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Efficacy of Entomopathogenic Fungi Against Brown Planthopper, N*ilaparvata Lugens* Stal. (Delphacidae: Hemiptea) on Rice

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ABSTRACT

Entomopathogenic fungi have potential for controlling brown planthoppers in paddy. Efficacy of entomopathogenic fungi like *Beauveria bassiana*, *Metarhizium anisopliae* and *Lecanicillium lecanii* (*Verticillium lecanii*) against BPH was studied under glasshouse conditions. The three tested fungi was ineffective at initial stage of spray but increased the time mortality of BPH was also increased. the three fungi caused mortality to an extent of 53.75 – 70.00 per cent at 10 days after application.

Key words: *Entomopathogenic, Planthopper, Rice.*

BPH is a destructive invasive pest and has become one of the most economically important rice pests. Effective control measures are desperately needed. However, the large use of chemical compounds has caused development of resistance and detrimental impact on natural enemies (Tanaka *et al.,* 2000; Jhansi Lakshmi *et al.,* 2010 and Preetha *et al.,* 2010). So, there is an urgent need to find alternative measures that maybe friendly to environment. A number of entomopathogenic fungi are already commercially available which offer an environmentally safe and economically viable and alternative to chemical control. When BPH were infected with entomopathogenic fungi the mortality started after three days and by the sixth day it was reached maximum. The insects developed the typical symptom of being overgrown by the mycelium. In this study to explore alternative strategies for sustainable control of sucking pest population by using commercial formulations of *B. bassiana*, *M. anisopliae* and *L. lecanii*.

MATERIAL AND METHODS

The experiment was conducted during 2014-15 under glasshouse, Department of Entomology, Indian Institute of Rice Research (IIRR), Hyderabad. Efficacy of entomopathogenic fungi, *B. bassiana*, *M. anisopliae* and *L. lecanii* to third instar nymphs and one day old female adults were tested under glasshouse conditions by two methods viz., spraying and dipping method. In spraying method the recommended dose of commercial formulation of entomopathogenic fungi (5g/l) was mixed with water and sprayed on 45 days old TN 1 plants and then twenty third instar nymphs or adults were released on to TN 1 plants covered with mylar tubes to prevent the escape of nymphs or adults. In dipping method the recommended dose of entomopathogenic fungi were prepared (5g/l), twenty third instar nymphs or twenty female adults were immersed in 20ml of fungal suspension in petriplate for 10s. then the treated insects were transferred to 45 days old TN1 plants and covered with mylar tube to prevent the escape of insects. Number of insects were died were recorded at 5 days and 10 days after spraying and per cent mortalities were calculated. It was found that *N. lugens* were infected with fungi moved sluggishly in the early stage of infection, female adults stopped oviposition and nymphs had difficulty in peeling. However, the infected BPH they died holding rice stems, which were not found in the control group.

RESULTS AND DISCUSSION

Effect of entomopathogenic fungi against BPH nymphs

Results pertaining to efficacy of entomopathogenic fungi on third instar nymphs of BPH were presented in the Table 1 Studies revealed that three fungi, *B. bassiana, M. anisopliae* and

L. lecanii significantly reduced the BPH population compared to control. In the present investigation, entomopathogenic fungi were tested using two methods of inoculation *viz.,* spraying and dipping. The entomopathogenic fungi *B. bassiana*, *M. anisopliae* and *L. lecanii* were found to be highly pathogenic to BPH by dipping method causing more mycosis to the nymphs compared to spraying. The results clearly indicated that among all the treatments, monocrotophos 36 SL as a check was found to be highly effective against BPH. *B. bassiana*, *M. anisopliae* and *L. lecanii* @ 5g/l were found to be ineffective at 5 days after releasing recording low per cent mortality. Their efficacy against BPH increased with increase in time after application and recorded more than 50 per cent mortality after 10 days. Efficacy of three fungi was on par with each other though inferior to chemical check but was found to be superior to control. Among three fungi, *M. anisopliae* has recorded high mortality of 60.00 per cent at 10 days after release in dipping method followed by both *B. bassiana* and *L. lecanii* with 53.75 per cent mortality. Spraying entomopathogenic fungi viz., *B. bassiana*, *M. anisopliae* and *L. lecanii* was ineffective at 5 days after spraying which recorded 8.75, 10.00 and 12.50 per cent mortality of BPH nymphs, respectively. However, efficacy of entomopathogenic fungi increased with increasing in time after spraying and at 10 days after spraying 26.25, 23.75 and 25.00 per cent mortality was recorded due to *B. bassiana*, *M. anisopliae* and *L. lecanii* infection respectively. In the present investigations, spraying method has recorded less mortality than dipping method which might be due to the reason that while spraying there was less chance of falling inoculum on the insect body. Present findings clearly indicate that entomopathogenic fungi could cause mycosis in BPH through fungal pathogenesis which depends on number of factors like, spore attachment to the body wall, spore germination, penetration, growth and proliferation within the haemocoel, interaction with insect defence mechanism and finally mycelial emergence on the cadaver (Thomas *et al.,* 1996). Reddy *et al*. (2013) reported that the entomopathogenic fungi, *B. bassiana*, *M. anisopliae* and *V. lecanii* showed low efficacy against BPH at 5 days after spraying but, at 10 days after spraying there was 58.1, 72.0 and 41.2 per cent reduction of BPH population over control respectively and they concluded that the efficacy of entomopathogenic fungi increased with increasing time after treatment. Kiran and Veeranna (2012) also reported that *M. anisopliae* decreased BPH population at 7 days after spraying where it was on par with thiamethoxam. Fang *et al.* (2005) showed that highly expressed chitinase (*Bbchit1*) gene of *B. bassiana* could significantly improve the insecticidal virulence. Toledo *et al.* (2010) observed similar phenomenon where during the process of conidial germination and penetration of the epidermis, the fungi secreted chitinase, esterase, and extracellular protease enzymes which have destroyed insect body surface and promoted successful invasion of the hyphae. During the process of entomopathogenic fungal infection chitinase not only helped in degradation of the insect body wall by itself, acted together with other enzymes, such as protease. Contrast to the present result, Senthamizhlselvan *et al.* (2010) reported higher mortality of third instar BPH nymphs in spraying method with *V. psalliotae* isolate i.e. 86.25 per cent compared to dipping method with 55.00 per cent mortality, which might be due to variation in the virulence of the fungal isolate used for the study.

Efficacy of entomopathogenic fungi against BPH females

The entomopathogenic fungi, *B. bassiana*, *M. anisopliae* and *L. lecanii* were found to be more effective to BPH females and their efficacy against BPH adults increased with increase in time after spraying. Results presented in the Table.2 indicated that one day old adult female BPH were more susceptible than nymphs in both the methods (spraying and dipping). The present findings revealed that all the fungi significantly reduced BPH population compared to control. Among all the treatments, the chemical check, monocrotophos 36 SL has recorded high per cent mortality i.e. 85.00 and 97.50 at 5 and 10 days after dipping respectively. The entomopathogenic fungi, *B. bassiana*, *M. anisopliae* and *L. lecanii* also significantly reduced BPH population compared to control recording 52.50, 42.50 and 45.00 per cent mortality respectively at 5 days after release and

Table 1. Efficacy of entomopathogenic fungi against BPH nymphs.

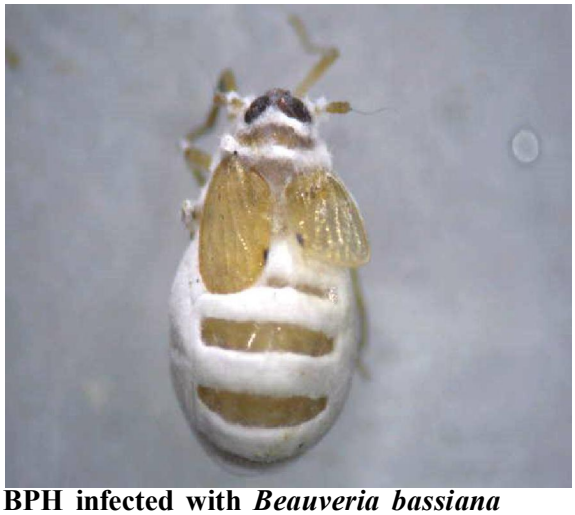
Fungus	Mortality of BPH nymphs (%)			
	Dipping method		Spraying method	
	5 DAR	10 DAR	5 DAS	10 DAS
B. bassiana	27.5 (31.62)[b]	53.75 (47.13)[b]	8.75 (17.20)[b]	26.25 (30.81)[b]
M. anisopliae	28.75 (32.41)[b]	60.00 (50.75)[b]	10.00 (18.43)[b]	23.75 (29.15)[b]
L. lecanii	23.75 (29.15)[b]	53.75 (47.13)[b]	12.50 (20.70)[b]	25.00 (29.99)[b]
Monocrotophos 36 SL	85.00 (67.19)[a]	87.50 (69.27)[a]	75.00 (59.98)[a]	78.75 (62.52)[a]
Control (Water spray)	1.25 (6.42)[c]	7.50 (15.89)[c]	0.00 (0.00)[c]	2.50 (9.09)[c]
CD (0.05%)	6.53	7.6	6.18	7.16
SE (m)	2.15	2.5	2.03	2.35

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

Table 2. Efficacy of entomopathogenic fungi against BPH adults.

Fungus	Mortality of BPH adults (%)			
	Dipping method		Spraying method	
	5 DAR	10 DAR	5 DAS	10 DAS
B. bassiana	52.5 (46.41)[b]	70.00 (56.77)[b]	16.25 (23.76)[b]	38.75 (38.48)[b]
M. anisopliae	42.50 (40.67)[b]	57.50 (49.29)[b]	13.75 (21.76)[b]	35.00 (36.26)[b]
L. lecanii	45.00 (42.11)[b]	57.50 (49.29)[b]	11.25 (19.59)[b]	35.00 (36.26)[b]
Monocrotophos 36 SL	85.00 (67.19)[a]	97.50 (85.36)[a]	78.75 (62.52)[a]	85.00 (67.19)[a]
Control (Water spray)	0.00 (0.00)[c]	5.00 (12.92)[c]	1.25 (6.42)[c]	6.25 (14.17)[c]
CD (0.05%)	6.64	11.07	5.83	3.90
SE (m)	2.18	3.64	1.92	1.28

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



BPH infected with *Beauveria bassiana*

BPH infected with *Metarhizium anisopliae*

BPH infected with *Lecanicillium lecanii*

the efficacy increased with time i.e. after 10 days to 70.00, 57.50 and 57.50 per cent mortality by *B. bassiana*, *M. anisopliae* and *L. lecanii*, respectively and these were on par with each other and superior over control with 5 per cent mortality at 10 days after dipping. However, in spraying method entomopathogenic fungi were ineffective at 5 days after spraying but their efficacy increased at 10 days after spraying recording 38.75, 35.00 and 35.00 per cent mortality by *B. bassiana*, *M. anisopliae* and *L. lecanii*, respectively.

Present studies clearly indicated that adult female BPH were more susceptible to fungal infection than third instar nymphs. These results are in conformity with the findings of Tuan (2014) who reported that middle instar nymphs (3^{rd} – 4^{th} instars) were more resistant to fungal infection than late instar nymphs (5^{th}) and adults. Li *et al.* (2012) also reported that *Beauveria* and *Metarhizium* isolates caused cumulative mortality of adult to an extent of 17.2 to 82.1 per cent at 10 days after inoculation. They also reported that gravid females were more susceptible to *Mf 82* infection than the adult female and male. The possible reason for this is that gravid female had more abdominal surface area and more fat than male. By germinated conidia of *B. bassiana* and *M. anisopliae* and hyphal penetration through the body surface of the planthopper *Peregrinus maidis*, it was shown that fat bodies was the most affected tissue (Toledo *et al.,* 2010). Li *et al.* (2014) also reported that *B. bassiana* and *B. brangniartii* caused cumulative mortality of adults ranging from 17.2 to 79.1 per cent at 10 days after inoculation.

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