J. Mycopathol. Res. **43**(1) : 121-123 (2005)

Evaluation of tolerance to fungicides in *Macrophomina phaseolina*, *Trichoderma harzianum*, *Trichoderma viride*, and *Gliocladium virens*

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Four fungicides, viz. blitox (copper oxychloride), dithane M-45 (mancozeb), captaf (captan) and bavistin (carbendazim) were evaluated at five different concentrations (50, 100, 200, 300 and 400 ppm) against *Macrophomina phaseolina*, the causal agent of stem rot of jute, the biocontrol agents *Trichoderma harzianum*, *Trichoderma viride* and *Gliocladium virens*. Dithane M-45 was highly suitable for integration with all the antagonists as it totally inhibited the mycelical growth of the pathogen but not as inhibitory to the antagonists. The antagonists were found to be moderately sensitive to captaf and blitox, therefore, these can also be integrated with some limitation. Bavistin cannot be used for integration as it totally inhibited the growth of antagonists.

Key words : Fungicides, tolerance, *Macrophomina phaseolina*, *Trichoderma harzianum*, *Trichoderma viride*, *Gliocladium virens*

INTRODUCTION

Stem rot, caused by *Macrophomina phaseolina*, is widely prevalent disease of jute in India. In the past severe outbreaks of this disease have caused considerable damage in Bangladesh and West Bengal (Rangaswami and Mahadevan, 1999). *Trichoderma* and *Gliocladium* spp., the most common soil inhabitants, are widely used to control a number of diseases due to soil borne plant pathogens (Papavizas, 1985). Search for effective biocontrol agents for the management of plant diseases have been intensified in recent years to reduce the dependence on ecologically hazardous chemicals (Mukhopadhyay, 1987, 1996). *Trichoderma* spp. have gained considerable importance either alone or integrated with lower dose of fungicides for the management of soilborne plant pathogens. Since the biocontrol agents have to be applied in soil it becomes imperative to ascertain its tolerance to agrochemicals used in crop production technology (Sharma and Mishra, 1995). Hence, in the present study different fungicides have been evaluated at various concentrations to know the tolerance limit of some biocontrol agents and the pathogen, *M. phaseolina*.

MATERIALS AND METHODS

The different biocontrol agents *T. harzianum*, *T. viride* and *G. virens* were isolated from rhizosphere soil of different crops of different sources by dilution plate technique (Harris and Sommers, 1968) using modified *Trichoderma* specific medium (Saha and Pan, 1997). The isolates were maintained on potato dextrose agar (PDA) slants at 4°C for subsequent use. The pathogen, *M. phaseolina* was isolated from infected stem portion of jute by using tissue segment method (Rangaswami, 1958).

Fungicides viz., blitox (copper oxychloride), dithane M-45 (mancozeb), captaf (captan) and bavistin (carbendazim) were tested at 5 different concentrations (50, 100, 200, 300 and 400 ppm) against the pathogen and antagonists *in vitro* by using Poisoned Food Technique (Fisher, 1969) to determine the most effective fungicide (s) for integration with bioagents which may inhibit the growth of the pathogen but not that of the antagonists. Disc (4 mm dim.) of pathogen and antagonists of 3 days old culture were inoculated in fungicide amended PDA plates. Control plates without any fungicides were also simultaneously inoculated for comparison. The inoculated plates were incubated at 28 ± 1°C till the pathogen and antagonists covered the PDA in control plates. The liner growth of the colony in each treatment was measured in two directions at right angles to each other. The per cent inhibition of growth in each treatment was calculated.

RESULTS AND DISCUSSION

The result (Table 1) shows that dithane M-45 totally inhibited the growth of *M. phaseolina* at all the concentrations tested. It inhibited the growth of *T. harzianum* ranging from 1.89 to 14.11%, *T. viride* 8.11 to 48.11% and *G. virens* 16.67% to 34.14% indicating that it is very less inhibitory to all the antagonists tested. Similarly, Singh *et al.* 1995) reported that the growth of *T. harzianum* (local and MTR-35 isolates) were inhibited 63.0 and 49.0% with 500 ppm of dithane M-45 after 3 days of incubation. In the present study all the antagonists were found to be less affected by dithane M-45. Therefore, dithane M-45 is highly suitable for integration with all the antagonists as it totally inhibited the mycelial growth of the pathogen but not as inhibitory to the antagonists. At 200 ppm captaf inhibited 41.44% growth of the pathogen but in case of *T. harzianum* it was only 5.56% and in case of *G. viride and T. viride* 16.89% and 25.88% respectively. According to Sharma *et al.* (2001) captaf inhibited 90% growth of *T. harzianum* at 1040 ppm but captaf was found to be a safe tolerance limit for the biocontrol agent at 169 ppm concentration. Blitox at 400 ppm inhibited 57.77% growth of the pathogen but in case of *T. harzianum, G. virens* and *T. viride* 17.78%, 21.11% and 23.33% respectively. From Table 1 it was clear that captaf and blitox were moderately inhibitory to the pathogen and less inhibitory to the antagonists. Therefore, these two fungicides can also be integrated with the antagonists with some limitations. Bavistin showed 100% growth inhibition of the pathogen as well as the antagonists at the all concentrations tested. So, bavistin cannot be used for integration with the antagonists. Ortiz Molinuevo *et al.* (1996) found good growth of bioagent at low and medium concentration of captaf and no growth with bavistin.

Table 1 : Effect of different concentrations of fungicides on the redial growth of *Macrophomina phaseolina, T. harzianum, Trichoderma viride* and *Gliocladium virens.*

Fungicides	Concentration	Mean growth inhibition (%)			
	(ppm)	*M. phaseolina*	*T. harzianum*	*T. viride*	*G. virens*
Blitox (Copper	50	8.89 (17.29)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)
onychloride)	100	15.55 (23.22)	0.00 (4.05)	7.78 (16.12)	0.00 (4.05)
	200	30.00 (33.20)	6.67 (14.85)	13.33 (21.37)	8.89 (17.33)
	300	43.33 (41.17)	10.00 (18.42)	21.11 (27.34)	16.67 (24.11)
	400	57.77 (49.48)	17.78 (24.93)	23.33 (28.88)	21.11 (27.33)
Dithane M-45	50	100 (89.55)	1.89 (6.53)	8.11 (16.47)	16.67 (24.12)
(Mancozeb)	100	100 (89.55)	3.67 (10.44)	12.55 (24.73)	18.11 (25.20)
	200	100 (89.55)	5.56 (13.64)	19.22 (25.80)	21.11 (27.35)
	300	100 (89.55)	6.67 (14.54)	13.64 (25.46)	26.67 (31.08)
	400	100 (89.55)	14.11 (21.97)	48.11 (43.94)	34.44 (48.84)
Captaf	50	14.44 (22.27)	0.00 (4.05)	22.22 (28.12)	7.78 (16.14)
(captan)	100	40.00 (39.23)	0.00 (4.05)	24.44 (29.61)	9.22 (17.71)
	200	41.44 (40.09)	5.56 (12.39)	25.88 (30.59)	16.89 (24.26)
	300	50.67 (45.64)	34.44 (35.93)	29.66 (32.96)	19.67 (26.29)
	400	66.33 (54.52)	46.33 (42.87)	46.33 (42.87)	26.33 (30.85)
Bavistin	50	100 (89.55)	100 (89.55)	100 (89.55)	100 (89.55)
(carbendazim)	100	100 (89.55)	100 (89.55)	100 (89.55)	100 (89.55)
	200	100 (89.55)	100 (89.55)	100 (89.55)	100 (89.55)
	300	100 (89.55)	100 (89.55)	100 (89.55)	100 (89.55)
	400	100 (89.55)	100 (89.55)	100 (89.55)	100 (89.55)
SEm ±		0.566	1.6672	1.4141	0.5840
CD at 5%		1.619	4.764	4.041	1.668

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(Accepted for publication November 25, 2004)