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Compatibility of *Trichoderma* Isolates to Selected Insecticides *in vitro*

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Eleven selected insecticides were evaluated for their compatibility to *Trichoderma* based on *in vitro* sensitivity of *T. harzianum* and *T. virens*. Observations on radial growth indicated that, chlorpyriphos and quinalphos were incompatible with *Trichoderma* spp showing 100 per cent inhibition of radial growth at field concentration. While dimethoate and endosulfan were least compatible showing more than 70 per cent inhibition of radial growth. Indoxacarb, carbofuran, fipronil were moderately compatible with radial growth inhibition in the range of 3-11per cent. Spinosad, emamectin benzoate, thiamethoxam and indoxacarb were found highly compatible with zero inhibition of radial growth of test *Trichoderma* isolates.

Key words : Insecticides, Compatibility, *Trichoderma*

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INTRODUCTION

Soil borne plant pathogenic fungi such as *Fusarium, Phytophthora, Pythium, Rhizoctonia, Sclerotium etc.* cause diseases in most of the economically important crop plants. Chemical means of managing the diseases caused by these pathogens are not practicable owing to high cost of chemicals and environmental pollution. Biological control offers a novel approach when applied either alone or in combination with other management practices without the demerits of chemical control (Papavizas, 1985 and Mukhopadhyay, 1987). *Trichoderma* is one of the most common soil inhabitants and extensively studied biocontrol agent in the management of soil borne plant pathogens (Elad *et al.,* 1980).

Species of *Trichoderma* are being used either as seed treatment or soil application. In both the cases, the antagonist has been continuously exposed to different insecticides applied to the field either in soil or as foliar sprays. Insecticides sprayed aerially reaches the soil (by means of air currents or are washed off the plant surface due to rain) and is likely to influence the efficacy of native or applied biocontrol agents like *Trichoderma*. Hence, it is necessary to assess *Trichoderma* compatibility to insecticides in order to use in the integrated disease management systems.Variations in tolerance of *Trichoderma* isolates to several insecticides reported earlier (Sushir and Pandey 2001; Reshmy Vijayaraghavan and Koshy Abraham, 2004) were based on arbitrary concentrations that were less than the field concentrations. Hence, the present investigation was conducted to evaluate the compatibility of two isolates of *Trichoderma* spp. *viz.,T. harzianum* (isolated from cotton cropping system) and *T. virens* (isolated from citrus orchard) to selected insecticides at field concentration.

RESEARCH METHODOLOGY

In the present investigation eleven insecticides *viz.,* endosulfan, chlorpyriphos, quinalphos, dimethoate, indoxacarb, carbofuran, imidacloprid, fipronil, thiamethoxam, emamectin benzoate and spinosad were used to assess the *in vitro* sensitivity of *Trichoderma* isolates by using the poisoned food technique (Nene and Thapliyal, 1993). Radial growth of the test *Trichoderma* isolates were recorded after 48 h of incubation and per cent inhibition of growth over control (unamended medium) was calculated using the following formula:

$$I = \frac{C - T}{C} x100$$

I – per cent inhibition
C – growth in unamended medium
T - growth in insecticides amended medium

RESULTS AND ANALYSIS

Both the isolates of *Trichoderma*, *viz*., *T. harzianum* and *T virens* grew equally well and attained a radial growth of 4.2 cm, 3.8cm and 9.0 cm after 24 and 48 h of incubation at 28±1°C, respectively on control PDA plates (Table 1).

In insecticides amended medium, most of the insecticides showed inhibitory effect on radial growth. Variation was observed in the compatibility of Trichoderma isolates towards insecticides.

Variation between isolates of *Trichoderma*:

Observations made on the radial growth of *Trichoderma* indicated significant variation in the sensitivity of *Trichoderma* isolates to insecticides or toxicity of insecticides towards *Trichoderma* isolates. When observations were recorded on radial growth for two consecutive days, in chlorpyriphos and quinalphos amended plates the growth was completely inhibited on both the days of incubation. Further, all the insecticides showed significant reduction in the growth of Trichoderma isolates on 1st and

Table 1: Effect of insecticides on *Trichoderma* radial growth (cm)

			T.harzianum		*T.virens*	
Sr.No.	Insecticides	Conc.	Day1	Day2	Day1	Day2
1.	Endosulfan	0.2%	2.1 (1.8)^{f}	3.7 (2.2)^{b}	0.9 (1.4)^{e}	1.1 (1.4)^{e}
2.	Chlorpyriphos	0.25%	0.0 (1.0)^{h}	0.0 (1.0)^{d}	0.0 (1.0)^{f}	0.0 (1.0)^{f}
3.	Quinalphos	0.2%	0.0 (1.0)^{h}	0.0 (1.0)^{d}	0.0 (1.0)^{f}	0.0 (1.0)^{f}
4.	Dimethoate	0.2%	1.2 (1.5)^{g}	3.1 (2.0)^{c}	0.0 (1.0)^{f}	0.0 (1.0)^{f}
5.	Indoxacarb	0.1%	4.9 (2.4)^{b}	9.0 (3.2)^{a}	3.5 (2.1)^{c}	8.5 (3.1)^{b}
6.	Carbofuran	25kg/ha	3.6 (2.1)^{e}	9.0 (3.2)^{a}	2.3 (1.8)^{d}	7.5 (2.9)^{c}
7.	Imidacloprid	0.025%	4.3 (2.3)^{c}	9.0 (3.2)^{a}	4.6 (2.4)^{a}	9.0 (3.2)^{a}
8.	Fipronil	0.2%	3.4 (2.1)^{e}	9.0 (3.2)^{a}	2.2 (1.8)^{d}	7.1 (2.8)^{d}
9.	Thiamethoxam	0.02%	5.1(2.5)^{a}	9.0 (3.2)^{a}	3.4 (2.1)^{c}	9.0 (3.2)^{a}
10.	Emamectin benzoate	0.045%	3.5 (2.1)^{e}	9.0 (3.2)^{a}	3.7 (2.2)^{b}	9.0 (3.2)^{a}
11.	Spinosad	0.04%	3.9 (2.2)^{d}	9.0 (3.2)^{a}	3.6 (2.1)^{c}	9.0 (3.2)^{a}
12.	Check		4.2 (2.3)^{c}	9.0 (3.2)^{a}	3.8 (2.2)^{b}	9.0 (3.2)^{a}
CV (%)			1.5	1.1	1.6	1.1
CD (P=0.01)			0.06	0.06	0.06	0.06

*Each treatment replicated thrice, *Figures in parentheses are square root transformed values
*Figures with similar alphabets do not differ significantly

Table 2: Effect of insecticides on *Trichoderma* radial growth - per cent inhibition

Sr. No.	Insecticides	Conc.	*T.harzianum*	*T.virens*	Mean
1.	Endosulfan	0.2%	59.2 (45.3)	87.7 (69.4)	73.4 (57.4)^{c}
2.	Chlorpyriphos	0.25%	100.0 (90.0)	100.0 (90.0)	100.0 (90.0)^{a}
3.	Quinalphos	0.2%	100.0 (90.0)	100.0 (90.0)	100.0 (90.0)^{a}
4.	Dimethoate	0.2%	65.5 (54.0)	100.0 (90.0)	82.7 (72.0)^{b}
5.	Indoxacarb	0.1%	0.0 (0.0)	6.0 (14.0)	3.0 (7.0)^{e}
6.	Carbofuran	25kg/ha	0.0 (0.0)	16.3 (23.8)	8.2 (11.9)^{d}
7.	Imidacloprid	0.025%	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)^{f}
8.	Fipronil	0.2%	0.0 (0.0)	21.1 (27.3)	10.5 (14.0)^{d}
9.	Thiamethoxam	0.02%	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)^{f}
10.	Emamectin benzoate	0.045%	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)^{f}
11.	Spinosad	0.04%	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)^{f}
	Mean		29.5 (25.4)^{b}	39.1 (36.7)^{a}	
CV (%)				6.3	
CD (P=0.01)			Insecticide 3.0	Isolate 1.3	Insecticide X Isolate 4.3

*Each treatment replicated thrice, *Figures in parentheses are angular transformed values
* Figures with similar alphabets do not differ significantly

2nd day of observations except in imidacloprid, thiamethoxam, emamectin benzoate and spinosad where in the growth was at par with unamended control. When mean inhibitory per cent in the radial growth of Trichoderma isolates was analyzed, cotton isolate *T. harzianum* was found less sensitive (29.5 per cent inhibition) compared to citrus isolate *T. virens* (39.1 per cent) (Table 2). This difference in per cent inhibition of radial growth was due to more sensitivity of *T. virens* to dimethoate, indoxacarb, carbofuran, fipronil and endosulfan compared to *T. harzianum*. Reports on inhibitory effect of different insecticides were reported by Sharma and Mishra (1995), Sushir and Pandey (2001) Reshmy Vijayaraghavan and Koshy Abraham (2004).

Relatively high sensitivity of *T. virens* may be due to the fact that the isolate was obtained from citrus orchard which is less exposed to the insecticides application. In other words, *T.harzianum* was less sensitive as it was isolated from cotton where in the insecticides usage is more.

Variation in insecticide toxicity:

Among the insecticides organophosphates were highly toxic (chlorpyriphos and quinalphos 100%, dimethoate 82.7% inhibition), followed by oragnochlorines (endosulfan 73.4%), new generation insecticides (fipronil 10.5%, indoxacarb 3%) and carbamate insecticide (carbofuran 8.2%). Further dimethoate was highly toxic on *T.virens* (100% inhibition) compared to *T.harzianum* (65.5%). Among new generation insecticides *viz.,* spinosad, emamectin benzoate, thiamethoxam and indoxacarb were highly compatible with both the Trichoderma isolates with nil toxic effect on the radial growth.

Based on the results obtained, all the test insecticides were grouped in to incompatible, least compatible, moderately compatible and highly compatible. Chlorpyriphos and quinalphos were incompatible with *Trichoderma* spp showing 100 per cent inhibition of radial growth at field concentration. While dimethoate, endosulfan were least compatible showing more than 70 per cent inhibition of radial growth. Indoxacarb, carbofuran, fipronil were moderately compatible with radial growth inhibition in the range of 3-11 per cent. Spinosad, emamectin benzoate, thiamethoxam and indoxacarb were found highly compatible with zero inhibition of radial growth of test *Trichoderma* isolates.

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