



Foliar application of organic fertilizer of amino acid chelated micronutrients for enhancing yield contributing traits in chilli (*Capsicum annum L.*)

DATIR RB

Department of Botany, Swami Muktanand College of Science, Yeola, Nasik, Maharashtra, India

Abstract

A pot experiment was carried out to study the effect of foliar application of un-chelated micronutrients, amino acids and organic fertilizer of amino acid chelated micronutrients on yield contributing traits in chilli var. Phule Jyoti during 2015 and 2016 at the Yeola, District Nasik. The micronutrients like Copper, Iron, Manganese, Molybdenum, Zinc, were organically chelated with seed amino acids. Forty day's old seedlings of chilli were transplanted in pots. In all six treatments T₀-untreated control plants sprayed with distilled water, T₁- 2.0 % unchelated micronutrients solution, T₂- 2.0 % amino acids solution, T₃- 1.0 % amino acid chelated micronutrients organic fertilizer, T₄- 1.5 % amino acid chelated micronutrients organic fertilizer and T₅- 2.0 % organic fertilizer of amino acid chelated micronutrients were applied through foliar spray on 15th and 30th days after transplantation. The results based on two years mean revealed that out of six different treatments, the application of micronutrients chelated organically with seed amino acids at the concentration of 1.5 and 2.0% resulted in more fruits per plant, increased length and weight of fruits and more total yield of fruits per plant. The untreated control plants sprayed with distilled water recorded the lowest fruit yield. The use of amino acid chelated micronutrients fertilizer proves to be an efficient for enhancing productivity in chili.

Keywords: Chelated micronutrients, foliar spray, *Capsicum annum L.*, growth, yield

Introduction

Red pepper (*Capsicum annum L.*) popularly known as chilli is an important commercial high value spice cum vegetable crop of India with tremendous export potential cultivated extensively in India. Chilli forms an essential ingredient of Indian curry and daily food of majority people of the world. It supplies vitamin 'C' and 'A' with plenty of minerals. Modern agriculture due to intensive application of chemical fertilizers deteriorated the soil fertility and disturbed the ecological equilibrium of biodiversity [4]. Deficiency of micronutrients is of general occurrence due to intensive cropping, with introduction of high yielding varieties, greater use of chemical fertilizer, and decreased use of farm yard manure. Large area of agricultural land has been found to be deficient in one or other micronutrients. It is realized that productivity of crops is being adversely affected due to deficiencies of micronutrients [2]. Micronutrients are usually required in minute quantities, nevertheless are vital to the growth of plant [1]. Micronutrients like Fe, Cu, Zn, Mo, Mg, and Mn if applied directly as inorganic salts, become insoluble forms, so their absorption by the plants decreases and also cause toxic effects in the plants, hence chelated forms of micronutrients is recommended for better yields. The chelating agent protects the metal ions from undesirable chemical reactions such as precipitation and hence increases the availability of these metal ions to plants. Well known strongest metal chelating agents like EDTA and EDDHA are available to chelate micronutrients but these are synthetic and expensive. On the other hand, natural organic chelating agents such as amino acids, humic and fulvic acids and polyflavonoids do help the plant in translocating the micronutrients. These chelators are not phytotoxic to plants [5]. They are easy to produce and are inexpensive. In recent times, consumers are highly interested in organic products and demanding quality and safer food [8]. Hence there is urgent need to produce

organic chelate of micronutrients for organic vegetable cultivation. As the green revolution is started in agriculture the concept of use of fertilizers for enhancing growth and yield of crop is changed. Instead of application of fertilizer to the soil various kind of fertilizers in the form of liquid are sprayed on plant. Such types of liquid fertilizers are found to be more beneficial than the soil application. Therefore, an attempt was made to test the effect of foliar application of organic fertilizer of seed amino acid chelated micronutrients on yield contributing traits in chilli as testing crop. The aim of the work has been to determine the percentage and extent of any effect on yield of vegetable crop like chilli due to spraying of fresh liquid amino acid micronutrients chelate as organic fertilizer in the form of foliar spray.

Materials and Methods

Production of Organic Fertilizer of Amino Acid Chelated Micronutrients

Organic fertilizer of amino acid chelated micronutrients was prepared in the laboratory by using seed amino acids. Micronutrients like zinc, iron, copper, manganese, and molybdenum each of 1 g were separately dissolved in 20 ml of 0.5 % boric acid solution and then mixed with 80 ml of amino acids solution. The mixture was then agitated on shaker to form chelate. The amino acid micronutrient chelates were confirmed with FTIR. After confirmation, all the solutions were mixed together to form composite solution of organic fertilizer of amino acid chelated micronutrients. Micronutrient each of 1.0 g was dissolved separately in 20 ml of 0.5 % boric acid and final volume was made to 100 ml with glass distilled water. These micronutrient solutions were then mixed in 500 ml flask. This was used at 2.0 % as un-chelated micronutrients (40 ppm of each micronutrient). Amino acids solution (400 ml) was diluted with 100 ml of distilled water and used at 2.0 % as amino acid treatment.

Foliar Application of Organic Fertilizer of Amino Acid Chelated Micronutrients

The experiments were conducted on potted plants to find out the effect of organic fertilizer of amino acid chelated micronutrients on yield of chilli. Seedlings of chilli var. Phule Jyoti were raised and forty day's old chilli seedlings were transplanted in the pots (five seedlings each). Total six treatments involving T₀- untreated control, T₁- 2.0 % micronutrient solution, T₂-2.0 % amino acid solution, T₃-1.0 % amino acid chelated micronutrients organic fertilizer T₄- 1.5 % organic fertilizer of amino acid chelated micronutrients and T₅-2.0 % organic fertilizer of amino acid chelated micronutrients was planned in potted plants with three replicates. The concentrations of the amino acid chelated micronutrients organic fertilizer were prepared with distilled water prior to spray. The solutions were applied in the form of foliar sprays at two growth stages on 15th and 30th days after transplantation. The control plants were sprayed with distilled water. Number of fruits, average fruit length and fruit weight was measured from each harvest and total yield per plant was determined after last harvest.

Results

Number of Fruits Per Plant and Fruit Length

Results pertaining to effects of un-chelated micronutrients, amino acid solution and increased doses of amino acid chelated micronutrients on yield contributing characters like fruits per plant and fruit length are given in table-1. It is clear from the data that number of fruits and fruit length increased significantly with the foliar application of increased dose of organic fertilizer of amino acid chelated micronutrients. Foliar application of chelated micronutrients fertilizer at the concentration of 2.0% produced maximum number of fruits (138.23 plant⁻¹), followed by 135.48 and 115.86 fruits plant⁻¹ at foliar application of 1.5 % and 1.0 % chelated micronutrients fertilizer respectively. Un-chelated micronutrients and amino acid solution at 2.0 % concentration resulted in average of 91.13 and 92.93 fruits plant⁻¹ respectively. However, lowest 79.48 number of fruits plant⁻¹ was recorded in control plants.

Foliar application of organically chelated micronutrient fertilizer at the concentration of 2.0 % produced significantly longer fruits with 10.73 cm length followed by average fruit length of 10.65 cm and 10.34 cm at the concentration of 1.5 % and 1.0 % chelated micronutrients fertilizer respectively. Un-chelated micronutrients and amino acid solution at 2.0% concentration resulted in fruits with length of 9.15 cm and 9.20 cm respectively. However, shorter fruits with average 7.99 cm length were recorded in control plants.

Fresh Fruit Weight and Fruit Yield Per Plant.

The results related to fresh fruit weight and fruit yield per plant is given in table-2. Fresh fruit weight was remarkably maximum (4.50 g fruit⁻¹) in plants treated with foliar spray of organically chelated micronutrient fertilizer at the concentration of 2.0 % followed by average fresh fruit weight of 4.48 and 4.14 g fruit⁻¹ achieved from treatments with foliar spray of 1.5 % and 1.0 % organically chelated micronutrient fertilizer respectively. Un-chelated micronutrients and amino acid solutions at 2.0 % foliar spray showed fresh fruit weight of 3.39 and 3.45 g fruit⁻¹

respectively. However, minimum average fresh fruit weight of 2.90 g fruit⁻¹ was obtained in control plants.

Total fresh fruit yield per plant was remarkably maximum (623.29 g plant⁻¹) in pots fertilized with foliar application of amino acid chelated micronutrient fertilizer at 2.0 % concentration. It was followed by average fresh fruit yield of 616.44 and 478.72 g plant⁻¹ at 1.5 and 1.0 % chelated micronutrients fertilizer respectively. The 2.0 % concentrations of un-chelated micronutrients and amino acid solutions showed fresh fruit yield of 309.06 and 322.36 g plant⁻¹, respectively. However, minimum fresh fruit yield of 231.51 g plant⁻¹ was recorded in control plants.

Discussion

Fruits Per Plant and Fruit Length, Fresh Fruit Weight and Fruit Yield Per Plant

Results given in table 1 and 2 indicate the yield contributing traits like number of fruits per plant, fruit length; fresh fruit weight and total fruit yield per plant were increased significantly with the application of amino acid chelated micronutrients fertilizer. Significantly highest numbers of fruits (70.46 % and 73.91 %), more fruit length (33.24 % and 34.26 %), and fresh fruit weight (54.69 % and 55.15 %) and fruit yield per plant (166.27 % and 169.23 %) were recorded in the plants treated with 1.5 % and 2.0% organically chelated micronutrients fertilizer respectively over control plants. Even un-chelated micronutrient and amino acid treatment at 2% showed plants with significant increase in number of fruits per plant (14.66 %, 16.92 %), fruit length (14.43 and 15.08 %) fruit weight (17.2 and 19.09%) and total yield of fruits per plant (33.50 and 39.24 %) respectively over control plants. Among the different treatments 1.5 and 2.0 % treatments of amino acid chelated micronutrients fertilizer showed significantly enhanced results than the other treatments at the time of flowering and fruiting.

Significantly highest numbers of fruits, more fruit length, fresh fruit weight and yield per plant were recorded in the plants treated with 1.5 and 2.0% organically chelated micronutrients over in control. This might be due to increase in values of fresh weights of the fruits per plant. Similar results were obtained previously^[3] who reported that application of micronutrients like Zn, Cu, Fe and Mo are essential for increase in yield, quality and ascorbic acid content in tomato fruits. The results of the present investigation are in concurrence with^[10] who applied N, P, K, Ca, Mg and Fe, B, Zn, Mn and Cu as foliar spray and observed increase in growth and yield contributing parameters in chili. These results are in line with earlier observations^[9] who applied foliar fertilizer "Polyfeed" and found significant effect on fruit number and fruit weight of chilies. Similar studies have also been conducted by others⁸ who found that foliar application of zinc 3.0 ppm, copper 1.0 ppm and boron 0.5 ppm produced the highest number of fruits per plant with increased fruit weight and more total yield per plant. The results are also in agreement with the findings of earlier workers^[7, 12]. The enhanced photosynthesis in presence of zinc and boron was also reported by previous worker^[11]. All the treatments of organically chelated micronutrients fertilizer proved superior over un-chelated micronutrients and amino acids solution for yield contributing parameters.

Table 1: Effect of organic fertilizer of chelated micronutrients on fruits per plant and fruit length in chilli.

Treatments	Number of fruits per plant				Fruit length (cm)			
	2013	2014	Pooled	PI	2013	2014	Pooled	PI
T ₀	78.93	80.03	79.48	--	7.86	8.12	7.99	--
T ₁	90.37	91.90	91.13	14.66	8.98	9.31	9.15	14.43
T ₂	92.07	93.80	92.93	16.92	9.03	9.37	9.20	15.08
T ₃	114.80	116.91	115.86	45.76	10.17	10.51	10.34	29.34
T ₄	132.43	138.53	135.48	70.46	10.43	10.86	10.65	33.24
T ₅	136.53	139.93	138.23	73.91	10.51	10.95	10.73	34.26
SEm±	0.92	0.94	0.44	--	0.10	0.27	0.06	--
CD (0.05)	3.72	3.69	2.83	--	0.41	1.03	0.32	--
CD (0.01)	6.05	6.00	4.61	--	0.67	1.67	0.52	--

Table 2: Effect of foliar application of organically chelated micronutrients fertilizer on fresh fruit weight and total yield per plant in chilli.

Treatments	Single fruit weight (g)				Total yield per plant (g)			
	2013	2014	Pooled	PI	2013	2014	Pooled	PI
T ₀	2.87	2.93	2.90	--	226.61	236.41	231.51	--
T ₁	3.34	3.44	3.39	17.02	302.10	316.01	309.06	33.50
T ₂	3.40	3.50	3.45	19.09	316.52	328.19	322.36	39.24
T ₃	4.09	4.18	4.14	42.73	470.19	487.25	478.72	106.78
T ₄	4.43	4.54	4.48	54.69	610.34	622.54	616.44	166.27
T ₅	4.45	4.55	4.50	55.15	613.47	633.11	623.29	169.23
SEm±	0.02	0.02	0.02	--	2.13	1.63	2.34	--
CD (0.05)	0.11	0.08	0.08	--	8.75	6.72	7.74	--
CD (0.01)	0.17	0.14	0.14	--	14.24	10.93	12.59	--

Conclusions

The results revealed that un-chelated micronutrient significantly improved yield contributing characters to a 10-15 %, where as amino acid spray contributed to 15-20% increase. On the other hand, amino acid-chelated micronutrients contributed overall 40-100 % increase in yield contributing characters in chilli. Among the treatments of organically chelated micronutrients, chilli responded well to the 1.5 % and 2.0% treatments. The yield contributing characters of chilli were significantly enhanced by the application of 1.5 % organically chelated micronutrients. However, these two treatments are at par and hence we recommend 1.5 % foliar spray for better yield in chilli. The results of present investigation have given insight in application of amino acid chelated micronutrients fertilizer in immediate rectification of micronutrient deficiency in fruit vegetable and also in organic farming.

References

1. Benepal PS. Influence of micronutrients on growth and yield of potatoes. Ame.Pot. J,1967:44:363-369.
2. Bose US, Tripathi SK. Effect of micronutrients on growth, yield and quality of tomato cv. Pusa Ruby in M.P. Cro. Res,1996:12:61-64.
3. Gupta PK, Gupta AK. Studies of PGR and Micronutrient mixtures on vitamin 'C' content in tomato (*Lycopersicon esculentum*, Mill) products. Indian Journal of horticulture,2004:61(1):102-103.
4. Hansra BS. Transfer of agricultural technology on irrigated agriculture. Fer. News,1993:38(4):31-33.
5. Ilhami Koksai A, Hatice Dumanoglu, Nurdan Tuna Günes, Mehmet Aktas. The Effects of Different Amino Acid Chelate Foliar Fertilizers on Yield, Fruit Quality, Shoot Growth and Fe, Zn, Cu, Mn Content of Leaves in Williams Pear Cultivar (*Pyrus communis* L.) Tr. J. of Agriculture and Forestry,1998:23:651-658.

6. Jiskani MM. Foliar fertilizers-fast acting agents. Daily DAWN, the Internet Edition, Monday December 5, 2005.
7. Nehra AS, IS Hooda, KP Singh. Effect of integrated nutrient management on growth and yield of wheat (*Triticum aestivum* L.) Indian J. Agron,2001:45:112-17.
8. Ouda BA, Mahadeen AY. Effect of fertilizers on growth, yield, yield components, quality and nutrient contents in broccoli (*Brassica oleracea*). Int. J. Agri. Biol,2008:10:627-32.
9. Patil R, Biradar R. Effect of foliar application of essential nutrients on chilies. Agricultura Tecnica Santiago,2001:51(3):256-259.
10. Radulovic M. Soil and vegetable nutrients supply in the region of the Zeta Montenegro. Review-of-Research-Work-at-the-Faculty-of-Agriculture, - Belgrade,1996:41(1):31-40.
11. Rawat PS, Mathpal KN. Effect of micronutrients on yield and sugar metabolism of some of the vegetables under Kumaon hill conditions. Sci. Cult,1984:50:243-244.
12. Sanwal SK, K Lakminarayana, RK Yadav, N Rai, DS Yadav, B Mousumi. *et al*. Effect of organic manures on soil fertility, growth, physiology, yield and quality of turmeric. Indian J. Hort,2007:64(4):444-449.