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RESEARCH PAPER

Effect of zinc, iron and boron on yield of bitter gourd (*Momordica charantia* L.) cv. PUSA VISHESH

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Abstract : Effect of zinc, iron and boron on yield of bitter gourd cv. PUSA VISHESH was studies. The experiment consisted of eighteen treatment combinations, comprising of three levels of zinc *viz.*, control (Zn_0), $ZnSO_4$ 0.5 per cent (Zn_1) and $ZnSO_4$ 1.0 per cent (Zn_2), three levels of iron *viz.*, control (Fe_0), $FeSO_4$ 0.5 per cent (Fe_1) and $FeSO_4$ 1.0 per cent (Fe_2) and two levels of boron *viz.*, control (B_1) and B_4O_7 0.1 per cent (B_2). Among different levels of zinc (0.0, 0.5 and 1.0%), Zn_1 ($ZnSO_4$ 0.5%) significantly increased fruit yield (15.65 t/ha. Among different levels of iron (0.0, 0.5 and 1.0%), Fe_1 ($FeSO_4$ 0.5%) significantly increased fruit yield (t/ha) (15.37 t/ha). Among different levels of boron (0.0 and 0.1 %), B_1 ($Na_2B_4O_7$ 0.1%) significantly increased fruit yield (t/ha) (14.96 t/ha). While among all the interactions of zinc, iron and boron, Fe_1Zn_1 ($FeSO_4$ 0.5% + $ZnSO_4$ 0.5%) significantly obtained highest fruit yield (16.33 t/ha) over control. The result based on one season data, it can be summarized that foliar application of micronutrients, $ZnSO_4$ 0.5 per cent + $FeSO_4$ 0.5 per cent at 30, 45 and 60 days after sowing along with a recommended dose of NPK (60+60+60 kg/ha) and FYM 20 tonnes/ha to the bitter gourd crop cv. 'Pusa Vishesh' was the most beneficial treatment for obtaining higher vegetative growth and yield of bitter gourd.

Key Words : Micronutrients, Bitter gourd, Zinc, Iron, Boron

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INTRODUCTION

Bitter gourd has a high nutrient requirement particularly macro and micronutrient such as nitrogen, phosphorus, potash, zinc, iron, boron and molybdenum. Bitter gourd fruit yield has been set aside by the deficiency of micronutrients, which leads to certain physiological disorders. Green fruits of bitter gourd are used as vegetables. The fruits rank first among the cucurbits in respect of iron and ascorbic acid (vit. C). It also contains proteins, fats, minerals, carotein, thiamine and riboflavins. The alkaloid momordicasoides imparts the bitter taste to the fruit. Bitter gourd is monoecious crop, where male and female flowers borne on the same plant. The production of staminate flower is normally much more than pistillate flowers ultimately only pistillate flowers contribute to the yield. Flowers are yellow in colour, stamens are 5 in number with free filaments and united anthers. Stigma is divided. Fruit is pendulous, fusiform, ribbed with numerous tubercles. Verma *et al.* (1984) reported that application of boron at 3 or 4 ppm gave the highest number of female flower per plant (28-32) and fruits per plant (23-26.4) in bitter gourd cv. Pusa Do Mousmi. Gedam *et al.* (1998) observed that application of boron 2, 4 and 6 ppm in bitter gourd increased fruit and seed yield and fruit maturity was earliest in the application of boron 4 ppm. Fruit yield was also highest in this treatment. But very little information regarding effect of zinc, iron and boron on growth, yield and quality of bitter gourd are available.

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MATERIAL AND METHODS

A field experiment was carried out to ascertain effect of zinc, iron and boron on growth, yield and quality of bitter gourd (*Momordica charantia* L) cv. Pusa Vishesh, during Summer season 2010, at Instructional farm, Junagadh with 18 treatment combinations. These 18 treatments consisted of three micronutrients and untreated control. These all micronutrients were tested alone and in combination with each other with untreated control. All the recommended agronomical practices were followed to raise the crop. The spraying of micronutrient solutions at mentioned doses were carried out. The spray of micronutrients solutions was applied; first foliar spray was applied at 30 days after sowing, second spray at 45 days after sowing and third spray at 60 days after sowing. Spraying was done with knapsack sprayer and the leaves were wetted thoroughly with fine mist. For better absorption of spray solution by bitter gourd leaves, a pinch of sticker was added to the spray solution before spraying. Care was taken to rinse the sprayer thoroughly before and after each spray with soap water to avoid contamination from treatment to treatment.

Observations on fruit yield were recorded by the numbers of fruit harvested from each of the treatment from time to time were weighed in kilogram. Similarly the fruit yield was worked out on hectare basis and it was expressed in t/ha. The fruit yield was calculated and subjected to ANOVA with arcsine transformed values.

RESULTS AND DISCUSSION

The result showed effect of zinc levels on fruit yield (t/ha) was found significant. The maximum fruit yield (t/ha) was recorded under Zn_1 ($ZnSO_4$ 0.5%) 15.65 t/ha. The significantly minimum fruit yield (tones/ha) was recorded under Zn_0 (control) 13.65 t/ha, which was found at par with Zn_2 ($ZnSO_4$ 1.0%) 14.14 t/ha. The effect of iron levels on fruit yield was found significant. The maximum fruit yield was recorded under Fe_1 ($FeSO_4$ 0.5%) 15.37 t/ha. Significantly minimum fruit yield was recorded under Fe_0 (control) 13.68 t/ha, which was found at par with Fe_2 ($FeSO_4$ 1.0%) 14.39 t/ha. The effect of boron levels on fruit yield was found significant. The maximum fruit yield was recorded under B_1 (B_4O_7 0.1%) 14.96 t/ha. The significantly minimum fruit yield (t/ha) was recorded under B_0 (control) 14.00 t/ha (Table 1 and Fig. 1). Interaction effect of zinc x iron (Zn × Fe) on fruit yield was found significant. The maximum fruit yield (16.33 t/ha) was observed in treatment combination of $ZnSO_4$ 0.5 per cent (Zn_1) and $FeSO_4$ 0.5 per cent (Fe_1), which was found at par with Zn_1Fe_0, Zn_0Fe_1, Zn_2Fe_2 and Zn_1Fe_2. Whereas, minimum fruit yield (12.33 t/ha) was recorded under treatment combination of $ZnSO_4$ 0.0 per cent (Zn_0) and $FeSO_4$ 0.0 per cent (Fe_0), which was found at par with Zn_0Fe_2 and Zn_2Fe_0. The remaining interaction *i.e.* zinc × boron (Zn × B), iron x boron (Fe × B) and zinc × iron × boron (Zn × Fe × B) were found non significant (Table 3).

Table 1 : Effect of different levels of zinc, iron and boron on fruit yield (kg/plot) and fruit yield (t/ha) of bitter gourd cv. 'PUSA VISHESH'

Treatments	Fruit yield (kg/plot)	Fruit yield (t/ha)
Zinc levels (Zn)		
Zn_0 (Control)	10.92	13.65
Zn_1 ($ZnSO_4$ 0.5 %)	12.52	15.65
Zn_2 ($ZnSO_4$ 1.0 %)	11.31	14.14
S.Em±	0.265	0.331
C.D. (P=0.05)	0.762	0.952
Iron levels (Fe)		
Fe_0 (Control)	10.94	13.68
Fe_1 ($FeSO_4$ 0.5 %)	12.29	15.37
Fe_2 ($FeSO_4$ 1.0 %)	11.51	14.39
S.Em±	0.265	0.331
C.D. (P=0.05)	0.762	0.952
Boron levels (B)		
B_0 (control)	11.20	14.00
B_1 ($Na_2B_4O_7$ 0.1%)	11.97	14.96
S.E±	0.216	0.270
C.D. (P=0.05)	0.622	0.777
Interactions		
Zn X Fe	Sig.	Sig.
Zn X B	NS	NS
Fe X B	NS	NS
Zn X Fe X B	NS	NS
C.V. %	9.70	9.70

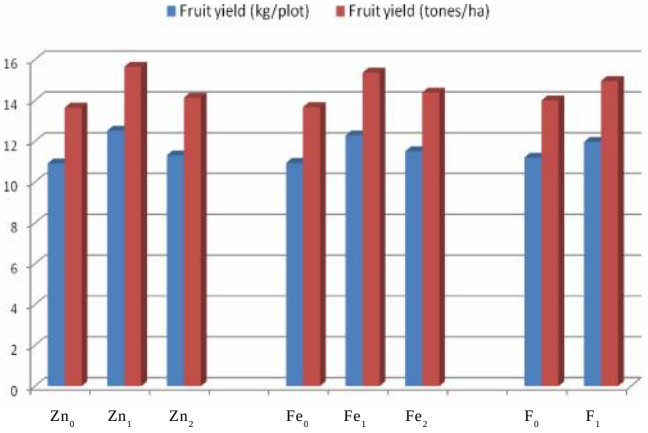

Fig. 1 : Effect of different levsel of zinc, iron and boron on fruit yield (kg/plot) and fruit yield (t/ha) of bitter gourd cv. PUSA VISHESH

The findings indicated the levels of zinc were found significant on fruit yield (t/ha). The maximum fruit yield (15.65 t/ha) were found in Zn_1 ($ZnSO_4$ 0.5%). While, minimum fruit

yield (13.65 t/ha) were found in Zn_0 (control). The increase in yield of bitter gourd is directly influence of micronutrients may be due to the higher rate of photosynthesis and sugar formation due to enhanced chlorophyll synthesis and enzyme activity which lead to translocation of more photosynthates to growing fruits which ultimately leads to higher production of dry matter and consequently more yield. Also, the various reactions in plant metabolism are catalyzed by micronutrients. Zinc as an essential catalyst in the synthesis of auxin from tryptophan would have encouraged the auxin biosynthesis in the active sinks which would have led to higher transport and accumulation of photosynthates in these sinks in fruits and hence, improving yield. These results are in conformity with those of Dongre *et al.* (2000) for yield per plant, yield per plot and yield per hectare in chilli, Nusain (1991) and Ingle *et al*. (1993) for fruit diameter, length of fruit and fresh green chillies per plot in chilli and Ravichandran *et al.* (1995) in brinjal. The fruit yield (t/ha) were increased under zinc concentration 0.5 per cent but the increased concentration of zinc to 1.0 per cent resulted in decreased fruit yield. These results are in accordance with Balyan and Dhankar (1988), Balyan and Singh (1994) in cauliflower, and Singh and Choudhary (1989) in chilli. This reduced yield might be due to the toxic effect of zinc that affects on physiological and metabolic activities of plant.

The results indicated that the levels of iron were found significant on fruit yield. The maximum fruit yield (15.37 t/ha) were found in Fe_1 ($FeSO_4$ 0.5%). While minimum fruit yield (13.68 t/ha) were found in Fe_0 (control). These perceptible increases in yield might be due to the beneficial effect of iron on plant. The iron might have helped in better absorption of nutrients resulting in efficient physiological and metabolic activities of plant. Dongre *et al.* (2000) reported that iron stimulate the more vegetative growth that ultimately beneficial for improving diameter of chilli fruits. Kumbhar and Deshmukh (1993) reported the beneficial effect of iron application in relation to higher fruit yield in tomato. The fruit yield were highest under iron concentration 0.5 per cent but the increased concentration of iron to 1.0% resulted in reduced fruit yield (14.39 t/ha). These findings are in accordance with Kumbhar and Deshmukh (1993) in tomato. This reduced yield might be due to the toxic effects of iron, which affects on physiological and metabolic activities of plant. Scarponi *et al.* (1979) studied the effect of 0.5 to 40 ppm Fe in the nutrient solution on leaf composition of French beans led to depression of chlorophyll, carbohydrates and protein contents of the leaves, might be due to the toxic effects of iron.

Application of boron at 0.1 per cent produced significantly higher yield. The maximum yield in (14.96 t/ha) was observed in treatment B_1 ($Na_2B_4O_7$ 0.1%). Possibly, it may be due to production of maximum female flowers and fruits per vine in this treatment. The present findings are in close confirmation with Singh *et al.* (1992) in muskmelon, Phatak *et al.* (1990) in watermelon and Rahman and Shoremeen (1999) in pumpkin.

The interaction effects between zinc and iron levels were found significant on fruit yield. The results indicated that Zn_1 ($ZnSO_4$ 0.5%) level produced significantly highest fruit yield with combination of Fe_1 ($FeSO_4$ 0.5%) level. The maximum fruit yield (16.33 t/ha) was recorded by the interaction Fe_1Zn_1 ($FeSO_4$ 0.5% + $ZnSO_4$ 0.5%). While, minimum fruit yield (12.33 t/ha) was recorded by the interaction Fe_0Zn_0 ($FeSO_4$ 0.0% + $ZnSO_4$ 0.0%).

This increased yield might be due to the combine beneficial effect of zinc and iron application on plant. The combine beneficial effect of zinc and iron application in

Table 2 : Interaction effect of zinc and iron on fruit yield (kg/plot) of bitter gourd cv. PUSA VISHESH

Zinc levels (Zn)	Fruit yield (kg/ plot)		
	Iron levels (Fe)		
	Fe_0 (Control)	Fe_1 ($FeSO_4$ 0.5 %)	Fe_2 ($FeSO_4$ 1.0 %)
Zn_0 (Control)	9.87	12.48	10.40
Zn_1 ($ZnSO_4$ 0.5 %)	12.50	13.07	12.00
Zn_2 ($ZnSO_4$ 1.0 %)	10.47	11.33	12.13
S.E. ±		0.459	
C.D. (P=0.05)		1.319	

Table 3 : Interaction effect of zinc and iron on fruit yield (t/ha) of bitter gourd cv. PUSA VISHESH

Zinc levels (Zn)	Fruit yield (tones/ha)		
	Iron levels (Fe)		
	Fe_0 (Control)	Fe_1 ($FeSO_4$ 0.5 %)	Fe_2 ($FeSO_4$ 1.0 %)
Zn_0 (Control)	12.33	15.61	13.00
Zn_1 ($ZnSO_4$ 0.5 %)	15.63	16.33	15.00
Zn_2 ($ZnSO_4$ 1.0 %)	13.08	14.17	15.17
S.E. ±		0.573	
C.D. (P=0.05)		1.649	

improving the yield was reported by Patnaik and Dhankar (2001) in tomato, Palanivel (1981) in onion. These results are in agreement with those of, Balyan and Singh (1994), Balyan *et al.* (1994), Singh *et al.* (1991) and Balyan and Dhankar (1988) in cauliflower. Patnaik *et al.* (2001), Kumbhar and Deshmukh (1993) in tomato, Dongre *et al.* (2000) in chilli and Ravichandran *et al.* (1995) in brinjal.

Conclusion :

It can be concluded that foliar application of micronutrients, $ZnSO_4$ 0.5 per cent + $FeSO_4$ 0.5 per cent at 30, 45 and 60 days after sowing along with a recommended dose of NPK (60+60+60 kg/ha) and FYM 10 tonnes/ha to the bitter gourd crop cv. PUSA VISHESH was the most beneficial for obtaining higher yield of bitter gourd.

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