J. Biol. Control, 17(2): 193-195, 2003

Research Note

Biological control of rhizome rot of turmeric (*Curcuma longa* L.) caused by *Fusarium solani*

M. N. REDDY, M. CHARITHA DEVI and N. V. SREEDEVI
Department of Applied Microbiology
S. P. Mahila Visvavidyalayam
Tirupati 517 502, Andhra Pradesh, India
E-mail: mopuri_nr@yahoomail.com

ABSTRACT: **Disease suppressive role of the antagonistic microorganisms, *Trichoderma harzianum*, *Trichoderma virens* and VAM fungus against rhizome rot of turmeric (*Curcuma longa* L.) caused by *Fusarium solani* was established in both pot culture and field studies. VAM treated plants in the infested soil showed reduced disease incidence as compared to *F. solani* alone treated plants. *Trichoderma* and *Gliocladium* treatment resulted in less disease incidence as compared to VAM treated plants. Among the three-biocontrol agents tested, *T. harzianum* was found to be the most effective in disease control as compared to others. Plants treated with biocontrol agents were healthy with enhanced biomass and also yield to varied extents.**

KEY WORDS: Biological control, *F. solani*, rhizome rot, turmeric

Rhizome rot caused by *Fusarium solani* is one of the most important diseases of turmeric, causing heavy crop losses. This disease is predominantly soil-borne in nature. There have been many reports of successful use of antagonistic fungi to control soil-borne pathogenic fungi. Species of the genera *Trichoderma* and *Gliocladium* have been evaluated by many workers for efficacy in the biocontrol of fungal plant pathogens (Papavizas, 1985). VAM can also suppress soil-borne plant pathogens effectively (Jalali and Chand, 1988). In this study, the efficacy of *T. harzianum*, *T. virens* and VAM in the control of rhizome - rot of turmeric caused by *F. solani* has been tested and the results presented.

F. solani was isolated from the infected rhizomes of turmeric collected during the survey of turmeric fields of Cuddapah and Guntur Districts of Andhra Pradesh. *T. harzianum* and *T. virens* were isolated from the rhizosphere soils of different turmeric growing areas. The VAM fungus *Glomus mosseae*, obtained from GKVK, Bangalore, was used throughout the study.

Pot culture and field studies were carried out to prove the antagonistic activity against the pathogen. The pots (22cm diam) were 3/4th filled with steam-sterilized soil. The pathogen, *Fusarium solani*, *Trichoderma* and *Gliocladium* were multiplied in oat meal-sand medium. The inoculum of the test pathogen and biocontrol agents (BCAs), *T. harzianum*, *T. virens* and VAM were mixed in 1:1 ratio with the soil. After inoculation, the pots were incubated for two days and then five seedlings of turmeric were planted in each pot and watered regularly. The number of colony forming units (CFUs) of *T. harzianum* per g of soil were 18.1 x 10^3,

T. virens were 15.7 x 10^3 and the pathogen 12.1 x 10^3. After 45 days of planting, observations were made for disease incidence, leaf defoliation, plant biomass and VAM colonization. The eight treatments involved in the pot culture study were:

T_1 - Control; T_2 - *F. solani*; T_3 - *T. harzianum*; T_4 - *T. harzianum* + *F. solani*; T_5 - *T. virens*; T_6 - *T. virens* + *F. solani*; T_7 - VAM and T_8 - VAM + *F. solani*.

Field experiments were conducted in a randomized block design in the sick soil at Agricultural Research Station, Anantharajupet of Cuddapah District with nine treatments of various combinations of the fungicides, namely, Mancozeb (0.3%), Ridomil-MZ (500 ppm), *Trichoderma harzianum*, *T. virens*, *T. harzianum* + Mancozeb, *Trichoderma harzianum* + Ridomil, *T. virens* + Mancozeb, *T. virens* + Ridomil and control. Treatments were replicated twice with a plot size of 2 x 2 m^2. Ten days prior to sowing of turmeric, *F. solani* mass multiplied on sorghum seeds was incorporated at the rate of 150 g/m^2 (Elad *et al.*, 1980). Three days after inoculation of the pathogen, bioagents were added at the rate of 150 g/m^2 and incubated for 7 days for multiplication in the soil. Observations on disease incidence and growth parameters were recorded. The fungicide and the bioagents were applied to the soil simultaneously. The bioagents were integrated at half rates when combined with the fungicides. The samples were collected for analysis at 45 days after inoculation.

In the pot culture studies VAM application resulted in suppressing *rhizome* rot caused by *F. solani*, besides enhancing the growth. Improved nutritional status of plants with mycorrhiza makes them more resistant to certain root diseases (Sieverding, 1991). The total phenol content in mycorrhizal roots was found to be higher than non-mycorrhizal roots and hence higher amount of phenols might be one of the factors responsible for increased resistance against *F. solani* (Bhatia *et al.*, 1972).

Soil application of *T. harzianum* resulted in the reduced disease incidence. Application of biocontrol agents to the soil resulted in reduced *rhizome* rot incidence and increased plant biomass. The specific activities of the antagonists that occur during its growth are probably more important in pathogen suppression.

Table 1. Effect of biocontrol agents on rhizome rot of turmeric (pot experiment)

Treatment	Disease incidence (%)	Plant biomass (g)	Leaf defoliation
T_1 Control	-	4.5 ± 0.57^{a}	-
T_2 *F. solani*	76.3 ± 1.15^{a}	0.53 ± 0.12^{b}	5.63 ± 0.12
T_3 *T. harzianum*	-	19.7 ± 0.17^{c}	-
T_4 *T. harzianum* + *F. solani*	22.23 ± 0.12^{b}	11.66 ± 0.16^{deg}	-
T_5 *T. virens*	-	10.9 ± 0.11^{eg}	-
T_6 *T. virens* + *F. solani*	24.06 ± 0.60^{b}	6.36 ± 0.08^{f}	-
T_7 VAM fungi	-	10.26 ± 0.13^{gh}	-
T_8 VAM fungi + *F. solani*	27.93 ± 1.03^{b}	9.06 ± 0.06^{ah}	-

Means donated with same letter, within each column do not differ significantly at $P < 0.01$.

Table 2. Effect of biocontrol agents and fungicides on the rhizome rot of turmeric (field experiment)

Treatment	Disease incidence (%)	Yield (kg)
T_1 Mancozeb (0.3%)	40.82 ± 1.07^{ag}	6.2 ± 0.45^{a}
T_2 Ridomil (500ppm)	25.6 ± 1.3^{bc}	8.2 ± 0.43^{bde}
T_3 *T. harzianum* (150g/m^2)	48.4 ± 1.06^{e}	5.8 ± 0.29^{ac}
T_4 *T. virens* (150g/m^2)	54.6 ± 2.4^{d}	5.0 ± 0.42^{acf}
T_5 *T. harzianum* + Mancozeb	38.4 ± 1.66^{a}	5.9 ± 0.24^{a}
T_6 *T. harzianum* + Ridomil	22.6 ± 1.45^{e}	8.6 ± 0.42^{de}
T_7 *T. virens* + Mancozeb	44.5 ± 1.73^{eg}	6.0 ± 0.62^{a}
T_8 *T. virens* + Ridomil	36.82 ± 1.77^{a}	7.8 ± 0.38^{e}
T_9 Control	81.64 ± 3.98^{f}	4.4 ± 0.33^{f}

Means donated with same letter, within each column do not differ significantly at $P < 0.01$.

VAM, *Trichoderma* and *Gliocladium* treated plants showed enhanced growth, in spite of the presence of pathogen. The root damage caused was compensated by enhanced rooting and growth. *F. solani* alone inoculated plants showed increase in disease incidence, leaf defoliation and decrease in plant biomass as the disease progressed (Table 1). *Trichoderma harzianum* when applied in the field against *rhizome* rot, resulted in reduced disease incidence and increase in the yield. The efficiency in the reduction of disease incidence and increased yields was more conspicuous in *Trichoderma* treated soils as compared to *Gliocladium* and VAM treated soils.

Field trials indicated *Trichoderma* to be the most effective in disease control as compared to other biocontrol agents. Ridomil also reduced the disease incidence. The combination of *Trichoderma* + Ridomil was more effective in suppressing the disease as compared to individual inoculations of *Trichoderma* or Ridomil alone (Table 2).

ACKNOWLEDGEMENT

Thanks are due to Dr. Y. R. Sarma, Director, Indian Institute of Spices Research, Calicut, for his constructive criticism and encouragement.

REFERENCES

Bhatia, J. S., Uppal, D. S. and Balaji, K. L. 1972. Influence of vesicular arbuscular mycorrhiza on plant pathogen. *Indian Phytopathology*, **25**: 231-235.

Elad, Y., Chet, I. and Katan, J. 1980. *Trichoderma harzianum* - a biocontrol agent effective against *Sclerotium rolfsii* and *Rhizoctonia solani*. *Phytopathology*, **70**: 119-121.

Jalali, B. L. and Chand, H. 1988. Role of VAM in biological control of plant diseases. pp. 209-215. In: (Mahadevan, A., Raman, N. and Natarajan K. (Eds.). *Mycorrhiza for Green Asia*. University of Madras.

Papavizas, G. S. 1985. *Trichoderma* and *Gliocladium*: Biology, Ecology and potential for biocontrol. *Annual Review of Phytopathology*, **23**: 23-54.

Sieverding, E. 1991. Vesicular - arbuscular mycorrhiza management in tropical agrosystems. Technical Co-operation, Federal Republic of Germany, Friedland, Bremar. 372 pp.