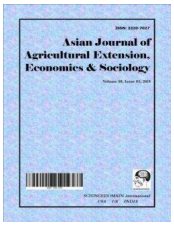

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Effect of Zinc and Boron Application on Yield of Brinjal (*Solanum melongena* L.) in Bharuch District of Gujarat

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Authors' contributions

This work was carried out in collaboration among all authors. Author DJM designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors LMP and HMV managed the analyses of the study. Author MMP managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The field demonstrations were carried out during 2016-17 in *Rabi* season to know effect of zinc and boron on yield of brinjal at total 10 farmers from Bharuch district. The production of brinjal is quite low in some part of the district due poor soil fertility status and imbalance fertilizer application by farmer. There was complete absence of micronutrients application to the crop. The initial soil analysis data showed deficiency of zinc and boron in experimental soil. Thus, to compare effect and method of use of zinc and boron; soil application and foliar spray were made along with improved practices against farmer practices. The highest plant height, average fruit weight, number of fruits per plant and fruit yield of brinjal was recorded with the soil application of zinc and boron

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which was superior over the foliar spray and farmer's practices. The gross return, net return and benefit cost ratio recorded was also maximum in improved practices consisting soil application of zinc and boron as compared farmer's practices.

Keywords: Brinjal; zinc; boron; yield and Economics.

1. INTRODUCTION

Brinjal (*Solanum melongena* L.), or egg plant is one of the most common, popular and major vegetable crop grown in India and other parts of the world. It is popularly known as eggplant belongs to family *solanaceae*. It is a good source of minerals like phosphorus, iron and vitamins especially the B complex. The demand for brinjal as a fruit vegetable is increasing rapidly among the vegetables consumers in view of its better fruit colour, size and taste. In India during 2015-16 it was cultivated in 0.66 million hectare area with a production of 12.51 million tonnes and productivity of 18.95 tonnes/ha. However, In Gujarat area under brinjal cultivation was 74060 hectare area with a production of 1.47 million tonnes and productivity of only 19.86 tonnes/ha. The highest productivity was recorded in Uttar Pradesh (34.34 tonnes/ha) [1]. Hence, there is a good scope to enhance average productivity in India as well as Gujarat.

The growth and yield of brinjal are mainly dependent on several interacting factors. Being long duration crop with high yield, brinjal removes large quantities of nutrients from the soil. Like macronutrients, micronutrients are equally important in plant nutrition. There is a need to go for balanced fertilization of both macro and micronutrients since micronutrients play a profound role in various metabolic functions of plant. If these elements are not available adequately, plants will go through physiological stresses caused by inefficiency of several enzymatic systems and other related metabolic functions. Various responses were observed in growth and yield in crops species and in cultivars to trace elements deficiency [2]. It was with this objective in view, the present study was initiated.

2. MATERIALS AND METHODOLGY

The technology was demonstrated in the field experiment at the ten farmer's field under supervision of Krishi Vigyan Kendra, Bharuch, Gujarat during 2016-17 in *Rabi* season in five villages of Bharuch district. Ten innovative and receptive progressive farmers from five villages were selected for conducting the trial to ensure their active participation. To understand status plant nutrients in experimental soils, samples were collected from each field plot. The initial soil analysis data showed deficiency of zinc and boron in experimental soil (Table 1). The trial was taken in area of 0.4 ha of each farmer which then equally divided for three treatments. The other improved practices consisting of soil application and foliar spray of zinc and boron along with recommended doses of fertilizer (100:50:50 kg NPK /ha) was compared against farmer practices. The soil application of zinc (10 kg per acre) and boron (4 kg per acre) was done along with basal dose, however the foliar spray of 0.5% zinc and 0.2% boron was made at the flowering and fruiting stage. Nitrogen was applied in at basal and at flowering stage. The parameters recorded were plant height, average fruit weight (gm), number of fruits per plant and total yield of each experimental plot as well as farmer's practices.

The primary data on output of brinjal yield were collected from the selected brinjal farmers plots, qualitative data was converted in to quantitative form and expressed in term of percent increased yield was calculated by using the formula given below.

$$\text{Percentage increased yield} = \frac{\text{Demonstration yield} - \text{Local check yield}}{\text{Local Check yield}} \times 100$$

Benefit cost ratio calculated by the formula given below

$$\text{Benefit cost ratio} = \frac{\text{Gross Return}}{\text{Cost of cultivation}} \times 100$$

Table 1. Soil test results of plots before conducting on farm trial

Treatment	pH	Electrical conductivity (dS/m)	Organic Carbon (%)	Available nitrogen (kg/ha)	Available phosphorus (kg/ha)	Available potash (kg/ha)	Available zinc (ppm)	Available Boron (ppm)
Field -1	6.54	1.05	0.75	270.51	38.90	160.80	0.10	0.38
Field -2	6.81	1.10	0.75	224.67	37.40	155.10	0.49	0.53
Field -3	6.75	1.01	0.44	320.52	41.19	282.50	0.55	0.39
Field -4	6.87	1.03	0.71	275.31	35.56	145.23	0.48	0.43
Field -5	7.30	1.07	0.64	186.90	83.48	144.34	0.45	0.32
Field -6	7.21	1.01	1.01	235.21	32.13	87.09	0.41	0.45
Field -7	6.93	1.05	0.83	295.75	134.69	180.60	0.44	0.51
Field -8	6.68	1.00	0.62	203.21	38.96	86.41	0.52	0.40
Field -9	7.12	1.04	0.68	370.36	75.48	141.30	0.35	0.48
Field -10	7.24	1.03	0.83	219.40	69.20	246.70	0.41	0.37

3. RESULTS AND DISCUSSION

The differences between improved practices and farmer's practice are shown in Table 2. The farmer's practices include no seed treatment, imbalance fertilizer application with no use of micronutrient and poor adoption of plant protection measures. All these collectively resulted in low yield of brinjal in the district. However, all the improved package of practices of brinjal including soil and foliar method of micronutrients was demonstrated at farmer's field to compare it with existing practices.

3.1 Performance of Improved Technology

The improved practices consisting soil application of zinc & boron in addition to recommended doses of fertilizer recorded significantly higher plant height (52.39 cm), average fruit weight (167.49 g), highest number of fruits per plant (11.02) and maximum yield per hectare (33.73 tonne) compared to farmer's practices (Tables 1-4). This was followed by improved practices composed of foliar spray application of zinc and boron. The plant height (51.17 cm), average fruit weight (164.8 g), highest number of fruits per plant (9.52) and yield per hectare (29.14 tonne) was recorded in improved practices comprises foliar spray application of zinc and boron along with recommended dose of fertilizer. These results were in conformity with those of Pandav et al. [3], Sliman et al. [4] and Acharya et al. [5].

3.2 Economic Return

The inputs and outputs prices of commodities prevailed during the study of demonstration were taken for calculating net return and benefit: cost ratio (Table 4). The cost of cultivation is comparatively more in improved practices along

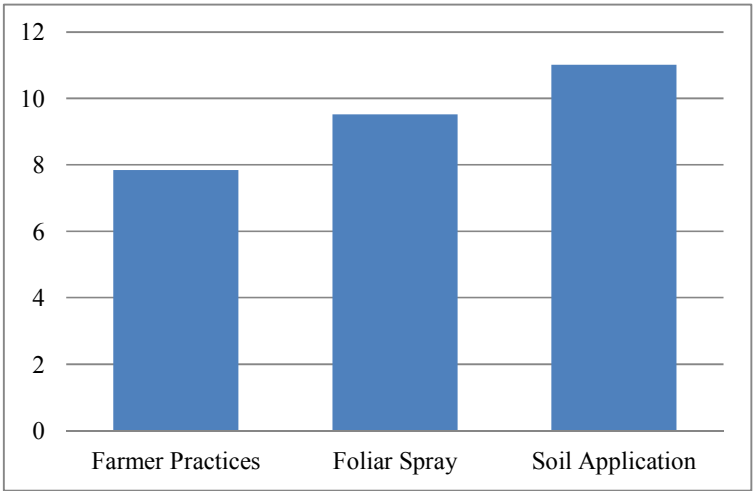

Fig. 1. Effcet of micronutrient on no. of fruit per plant in brinjal

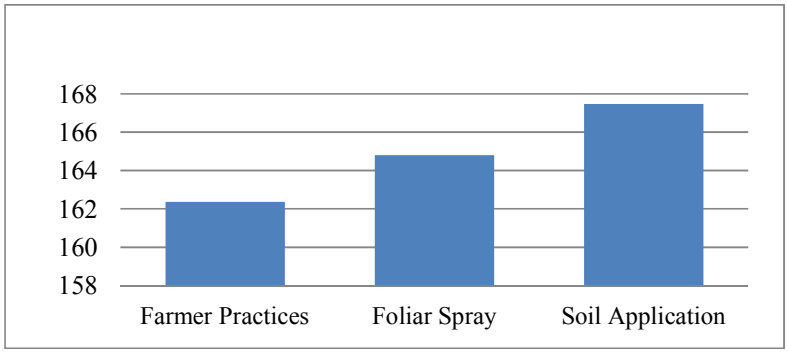

Fig. 2. Effcet of micronutrient on average fruit weight (gm) in brinjal

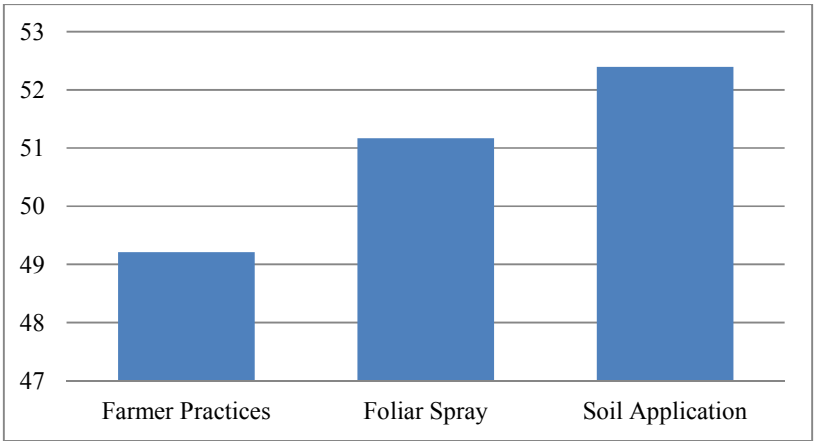

Fig. 3. Effcet of micronutrient on average fruit weight (gm) in brinjal

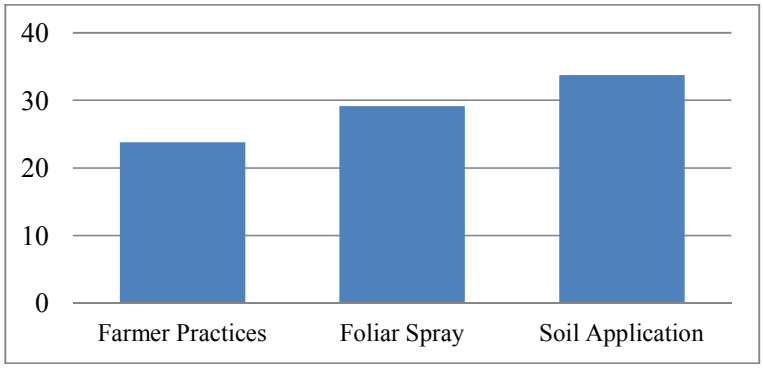

Fig. 4. Effcet of micronutrient on yield per hectare in brinjal

with soil application of zinc and boron (Rs 49320 per ha) as well as in foliar application of zinc and boron (Rs 48500 per ha) as compared to farmer's practices (Rs 41600 per ha). The cultivation of brinjal under improved practices involved of recommended dose of fertilizer along with soil application of zinc and boron gave higher net return of Rs. 119180/- per hectare followed by foliar spray of zinc and boron Rs. 97200/- per ha as compared to farmer's practices. The benefit cost ratio of brinjal cultivation under soil application of zinc and boron practices were 3.41 against 2.86 under farmer's practice. This may be due to higher yield obtained under improved technologies compared to farmer's practice. More or less similar findings were reported by Kiran [6] Sharma and Brar [7] and Suganiya and Kumuthini [8].

Table 2. Details of brinjal growing under improved practices and farmer's existing practices

Operation	Existing practices	Improved practices of demonstrated
Variety Use	Surti Gulabi	Surti Gulabi
Seed treatment	No seed treatment	Seed treatment with Biofertilizer (20 ml/kg seed) & *Trichoderma viride* 3 gm/kg seed.
Sapling root treatment	No sapling root treatment	Sapling root treatment with Imidacloprid 5 ml/10 liter water for 30 minutes
Spacing	80 cm x 60 cm	90 cm X 90 cm
Fertilizer application & Soil trial	Imbalance application of fertilizer & no soil test	Application of recommendation dose of fertilizer: FYM 10 t/ha and 100:50:50 kg NPK /ha and application of zinc and boron.
Plant protection measure	Poor adoption of IPM practices	Spraying of Imidacloprid 5 ml/10 liter water for sucking pest & Carbendazim 20 gm/10 liter water for fungus diseases.

Table 3. Effect of soil application and foliar sprays of zinc and boron on growth and yield parameters of brinjal

Treatment	Plant height (cm)	Average fruit weight (gm)	No. of fruit per plant	Yield per ha (tonne)
Farmer's Practices	49.21	162.37	7.84	23.81
Recommended doses of fertilizer (RDF) + Foliar Spray	51.17	164.81	9.52	29.14
Recommended doses of fertilizer (RDF) + Soil Application	52.39	167.49	11.02	33.73
C.D.5 %	1.73	3.95	0.59	2.40
CV	2.91	2.06	5.39	7.15

Table 4. Economic Impact of soil application and foliar sprays of zinc and boron on brinjal

Economics of demonstration (Rs/ha)								Economics of farmer practices (Rs/ha)			
Recommended doses of fertilizer + Soil Application				Recommended doses of fertilizer + Foliar Spray							
Gross cost	Gross Income (Rs./ha)	Net Return (Rs./ha)	BCR	Gross cost	Gross Income (Rs./ha)	Net Return (Rs./ha)	BCR	Gross cost	Gross Income (Rs./ha)	Net Return (Rs./ha)	BCR
49320	168500	119180	3.41	48500	145700	97200	3.0	41600	119050	77450	2.86

4. CONCUSION

The soil application of zinc and boron in addition to recommended practices can be effective practice to deal with low productivity of the brinjal due to zinc and boron deficiency. Farmers were very much satisfied with average fruit weight and no of fruits per plants & yield and higher benefit cost ratio that was better in soil application of deficient micronutrients as compare to routine practices. However horizontal spread of recommended and improved technologies may be achieved by the successful implementation of results of trials and various extensions activities.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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