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RESEARCH ARTICLE

Compatibility of certain biopesticides Azadirachtin formulations and sodium bicarbonate with *Trichoderma harzianum* (Th-43)

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ABSTRACT

The sharp increase in the use of chemical pesticides in India in recent years has resulted in severe implications in the development of pesticidal resistance in key pest species, pesticidal residues in food chain and degradation in the quality of eco-system and human health. It is therefore, important to identify alternatives to chemical pesticide in plant protection without sacrificing the productivity and profitability of agriculture. Among various non-chemical options (host plant resistance, cultural, biological and integrated pest management), biopesticides which are target specific, eco-friendly and biodegradable are potential alternatives to chemical pesticides and are known to exhibit antifungal activities against certain plant pathogenic fungi. In the present investigation, studies were conducted to evaluate *Azadirachtin* formulations (Soluneem , Mycostat) and Sodium bicarbonate for their compatibility with bioagents in order to increase their action spectrum. *Trichoderma harzianum* (Th-43) showed some degree of compatibility with Mycostat at lower concentrations (1000-4000 ppm) but was incompatible at higher concentrations (6000 ppm). The bioagent showed relatively less sensitivity with Soluneem and Sodium bicarbonate thus, could be considered compatible by showing an additive effect. The present result will help to delineate the possibility of combining *Trichoderma harzianum* (Th-43) biocontrol agent and biopesticides for use in an integrated pest management.

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INTRODUCTION

The present agricultural scenario signifies the importance of IPM strategies in crop protection. The long term exposure and high dose of fungicides have led to development of resistant strains in several fungal pathogens. From all angles efficiency, feasibility, economy and environmental sustainability, biocontrol of plant pathogens is one of the best management options available (Bagwan, 2003). Species of *Trichoderma* are common soil saprophytic hyphomycetes found in all climates throughout the world. Members of this genus have been studied as antagonists in biocontrol systems against various plant pathogens. These fungi are very effective as biocontrol agents because their powerful extracellular lytic enzymes produce necrotrophic action on fungi through lysis of cell walls (Bacon *et al*., 2001). *Trichoderma* is one of the most potent biocontrol agents used now a day's majority for seed and soil treatment due to its efficient antagonistic activity against various soil borne micro flora. Application of concerned antagonist is easy, economically feasible, save time and money besides reducing the amount of agrochemicals required to control a disease at field level both at pre-and post-infection stages (Kumar *et al.,* 2005). Therefore, a biological agent besides being effective should be compatible with the latest crop production practices including pesticides use. Reports on the greater tolerance of

Trichoderma spp. to broad spectrum biopesticides are also available (Lal and Maharshi, 2007).

Keeping the above view in mind, a laboratory study was carried out to assess the compatibility of *Trichoderma harzianum* (Th-43) with different doses of biopesticides.

MATERIALS AND METHODS

The fungal antagonist, *Trichoderma harzianum* (Th-43) taken from bio control laboratory of Department of Plant Pathology, GBPUA and T., Pantnagar was used in the present study. The sensivity of biocontrol agent against biopesticides was examined by poison food technique.

Double strength solution of each biopesticide was prepared in sterilized distilled water in 250 ml Erlenmeyer flask containing same amount of sterilized molted double strength PDA so as to get final concentration of biopesticides. The medium containing different concentrations of biopesticides was poured into sterilized petriplates and allow to solidify. Each Petriplate was centrally inoculated with 5 mm mycelial disc cut with the help of sterilized cork borer from 48 hrs old culture of fungal biocontrol agent and unamended PDA plates served as check. Three replications were maintained for each treatment and incubated at 26±1^{0}C. Regular observations were recorded and finally the colony diameter was measured when the check plates were fully covered with mycelial growth of test fungus.

Per cent inhibition of growth was calculated as follows :

$$I = (C - T/C) x100$$

where,

I = Per cent inhibition

C = Radial growth in check (cm)

T= Radial growth in treated plates (cm)

RESULTS AND DISCUSSION

The experimental findings of the present study have been presented in the following sub heads:

Compatibility of Azadirachtin formulation, Mycostat with *Trichoderma harzianum* (Th-43) :

Effect of mycostat on radial growth of *Trichoderma harzianum* (Th-43) was evaluated under *in vitro* condition using poisoned food method. The results are given in (Table1 and Fig.1). Mycostat was evaluated at ten different concentrations (*viz.,* 1000, 2000, 3000, 4000, 5000, 6000, 6500, 7000, 7500 and 8000 ppm) against *Trichoderma harzianum* (Th-43) and it was found that Mycostat significantly inhibited the growth of *Trichoderma harzianum* (Th-43) at all the concentrations. Mycostat checked the growth completely at higher concentration (6000 ppm) but it allowed the biocontrol agent to grow at lower concentrations (1000-4000 ppm). *Trichoderma harzianum* (Th-43) showed some degree of compatibility with Mycostat at lower concentrations but was found to be totally incompatible at higher concentrations.

Table 1 : Compatibility of *Trichoderma harzianum* (Th-43) with Azadirachtin formulation, Mycostat

Sr. No.	Biopesticide concentration (ppm)	Per cent inhibition at different concentrations of Mycostat after full growth in control	
		Growth (cm)	% Inhibition
1.	1000	4.18	53.51 (47.01)
2.	2000	1.86	79.25 (62.91)
3.	3000	1.45	83.84 (66.29)
4.	4000	1.33	85.18 (67.36)
5.	5000	1.03	88.51 (70.19)
6.	6000	-	100 (90)
7.	6500	-	100 (90)
8.	7000	-	100 (90)
9.	7500	-	100 (90)
10.	8000	-	100 (90)
C.D. (P = 0.05)			1.023
CV (%)			0.786

* Values in parenthesis are in angular transformation

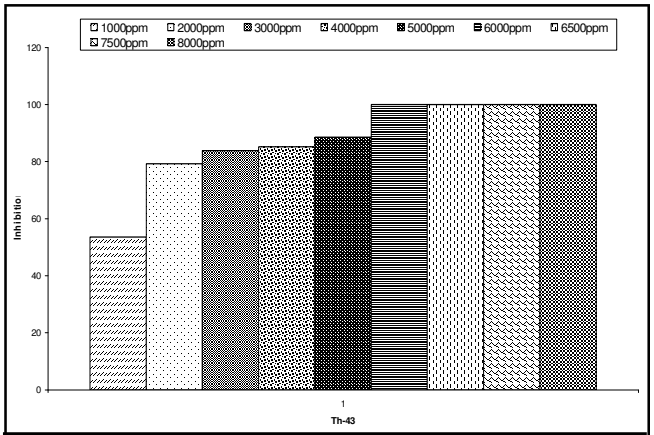

Fig. 1 : Compatibility of Azadirachtin formulation, Mycostat with *Trichoderma harzianum* (Th-43)

Compatibility of Azadirachtin formulation Soluneem with *Trichoderma harzianum* (Th-43) :

Azadirachtin formulation, Soluneem was evaluated at six different concentrations *viz.,* (100, 200, 300, 400, 500 and 600 ppm, against *Trichoderma harzianum* (Th-43) by poisoned food technique. Results are given in (Table 2 and Fig. 2).

It was observed that Soluneem favoured the growth of *Trichoderma harzianum* at all concentrations tested suggesting that Soluneem was less effective in inhibiting the radial growth of fungal biocontrol agent at all the concentrations. Thus, *Trichoderma harzianum* (Th-43)

showed relatively less sensitivity to Soluneem and could be considered compatible with Soluneem.

Table 2 : Compatibility of *Trichoderma harzianum* (Th-43) with Azadirachtin formulation, Soluneem

Sr. No.	Biopesticide concentration (ppm)	Per cent inhibition at different concentrations of Soluneem after full growth in control	
		Growth (cm)	% Inhibition
1.	100	8.26	8.14 (16.46)
2.	200	7.53	16.29 (23.75)
3.	300	7.15	20.55 (26.95)
4.	400	7	22.14 (28.06)
5.	500	6.06	32.59 (34.81)
6.	600	5.5	38.88 (38.57)
C.D. (P = 0.05)			2.807
CV (%)			3.35

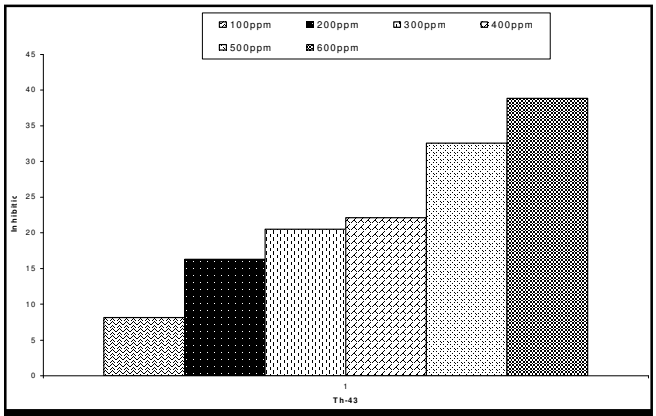

Fig. 2 : Compatibility of Azadirachtin formulation, Soluneem with *Trichoderma harzianum* (Th-43)

Table 3: Compatibility of *Trichoderma harzianum* (Th-43) with Sodium bi carbonate

Sr. No.	Biopesticide concentration (ppm)	Per cent inhibition at different concentrations of Sodium bi carbonate after full growth in control	
		Growth (cm)	% Inhibition
1.	100	6.78	24.62 (29.75)
2.	250	5.39	40.03 (39.25)
3.	500	4.08	54.62 (47.65)
4.	1000	2.2	75.55 (60.36)
5.	1500	2.1	76.58 (61.06)
6.	2000	1.77	80.29 (63.64)
7.	2500	1.51	83.14 (65.75)
8.	3000	1.43	84.07 (66.47)
9.	3500	1.1	87.77 (69.56)
10.	4000	0.78	91.29 (72.88)
C.D. (P = 0.05)			1.27
CV (%)			1.30

* Values in parenthesis are in angular transformation

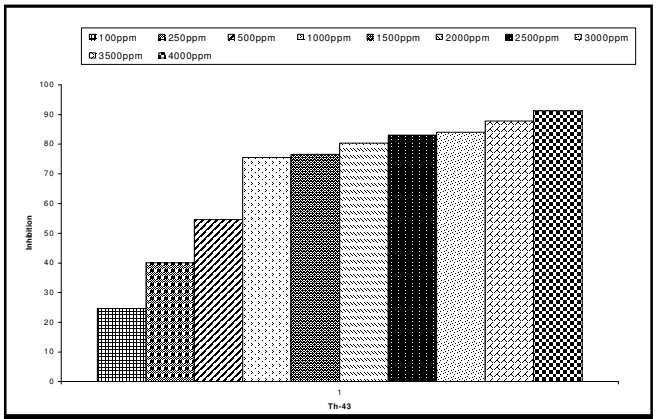

Fig. 3 : Compatibility of sodium bicarbonate with *Trichoderma harzianum* (Th-43)

Compatibility of Sodium bicarbonate with *Trichoderma harzianum* (Th-43) :

Sodium bicarbonate was evaluated at ten different concentrations (100, 250, 500, 1000, 1500, 2000, 2500, 3000, 3500, 4000 ppm) against *Trichoderma harzianum* (Th-43). Results are given in (Table 3 and Fig. 3).

It was found that at all the concentrations tested *i.e.*, 100, 250, 500, 1000, 1500, 2000, 2500, 3000, 3500, 4000 ppm of Sodium bi carbonate was found less effective in inhibiting mycelial growth of *Trichoderma harzianum* (Th-43) and thus can be considered compatible with *Trichoderma harzianum* (Th-43). One of the most desirable characteristics of a biocontrol agent is its insensitivity to the biopesticides which are effective against the test pathogen. Unless and until the biocontrol agents are insensitive to the biopesticides, they cannot be integrated successfully with biopesticides for the purpose of plant disease control.

The results on sensitivity of biopesticides against *Trichoderma* sp. revealed that Multineem at lower concentration favoured the growth of fungus *Trichoderma viride* (Bhatnagar, 2004). Singh and Singh (2007) found that Bavistin checked the growth completely at all concentrations followed by Captan and Vitavax. Monocrotophos was least effective pesticide inhibiting the growth of *Trichoderma viride*-1 and *Trichoderma viride*-2 at all the concentrations. It showed that *Trichoderma viride*-1 and *Trichoderma viride*-2 were compatibile with monocrotophos and less compatibile with Captan and Vitavax and non-compatibile with Bavistin.

Singh and Singh (2003) recorded best compatibility of *Trichoderma harzianum* with Captan and monocrotophos at all the concentrations and moderate compatibility with Vitavax**.** Gupta (2004) recorded that Bavistin was completely

incompatible with *Trichoderma harzianum,* while Captan and monocrotophos showed highest compatibility at 1000 ppm concentration. Abd- EI-Moity *et al.* (1982) observed that while Benomyl was found to be strongly inhibitory to *Trichoderma* in culture even at 0.5 mg/ml, Captan and PCNB were not inhibitory to *Trichoderm*a spp.

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