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Effect of foliar application of macro and micro nutrients on production of green chilies (*Capsicum annuum* L.)

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A commercial foliar fertilizer, HiGrow is a composition of various macro and micronutrients was applied on chilies at the concentrations 4, 5, 6, 7 and 8 ml/L water in addition to soil applied NPK fertilizers at 50-50-25 kg ha^{-1} to investigate their associative effect on production of green chilies. HiGrow at 8 ml/L water resulted 68 cm plant height, 6.93 branches $plant^{-1}$, 118.86 fruits $plant^{-1}$, 4.19 cm fruit length, 395 g fresh chilies fruit weight $plant^{-1}$ and 14977 kg fresh chilies yield ha^{-1}; while decreasing concentration to 7 ml/L water produced 67.86 cm plant height, 6.53 branches $plant^{-1}$, 117.20 fruits $plant^{-1}$, 4.14 cm fruit length, 391.33 g fresh chilies weight $plant^{-1}$ and 14562.33 kg fresh chilies yield ha^{-1}. HiGrow at 6 ml/L water formed 66.46 cm plant height, 5.80 branches $plant^{-1}$, 112.36 fruits $plant^{-1}$, 3.89 cm fruit length, 351.66 g fresh chilies weight $plant^{-1}$ and 12696.33 kg fresh chilies yield ha^{-1}. Similarly, the reduced HiGrow concentration to 5 ml/L and 4 ml/L water caused significant negative effect on all the growth and yield components of chilies. However, the control plots produced 63.46 cm plant height, 4.20 branches $plant^{-1}$, 93.06 fruits $plant^{-1}$, 2.87 cm fruit length, 388.33 g fresh chilies weight $plant^{-1}$ and 10525.00 kg fresh chilies yield ha^{-1} which were significantly lesser than foliar fed plots. There was a consecutive improvement in growth and yield components of chilies with increase in HiGrow concentration, but such increase beyond 7 ml/L water was not so pronounced and hence 7 ml/L water was considered to be an optimum HiGrow concentration for commercial production of chilies.

Key words: chilies, foliar fertilizers, HiGrow, growth, fresh fruit yield.

Introduction

Chilies (*Capsicum annuum* L.) belong to the nightshade family, *Solanaceae* and originates from South America; the name comes from Nahuat via the Spanish word chili (Wikipedia, 2006). Chilies are very rich in vitamin C and pro-vitamin A, particularly the red chilies. Yellow and especially green

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chilies (which are essentially unripe fruit) contain a considerably lower amount of both substances. In addition, peppers are a good source of most B vitamins, and vitamin B_6 in particular. They are very high in potassium and high in magnesium and iron. Their high vitamin C content can also substantially increase the uptake of non-heme iron from other ingredients in a meal, such as beans and grains (Sparkyby, 2006).

The yield of chilies obtained in Pakistan is far less than the potential exists. The causes of low yield may be due to improper cultural operations, inputs etc. Of the inputs, N.P.K. fertilizers play a significant role in successful chillies production (Jack *et al*., (2006). Balanced nutrients are paid little attention. Its deficiencies emerge in the farmer's field and are recognized as the symptoms on foliage and reduction in the quality and yield. Rapid uptake of nutrients applied to crop foliage ensures a fast response within the plant as micronutrients directly enter the metabolic processes. Micronutrients are completely available to the plant and thus particularly effective because they are not fixed or diluted in large volumes of soil. However, overdosing or application at undesired time can lead to crop damage. For intensive cropping with continuously high yield levels more micronutrients are required, and hence it is best to use more frequent applications at the lower rate. If slight deficiency symptoms are already visible on the plants then larger quantities of micronutrients are necessary to achieve a curative effect. In cases of severe deficiency, when the plant parts are obviously discoloured or distorted and partially dying-off, the plants are so weakened that they react very sensitively to any type of treatment. For this reason the lower rate should be applied repeatedly at 2-week intervals (Anonymous, 2007).

Besides, foliar application of various macro and micro nutrients has been proved beneficial, foliar feeding is a relatively new and controversial technique of feeding plants by applying liquid fertilizer directly to their leaves. In some cases, a dramatic example being tomatoes, this goes against long-standing structures ever allowing the leaves to get wet. While the conventional wisdom is "don't even spray your tomato plants, only water them by soaking the ground beneath", modern gardening techniques strongly recommend spraying the leaves of a tomato plant with fertilizer, as part of the normal fertilization routine (Anonymous, 2004).

Foliar fertilizers are being used in vegetable and fruit crops that contain various macro and micro nutrients. Foliar fertilizers are known to immediately deliver nutrients to the tissues and organs of the crop. For instance, 80 per cent of the phosphorus applied through conventional fertilizers may get fixed up in the soil but up to 80 percent of the foliar-added phosphorus is directly absorbed. The study showed that crop yield in chillies enhanced when

micronutrients were applied in combination .The foliar application of zinc 3.0 ppm, copper 1.0 ppm and boron 0.5 ppm gave maximum net return to the growers. Similarly for chili, the treatment of 100 per cent NK + three sprays of Polyfeed + two sprays of Multi-K produced the highest number of fruits per plant, dry fruit yield, net income and benefit cost ratio. Increasing frequency of Polyfeed spraying from three to four times do not increase the number of chili fruits per plant (Jiskani, 2005). Considering the significance of foliar fertilizers for chillies, this study was carried out to investigate the effect of foliar application of macro and micro nutrients on production of green chillies, using a commercial product called "HiGrow" which consists of essential macro and micro nutrients.

Materials and methods

The experiment was laid out in a three replicated randomized completely block design using chillies variety "Ghotki" in a plot size of 3.0m × 3.5m ($10.50m^2$). The land was thoroughly ploughed up by giving 2 dry plowings, the clods were crushed, and leveling was done to eradicate the weeds and to make the soil surface leveled for uniform distribution of irrigation water during soaking dose. Ridges were prepared at the distance of 60 cm and the sub-plots were separated from each other by 45 cm wide bunds. Each block then was sub-divided into three beds. The beds were separated from each other by 30 cm wide bunds. The sowing of seed for nursery was done on 16th February, 2006 and on attaining the age of one and half month, the nursery/seedlings were transplanted on one side of the ridges on 30th March, 2006. Chillies crop was given various foliar applications of HiGrow, which is a compound commercial fertilizer, particularly prepared for foliar application of various macro and micronutrients to improve the foliage and production of chillies. The HiGrow is manufactured by the Agriculture Technology Institute Karachi containing Nitrophen (4 %), Nitrogen compound (12%), Iron (2 %), Magnesium 2%, Manganese 2%, Boron 2%, Copper 4%, Molybdenum 2%, Potash 8%, P_2O_5 12% and Calcium 8% (w/v). The NPK fertilizers were applied at the rate of 50-50-25 Kg ha^{-1} in all the experimental plots uniformly. The nitrogen was applied in the form of Urea (46% N), while P in the form of di-ammonium phosphate (18-45% N-P) and sulphate of potash (SOP) was applied to get the required dose of K.

Interculturing was followed by earthing and weeding operations were performed when the crop had good stand. Plant protection measures were also kept in operation and three sprayings were done when it was felt that the pest population is crossing economic injury level. For identification of insect pests and spraying recommendations, the help was acquired from Entomology

Section of Agriculture Research Institute, Tandojam. Up to the final harvest, the crop was irrigated when felt necessary and three sprayings of insecticides (Dimethoate) were applied against fruit borers. For recording observations on various parameters, five plants in each bed were selected at random and labeled. The data thus recorded were tabulated and statistically analyzed to discriminate the superiority of treatment means, using Least Significant Differences (L.S.D) (Gomez and Gomez, 1984) and Mstat-C Computer Software.

Results and discussion

Plant height

Chilies received foliar application of HiGrow at the concentration of 8 ml/L water resulted plants of maximum height (68cm), closely followed by 67.86 and 66.46 cm plant height observed when HiGrow was foliarly applied at the concentrations of 7 and 6 ml/L water, respectively (Table 1). The results further indicated that reduced HiGrow concentration of 5 and 4 ml/L water produced plants of lesser height i.e. 65.86 and 65.60 cm, respectively. However, the least plant height of 63.46 cm was recorded in control, where only soil applied NPK fertilizers were used and foliar application of HiGrow was controlled. The results of the present investigation are in concurrence with Radulovic (1996), who applied foliar application of N, P, K, Ca, Mg and Fe, B, Zn, Mn and Cu and resultantly these nutrients were established in leaves, indicating the possibility of reducing the application of nitrogen fertilizers.

Number of branches

The chilies crop that supplied with foliar application of HiGrow at the concentration of 8 ml/L water produced maximum number of branches (6.93 plant^{-1}), followed by 6.53 and 5.80 number of branches plant^{-1} at 7 and 6 ml/L water, respectively (Table 1). The lower HiGrow concentration of 5 and 4 ml/L water produced relatively lesser number of branches i.e. 5.20 and 4.26, respectively. However, the minimum number of branches (4.20 plant^{-1}) was recorded in control plots, where only NPK fertilizers were applied. Similar results have been reported by Sharma *et al*. (2000) using compound liquid fertilizer containing most macro and micro nutrients “Polyfeed and Multi” alongwith NPK and mentioned that these fertilizers provide nutrients to the plant by foliar application and significant effect on branches per plant.

Number of fruits

Foliar application of HiGrow at the concentration of 8 ml/L water produced maximum number of fruits (118.86 plant^{-1}), followed by 117.20 and 112.36 fruits plant^{-1} at of 7 and 6 ml/L water, respectively (Table 1). The reduced HiGrow concentration of 5 and 4 ml/L water resulted reduction in the number of fruits to the level of 102.56 and 99.60 plant^{-1}, respectively. However, the lowest number of fruits (93.06 plant^{-1}) was recorded in control plots. Similar studies have also been conducted by Jiskani (2005) 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 and increasing frequency of Polyfeed spraying from three to four times did not increase the number of chili fruits per plant.

Fruit length

Foliar application of HiGrow at the concentration of 8 ml/L water resulted significantly longer fruits (4.19 cm) followed by average fruit length of 4.14 and 3.89 cm at 7 and 6 ml/L water, respectively (Table 1). The minimizing HiGrow concentration to 5 and 4 ml/L water further decreased fruit length to the level of 3.78 and 3.37 cm, respectively. However, the minimum fruit length of 2.87 cm was obtained in control plots. Similarly, Anonymous (2007) applied a foliar fertilizer "Fetrilon-Combi" in chillies and found considerable improvement in fruit development and crop yields as compared to those supplied only with straight chemical fertilizers.

Fresh fruit weight

The fresh fruit weight was remarkably maximum (395 g plant^{-1}) in plots fertilized with foliar application of HiGrow at the highest concentration of 8 ml/L water followed by average fresh fruit weight of 391.33 and 3.51 g plant^{-1} achieved from the treatments under foliar application of macro and micro nutrients (HiGrow) at the concentrations of 7 and 6 ml/L water, respectively (Table 1). The reduction in HiGrow concentration to 5 and 4 ml/L water further diminished fresh fruit weight to 337.66 and 308.00 g plant^{-1}, respectively. However, the minimum fresh fruit weight of 288.33 g plant^{-1} was obtained in control plots. These results are in line with those of Patil and Biradar (2001) who applied foliar fertilizer "Polyfeed" and found significant effect on fruit weight of chillies.

Fresh fruit yield

Fresh fruit yield was remarkably maximum (14977 kg ha^{-1}) in plots fertilized with foliar application of HiGrow at the highest concentration of 8 ml/L water followed by average fresh fruit yield of 14562 and 12696.33 kg ha^{-1} at 7 and 6 ml/L water, respectively (Table 1). The reduced concentrations of HiGrow i.e. 5 ml/L or 4 ml/L water further deteriorated the fresh fruit yield to 12059.33 and 11187 kg ha^{-1}, respectively. However, the minimum fresh fruit yield of 10525 kg ha^{-1} was recorded in control plots. These results have been further supported by Jiskani (2005), who reported that significant effect on crop yield in chillies was recorded when micronutrients were applied in combination with NPK instead of alone; while Lovatt (2005) indicated that foliar spray of 1 % either Polyfeed or Multi 'K' at 45, 60 and 75 days after planting increased the crop yield by about 10 % over unsprayed control.

Conclusions

Consecutive improvement in growth and yield of chilies was evident with increase in HiGrow concentration. but application beyond 7 ml/L water was not effective and thus 7 ml/L water was considered to be an optimum HiGrow concentration for commercial production of chillies.

Table 1. Mean values for various growth and yield components of chilies as influenced by foliar application of macro and micro nutrients (HiGrow).

Treatments	Plant height (cm)	No. of branches per plant	No. of fruits per plant	Fruit length (cm)	Fresh fruit weight (g $plant^{-1}$)	Fresh fruit yield (kg ha^{-1})
T1=Control	63.46 c	4.20 d	93.06 d	2.87 d	288.33 e	10525.00 e
T2=HiGrow @ 4 ml/L water	65.60 b	4.26 d	99.60 c	3.37 b	308.00 d	11187.00 d
T3=HiGrow @ 5 ml/L water	65.86 b	5.20 c	102.56 c	3.78 b	337.66 c	12059.66 c
T4=HiGrow @ 6 ml/L water	66.46 a	5.80 b	112.36 b	3.89 a	351.66 b	12696.33 b
T5=HiGrow @ 7 ml/L water	67.86 a	6.53 ab	117.20 a	4.14 a	391.33 a	14562.33 a
T6=HiGrow @ 8 ml/L water	68.00 a	6.93 a	118.86 a	4.19 a	395.00 a	14977.00 a
SE±	0.4165	0.0755	1.0379	0.0657	2.2224	65.4614
LSD 0.05	1.750	0.3163	4.3610	0.2766	9.3380	425.10
LSD 0.01	2.398	0.4334	5.9750	0.3790	12.790	536.90
CV%	4.54	5.73	4.37	4.34	5.58	5.71

Values followed by same letters do not differ significantly at 0.05 probability level.

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