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Effect of copper nutrition on uptake, yield and economics of chilli (*Capsicum annuum* L.) in a vertisol of zone-8, Karnataka

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ABSTRACT

A field experiment was carried out on a vertisol to evaluate the effect of copper nutrition on yield and uptake of major and micronutrients by chilli at Main Agricultural Research Station, UAS, Dharwad during *Kharif* 2008. Combined application of $CuCl_2$ at 2.5 kg ha^{-1} through soil and 0.25 per cent foliar spray registered significantly highest dry fruit yield (10.38 q ha^{-1}). The uptake of major nutrients (75.64, 14.14 and 119.12 kg ha^{-1} N, P and K, respectively) and micro nutrients (61.88, 113.24, 431.60 and 100.10 g ha^{-1} of Cu, Zn, Fe and Mn, respectively) were highest in the treatment T_8 followed by T_{10}. The treatment that received combined application of $CuCl_2$ at 2.5 kg ha^{-1} through soil and 0.25 per cent foliar spray recorded highest B:C ratio (3.34) along with highest yield and better quality chilli fruits. Treatment (T_{11}) receiving application of $CuCl_2$ at 5 kg ha^{-1} through soil + 0.50 per cent foliar spray recorded lowest B:C ratio of 2.30.

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Key words : Vertisol, B:C ratio, Micronutrients, Byadgi dabbi

INTRODUCTION

Micronutrients play a vital role in influencing quality of crops in addition to regulating many of the metabolically important enzyme reactions in plants. In the post green revolution era there was a gradual decline in the yield of most crops after reaching a plateau particularly in irrigated areas. This was because of imbalanced application of fertilizers without emphasis on secondary and micronutrients. Indiscriminate use of high analysis fertilizers and apathy towards the use of organic manures along with increased cropping intensity and productivity resulted in country wide micronutrient deficiencies including copper. So in the present study, an attempt has been made to study the effect of copper nutrition on yield and uptake of nutrients besides working out the economics of different treatments.

MATERIALS AND METHODS

A field experiment was conducted at Main Agricultural Research Station UAS, Dharwad in Zone-8 of north Karnataka on a vertisol during *Kharif* 2008 to study the effect of copper nutrition on nutrient uptake, yield and economics of chilli (cv. BYADGI DABBI). A composite soil sample was collected from the experimental site (0-20cm) and was analysed for physico-chemical properties before the experiment. The soil had a pH of 7.44, EC- 0.38 dSm^{-1}, organic carbon-5.72 g kg^{-1}. The available N, P and K were 299, 20 and 390 kg ha^{-1}, respectively. The available micronutrients were 3.00, 0.48, 0.64 and 9.30 mg kg^{-1} of Fe, Zn Cu and Mn, respectively. The experiment was laid out in Randomized Block Design with three replications and eleven treatments. All the treatments received farmyard manure @ 10 t ha^{-1} (spot application). Nitrogen was supplied partly through urea and partly through DAP while entire doses of phosphorus and potassium were supplied through DAP and muriate of potash, respectively. Copper was applied in the form of $CuCl_2$ through soil in two doses *viz.,* 2.5 and 5 kg ha^{-1} and in foliar spray at 0.25 and 0.50 per cent at 30 and 60 DAT. Based on the net plot yield, yield per hectare was calculated and expressed in quintals. Concentrations of N, P, K and micronutrients in plant samples were determined as per the standard procedures outlined by Tandon (1998).

The uptake of nutrients at 75 DAT and at 140 DAT (final picking of chilli) was worked out using the formulae.

$$\text{Biomass yield (kg ha}^{-1}\text{)} = \text{Dry matter yield plant}^{-1}\text{ (kg) x Plant population ha}^{-1}$$

$$\text{Nutrient uptake kg ha}^{-1}\text{)} = \frac{\text{Nutrient concentration (\%)}}{100} \text{ x Biomass yield (kg ha}^{-1}\text{)}$$

Based on the prevailing price of inputs and produce obtained during the year (2008), the net profit per hectare and benefit cost ratio were worked out by using the following formulae.

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Net profit ha^{-1}(Rs.) = Gross income ha^{-1} (Rs.) – Cost of cultivation ha^{-1}(Rs.)

$$\text{Benefit : Cost} = \frac{\text{Gross income ha}^{-1}\text{ (Rs.)}}{\text{Cost of cultivation ha}^{-1}\text{ (Rs.)}}$$

RESULTS AND DISCUSSION

The treatment that received application of $CuCl_2$ at 2.5 kg ha^{-1} through soil + 0.25 per cent foliar spray registered significantly highest dry fruit yield (10.38 q ha^{-1}) (Table 1). Copper plays an important role in plant metabolism as well as in biosynthesis of auxins which may reduce the flower and fruit drop. The increased fruit yield of chilli was the manifestation of various growth and yield attributing characters like number of fruits/plant, 100 fruit weight, fruit size etc. The supplementation of Cu through soil and foliar spray at optimum dose might promote more uptake of other nutrients that might have helped to produce more vegetative growth and more number of flowers per plant. By this, effective translocation of carbohydrate to reproductive parts (fruits) might have increased fruit yield. Further, with increase in the concentration of foliar spray of $CuCl_2$ either (T_4 and T_5) (0.5%) alone or along with higher dose (5 kg ha^{-1}) of soil application (T_{10} and T_{11}) did not enhance the fruit yield. This might be due to excess concentration of Cu might cause toxicity, imbalance and scorching effect on plant parts. Higher dose of soil application might have antagonistic effect on the uptake of other nutrients. The results obtained are in conformity with findings of Dod *et al.* (1989) in chilli and Tamilselvi *et al.* (2002) in tomato. The treatment (T_8) receiving soil application of $CuCl_2$ at 2.5 kg + 0.25 per cent foliar spray recorded the highest N uptake compared to all other treatments. This might be due to increased copper availability in soil because of applied $CuCl_2$ resulting in higher dry matter production and higher uptake of N by plants and also might be the synergistic relationship between Cu and N ions in translocation. Similar findings were reported by Barik and Chandel (2002) in soybean, Antil *et al.* (1988) in raya and Grundon (1991) in wheat.

The highest P (14.14 kg ha^{-1}) and K (119.12 kg ha^{-1}) uptake were observed in the treatment (T_8) receiving combined application of $CuCl_2$ at 2.5 kg ha^{-1} through soil and 0.25 per cent foliar spray. This might be due to synergistic effect of copper on phosphorus and potassium uptake. It is obvious because of increased dry matter yield that has resulted in higher uptake of K. Further, optimum level of Cu concentration might have synergistic effect on potassium uptake. The results obtained are in accordance with the findings of Gundlur and Manjunathaiah (2000) in groundnut. The results obtained are in accordance with the findings of Agrwal *et al.* (2004), in groundnut and Prasad and Ram (1991) in

Table 1 : Effect of copper nutrition on uptake, yield and economics of chilli

Treatments	Dry fruit yield (q ha^{1})	Uptake of major and micronutrients							B:C ratio
		N	P	K	Cu	Zn	Fe	Mn	
T_1 – RDF	7.03	32.77	5.09	73.02	20.94	43.24	213.99	45.73	3.10
T_2 – RDF + FYM	7.97	53.36	9.06	84.53	31.76	67.46	260.89	60.16	3.02
T_3 – RDF + FYM + NAA	9.22	65.32	11.51	103.07	42.34	91.75	342.28	84.56	3.20
T_4 – RDF + FYM + 0.25% $CuCl_2$ foliar spray	9.10	63.39	11.23	101.48	44.02	91.67	329.85	79.33	3.53
T_5 – RDF + FYM + 0.5% $CuCl_2$ foliar spray	8.17	55.48	9.82	86.39	34.65	70.88	272.55	63.37	3.02
T_6 – RDF + FYM + 2.5 kg ha^{-1} $CuCl_2$ soil application	8.92	59.39	10.58	93.81	40.74	84.27	298.16	75.09	3.07
T_7 – RDF + FYM + 5.0 kg ha^{-1} $CuCl_2$ soil application	8.98	61.57	10.66	96.82	41.53	85.59	313.76	78.05	2.64
T_8 – RDF + FYM + 2.5 kg ha^{-1} $CuCl_2$ soil application + 0.25% $CuCl_2$ foliar spray	10.38	75.64	14.14	119.12	61.88	113.24	431.6	100.1	3.34
T_9 – RDF + FYM + 2.5 kg ha^{-1} $CuCl_2$ soil application + 0.5% $CuCl_2$ foliar spray	8.21	57.17	10.24	90.40	37.71	75.82	284.48	71.07	2.52
T_{10} – RDF + FYM + 5.0 kg ha^{-1} $CuCl_2$ soil application + 0.25% $CuCl_2$ foliar spray	10.25	72.91	13.02	115.79	58.28	108.35	419.21	96.19	2.83
T_{11} – RDF + FYM + 5.0 kg ha^{-1} $CuCl_2$ soil application + 0.5% $CuCl_2$ foliar spray	8.29	58.25	10.37	93.24	39.02	78.43	292.7	70.38	2.30
S.E.±	0.30	3.48	0.892	3.86	2.39	6.79	24.65	6.23	
C.D. (P=0.05)	0.90	10.27	2.631	11.38	7.05	20.04	72.71	18.38	

RDF - Recommended dose of fertilizer (100:50:50 kg N, P_2O_5 and K_2O ha^{-1})
FYM - Farmyard manure (10 t ha^{-1} spot application)
NAA – Naphthalene acetic acid

mungbean. Significantly higher uptake of copper (61.88 g ha^{-1}) was noticed in the treatment that received combined application of $CuCl_2$ at 2.5 kg ha^{-1} through soil + 0.25 per cent foliar spray. Higher uptake of copper was mainly due to its increased availability in soil and absorption of Cu directly by leaves because of foliar spray This absorbed Cu might have increased photosynthetic pigment content (Yokout 1982 in soybean) ultimately increasing dry matter yield. The results are in accordance with Kumar *et al.* (1990) and Grundon (1991) in wheat, and Gundlur and Manjunathaiah (2000) in groundnut. The treatment that received combined application of $CuCl_2$ at 2.5 kg ha^{-1} through soil + 0.25 per cent foliar spray recorded the significantly highest uptake of Zn, Fe and Mn.

The acceptance of any generated technology is ultimately based on the cost of cultivation involved and net returns obtained from it. Treatment (T_8) receiving soil application of $CuCl_2$ at 2.5 kg ha^{-1} + 0.25 per cent foliar spray of $CuCl_2$ at 30 and 60 DAT recorded the highest gross income (Rs.57,090) as well as net returns (Rs.39,986) which was closely followed by treatment (T_{10}) receiving soil application of $CuCl_2$ at 5 kg ha^{-1} + 0.25 per cent foliar spray. The lowest gross income (Rs. 31,635) as well as net return (Rs. 22,431) was obtained in the treatment (T_1) that received RDF alone. The treatment T_4 has recorded highest B: C ratio (3.53) with net profit of Rs 35,696 and was found significantly lower to T_8 with respect to yield and quality of chilli fruits. The treatment T_8 even though stands second in B:C ratio, (3.34) the difference of net profit between control (T_2) and T_8 was highest (Rs 13,340) among all the treatments. It also recorded the highest yield and quality parameters with net profit of Rs 39,986 and hence found superior.

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