Effect of Entomopathogenic Fungi Against Brown Plant Hopper, *Nilaparvata lugens* (Stal.) (Hemiptera: Delphacidae) Infesting Rice

Shoaib H. Shaikh[1], Pandurang Mohite[2]

[1]M.Sc.(Agri.) Student, Department of Entomology, College of Agriculture, Kolhapur-416004(M.S.)INDIA

[2](Research Guide), Professor of Entomology, College of Agriculture, Kolhapur-416004 (M.S.)

Abstract: ***An investigation was undertaken with objective to study the relative efficacy of microbial insecticides viz., Metarhizium anisopliae, Beauveria bassiana and Verticillium lecanii against rice brown plant hopper. Overall performance of various microbial treatments based on mean hopper population data, revealed that the treatment with M. anisopliae with conidial concentration 1 x 10^{10}, 1 x 10^{9} per ml was the most consistently effective and significantly superior over all other fungal treatments throughout the trial followed by B. bassiana 1 x 10^{10}, 1 x 10^{9} and V. lecanii in reducing the hoppers population. M. anisopliae is superior to B. bassiana and V. lecanii on 3 DAS and 7 DAS, whereas on 10 DAS, M. anisopliae 1 x 10^{10} and B. bassiana 1 x 10^{10} recorded 70-80 per cent reduction in survival population.***

Keywords: Brown Plant Hopper, *Nilaparvata lugens Metarhizium anisopliae, Beauveria bassiana* and *Verticillium lecanii*

1. Introduction

India is world's second largest rice producer and consumer next to China. In India total area under rice 42.40 million hectors with production of 104.398 million tonnes (Anonymous, 2012). However, in Maharashtra state it is cultivated over an area about 15.43 lakh/ha with production about 28.41 lakh tonnes having productivity 1.84 tonnes/ha (Anonymous, 2012). Major Rice growing districts in Maharashtra are Thane, Ratnagiri, Raigad, Sindhudurg and Kolhapur.

Beside high economic value now a days cultivation is becoming means to the farmer because of attack of insect pest causing damage from seedling stage to its maturity. Losses caused by pests remained an important constraint to achieving high rice yields (Waddington *et al.,* 2010). The stem borer (*Scirpophaga incertulas*), brown plant hopper (*Nilaparvata lugens*), green leaf hopper (*Nephotettix virescens),* paddy gall midge (*Orseolia oryzae*) are major pest of paddy. However, stem borer and brown plant hopper are the worst pests that can cause severe damage and yield loss to rice crop in later stage. BPH also transmits viruses such as rice ragged stunt virus (RRSV) and rice grassy stunt virus (RGSV), and wilted stunt (Hibino, 1979; Matsumura, 2001; Krutmuang, 2011). Large use of chemical compounds has caused BPH to develop resistance and detrimental impact on natural enemies (Liu *et al*., 2006; Preetha *et al*., 2010).

To cope with ever challenging insect pest problem in rice, the farmer needs to have the latest technological knowledge in pest management. The present investigation was therefore undertaken to evaluate the new formulations of different microbial pesticides like *Metarhizium anisopliae, Beauveria bassiana and Verticillium lecanii* with different conidial concentrations against brown plant hopper (*Nilaparvata lugens*),

2. Material and Methods

Field trial with microbial insecticides against brown plant hopper, *Nilaparvata lugens* (Stal.) in rice crop varity Menaka was conducted during Kharif 2013-14 on farmer's field. All the agronomical practices were carried out as per recommended cultivation practices except plant protection measures. Biopesticide required for spraying for preparation of spray fluid per plot of different concentrations were worked out at the time of spraying and mixed in clean water. The spraying of insecticides was carried out during evening hours by hand operated knapsack sprayer. In all total two sprays were given at 60 and 85 days after transplanting during tillering stage which coincided with the reproductive phase of the crop when maximum BPH population is observed. Experiment was conducted in randomized block design replicated thrice.

The efficacy of microbial treatments against paddy brown plant hopper, *N. lugens* was judged on the basis of survival population of hoppers at crop reproductive stage. The spraying was undertaken on ETL basis when sufficient population of BPH was observed.

The observations were recorded on the number of BPH nymphs and adults present at the base of the rice plants. Pretreatment observation was recorded 24 hours before and post treatment observations were recorded on 3rd, 7th and 10th days after spraying. Hopper burn symptoms were recorded as damage symptoms. The data were transformed and mean data were subjected to analysis of variance.

3. Results and Discussion

3.1 First Spraying

The data on effects of microbial treatments on mean survival population of brown plant hoppers *N. lugens* under field condition are given in Table 1 . Population of hoppers were ranged from 11.93 to 12.60 per hill just before exhibited non significant results, indicating uniform population in the experimental plot.

The observations were recorded 3 DAS, revealed that all the treatments were significantly superior over untreated control. The treatment (T3) *Metarhizium anisopliae* with 1 x 10^{10} conidia ml^{-1} proved to be the most effective and superior over rest of the treatments, recorded the lowest 6.85 hoppers per hill which was on par with treatment (T2) *Metarhizium anisopliae* with 1 x 10^{9} conidia ml^{-1} and treatment (T6) *Beauvaria bassiana* 1 x 10^{10} conidia ml^{-1} recorded 7.11 and 7.15 hoppers per hill, respectively.

The treatment (T3) *Metarhizium anisopliae* with1 x 10^{10} conidia ml^{-1} proved to be the most effective and superior over rest of the treatments, recorded the lowest 4.31 hoppers per hill. However, the treatment (T2) *Metarhizium anisopliae* with 1 x 10^{9} conidia ml^{-1} recorded 5.71 hoppers per hill which was on par with treatment (T6) *Beauvaria bassiana* 1 x 10^{10} conidia ml^{-1} recorded 5.83 hoppers per hill were next in order of efficacy when observation recorder 7th DAT.

The observation recorded 10 DAS revealed that all the treatments were significantly superior to untreated control. The treatment (T3) *Metarhizium anisopliae* with 1 x 10^{10} conidia ml^{-1} found to be consistently effective and superior over the rest of the treatments, recorded the lowest 1.20 hoppers per hill which was on par with treatment (T2) *Metarhizium anisopliae* 1 x 10^{9} and treatment (T6) *Beauvaria bassiana* 1 x 10^{10} conidia ml^{-1} recorded 2.40 and 2.84 per hill, respectively.

3.2 Second Spraying

The observations were recorded 3 DAS, revealed that all the treatments were significantly superior over untreated control. The treatment (T3) *Metarhizium anisopliae* with 1 x 10^{10} conidia ml^{-1} proved to be the most effective and superior over rest of the treatments, which recorded the lowest 5.04 hoppers per hill. The treatment (T2) *Metarhizium anisopliae* with 1 x 10^{9} conidia ml^{-1} recorded 5.65 hoppers per hill which was on par with treatment (T6) *Beauvaria bassiana* 1 x 10^{10} conidia ml^{-1} recorded 5.82 hoppers per hill were next in order of efficacy. The treatment (T3) *Metarhizium anisopliae* with 1 x 10^{10} conidia ml^{-1} proved to be the most effective and superior over rest of the treatments, recorded the lowest 3.44 hoppers per hill which was on par with treatment (T2) *Metarhizium anisopliae* with 1 x 10^{9} and treatment (T6) *Beauvaria bassiana* 1 x 10^{10} conidia ml^{-1} recorded 3.54 and 3.61 hoppers per hill, respectively when observation recorder 7th DAT.

The treatment (T3) *Metarhizium anisopliae* with 1 x 10^{10} conidia ml^{-1} found to be consistently effective and superior over rest of the treatments, recorded the lowest 1.18 hoppers per hill which was on par with treatment (T2) *Metarhizium anisopliae* 1 x 10^{9} and treatment (T6) *Beauvaria bassiana* 1 x 10^{10} conidia ml^{-1} recorded 2.05 and 2.32 hoppers per hill, respectively when the observations were recorded 10 DAS. The results obtained from study clearly revealed that the efficacy of *M. anisopliae*, *B. bassiana* and *V. lecanii* increased with increase in the number of days after spray and reached highest efficacy on 10 DAS in each spray. These results are in consonance with Reddy *et al.*, (2013) reported that *B. bassiana* an *M. anisopliae* @ 5 g/l found to be in effective at 5 days after first spray, their efficacy against BPH increased with increase in days after spray. Among the entomopathogens, *B. bassiana*, and *M. anisopliae* were found to be relatively more effective and *V. lecanii* least effective against BPH. Same results also reported by Maketon and Jaichuen (1994), Nguyen Thi Loc *et al.*, (2005), Krutmuang (2011), Li *et al.*, (2012).

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Table 1: Efficacy of microbial insecticides against rice brown plant hopper (first spraying)

Sr. No.	*Treatments*	*Concentrations (conidia ml^{-1})*	*BPH Mean survival population per hill*				*Mean Population*
			1 DBS	*3 DAS*	*7 DAS*	*10 DAS*	
T1.	*Metarhizium anisopliae*	1×10^8	12.17* (3.55)**	9.41 (3.14)	8.91 (3.06)	6.05 (2.56)	8.12 (2.93)
T2.	*Metarhizium anisopliae*	1×10^9	12.05 (3.54)	7.11 (2.75)	5.71 (2.49)	2.40 (1.70)	5.07 (2.36)
T3.	*Metarhizium anisopliae*	1×10^{10}	11.93 (3.52)	6.85 (2.71)	4.31 (2.19)	1.20 (1.30)	4.12 (2.14)
T4.	*Beauvaria bassiana*	1×10^8	12.08 (3.54)	9.45 (3.15)	9.24 (3.21)	8.14 (2.93)	8.94 (3.07)
T5.	*Beauvaria bassiana*	1×10^9	11.98 (3.53)	9.33 (3.13)	8.48 (2.99)	5.78 (2.50)	7.86 (2.89)
T6.	*Beauvaria bassiana*	1×10^{10}	12.33 (3.58)	7.15 (2.76)	5.83 (2.51)	2.84 (1.82)	5.27 (2.40)
T7.	*Verticillium lecanii*	1×10^8	12.32 (3.58)	12.21 (3.56)	11.65 (3.48)	9.88 (3.22)	11.24 (3.42)
T8.	*Verticillium lecanii*	1×10^9	12.30 (3.57)	12.12 (3.55)	11.57 (3.47)	9.06 (3.09)	10.91 (3.37)
T9.	*Verticillium lecanii*	1×10^{10}	12.15 (3.55)	11.60 (3.47)	10.68 (3.3)	8.83 (3.05)	10.37 (3.29)
T10.	Untreated control	-	12.60 (3.61)	13.45 (3.73)	13.61 (3.75)	14.07 (3.81)	13.71 (3.77)
	S.E. ±	-	NS	0.08	0.03	0.17	0.09
	C.D. @ 5%	-	NS	0.23	0.10	0.53	0.28

** Figures in parenthesis are X + 0.5 square root transformed values
* Mean of three replication

Table 2: Efficacy of microbial insecticides against rice brown plant hopper (second spraying)

Sr. No.	*Treatments*	*Concentrations (conidia ml^{-1})*	*Mean survival population BPH per hill*				Mean population
			1 DBS	*3 DAS*	*7 DAS*	*10 DAS*	
T1.	*Metarhizium anisopliae*	1×10^8	11.45* (3.45)**	8.71 (3.03)	6.20 (2.59)	4.94 (2.32)	6.62 (2.66)
T2.	*Metarhizium anisopliae*	1×10^9	9.94 (3.23)	5.65 (2.48)	3.54 (2.01)	2.05 (1.59)	3.74 (2.06)
T3.	*Metarhizium anisopliae*	1×10^{10}	9.45 (3.15)	5.04 (2.35)	3.44 (1.98)	1.18 (1.29)	3.22 (1.92)
T4.	*Beauvaria bassiana*	1×10^8	9.52 (3.16)	8.80 (3.05)	6.24 (2.59)	5.20 (2.38)	6.74 (2.69)
T5.	*Beauvaria bassiana*	1×10^9	9.57 (3.17)	8.66 (3.02)	6.12 (2.56)	4.81 (2.30)	6.53 (2.65)
T6.	*Beauvaria bassiana*	1×10^{10}	9.36 (3.14)	5.82 (2.51)	3.61 (2.02)	2.32 (1.67)	3.91 (2.10)
T7.	*Verticillium lecanii*	1×10^8	10.06 (3.25)	9.91 (3.22)	8.11 (2.93)	7.30 (2.79)	8.44 (2.99)
T8.	*Verticillium lecanii*	1×10^9	11.04 (3.39)	9.42 (3.15)	8.01 (2.91)	7.02 (2.74)	8.15 (2.94)
T9.	*Verticillium lecanii*	1×10^{10}	11.12 (3.40)	9.30 (3.13)	6.85 (2.71)	5.34 (2.41)	7.16 (2.76)
T10.	Untreated control		11.40 (3.45)	12.90 (3.66)	12.97 (3.67)	13.45 (3.73)	13.10 (3.68)
	S.E. ±		NS	0.02	0.02	0.15	0.06
	C.D. @ 5%		NS	0.07	0.08	0.47	0.20

** Figures in parenthesis are X + 0.5 square root transformed values
* Mean of three replications