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Bioefficacy of *Trichoderma harzianum* and *Trichoderma viride* against *Fusarium oxysporum* f. sp. *capsici* causing wilt disease in chilli

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Abstract

Trichoderma harzianum and *Trichoderma viride* were tested for their bioefficacy against *Fusarium oxysporum* f.sp. *capsici* in green house conditions. Talc based and liquid formulations of 1% each were prepared and evaluated. Among the various treatments, 1% talc based formulation of *T. harzianum* significantly reduced the wilt disease as 87.5 percent followed by 1% talc based formulation *T. viride* as 83.93 percent. 1% talc based formulation of *T. harzianum* has also recorded maximum germination along with enhanced plant height, root length and yield. Based on these observations, it is rated as "Highly Efficient". The maximum 35.27% wilt incidence was observed in untreated control.

Keywords: Bioefficacy, *Trichoderma harzianum*, *Trichoderma viride*, wilt disease

Introduction

Chilli (*Capsicum annum* L.) is one of the most commercialized spice crop. According to Department of Agriculture Cooperation and Farmers Welfare, Government of India, area and production of dried Chilli, for the year 2016-17 is 8,40,000 ha and 20,96,000 MT respectively [1]. India contributes 36 percent to total world's production and remained in first position in terms of international trade by exporting nearly 30 percent from its total production [2]. Despite of India being the leading producer, the average productivity is very low (1.11 t/ha dry chilli) as compared to developed countries like USA, China, South Korea, Taiwan etc, where the average yield ranges from 3 – 4 t/ha. Low productivity in Chilli is mainly attributed to lack of high yielding resistant varieties, diseases and pest. Among various diseases; wilt caused by *Fusarium oxysporum* f. sp. *capsici* is one of the most widely spread and prevalent throughout the country causing considerable loss in India. Use of chemicals for disease management calls for pesticides residues in foodstuffs, development of resistance in plant pathogens and appearance of new strains of these pathogens. Thus, it is a universal requisite to implement the practice of sustainable agriculture, using eco-friendly approaches. The use of bio-control agents (BCA's) in combination with organic manures and bio-fertilizers is the suitable alternative to chemical applications. There is a need to identify such bio-agents with multiple activities such as disease resistance as well as plant growth promotion. Among various bio-control agents *Trichoderma* spp. are considered nowadays as one of the most promising alternatives for plant disease control (Harman *et al.*, 2004) [3] and plant growth promotion (Yedidia *et al.*, 2001; Harman *et al.*, 2004) [4]. *In vitro* effectiveness of *Trichoderma* spp. against *Fusarium* spp. has been reported by Padmodaya and Reddy (1996) [5]. Present study is done with an objective to evaluate the bioefficacy of *Trichoderma harzianum* and *Trichoderma viride* against *Fusarium oxysporum* f. sp. *capsici*

Material and methods

A pot experiment was designed under greenhouse conditions in earthen pots of 15 cm diameter containing 2.7 Kg of sterilized soil. Soil was infested with inoculum of *Fusarium oxysporum* f. sp. *capsici* (@ 2% w/w) before sowing. Infested pots were irrigated for 5 days before sowing. Five chilli seedlings of variety G4 (treated) were sown in each pot; three replicate pots were specified for each treatment in Completely Randomized Experimental Design (CRD).

The experiment include 5 Seedling treatments, which were *F. oxysporum* f. sp. *capsici* (Soil) with 1% talc based formulation of *T. harzianum*; *F. oxysporum* f. sp. *capsici* (Soil) with 1% talc based formulation of *T. viride*; *F. oxysporum* f. sp. *capsici* (Soil) with 1% liquid formulation of *T. harzianum*; *F. oxysporum* f. sp. *capsici* (Soil) with 1% liquid formulation of *T. viride* and Control (Bioagents were applied to the seedlings 12 hr beforehand). Pots were kept under greenhouse conditions till the end of the experiment.

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Germination percentage was assessed at seven days after sowing. Disease assessment for incidence of wilt was determined after three weeks of sowing and Percent Disease Incidence was recorded at 30th day after sowing.

$$\text{Germination (\%)} = \frac{\text{Number of seedlings germinated}}{\text{Total number of seedlings sown}} \times 100$$

$$\text{Percent disease incidence} = \frac{\text{Number of seedlings affected}}{\text{Total number of seedlings germinated}} \times 100$$

For rating the bio agent, the disease grading scale proposed by Srivastava *et al.* (2002) [6] was followed. Seedling vigour

index was calculated by using the formula as described by Baki and Anderson (1973) [7].

$$\text{Vigour index} = (\text{Mean root length} + \text{Mean shoot length}) \times \text{Germination (\%)}$$

Results and Discussions

Among the various treatments, T₁ (*F.o.c* + 1% talc based formulation of *T. harzianum*) significantly reduced the wilt disease as 87.5 percent while treatments T₂, T₃, & T₄ reduced 83.93, 80.9 and 82.00 percent wilt incidence as compared to control. Based on the observations, treatment T₁ rated as “Highly Efficient (HE)”. The maximum 35.27% wilt incidence was observed in untreated control. Treatment T₁ also recorded the maximum. It was observed that this treatment (T₁) induce enhanced plant height, root length and yield.

Table 1: Effect of seedling treatment with *Trichoderma* spp. on Disease control of Chilli in glasshouse conditions

Treatment No.	Treatment details	Germination (%) [*]	Wilt incidence [*] (%)	Disease control (%)	Rating of the bio-efficacy
T ₁	<i>F.o.c</i> + 1% talc based formulation <i>T. harzianum</i>	90.0	12.45	87.55	Highly Efficient (HE)
T ₂	<i>F.o.c</i> + 1% talc based formulation <i>T. viride</i>	82.0	12.05	83.93	Moderately Efficient
T ₃	<i>F.o.c</i> + 1% liq. formulation of <i>T. harzianum</i>	81.0	14.32	80.90	Efficient
T ₄	<i>F.o.c</i> + 1% liq. formulation of <i>T. viride</i>	80.0	12.45	82.00	Efficient
T ₅	Control	73.0	35.27	-	-
	SE	1.30	1.23		
	CD @ 5%	2.50	2.74		

* Mean of three replications

Table 2: Effect of seedling treatment with *T. harzianum* and *T. viride* on the biometrics of chilli crop in greenhouse conditions

Treatment No.	Treatment details	Shoot length (cm) [*]	Root length (cm) [*]	Vigour Index	Yield g/pot [*]
T ₁	<i>F.o.c</i> + 1% talc based <i>T. harzianum</i>	17.50	7.20	2223	146.00
T ₂	<i>F.o.c</i> + 1% talc based <i>T. viride</i>	14.73	6.00	1699	136.00
T ₃	<i>F.o.c</i> + 1% liq. formulation of <i>T. harzianum</i>	14.63	6.37	1701	133.00
T ₄	<i>F.o.c</i> + 1% liq. formulation of <i>T. viride</i>	18.33	7.07	2032	111.67
T ₅	Control	15.53	5.40	1528	40.67
	SE	0.48	0.21		5.46
	CD @ 5%	1.53	0.66		17.21

* Mean of three replications

In our investigation, seedling treatment with 1% talc based formulation of *Trichoderma harzianum* and *Trichoderma viride* was found highly significant in reducing wilt incidence in chilli under glass house and field conditions. The inhibitory effect of these bio-agents against tested pathogen was probably due to competition and antibiosis.

Conclusion

Seedling treatment with 1% talc based formulation of *Trichoderma harzianum* and *T. viride* showed promising performance against Chilli wilt among all treatments tested in this investigation. These bio-control agents could be used as an eco-friendly approach to manage wilt in Chilli and may be advised to the farmer for profitable organic farming.

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