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Effect of zinc and iron application on vegetative growth and quality of brinjal cv. Pusa Kranti

Usha Meena, Atul Chandra and I. J. Gulati
Department of Horticulture, College of Agriculture, RAU, Bikaner-334006, Rajasthan E-mail : ruchira_tini@rediffmail.com

Abstract

A field experiment to study the effect of zinc and iron application on vegetative growth and quality of brinjal cultivar Pusa Kranti was conducted during Dec., 2006 to July, 2008 as main crop and ratoon crop of brinjal at the Department of Horticulture, College of Agriculture, Bikaner. The results revealed that soil application of 40 kg $FeSO_4$ before transplanting followed by 40 kg $ZnSO_4$ ha^{-1} as soil application showed increased plantheight, stem girth, number of fruits per plant, fruit weight, fruit width, fruit length and ascorbic acid content in the fruits considerably.

Key words : *Brinjal, micronutrient, nutrition, zinc and iron.*

Introduction

Brinjal (*Solanum melongena* L.) is a major vegetable crop of India after potato. It is highly nutritive and contains fairly high amounts of iron and ascorbic acid. It has medicinal value and reported to lower down blood cholesterol level and is also said to be good remedy for those suffering from liver complications. Under arid areas of Rajasthan, its cultivations is being done successfully. However, productivity is low i.e. about 2.82 MT ha^{-1}, mainly because of poor fertility status. Soils of Bikaner are high in pH (8.20), low in organic carbon (0.09%), low in zinc (0.24 mg kg^{-1}) and medium in iron (3.93 mg kg^{-1}). Zinc and iron are important micronutrients for vegetative growth, yield attributing characters and quality of fruits in brinjal crops (Ravichandran *et al.*, 1995 and Raj *et al.*, 2001). Such studies were also under taken by Yadav *et al.* (2001) at Hisar in Haryana. There was need to initiate the study on the response of these micronutrients under extreme arid irrigated conditions of Bikaner in Rajasthan. Therefore, keeping in view the above consideration, an experiment was carried out to find out effect of zinc and iron on vegetative growth and quality of brinjal cv. Pusa Kranti.

Materials and methods

The experiment was laid out at experimental farm of College of Agriculture, Rajasthan Agricultural university, Bikaner during the year 2006-07 with brinjal cultivar Pusa Kranti. The seedlings of brinjal were transplanted in the field on 21 Dec., 2006. Prior to transplanting, well rotten FYM @ 150 q ha^{-1} was incorporated in the soil and also nitrogen was applied through urea half as basal dose of total 120 kg N ha^{-1} + full quantity of phosphorus (40 kg ha^{-1}) through single super phosphate and potassium 60 kg ha^{-1} through murate of potash. Remaining half quantity of nitrogen was applied in two equal doses at 30 and 45 days after transplanting. Basal dose of $FeSO_4$ and $ZnSO_4$ (20, 30, 40 kg ha^{-1}, respectively) were applied at the time of transplanting. The treatments consisted of three levels of each zinc and iron as soil application *viz.* 20, 30 and 40 kg $ZnSO_4$ ha^{-1} i.e. T_3, T_4, T_5, respectively and 20, 30 and 40 kg $FeSO_4$ ha^{-1} i.e. T_8, T_9, T_{10}, respectively and foliar spray of 0.1 per cent citric acid (T_1), 1 per cent urea (T_2), 0.25% $ZnSO_4$ + 1% urea (T_6), 0.50% $ZnSO_4$ + 1% urea (T_7), 0.5% $FeSO_4$ + 0.1% citric acid (T_{11}), 1.0% $FeSO_4$ + 0.1% citric acid (T_{12}), 1.5% $FeSO_4$ + 0.1% citric acid (T_{13}) and absolute control (T_0). Total 14 treatment combinations were replicated thrice in the randomized block design having plot size of 3 x 2.4 sqm with 60 cm x 45 cm plant to plant and row to row distance.

In main crop, foliar application of micronutrients, urea and citric acid as per treatments was done 105 and 120 days after transplanting. Thereafter on 14.09.2007 pruning was done and uniform application of vermicompost @ 25 kg/ plot was done on 22nd October, 2007. Subsequent flowering and fruiting was damaged by severe cold and frost conditions experienced during December, 2007 to February, 2008. It was maximum

between 2 February, 2008 to 4th February, 2008. The entire crop was burnt due to severe frost occurrence. Foliar sprays of micronutrients were again done on 25 February, 2008, 18.03.2008 and 07.04.2008 after pruning.

The observations on plant height and stem girth were recorded 115, 130 and 145 days after transplanting. No. of fruits per plant, fruit weight, fruit length and fruit width were recorded at the time of each picking. There were 11 pickings in main crop and 14 pickings in ratoon crop. First picking in main crop started from 24 April, 2007 and lasted on 2 July. 2007. whereas, in ratoon crop first picking started on 19 April, 2008 and continued upto 15 July, 2008. Ascorbic acid content was estimated in the fruits of first picking of both main crop as well as ratoon crop.

Results and discussion

Plant height

The present investigation revealed that application of 40 kg $FeSO_4$ ha^{-1} soil application had maximum plant height at 115 days after transplanting (31.34 cm) followed by 40 kg $ZnSO_4$ ha^{-1} soil application (30.99 cm). Similarly at 130 days after transplanting, 40 kg $FeSO_4$ ha^{-1} soil application had maximum plant height (32.90 cm) followed by (32.48 cm) in T_5 i.e. 40 kg $ZnSO_4$ ha^{-1} soil application and also it was minimum in control. At 145 days after transplanting, the same trends was observed (Table 1). It is because of the fact that soil application of zinc and iron might have improved their status in soil as the experimental field was low in available zinc (0.24 mg kg^{-1}) as well as in available iron (3.93 mg kg^{-1}). The application of these micronutrients through zinc sulphate and ferrous sulphate in the soil increased their availability in the soil for uptake by the plants. Similar findings have been reported by Singh and Maurya (1979) and Mallick and Muthukrishan (1979) who observed enhancement of plant height due to application of zinc in case of okra and tomato, respectively. Hatwar *et al.* (2003) also reported increase in the plant height due to foliar application of zinc, iron and boron in chilli.

Stem girth

Similar to results of plant height, maximum stem girth was recorded at 40 kg $FeSO_4$ ha^{-1} soil application at 115, 130 and 145 DAT which was 2.45 cm, 2.85 cm and 3.06 cm, respectively under this treatment. It was followed by 30 kg soil application of $FeSO_4$ ha^{-1} and soil application of 40 kg $ZnSO_4$ ha^{-1}. It is because of beneficial effect of zinc and iron in plant metabolism. Similar results have been reported by Seelliger and Moss (1976) and Sharma (1994) in pea and radish, respectively.

Number of fruits per plant

Number of fruits per plant were maximum in both main crop and ratoon crop in the treatments 40 kg $FeSO_4$ ha^{-1} as soil application which were recorded 7.11 and 6.97, respectively and was followed by 40 kg $ZnSO_4$ ha^{-1} soil application. The present findings is in agreement to the finding of Dube *et al.* (2003) in tomato and also by Ravichandran *et al.* (1995) in brinjal and Hatwar *et al.* (2003) in chilli.

Fruit weight

Fruit weight was recorded maximum (38.50 g) in 20 kg $ZnSO_4$ as soil application in main crop whereas at ratoon crop, maximum fruit weight (39.42 g) was recorded in the treatment of 20 kg $FeSO_4$ ha^{-1} as soil application (Table 1). The present finding is in agreement with the finding of Chaudhary and Mukherjee (1994) in cauliflower and also of Bhatt *et al.* (2004) and Seediger and Moss (1976) in pea. The increase in fruit weight by application of zinc and iron might be because of increased photosynthetic activity resulting more production of metabolities and thus help in increasing fruit weight in brinjal.

Fruit yield

Fruit yield was obtained maximum under soil application of 40 kg $FeSO_4$ ha^{-1} (442.80 q ha^{-1}) closely followed by 40 kg $ZnSO_4$ soil application ha^{-1} (437.68 q ha^{-1}) as compared to 264.54 q ha^{-1} obtained in absolute control in main crop whereas in ratoon crop it was also maximum in soil application of 40 kg $FeSO_4$ ha^{-1} (592.01 q ha^{-1}) followed by 30 kg soil application of $FeSO_4$ (540.47 q ha^{-1}) and 40 kg $ZnSO_4$ ha^{-1} (511.44 q ha^{-1}) as compared to 279.60 q ha^{-1}. Similarly soil application of zinc sulphate and different treatment combinations of zinc and iron along with citric acid and urea as foliar application also significantly increased fruit yield in main as well as in ratioon crop. These results are in agreement with the findings of Reddy *et al.* (1995) who reported application of zinc through $ZnSO_4$ either to soil or as foliar spray and iron as foliar spray through $FeSO_4$ resulted in significantly increased fruit yield of tomato accompanied by increased concentration of zinc and iron. Similarly, Bid *et al.* (1994), Ravichandran *et al.* (1995) and Raj *et al.* (2001).

Fruit width and fruit length

Fruit width was maximum in both main crop and in ratoon crop in the treatment of 40 kg $FeSO_4$ ha^{-1} soil application which was recorded 3.14 cm and 3.09 cm, respectively followed by 40 kg $ZnSO_4$ ha^{-1} as soil application. Similarly, fruit length was also recorded maximum under the above treatment (Table 2). It is in conformity to the findings of Pal *et al.* (2004) who also observed maximum fruit length and width in chilli cultivar Yolol wonder.

Table 1. Effect of different doses of zinc sulphate and ferrous sulphate as soil application and foliar application on plant height, stem girth, number of fruits per plant and yield of brinjal cv. Pusa Kranti

	Treatment	Plant height (cm)			Stem girth (cm)			Number of fruits per plant		Yield (q ha^{-1})	
		115 DAT	130 DAT	145 DAT	115 DAT	130 DAT	145 DAT	Main crop	Ratoon crop	Main crop	Ratoon crop
T_0	Absolute control	26.77	28.88	31.14	2.00	2.38	2.64	4.80	5.27	264.54	279.60
T_1	0.1% citric acid foliar spray	26.92	29.88	31.53	2.15	2.42	2.74	5.80	6.53	282.63	293.33
T_2	1.0% urea foliar spray	28.28	30.47	33.08	2.16	2.46	2.80	5.92	6.55	271.33	315.39
T_3	20 kg $ZnSO_4$ ha^{-1} soil application	30.04	31.02	33.19	2.23	2.60	2.89	6.37	6.75	414.23	325.11
T_4	30 kg $ZnSO_4$ ha^{-1} soil application	30.64	31.91	33.70	2.29	2.63	2.90	6.95	6.86	382.86	511.44
T_5	40 kg $ZnSO_4$ ha^{-1} soil application	30.99	32.48	35.12	2.35	2.72	2.94	7.03	6.89	437.68	493.72
T_6	0.25% $ZnSO_4$ + 1% urea foliar application	28.37	30.68	34.13	2.29	2.53	2.79	6.12	6.70	399.74	462.38
T_7	0.50% $ZnSO_4$ + 1% urea foliar application	28.34	30.69	34.18	2.32	2.59	2.85	6.62	6.75	411.80	459.01
T_8	20 kg $FeSO_4ha^{-1}$ soil application	29.89	32.02	34.20	2.24	2.57	2.85	6.50	6.78	410.11	535.33
T_9	30 kg $FeSO_4ha^{-1}$ soil application	30.15	32.81	34.25	2.40	2.75	3.05	6.63	6.95	424.02	540.97
T_{10}	40 kg $FeSO_4ha^{-1}$ soil application	31.34	32.90	35.22	2.45	2.85	3.06	7.11	6.97	442.80	592.01
T_{11}	0.5% $FeSO_4$ + 0.1% citric acid foliar spray	29.17	31.25	33.83	2.17	2.45	2.83	6.28	6.78	390.99	505.91
T_{12}	1.0% $FeSO_4$ + 0.1% citric acid foliar spray	29.84	31.34	34.24	2.21	2.55	2.79	6.39	6.83	346.57	460.16
T_{13}	1.5% $FeSO_4$ + 0.1% citric acid foliar spray	30.00	32.89	34.94	2.21	2.56	2.88	6.93	6.83	368.03	426.39
	S.Em±	0.77	0.74	0.68	0.06	0.07	0.07	0.39	0.13	19.38	35.05
	CD at 5%	2.25	2.15	1.99	0.17	0.21	0.20	1.10	0.38	56.34	101.89
	C.V. (%)	4.57	4.10	3.50	4.46	4.79	4.11	19.46	7.53	8.96	13.71

Table 2 . Effect of different doses of zinc sulphate and ferrous sulphate as soil application and foliar application on fruit weight, fruit length, fruit width and ascorbic acid of brinjal cv. Pusa Kranti

	Treatment	Fruit weight (g)		Fruit length (cm)		Fruit width (cm)		Ascorbic acid content (mg/100 g pulp)	
		Main crop	Ratoon crop	Main crop	Ratoon crop	Main crop	Ratoon crop	Main crop	Ratoon crop
T_0	Absolute control	34.80	35.18	7.72	7.08	1.99	1.98	9.00	9.28
T_1	0.1% citric acid foliar spray	35.27	37.26	7.86	7.27	2.00	2.02	10.00	10.25
T_2	1.0% urea foliar spray	37.13	37.60	7.90	7.49	2.15	2.13	10.40	10.25
T_3	20 kg $ZnSO_4$ ha^{-1} soil application	38.50	38.22	11.60	10.98	2.71	2.83	11.60	11.75
T_4	30 kg $ZnSO_4$ ha^{-1} soil application	35.67	38.31	11.61	11.04	2.81	2.85	12.50	12.25
T_5	40 kg $ZnSO_4$ ha^{-1} soil application	36.50	37.53	11.77	11.64	3.06	3.00	13.00	12.75
T_6	0.25% $ZnSO_4$ + 1% urea foliar application	37.17	36.83	10.87	10.77	2.73	2.80	12.30	12.10
T_7	0.50% $ZnSO_4$ + 1% urea foliar application	36.43	38.18	11.27	10.97	2.74	2.84	13.00	13.30
T_8	20 kg $FeSO_4ha^{-1}$ soil application	34.77	39.92	11.39	10.72	2.91	2.90	12.20	12.20
T_9	30 kg $FeSO_4ha^{-1}$ soil application	32.73	38.47	11.61	11.43	2.99	2.96	13.00	14.24
T_{10}	40 kg $FeSO_4ha^{-1}$ soil application	36.40	38.47	11.94	12.03	3.14	3.09	14.52	13.63
T_{11}	0.5% $FeSO_4$ + 0.1% citric acid foliar spray	38.37	39.64	11.20	10.70	2.90	2.71	12.00	13.50
T_{12}	1.0% $FeSO_4$ + 0.1% citric acid foliar spray	37.60	38.23	11.32	11.11	2.96	2.92	12.50	12.40
T_{13}	1.5% $FeSO_4$ + 0.1% citric acid foliar spray	34.33	37.11	11.51	11.15	3.06	2.85	13.50	12.50
	S.Em±	1.94	0.75	0.32	0.29	0.13	0.09	0.58	0.30
	CD at 5%	NS	2.09	0.92	0.81	0.37	0.24	1.68	0.92
	C.V. (%)	16.99	7.40	9.48	10.48	15.20	11.91	8.25	3.50

Ascorbic acid

Ascorbic acid content was also recorded maximum in soil application treatment of 40 kg $FeSO_4$ in main crop (14.52 mg/100g) and ratoon crop (13.63 mg/ 100 g), respectively which is similar to fruit size parameters. Other treatments of zinc and iron both in soil application and foliar application also resulted in increased ascorbic acid content in brinjal fruits in main crop as well as in ratoon crop significantly (Table 2). It might be because of better vegetative growth, more availability of metabolites for ascorbic acid synthesis and accelerated activity of ascorbic acid oxidase enzyme due to improved in zinc and iron. The positive response of increased ascorbic acid content in fruits by application of zinc and iron has also been reported by Singh and Tewari (1993) in onion, Ravichandran *et al.* (1995) in brinjal and Dube *et al.* (2003) in tomato.

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