INNOVATIVE ENERGY TECHNOLOGY SYSTEMS AND ENVIRONMENTAL CONCERNS: A SUSTAINABLE APPROACH
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Efficacy of Heavy Metals in Management of *Fusarium Udum* and *Fusarium Oxysporum F.Sp.Ciceri*

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Abstract

The present study mainly use to evaluate the effect of three heavy metal i.e. Cobalt, Copper and Cadmium against the growth of fusarium udum and fusarium oxysporum f. sp. ciceri causing wilt in arhar and chickpea. Results from the study shows that copper significantly checks the growth of fusarium udum by 100% at 100 ppm conc followed by Cadmium (95.19%) and Cobalt (37.52%) at 100 ppm (at p<0.01) respectively .In case of fusarium oxysporum f. sp. ciceri Cadmium inhibited the growth significantly (100%) at 75 and 100 ppm followed by Copper(89.15%) and Cobalt(48.48%) at 100 ppm conc respectively (at p<0.01). It is shown by findings that copper and cadmium effectively suppressed the growth of both fusarium spp. with increasing concentration. Cobalt shows moderate effect against both the pathogen.

1. Introduction

Heavy metal contamination has been shown to affect the species composition of microbial communities in soil (Doelman, 1985; Duxbury, 1985; Bààth, 1989). Several studies have been done on ecotoxicological impact of heavy metals and metalloids composition and function soil microbial communities (Griller *et al.,* 1998; Kandeler *et al.,* 2000; Renella *et al*., 2005).Some soil-borne diseases *viz. fusarium* wilt of tomato and other vegetable crops have been suppress by micro and macroelements (Engelhard, 1989).Mineral elements also modify the plant root exudates results inhibiting the pathogens along with enhancing the population of plant growth promoting and antagonistic microorganisms (Huber, 1989). With the application of mineral elements in the host plants, enhanced the nutritional status which results in inhibition against fungal pathogens and also alter the physical and chemical properties of the soil and pH of rhizosphere (Schneider *et al*., 1995).Saikia *et al*. (2009) reported the combined activity of *Pseudomonas fluorescens* 4-92(Pf4-92) with zinc, copper and zinc+ copper against *Fusarium oxysporum f.sp.ciceri* causing chickpea wilt. *In vitro* study showed that 20, 30 and 40 g/ml concentration of Zn, Cu and Zn+Cu minerals inhibited the production of fusaric acid and enhanced the production of 2,4 diacetylphloroglucinol(DAPG), Salicylic acid, Pyochelin and Pyoluteorin by Pf4-92. This showed that Zn and Cu with enhancing the biocontrol activity reduced the production of fusaric acid (FA) by pathogen *Fusarium oxysporum f.sp.ciceri.*Application of 400ppm, 800ppm and 1200ppm of different heavy metals alone or in combination was used against *Sclerotium rolfsii sacc*. causing foot-rot in barley. *In vitro* studies indicated that zinc was most effective either alone i.e.1200ppm concentration or in combination wit Cu,Fe and magnesium at all concentrations for control of pathogen in soil,

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pot culture and field trail(R.K.Singh,1988).Dwivedi (1990) also reported that mercury, cadmium and copper completely (100%) checked the growth of *fusarium oxysporum* f.sp.*psidii* causing wilt disease of guava at 100 µg/ml concentration. Nickel, Cobalt and Stannous reduced the growth at about 60%,42.8% and 33.3% while barium,zinc,calcium, magnese and iron significantly inhibited the growth at higher concentration i.e. 200 µg/ml to 21.4%,21.6%,25.7%,26.6% and 30%.The objective of the present study was to evaluate the effect of three heavy metals viz. Cadmium (Cd), Cobalt (Co) and Copper(Cu) against the growth of *fusarium udum* and *fusarium oxysporum f.sp.ciceri.*

1.1 Materials and Methods

Soil samples and plant parts showing wilt characteristic has been collected from the field of pigeonpea and chickpea. The samples has been taken from Kalli paschim village, District Sarojini nagar, Lucknow . The plant parts are examine under microscope to confirm the presence of respective pathogen .First of all infected plant parts were cut in to pieces (2-3 mm), then it is surface sterilize with 0.1% mercuric chloride solution for 30 seconds. The isolation was made from roots as well as from the foliar parts of wilted pigeonpea and chickpea plants. The plant parts were washed three times with sterilized distilled water and then were transferred aseptically on Potato dextrose Agar (PDA) media. The inoculated plates has been incubated at room temperature (27±2°C) and observations are made daily for emergence of culture. After the development of the fungal colonies stock cultures were prepared using PDA in test tubes and stored in refrigerator at 4°C. Both wilt pathogens viz. *fusarium udum* and *fusarium oxysporum* f. sp.*ciceri* are isolated from infected pigeonpea and chickpea plants and identify as per the monograph and standard procedures.

1000 ppm stock solution of chloride form of heavy metals *viz.*, Cadmium, Chromium and Copper are prepared by adding sterilized distilled water. Toxicity test against both the pathogens has been done by food poisoned technique (Groover and Moore, 1962). Czapek-dox medium is prepare and autoclave at 15lb/in^2 twice for one hour and allow to cool it. After cooling, the desired quantities of heavy metals are mixed with Czapek-Dox agar medium to get final concentration of 50, 75 and 100 ppm. Incorporated medium is pour in petriplates with control one having no phenolic compound. Each experiment has been done in triplicates. 5 mm diameter disks cut from one week old culture of *Fusarium udum* and *Fusarium oxysporum f.sp. ciceri* are transfer at the center of each plate separately. Plates are incubate at 25±2˚C for a week. After 7 days, redial growth is measure and percent growth inhibition is calculate. Data has been analyzed statistically.

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2. Observations

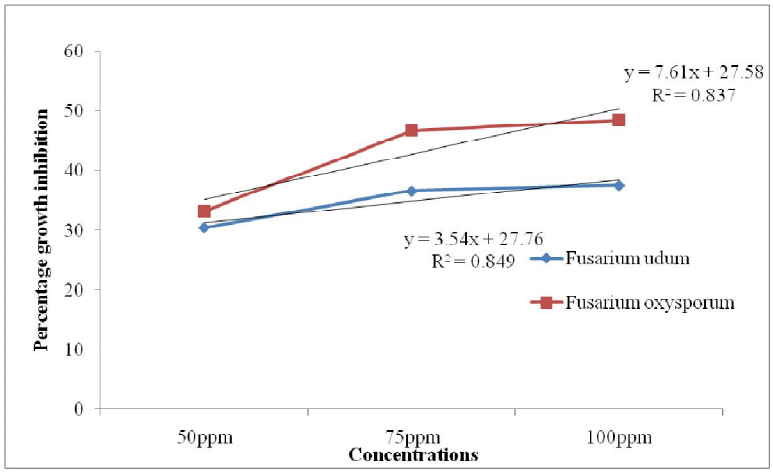

Fig. 1: Effect of cobalt against the growth of Fusarium udum and Fusarium oxysporum f.sp.ciceri

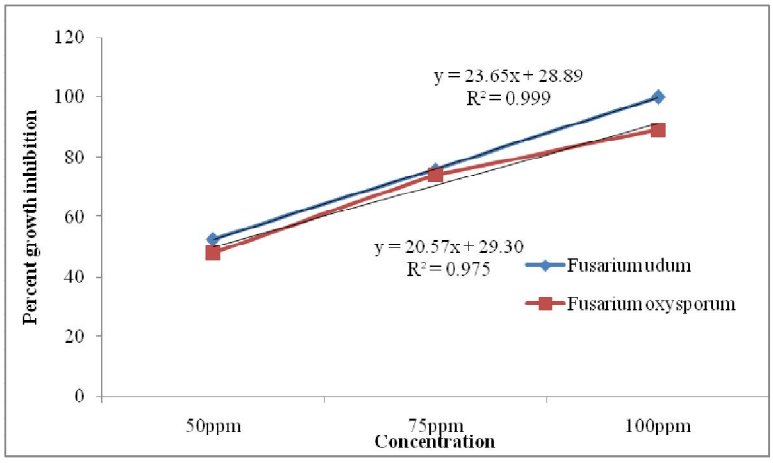

Fig. 2: Effect of copper against the growth of Fusarium udum and Fusarium oxysporum f.sp.ciceri.

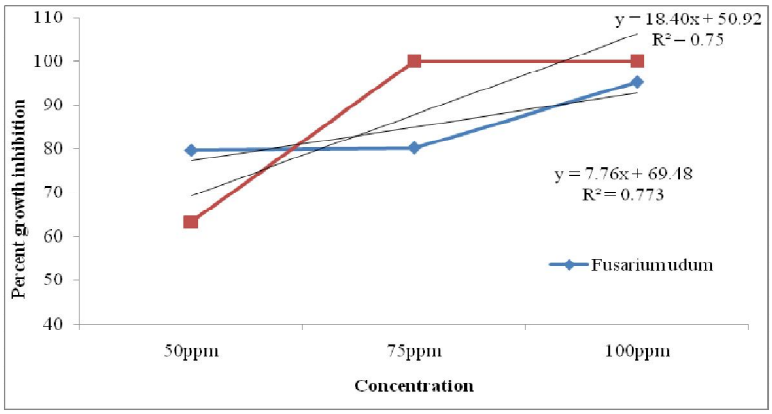

Fig. 3: Effect of cadmium against the growth of Fusarium udum and .Fusarium oxysporum f.sp.ciceri

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3. Result and Discussion

Findings shows that Cobalt at 50 ppm inhibits the growth of *fusarium udum* upto 30.44%, 36.56% at 75 ppm and 37.52% at 100 ppm with r^2 value 0.849 while in case of *fusarium oxysporum* f.sp.*ciceri* growth is inhibits to 33.26%, 46.67% and 48.48% at 50 ppm, 75 ppm and 100 ppm concentration of cobalt having r^2 value 0.837 respectively(Fig. 1). In case of Copper at 50 ppm inhibits the growth of *fusarium udum* upto 52.70%, 75.89% at 75 ppm and 100% at 100 ppm concentration. The regression coefficient value is 0.999. The radial growth of *fusarium oxysporum* f.sp.*ciceri* inhibits to 48.0% at 50 ppm, 74.22% at 75 ppm and 89.15% at 100 ppm concentration of copper with r^2 value 0.975 (Fig. 2). Cadmium reduce the growth of *fusarium udum* upto 79.67% , 80.15% and 95.19% with increasing concentration 50ppm, 75ppm and 100 ppm concentration having r^2 value 0.773 while radial growth of *fusarium oxysporum* f.sp.*ciceri* is reduce to 63.19% at 50 ppm, 100% at both 75 and 100 ppm concentration with r^2 value 0.75 (Fig 3). It is observe that growth of *fusarium udum* is completely check at 100 ppm of Copper, while 75 and 100ppm of Cadmium completely inhibits the growth of *fusarium oxysporum* f.sp.*ciceri* . There is significant reduction in the growth of *fusarium udum* was significantly reduced at 75 and 100 ppm concentration of cadmium. Cobalt shows the moderate effect against both the pathogen.

It may be conclude from above study that Copper significantly checks the growth of *fusarium udum* by 100% at 100 ppm conc followed by Cadmium (95.19%) and Cobalt (37.52%) at 100 ppm (at $p<0.01$) respectively wherease in case of *fusarium oxysporum* f. sp. *ciceri*, Cadmium inhibited the growth significantly (100%) at 75 and 100 ppm followed by Copper(89.15%) and Cobalt(48.48%) at 100 ppm conc. respectively (at $p<0.01$). In case of heavy metals 100 ppm of copper completely inhibited the growth of *fusarium udum*, while complete inhibition of growth of *fusarium oxysporum* f.sp. *ciceri* has been found at 75 and 100 ppm concentration of cadmium. Dwivedi (1990) also reported that mercury, cadmium and copper completely (100%) checked the growth of *fusarium oxysporum* f.sp.*psidii* causing wilt disease of guava at 100 µg/ml concentration. Nickel, Cobalt and Stannous reduced the growth at about 60%,42.8% and 33.3% while barium , zinc, calcium, magnese and iron significantly inhibited the growth at higher concentration i.e. 200 µg/ml to 21.4%,21.6%,25.7%,26.6% and 30%. The heavy metals and their sensitivity to a fungus vary depending on the types of metals (Ashida,1965; Huisingh,1974). Cadmium and copper were more toxic based on the observation of babich and stotzky(1977). Their tolerance at higher degree may be due to their low permibility to cell memberane as cadmium and copper were toxic at very low level(Babich and Stotzky,1978;Dubey and Dwivedi,1988). The effects of cadmium, cobalt, nickel and zinc on the growth and survival of *Macrophomina phaseolina* has been studied by Dubey and Dwivedi(1988).

Haider(1978) reported that copper fungicide 70% reduced the wilt disease of pigeonpea significantly followed by Brassicol, ceresin dust,sulphur dust and fytola. Ashour *et al.*,1973 reported 100% control of bulb rot of onion caused by *fusarium oxysporum* f. sp. *cepea*.Nickel salts sprayed to crop helps to control mint rust fungus *Puccinia menthae* (Garret, 1970). Preston (1931) studied that *Plasmodiophora brassicae* causing club root disease in cabbages can be control by watering with mercuric chloride. Damping–off peas and tobacco had controlled by soil amended with chlorobromopropene and copper sulphates (Kreutzer *et al.*, 1950 and R.G.Orellana, 1953).Mandal and Sinha (1992) founded that copper chloride, ferric chloride, magnese sulphate controlled *Fusarium oxysporum* f.sp.*lycopersici* by inducing resistance in suspectible tomato plant.

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4. Conclusion

On the basis of above study, it has been concluded that heavy metal can effectively reduced the growth of both *fusarium udum* and *fusarium oxysporum f.sp.cicer*i. Copper and cadmium at higher concentrations reduced the growth of both the fusarium spp.Hence heavy metals can be used effectively in wilt disease management.

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