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Effect of Different Doses of *Trichoderma harzianum* and Fungicides for the Management of Collar Rot of Chickpea Caused by *Sclerotium rolfsii*

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ABSTRACT

Soil application of maize grain based culture of T. harzianum at 5, 10, 15 and 20 g per pot showed significant reduction in mortality of chickpea seedlings caused by Sclerotium rolfsii. Maximum control of collar rot (53.33%) was recorded in treatment where T. harzianum was applied @ 20 g per pot. Seed treatment with fungicides significantly reduced the mortality of chickpea seedlings when compared with control. The Seeds treated with Carboxin (Vitavax) @ 2 g/kg proved most effective and showed 66.70 % disease control followed by Propiconazole @ 2 g/kg seed.

Key words: *Sclerotium rolfsii, Trichoderma harzianum, Fungicides*

INTRODUCTION

Chickpea (*Cicer arietinum* L.) commonly known as gram, is an important grain legume in Asia including India and the world. Firstly, it was cultivated in south eastern areas of the world but now it is also cultivated in semi-arid regions[1]. India accounts for approximately 75 per cent of world's chickpea production. Chickpea contributes about 71% to *rabi* pulse production and 46% of the total pulse production in India. It occupies an area of 8 m ha and its production is 7.1 mt with an average productivity of 885 kg/ha[5]. It is not only a major source of dietary protein for human consumption but it also plays an important role in the management of soil fertility because of having the ability of nitrogen fixation in its root nodules[6]. There is a growing demand of chickpea due to its nutritional value. It is the better source of carbohydrates and proteins as compared to other important pulses[4]. It is free of cholesterol and provides several vitamins and minerals[15]. *Sclerotium rolfsii* Sacc. is a well known and most destructive soil borne fungus initially described by Rolfs[11] on tomato. Among the biotic constraints, soil borne diseases such as Fusarium wilt (*Fusarium oxysporum* f. sp. *ciceri*), dry root rot (*Rhizoctonia bataticola*) and collar rot (*Sclerotium rolfsii*) are the major limiting factors in chickpea production.

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Chickpea diseases may cause yield losses of up to 100% depending on time of infection. Dry root rot and collar rot are emerging as a major threat to chickpea production due to drastic climate change[9]. The fungus is characterized by small tan to dark-brown or black spherical sclerotia with internally differentiated rind, cortex, and medulla were placed in the form genus *Sclerotium*[10]. *Sclerotium rolfsii* Sacc. is predominantly distributed throughout tropical and subtropical regions where, the temperature reaches higher levels during the rainy season. This pathogen causes a variety of symptoms on different hosts like collar rot in chickpea, southern blight of sugar beet, foot rot of finger millet, leaf spot in *Lotus meliloti*, bud rot of *Colocasia variagata* and fruit rot in *Citrullus vulgaris* etc. Consequently the diseases caused by this fungus are more serious in tropical and subtropical regions than in temperate regions and this pathogen is of major importance throughout the world. Use of fungicides for the management of plant diseases is a common practice. As *Sclerotium* is a soil borne pathogen with a wide host range, crop rotation may not be of much help, hence efficacy of certain fungicides as seed treatment and potential isolate of *T. harzianum* by using different formulation doses to know their efficacy against *S. rolfsii* for further utilization in field to manage the disease.

MATERIALS AND METHODS

Biological management of collar rot

Non-autoclaved soil filled in earthen pots of 24 cm diameter (4 kg soil capacity) was used for the experiment. Soil was inoculated with mass culture of *S. rolfsii* grown on sorghum grains @ 10 g/pot. Thereafter, maize grain based preparation of *T. harzianum* was mixed in upper 5 cm soil @ 5 g, 10g, 15 g, 20 g per pot. These pots were then left for 5 days to allow the antagonist to grow and interact with the test fungus in the soil. Appropriate moisture was maintained in pot soil by watering as and when required. Six seeds of chickpea variety Pusa 256 was sown in each pot inoculated with *S. rolfsii* five days after *T. harzianum* application. Observation on pre and post emergence mortality was recorded. Final observation on the disease was recorded 45 days after sowing. Percent disease control was calculated by using the following formula:

$$\text{Per cent disease control} = \frac{C-T}{C} \times 100$$

Where,

C = Per cent mortality in check inoculated with *Sclerotium rolfsii*

T = per cent mortality in treatment.

Chemical management of collar rot

Non-autoclaved soil collected from chickpea plot was used for pot experiments. The texture, pH and electrical conductivity of the soil were, silty loam, 7.5 and 0.16 mhos respectively. Earthen pots of 24 cm diameter (4 kg soil capacity) were filled with soil and then inoculated with culture of *S. rolfsii* grown on sorghum grains at the rate of 10 g per pot. Chickpea seeds of variety Pusa 256 were treated with fungicides viz., Propiconazole (Tilt), Hexaconazole (Trigger), Carbendazim (Bavistin), Carboxin (Vitavax) and Thiophanate Methyl (Roko) @ 2gm per Kg, seed. Six seeds of chickpea were sown in each pot. Each treatment was replicated three times. The pots sown with untreated chickpea seeds in soil infested with *S. rolfsii* served as control. Observation on total stand and affected plants were recorded. Final observation was recorded 45 days after sowing. Per cent disease control was calculated by applying the following formula**:**

$$\text{Per cent disease control} = \frac{C-T}{C} \times 100$$

Where,

C = Per cent mortality in check inoculated with *S. rolfsii.*

T = per cent mortality in treatment.

RESULTS AND DISCUSSION

Effect of different doses of *T. harzianum* on Collar rot management

Maize based mass culture of *T. harzianum* at 4 doses i.e. 5.0, 10.0, 15.0 and 20.0 g per pot were evaluated as soil application to manage the collar rot of chickpea. It is obvious from the data given in table 1 that all the treatments reduced seedling mortality significantly when compared with control. Among the doses tested, minimum seedling mortality (38.89%) and maximum disease management of 53.33% was recorded in treatment where *T. harzianum* was applied @ 20.0 g/pot. On the other hand maximum seedling mortality (61.11%) and minimum disease management of 26.67% was recorded in lowest rate of *T. harzianum* application i.e. 5.0 g/pot. As the doses of *T. harzianum* application in soil increased, the disease control correspondingly increased indicating positive relationship in doses of *T. harzianum* application and disease control. Recent research has indicated that fermenter biomass preparations formulated as a powder , slurry or alginate pellets and added to soil not only proliferate *Trichoderma* dramatically, but also suppress diseases more effectively than bare condia or chlamydospores[2]. Pellets of fermenter biomass of *T. hamatum, T. harzianum, T. viride* and *G. virens* reduced the survival and growth of *R. solani* in soil[2]. Maximum disease control (53.33%) was recorded in treatment where *T. harzianum* was applied @ 20 g/pot and minimum (26.67%) in 5 g/pot in present study. A positive relationship in increasing dose of application of *T. harzianum* and disease management was observed. The results of present investigation clearly indicated that biocontrol of collar rot may be achieved by soil augmentation of maize grain preparation of *T. harzianum.* However, field experiments are needed to support the results of pot experiments. Similar observation was repoted by Tripathi[14] when seed treatment with all the six *Trichoderma* spp. including local isolates were found to be effective against *Sclerotium rolfsii* in increasing germination and decreasing the mortality of seedlings over control. Biological control of soil borne pathogens especially *Pythium, Rhizoctonia, Sclerotium* and *Fusarium* have been achieved by soil augmentation of species of *Trichoderma* in several crops such as tobacco[8].

Fungicidal management of collar rot

Five fungicides viz., Propiconazole (Tilt), Hexaconazole (Trigger), Carbendazim (Bavistin), Carboxin (Vitavax) and Thiophanate Methyl (Roko) were evaluated as seed treatment @ 2.0 g/kg seed for control collar rot of chickpea in pots. The pot soil was infested with mass culture of *S. rolfsii* @10g mass culture/pot. All the treatment proved significantly superior in controlling the disease when compared with untreated control. Vitavax @ 2.0 g/kg of seed treatment proved to be the best and showed maximum disease control (66.70%). The disease control obtained in Bavistin, Propiconazole and Hexaconazole at 2 g/kg seed showed 46.69, 53.42 and 60.02 respectively and did not differ significantly among each other i.e. indicating equally good performance. Minimum disease control of 34.99 percent was recorded in Topsin M seed treatment (Table 2). Results of the pot experiment presented in table 2 clearly indicated that treatment with fungicides proved significantly superior in controlling collar rot of chickpea when compared with untreated control. Seed treatment with Vitavax @ 2 g/kg of seed proved the best and showed 73.32% disease control followed by Propiconazole @ 2 g/kg of seed treatment but this did not differ significantly with Vitavax 2 g. Topsin-M was least effective in controlling the collar rot of chickpea in pots. Superiority of Vitavax in controlling the collar rot of chickpea caused by *S.rolfsii* has been reported by Shukla *et al.*[12] also. Chaube *et al.*[3] studied the efficacy of ten fungicides against chickpea wilt complex under field condition and reported that Bavistin 1.0 g or mixture of Bavistin + Thiram (1:4) @ 2.5 g/kg seed used as seed dressers improved germinability, plant stand and yield as compared to check. Other effective fungicides were Panorm 2.5 g, Bayleton 1.0 g and mixture of Brassicol + Thiram (1:1) 2.5 g/kg seed. Thakur *et al.*[13],

studied the effect of 0.2% Captan, Benomyl, Prochloraz, Mancozeb, Bavistin and Thiram on chickpea growth under artificial inoculation conditions and reported that Bavistin gave the highest seed germination percentage, shoot length and fresh weight, while it also gave the lowest infection percentage. Captan, Benomyl and Mancozeb gave the highest root length, dry weight and number of nodules.

Table1: Management of collar rot of chickpea by soil application of *T. harzianum* isolate 4

***T. harzianum* (g/pot) (Maize grain based formulation)**	**Total mortality (%)**	**Disease control over check (%)**
5.0	61.11* (37.65)**	26.67* (15.46)**
10.0	55.53 (33.72)	33.36 (19.48)
15.0	44.44 (26.38)	46.67 (27.81)
20.0	38.89 (22.87)	53.33 (32.22)
Control(*S. rolfsii* @ 10 gm / pot)	83.33 (56.42)	0.00
SEM	2.36	2.375
C.D at 5%	7.81	7.86
C.V	11.50	14.248

*Mean of 03 replications.

**Values given in parentheses are Arcsin $\sqrt{\ }$transformaion

Table 2: Fungicidal management of collar rot

Fungicides	**Seed treatment (g/kg)**	**Mortality (%)**	**Disease control (%)**
Propiconazole	2.0	35.23* (33.30)**	60.02* (50.76)**
Hexaconazole	2.0	38.80 (38.49)	53.42 (46.91)
Carbendazim	2.0	44.44 (41.73)	46.69 (43.09)
Thiophanate Methyl	2.0	55.5 (48.23)	34.99 (33.37)
Carboxin	2.0	27.81 (22.22)	66.70 (59.20)
Control	-	83.33 (65.86)	0
SEM		3.337	4.15
C.D at 5%		9.789	12.24
C.V		13.198	18.41

*Mean of 03 replications.

**Values given in parentheses are Arcsin $\sqrt{\ }$transformaion

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