RESEARCH ARTICLE

COMPATIBILITY OF ENTOMOPATHOGENIC FUNGI WITH BUPROFEZIN FOR MANAGEMENT OF BROWN PLANTHOPPER, *NILAPARVATA LUGENS* STAL (DELPHACIDAE: HEMIPTERA) IN RICE

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Abstract: Compatibility between Buprofezin 25SC and entomopathogenic fungi studies were conducted at IIRR (Indian Institute of Rice Research), Hyderabad. Buprofezin 25 SC was tested at three concentrations viz., recommended concentration (RC), sub lethal concentration (0.5 RC) and more than recommended concentration (1.5 RC) against three entomopathogenic fungi viz., *Beauveriabassiana*, *Metarhiziumanisopliae* and *Lecanicilliumlecanii* (*Verticilliumlecani*) by using poison food technique under laboratory conditions. Buprofezin 25 SC was harmless to all three tested entomopathogenic fungi at 0.5 RC and RC recorded 5.53 to 15.96 per cent inhibition of the entomopathogenic fungi. At 1.5 RC buprofezin was harmless to *B. bassiana* (19.57 per cent inhibition in growth of the fungus) and slightly harmful to *M. anisopliae* and *L. Lecanii* recorded 20.21 and 23.40 per cent reduction in growth of the fungus respectively.Combined use of imidacloprid with entomopathogenic fungi at recommended concentrations against BPH under glasshouse conditions indicating buprofezin alone could cause 55.00 per cent mortality in BPH. Buprofezin combined with entomopathogenic fungi increased the mortality of BPH compared to buprofezin alone spray.

Keywords: *Beauveria*, Brown planthopper, Entomopathogenic fungi, *Lecanicillium*, *Metarhizium*, *Nilaparvata lugens*

INTRODUCTION

Rice is Life" describes the importance of rice in human diet. It is grown worldwide over an area of 153 million hectares with annual production of more than 600 million tonnes. In India, it is cultivated in an area of 44.80 million hectares with an annual production of 89.31 million tonnes and productivity over two tonnes of milled rice per hectare (CMIE, 2014). Insect pests are the severe constraints to rice production throughout the world (Dale, 1994) where more than 100 species of insect pests attack and damage rice (Pathak, 1968). Among all brown planthopper (BPH), *Nilaparvata lugens* (Stal) (Hemiptera: Delphacidae) is one of the most economically important insect, which can cause huge damage where both nymphs and adults suck the plant sap directly and indirectly transmit viruses such as ragged stunt and grassy stunt (Jena *et al.*, 2006). Due to infestation plants turn yellow and dry up rapidly. At early infestation, round and yellow patches appear, which soon turn brownish due to the drying up of the plants which is called as 'hopper burn', and could result in causing yield loss ranging from 10-75% (Park *et al.*, 2008). Insecticides are the major means of managing the BPH. However, continuous use of these insecticides causing health hazards and environmental pollution, besides this it cause development of insecticide resistance in the insects (Jhansi Lakshmi *et al.*, 2010b). So, it is very difficult to manage the insect by insecticides alone, for this BIPM **(**Bio-intensive Integrated Pest Management) include combined use of chemical pesticides with bio pesticides such as bacteria, fungi and viruses for control of pests. Therefore, the present investigation has been planned with combined use of fungal formulations and buprofezin for managing BPH. Buprofezin is a growth regulator which inhibits chitin synthesis in insect.

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MATERIALS AND METHODS

Experiment was carried out to evaluate compatibility between buprofezin and entomopathogenic fungi (*Beauveriabassiana*, *Metarhiziumanisopliae* and *Lecanicilliumlecanii*) both in the laboratory and glasshouse at Indian Institute of Rice Research (Formerly Directorate of Rice Research), Hyderabad.

Inhibitory studies in the laboratory (Poison food technique)

Standard poison food technique was followed to assess compatibility of the entomopathogenic fungi with various insecticides (Moorhouse *et al.*, 1992). Desired quantity of insecticide (Buprofezin 25SC) based on field application rate (recommended concentration, half recommended concentration and 1.5 recommended concentration) was added to the PDA medium (200 ml), autoclaved at 121°C (15 Psi) for 15-20 minutes in the conical flask before solidification (medium temperature 48°C) to get desired concentration and later was mixed thoroughly. The medium was then poured equally into the petriplates. Each treatment was replicated four times. Small disc (5 mm dia.) of young fungal mycelium was cut with sterile cork borer and placed aseptically in the centre of plate containing the poisoned medium. Petri plates were incubated at 27±1°C, 80±5% relative humidity. Suitable check without poison was kept for comparison under the same conditions. Diameter of the fungal colony was measured at 2, 4, 6, 8 and 10 days after inoculation (DAI) and compared with standard check. The data were expressed as percentage growth inhibition of fungiby insecticide treated PDA (Hokkanen and Kotiluoto, 1992) and calculated by the formula

$$X = \frac{Y-Z}{Y} \times 100$$

Where X, Y, Z stand for percentage growth inhibition, radial growth of the fungus in untreated check and radial growth of the fungus in poisoned medium, respectively. The pesticides were further classified in evaluation categories of 1- 4 scoring index. 1 = harmless (<20% reduction), 2 = slightly harmful (20-35% reduction), 3 = moderately harmful (35- 50% reduction), 4 = harmful (>50% reduction) in toxicity tests *in vitro* according to Hassan's classification scheme (Hassan, 1989).

Inhibitory studies under glasshouse conditions

The recommended dose of buprofezin 25 SC(2ml/l) was mixed with the recommended dose of effective fungal commercial formulations (5g/l) and sprayed on to the rice plants. BPH were released on the sprayed plants and mortality was recorded at 24 hrs interval up to five days after spraying. The results were compared with those of buprofezin and fungal pathogens alone by recording data on per cent mortality.

RESULTS AND DISCUSSION

Effect of buprofezin 25 SCon growth of entomopathogenic fungi

Buprofezin at 0.5 RC and RC did not significantly inhibit the growth of three entompathogenic fungi (5.53 – 15.96 %) (Table.1). However, the inhibitory effect was observed at 1.5 RC and was found slightly harmful to growth of the fungi recording 19.57 to 23.40 per cent reduction of radial growth over control. When the media was mixed with 0.5 RC, RC and 1.5 RC of buprofezin and inoculated with *B. bassiana*, it resulted in 6.52, 11.96 and 19.57 per cent reduction of radial growth of the fungus. Similarly 5.53, 15.74 and 23.40 per cent reduction in *M. anisopliae* and 6.38, 15.96 and 20.21 per cent reduction in case of *L. lecanii* was observed. Anderson *et al.* (1989) also reported that insecticides of microbial origin and chitin inhibitors such as abamectin, thuringiensin and triflumuron were compatible with *B. bassiana* even at higher doses supporting the present observation where in buprofezin, a chitin inhibitor was found to be slightly harmful at higher concentration. Further, it was confirmed by Andrew *et al.* (2005) who have reported that the active ingredient buprofezin provided an acceptable level of spore germination of *L. muscarium*.

According to present results buprofezin was harmless to all three tested entomopathogenic fungi at 0.5 RC and RC. At 1.5 RC buprofezin was harmless to *B. bassiana* and slightly harmful to *M. anisopliae* and *L. lecanii*.

Effect of buprofezin 25 SC +entomopathogenic fungi on BPH

Buprofezin is an insect growth regulator and it mainly inhibits chitin synthesis affecting development of BPH nymphs. Present results indicated that buprofezin alone caused 55.00 per cent mortality at 5 DAS, and mortality was increased by combining buprofezin with the entomopathogenic fungi, *B. bassiana*, *M. anisopliae* and *L. lecanii*. Results presented in the Table 2.indicated that there was negligible mortality of BPH for first two days after spraying which increased with increase in time when buprofezinwas used alone or combined with entomopathogenic fungi. At 1 DAS, buprofezin alone, buprofezin + *B. bassiana*, buprofezin + *M. anisopliae* and buprofezin + *L. lecanii* recorded 2.50, 2.50, 0.00 and 1.25 per cent mortality, respectively and at 2 DAS, mortality increased to 16.25, 11.25, 10.00 and 11.25 per cent, respectively. However, mycosis was observed from 3 DAS and the mortality increased in combination treatments compared to buprofezin alone. At 3 DAS, highest mortality of BPH was observed in buprofezin + *L. lecanii*(48.75%) followed by buprofezin + *B. bassiana*(43.75 per cent) and buprofezin + *M. anisopliae*(43.75 per cent).Buprofezin alone recorded 36.25 per cent mortality which was on par with buprofezin + *B. bassiana* and buprofezin + *M. anisopliae*treatments and these were significantly superior over control (2.50 per cent mortality). Mortality of BPH was increased in combination treatments at 4 DAS i.e. buprofezin + *B. bassiana*(63.75 per cent), buprofezin + *M. anisopliae*(60.0 per cent) and buprofezin + *L. lecanii* (66.25 per cent) which were on par with each other and significantly superior over buprofezin alone which recorded 46.25 per cent mortality. Similarly at 5 DAS, mortality has further increased to 77.5, 82.5 and 82.5 per cent inbuprofezin + *B. bassiana* and buprofezin + *M. anisopliae* and buprofezin + *L. lecanii*treatments, respectively which were on par with each other and significantly superior over buprofezin alone which has recorded 55.00 per cent mortality. In the present investigation, at five days after spraying buprofezin + *B. bassiana* (77.50 per cent), buprofezin + *M. anisopliae* (82.50 per cent) and buprofezin + *L. lecanii* (82.50 per cent) treatments recorded highest per cent mortality compared to individual spraying of buprofezin (55.00 per cent mortality), *B. bassiana*with 8.75 per cent mortality,*M. anisopliae*with 10.00 per cent mortality and *L. lecanii* with 12.50 per cent mortality.

Buprofezin being a growth regulator which inhibits the growth of the insect, it doesn't kill the insect immediately and provide more time for disease development. These findings are in corroboration with the findings of Feng*et al.* (2011) who reported 54 to 60 per cent BPH mortality in the field by spraying of Ma456 and Ma576 alone @ 1.5 x 10^{13} conidia/ha and they further suggested that mortality could be increased to 80 to 83 per cent by incorporating 30.8 g/ha buprofezin along with fungal sprays; These reports support present study where in by mixing of entomopathogenic fungi with buprofezin, per cent mortality of BPH could be increased from 55.00 per cent (buprofezin alone) to 82.50 per cent with *M. anisopliae* and *L. lecanii* and 77.50 per cent with *B. bassiana*.

Table 1. Effect of buprofezin 25 SC on growth of entomopathogenic fungi

Fungus	0.5 Recommended Concentration		Recommended Concentration		1.5 Recommended Concentration		Untreated Control Radial growth (cm)	Mean
	Radial growth (cm)	Inhibition (%)	Radial growth (cm)	Inhibition (%)	Radial growth (cm)	Inhibition (%)		
B. bassiana	4.30	6.52	4.05	11.96	3.70	19.57	4.60	4.16^{b}
M. anisopliae	5.55	5.53	4.95	15.74	4.50	23.40	5.88	5.22^{a}
L. lecanii	4.40	6.38	3.95	15.96	3.75	20.21	4.70	4.20^{b}
Mean	4.75^{b}		4.32^{c}		3.98^{d}		5.06^{a}	
CV (%)	3.19							
LSD (5%)								
Fungus	0.10							
Concentration	0.12							

Means with same letter are not significantly different at 5% level by DMRT
RC- Recommended Concentration

Table 2. Effect of buprofezin 25 SC in combination with entomopathogenic fungi on BPH

Treatment	Mortality (%)				
	1 DAS	**2 DAS**	**3 DAS**	**4 DAS**	**5 DAS**
Buprofezin 25SC @ 2ml/l	2.50 (9.09)	16.25 (23.76)^{a}	36.25 (37.00)^{b}	46.25 (42.83)^{b}	55.00 (47.85)^{b}
Buprofezin 25SC @ 2ml/l + *B. bassiana*@ 5g/l	2.50 (9.09)	11.25 (19.59)^{a}	43.75 (41.39)^{ab}	63.75 (52.96)^{a}	77.50 (61.66)^{a}
Buprofezin 25SC @ 2ml/l + *M. anisopliae*@ 5g/l	0.00 (0.00)	10.00 (18.14)^{a}	43.75 (41.39)^{ab}	60.00 (50.75)^{a}	82.50 (65.24)^{a}
Buprofezin 25SC @ 2ml/l + *L. lecanii*@ 5g/l	1.25 (6.42)	11.25 (11.59)^{a}	48.75 (44.27)^{a}	66.25 (54.46)^{a}	82.50 (65.24)^{a}
Control	0.00 (0.00)	0.00 (0.00)^{c}	2.5 (9.09)^{c}	3.75 (11.16)^{c}	8.75 (17.20)^{c}
CD	**N.S**	**5.89**	**7.28**	**8.03**	**5.58**
SE(m)	**2.77**	**1.94**	**2.39**	**2.64**	**1.84**

Means with same letter are not significantly different at 5% level by DMRT
DAS- Days after spraying

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