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Evaluation of *Trichoderma* spp. along with farm yard manure for the management of *Fusarium* wilt of cumin (*Cuminum cyminum* L.)

S Gangopadhyay & Ram Gopal

Department of Plant Pathology, College of Agriculture
SK Rajasthan Agricultural University
Bikaner – 334 006, Rajasthan, India.
Email: gsamiran@yahoo.com

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Abstract

The efficacy of *Trichoderma harzianum* and *T. viride* used as seed treatment and soil application with and without farm yard manure in controlling wilt of cumin (*Cuminum cyminum*) caused by *Fusarium oxysporum* f. sp. *cumini* was studied at Bikaner (Rajasthan) in pathogen inoculated soil under green house condition. The two antagonists were evaluated as seed treatment @ 4, 6 and 8 g kg^{-1} seed; in case of soil application, these were evaluated @ 5 g kg^{-1} soil. Among the 12 combinations tested, maximum reduction in disease incidence was recorded when *T. harzianum* was used as seed treatment @ 4 g kg^{-1} seed + soil application @ 5 g kg^{-1} soil along with soil amendment of farm yard manure @ 10 kg^{-1} soil. This treatment also resulted in highest dry weight of cumin plants.

Keywords: biological control, cumin, *Cuminum cyminum,* farm yard manure, *Fusarium oxysporum* f. sp. *cumini,* wilt, *Trichoderma* spp.

Among the various fungal diseases affecting cumin (*Cuminum cyminum* L.), wilt caused by *Fusarium oxysporum* (Schlecht) f. sp. *cumini* Prasad and Patel is a serious problem in most of the cumin growing areas in India. Seed treatment with carbendazim is commonly used to protect the crop from *Fusarium* wilt (Agnihotri & Sharma 1987). However, since the crop remains vulnerable to *Fusarium* infection at all stages of growth, the chemical seed dressing does not provide satisfactory protection against this disease. The present paper reports the efficacy of farm yard manure (FYM) and *Trichoderma harzianum* Rifai and *T. viride* Pre. Ex. S.F. Gray used as seed treatment and soil application against *Fusarium* wilt in cumin under green house condition.

A virulent isolate of *F. oxysporum* f. sp.*cumini*, was used in the present study. Cumin cv. Local was used as the test host crop. Two antagonists, *T. harzianum* and *T. viride* obtained from the culture collection of the Department of Plant Pathology, College of Agriculture, Bikaner were used in the present study. These two antagonists were selected based on their efficacy of inhibiting *F.*

oxysporum f. sp. *cumini* under laboratory conditions. The pathogen was mass cultured in potato dextrose broth media. The mycelial mats were macerated in homogenizer and added in each pot containing 1 kg sterilized soil and incubated for 48 h in shade before sowing cumin seeds. Both the antagonists were grown on potato dextrose agar medium and talc based formulaton containing 10^8 CFU g^{-1} prepared.

Cumin seeds were treated with talc based formulations of *T. harzianum* and *T. viride* @ 4, 5 and 8 g kg^{-1} seed. Talc based formulation of the antagonists (5 g) was added in pathogen inoculated soil in pots. Two sets of experiments were carried out. In the first set, the effect of antagonists used as seed treatment alone on wilt incidence was recorded. In another set, the influence of antagonists used both as seed treatment (ST) and soil application (SA) was observed. Ten seeds were sown in each pot. The experiments were conducted following a completely randomized design with three replications for each treatment. Observations on disease incidence was recorded periodically upto 90 days after sowing (DAS). Cumin plants were uprooted after 90 DAS, washed in tap water and dried in oven at 60^0C for 24 h. Dry weight of five plants from each replication was recorded.

In the next experiment the effect of FYM on efficacy of antagonists in controlling cumin wilt was studied. In this experiment FYM was used @ 5 and 10 kg^{-1} soil. Talc based formulations of *T. harzianum* and *T. viride* were used as seed treatment (4 g kg^{-1} seed) and soil application @ 5 g kg^{-1} soil. FYM was mixed with soil at required proportions followed by soil inoculation with mycelial suspension of the pathogen. The two antagonists were added after 3 days of soil inoculation with the pathogen and mixed thoroughly. In case of control, cumin seeds were sown in *Fusarium* inoculated soil without FYM and antagonists. Observations on disease incidence was recorded periodically upto 90 DAS. Dry weight of plants was also recorded as mentioned earlier. Per cent disease incidence, disease control and increase in dry weight were calculated.

In the first experiment (seed treatment alone) the disease incidence recorded in *T. harzianum* treatment was significantly lower than the corresponding treatment of *T. viride* except at 6 g kg^{-1} seed dosage (Table 1). In the second experiment, disease control was higher when the antagonists were used both as seed treatment and soil application as compared to seed treatment alone. Maximum disease control (81.0%) was recorded in *T. harzianum*

Table 1. Efficacy of *Trichoderma* spp. used as seed treatment in controlling cumin wilt

Treatment	Dose (g kg^{-1} seed)	Disease incidence (%)	Disease control (%)	Dry wt. of plant at 90 DAS (mg)	Increase in dry wt. over control (%)
Trichoderma harzianum	4	35.1(36.3)*	47.3	287.7	81.0
	6	30.6(33.6)	54.1	308.0	93.7
	8	26.1(30.8)	60.8	321.0	101.9
Trichoderma viride	4	43.9(41.5)	34.2	246.7	55.1
	6	38.7(38.5)	41.9	270.7	70.2
	8	35.5(36.6)	46.8	284.3	78.8
Control (Pathogen inoculated)		66.7(54.8)	-	159.0	-
CD (P=0.05)		5.0		33.9	

DAS=Days after sowing; *Figures in parentheses are angular transformed values

used as seed treatment @ 8 g kg^{-1} seed + soil application @ 5 g kg^{-1} soil that was at par with seed treatment @ 6 g kg^{-1} seed + soil application @ 5 g kg^{-1} soil. The treatment also resulted in enhanced dry weight of plants (Table 2). The disease control efficacy of both the bioagents was positively influenced by FYM in the next experiment. With increase in dose of FYM, the disease incidence was significantly reduced. *T. harzianum* was more effective in suppressing the wilt incidence as compared to *T. viride*. Maximum reduction in disease incidence was recorded when *T. harzianum* was used as seed treatment @ 4 g kg^{-1} seed + soil application along with FYM used @ 10 kg ha^{-1} soil. Dry weight of cumin plants was significantly enhanced in presence of FYM. Maximum dry weight was recorded in *T. harzianum* seed treatment (4 g kg^{-1}) + soil application (5 g kg^{-1}) along with application of FYM @ 10 g kg^{-1} soil (Table 3).

Seed treatment with *T. harzianum* and *T. viride* also gave satisfactory control of *Fusarium* wilt in chickpea and coriander (Mukhopadhyay & Kaur 1990; Gandhikumar & Ranganathan 2000). Kumar & Dubey (2001) reported that *T. harzianum* isolates were more effective than *T. viride* isolates against *Fusarium solani* f. sp. *pisi* under laboratory conditions.

The present study indicated the potential of utilizing bioagents like *Trichoderma* spp. along with organic substrate such as FYM for effective control of *Fusarium* wilt of cumin.

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Table 2. Efficacy of *Trichoderma* spp. used as seed treatment and soil application against cumin wilt

Treatment	Method and dose	Disease incidence (%)	Disease control (%)	Dry weight of plant at 90 DAS (mg)	Increase in dry wt. over control (%)
Trichoderma harzianum	SA (5 g kg^{-1} soil)	28.4(32.2)*	59.4	283.3	75.6
	ST (4g kg^{-1}seed) + SA (5 g kg^{-1} soil)	20.5(26.9)	70.8	319.7	98.1
	ST (6 g kg^{-1} seed) + SA (5 g kg^{-1} soil)	15.7(23.3)	77.5	330.0	104.6
	ST (8 g kg^{-1} seed) + SA (5 g kg^{-1} soil)	13.3(21.4)	81.0	340.3	110.9
Trichoderma viride	SA (5 g kg^{-1} soil)	37.7(37.9)	46.2	243.0	50.6
	ST (4 g kg^{-1} seed) + SA (5 g kg^{-1} soil)	29.3(32.8)	58.1	277.3	71.9
	ST (6 g kg^{-1} seed) + SA (5 g kg^{-1} soil)	26.8(31.1)	61.8	289.7	79.5
	ST (8 g kg^{-1} seed) + SA (5 g kg^{-1} soil)	24.4(29.6)	65.1	299.0	85.3
Control (Pathogen inoculated)		70.0(56.8)	-	161.3	-
CD (P=0.05)		3.8	-	33.5	-

*Figures in parentheses are angular transformed values
DAS = Days after sowing; ST = Seed treatment; SA= Soil application

Table 3. Effect of farm yard manure on disease control efficacy of *Trichoderma* spp. against cumin wilt

Treatment	Disease incidence (%)	Disease control (%)	Dry weight of plant at 90 DAS (mg)	Increase in dry wt. over control (%)
T. harzianum ST 4 g kg^{-1} seed	36.7(37.3)*	45.0	284.3	78.5
T. harzianum ST 4 g kg^{-1} seed + SA 5 g kg^{-1} soil	28.5(32.3)	57.3	305.0	91.4
T. harzianum ST 4 g kg^{-1} seed + FYM 5 g kg^{-1} soil	29.4(32.8)	55.9	341.0	114.0
T. harzianum ST 4 g kg^{-1} seed + SA 5 g kg^{-1} soil + FYM 5 g kg^{-1} soil	23.3(28.7)	65.0	369.7	132.0
T. harzianum ST g 4 kg^{-1} seed + FYM 10 g kg^{1} soil	20.7(27.1)	69.0	392.3	146.2
T. harzianum ST 4 g kg^{-1} seed + SA 5 g kg^{-1} soil + FYM 10 g kg^{-1} soil	15.3(23.0)	77.1	417.0	162.0
T. viride ST 4 g kg^{-1} seed	44.5(41.9)	33.3	229.0	43.7
T. viride ST 4 g kg^{-1} seed + SA 5 g kg^{-1} soil	34.1(35.7)	48.9	263.7	65.5
T. viride ST 4 g kg^{-1} seed + FYM 5 g kg^{-1} soil	34.2(35.8)	48.7	323.3	102.9
T. viride ST 4 g kg^{-1} seed + SA 5 g kg^{-1} soil + FYM 5 g kg^{-1} soil	28.3(32.4)	57.6	345.0	116.5
T. viride ST 4 g kg^{-1} seed + FYM 10 g kg^{1} soil	29.1(32.7)	56.3	367.7	130.7
T. viride ST 4 g kg^{-1} seed + SA 5 g kg^{-1} soil + FYM 10 g kg^{-1} soil	20.3(26.7)	69.5	389.3	144.3
Control (Pathogen inoculated)	66.7(54.8)	-	158.3	-
CD (P=0.05)	3.7		34.3	

*Figures in parentheses are angular transformed values
DAS = Days after sowing; FYM = Farm yard manure; ST = Seed treatment; SA= Soil application

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