International Journal of Agriculture Innovations and Research
Volume 2, Issue 2, ISSN (Online) 2319-1473
Manuscript Processing Details (dd/mm/yyyy) :
Received : 28/08/2013 | Accepted on : 12/09/2013 | Published : 17/09/2013

Compatibility of Bacterial Bioagent of Bacterial Leaf Blight of Rice with Chemical Pesticides, Commonly Used in Rice Cultivation

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***Abstract* - Present study was carried out to evaluate the compatibility of bacterial bioagent of bacterial leaf blight of rice (*Pseudomonas fluorescens* isolate 83) with different chemical pesticides (fungicides, antibiotic, insecticides and herbicides) which are commonly used in rice crop cultivation. Among fungicides, Tricyclazole and carbendazim was compatible with *P. fluorescens* isolate 83 at all four concentrations (2000, 1000, 500 and 250 ppm). However, propiconazole showed compatibility at 1000, 500 and 250 ppm and chlorothalonil at 500 and 250 ppm since these were statistically equal to check. Among insecticides, Profenophos was compatible with *P. fluorescens* isolate 83 at all four concentrations and Quinalphos was compatible at 500 and 250 ppm. Among herbicides, Butachlor and pendimethalin was compatible with *P. fluorescens* isolate at all four concentrations (2000, 1000, 500 and 250 ppm) whereas, anilophos exhibited compatibility only on lower concentrations (500 and 250 ppm). Present study indicated the possibilities of deployment of compatible bioagent formulations for management of bacterial leaf blight disease of rice. In the integrated disease management package, compatible pesticide can be incorporated along with bioagents for effective and sustainable disease management with lesser disturbance to agro-ecosystem.**

***Keywords* – Bacterial Leaf Blight of Rice, Compatibility, Pesticides, *Pseudomonas Fluorescens*.**

I. Introduction

Bacterial leaf blight of rice caused by *Xanthomonas oryzae* pv. *oryzae* is the disease of great economic importance in all rice growing areas of the world and is particularly destructive in Asia during the heavy rains of monsoon season (Mew *et al.*, 1993). The severity and significance of damage caused by bacterial leaf blight disease of rice has necessitated the development of strategies to manage the diseases, so as to reduce crop loss and divert epiphytotic. The prime importance in the agriculture is to increase the productivity with ensured food safety. Though the chemical pesticides have adverse effects but they still are very importance in crop protection. Hazardous effects of chemical pesticides have imposed the development of suitable eco-friendly means to manage plant diseases. Microbial antagonists occur in nature are host specific, virulent, self perpetuating and genetically stable. Being a biological entity these organism may also influence the ecological factors in the favor of crop or mitigating the effect of pathogen. These also stimulate plant growth, even if there is no disease, which results in better yield (Kloepper and Schroth, 1978; Mishra and Sinha, 2000). So, they are potential candidates for management of plant diseases. Biological control of bacterial blight disease of rice may have a vital role in organic crop production and integrated disease management. Attempts were made to manage bacterial leaf blight disease of rice by means of bacterial antagonist, *P. fluorescens* (Gangwar and Sinha, 2010; Gangwar and Sinha, 2012a&b; Gangwar, 2012 and Gangwar, 2013).

Application of pesticides *viz*, chemical fungicides, insecticides herbicides and antibiotics may affect the effectivity of bioagents adversely. Whereas these are necessary to manage pests and weeds causing huge loss to the rice crop and are commonly applied in rice cultivation now days. Testing the compatibility of bioagents with these commonly used pesticides is very important for successful of biological control of disease under conventional rice cultivation. So, study on compatibility of potential bioagents with commonly used chemical pesticides is important area of biological control research. *Pseudomonas fluorescens* isolate 83 was isolated from rice phylloplane and was found to be effective against *Xanthomonas oryzae* pv. *oryzae* (Gangwar and Sinha, 2010 and Gangwar and Sinha, 2012a) causing bacterial leaf blight of rice and exhibited significantly reduced disease severity, under glasshouse (Gangwar and Sinha, 2012b) and field conditions (Gangwar, 2012 and Gangwar, 2013). So keeping these facts in mind, present study was carried out to evaluate compatibility of bacterial bioagent of bacterial leaf blight of rice (*P. fluorescens*) against different chemical pesticides which are commonly used in rice crop cultivation.

II. Materials and Methods

Present study was carried out to tested compatibility of bacterial bioagent (*P. fluorescens* isolate 83) of bacterial leaf blight of rice with different chemical pesticides *viz.* fungicides (tricyclazole, chlorothalonil, carbendazim, copper oxychloride, propiconazole and mancozeb), antibiotic (streptocycline), insecticides (buprofezin, dichlorovas, triazophos, profenophos, quinalphos and monocrotophos) and herbicides (anilophos, pretilachlor, butachlor, pendimethalin and 2, 4-D) The experiment was carried out in Rice Pathology Laboratory, Department of Plant Pathology, G. B. Pant University of Agriculture and Technology, Pantnagar.

Sterilized King's B medium amended with *P. fluorescens* cell suspension was poured in the Petri dishes and allowed to solidify. Sterilized 5 mm paper discs were dipped in different chemical pesticides solutions (fungicides, antibiotic, insecticides and herbicides at 2000, 1000, 500 and 250 ppm concentration) and allow excess solution to trickle down before placing in Petri dish. These paper discs were placed at the center of Petri dishes. Petri dishes containing paper disc dipped in sterilized water were 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 inhibition zone were recorded.

III. Results and Discussion

Compatibility of bacterial bioagent with fungicides and antibiotic

Table 1 exhibited that minimum mean inhibition zone (1.9 mm) was recorded at 250 ppm, followed by 500 ppm (2.9mm) and 1000 ppm (3.9 mm).

Table 1: Compatibility of bacterial bioagent (*P. fluorescens* isolate 83) of bacterial leaf blight of rice with different fungicides and antibiotic, after 3 days of inoculation

Treatment	Inhibition zone (mm)				
	2000 ppm	1000 ppm	500 ppm	250 ppm	Mean
Tricyclazole	0.0	0.0	0.0	0.0	0.0
Chlorothalonil	3.3	1.6	0.6	0.0	1.4
Carbendazim	0.0	0.0	0.0	0.0	0.0
Copper oxychloride	5.0	3.6	2.6	1.0	3.0
Propiconazole	2.6	1.0	0.0	0.0	0.9
Mancozeb	5.3	4.3	4.0	3.6	4.3
Streptocycline	24.6	20.6	16	11.0	18.0
Check	0.0	0.0	0.0	0.0	0.0
Mean	5.1	3.9	2.9	1.9	3.4
CD at 5 %	A (concentrations) = 0.36				
	B (treatments) = 0.51				
	A × B = 1.02				

* Mean of three replications

Antibiotic, streptocycline was most effective in inhibiting growth of *P. fluorescens* isolate 83 and showed mean inhibition zone by 18.0 mm. Tricyclazole and carbendazim exhibited compatibility with *P. fluorescens* isolate 83 at all four concentrations. However propiconazole exhibited compatibility at 1000, 500 and 250 ppm while, chlorothalonil at 500 and 250 ppm since statistically found equal to check. Similarly, Tu and Zheng (1993) reported that *P. fluorescens* was compatible with low concentration of DCT (diazinon + captan + thiophanate-methyl) and they suggested the incorporation of *P. fluorescens* with DCT for seed treatment may extend the effect of DCT to give protection against root rot of *Phaseolus vulgaris* caused *by Rhizoctonia solani, Fusarium solani* and *Pythium ultimum*. Yang *et al.* (1993) isolated a copper-resistant strain (09906) of *P. fluorescens* and they suggest that copper resistance genes can be important factors in persistence of *P. fluorescens* in soil contaminated with copper and in addition, these genes appear to play a role in competitive fitness, even in soils with a low copper content. Compatibility of biocontrol agent *T. harzianum* C52 with selected fungicides was evaluated by McLean *et al.* (2001). Khan and Shahzad (2007) carried out screening of *Trichoderma* species for tolerance to fungicides. The differential response to 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. 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. The antagonists could tolerate 400 µM of the organophosphorus fungicides compared with 4 µM of the benzimidazole fungicides.

Compatibility of bacterial bioagent with insecticides

It revealed by the data presented in Table 2 that minimum mean inhibition zone (1.0 mm) was recorded at 250 ppm concentration which is followed by 500 ppm (1.5 mm) and 1000 ppm (2.6 mm). Profenophos did not showed mean inhibition zone and was compatible with *P. fluorescens* isolate 83 while, quinalphos showed mean inhibition zone by 0.5 mm can also be considered as compatible. Profenophos was found compatible with *P. fluorescens* isolate 83 at all four concentrations *viz.* 2000, 1000, 500 and 250 ppm. Quinalphos was compatible at 500 and 250 ppm.

Table 2: Compatibility of bacterial bioagent (*P. fluorescens* isolate 83) of bacterial leaf blight of rice with different insecticides, after 3 days of inoculation

Treatment	**Inhibition zone (mm)**				
	2000 ppm	**1000 ppm**	**500 ppm**	**250 ppm**	**Mean**
Buprofezin	2.3	2.0	2.0.	2.0	2.0
Dichlorovas	10.0	8.3	4.6	2.6	6.4
Triazophos	5.3	3.0	1.0	0.0	2.3
Profenophos	0.0	0.0	0.0	0.0	0.0
Quinalphos	1.3	0.6	0.0	0.0	0.5
Monocrotophos	5.6	4.6	3.3	2.3	4.0
Check	0.0	0.0	0.0	0.0	0.0
Mean	3.5	2.6	1.5	1.0	2.1
CD at 5 %	A (concentrations)	= 0.22			
	B (treatments)	= 0.29			
	A × B	= 0.59			

* Mean of three replications

Das *et al.* (2003) investigated effect of insecticides on the population and distribution of bacteria and reported that *Pseudomonas* was inhibited by carbofuran at rates of 1.0 kg a.i. ha[1]. Carbofuran persisted in the rhizosphere soil for a short period of time. Desai and Kulkarni (2002) recorded 100 per cent inhibition of mycelium growth and sporulation of *T. viride* with chloropyrifos and 10.26 and 17.72% inhibition of mycelial growth and sporulation, respectively with acephate. Rao and Divakar, (2002) reported an immediate reduction of *T. viride* colony forming units (CFU) resulted when phorate (at 1000 and 600 ppm) were added to the soil. Gowder *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.

Compatibility of bacterial bioagent with herbicides

As depicted by Table 3, minimum mean inhibition zone (0.8 mm) was measured at 250 ppm which was found statistically equal to that of 500 ppm (1.0 mm). Butachlor and pendimethalin showed compatibility with *P. fluorescens* isolate 83 and did not exhibit inhibition zone. However, anilophos showed mean inhibition zone by 0.8 mm can also be considered as compatible with *P. fluorescens* isolate 83. Butachlor and pendimethalin showed compatibility with *P. fluorescens* at lower concentrations (500 and 250 ppm) as well as on higher concentrations (2000 and 1000 ppm). Whereas anilophos was exhibited compatibility with *P. fluorescens* isolate 83 only on lower concentrations (500 and 250 ppm). Macek and Lesnik (1994) reported that the primisulfuron and triasulfuron + fluoroglycofen stimulated the mycelial growth of *Trichoderma longibrachiatum* at low concentration. Ciraj (1996) concluded sulfonylurea based herbicides had no significant negative effect on antagonistic fungi *Trichoderma* spp, and in some cases they stimulated growth of fungi. Rao and Divakar (2002) reported treatment with 50 ppm butachlor resulted in the increased CFU of *T. viride* 24 h after treatment. Milicic *et al.* (2003) observed highest level of inactivation of atrazine with *T. viride* in the soil and was capable of inactivating-detoxicating of simazine.

Table 3: Compatibility of bacterial bioagent (*P. fluorescens* isolate 83) of bacterial leaf blight of rice with different herbicides, after 3 days of inoculation

Treatment	**Inhibition zone (mm)**				
	2000 ppm	**1000 ppm**	**500 ppm**	**250 ppm**	**Mean**
Anilophos	2.3	1.0	0.0	0.0	0.8
Pretilachlor	4.3	3.3	2.3	1.6	2.9
Butachlor	0.0	0.0	0.0	0.0	0.0
Pendimethalin	0.0	0.0	0.0	0.0	0.0
2, 4-D	5.6	5.0	4.0	3.6	4.5
Check	0.0	0.0	0.0	0.0	0.0
Mean	2.0	1.5	1.0	0.8	1.3
CD at 5 %	A (concentrations)	= 0.28			
	B (treatments)	= 0.34			
	A × B	= 0.69			

* Mean of three replications

International Journal of Agriculture Innovations and Research
Volume 2, Issue 2, ISSN (Online) 2319-1473

Different chemical pesticides *viz.* fungicides (tricyclazole and Carbendazim), insecticide (Profenophos) and herbicides (Butachlor and pendimethalin) were found to be compatible with bioagent (*P. fluorescens* isolate 83) of bacterial leaf blight of rice. In the integrated disease management package compatible pesticide can be incorporated along with bioagents for effective and sustainable disease management with lesser disturbance to agro-ecosystem. Present studies indicated the possibilities of deployment of compatible bioagents in rice cultivation. Further studies are required in this area of research.

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My major field of M.Sc. Thesis Research was studies on mass multiplication and compatibility of *Beauveria bassiana* (Balsamo) Vuilemin with chemical and bio-pesticides and of Ph. D. Thesis Research was biological management of bacterial leaf blight of rice by caused by *Xanthomonas oryzae* pv. *oryzae* (Uyeda and Ishiyama) Dowson. I have eight research papers published in the journals of repute. Presently, I am working as research associate.
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Ph. D.	2010	Plant Pathology	GBPUA&T, Pantnagar
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