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RESEARCH ARTICLE

FIELD EVALUATION OF WHITE MUSCARDINE FUNGUS, *BEAUVERIA BASSIANA* 1.15% W/W AGAINST LEAF FOLDER, *CNAPHALOCROSIS MEDINALIS* GUENEE IN RICE

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ABSTRACT

Beauveria bassiana (Ascomycota: Hypocreales) is a fungus that grows naturally in soils throughout the world and acts as a parasite on various arthropod species, causing white muscardine disease and it is being used as a biological insecticide to control a number of pests. It can infect more than 700 species of arthropods and its use as microbial insecticides is a more appropriate approach to suppress pest population in the present scenario of integrated pest management. This potential pathogen is mass produced and marketed as various formulations. In this context, a field experiment was conducted to investigate the effective dosage of *Beauveria bassiana* against rice leaf folder, *Cnaphalocrocis medinalis* Guenee (Lepidoptera: Pyralidae) under normal field conditions. Among the dosages tested, increased dose of *Beauveria bassiana* 1.15% w/w had caused higher mortality of larval population of *Cnaphalocrocis medinalis* and less infestation percentage of rice plants. The grain yield was observed higher in the plot treated with *Beauveria bassiana* 1.15% w/w @ 3 kg/ha than other treatments. Hence, *Beauveria bassiana* 1.15% w/w @ 3 kg/ha can be recommended to control the rice leaf folder *Cnapholocrocis medinalis* in the rice field for effective management.

Key words: *Beauveria bassiana*, *Cnaphalocrosis medinaliss,* formulation, entomopathogenic fungi.

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INTRODUCTION

Rice (Oryza sativa L.) is the stable food crop of south east Asia and the crop is damaged by number of insect pests and cause enormous loss may account to 20-30% annually. Management methods have to be taken when the population level of insect pests and their damage reached the threshold or injury level. Microorganisms like fungi, bacteria, and viruses play an important role in checking the insect pest population. Among which fungi parasitize the insects and cause severe epizootics than bacteria and viruses. Many entomopathogenic fungi were examined as possible control agents for various insect pests. During the recent years, there has been a resurgence of interest in entomopathogenic fungi caused by factors such as increasing insecticide resistance and environmental concerns over pesticide use. Increasing awareness about abuse of chemical pesticides had stimulated renewed interest in the development of alternative and environmentally compatible materials for insect pest control. In this regard, entomopathogenic fungi have been considered as one of the components of IPM.

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Before "Green Revolution" in our country, farmers largely relied on organic manure and traditional method of pest management, which were helpful in promoting biocontrol agents. Diversified fungal species occur on insect pests in different ecosystem, thus maintaining a biotic tolerance to keep the pest population below economic injury level. Under natural conditions, fungi are a frequent and often important natural mortality factor in insect population. However, most species of fungi are obligate pathogens; they are quite specific. But, these fungi often have a wide host range although there is considerable genetic diversity within species (Driver *et al.* 2000). Many entomopathogenic fungi are relatively common and often induce epizootics and are therefore an important factor in regulating insect populations. Unlike other potential biocontrol agents, fungi do not have to be ingested to infect their hosts but invade directly through the cuticle so that they can be effectively used for the control of insects pests (Roberts and Yendol, 1971). Fungal pathogens flourish abundantly in the rice ecosystem with its prevailing high humidity and infection occurs naturally (Narayanasamy, 1994). Epizootics caused by naturally occurring viral and fungal pathogens are often responsible for spectacular crashes of insect pest populations (Evans, 1986). Introduction of fungal pathogens into the host population initiates epizootics and prevents or reduces damage by the pest. The initiation of artificial epizootics has been accomplished for long-term control especially in areas where high humidity condition prevails (Sandhu *et al.,* 2012). The use of entomopathogenic fungi has been considered as one of the potential tools in biological control of insect pests. *Cnaphalocrocis medinalis* causes 15-25% yield losses and the losses can reach 50% if the pest is not managed properly. Beauveria infect the hosts by penetrating through the cuticle, gaining access to the haemolymph, producing toxins, and grow by utilizing nutrients present in the haemocoel to avoid insect immune responses. Entomopathogenic fungi may be applied in the form of conidia or mycelium which sporulates after application. Their hosts comprise of numerous pests and its large distinction in virulence towards different insect hosts makes it one of the more resourceful entomophagous fungi for the biological control of insect pests. Hence, the use of alternate eco-friendly strategies like microbial insecticides is a more appropriate approach to suppress pest population. The objective of this study was to investigate the effective dosage of Beauveria bassiana against rice leaf folder under field conditions.

MATERIALS AND METHODS

A field experiment was conducted in the Dept. of Entomology, Facuty of Agriculture, Annamalai University, Annamalai nagar, Tamilnadu to find out the effective dosage of *Beauveria bassiana* against rice leaf folder, *Cnaphalocrocis medinalis* Guenee (Lepidoptera: Pyralidae) under normal field conditions. The field was well prepared according to the requirements and the irrigation and fertilizer was applied constantly to meet the crop nutrient requirements as per recommendation. Agronomic practices were also followed uniformly in all the plots sized 5x4 m and the experiment were laid down in Completely Randomized Block Design (CRD) with four replications in each treatment along with treated and untreated check. The incidence of Rice Leaf folder was observed at regular intervals in each experimental unit when population of rice leaf folder crosses the ETL level, 1st application of Beauveria bassiana was applied in different concentrations like 2, 2.5 and 3 kg /ha. with the help of hand sprayer to suppress the test insect pest population. The pre-treatment data like percent hills infested and larval populations were recorded in all the treatments before spray. Percent hills infested and larval populations were recorded in all the plots after 3rd, 7th and 15 days after first spray. Second application of treatments was applied after 30 days of 1st application of treatments and data was recorded after the same interval of time as in the first application. Grain yield per plot was also recorded in all the treatments.

Statistical Analysis

The data collected was analyzed statistically by using SPSS. The treatment means were compared by Least Significant Difference (LSD) for their significance at 5% probability level.

RESULTS AND DISCUSSION

The data presented in Table 1 regarding the percent hill infestation of *Cnaphalocrocis medinalis* after 1^{st} and 2^{nd} spray showed that the highest dose of *Beauveria bassiana* 1.15% w/w @ 3 kg/ha was promising in reduce the percent damage of leaf folder to 4.89 and 3.77 respectively whereas the other dosages like 2.5 kg/ha and 2 kg/ha were followed suit in both the sprays. The same results were also obtained in the presence of larval population after 1^{st} and 2^{nd} spray. The results revealed that, the low level of population of *C. medinalis* was evident in the plots treated with *Beauveria bassiana* 3 kg/ha with 3.16 numbers after second spray followed by 2.5 kg/ha and 2 kg/ha with 4.08 and 4.58 number of larvae respectively (Table 2). Bajya and Ranjith (2018) also found similar results from their study that *B. bassiana* 1.15% WP @ 3000 and 2500 g ha^{-1} was effective, after two sprays, and it was observed that chlorantriniliprole 18.5% SC and quinalphos 25% EC were also effective. The chemical insecticide Chlorpyriphos @ 500 a.i g/ha was found effective in the initial periods of the field experiments. It caused immediate reduction in the population of the leaf folder after the first spray. But, the data obtained after 10^{th} day of first spray till the 15^{th} day showed more larval population than *Beauveria bassiana* 1.15% w/w sprayed @ 3 kg/ha. Mean percent hill infestation and also mean percent population of *Cnaphalocrocis medinalis* was found less in the plots treated with *Beauveria bassiana* 1.15% w/w @ 3 kg/ha followed by 2.5 kg/ha, Chlorpyriphos @ 500 a.i g/ha and *Beauveria bassiana* 2 kg/ha. The same trend was also noticed after 2^{nd} spray (Table 1and 2). Regarding the grain yield of rice, *Beauveria bassiana* 1.15 w/w @ 3 kg/ha applied plots yielded high (4.73 ton/ ha.) followed by *Beauveria bassiana* 1.15 w/w

Table 1. Bio-efficacy of *Beauveria bassiana* 1.15% w/w against leaf folder *Cnaphalocrocis medinalis* damage in rice

Treatments	Dosage (kg/ha)	Percentage of hills infested after first spray					Percentage of hills infested after second spray				
		Pretreatment	3^{rd} DAT	7^{th} DAT	15^{th} DAT	Over all mean	Pretreatment	3^{rd} DAT	7^{th} DAT	15^{th} DAT	Over all mean
T^1	2	10. 85 (19.10)	8.77 $(17.18)^b$	7.93 $(16.35)^c$	5.77 $(13.73)^{bc}$	7.49	5.86 (13.99)	5.02 $(12.86)^b$	4.16 $(11.72)^a$	4.16 $(11.72)^b$	4.44
T^2	2.5	11.29 (19.58)	7.79 $(16.35)^b$	5.88 $(14.00)^{bc}$	3.77 $(10.99)^{ab}$	5.86	6.32 (14.53)	6.13 $(13.99)^b$	5.44 $(13.46)^a$	4.16 $(11.72)^b$	5.24
T^3	3	10.85 (19.10)	7.53 $(15.92)^b$	4.60 $(12.26)^{ab}$	2.54 $(9.07)^a$	4.89	6.27 (14.42)	5.02 $(12.86)^b$	4.15 $(11.72)^a$	2.15 $(8.35)^a$	3.77
T^4	Chlorpy-riphos	10.85 (19.10)	3.35 $(10.40)^a$	3.38 $(10.27)^a$	7.96 $(16.34)^c$	4.89	6.32 (14.53)	1.27 $(0.76)^a$	2.54 $(0.76)^a$	5.02 $(12.86)^b$	2.94
T^5	Control	11.27 (19.51)	12.10 $(20.26)^c$	14.16 $(22.12)^d$	15.41 $(23.11)^d$	13.89	7.93 (16.35)	9.16 $(17.60)^c$	9.58 $(18.02)^b$	12.52 $(20.67)^c$	10.42
S.Ed			1.16	1.37	1.30			1.54	1.68	1.25	
CD (0.05)			2.53	2.98	2.85			3.36	3.67	2.74	

- Each value is a mean of four replications.
- Values followed by common alphabet do not significant according to LSD.
- Values in parentheses are arcsine transformed.

Table 2. Bio-efficacy of Beauveria bassiana 1.15% w/w against leaf folder *Cnaphalocrocis medinalis* population

Treatments	Dosage (kg/ha)	Mean number of larval population after first spray					Mean number of larval population after second spray				
		Pretreatment	3rd DAT	7th DAT	15th DAT	Over all mean	Pretreatment	3rd DAT	7th DAT	15th DAT	Over all mean
T^1	2	8.75 (2.96)	8.75 (2.96)^{c}	7.25 (2.69)^{c}	3.00 (1.72)^{b}	6.33	6.00 (2.45)	5.75 (2.39)^{bc}	4.50 (2.12)^{c}	3.50 (1.87)^{b}	4.58
T^2	2.5	10.50 (2.78)	8.00 (2.83)^{bc}	7.00 (2.64)^{c}	2.50 (1.57)^{b}	5.83	5.25 (2.28)	5.25 (2.21)^{b}	5.00 (2.33)^{c}	2.00 (1.39)^{a}	4.08
T^3	3	7.50 (3.28)	7.00 (2.64)^{b}	5.00 (2.23)^{d}	1.25 (1.10)^{a}	4.41	5.50 (2.34)	4.50 (2.10)^{b}	3.25 (1.80)^{b}	1.75 (1.31)^{a}	3.16
T^4	Chlorpyriphos	9.25 (2.33)	1.50 (1.21)^{a}	1.50 (1.18)^{a}	2.75 (1.62)^{b}	1.91	6.00 (2.44)	1.25 (1.20)^{a}	1.75 (1.30)^{a}	3.25 (1.80)^{b}	2.08
T^5	Control	9.25 (2.33)	10.75 (3.27)^{d}	11.75 (3.43)^{d}	14.00 (3.74)^{c}	12.16	6.25 (2.50)	7.00 (2.64)^{c}	7.75 (11.10)^{d}	10.50 (3.23)^{c}	8.41
S.Ed			0.18	0.19	0.22			0.17	0.18	0.20	
CD (0.05)			0.26	0.28	0.35			0.29	0.26	0.33	

- Each value is a mean of four replications.
- Values followed by common alphabet do not significant according to LSD.
- Values in parentheses are square root transformed.

@ 2.5 kg/ha, but the treatment Chlorphyriphos @ 500 a.i g/ha was on per with *Beauveria bassiana* 1.15 w/w @ 2 kg/ha (Table 3).

Table 3. Rice grain yield as influenced by *Beauveria bassiana* treatments

Treatments	Dose (kg/ha)	Yield (ton/ha)
T^1	2	4.53 (2.13)^{c}
T^2	2.5	4.60 (2.14)^{b}
T^3	3	4.73 (2.17)^{a}
T^4	Chlorpyriphos	4.53 (2.13)^{c}
T^5	Control	2.83 (1.68)^{d}
S.Ed	CD (0.05)	0.006 0.013

- Each value is a mean of four replications.
- Figures in parentheses are square root transformed.
- Values followed by common alphabet do not significant according to LSD.

Increased dose of *Beauveria bassiana* 1.15% w/w had caused higher mortality of larval population of *Cnapholocrocis medinalis* and less infestation percentage of rice hills. Though the grain yield was higher in the plot treated with *Beauveria bassiana* 1.15% w/w @ 3 kg/ha than other treatments. Hence, it is recommended that *Beauveria bassiana* 1.15% w/w @ 3 kg/ha can be used to control the rice leaf folder *Cnapholocrocis medinalis* in the rice field for effective management.

Conclusion

In the light of the above findings, it is concluded that *Beauveria bassiana* 1.15% w/w @ 3 kg/ha can be recommended against the rice leaf folder (*Cnaphalocrocis medinalis*) in field conditions.

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