} (7.71 cm) followed by T_{12} (7.53 cm). The minimum plumule length was recorded under the treatment T_1 (6.23). Highest value of seedling vigour index-I was recorded with treatment T_{13} (1328.50) followed by treatment T_{12} (1245.05) and the minimum seedling vigour index-I was recorded under the treatment T_1 (966.75), which was statistically inferior to all other treatments.

Increase in number of seeds per fruit is may be due to adequate mother plant nutrition. Effective ovule fertilisation, which results in the development of seeds, is dependent on proper pollen germination, which is made possible by boron. Seed yield per fruit, seed yield per plant, seed yield per hectare majorly depends on yield attributing characters such as number of fruits, fruit length, fruit girth, average fruit weight and number of seeds per fruit, which were positively affected by the foliar application of Zinc, Iron and Boron. Zinc and Iron improves photosynthesis and assimilates transportation to sinks and finally increased seed yield (Ebrahimian and Ahmad, 2011) [7]. Where, Boron involves in maximizing seed yield *via* pollen germination and fertilization.

The reason for an increase in seed weight could be attributed to improved mineral uptake by plants, which is coupled with increased photosynthetic activity and photosynthase diversion from source to sink. Accumulation of food reserve material in the form of endosperm could be an additional factor of the rise in seed weight. Increase in seed weight shows the relationship with reserve food material which ultimately directs to good quality seed. The increase in seed quality parameters may be due to the participation of micronutrients (Zn, B and Fe) in catalytic activity and breakdown of complex substances into simple form (glucose, amino acids and fatty acids *etc.*) which leads to increased ATP synthesis *via* accelerate respiration and this ATP synthesis permits subsequent growth. These in turn were reflected on enhanced germination, elongation of root and shoot of brinjal seedling (Santosh, 2012) [24]. SVI of seedling were increased due to good quality seeds of bigger sizes. The results of present investigation are in agreement with the findings of Salam *et al*., (2010) [23] combined application of boron and zinc along with recommended dose of NPK leads higher number of seeds per fruit. Similar results were reported by Natesh *et al*., (2005) [17] in chilli, Hamsaveni *et al*., (2003) [9] in Tomato. Patra *et al*., (2017) [19], Kumar and Malabasari, (2011) [14] and Kiran *et al*., (2010) [12], Yoganand, (2001) [26], Zeidan *et al*., (2010) [27] reported that application of Zn and B significantly increased grain yield and yield components of wheat. Maria *et al*., (2021) [15] in sweet pepper, and Gogoi *et al*., (2012) [8] in brinjal.

Table 1: Effect of micronutrients and biofertilizers on yield attributes in *rabi* season (pooled over 2 years) in cv. Kashi Taru

Treatments	No. of Fruits Per Plant			Average Fruit Weight (g)			Fruits girth (cm)			Fruits Lenght (cm)		
	Harvest			Harvest			Harvest			Harvest		
	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled
Control	24.90	23.20	24.05	254.61	245.08	249.85	4.85	4.89	4.87	24.51	23.47	23.99
$ZnSO_4$ 0.5% + 100% RDF	25.17	23.87	24.52	262.96	258.58	260.77	5.14	5.01	5.08	24.78	23.78	24.28
$FeSO_4$ 0.5% + 100% RDF	24.84	23.60	24.22	257.54	251.17	254.35	5.21	5.17	5.19	24.70	23.71	24.20
Boron 0.2% + 100% RDF	25.14	24.87	25.00	265.15	259.25	262.20	5.29	5.38	5.34	24.59	24.60	24.60
$ZnSO_4$ 0.2% + PSB + AZ + 75% RDF	25.50	23.93	24.72	270.23	263.75	266.99	5.32	5.19	5.26	25.90	24.77	25.33
$ZnSO_4$ 0.5% + PSB + AZ + 75% RDF	27.31	25.93	26.62	273.90	278.92	276.41	5.39	5.33	5.36	26.57	24.84	25.71
$FeSO_4$ 0.2% + PSB + AZ + 75% RDF	25.78	24.07	24.92	267.87	275.67	271.77	5.24	5.28	5.26	26.12	23.88	25.00
$FeSO_4$ 0.5% + PSB + AZ + 75% RDF	26.24	25.67	25.95	279.85	276.67	278.26	5.43	5.36	5.40	26.66	24.72	25.69
Borax 0.1% + PSB + AZ + 75% RDF	25.70	25.00	25.35	274.12	272.17	273.15	5.20	4.95	5.07	25.18	24.33	24.75
Borax 0.2% + PSB + AZ + 75% RDF	27.12	26.93	27.03	280.80	278.14	279.47	5.58	5.41	5.49	26.93	25.80	26.37
$ZnSO_4$ 0.2% + $FeSO_4$ 0.2% + PSB + AZ + 75% RDF	27.44	26.80	27.12	281.26	282.92	282.09	5.63	5.55	5.59	27.06	25.96	26.51
$FeSO_4$ 0.2% + Borax 0.1% PSB + AZ + 75% RDF	29.64	28.67	29.15	293.39	295.58	294.49	5.96	5.86	5.91	27.94	27.41	27.68
$ZnSO_4$ 0.2% + Borax 0.1% + PSB + AZ + 75% RDF	31.30	30.06	30.68	297.27	299.50	298.38	6.08	5.89	5.98	28.12	27.48	27.80
SEm	0.79	1.27	1.03	7.41	16.20	11.81	0.09	0.18	0.14	0.95	0.81	0.88
CD(5%)	2.31	3.72	3.02	21.63	47.30	34.47	0.29	0.55	0.42	2.79	2.38	2.59

Table 2: Effect of micronutrients and biofertilizers on seed yield in *rabi* season (pooled over 2 years) in cv. Kashi Taru

Treatments	No. of seeds per fruit			1000 Seed Weight			Seed Yield Per Fruit (g)			Seed Yield Per Plant (g)			Seed yield Per Hectare (kg/ha)		
	Harvest			Harvest			Harvest			Harvest			Harvest		
	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled
Control	1348.46	1329.00	1338.73	5.97	5.89	5.93	7.35	6.59	6.97	165.43	135.11	150.27	774.76	770.20	772.48
$ZnSO_4$ 0.5% + 100% RDF	1408.93	1383.11	1396.02	6.53	6.39	6.46	8.19	6.83	7.51	180.21	185.42	182.82	798.13	795.78	796.95
$FeSO_4$ 0.5% + 100% RDF	1356.37	1374.43	1365.40	6.51	5.95	6.23	7.55	6.63	7.09	179.19	172.29	175.74	794.35	794.56	794.46
Boron 0.2% + 100% RDF	1429.46	1393.83	1411.65	6.02	6.11	6.07	8.31	7.26	7.79	172.05	159.43	165.74	790.31	791.97	791.14
$ZnSO_4$ 0.2% + PSB + AZ + 75% RDF	1388.93	1395.37	1392.15	6.15	5.99	6.07	7.14	7.84	7.49	189.63	175.91	182.77	876.88	864.65	870.77
$ZnSO_4$ 0.5% + PSB + AZ + 75% RDF	1392.03	1404.88	1398.45	6.57	6.24	6.40	8.44	7.92	8.18	190.37	185.25	187.81	895.45	905.33	900.39
$FeSO_4$ 0.2% + PSB + AZ + 75% RDF	1354.59	1331.42	1343.00	6.34	6.12	6.23	7.83	7.10	7.47	180.83	186.30	183.57	891.05	853.46	872.26
$FeSO_4$ 0.5% + PSB + AZ + 75% RDF	1383.10	1345.67	1364.38	6.53	6.48	6.50	8.50	8.53	8.51	192.64	187.83	190.24	875.67	851.02	863.34
Borax 0.1% + PSB + AZ + 75% RDF	1372.55	1401.00	1386.78	6.05	5.85	5.95	7.42	8.30	7.86	185.26	180.15	182.71	862.27	863.37	862.82
Borax 0.2% + PSB + AZ + 75% RDF	1437.92	1443.67	1440.79	6.58	6.46	6.52	8.61	8.75	8.68	195.97	186.56	191.27	910.56	915.62	913.09
$ZnSO_4$ 0.2% + $FeSO_4$ 0.2% + PSB + AZ + 75% RDF	1471.04	1488.30	1479.67	6.79	6.61	6.70	8.76	8.86	8.81	198.41	189.43	193.92	971.22	947.80	959.51
$FeSO_4$ 0.2% + Borax 0.1% PSB + AZ + 75% RDF	1489.99	1489.60	1489.80	6.81	6.88	6.85	9.56	9.02	9.29	203.59	194.10	198.85	985.16	976.56	980.86
$ZnSO_4$ 0.2% + Borax 0.1% + PSB + AZ + 75% RDF	1491.45	1498.67	1495.06	6.89	6.92	6.91	9.59	9.15	9.37	210.10	200.78	205.44	1012.98	986.47	999.72
SEm	30.18	23.91	27.05	0.2	0.18	0.19	0.34	0.23	0.29	4.02	3.61	3.82	39.96	35.17	37.57
CD(5%)	88.10	69.79	78.95	0.61	0.53	0.57	1.00	0.69	0.85	11.74	10.54	11.14	116.64	102.66	109.65

Table 3: Effect of micronutrients and biofertilizers on seed quality attributes in *rabi* season (pooled over 2 years) in cv. Kashi Taru

	Germination %			Root Length(cm)			Shoot Length (cm)			Seedling Length (cm)			seedling dry weight (mg)			SVI-I			SVI-II		
Treatments	**2022-23**	**2023-24**	**Pooled**	**2022-23**	**2023-24**	**Pooled**	**2022-23**	**2023-24**	**Pooled**	**2022-23**	**2023-24**	**Pooled**	**2022-23**	**2023-24**	**Pooled**	**2022-23**	**2023-24**	**Pooled**	**2022-23**	**2023-24**	**Pooled**
Control	88.03	88.79	88.41	4.82	4.65	4.74	6.30	6.15	6.23	10.53	10.11	10.32	35.55	36.30	35.93	981.50	952.01	966.75	31.26	32.22	31.74
$ZnSO_4$ 0.5% + 100% RDF	89.53	88.67	89.10	4.93	4.87	4.90	6.70	6.79	6.75	11.00	10.18	10.59	35.52	37.39	36.46	1028.03	1008.46	1018.25	31.81	33.14	32.47
$FeSO_4$ 0.5% + 100% RDF	88.53	88.29	88.41	4.87	4.85	4.86	6.82	6.77	6.79	12.03	10.89	11.46	41.56	37.37	39.46	1100.83	1062.48	1081.66	36.78	32.86	34.82
Boron 0.2% + 100% RDF	88.91	87.37	88.14	4.97	4.69	4.83	6.43	6.45	6.44	11.78	11.24	11.51	38.15	32.93	35.54	1113.93	1026.42	1070.18	33.9	28.79	31.34
$ZnSO_4$ 0.2% + PSB + AZ + 75% RDF	90.26	89.58	89.92	4.83	4.93	4.88	6.71	6.70	6.70	11.32	11.02	11.17	36.91	37.58	37.25	1057.26	1043.14	1050.20	33.32	33.67	33.49
$ZnSO_4$ 0.5% + PSB + AZ + 75% RDF	90.49	88.33	89.41	5.41	5.47	5.44	6.80	6.82	6.81	11.84	11.82	11.83	43.03	36.52	39.78	1132.93	1086.01	1109.47	38.95	32.26	35.61
$FeSO_4$ 0.2% + PSB + AZ + 75% RDF	89.88	87.04	88.46	5.29	5.35	5.32	6.39	6.54	6.46	12.07	11.59	11.83	37.45	38.32	37.89	1050.28	1019.24	1034.76	33.77	33.36	33.56
$FeSO_4$ 0.5% + PSB + AZ + 75% RDF	90.35	88.37	89.36	5.45	5.58	5.51	6.83	6.80	6.81	11.73	10.86	11.30	37.43	37.65	37.54	1099.32	1066.81	1083.06	33.8	33.26	33.53
Borax 0.1% + PSB + AZ + 75% RDF	90.45	90.05	90.25	5.07	4.75	4.91	6.73	6.37	6.55	11.97	11.34	11.65	38.54	40.95	39.75	1090.64	1046.84	1068.74	34.85	37.09	35.97
Borax 0.2% + PSB + AZ + 75% RDF	90.90	88.67	89.79	5.65	5.62	5.64	6.86	6.88	6.87	12.06	12.37	12.21	43.15	38.85	41.00	1156.13	1133.92	1145.03	39.22	34.45	36.84
$ZnSO_4$ 0.2% + $FeSO_4$ 0.2% + PSB + AZ + 75% RDF	91.66	89.53	90.60	5.77	5.70	5.73	6.89	6.81	6.85	12.41	12.52	12.47	45.45	41.54	43.49	1178.77	1143.44	1161.10	41.67	37.18	39.42
$FeSO_4$ 0.2% + Borax 0.1% PSB + AZ + 75% RDF	92.83	92.25	92.54	5.91	5.87	5.89	7.57	7.49	7.53	12.90	12.88	12.89	46.04	44.82	45.43	1307.12	1182.99	1245.05	42.76	41.37	42.06
$ZnSO_4$ 0.2% + Borax 0.1% + PSB + AZ + 75% RDF	95.73	94.58	95.16	5.98	5.89	5.94	7.83	7.58	7.71	13.43	13.78	13.61	47.74	46.46	47.10	1365.70	1291.30	1328.50	45.97	50.6	48.28
SEm	1.21	1.18	1.20	0.16	0.19	0.18	0.2	0.23	0.22	0.14	0.33	0.24	3.52	2.63	3.08	33.77	45.72	39.75	3.4	3.75	3.58
CD (5%)	3.54	3.46	3.50	0.49	0.56	0.53	0.6	0.7	0.65	0.43	0.98	0.71	NS	NS	NS	98.57	133.47	116.02	NS	NS	NS

Conclusion

The data obtained from the present study suggests that foliar application of micronutrients and biofertilizers along with 75% RDF increase the yield components (no. of fruits per plant, average fruit weight (g), fruit length (cm), fruit girth (cm) and seed yield and its quality parameters (number of seeds per fruit, seed yield per fruit (g), seed yield per plant (kg), seed yield per hectare (kg ha^{-1}), 1000 seed weight (g), germination %, seedling length (cm), radicle length (cm), plumule length (cm), and seedling vigour index-I of brinjal plant. Bio-fertilizers like *Azotobacter* are important for their nitrogen fixing efficiency and ability to produce antibacterial and antifungal compounds as well as enhancement of growth, yield and quality of vegetable crops. Phosphate solubilizing bacteria are found to be effective in improving phosphorus use efficiency and effects growth and yield of crops. The results made it clear that application of bio-fertilizers and micronutrients, either singly or in combinations specially $ZnSO_4$ 0.2% + Borax 0.1% + PSB + AZ + 75% RDF & $FeSO_4$ 0.2% + Borax 0.1% PSB + AZ + 75% RDF have enhancing effects on seed yield.

References

1. Anonymous. ISTA International rules for seed testing. Seed Science and Technology. Supplement Rules. 1999;27:20-25.
2. Ahirwar K, Tripathi UK, Singh RK, Ahirwar MK, Sharma R. Effect of micronutrients and biofertilizers growth on yield and yield attributes character of tomato. International Journal of Horticulture and Food Science. 2019;1(1):13-16.
3. Anonymous. Directorate Horticulture and Farm Forestry, Chhattisgarh. Area, production and productivity of horticulture crops in Chhattisgarh (Final Report); c2022-2023.
4. Bhattacharyya P, Jha D. Plant growth-promoting rhizobacteria (PGPR): emergence in agriculture. World Journal of Microbiology and Biotechnology. 2012;28:1327-1350.
5. Dixit A, Sharma D, Sharma TK, Bairwa PL. Effect of foliar application of some macro and micronutrients on growth and yield of tomato (*Solanum lycopersicum* L.) cv. Arka Rakshak. International Journal of Current Microbiology and Applied Sciences. 2018;6:197-203.
6. Doijode SD. Effect of storage environment on brinjal (*Sorghum melongena*) seed viability. Progressive Horticulture. 1988;20:292-293.
7. Ebrahimian E, Ahmad B. Effect of iron foliar fertilization on growth, seed and oil yield of sunflower grown under different irrigation regimes. Middle-East Journal of Scientific Research. 2011;9:621-627.
8. Gogoi S, Das MR, Bora P, Mazumder N. Effect of foliar application of nutrients on fruit and seed production of brinjal (*Solanum melongena*). Crop Research. 2012;44(3):366-369.
9. Hamsaveni MR, Kurdikeri MB, Shekhargouda M, Shashidhara SD, Dharmatti PR. Effect of gypsum and boron on seed yield and quality on tomato cv. Megha. Karnataka Journal of Agricultural Sciences. 2003;16(3):457-459.
10. Hazra P, Rout A, Roy U, Nath S, Roy T, Dutta R, *et al*. Characterization of brinjal (*Solanum melongena* L.) germplasm. Vegetable Science. 2003;30:145-149.
11. Karthick R, Rajalingam GV, Praneetha S, Sujatha KB, Arumugam T. Effect of micronutrients on growth, flowering, and yield of bitter gourd (*Momordica charantia*) cv. CO1. International Journal of Chemical Studies. 2018;6(1):845-848.
12. Kiran J, Vyakaranahal BS, Raikar SD, Ravikumar GH, Deshpande VK. Seed yield and quality of brinjal as influenced by crop nutrition. Indian Journal of Agricultural Research. 2010;44(1):1-7.
13. Khan MS, Shil NC, Noor S. Integrated nutrient management for sustainable yield of major vegetable crops in Bangladesh. Bangladesh Journal of Agriculture and Environment. 2008;4(5):81-94.
14. Kumar DMR, Malabasari TA. Effect of planting geometry and foliar spray of micronutrients on plant growth, seed yield and quality of bell pepper (*Capsicum annuum* L.). M.Sc. (Agri.) Thesis, University of Agricultural Sciences, Dharwad, Karnataka, India; c2011. p. 52.
15. Maria I, Saha A, Karim MR, Rahman MS, Choudhury AK, Rahman MM, *et al*. Impact of foliar boron sprays on seed yield and seed quality of sweet pepper. North American Academic Research. 2021;4(12):212-218.
16. Mousavi SR. Zinc in crop production and interaction with phosphorus. Australian Journal of Basic and Applied Science. 2011;5:1503-1509.
17. Natesh N, Vyakaranahal BS, Shekhargouda M, Deshpande VK. Effect of micronutrients and organics on growth, seed yield and quality of chilli. Karnataka Journal of Agricultural Sciences. 2005;18(2):334-337.
18. Pathak DV, Kumar M, Rani K. Biofertilizer application in horticultural crops. Springer Nature Singapore Pte Ltd.; c2017.
19. Patra C, Sahoo LP, Das S, Rai AK. Effect of bio-fertilizers and micronutrients on seed yield and quality in tomato (*Lycopersicon esculentum* MILL). International Journal of Science, Environment and Technology. 2017;6(2):1526-1534.
20. Polunin I. Plants and flowers of Singapore. Singapore: Times editions; c1987. p. 148. (Call no.: RSING 581.95957 POL).
21. Ramya SS, Vijayanand N, Rathinavel S. Foliar application of liquid biofertilizers of boron alga *Stoechospermum marginatum* on growth, biochemical and yield of *Solanum melongena*. International Journal of Recycling of Organic Waste in Agriculture. 2015;4:167-173.
22. Rao CK. Use of brinjal in alternative and complementary systems of medicine in India is a factoid; c2011.
23. Salam MA, Siddique MA, Rahim MA, Rahman MA, Saha MG. Quality of tomato (*Lycopersicon esculentum* Mill.) as influenced by boron and zinc under different levels of NPK fertilizers. Bangladesh Journal of Agricultural Research. 2010;35(3):475-488.
24. Santosh K. Effect of micronutrients on quality of fruit and seed in tomato (*Solanum lycopersicum* L.). International Journal of Farm Sciences. 2012;2:43-46.
25. Sathiyamurthy VA, Shanmugasundaram T, Rajasree V, Arumugam T. Effect of foliar application of micronutrients on growth, yield and economics of tomato (*Lycopersicon esculentum* Mill.). Madras Agricultural Journal. 2017;104(4-6):188-193.

26. Yoganand DK. Effect of mother plant nutrition and growth regulators on plant growth, seed yield and quality of bell pepper cv. California Wonder. M.Sc. (Agri.) Thesis, University of Agricultural Sciences, Dharwad, Karnataka, India; c2001.
27. Zeidan MS, Mohamed MF, Hamouda HA. Effect of foliar fertilization of Fe, Mn and Zn on wheat yield and quality in low sandy soils fertility. World Journal of Agricultural Sciences. 2010;6:696-699.