The Journal of Rural and Agricultural Research Vol. 16 No. 2, 49-53 (2016)
Received October 2016; Acceptance December 2016

Studies on *Trichodermaviride* 1.15% WP for Bioefficacy, Phytotoxicity and effect on beneficial Microbes against Seedling Root Rot in Cotton

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Abstract

The experiment was conducted in the experimental field of Institute of Pesticide Formulation Technology, Gurgaon during the period from 2008-2009 (first season) & 2009-2010 (second season).The experiment was conducted to evaluate the bioefficacy and phytotoxicity of different doses of Tricodermaviride *1.15% WP as seed treatment and soil application in comparison with existing product i.e. market sample of Carbendazim 50% WP against seedling root rot in cotton crop during kharif 2008-09 (First Season) & 2009-10 (Second Season).Seed treatment of* Trichodermaviride *1.15% WP @ 10 g/kg of seeds (22.35) recorded significantly least PDI as compared to soil application @ 2.0 to 5.0 kg/ha and seed treatment @ 4 and 5 gm/kg seed. It was also found that* Trichodermaviride *1.15% WP @ 10 g/kg of seed treatment (22.35) and Carbendazim 50% WP @ 2.0 gm/kg seed treatment (21.15) statistically at par in % reduction of disease incidence.*Tricodermaviride *1.15% WP @ 4-10 gm per kg seed treatment and soil application @ 2.0 to 5.0 kg/ha can be applied to the cotton crop for the management of Root Rot disease of cotton seedling (*Macrophominaphaseoli*).* Tricodermaviride *has no phytotoxicity effect on cotton plant and also no harmful effect on beneficial microorganisms in soil.*

Keywords: Cotton Plant, *Tricodermaviride,* Bio control

Introduction

Cotton (*Gossypiumhirsutum* L.) is the third largest important economic crop in India produced for cloth and other kind of things of human need serving many other important uses. The plant is tropical in nature and it grows best in warm temperatures. Recently, efficient and exploitive agriculture throughout the world is practiced at great cost to the environment. After decades of warning, the inappropriate usage of pesticides has led to development of more than 500 resistant pathogens (Georghiou, 1990). The increased pressure from public and environmental scientists, on the ill effects of chemical pesticides led to the genesis of bio control agents (Nakkeeran et al., 2005).Some bacteria and fungi prevent diseases and enhance plant growth. Beneficial free-living soil bacteria that increase plant growth are generally referred to as plant growth-promoting bacteria and are found in association with the roots of various plants (Kloepper et al., 1991; Sajjad et al., 2001; Shanmugaiah 2007). Beneficial microbes associate with plants in several ways. Some may inhabit the rhizosphere, taking advantage of root exudates; others may live on root or leaf surfaces and some may colonize intracellular spaces and vascular tissues inside the plant (Preston, 2004). Cotton is infected by a number of pathogens inducing different diseases, among them the damping-off caused by *Rhizoctoniasolani* and so the plant suffers heavy losses particularly during the early stage of crop growth (Nawar, 2008). Diseased seedlings showed damping-off in which the fungus attacked the basal part of the stem and eventually led to collapse of the plant on the soil surface. *Trichoderma*species are effective in the control of soil/seed borne fungal diseases in several crop plants (Kubicek et al., 2001). *Trichoderma sp.* and other beneficial root-colonizing fungi also enhance plant growth and productivity (Balasubramanian, 2003). However, many resistance-inducing fungi and bacteria increase both shoot and root growth, some non-pathogenic root-colonizing fungi also have similar effect (Harman et al., 2004). The increased growth response induced by *Trichoderma*sp. has been reported for many crops such as beans (*Phaseolus vulgaris*) cucumber (*Cucumissativus*), pepper

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(*Capsicum annum*), carnation (Dianthus carophyllus), maize (*Zea mays*), and wheat (*Tritichumaestivum*) (Lo and Lin, 2002).

Methodology

The experiment was conducted in the experimental field of Institute of Pesticide Formulation Technology, Gurgaon during the period from 2008-09 and 2009-10. The experiment was conducted to evaluate the bioefficacyand phytotoxicity of different doses of *Tricodermaviride* 1.15% WP as seed treatment and soil application in comparison with existing product i.e. market sample of Carbendazim 50% WP against seedling root rot in cotton crop during kharif 2008-09 (First Season) & 2009-10 (Second Season) in a simple Randomized Block Design with nine treatments and three replications using var. FS846 in a plots of 1 sq. Mt size at Institute of Pesticide Formulation Technology Research Farm Gurgaon (Haryana). The cotton crop was sown during the 2nd fortnight of July. All normal agronomical practices were followed to raise a good crop.

Observations on Percent disease incidence, and Percent seedling mortality were recorded by visual observations. Accordingly, percent disease control over inoculated and non inoculated control were calculated.

For phytotoxicity evaluation on soybean crop following observations were recorded on temporary or longer lasting damage caused to plants if any, leaf injury on tips and leaf surface, Wilting, Vein clearing, Necrosis, Epinasty, Hyponasty, Plant Height. Crop injury was observed and graded on visual rating from 1-10 as given below:

Rating	Crop Injury %	Verbal description
0	0	No adverse effect
1	1-10	Very slight discoloration
2	11-20	More severe, but not lasting
3	21-30	Moderate and more lasting
4	31-40	Medium and lasting
5	41-50	Moderately heavy
6	51-60	Heavy
7	61-70	Very Heavy
8	71-80	Nearly destroyed
9	81-90	Destroyed
10	91-100	Completely destroyed

Results and Discussion

Disease Incidence

A perusal of table 1 (2008-09) indicates that significant reduction in % disease incidence was observed under all the treatments when compared with inoculated control (No soil application or seed treatment). Seed treatment of *Trichodermavirde*

Table 1: Studies on bioefficacy of Tricodermaviride 1.15% WP against seedling Root Rot in cotton 2008-09

S. Treatments	% Root rot incidence (PDI) after 45 DAS*	% Disease Control (PDC) Over Inoculated Control	Non-inoculated Control	% Seedling Mortality after 60 DAS*
T1 *Tricodermaviride* 1.15% WP Soil Application @ 2 kg/ha	34.26	51.29	38.08	22.27
T2 *Tricodermaviride* 1.15% WP Soil Application @ 2.5 kg/ha	31.05	55.85	43.88	20.18
T3 *Tricodermaviride* 1.15% WP Soil Application @ 5 kg/ha	28.21	59.89	49.02	18.34
T4 *Tricodermaviride* 1.15% WP Seed Treatment @4 gm/kg of seed	32.22	54.19	41.77	20.94
T5 *Tricodermaviride* 1.15% WP @ 5 gm/kg of seed	27.12	61.44	50.98	17.63
T6 *Tricodermaviride* 1.15% WP Seed Treatment @10 gm/kg of seed	22.35	68.22	59.61	14.53
T7 Carbendazim 50% WP Seed Treatment @ 2gm/kg of Seed	21.15	69.93	61.77	13.75
T8 Inoculated Control	70.33		27.11	45.71
T9 Non- inoculated control	55.33	21.33		35.96
CD at 5%	2.60			2.88

*Mean of three replications

Table 2: Studies on bioefficacy of Tricodermaviride 1.15% WP against seedling Root Rot in cotton 2009-10

S.No. Treatments	% Root rot incidence (PDI) after 45 DAS*	% Disease Control (PDC) Over Inoculated Control	Non-inoculated Control	% Seedling Mortality after 60 DAS*	Yield (q/ha)
T1 *Tricodermaviride* 1.15% WP Soil Application @ 2 kg/ha	20.75	68.44	58.5	20.17	8.11
T2 *Tricodermaviride* 1.15% WP Soil Application @ 2.5 kg/ha	19.22	70.76	61.56	18.28	8.93
T3 *Tricodermaviride* 1.15% WP Soil Application @ 5 kg/ha	17.30	73.68	65.4	16.54	9.80
T4 *Tricodermaviride* 1.15% WP Seed Treatment @4 gm/kg of seed	20.37	69.01	59.26	18.74	8.6
T5 *Tricodermaviride* 1.15% WP @ 5 gm/kg of seed	16.15	75.43	67.7	15.83	10.88
T6 *Tricodermaviride* 1.15% WP Seed Treatment @10 gm/kg of seed	12.06	81.65	75.88	13.49	12.45
T7 Carbendazim 50% WP Seed Treatment @ 2gm/kg of Seed	10.97	83.31	78.06	12.76	13.44
T8 Inoculated Control	65.75			47.8	3.42
T9 Non- inoculated control	50.00			36.89	4.29
CD at 5%	2.55			2.79	1.58

*Mean of three replications

1.15% WP @ 10 g/kg of seeds (22.35) recorded significantly least PDI as compared to soil application @ 2.0 to 5.0 kg/ha and seed treatment @ 4 and 5 gm/ kg seed. It was also found that *Trichodermavirde* 1.15% WP @ 10 g/kg of seed treatment (22.35) and Carbendazim 50% WP @ 2.0 gm/kg seed treatment (21.15) statistically at par in % reduction of disease incidence (Table 1).

A perusal of table 2 (2009-10) indicates that a significant reduction in % disease incidence was observed under all the treatments when compared with inoculated control (No soil application or seed treatment). Seed treatment of *Trichodermavirde* 1.15% WP @ 10 g/kg of seeds (12.06) recorded significantly least PDI as compared to soil application @ 2.0 to 5.0 kg/ha and seed treatment @ 4 and 5 gm/ kg seed. It was also found that *Trichodermavirde* 1.15% WP @ 10 g/kg of seed treatment (12.06) and Carbendazim 50% WP @ 2.0 gm/kg seed treatment (10.97) statistically at par in % reduction of disease incidence.

Percent Disease Control

The percent reduction of the disease was highest in seed treatment of Carbendazim followed by *Trichodermavirde* 1.15% WP @ 10 g/kg of seeds treatment.

Seedling Mortality

It is evident from the table 1& table 2 that all the treatments showed significantly less seedling mortality then both inoculated and noninoculated controls.

Phytotoxicity

After sowing of the crop, the crop was continuously monitored for all phytotoxicity symptoms and crop health as described under methodology as such there was no phytotoxicityeffect (rating 0), if any of *Trichodermavirde* 1.15% WP doses in cotton.

Effect on beneficial microbes of cotton field

The effect of different treatments on the beneficial micro organisms in soil was studied with respect to *Rhizobium* population as described in the methodology and presented in table 3. The results indicated that there was no effect on *Rhizobium* population in soil due to *Trichodermavirde* 1.15% WP.

*Trichoderma*is a genus of asexual fungi found inthe soils of all climatic zones. *Trichoderma* is asecondary opportunistic invader, a fast growingfungus, a strong spore producer, a source of cell walldegrading enzymes, and an important antibiotic producer(Vinal et al., 2008).Numerous strains of this genus arerhizosphere competent and are able to degradehydrocarbons, chlorophenolic compounds,

Table 3: Effect of *Tricodermaviride* 1.15% WP on beneficial microbes of cotton 2008-2009

S.No. Treatments	*Rhizobium Population*	
	Before Treatment	After 30 days of treatment
T1 *Tricodermaviride* 1.15% WP Soil Application @ 2 kg/ha	3 x 10u	3 x 10u
T2 *Tricodermaviride* 1.15% WP Soil Application @ 2.5 kg/ha	5 x 10u	5 x 10u
T3 *Tricodermaviride* 1.15% WP Soil Application @ 5 kg/ha	5 x 10u	3 x 10u
T4 *Tricodermaviride* 1.15% WP Seed Treatment @4 gm/kg of seed	7 x 10u	8 x 10u
T5 *Tricodermaviride* 1.15% WP @ 5 gm/kg of seed	6 x 10u	5 x 10u
T6 *Tricodermaviride* 1.15% WP Seed Treatment @10 gm/kg of seed	6 x 10u	5 x 10u
T7 Carbendazim 50% WP Seed Treatment @ 2gm/kg of Seed	4 x 10u	3 x 10u
T8 Inoculated Control	7 x 10u	2 x 10u
T9 Non- inoculated control	3 x 10u	3 x 10u

Table 4: Effect of *Tricodermaviride* 1.15% WP on beneficial microbes of cotton 2009-2010

S.No. Treatments	*Rhizobium Population*	
	Before Treatment	After 30 days of treatment
T1 *Tricodermaviride* 1.15% WP Soil Application @ 2 kg/ha	5 x 10t	6 x 10t
T2 *Tricodermaviride* 1.15% WP Soil Application @ 2.5 kg/ha	4.8 x 10t	5.2 x 10t
T3 *Tricodermaviride* 1.15% WP Soil Application @ 5 kg/ha	4.9 x 10t	5.7 x 10t
T4 *Tricodermaviride* 1.15% WP Seed Treatment @4 gm/kg of seed	4.9 x 10t	6.2 x 10t
T5 *Tricodermaviride* 1.15% WP @ 5 gm/kg of seed	5.2 x 10t	6 x 10t
T6 *Tricodermaviride* 1.15% WP Seed Treatment @10 gm/kg of seed	5 x 10t	5.6 x 10t
T7 Carbendazim 50% WP Seed Treatment @ 2gm/kg of Seed	4 x 10t	3 x 10t
T8 Inoculated Control	5.2 x 10t	2 x 10t
T9 Non- inoculated control	5.3 x 10t	5.3 x 10t

polysaccharides and xenobiotic pesticides used inagriculture (Harman and Kubicek, 1998; Harman et al.,2004).*Trichoderma* species are well known as biocontrolagents of several crop diseases (Tsuen Lo and Yih Lin, 2002).The main bio-control mechanisms that*Trichoderma* utilizes in direct confrontation with fungalpathogens are mycoparasitism (Papavizas, 1985;Harman and Kubicek, 1998; Howell, 2003) and antibiosis(Howell, 1998; Sivasithamparam and Ghisalberti, 1998). In the present study, *Trichoderma*spp. showed variousdegrees of increased plant growth responses. The resultssuggested that various unknown factors might interact to mediate responses. The factors might result inrhizosphere affinity or survival ability of these species indifferent crops (Lo et al., 1997). Enhanced root andshoot growth as well as plant vigor has been observedfollowing application of *Trichoderma*spp. to many crops.For example, Lo et al. (1997) reported that *T. Harzianm*increased plant vigorbentagrass. Bjorkman et al. (1994)also reported that the fungus increased both root andshoot growth of corn. Also, Ozbay and Newman (2004)showed that *Trichoderma* spp. have evolved numerousmechanisms that are involved in attacking other fungi andso enhance plant and root growth. The enhanced growthresponse of several plants following application of*Trichoderma* spp. has also been well documented(Kleifield and Chet, 1992). Also, Tsuen Lo and Yih Lin (2002) reported that some selected isolates of*Trichoderma* spp. increased the root length and lateralroot numbers of cucumber seedlings. In conclusion, the application of *Trichoderma* spp. ortheir metabolites for crop protection such as the host defenceinducers and antibiotics can be produced cheaplyin large quantities on an industrial scale, easily preparedfrom the fungal biomass, dried and formulated for sprayor drench applications. Consequently, more detail studiesin the various strains of *Trichoderma*are still needed in order to provide a better understanding of the mechanisms of controlling damping-off and root rot and also promoting plant growth responses of cotton plants

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