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Compatibility of *Trichoderma harzianum* with different fungicides under *In vitro*

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Abstract

This study was undertaken to evaluate the compatibility of commonly used agrochemicals at recommended dosages with *Trichoderma harzianum* at 100, 250, 500, 750 and 1000 ppm concentrations by using poisoned food technique. All the fungicides found to be more compatible and safer to the *Trichoderma harzianum* (Th-8 isolate) isolate at all the concentration and these fungicides did not adversely affect the growth of test antagonist except Thiram. Metalaxyl was found to be least effective and best compatible with *Trichoderma harzianum* (Th-8 isolate), since the percent inhibition of *Trichoderma* (Th-8 isolate) was only 6.68 percent at 1000 ppm concentration. Present finding suggest that compatible fungicides can be used with *Trichoderma harzianum* in an integrated disease management practices for the control of soil born pathogen.

Keywords: Cucumber, boron, yield, quality, konkan

Introduction

Fungi of the genus *Trichoderma* have emerged as most powerful bio-protectants for management of soil borne plant disease. *Trichoderma* have long been known as bio-control agents of plant diseases, and have become a valuable part of agricultural disease control. *Trichoderma* spp. has received the most attention for control soil borne pathogens. *Trichoderma harzianum* is a fungal biocontrol agent that attacks a range of pathogenic 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) [6, 7, 8]. Mukherjee (1987) [9] reported insensitivity of *T. harzianum* to apron, fytolan but sensitivity to thiram. Mukhopadhyay *et al.* (1986) [10] reported the tolerance of *T. harzianum* to metalaxyl concentration of 100 ppm. To develop an effective disease management programme the compatibility of potential bioagents with fungicides and organic cakes is essential. Combining antagonists with synthetic and non-synthetic chemicals eliminates the chance of resistance development and reduces the fungicides application. In view of this, laboratory experiments were conducted to test the possibility of combining *Trichoderma viride* with fungicides and organic cakes. The longterm goal is to develop an effective integrated disease management practices for management soil borne plant diseases as well as to prevent the resistance development in pathogens to chemicals. Integrating chemical resistance *Trichoderma* strains has an important in the framework of integrated disease management.

Materials and Method

Four fungicides i.e. Thiram, Copper oxychloride, Mancozeb and Metalaxyl at four concentrations viz., 100, 250, 500, 750 and 1000 ppm were evaluated against *Trichoderma* isolate 8 *in vitro* using 'Food Poison Technique' (Schmitz, 1930) to find out relative compatibility. Details are mentioned in Table 1. The requisite concentration of fungicide, (prepared by stock solution) was incorporated into PDA flasks separately, mixed thoroughly by shaking and poured 20 ml in each Petri plate. The medium was allowed to solidify and then each Petri plate was centrally inoculated with 7 mm disc of 3 days old culture of Th8. Petri plates were incubated at 28±1°C for 3 days. The PDA Petri plates without any treatment, inoculated with Th8 served as check. Three replications were kept for each concentration. The observations on radial growth (mm) of each Petri plate was measured 4 days after incubation when check plates were filled with the Th8. Observations on radial growth of each test

pathogen was recorded after 4 days of incubation and percent mycelial growth inhibition over check was calculated using following formula Vincent (1947).

$$\text{Percent inhibition over check} = \frac{C-T}{C} \times 100$$

Where,

C= growth of pathogen in check

T = growth of pathogen in treatment

Table 1: Details of fungicides

Name of the Fungicides	Trade name
Copperoxychloride	Blitox – 50 WP
Mancozeb	Indofil M-45
Metalaxyl	Ridomil 35% WP
Thiram	Arasan 75% WP

Results

Four fungicides *i.e.* Thiram, Copperoxychloride, Mancozeb and Metalaxyl at five concentrations viz., 100, 250, 500, 750

and 1000 ppm were evaluated against *Trichoderma harzianum* isolate *in vitro* using Food Poison Technique to find out relative compatibility. The data are presented in the Table 2.

The results indicated that lesser concentration of fungicides had lesser inhibitory effect as compared to higher concentration. The growth inhibition by these fungicides was observed from 0.0 percent to 80.37 percent. All the fungicides were found to be more compatible and safer to the *Trichoderma harzianum* isolate at all the concentration (100, 250, 500, 750 and 1000ppm) and these fungicides did not adversely affect the growth of test antagonist except Thiram (Fig.1, Plate 1). Thiram inhibited by 34.45, 60.00, 71.48, 77.03, and 80.37 percent growth of *Trichoderma harzianum* isolate at 100, 250, 500 750 and 1000 ppm concentrations, respectively. Metalaxyl was found to be least effective and most compatible with *Trichoderma harzianum* isolate, since the percent inhibition of *Trichoderma* (Th-8 isolate) was only 6.68 percent at 1000 ppm concentration.

Table 2: Evaluation of some commonly used fungicides for their compatibility with *Trichoderma harzianum* (Th 8) *in vitro*

Treatment	Concentration (ppm)	Radial growth of Th-8 isolate (mm)	Inhibition over control (%)
Thiram	100	59.00	34.45 (35.91)
	250	39.33	56.29 (48.59)
	500	25.67	71.48 (57.49)
	750	20.67	77.03 (61.34)
	1000	17.67	80.37 (63.67)
Copperoxychloride	100	89.67	0.37 (2.01)
	250	89.00	1.11 (6.09)
	500	87.50	2.77 (11.85)
	750	85.00	5.55 (13.75)
	1000	82.33	8.52 (16.94)
Mancozeb	100	89.67	0.37 (2.01)
	250	88.33	1.86 (6.35)
	500	85.50	5.00 (12.89)
	750	81.67	9.26 (17.69)
	1000	78.33	12.97 (21.24)
Metalaxyl	100	90.0	0.00 (0.00)
	250	89.33	0.75 (4.02)
	500	87.66	2.60 (8.63)
	750	87.0	3.33 (10.41)
	1000	84.0	6.67 (14.91)
control		90.0	0.00 (0.00)
C.D. ($P < 0.5$)			2.04 (1.62)
SE(m)±			0.71 (0.42)

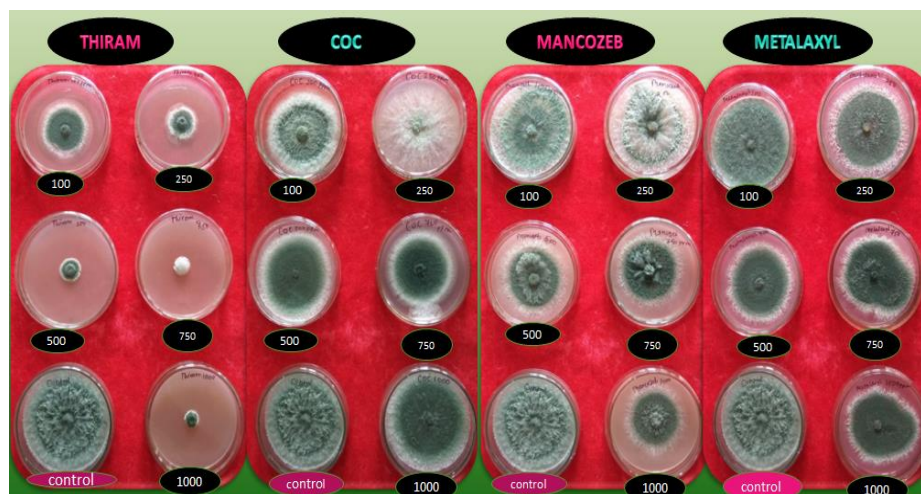


Plate 1: Mycelial growth of *Trichoderma harzianum* at different concentration with different fungicides

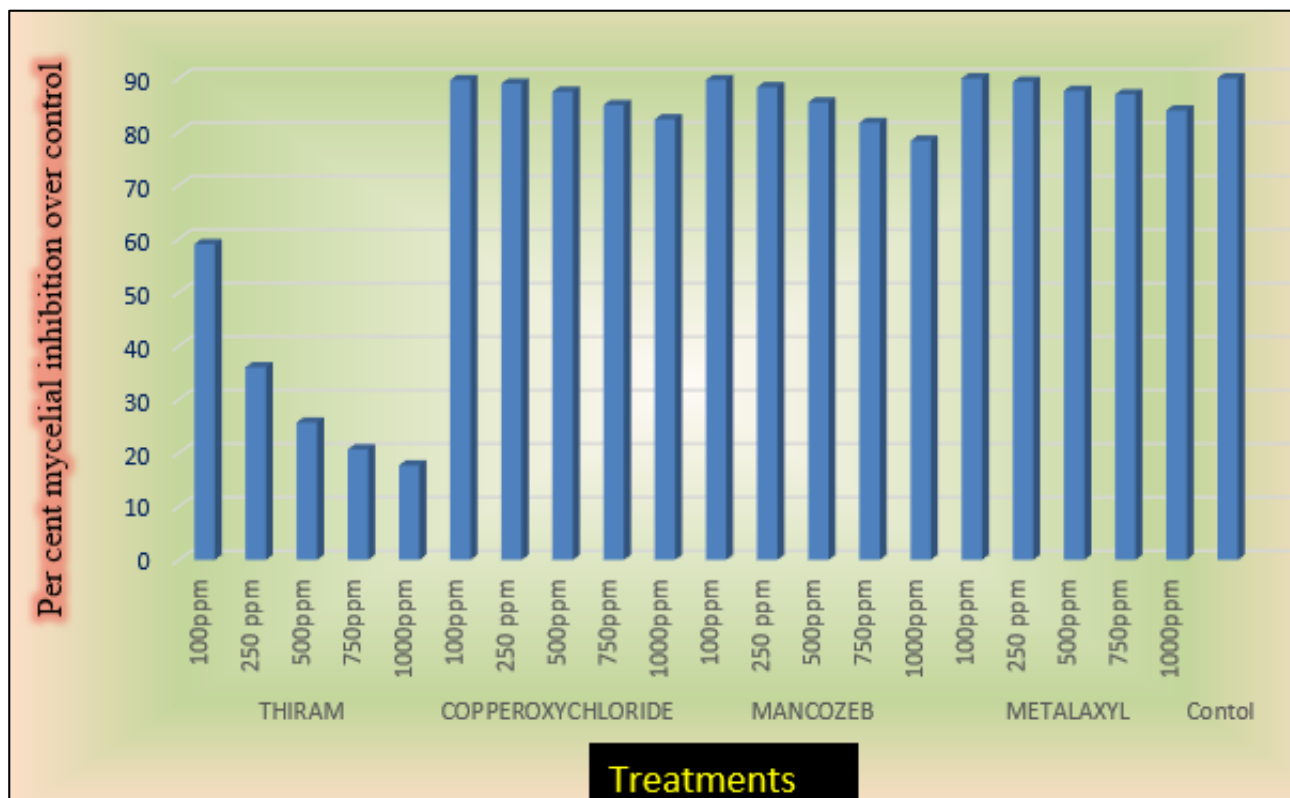


Fig 1: *In vitro* compatibility of *Trichoderma harzianum* (Th-8 isolate) with different fungicides

Discussion

In the present investigation, among the four fungicides were tested against *Trichoderma harzianum* (Th 8 isolate). The results indicated that lesser concentration of fungicides had lesser inhibitory effect as compared to higher concentration. The growth inhibition by these fungicides was observed from 0.0 percent to 80.37 percent. Metalaxyl was found to be highly compatible as the overall inhibition of *Trichoderma harzianum* (Th8 isolate) was only 6.68 percent at 1000 ppm concentration. Thiram was to be more inhibitory at 1000 ppm. Integrated seed treatment with chemicals and compatible antagonists not only protect the seed and seedlings from soil-borne infection but also provides protection from seed borne inoculum. Compatible fungicides are therefore essential for integrated management (Dubey and Patel, 2001) [5]. Various studies have been under taken on compatibility of *Trichoderma* spp. with different fungicides. Sharma *et al.* (1999) [11] reported that *T. harzianum* and *T. pseudokoningi* were compatible with mancozeb at all concentrations viz., 100, 500, 1000 and 2000 ppm. Naseema Beevi *et al.* (2005) [4] studied the *in vitro* compatibility of *T. harzianum* with mancozeb, carbendazim and copperoxychloride and found that carbendazim at 0.1 percent completely inhibited the mycelial growth while mancozeb and copper oxychloride showed compatibility with the antagonist at 0.2 and 0.1 percent respectively. Bagwan (2010) [2] reported that thiram (0.2%), copperoxychloride (0.2%) and mancozeb (0.2%) are compatible with *Trichoderma harzianum*. Rai *et al.* (2016) [3] observed compatibility of *Trichoderma harzianum* (Th14) with Mancozeb and Metalaxyl at low concentrations. Sonavane and Venkataravanappa (2017) [1] reported that contact fungicides at selected concentration were found to be safer than systemic and combined products except Chlorothalonil. In systemic fungicidal treatments complete mycelial inhibition of *T. harzianum* was recorded in Carbendazim, Hexaconazole, Thiophenate Methyl and Propiconazole.

Conclusion

In vitro compatibility of four fungicides used against *Trichoderma harzianum* isolates Th-8 at 100, 250, 500, 750 and 1000 ppm concentrations by using poisoned food technique. All the fungicides found to be more compatible and safer to the *Trichoderma harzianum* (Th-8 isolate) isolate at all the concentration and these fungicides did not adversely affect the growth of test antagonist except Thiram. Metalaxyl was found to be least effective and best compatible with *Trichoderma harzianum* (Th-8 isolate), since the percent inhibition of *Trichoderma* (Th-8 isolate) was only 6.68 percent at 1000 ppm concentration. Present finding suggest that compatible fungicides can be used with *Trichoderma harzianum* in an integrated disease management practices for the control of soil born pathogen.

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