Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; SP2: 76-79

MSV Satyanarayana
Department of Plant Pathology, College of Horticulture, Dr. Y.S.R. Horticultural University, Anantharajupeta, YSR Kadapa, Andhra Pradesh, India

K Gopal
Department of Plant Pathology, College of Horticulture, Dr. Y.S.R. Horticultural University, Anantharajupeta, YSR Kadapa, Andhra Pradesh, India

M Kavitha
Department of Plant Pathology, College of Horticulture, Dr. Y.S.R. Horticultural University, Anantharajupeta, YSR Kadapa, Andhra Pradesh, India

Ch. Ruth
Department of Plant Pathology, College of Horticulture, Dr. Y.S.R. Horticultural University, Anantharajupeta, YSR Kadapa, Andhra Pradesh, India

Syed Sadarunnisa
Department of Vegetable Science, College of Horticulture, Dr. Y.S.R. Horticultural University, Anantharajupeta, YSR Kadapa, Andhra Pradesh, India

Correspondence
MSV Satyanarayana
Department of Plant Pathology, College of Horticulture, Dr. Y.S.R. Horticultural University, Anantharajupeta, YSR Kadapa, Andhra Pradesh, India

Integrated disease management study on growth and agronomical characters against *Fusarium* root rot in coriander (*Coriandrum sativum* L.)

MSV Satyanarayana, K Gopal, M Kavitha, Ch. Ruth and Syed Sadarunnisa

Abstract
Fusarium solani, an incitant of *Fusarium* root rot in coriander which causes economical yield loss and damage to coriander crop in Andhra Pradesh. The diseased plants showed poor growth and partial or fully damaged root system with conspicuous reduction in yield. To permit environment safe and to avoid dispensable use of fungicides sprays an integrated disease management trail was conducted against *Fusarium* root rot disease with Neemcake, Carbendazim + Mancozeb and *Trichoderma harzianum* in seven treatments and three replications under field conditions using direct and combined applications. Results from the present study depicts application of Neemcake @250kg/ha + *Trichoderma harzianum* @5kg/ha significantly showed better growth and yield paramters *viz*., Plant height (37.7cm), No. of. Branches/plant (4.7), No. of. Umbels/plant (6.3), No. of. Umbellets/umbel (5.0), Root length (16.5cm), Seeds/umbel (6.7) and Yield/plant (1.8g) over the control plot.

Keywords: *Fusarium solani*, IDM, coriander, root rot

Introduction
In the Indian sub-continent coriander (*Coriandrum sativum* L.) is an important herb and is extensively used in various dishes due to its varied health benefits *viz*., to treat ulcers, diarrhoea, blood pressure, anemia, menstrual disorders conjunctivitis and rheumatism. It is a soft plant growing to a height of 30 to 70 cm. The cultivated area in India is 552.7 thousand hectares with productivity of 0.8 metric tonnes per hectare in 2014-15 (Spice Board, 2015) [19]. The area of this crop covers four per cent of the total area under spices and condiments in India. It is extensively cultivated in states of Rajasthan, Gujarat, Andhra Pradesh, Madhya Pradesh, Tamil Nadu and Uttar Pradesh etc.,. Although, the area and production of crop is increasing year after year however the productivity is stagnant in spite of development of high yielding varieties and improved package of production technology. A side from productivity, it is affected with a number of soil and air borne fungal pathogens that causes major diseases and leaven in yield reduction. Among them, the soil borne pathogens especially *Fusarium* spp. are microscopic, hidden and unevenly distributed in the soil which often causes infection to the growing crop in a highly damaging manner which cause decrease in yield. These enters through roots and become systemic causing abroad range of diseases on various host plants, such as vascular wilts, pre and post emergence blights as well as root, wilts and stem rots (Pascale *et al*., 2002; Muthulakshmi *et al*., 2002; Schollenberger *et al*., 2006) [13, 11, 17]. In the southern region of India many farmers cultivated coriander, but they gave up its cultivation owing to the frequent occurrence of soil borne diseases which destroyed the crop. To solve this problem farmers used fumigants and chemical fungicides over the past few years, however they failed to control the disease. Further, unknowingly they cause damage to the environment, toxic to humans and harmful to soil micro flora. Hence the present study was investigated to study the efficacy of integrated disease management against *Fusarium* root rot in coriander of Andhra Pradesh (AP).

Material and Methods
Isolation of pathogen
The pathogen used in this study was isolated from the diseased coriander root rot samples which were collected from Kadapa, Kurnool, Guntur and Prakasam districts of AP during 2016-17 *Rabi* season. *Fusarium solani* was isolated from collected samples, infected by root rot, on Potato Dextrose Agar (PDA) and incubated at 27^0C and is used to prepare inocula on sand-sorghum medium for further studies.

Mass multiplication of *Fusarium solani* and soil inoculation

Sand- Sorghum medium (SSM) was prepared in the proportion 95:5 in order to get maximum inoculum of the fungus. SSM was prepared by mixing 100g sorghum grain, 50 g sand, 50ml distilled water in 250 ml conical flask and sterilized at 15 psi for one hour for three consecutive days (Ravichandran and Kumar, 2012) [16]. About 200g of Sand-sorghum medium was taken in 1000ml flasks and watered to 20 percent of its weight and sterilized at 1.33 kg/sq.cm for one hour. A 6mm disc of the pure culture of *F. solani* was inoculated separately to the flask under aseptic conditions and incubated at 27±1ºC for 15 days. Later the inoculum was adjusted to 10^6 conidia/gram of inoculum by diluting infested sorghum grain seed with non- infested sorghum grain (w/w). The flasks were shaken on alternate days to get uniform growth. The giant culture so obtained was used for preparing sick soil at 75g/plot before twenty days of seed sowing.

Field Trail

An investigative field trail was conducted using to study the effectiveness of IDM on *Fusarium* root rot disease choosing coriander cv. Sudha as a susceptible check for growth and agronomical characters using 30×10 cm spacing in 1×0.8m individual plot size at College of Horticulture, Anantharajupeta, Dr. Y.S.R. Horticultural University during 2016-17 in *rabi* season. Each individual plot represents a replication of treatment. Application of Neemcake @250kg/ha, *Trichoderma harzainum* @5kg/ha was done 10 days before seed sowing (DBS) and drenching of fungicide @0.25% was done at 20 days after sowing (DAS) after rotting symptom was identified. The experiment was carried out in a randomized block design (RBD) with three replications having seven treatments. The details of the experiment treatments were given in Table 1. Observations *viz*., plant height (cm), no. of. branches/plant, no. of. umbels/plant, no. of. umbellets/umbel, root length (cm), seeds/umbel, yield/plant (g) and crop duration was recorded from 40 and 60 days after sowing.

Results and Discussion

***In vivo* integrated disease management (IDM) of *Fusarium* root rot**

Among the treatments imposed, the effect of IDM on plant height of coriander cv. Sudha at 40 DAS was non-significant (Table 2). Maximum plant height (37.7 cm) (Plate 1) was observed in plants treated with Neemcake + *T. harzianum* followed by application of Neem cake + Carbendazim + Mancozeb, Neem cake and *T. harzianum* (35.3 cm), whereas the lowest plant height (30.3 cm) was observed with application of Carbendazim + Mancozeb, untreated plants under field conditions. The better performance of the plants with neem cake and *Trichoderma* was probably because these acted as a natural fertilizer and prolongs the availability of nitrogen which resulted in higher vegetative growth. The above finding is in good agreement with the reports of several researchers (Kamal and Yousuf, 2012; Mazhabi *et al*., 2011). Doni *et al*. (2014) [6, 10, 3] reported that plants inoculated with *Trichoderma* showed increased growth components.

No. of. branches/plant at 60 DAS was non-significant during the study. Maximum number of branches (4.7) was found with application of Neem cake + *T. harzianum* and with direct application of Neem cake. Whereas remaining all treatments for no. of. branches/plant (4.0) wound considerably on par with each other along with untreated plants.

With respect to number of umbels/plant highest number (6.3) umbels/plant was recorded with treatment of Neem cake + *T. harzianum*, Neem cake + Carbendazim + Mancozeb which was significant superior and found best among all the treatments. Application of *T. harzianum* (6.0) was found next best which is on par with Neem cake (5.0). Treatment combination of *T. harzianum* + Carbendazim + Mancozeb (4.7) was found next best which was on par with treatment Carbendazim + Mancozeb (4.7) whereas the lowest number of umbels/plant was observed in control.

Similar trend was observed in increase of number of seeds/umbel with application of Neem cake + *T. harzianum* (6.7) was found superior over all the treatments which was followed by application of Neem cake + Carbendazim + Mancozeb (5.3) which is on par with treatment combination *T. harzianum* + Carbendazim + Mancozeb (5.3). Whereas least number of seeds 4.7/ umbel was observed with treatments Neem cake and Carbendazim + Mancozeb. Application of Neem cake along with biocontrol agent like *Trichoderma* apparently increases plant growth which is supported by Punja and Utkhede (2003) [15]; Whipps and Lumsden (2001) [21]. The above results are in coinciding with Shekhawat *et al*., 2016 [18].

A significant difference was evident from the results in crop duration (days) among the treatments. Neemcake + *T. harzianum* (91.3 days) was found best followed by Neemcake + Carbendazim + Mancozeb (82.0) and was on par with *T. harzianum* + Carbendazim + Mancozeb (81.7). Application of *T. harzianum* (71.3 days) was found next best followed by Carbendazim + Mancozeb (69.3). Least crop duration (47.3 days) was recorded in control. The best is due to initially application of fungicide reduced the initial germination capability of inoculum, but subsequently fungicide got diluted leading to germination of spores mean while applied *Trichoderma* population will be increased rapidly in soil and effectively enhance the growth of the plants and this hypothesis was supported by findings of Kay and Stewart, 1994 [7]; Shekhawat *et al*., 2016 [18].

Combined application of Neem cake + *T. harzianum* showed and found superior root length (16.5 cm) (Plate 2). It was significantly differed from Neem cake + Carbendazim + Mancozeb (12.5 cm) which is followed by *T. harzianum* + Carbendazim + Mancozeb (11.6 cm). Treatment Carbendazim + Mancozeb (8.9 cm) was found next best which is on par with *T. harzianum* (8.5 cm), Neem cake (7.7 cm) and the lowest root length was observed in inoculated untreated control (6.6 cm). The superior root length is may be due to inoculation of *Trichoderma* this result is similar with the findings of Adams *et al*. (2007) [1]. Cai *et al*. (2013) [2] reported that harzianolide produced by *Trichoderma* spp. can enhance root length. Besides that *Trichoderma* spp. may also solubilize minerals such as phosphorous which aids in better root development (Tripathi *et al*., 2010; Prakash *et al*., 2010; Nzanza *et al*., 2011) [20, 14, 12].

Treatment Neem cake + *T. harzianum* significantly recorded increase in yield (1.8g/plant) followed by Neem cake + Carbendazim + Mancozeb (1.7g). Whereas application of *T. harzianum* + Carbendazim + Mancozeb (1.1g) is on par with *T. harzianum* (0.9g), Carbendazim + Mancozeb (0.9g), control plot was recorded least yield (0.6g). Significant yield enhancement by *Trichoderma* application was reported by Khan and Gupta (1998) [9] and a report of application of neemcake which was best fitted as a natural fertilizer increases yield (Kamal and Yousuf, 2012; Habibi and

Thomas, 2016; Eifediyi *et al*., 2015) [6, 5, 4] in turmeric, eggplant and okra respectively. Similar results of highest seed yield/plant were noticed in Carbendazim treated plots of cumin line CN 026 (Khalequzzaman *et al*., 2016) [8].

Table 1: Treatments included to manage *Fusarium* root rot in IDM

S. No	Treatments	Description
1	T1	Application of Neem cake @250kg/ha
2	T2	Application of bio-agent @5kg/ha
3	T3	Application of fungicide @0.25%
4	T4 (T1+T2)	Application of Neem cake @250kg/ha + Application of bio-agent @ 5kg/ha
5	T5 (T1+T3)	Application of Neem cake @250kg/ha + Application of fungicide @0.25%
6	T6 (T2+T3)	Application of bio-agent @5kg/ha + Application of fungicide @0.25%
7	T7	Control

Table 2: Effect of integrated disease management treatments on *Fusarium* root rot effect in Coriander cv. Sudha

Treatments	Plant height (cm)	Branches/Pl	Umbels/Pl	Umbellets/umbel	Root length(cm)	Seeds/umbel	Yield/pl (g)	Crop duration
T1	35.3*	4.7	5.0	5.0	7.7	4.7	0.7	68.0
T2	35.3	4.3	6.0	5.3	8.5	5.0	0.9	71.3
T3	30.3	4.0	4.7	4.7	8.9	4.7	0.9	69.3
T4	37.7	4.7	6.3	5.0	16.5	6.7	1.8	91.3
T5	35.3	4.3	6.3	4.3	12.5	5.3	1.7	82.0
T6	35.0	4.0	4.7	5.0	11.6	5.3	1.1	81.7
Control	30.3	4.0	4.0	4.0	6.6	5.0	0.6	47.3
SEm (±)			0.4	0.2	0.7	0.4	0.1	5.5
CD at 5%	NS	NS	1.3	0.7	2.1	1.1	0.3	17.1

*Data are the mean values of three replicates NS- Non Significant

Plate 1: Growth parameters of coriander cv. Sudha under different IDM treatments for *Fusarium* root rot

Plate 2: Root characters of coriander cv. Sudha under different IDM treatments for *Fusarium* root rot

Conclusions

Integrated disease management of *Fusarium* root rot in coriander cv. Sudha reveals that application of Neem cake @250kg/ha + *Trichoderma harzianum* @5kg/ha (T_4) was proved to be best and significant over other treatments regarding growth characters and seed yield of plant and it is evident from the present investigation that IDM is an effective approach to manage any disease and to obtain better growth of crop.

References

1. Adams P, De Leji FAAM, Lynch JM. *Trichoderma harzianum* Rifai 1295- 22 mediated growth promotion of crack (*Salix fragilis*) sapling in both clean and metal-contaminated soil. Microbiology Ecology. 2007; 54:306-313.
2. Cai F, Yu G, Wang P, Wei Z, Fu L, Shen Q *et al*. Harzianolide, a novel plant growth regulator and systemic resistance elicitor from *Trichoderma harzianum*. Plant Physiology and Biochemistry. 2013; 73:106-113.
3. Doni F, Isahak A, Che Mohd Zain CR, Wan Yusoff WM. Physiogical and growth response of rice plants (*Oryza sativa* L.) to *Trichoderma* spp. inoculants. AMB Express. 2014; 4(45):1-7.
4. Eifediyi EK, Mohammed KO, Remison SU. Effects of neem (*Azadirachta indica* L.) seed cake on the growth and yield of Okra (*Abelmoschus esculentus* (L.) Moench). *Poljoprivreda*. 2015; 21(1):46-52.
5. Habibi Fazal haq, Thomas T. Effect of different level of Fertilizers and Neem cake on attributes and yield of potato (*Solanum tuberosum* L.). International Journal of Multidisciplinary Research and Development. 2016; 3(4):196-199.
6. Kamal MZU, Yousuf MN. Effect of organic manures on growth, rhizome yield and quality attributes of Turmeric (*Curcuma longa* L.). The Agriculturists. 2012; 10(1):16-22.
7. Kay SJ, Stewart A. Evaluation of fungal antagonists for control of Onion white rot in soil box trials. Plant Pathology. 1994; 43:371-377.
8. Khalequzzaman KM, Uddin MK, Hossain MM, Kamrul Hasan Md. Effect of fungicides in controlling wilt disease of cumin. Malaysian Journal of Medical and Biological Research. 2016; 3(2):69-74.
9. Khan MR, Gupta J. Antagonistic effects of *Trichoderma* species against *Macrophomina phaseolina* on eggplant.

Journal of Plant Diseases and Protection. 1998; 105:387-393.
10. Mazhabi M, Nemati H, Rouhani H, Tehranifar A, Moghadam EM, Kaveh H *et al*. The effect of *Trichoderma* on Polianthes qualitative and quantitative properties. The Journal of Animal and Plant Sciences. 2011; 21(3):617-621.
11. Muthulakshmi P, Cheziyan N, Muthukrishnan K, Sabita Doraisamy. Management of coriander wilt using biocontrol agents. Journal of Spices and Aromatic Crops. 2002; 11(2):138-140.
12. Nzanza B, Marais D, Soundy P. Tomato (*Solanum lycopersicum* L.) seedling growth and development as influenced by *Trichoderma harzianum* and arbuscular mycorrhizal fungi. African Journal of Microbiology Research. 2011; 5(4):425-431.
13. Pascale M, Visconti A, Chelkowski J. Ear rot susceptibility and mycotoxin contamination of maize hybrids inoculated with *Fusarium* species under field conditions. European Journal of Plant Pathology. 2002; 108:645-651.
14. Prakash KR, Namasivayam N, Nivedetha, Vishnu Tejaswini K. Optimization of humic acid by *Trichoderma viride* and its effect on sorghum plant. Journal of Biopesticides. 2010; 3:155-157.
15. Punja ZK, Utkhede RS. Using fungi and yeasts to manage vegetable crop diseases. Trends Biotechnology. 2003; 21:400-407.
16. Ravichandran M, Kumar M. Studies on cultural, morphological variability in isolates of *Fusarium solani* (Mart.) Sacc. incitant of dry root-rot of Citrus. Current Biotica. 2012; 6(2):152-162.
17. Schollenberger M, Muller HM, Rufle M, Suchy S, Plank S, Drochner W. Natural occurrence of 16 *Fusarium* toxins in grains and feedstuffs of plant origin from Germany. Mycopathologia. 2006; 161:43-52.
18. Shekhawat KS, Shivran AC, Singh D, Mittal GK, Singh B. Eco-friendly approaches for the management of diseases and pest in cumin. International Journal of Seed Spices. 2016; 6(2):84-87.
19. Spice Board. Spices Board, India Ministry of Agriculture and Farmers Welfare, Govt. of India, 2015.
20. Tripathi RC. Fungal Biosolubilization of Neyveli Lignite into Humic acid. *Energy Sources*, Part A: Recovery, Utilization and Environmental Effects. 2010; 32:72-82.
21. Whipps JM, Lumsden RD. Commercial use of fungi as plant disease biological control agents: status and prospects. pp. 9-22. In: Fungi as Biocontrol Agents: Progress, Problems and Potential: T.M. Butt, C. Jackson, N. Magan, eds. CABI Publishing: Wallingford, UK, 2001, 390 pp.