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Compatibility of fungal bioagent for bacterial leaf blight of rice with chemical pesticides, commonly used in rice cultivation

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Abstract: Though the pesticides have adverse effects but they still are very important in crop protection. Hence, present study on compatibility of fungal bioagent (*Trichoderma harzianum*) of bacterial leaf blight of rice with chemical pesticides which are commonly used in rice cultivation was carried out with aim to look the possibilities of integrating biological control with chemical control to manage bacterial leaf blight of rice effectively. All the chemical pesticides (fungicides, antibiotic, insecticides and herbicides) exhibited varying adverse effect on mycelial growth of *T. harzianum* but none of these was antisporulant. Among fungicides and antibiotic, copper oxychloride and streptocycline was compatible with *T. harzianum* at all concentrations (2000, 1000, 500 and 250 ppm) but mancozeb exhibited compatibility only on lower concentrations (500 and 250 ppm). All insecticides and herbicides were compatible with *T. harzianum* at all concentrations (2000, 1000, 500 and 250 ppm). Further studies are required in this area of research.

Keywords: Bacterial leaf blight of rice, Compatibility, Fungicides, Herbicides, Insecticides, *Trichoderma harzianum*

INTRODUCTION

The prime importance in the agriculture is to increase the productivity with ensured food safety. Though the pesticides have adverse effects but they still are very importance in crop protection. Bioagents being a biological entity are influenced by various factors which may also affect the effectivity of bioagents adversely (Singh, 2003; Khan, 2003). In many cases bioagents fail to manage the disease effectively due to various reasons and they would be used successfully if could integrated with compatible chemical pesticides. Hence testing compatibility with commonly used fungicides and antibiotics in crop cultivation is very important. Application of other agricultural pesticides *viz*. insecticides and herbicides may also affect the effectivity of bioagents adversely but these are necessary to manage pest and weeds causing huge loss to the rice crop. Hence, these are commonly applied in rice cultivation now days. Testing the compatibility of bioagents with these pesticides is also very important for successful biological control of disease under conventional rice cultivation (Sirvi *et al*., 2013).

Bacterial leaf blight of rice caused by *Xanthomonas oryzae* pv. *oryzae* is the disease known to occur in epidemic proportions in many parts of the world. The severity and significance of damage caused by disease has necessitated the development of strategies to manage the diseases, so as to reduce crop loss and to divert epiphytotic (Rao and Kaufmann, 1977). Microbial antagonists occur in nature are host specific, virulent, self perpetuating and genetically stable. These also stimulate plant growth, even if there is no disease, which results in better yield (Kloepper and Schroth, 1978; Mishra and Sinha, 2000). Therefore, they are potential candidates for management of plant diseases. Biological control of bacterial blight disease of rice has very important role in organic crop production and integrated disease management. Attempts were made to manage bacterial leaf blight disease of rice by means of fungal antagonist, *Trichoderma harzianum* (Gangwar and Sinha, 2010; Gangwar, 2012; Gangwar and Sinha, 2012a,b&c and Gangwar, 2013). Therefore, the present study was carried out to find out the compatibility of fungal bioagent (*T. harzianum*) with different chemical pesticides.

MATERIALS AND METHODS

Present study was carried out in Rice Pathology Laboratory, Department of Plant Pathology, G. B. Pant University of Agriculture and Technology, Pantnagar. *Trichoderma harzianum* was isolated from rice phyloplane. *T. harzianum* was effective against bacterial leaf blight of rice pathogen, *Xanthomonas oryzae* pv. *oryzae* (Gangwar and Sinha, 2010 and Gangwar and Sinha, 2012a) and against bacterial leaf blight disease of rice under glasshouse (Gangwar and Sinha, 2012b) and field conditions (Gangwar, 2012 and Gangwar, 2013). Present study was carried to tested compatibility of *T. harzianum*

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with different chemical pesticides. Six fungicides (tricyclazole, chlorothalonil, carbendazim, copper oxychloride, propiconazole and mancozeb), one antibiotic (streptocycline), six insecticides (buprofezin, dichlorovas, triazophos, profenophos, quinalphos and monocrotophos) and five herbicides (anilophos, pretilachlor, butachlor, pendimethalin and 2,4-D) were evaluated for their compatibility with *T. harzianum*.

Potato dextrose agar (PDA) medium poisoned with different pesticides (fungicides, antibiotic, insecticides and herbicides) at 2000, 1000, 500 and 250 ppm concentration was poured in sterilized petri dishes. After solidification of PDA, 5 mm disc was cut from growing mycelium of *T. harzianum* colony and was placed in the center of petri dishes. Petri dishes with unamended medium served as check. Three replications were maintained for each treatment. These petri dishes were incubated at 28 ±1 ^{0}C in BOD incubator. Periodic observations on radial growth and sporulation were recorded.

RESULTS AND DISCUSSION

All the chemical pesticides (fungicides, antibiotic, insecticides and herbicides) exhibited adverse effect on mycelial growth of *T. harzianum* but none of these was antisporulant.

Effect of fungicides and antibiotic: Data presented in Table 1 revealed that maximum mean radial growth (66.5 mm) of *T. harzianum* was recorded with streptocycline followed by copper oxychloride (30.7 mm) and mancozeb (11.9 mm). At lowest concentration (250 ppm), maximum radial growth was observed by streptocycline (85.0 mm) followed by copper oxychloride (37.3 mm) and mancozeb (26.3 mm). At 2000 ppm concentration, maximum radial growth of *T. harzianum* was observed with copper oxychloride (20.6 mm) and streptocycline (11.3 mm). Copper oxychloride and streptocycline was compatible with *T. harzianum* at higher (2000 and 1000 ppm) and lower concentrations (500 and 250 ppm). Mancozeb was compatible only on lower concentrations (500 and 250 ppm). Viji *et al.* (1997) observed that the benzimidazole group of fungicides (carbendazim and benomyl) was toxic to the antagonists (*Gliocladium virens, Trichoderma longibrachiatum* and *T. harzianum*), while the organophosphorus fungicides (edifenphos and iprobenfos) were less toxic the antagonists. Mishra (1998) demonstrated insensitiveness of *G. virens* to Vitavax, Captan and Thiram. Singh and Singh (2003) reported that carboxin at 5, 10 and 25 ppm had no effect on the radial growth of *T. virens* isolates. Malathi and Doraisamy (2003) reported that Captan and Thiram were compatible with the fungal antagonist *T. harzianum* TH-5. The differential response of biocontrol agents to various fungicides might be due to their inherent resistance to most of fungicides and their ability to degrade chemicals (Papavizas, 1985 and Viji *et al.,* 1997). Fungicides those are active against a narrow spectrum of plant pathogen but not against biocontrol agent offer an opportunity for integration of chemical and biocontrol agents. When biocides are applied in sub lethal doses, some fungal biocontrol agents (*Trichoderma* sp. etc.) are known to proliferate and produce antibiotics in soil (Papavizas, 1985). Further, their application may metabolically weaken the pathogen and make it vulnerable to potent biocontrol agents. The antagonists could tolerate 400 µM of the organophosphorus fungicides compared with 4 µM of the benzimidazole fungicides.

Effect of insecticides: Table 2 depicts that all insecticides were compatible with *T. harzianum* at all concentrations (2000, 1000, 500 and 250 ppm). Maximum mean radial growth of *T. harzianum* (74.7 mm) was measured with buprofezin which was followed by monocrotophos (65.8 mm) and dichlorovas (60.0 mm). Quinalphos showed minimum mean radial growth (22.0 mm) of *T. harzianum*. At lowest concentration (250 ppm), maximum radial growth (85.0 mm) was shown by monocrotophos, which followed by buprofezin (83.3 mm) and dichlorovas (71.6 mm). At highest concentration (2000 ppm), maximum radial growth (66.3 mm) was obtained by buprofezin which was followed by dichlorovas (44.3 mm) and monocrotophos (34.0 mm). Tiwari *et al.* (2004) recorded that Chlorpyrifos (dust), Methyl Parathion [parathion-methyl] (dust), Lindane (dust) and acephate (soluble powder) were not inhibitory to the mycelial growth of *T. harzianum*. Gowdar *et al.* (2004) reported that the maximum inhibition of *T. harzianum* (74.37 %) was recorded at 1.25 % Imidacloprid at 7 days after the treatment (DAT), and the minimum (12.50 %) at 0.25 % Imidacloprid at 21 DAT.

Effect of herbicides: It is evident from table 3 that all the herbicides were compatible with *T. harzianum* at all concentrations (2000, 1000, 500 and 250 ppm). Maximum mean radial growth (45.7 mm) of *T. harzianum* was observed with anilophos, followed by butachlor (42.5 mm) and pendimethalin (36.0 mm). Maximum radial growth (67.6 mm) was observed at lowest concentration (250 ppm) of anilophos, which was followed by 2,4-D (63.0 mm) and butachlor (61.6 mm). At higher concentrations (2000 and 1000 ppm), maximum radial growth (32.6 and 35.6 mm, respectively) was observed with butachlor, followed by anilophos (26.6 and 34.6 mm, respectively). Similarly, Desai and Kulkarni (2004) reported that captan, acephate, atrazine and 2,4-D were comparatively safe to the biological control agent. Ciraj (1996) concluded sulfonylurea based herbicides had no significant negative effect on antagonistic fungi *Trichoderma* species, and in some cases they stimulated growth of fungi. Rao and Divakar (2002) reported treatment with 50 ppm butachlor resulted in the increase of CFU of *T. viride* 24 h after treatment.

Table 1. Compatibility of different fungicides and antibiotic with *T. harzianum* after 7 days of inoculation.

Treatment	Radial growth *T. harzianum* (mm)				
	2000 ppm	1000 ppm	500 ppm	250 ppm	Mean
Tricyclazole	2.6	4.0	9.3	12.6	7.1
Chlorothalonil	4.0	4.3	5.3	8.0	5.4
Carbendazim	0.0	0.0	0.0	0.0	0.0
Copper oxychloride	20.6	32.3	32.6	37.3	30.7
Streptocycline	11.3	85.0	85.0	85.0	66.5
Propiconazole	0.0	0.0	0.0	0.0	0.0
Manacozeb	0.0	0.0	21.3	26.3	11.9
Check	85.0	85.0	85.0	85.0	85.5
Mean	15.4	26.3	29.8	31.7	25.8
CD at 5 %	A (concentrations) = 0.51				
	B (treatments) = 0.71				
	A × B = 1.47				

*Mean of three replications

Table 2. Compatibility of different insecticides with *T. harzianum* after 7 days of inoculation.

Treatment	Radial growth *T. harzianum* (mm)				
	2000 ppm	1000 ppm	500 ppm	250 ppm	Mean
Buprofezin	66.3	73.3	76.0	83.3	74.7
Dichlorovas	44.3	56.3	68.0	71.6	60.0
Triazophos	17.3	34.3	41.0	45.0	34.4
Profenophos	18.6	31.0	45.3	56.0	37.7
Quinalphos	13.0	14.3	22.6	38.3	22.0
Monocrotophos	34.0	69.3	75.0	85.0	65.8
Check	85.0	85.0	85.0	85.0	85.0
Mean	39.8	51.9	59.0	66.3	54.2
CD at 5 %	A (concentrations) = 1.00				
	B (treatments) = 1.33				
	A × B = 2.67				

*Mean of three replications

Table 3. Compatibility of different herbicides with *T. harzianum* after 7 days of inoculation.

Treatment	Radial growth *T. harzianum* (mm)				
	2000 ppm	1000 ppm	500 ppm	250 ppm	Mean
Anilophos	26.6	34.6	54.0	67.6	45.7
Pretilachlor	23.0	29.6	35.6	54.6	35.7
Butachlor	32.6	35.6	40.0	61.6	42.5
Pendimethalin	15.3	30.3	44.0	54.6	36.0
2, 4-D	9.3	10.3	31.3	63.0	28.5
Check	85.0	85.0	85.0	85.0	85.0
Mean	32.0	37.6	48.3	64.4	45.5
CD at 5 %	A (concentrations) = 0.83				
	B (treatments) = 1.01				
	A × B = 2.03				

*Mean of three replications

Conclusion

The present study revealed that different chemical pesticides *viz*. Copper oxychloride (fungicide) and streptocycline (antibiotic) buprofezin, monocrotophos, dichlorovas (insecticides) and anilophos, butachlor, pendimethalin, pretilachlor (herbicides) exhibited compatibility with fungal bioagent (*T. harzianum*) of bacterial leaf blight of rice. There are possibilities of deployment of compatible bioagents in rice cultivation. In the integrated disease management package, compatible pesticides can be incorporated along with bioagents for effective and sustainable disease management with lesser disturbance to agro-ecosystem.

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