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Amino acid Chelated Multi-Micronutrient Fertilizer –A Modern invention in Plant Nutrition

R.B. Datir

Department of Botany, Swami Muktanand College of Science, Yeola, Tal-Yeola, Dist-Nasik 423 401, M.S., India

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ABSTRACT

During the past few decades deficiency of micronutrients is reported in agricultural crops and fields. Fertility of agricultural land and yield of crops is harmfully affected by many fertilizing strategies throughout the world. Aminochelates are quite new fertilizer inventions with better efficacy for agricultural applications. Chelates are synthetic complexes which are widely used in agriculture to increase crop growth and yield. Responses of many plants to these amino acid chelated fertilizers have not yet been well studied. Thus, a pot experiment was conducted to study the effect of foliar application of amino acid chelatedmulti-micronutrient fertilizer on yield contributing traits of chili (*Capsicum annum* L.). Forty day's old seedlings of chili were transplanted in pots. The micronutrients like Iron, Zink, Copper, Molybdenum, and Manganese were chelated with seed amino acids. Control plans were treated with distilled water, the experimental plants were treated with 2.0 % unchelated micronutrients solution, 2.0 % amino acids solution and 1.0 %, 1.5 % and 2.0%, amino chelated multi-micronutrient fertilizer. All treatments were applied through foliar spray on 15th and 30th days after transplantation of seedling. The results revealed that application of amino acid chelated multi-micronutrient fertilizerat 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 results indicated that the use of amino acid chelated multi-micronutrient fertilizer proves to be an efficient for enhancing productivity in chili.

Key words: *Amino acid, Micronutrients, Chelate, Chili, Yield, traits.*

Introduction

Red pepper (*Capsicum annuum* L.) generally known as chili is chief marketable spice cum vegetable crop of India with great export potential. It supplies vitamin 'C' and 'A' with plenty of minerals.Hansra B. S. (1993) in his studies on transfer of agricultural technology on irrigated agriculture indicated that due to intensive application of chemical fertilizers inmodern agriculture deteriorated the soil fertility and disturbed the ecological equilibrium of biodiversity. Deficiency of micronutrients is of universal 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 beenfound to be deficient in one or other micronutrients. Bose and Tripathi (1996) in his studies oneffect of micronutrients on growth, yield and quality of tomato realized that productivity of crops is being adverselyaffected due to deficiencies of micronutrients, Benepal (1967) in his studies suggested that

(Assistant Professor)

micronutrients are usually required in minute quantities, however are vital to the growth of plant. 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 suggested 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 dohelp the plant in translocating the micronutrients. These chelators are not phytotoxic to plants noted by Ilhami Koksal *et al*. (1998) while studying the effects of different amino acid chelate foliar fertilizers on yield, fruit quality, shoot in williams pear. They are easy to produce and are cheap. Ouda (2008) while studying effect of fertilizers on growth, yield, yield components, quality and nutrient contents in broccoli expressed that in recent times, consumers are highly interested in organic products and demanding quality and safer food. 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 liquid fertilizers are applied in the form of foliar spray. 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 amino acid chelated micronutrients on yield contributing traitsin chili as testing crop. The purpose of the work was to determine the percentage and extent of any effect on yield of vegetable crop like chili due to application of fresh liquid amino acid chelated micronutrient fertilizer in the form of foliar spray.

Materials and Methods

Production of amino acid chelated multi-micronutrient fertilizer

Amino acid chelated multi-micronutrient fertilizer 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 amino acid chelated multi-micronutrient fertilizer. Micronutrients 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 solutions of each micronutrient were then mixed in 500 ml flask. This was used at 2.0 % as unchelated 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 amino acid chelated muti-micronutrient fertilizer

The experiments were conducted on potted plants to find out the effect of amino acid chelated multi-micronutrient fertilizer on yield of chili. Seedlings of chili var. *Phule Jyoti* were raised and forty days' old five seedlings were transplanted in each pot. Total six treatments involving T_0-untreated control, T_1- 2.0 % micronutrients solution, T_2-2.0 % amino acid solution, T_3-1.0 % amino acid chelated multi-micronutrient fertilizer, T_4-1.5 % amino acid chelated multi-micronutrient fertilizer and T_5-2.0 % amino acid chelated multi-micronutrient fertilizer was planned in potted plants with three replicates. The concentrations of the amino acid chelated multi-micronutrient fertilizer were prepared freshly with distilled water just before to spray. The solutions were applied in the form of foliar sprays at two growth stages on 15th and 30th days after transplantation. Foliar spray of distilled water was given to the untreated control plants. Number of fruits per plant, 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 average fruit length

Results relating to the effect of composite solution of un-chelated micronutrients, amino acid solution and increased doses of amino acid chelated multi-micro-

nutrient fertilizer on yield contributing characters like number of fruits per plant and average 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 amino acid chelated multi-micronutrient fertilizer. Foliar application of amino chelated multi-micronutrient fertilizer at the concentration of 2.0% produced maximum number of fruits per plant (138.23 plant^{-1}), followed by 135.48 and 115.86 fruits plant^{-1} at foliar application of 1.5 % and 1.0 % amino chelated multi-micronutrient fertilizer respectively. Un-chelated mixture of 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-1was 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. Unchelated 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.

Weight of fresh fruit and fruit yield per plant

The results concern to weight of fresh fruit and fruit yield per plant is given in Table 2. Weight of fresh fruit was remarkably increased (4.50 g fruit^{-1}) in treatment with foliar spray of chelated multi-micronutrient fertilizer at the concentration of 2.0 % followed by average weight of fresh fruit 4.48 and 4.14 g fruit^{-1} reached from treatments with foliar spray of 1.5 % and 1.0 % amino chelated multi-micronutrient fertilizer respectively. Un-chelated micronutrients and amino acid solutions at 2.0% foliar spray exhibited weight of fresh fruit 3.39 and 3.45 g fruit^{-1} respectively. However, minimum average fresh fruit weight of 2.90 g fruit^{-1} was achieved in control plants treated with distilled water.

Maximum yield of total fresh fruit per plant was remarkably obtained in plants treated with foliar spray of amino acid chelated multi-micronutrient fertilizer at 2.0% concentration (623.29 g plant^{-1}). It

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

Treatments	Number of fruits per plant				Fruit length (cm)			
	1st year	2nd year	Pooled	PI	1st year	2nd year	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 chili.

Treatments	Single fruit weight (g)				Total yield per plant (g)			
	1st year	2nd year	Pooled	PI	1st year	2ndyear	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	

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. Minimum yield of fresh fruit 231.51 g plant^{-1} was documented in control plants.

Discussion

Number of fruits per plant and average fruit length fresh fruit weight and fruit yield per plant

Results related to yield contributing traits given in Table 1 and 2 indicate that number of fruits per plant, fruit length; weight of fresh fruit and overall fruit yield per plant were improved significantly with the application of amino acid chelated multi-micronutrient fertilizer. Significantly highest numbers of fruits per plant (70.46 % and 73.91 %), maximum fruit length (33.24 % and 34.26%), weight of fresh fruit (54.69% and 55.15%) and total yield of fruit per plant (166.27 % and 169.23%) were documented in the plants treated with 1.5% and 2.0% amino acid chelated multi-micronutrients fertilizer respectively over control plants treated with distilled water. Treatment with 2% un-chelated micronutrient and amino acid solution showed plants with significant increase in number of fruits per plant (14.66 %, 16.92%), increase in average length of fruit (14.43 and 15.08 %), fresh fruit weight (17.2 and 19.09%) and increase in total fruit yield 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 multi-micronutrient 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% amino chelated multi-micronutrient fertilizer over in control. This might be due to increase in values of fresh weights of the fruits per plant. Similar results were obtained previously by Gupta and Gupta (2004) in their studies of PGR and micronutrient mixtures on vitamin 'C' content in tomato and 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 correspondence with Radulovic (1996) 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 of Patil and Biradar (2001)who applied foliar fertilizer "Polyfeed" and found significant effect on fruit number and fruit weight of chilies. while studying effect of foliar application of essential nutrients on chilies. Similar studies have also been conducted by Ouda and Mahadeen (2008) effect of fertilizers on growth, yield, yield components, quality and nutrient contents in broccoli. 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 Nehra, and others (2001), Sanwal, and others (2007). The improved photosynthesis in presence of zinc and boron was also reported by Rawat and Mathpal (1984) in study on effect of micronutrients on yield and sugar metabolism of some of the vegetables under Kumaon hill conditions. All the treatments of amino acid chelated multi-micronutrient fertilizer confirmed superior over un-chelated micronutrients and amino acids solution for yield contributing parameters.

Conclusion

The results revealed that un-chelated micronutrient significantly improved yield contributing characters to a 10-15 %, whereas amino acid spray contributed to 15-20% increase. On the other hand, amino acid chelated multi-micronutrients fertilizer contributed overall 40-100 % intensification in yield contributive characters in chili. Among the treatments of amino acid chelated micronutrients, chili responded well to the 1.5% and 2.0% treatments. The yield contributing characters of chili were significantly enhanced by the application of 1.5 % amino acid chelated micronutrients. However, these two treatments are at par and hence we recommend 1.5 % foliar spray for better yield in chili. The results of present investigation have given vision in application of amino acid chelated micronutrients fertilizeras a modern method in plant nutrition in immediate rectification of micronutrient deficiency in fruit vegetable.

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