Research Paper :

Effect of copper nutrition on disease incidence and quality of chilli in a vertisol of zone-8, Karnataka

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SUMMARY

A field experiment was carried out to study the effect of copper nutrition on disease incidence and quality of chilli. Results revealed that, treatment receiving soil application of $CuCl_2$ at 2.5 kg ha^{-1} + 0.25 per cent $CuCl_2$ foliar spray at 30 and 60 DAT registered highest ascorbic acid content in green chillies (170.72 mg 100^{-1}), highest oleoresin content (16.56%) and total extractable colour (239.09 ASTA units). Treatment receiving only RDF recorded lowest quality attributes and differed significantly from T_8 treatment Further, lowest discoloured fruits (5.52%), anthracnone affected fruits (4.36%) and murda disease complex (8.23%) were noticed in the treatment receiving soil application of $CuCl_2$ at 2.5 kg ha^{-1} + 0.25 per cent foliar spray (T_8) of $CuCl_2$. Highest disease affected plants were noticed in the treatment receiving only RDF.

Key words : Vertisol, Anthracnose, Murda, Colour value, Oleoresin, Chilli

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Chilli (*Capsicum annuum* L.) an important spice cum vegetable is cultivated extensively in India. The important quality attributes in dry chillies are colour value, pungency and oleoresin. India felt the taste of this pungent spice in 1498 by Vasco-de-Gama and today it's unimaginable to think of food without chilli as it imparts both pungency and colour to the dishes and has become a favourite ingredient in culinary items. Continuous use of major plant nutrients through chemical fertilizers has resulted in the depletion of micronutrients which play a vital role in growth and development of crops and they occupy a position of importance by virtue of their essential nature. Copper is one such important micronutrient required by the crop plants for the completion of normal life cycle. It is a constituent of certain oxido-reductase enzymes (tyrosinase and ascorbic acid oxidase). Copper is a constituent of plastocyanin which plays a key role in the transport of electrons in photosynthesis. It is also involved in respiration as it is a component of cytochrome oxidase. Copper is highly toxic to fungal pathogens which cause the diseases. Hence, copper salts can be exploited in controlling diseases and being an essential micronutrient, can also be utilized for improving yield/quality of crops. In the present study, an attempt has been made to study the effect of copper nutrition on disease incidence and quality of chilli.

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 disease incidence and quality 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} and 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 9.30mg kg^{-1} of Fe, Zn Cu and Mn, respectively. The experiment was laid out in randomized block design (RBD) with eleven treatments and three replications. Recommended dose of N, P_2O_5 and K_2O for chilli is 100:50:50 kg ha^{-1}. 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 according to treatments in the form of $CuCl_2$. Foliar spray

of $CuCl_2$ and NAA were given at 30 and 60 DAT. Ascorbic acid content of mature green fruits was estimated using 2,6-dichlorophenol indophenol dye by visual titration method (Sadasivam and Manickam, 1992). Colour value of chilli fruits was determined by extracting colour with acetone and calculated by the formula as suggested by Woodbury (1977):

$$I_f = \frac{\text{Declared absorbance of glass reference std.}}{\text{Absorbance obtained at 465 nm on glass reference st.}}$$

$$\text{Extractable colour value in ASTA units} = \frac{\text{Absorbance at 460 nm x 16.4 x } I_f}{\text{Sample weight (g)}}$$

16.4 is a conversion factor to express the colour value in American Spice Trade Association (ASTA) units.

Per cent oleoresin was estimated as per the procedure of AOAC (1997). Murda scoring per plant from five selected plants in net plot were recorded at weekly intervals. If the 25 per cent of plants were affected by murda disease then it was recorded as grade I, similarly if the plant affected by 50, 75 and 100 per cent, then it was recorded as grade II, grade III and grade IV, respectively. By adding the values of each week, the extent of murda disease was calculated.

RESULTS AND DISCUSSION

It is evident from Table 1 that the treatment that received soil application of $CuCl_2$ at 2.5 kg ha^{-1} + foliar spray at 0.25 per cent ($CuCl_2$) registered significantly highest ascorbic acid content (170.72 mg 100^{-1}) which was 26.15 per cent more than the treatment receiving RDF along with FYM (135.33 mg 100^{-1}). The reason might be due to enhanced enzyme activity of ascorbic acid oxidase due to copper nutrition which enhanced the ascorbic acid content in green chilli fruits and also as Cu is involved in carbohydrate metabolism and there exists positive and close relationship with formation of ascorbic acid. Results obtained are in conformity with the findings of Mallick and Murthukrishnan (1980) and Tamilselvi *et al.* (2002) in tomato, Dod *et al.* (1989) in chilli and Mahamooth (1982) in groundnut. The highest oleoresin content (16.56%) was registered in the treatment receiving combined application of $CuCl_2$ at 2.5 kg ha^{-1} through soil and 0.25 per cent foliar spray which was 19.48 per cent more than the treatments which received RDF along with FYM and was at par with treatments receiving combined application of $CuCl_2$ at 5 kg ha^{-1} through soil and 0.25 per cent foliar spray (16.12%) and foliar spray of $CuCl_2$ at 0.25 per cent (15.91%). High oleoresin content is attributed to big fruit size and fruit weight because of greater synthesis and translocation of photosynthates to developing fruits on account of increased uptake of nutrients. Lowest quality attributes (13.29 per cent oleoresin. 161.94 ASTA units of colour value T_1) were recorded in treatment receiving only RDF.

The highest colour value (239.09 ASTA units) was noticed in the treatment 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 which was 30.58 per cent higher than treatment (T_2) receiving RDF along with FYM (183.09). The increased colour value might be due to the role of copper in protein synthesis and enzymatic activities. Supplementation of optimum dose of copper through soil and foliar spray increased the uptake of K which resulted in rapid transformation of green colour to pink and then to red colour. It is also found that increased uptake of K due to copper nutrition brings about equilibrium between acids and sugar ratio in fruits due to increased translocation of photosynthates which resulted in good ripening and development of red colour. The results are in conformity with findings of Tamilselvi *et al.* (2002) and Bidari (2000). They reported increased lycopene content in tomato due to foliar spray of copper at 100 ppm. The treatment receiving RDF alone recorded highest per cent discoloured fruits (8.75 %). Lowest per cent discoloured fruits (5.52 and 5.94 %) were obtained in the treatments that received application of $CuCl_2$ at 2.5 kg ha^{-1} through soil + 0.25 per cent foliar spray (T_8) and 5 kg ha^{-1} through soil + 0.25 per cent foliar spray (T_{10}).

The treatment (T_8) receiving application of $CuCl_2$ at 2.5 kg ha^{-1} through soil + 0.25 per cent foliar spray registered lowest fruits (4.36%) affected by anthracnose disease and was 46.30 per cent lower than the treatment (T_2) receiving RDF along with FYM (8.12) and it was at par with rest of $CuCl_2$ treated plots. This might be due to the established role of Cu in controlling fungal pathogens responsible for causing anthracnose disease. Copper is considered to be toxic or fungistatic to the plant pathogens before or during the early stages of infection (Das, 2000). The treatment that received combined application of $CuCl_2$ at 2.5 kg ha^{-1} through soil and 0.25 per cent foliar spray showed the lowest murda complex (8.23%) and it was 49.6 per cent less than the treatment receiving RDF alone (16.33%) and 37.7 per cent less than the treatment receiving RDF along with FYM (13.23%). But all the treatments receiving $CuCl_2$ were at par with each other. It is well known fact that copper is extensively used as a fungicide and its fungicidal properties are used against foliar pathogens, since applied Cu in the soil is quickly adsorbed and only low concentrations remains in the soil

Table 1 : Effect of copper nutrition on quality parameters, anthracnose and murda disease incidence in chilli

Treatments	Ascorbic acid (mg 100 g^{-1}) in green fruits	Per cent oleoresin	Colour value (ASTA units)	Per cent discoloured fruits	Per cent Anthracnose affected fruits	Per cent Murda complex
T_1 – RDF	117.67	13.29	161.94	8.75	8.84	16.33
T_2 – RDF + FYM	135.33	13.86	183.09	7.65	8.12	13.23
T_3 – RDF + FYM + NAA	151.21	14.77	212.44	6.06	7.76	12.33
T_4 – RDF + FYM + 0.25% $CuCl_2$ foliar spray	150.33	15.91	218.41	6.40	5.62	9.87
T_5 – RDF + FYM + 0.5% $CuCl_2$ foliar spray	143.12	13.50	184.92	7.31	6.94	9.93
T_6 – RDF + FYM + 2.5 kg ha^{-1} $CuCl_2$ soil application	145.39	15.08	205.81	6.44	6.02	10.47
T_7 – RDF + FYM + 5.0 kg ha^{-1} $CuCl_2$ soil application	148.44	15.54	208.78	6.40	5.95	9.97
T_8 – RDF + FYM + 2.5 kg ha^{-1} $CuCl_2$ soil application + 0.25% $CuCl_2$ foliar spray	170.72	16.56	239.09	5.52	4.36	8.23
T_9 – RDF + FYM + 2.5 kg ha^{-1} $CuCl_2$ soil application + 0.5% $CuCl_2$ foliar spray	144.68	14.26	188.87	7.06	6.18	8.83
T_{10} – RDF + FYM + 5.0 kg ha^{-1} $CuCl_2$ soil application + 0.25% $CuCl_2$ foliar spray	168.84	16.12	237.37	5.94	4.42	8.33
T_{11} – RDF + FYM + 5.0 kg ha^{-1} $CuCl_2$ soil application + 0.5% $CuCl_2$ foliar spray	145.52	14.48	190.04	6.70	6.07	8.53
S.E.±	6.34	0.45	6.93	0.31	0.51	0.97
C.D. (P=0.05)	18.72	1.33	20.42	0.93	1.49	2.86

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)
DAT - Days after transplanting
NAA - Naphthalene acetic acid
NS - Non-significant

solution (Das, 2000). The treatments (T_5, T_7, T_9 and T_{11}) receiving higher concentration of $CuCl_2$ through both soil application (5 kg/ha) and foliar spray (0.5%) found better in controlling the murda complex than the treatments receiving lower dose (2.5 kg/ha) $CuCl_2$ through soil application or foliar spray (0.25%) alone. This might be due to toxic effect of Cu on plant pathogens at higher dose and concentration..

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