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Assessment of Compatibility of *Trichoderma* Species with Different Fungicides *in vitro*

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A B S T R A C T

The test organism *Trichoderma* was isolated from the soil using Trichoderma selective medium, observations for radial growth, colony characters and pigmentation were recorded on potato dextrose agar medium. For assessing the compatibility of *Trichoderma* species, eight fungicides (carbendazim, carboxin, triadimefon, thiophanate methyl, chlorothalonil, copper- oxychloride, mancozeb, and wettable sulphur) were used each at three concentrations 500, 1000 and 1500 ppm, respectively in addition to control and poisoned food techniques was followed *in vitro*. All the fungicides significantly reduce the radial growth of *T. viride* and *T. harzianum* except wettable sulphur and mancozeb. There was no radial growth of *T. viride* and *T. harzianum* in carbendazim, carboxin and thiophanate methyl, while maximum mean radial growth of *T. viride* (85.22 mm) and *T. harzianum* (79.77 mm) were recorded in wettable sulphur and mancozeb. All the three concentrations significantly reduced the radial growth of 41.15 mm in *T. viride* and 34.66 mm in *T. harzianum* being maximum in 1500 ppm. The significant interaction component clearly revealed that with increasing concentration of each fungicide, there was a significant reduction in radial growth.

Introduction

The present agricultural scenario signifies the importance of IDM strategies in crop protection. Therefore a through know-how of the bio-control status involving mechanism of action, spectrum of activity, efficiency of the bio-agent and effect of concerned micro-environment on its growth and survival is very essential. *Trichoderma* is one of the most potent bio-control agent used nowadays majority for seed and soil treatment due to its efficient antagonistic activity against various soil and seed borne pathogens. Application of the concerned antagonist is easy, economically feasible, saves time and money besides reducing the amount of agro-chemicals required to control a disease at field level both at pre and post infection stages. Fungicides are applied to the field as both soil drenches and foliar sprays. Besides, agro-chemicals sprayed aerially reach the soil by means of air currents or are washed off the plant surface due to rain. Thus, there is a need

to determine the compatibility of the bio-agents in presence of commonly used fungicides to obtain the desired effect after their survival and colonizing capacity.

Materials and Methods

To test organism *Trichoderma* was isolated from soil using Trichoderma selective medium. A total of eight fungicides each at three concentrations 500, 1000 and 1500 ppm, respectively. Three replications were maintained for each concentration. Out of these carbendazim, carboxin, triadimefon and thiophanate methyl are systemic, whereas, chlorothalonil, copper- oxychloride, mancozeb, and wettable sulphur are non-systemic. Poisoned food technique was followed to evaluate the effect of fungicides on *Trichoderma* species were tested against *in vitro*. Observations for radial growth (in mm), along with the colony characters were recorded. The data were analyzed by using the square root transformation values in factorial C.R.D.

Results and Discussion

The data in table 1 showed that all the fungicides significantly reduced the radial growth of *T. viride* except wettable sulphur, mancozeb, copper-oxychloride, chlorothalonil and triadimefon. There was no radial growth of *T. viride* in carbendazim, carboxin, and thiophanate methyl, while maximum growth (85.22 mm) was recorded in wettable sulphur and minimum (26.88 mm) in chlorothalonil as compared to (90.00 mm) in control. These finding are in parallel with Sharma *et al*., (4) who reported that at lower concentration of mancozeb was compatible with *T. viride.* It has been observed that the highest rate of reduction in growth of *T. viride* was noted in case of toxic action of carbendazim where no radial growth was recorded in all the three concentration. Malathi *et al.,* (3) provided proof that *Trichoderma* isolates did not grow even at concentration as low as 1 and 5 ppm of carbendazim.

The fungi static activity of wettable sulphur was interesting higher in all observations were nearly at par with control.

All the three tested concentrations significantly reduced the radial growth of *T. viride,* being maximum (41.15 mm) in 1500 ppm. The significant interaction component clearly revealed that with increasing concentration of each fungicide, there was a significant reduction in radial growth of *T. viride*, except carbendazim, carboxin, and thiophanate methyl.

The colony of *T. viride* was loose and cottony growth in copper- oxychloride, mancozeb, and wettable sulphur, while oppressed in triadimefon and chlorothalonil. As regard to pigmentation, it is varied from light green to dark green on upper side and dirty white to light yellow on lower side in all the fungicides (Table 2).

The radial growth of *T. harzianum* was significantly reduced in all the fungicides. There was a mark of reduction in the growth of *T. harzianum* with increasing concentration of fungicides. *T. harzianum* showed compatibility with mancozeb followed by wettable sulphur, copper-oxychloride and highest rate of reduction in the growth of *T. harzianum* were noted of carbendazim, carboxin, and thiophanate methyl where no radial growth at all three test concentrations of the fungicide (Table 3). The trend of results was confirmation with Jayaraj and Radhakrishnan (1) who reported that minimum population of *T. harzianum* was recorded at the highest test concentration of 500 ppm. The fungi static activity of mancozeb was interesting higher in all observations were nearly at par with control.

Table.1 Effect of fungicides on radial growth (in mm) of *Trichoderma viride*

S. N.	Treatments	Concentration (in ppm)			Mean
		500	1000	1500	
1	Carbendazim	00.0 (0.70)*	00.0 (0.70)*	00.0 (0.70)*	00.0 (0.70)
2	Carboxin	00.0(0.70)	00.0(0.70)	00.0(0.70)	00.0(0.70)
3	Thiophanate methyl	00.0(0.70)	00.0(0.70)	00.0(0.70)	00.0(0.70)
4	Triadimefon	49.33 (7.06)	45.33(6.76)	39.33(6.30)	46.66(6.71)
5	Chlorothalonil	32.66 (5.76)	25.33(5.08)	26.66(4.81)	26.88(5.22)
6	Copper- oxychloride	88.66 (9.44)	71.33(8.47)	59.33(7.73)	73.10(8.54)
7	Mancozeb	85.33(9.26)	81.33(9.04)	76.66(8.78)	81.10(9.03)
8	Wettable sulphur	88.66(9.44)	84.66(9.23)	82.33(9.10)	85.22(9.26)
9	Control	90.00(9.51)	90.00(9.51)	90.00(9.51)	90.00(9.51)
Mean		48.29(5.84)	42.22(5.58)	41.15(5.37)	

*Figures in parentheses are Arc sin transformed values
CD at 5% I) Fungicides (F) 0.13 II) Concentrations (C) 0.07 III) FXC 0.22

Table.2 Colony characters and pigmentation of *Trichoderma viride* in different Fungicides

S. N.	Treatments	Colony characters	Pigmentation	
			Upper	Lower
1	Carbendazim	NA	NA	NA
2	Carboxin	NA	NA	NA
3	Thiophanate methyl	NA	NA	NA
4	Triadimefon	Oppressed	Light brown	Light yellow
5	Chlorothalonil	oppressed		Light yellow
6	Copper- oxychloride	Loose & Cottony	Light green	Light yellow
7	Mancozeb	Loose & Cottony	Light green	Dirty white
8	Wettable sulphure	Loose & Cottony	Light green	Light brown
9	Control	Loose & Cottony	Light green	Light yellow

Table.3 Effect of fungicides on radial growth (in mm) of *Trichoderma harzianum*

S. N.	Treatments	Concentration (in ppm)			Mean
		500	1000	1500	
1	Carbendazim	00.0 (0.70)*	00.0 (0.70)*	00.0 (0.70)*	00.0 (0.70)
2	Carboxin	00.0 (0.70)	00.0 (0.70)	00.0 (0.70)	00.0(0.70)
3	Thiophanate methyl	00.0 (0.70)	00.0 (0.70)	00.0 (0.70)	00.0(0.70)
4	Triadimefon	46.66 (6.72)	30.66 (5.58)	19.33 (4.45)	31.55 (5.58)
5	Chlorothalonil	39.33 (6.31)	34.66 (5.93)	24.66 (5.01)	32.88 (5.75)
6	Copper- oxychloride	87.33 (9.37)	69.33 (8.35)	57.33 (7.60)	73.33 (8.44)
7	Mancozeb	89.33(9.47)	87.33 (9.37)	62.66 (7.95)	79.77 (8.93)
8	Wettable sulphure	88.66 (9.33)	83.33 (9.15)	58.66 (7.69)	76.21 (8.72)
9	Control	89.33 (9.47)	89.33 (9.47)	89.33 (9.47)	89.33 (9.47)
Mean		48.51(5.86)	43.85 (5.55)	34.66 (4.92)	

*Figures in parentheses are Arc sin transformed values
CD at 5% I) Fungicides (F) 0.06 II) Concentrations (C) 0.03 III) FXC 0.10

Table.4 Colony characters and pigmentation of *Trichoderma harzianum* in different fungicides

S. N.	Treatments	colony characters	Pigmentation	
			Upper	Lower
1	Carbendazim	NA	NA	NA
2	Carboxin	NA	NA	NA
3	Thiophanate methyl	NA	NA	NA
4	Triadimefon	Oppressed	dark brown	Light brown
5	Chlorothalonil	oppressed	Dark green	Light yellow
6	Copper- oxychloride	Loose & Cottony	Light green	Light brown
7	Mancozeb	Loose & Cottony	Dark brown	Light yellow
8	Wettable sulphure	Loose & Cottony	darkt green	Light yellow
9	Control	Loose & Cottony	Light green	Light yellow

All the three tested concentrations significantly reduced the radial growth of *T. harzianum*, with maximum growth in 1500 ppm (34.66 mm). The colony character of *T. harzianum* differed in different fungicides ranging from fluffy (cottony) to oppressed (Table 4). Similarly, pigmentation too ranged from light green (copper-oxychloride) to dark brown mancozeb and triadimefon) and dark green (chlorothalonil and wettable sulfur) on upper side. On lower side, the pigmentation varied from light yellow (mancozeb, chlorothalonil and wettable sulfur) to light brown (triadimefon and copper-oxychloride).

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