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Response of foliar application of micro-nutrients on yield and economics of bitter gourd (*Momordica charantia* L.)

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ABSTRACT : A field experiment was carried out to study the response of foliar application of micro nutrients on the productivity and economic feasibility in bitter gourd during 2010-11, 2011-12 and 2012-13 at the All India Co-ordinated Vegetable Improvement Project in the Regional Horticultural Research and Extension Center, Dharwad. The results based on three years pooled data revealed that, out of nine different treatments, the application of boric acid @100ppm sprayed at 30 and 40 DAS(Days after sowing)resulted in maximum number of fruits per plant (16.48) and fruit weight (91.72g).The same treatment recorded highest fruit yield/plant (15.51 kg) and fruit yield (10.6 t/ha) ,with maximum B:C ratio of (1:1.79). Followed by the next best treatment, mixture of micro-nutrients (Bo + Zn + Mn + Cu + Fe @100ppm and Mo @ 50ppm) recorded fruit yield of (9.89 t/ha) with B:C ratio of (1:1.57) differed significantly from the control.

KEY WORDS : Bitter gourd, Micronutrients, Foliar application, Growth, Yield

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Bitter gourd is an important cucurbitaceous vegetable plays a vital role in Indian diet by virtue of its nutrients, medicinal value and various modes of consumption. It ranks first among the cucurbits in respect of iron and vitamin C and also contains proteins and minerals. Fruit is said to be wormicidal and a cure for stomach disorder. It has beneficial effect on diabetic and person suffering from arthritis, rheumatism and asthma complaints. Bitter gourd can be canned, pickled and used as and when required. It is realized that productivity of crop is being adversely affected in different areas due to deficiencies of micro nutrients (Bose and Tripathi,1996) recently which has been increased markedly due to intensive cropping, loss of top soil by erosion, loss of micro nutrients by leaching ,liming of soil and decreased availability and use of farm yard manure (Fageria *et al.,* 2002).

Micronutrients are usually required in minute quantities, nevertheless, are vital to the growth of plant (Benepal,1967). They improve general condition of plants and are known to act as catalyst in promoting organic reactions taking place in plant. In the present study, an attempt has been made to study the effect of foliar application of micronutrients on growth, yield and economics of bitter gourd.

RESEARCH METHODS

The present investigation was carried out for three years at the All India Vegetable Improvement Project (AICVIP), Regional Horticultural Research and Extension Centre, Dharwad (Karnataka) during 2010, 2011 and 2012 on bitter gourd variety Arka Harit. The soil was shallow red embedded with small sand and gravel with pH 6.5 - 6.9 with medium available nitrogen ,phosphorus and potash contents. The experiment was laid out with Randomized Block Design with three replications and eight micronutrients treatments. Details of the treatments are given in Table 1. The crops were sown at a spacing of 0.75m x1.5m in a gross plot size of 4.5m x 3m. The recommended dose of NP @ 62.5:50 kg/h

was applied uniformly in all the plots. Boron as boric acid, zinc as zinc sulphate and manganese as manganese sulphate were applied @ 100ppm each while molybdenum was applied at 50ppm in the form of ammonium molybdate, singly or in combination through foliar spray at two growth stages 40 and 50 days after sowing. The data on growth parameters and yield attributes were recorded and was analyzed statistically the method advocated by Panse and Sukhatme (1967).

Table A : Details of treatments applied for foliar application of micronutrients study in bittergourd

Treatments	Treatment details
T_1	Control
T_2	Boric acid 100 ppm (0.571 g/l)
T_3	Zinc sulphate 100 ppm (0.246g/l)
T_4	Ammonium molybdate 50ppm (0.644g/l)
T_5	Copper sulphate 100ppm (0.52g/l)
T_6	Ferrous sulphate 100ppm (0.515g/l)
T_7	Manganese sulphate 100ppm (0.32g/)
T_8	Mixture of all (T_2+T_3+T_4+T_5+T_6+T_7)
T_9	Commercial formulation multiplex 100ppm

RESEARCH FINDINGS AND DISCUSSION

Pooled data over three year revealed that, the number of fruits/vine (16.48 and 16.19), single fruit weight (91.72 g and 88.27g) and fruit yield /vine (1551.96 g and 1413.97 g) were significantly higher with foliar spray of boric acid @100ppm and mixture of all the micronutrients, respectively and both the treatments remained at par with each other except in fruit yield /vine (Table 1). Foliar application of all the micronutrients resulted higher yields over control, However, ammonium molybdate 50 ppm and zinc sulphate 100ppm recorded lower yields. It may be due to subnormal dose or excess dose which may lead to adverse effect on enzyme activity in cell, this may affect yield. Hence, there is need to study more on quantification of correct dose in bitter gourd.

Among the different treatments, foliar spray of boric acid @100ppm was found to be significantly superior with respect to yield per plot and hectare (14.31 kg and 10.81 tones ha^{-1}), as compared to the other treatments. However, it was found to be at par with treatment mixture of all the micronutrients (13.36 kg per plot and 10.10 t ha^{-1}). While

Table 1 : Yield attributing characters of bitter gourd as influenced by foliar application of micronutrients

Treatments	No. of fruit /vine				Fruit wt.(g)				Fruit yield/vine (g)			
	2010-11	2011-12	2012-13	Pooled	2010-11	2011-12	2012-13	Pooled	2010-11	2011-12	2012-13	Pooled
T_1	14.33	14.67	14.00	14.33	84.20	85.37	83.40	84.32	1206.33	1252.00	1188.17	1215.50
T_2	17.00	16.67	15.78	16.48	91.90	93.33	89.91	91.72	1561.00	1587.67	1507.22	1551.96
T_3	14.67	13.00	14.44	14.04	82.80	89.00	83.58	85.13	1215.67	1160.00	1155.55	1177.07
T_4	13.67	12.67	11.89	12.74	80.90	86.67	82.56	83.37	1106.67	1098.67	1078.96	1094.76
T_5	15.67	13.67	12.55	13.96	89.53	87.67	85.24	87.48	1350.33	1201.00	1283.60	1278.31
T_6	15.67	12.33	12.89	13.63	80.20	87.33	82.75	83.43	1252.33	1075.67	1085.88	1137.96
T_7	16.33	13.33	13.22	14.30	82.00	83.00	83.39	82.80	1337.67	1101.33	1202.46	1213.82
T_8	16.67	16.33	15.56	16.19	87.67	90.67	86.49	88.27	1461.33	1478.33	1302.23	1413.97
T_9	15.67	15.00	12.67	14.44	85.13	85.33	84.95	85.14	1329.00	1274.67	1245.47	1283.04
S.E.±	0.66	1.01	0.44	0.403	2.69	2.14	0.479	1.090	64.94	84.26	42.05	31.469
C.D. (P=0.05)	1.98	3.04	1.34	1.208	8.06	6.42	1.437	3.267	194.69	252.60	126.06	94.346

Table 2 : Yield of bitter gourd as influenced by foliar application of micronutrients

Treatments	Yield /plot (kg)				Yield /ha (t/h)			
	2010-11	2011-12	2012-13	Pooled	2010-11	2011-12	2012-13	Pooled
T_1	10.87	11.27	11.17	11.10	8.05	8.35	8.27	8.22
T_2	14.03	14.30	14.60	14.31	10.40	10.60	10.81	10.60
T_3	10.40	10.44	10.60	10.48	7.70	7.73	7.85	7.76
T_4	9.97	9.87	9.84	9.89	7.38	7.31	7.29	7.33
T_5	12.17	10.80	11.28	11.42	9.01	8.00	8.35	8.46
T_6	11.27	9.67	10.62	10.52	8.35	7.16	7.87	7.79
T_7	12.03	9.93	12.45	11.47	8.91	7.36	9.22	8.50
T_8	13.13	13.30	13.63	13.36	9.73	9.85	10.10	9.89
T_9	11.93	11.47	12.38	11.93	8.84	8.49	9.17	8.84
S.E.±	0.62	0.75	0.38	0.281	0.46	0.56	0.29	0.21
C.D.	1.87	2.26	1.16	0.843	1.38	1.68	0.86	0.62

Table 4 : Economics of bittergourd as influenced by foliar application of micronutrients

Sr. No.	Treatments	Fruit yield t/ha	Cost of cultivation (Rs./ha)	Gross return (Rs./ha)	Net returns (Rs./ha)	B:C ratio
T_1	Control	8.22	69950	98400	28450	1:1.40
T_2	Boric acid 100 ppm (0.571 g/l)	10.60	70762.5	127200	56437.5	1:1.79
T_3	Zinc sulphate 100 ppm (0.246g/l)	7.76	70647.5	93000	22352.5	1:1.31
T_4	Ammonium molybdate 50ppm (0.644g/l)	7.33	74420	87600	13180	1:1.17
T_5	Copper sulphate 100ppm (0.52g/l)	8.46	70902.5	101400	30497.5	1:1.43
T_6	Ferrous sulphate 100ppm (0.515g/l)	7.79	70660	93300	22640	1:1.32
T_7	Manganese sulphate 100ppm (0.32g/)	8.50	70755	101700	30945	1:1.43
T_8	Mixture of all	9.89	75277.5	118500	43222.5	1:1.57
T_9	Commercial formulation multiplex 100ppm	8.84	71075	105900	34825	1:1.48
	S.E.±	0.21				
	C.D. (P=0.05)	0.62				

least yield was noticed in treatment ammonium molybdate @ 50ppm (9.89 kg and 7.29 t ha^{-1}) (Table 3). From this result it can be concluded that foliar spray of boric acid @100ppm was found to be best treatment. It is due to the reason being that boron is associated with the development of cell wall, cell differentiation, shoot growth and also increases flowering and fruit yield. The results are in agreement with the findings of Singh and Verma (1999) and Narayanamma *et al.* (2009).

Economics:

The data on economics of bittergourd as influenced by foliar application of different micronutrients are presented in Table 4.

Among the treatments imposed, the treatment with foliar spray of boric acid @100ppm obtained highest net income(Rs.56437.5/ha),with cost of cultivation of Rs.70762.5 per ha followed by mixture of all micronutrients with net income (Rs.43222.5/ha) and Rs. 75277.5 per hectare with cost of cultivation.

Higher B: C ratio 1:1.79 was recorded in the treatment application foliar spray of boric acid @100ppm and with application of mixture of all micronutrients, it was only 1:1.57. The results are in agreement with the findings of Bhatt *et al.*(2004) and Narayanamma *et al.* (2009).

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