



# Plant Pathology Journal

ISSN 1812-5387

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## Compatibility of Different Insecticides with *Trichoderma harzianum* Under *in vitro* Condition

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**Abstract:** *Trichoderma* spp. are also known as effective bio-control agents against soil-borne pathogens of several important crops. Integration of chemicals and bio-control agents has been the subject of research during recent years. The potential value of bio-pesticides for the control of important plant pathogens requires investigation due to the general requirement for very low pesticide residues in foodstuffs and concerns over the increasing development of resistance to the different classes of chemicals. The aim of the present study was to check the compatibility of different insecticides viz., Decis (Deltamethrin 2.8% EC), Ekalux 25% EC (Quinolphos 25% EC), Fenval 20% EC (Fenvalerate 20% EC), Hilcron 36% SL (Monocrotophos 36% SL), Hildan 35% EC (Endosulfan 35% EC), Hilmida (Imidacloprid 17.8% SL), Marshal 25% EC (Carbosulfan 25% EC), Rogor 30% EC (Dimethoate 30% EC), Rocket 44% EC (Profenofos 40%+Cypermethrin 4%) with V<sub>15</sub> strain of *Trichoderma harzianum* Rifai. Mycelial growth of V<sub>15</sub> strain of *Trichoderma harzianum* was calculated in the presence of above mentioned insecticides by using Potato Dextrose Broth (PDB) Medium and SP<sub>3</sub> Medium separately. Hilmida (Imidacloprid 17.8% SL) was found to be most compatible with V<sub>15</sub> strain of *Trichoderma harzianum* in both the liquid media as it shows nil percentage reduction of mycelium. It was concluded that Decis (Deltamethrin 2.8% EC), Hilcron 36% SL (Monocrotophos 36% SL), Hilmida (Imidacloprid 17.8% SL) and Rogor 30% EC (Dimethoate 30% EC) are compatible insecticides with biocontrol agent (*Trichoderma harzianum*) while some insecticides viz. Ekalux 25% EC (Quinolphos 25% EC), Marshal 25% EC (Carbosulfan 25% EC) and Rocket 44% EC (Profenofos 40%+Cypermethrin 4%) inhibits the growth of *Trichoderma* spp.

**Key words:** Compatibility, bio-control agent, insecticides, potato dextrose broth, SP<sub>3</sub> medium

### INTRODUCTION

*Trichoderma* spp. are fungi that occur worldwide. Recent studies show that these fungal parasites are able to produce antibiotics against plant pathogens. In addition, certain strains of *Trichoderma* spp. can induce systemic and localized resistance to several plant pathogens. Some strains may also enhance plant growth and development (Ha, 2010).

Biological control is an alternative to the use of chemical pesticides. Biological fungicides may act to suppress the population of the pathogenic organism through competition with pathogenic organisms, stimulate plant growth which may allow plants to quickly outgrow any pathogen effects, or damage the pathogen by means

of toxins produced (Cook, 2000; Gilreath, 2002). *Trichoderma* spp. has received the most attention for control of soil borne pathogens. *Trichoderma harzianum* is a fungal biocontrol agent that attacks a range of phytopathogenic fungi. It can be used either alone or in combination with other *Trichoderma* species in biological control of several plant diseases (Papavizas, 1985; Chet, 1987; Samuels, 1996).

Although use of biocontrol agents could reduce chemical application to a limited extent, it is less reliable and less efficient (Monte, 2001). Integrated Pest Management (IPM) is an approach involving the use of biological, physical and chemical measures to manage pest and pathogen populations in a cost-effective ecological way. Within these complex plant protection

strategies, one may need to combine biocontrol agents with chemicals to achieve the target (Kredics *et al.*, 2003). The combined use of biocontrol agents and chemical pesticides has attracted much attention as a way to obtain synergistic or additive effects in the control of soil-borne pathogens (Locke *et al.*, 1985).

The objective of the present study was to check the compatibility of different insecticides viz., Decis (Deltamethrin 2.8% EC), Ekalux 25% EC (Quinolphos 25% EC), Fenval 20% EC (Fenvalerate 20% EC), Hilcron 36% SL (Monocrotophos 36% SL), Hildan 35% EC (Endosulfan 35% EC), Hilmida (Imidacloprid 17.8% SL), Marshal 25% EC (Carbosulfan 25% EC), Rogor 30% EC (Dimethoate 30% EC), Rocket 44% EC (Profenofos 40%+Cypermethrin 4%) with V<sub>15</sub> strain of *Trichoderma harzianum* Rifai.

## MATERIALS AND METHODS

Whole experiment was carried out in the year 2007 in the laboratory of Division of Plant Pathology, National Botanical Research Institute, Lucknow, Uttar Pradesh, India.

**Estimation of compatibility of *Trichoderma harzianum* with insecticides:** V<sub>15</sub> strain of *Trichoderma harzianum* Rifai. was studied with nine insecticides viz. Decis (Deltamethrin 2.8% EC), Ekalux 25% EC (Quinolphos 25% EC), Fenval 20% EC (Fenvalerate 20% EC), Hilcron 36% SL (Monocrotophos 36% SL), Hildan 35% EC (Endosulfan 35% EC), Hilmida (Imidacloprid 17.8% SL), Marshal 25% EC (Carbosulfan 25% EC), Rogor 30% EC (Dimethoate 30% EC), Rocket 44% EC (Profenofos 40%+Cypermethrin 4%). Mycelial growth of V<sub>15</sub> strain of *Trichoderma harzianum* was calculated in the presence of above mentioned insecticides by using Potato Dextrose Broth (PDB) Medium and SP<sub>3</sub> Medium separately. Both recommended dose and double amount of recommended dose of insecticides were used separately in PDB and SP<sub>3</sub> medium for the mycelial growth of V<sub>15</sub> strain of *Trichoderma harzianum*. Take 10 mL PDB and 10 mL SP<sub>3</sub> medium in 19 conical flasks, respectively. Add recommended dose (100 µL) of insecticides in 9 conical flasks of PDB medium and 9 conical flasks of SP<sub>3</sub> medium aseptically. Similarly, add double amount of recommended dose (200 µL) of insecticides in 9 conical flasks of PDB medium and 9 conical flasks of SP<sub>3</sub> medium. One flask of 10 mL PDB and 1 flask of 10 mL SP<sub>3</sub> medium used as control without any insecticide.

Cut 6 mm discs of seven days old culture of V<sub>15</sub> strain of *Trichoderma harzianum* Rifai. by the sterilized cork borer and put a single disc in each conical flask containing PDB and SP<sub>3</sub> medium with the help of

inoculating needle under aseptic condition. Then all the flasks are kept on shaker for a week. After that harvesting and weighing of fungal growth was done.

**Calculation for the percent reduction of the mycelial growth of the *Trichoderma harzianum*:** The percent reduction of fungal growth was calculated by using the following formula (Vincent, 1947).

$$I = \frac{C-T}{C} \times 100$$

Where:

C = Control

T = Treatment

## RESULTS

After the completion of the experiment, it was found that four insecticides out of nine viz. Decis (Deltamethrin 2.8% EC), Hilcron 36% SL (Monocrotophos 36% SL), Hilmida (Imidacloprid 17.8% SL) and Rogor 30% EC (Dimethoate 30% EC) are compatible insecticides with biocontrol agent (*Trichoderma harzianum*).

As the data revealed in Table 1 shows that at 100 µL concentration of insecticides used, the conclusion come according to the recorded data that in liquid media i.e., in Potato Dextrose Broth (PDB), Decis (Deltamethrin 2.8% EC), Fenval 20% EC (Fenvalerate 20% EC), Hilcron 36% SL (Monocrotophos 36% SL), Hilmida (Imidacloprid 17.8% SL) and Rogor 30% EC (Dimethoate 30% EC) are compatible with V<sub>15</sub> strain of *Trichoderma harzianum* Rifai. in which Hilmida (Imidacloprid 17.8% SL) is most compatible by showing no percent reduction of *Trichoderma harzianum*. Marshal 25% EC (Carbosulfan 25% EC) shows medium compatibility because percentage reduction of mycelium is 37.720%. While Ekalux 25% EC (Quinolphos 25% EC), Hildan 35% EC (Endosulfan 35% EC) and Rocket 44% EC (Profenofos 40%+Cypermethrin 4%) are found to be incompatible with V<sub>15</sub> strain of *Trichoderma harzianum* as they had shown more than 50% of percentage reduction of mycelial growth of the fungus. At the same concentration of insecticides in SP<sub>3</sub> medium it was concluded that Decis (Deltamethrin 2.8% EC), Fenval 20% EC (Fenvalerate 20% EC), Hilcron 36% SL (Monocrotophos 36% SL), Hilmida (Imidacloprid 17.8% SL), Marshal 25% EC (Carbosulfan 25% EC) and Rogor 30% EC (Dimethoate 30% EC) are found to be compatible with V<sub>15</sub> strain of *Trichoderma harzianum*. While Ekalux 25% EC (Quinolphos 25% EC), Hildan 35% EC (Endosulfan 35% EC), and Rocket 44% EC (Profenofos 40%+Cypermethrin 4%) are found to be incompatible with

Table 1: Mycelial growth and percentage reduction of V<sub>15</sub> strains of *Trichoderma harzianum* in the presence of recommended dose (100 µL) of different insecticides in potato dextrose broth medium and SP<sub>3</sub> medium

Insecticide	Potato dextrose broth		SP <sub>3</sub>	
	Biomass	Percentage reduction	Biomass	Percentage reduction
Decis (Deltamethrin 2.8% EC)	0.490	15.224	0.573	12.390
Hilcron (Monocrotophos 36% SL)	0.544	05.880	0.552	15.600
Hildan (Endosulfan 35% EC)	0.215	62.800	0.300	54.120
Hilmida (Imidacloprid 17.8% SL)	0.618	Nil	0.646	01.230
Marshal (Carbosulfan 25% EC)	0.360	37.720	0.498	23.860
Rogor (Dimethoate 30% EC)	0.504	12.802	0.525	19.730
Rocket (Profenofos 40%+Cypermethrin 4%)	0.168	70.935	0.221	66.200
Fenval (Fenvalerate 20% EC)	0.487	15.742	0.650	0.620
Ekalux (Quinolphos 25% EC)	0.269	53.450	0.290	55.657
Control	0.578		0.654	

EC: Emulsifiable concentrate, SL: Soluble concentrate

Table 2: Mycelial growth and percentage reduction of V<sub>15</sub> strains of *Trichoderma harzianum* in the presence of double amount of recommended dose (200 µL) of different insecticides in potato dextrose broth medium and SP<sub>3</sub> medium

Insecticide	Potato dextrose broth		SP <sub>3</sub>	
	Biomass	Percentage reduction	Biomass	Percentage reduction
Decis (Deltamethrin 2.8% EC)	0.387	33.045	0.481	26.453
Hilcron (Monocrotophos 36% SL)	0.075	87.024	0.141	78.440
Hildan (Endosulfan 35% EC)	0.140	75.779	0.160	75.535
Hilmida (Imidacloprid 17.8% SL)	1.759	Nil	0.776	Nil
Marshal (Carbosulfan 25% EC)	0.339	41.349	0.157	75.994
Rogor (Dimethoate 30% EC)	0.481	16.782	0.152	76.758
Rocket (Profenofos 40%+Cypermethrin 4%)	0.059	89.792	0.145	77.829
Fenval (Fenvalerate 20% EC)	0.404	30.103	0.602	07.951
Ekalux (Quinolphos 25% EC)	0.060	89.619	0.130	80.122
Control	0.578		0.654	

EC: Emulsifiable concentrate, SL: Soluble concentrate

V<sub>15</sub> strain of *Trichoderma harzianum* as they had shown more than 50% of percentage reduction of mycelial growth of the fungus.

According to the data presented in Table 2, at 200 µL concentration of insecticides in Potato Dextrose Broth (PDB) only Hilmida (Imidacloprid 17.8% SL) and Rogor 30% EC (Dimethoate 30% EC) are compatible with V<sub>15</sub> strain of *Trichoderma harzianum*. Hilmida (Imidacloprid 17.8% SL) are most compatible because it shows nil percentage reduction of mycelium. Rest of the insecticides viz. Decis (Deltamethrin 2.8% EC), Ekalux 25% EC (Quinolphos 25% EC), Fenval 20% EC (Fenvalerate 20% EC), Hilcron 36% SL (Monocrotophos 36% SL), Hildan 35% EC (Endosulfan 35% EC), Marshal 25% EC (Carbosulfan 25% EC) and Rocket 44% EC (Profenofos 40%+Cypermethrin 4%) are found to be incompatible with V<sub>15</sub> strain of *Trichoderma harzianum*. At the same concentration (200 µL) of insecticides in SP<sub>3</sub> medium it was concluded that Decis (Deltamethrin 2.8% EC), Fenval 20% EC (Fenvalerate 20% EC) and Hilmida (Imidacloprid 17.8% SL) had shown less percentage reduction in mycelial growth so it is compatible with V<sub>15</sub> strain of *Trichoderma harzianum*. Rest of the insecticides viz. Ekalux 25% EC (Quinolphos 25% EC), Hilcron 36% SL (Monocrotophos 36% SL), Hildan 35% EC (Endosulfan 35% EC), Marshal 25% EC (Carbosulfan 25% EC), Rogor 30% EC (Dimethoate 30% EC) and Rocket 44% EC

(Profenofos 40%+Cypermethrin 4%) are found to be incompatible with V<sub>15</sub> strain of *Trichoderma harzianum* in SP<sub>3</sub> medium.

After dual culture on control as well as insecticides amended media I came to conclude that Decis (Deltamethrin 2.8% EC), Hilcron 36% SL (Monocrotophos 36% SL), Hilmida (Imidacloprid 17.8% SL) and Rogor 30% EC (Dimethoate 30% EC) are compatible insecticides with biocontrol agent (*Trichoderma harzianum*) as they have the same biocontrol activity on pathogen in comparison to control. It means that when these chemicals and biofungicides are applied in the same field there is no any adverse effect occurs on the growth of *Trichoderma harzianum* due to these chemicals. While some insecticides viz., Ekalux 25% EC (Quinolphos 25% EC), Marshal 25% EC (Carbosulfan 25% EC) and Rocket 44% EC (Profenofos 40% + Cypermethrin 4%) inhibits the growth of *Trichoderma* spp. So, it was concluded that in presence of biocontrol agent these insecticides are not used.

## DISCUSSION

The superiority of chemicals over bio-control agents in terms of effective and quick disease control was already confirmed but ill effects of chemicals on human health and environment are a major setback to application of chemical

pesticides in long run (Sharma, 2011). Sterk *et al.* (2002) found that the two neonicotinoids viz., imidacloprid and thimethoxam, alone were very toxic and even may harmful for the beneficial macro-organisms also. Massive pesticide used in the traditional plant protection has affected the biological environment, human life and sustainable agricultural development. Biological control characterized by safety, economy and non-polluting, provides sustainable agriculture with new opportunity and technological bases and solves many problems in the implementation of sustainable agriculture (Haowen *et al.*, 2004). Madhavi *et al.* (2008) were reported that both the species i.e., *Trichoderma harzianum* and *Trichoderma viride* showed high compatibility with imidacloprid (0.025%). Jegathambigai *et al.* (2010) were observed that *Trichoderma harzianum* was superior in producing spores in all the liquid substrates. In terms of the insecticides tested, quinalphos and dicofol exhibited toxicity (quinalphos more so), even at the low concentration of 10 ppm. Endosulfan, fenprothrin and propargite were less toxic which indicated the compatibility of these insecticides with *T. harzianum* (Sarkar *et al.* 2010). Bhai and Thomas (2010) reported that percent mycelial inhibition of *Trichoderma harzianum* was 55.84% in the presence of Quinalphos. The duration of active disease control can be extended by using chemical and biological control agents together in integrated management system.

### CONCLUSION

From the above experiments it was concluded that if the formulations made by the recommended dose of insecticides with the bio-control agent *Trichoderma harzianum* and used for the management of various plant pests show promising effect than the chemicals alone. It is cost effective and environment friendly also.

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