Short communication

Management of seedling rot of chilli (*Capsicum annuum* L.) using *Trichoderma* spp. and fluorescent pseudomonads *(Pseudomonas fluorescens)*

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Abstract

Isolates of *Trichoderma* (*T. harzianum* TR20 and *T. pseudokoningii* TR17) and fluorescent pseudomonads (*Pseudomonas fluorescens* P28 and P51) were evaluated (alone and in combination) under greenhouse and field conditions for efficacy in suppressing rhizoctonia root rot incidence and promoting plant growth in chilli. The combination, *T. harzianum* (TR20) + *P. fluorescens* (P28), was most effective in reducing disease incidence (66.7% more efficient than the control), but was at par with copper oxychloride (0.3%). Highest per plant yield also was recorded in the treatment combination TR20 + P28, followed by *T. pseudokoningii* (TR17) + *P. fluorescens* (P51). *T. pseudokoningii* (TR17) and *T. harzianum* (TR20) when applied alone also significantly increased the yield per plant and was superior to both the pseudomonads applied individually.

Keywords: Biological control, Damping-off, Mycoparasitism, *Rhizoctonia solani.*

Rhizoctonia solani causing damping-off disease of seedlings as well as root and stem rot in young transplants is a major soil-borne pathogen of chilli (*Capsicum annuum* L.). Although some chemicals are known to control *R. solani*, they are not effective always. Furthermore, being a vegetable crop, using chemicals for disease control is probably not advisable in view of the residue problems. Biocontrol of plant pathogens using antagonistic fungi and bacteria, therefore, assumes significance. Among the antagonistic fungi, *Trichoderma harzianum* has shown promise as a biocontrol agent of *R. solani* in chilli (Bunker and Mathur, 2001). Varshney and Chaube (1999) observed that fluorescent pseudomonads are also good biocontrol agents against several pathogens of tomato including *R. solani*. Therefore, greenhouse and field investigations to test the efficacy of the native isolates of the antagonistic fungi and bacteria *viz*., *Trichoderma* spp. and fluorescent pseudomonads (*Pseudomonas fluorescens*) against *R. solani* seedling rot of chilli were initiated.

Trichoderma spp. and fluorescent pseudomonads were isolated (Johnson and Curl, 1972) from the rhizosphere soils of healthy chilli plants collected from major vegetable growing areas of Thiruvananthapuram, Ernakulam, and Idukki districts in Kerala. Virulent isolates of *R. solani* were also collected from naturally infected chilli plants. Fungal and bacterial cultures were purified and maintained on potato dextrose agar and King's B medium respectively.

Twenty six isolates of *Trichoderma* and 56 isolates of fluorescent pseudomonads obtained were tested for their efficacy in suppressing *R. solani* by dual culture technique under *in vitro* conditions. *Trichoderma harzianum* (TR20), *Trichoderma pseudokoningii* (TR17), and *Pseudomonas fluorescens* isolates (P28 and P51) were found more antagonistic to *R. solani* under *in vitro* tests than other isolates and were thus selected for the greenhouse studies on disease suppression and plant growth promotion. For this, a pot culture experiment in

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completely randomized design was conducted at Vellayani during September–December 2003 with three replications. The experimental variables included *T. harzianum* (TR20), *T. pseudokoningii* (TR17), and *P. fluorescens* (P28 and P51) applied individually and in combination with each other. Copper oxychloride (0.3%) was used as the standard chemical check. *Trichoderma* inoculum multiplied in cowdung-neem cake mixture as per the recommended practices (KAU, 2002) with a slight modification in the quantity (6:1 v/v) was applied to the pots (100 g pot^{-1} one week before transplanting). The talc-based formulation of *Pseudomonas* sp. was applied as seed treatment, seedling root dip, and soil treatment (2%). To incite the disease, 15 day-old seedlings transplanted into the pots were inoculated with *R. solani* multiplied in rice bran-sand mixture (5 g kg^{-1} soil) 5 days after transplanting. Observations on disease incidence were made for a period of 2 weeks starting from the third day of inoculation. Biometric observations *viz*., yield, shoot and root length, and shoot and root weight were also recorded at 90 days after planting.

The fungal and bacterial isolates (TR20 and P28) which showed better response in disease suppression and plant growth improvement in the greenhouse trial were further evaluated under field conditions during February to May 2004. Observations on percent disease incidence and other biometric characters were made as in the greenhouse experiment. The data were subjected to analysis of variance technique after appropriate transformation, wherever needed.

A comparison of the data in Table 1 reveals that all treatments tested in the greenhouse experiment were effective in reducing *Rhizoctonia* rot incidence in chilli compared to the control. However, disease incidence was least (10%) for the combination *T. harzianum* (TR20) + *P. fluorescens* (P28). Reduction in disease severity in this treatment was comparable to that of copper oxychloride (0.3%). Among other treatments, where antagonists were applied individually, *T. harzianum* (TR20) was most effective.

In addition to reducing the disease, the antagonist treatment greatly enhanced plant growth and crop yields. Growth promotion was more pronounced when *T. harzianum* (TR20) + and *P. fluorescens* (P28) were applied in conjunction with one another (Table 1). It was also observed that the treated plants were sturdier and taller than the control plants even at the early stages of growth (Fig. 1). Highest yield was for *T. harzianum* (TR20) + P28 (427.7 g plant^{-1}) followed by *T. pseudokoningii* (TR17) + P51 (401 g plant^{-1}). Likewise, the combination of *T. harzianum* (TR20) + P28 recorded

Table 1. Effect of antagonists on the incidence of Rhizoctonia rot and plant growth characters of chilli at 90 days after planting under greenhouse conditions at Vellayani, Kerala.

Treatments	Disease incidence (%)*	Yield (g plant^{-1})	Plant height (cm)	Shoot dry weight (g)	Root length (cm)	Root dry weight (g)
Pathogen alone (control)	30 (33.2)	189.3	51.83	34.2	35.9	6.9
Trichoderma pseudokoningii (TR17)	20 (26.6)	395.3^a	57.43	39.5	31.0	10.0
Trichoderma harzianum (TR20)	17 (24.1)^a	360.7^a	49.17	35.8	35.2	10.6
Pseudomonas fluorescens (P28)	20 (26.6)	224.3	54.20	47.3^a	36.7	15.9^a
Pseudomonas fluorescens (P51)	20 (26.6)	195.3	47.57	35.4	27.6	8.8
TR17 + P28	17 (24.1)^a	342.0^a	58.67	47.9^a	29.2	10.7
TR20 + P28	10 (18.4)^a	427.7^a	57.07	58.2^a	36.2	13.0^a
TR17 + P51	20 (26.6)	401.0^a	53.63	44.0	34.7	10.6
TR20 + P51	17 (24.1)^a	373.0^a	58.63	45.5^a	36.2	16.0^a
Copper oxychloride (0.3 %)	10 (18.4)^a	161.7	47.43	24.6	29.3	4.4
Untreated check	-	162.0	41.93	27.4	25.8	8.6
CD (0.05)	10.6	84.2	12.70	10.8	10.2	4.4

*Figures in parenthesis indicates angular transformed values; [a]significantly different from control at $p = 0.05$. All values are means of three replicates.

T_0 - Pathogen alone
T_1 - *Trichoderma* sp. (TR17) + pathogen
T_2 - *Trichoderma* sp. (TR20) + pathogen
T_3 - *Pseudomonas* sp. (P28) + pathogen
T_4 - *Pseudomonas* sp. (P51) + pathogen
T_5 - TR17 + P28 + pathogen
T_6 - TR20 + P28 + pathogen
T_7 - TR17 + P51 + pathogen
T_8 - TR20 + P51 + pathogen

Figure 1. Effect of different antagonist treatments on the growth of chilli plants at 45 days after transplanting

the maximum dry weight of shoots (at 90 days after planting), whereas dry weight of roots was maximum in *T. harzianum* (TR20) + P51 combination. *T. pseudokoningii* (TR17) and *T. harzianum* (TR20) applied individually also recorded significant yield increases (395.3 and 360.7 g plant^{-1} respectively) and was superior to both the pseudomonads (applied separately).

In general, the results of the field experiment (Table 2) were similar to that of the greenhouse study. The field study showed that seedling rot incited by *R. solani* was least for *T. harzianum* (TR20) application (22.9%) although this was the second best treatment in the greenhouse study. TR20 + P28 (34.4%) and fungicide application (37.4%) emerged as the two next best treatments. TR20 + P28 also showed the highest dry weight of the shoot (70.8 g), but the highest fruit yield (370.3 g plant^{-1}) was for the *T. harzianum* (TR20) + P28 combination. Manoranjitham et al. (2001) reported similar results for tomato.

It is also evident from the present results that *T. harzianum* (TR20) is more effective against *R. solani* causing seedling rot in chilli than the fluorescent pseudomonads and *T. pseudokoningii* under *in vivo* conditions. This may probably be due to the potential of *T. harzianum* for mycoparasitism rather than antagonism through antibiosis. Devi and Reddy (2002) also reported *T. harzianum* as the most potential antagonist among five isolates of *Trichoderma* spp., *P. fluorescens*, and *Bacillus* sp. against *R. solani* causing damping off in groundnut.

In summary, our results indicate the possibility of using native isolates of *Trichoderma* and fluorescent pseudomonads for the management of seedling diseases in chilli. However, this should be further evaluated by comparing the present isolates with other cultures.

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Table 2. Effect of antagonists on the incidence of Rhizoctonia rot and growth characters of chilli at 90 days after planting under field conditions at Vellayani, Kerala.

Treatments	Disease incidence (%)	Yield (g plant^{-1})	Plant height (cm)	Shoot dry weight (g)
Pathogen alone (control)	40.2 (39.3)	330.50	52.25	53.88
Trichoderma harzianum (TR20)	22.9 (28.6)[a]	329.50	55.00	65.93
Pseudomonas fluorescens (P28)	40.2 (39.4)	273.25	41.50	36.08
TR20 + P28	34.4 (35.9)	370.25[a]	49.50	70.78[a]
Copper oxychloride (0.3%)	37.4 (37.7)	305.50	42.50	43.58
Untreated check	-	331.75	42.75	46.15
CD (0.05)	10.2	39.07	8.93	15.64

Figures in parenthesis indicates angular transformed values; [a]significantly different from control at $p = 0.05$. All values are means of three replicates.

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