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Biosafety of oil formulation of *Beauveria bassiana* (Bb 112) to *Chrysoperla zastrowi sillemi*

J. N. PRITHIVA, N. GANAPATHY and S. JEYARANI

Department of Agricultural Entomology, Centre for Plant Protection Studies, Tamil Nadu Agricultural University, Coimbatore-641 003, Tamil Nadu, India

E-mail: jnprithiva@gmail.com

ABSTRACT: *Aphis gossypii, Bemisia tabaci, Thrips tabaci* are important sucking pests of horticultural crops. Fungal pathogen, *Beauveria bassiana* is known to cause high infection in sucking pest populations. The present investigation was undertaken to evaluate the safety of oil formulation of fungal pathogen *B. bassiana* (Bb 112) available at the Department of Agricultural Entomology, TNAU, Coimbatore against the eggs and grubs of *Chrysoperla zastrowi sillemi* under laboratory condition. The safety studies of *B. bassiana* to the eggs of *C. zastrowi sillemi* revealed that egg hatchability was 66.88 per cent in the highest dose of Bb 112 (10^8 spores ml^{-1}) and per cent hatchability increased with lower doses of Bb 112. In case of grubs, survival was 95.71 per cent at 10^4 spores ml^{-1} and it declined with increased spore load. Further research should focus on development of efficient mass production systems, formulation, and delivery systems of fungal pathogens.

Keywords: *Beauveria bassiana,* safety, oil formulation, *Chrysoperla zastrowi sillemi*

INTRODUCTION

Biological control agents can cause substantial decrease in pest population numbers. While the use of insecticides remains an important component of Integrated pest management (IPM), biological suppression of insect pests is also considered as an equally important tool. Hence, the protection and preservation of natural enemies of the pests are essential. Among the various predators, *Chrysoperla zastrowi sillemi* is a very important predator of sucking pests. The indiscriminate use of insecticides has affected the population of biocontrol agents, as all the conventional recommended insecticides are highly toxic to predators and parasitoids (Singh, 1994). The population of predators has declined by 68.4 per cent during the last two decades and many parasitoids have been eliminated (Dhawan and Simwat, 1996). Hence, the present study was undertaken to know the safety level of biopesticide on *C. zastrowi sillemi*.

MATERIALS AND METHODS

Beauveria bassiana (Bb 112) formulation

Oil based formulation of *B. bassiana* (Bb 112) was prepared as per the protocol standardized by Sangamithra (2015). Efficacy of potent isolate Bb 112 was evaluated against sucking insect pests of tomato, brinjal, onion and chilli and based on the results, safety of oil formulation was evaluated against eggs and grubs of *C. zastrowi sillemi.*

Effect on egg hatchability

Laboratory studies were conducted to assess the effect of Bb 112 oil formulation on eggs of *C. zastrowi sillemi*, as per the method described by Krishnamoorthy (1985). The eggs along with stalk collected on brown paper strips were sprayed with different concentrations of oil formulation using an atomizer with an untreated check. Each treatment was replicated four times with 30 eggs per replication. Untreated check was maintained by spraying distilled water. The number of grubs hatching from each treatment was recorded and per cent hatchability was worked out by the formula,

Effect on grub survival

Dry film method

The bioassay method described by Mc Cutchen and Plapp (1988) was adopted with modifications. Glass vials of 20 ml capacity with 1 mm thickness were evenly coated with 1ml of Bb 112 oil formulation and dried by rolling for few minutes. Second instar predatory lacewing grubs were released into the vials at 30 per vial, covered with untreated muslin cloth and secured with a rubber band. For untreated check only tween 80 was used. Observations on survival of grubs were recorded for 7 days. After 3 h of exposure, grubs were transferred to test tubes with field collected mealybugs as feed to the grubs.

Table 1. Relative safety of oil based formulation of *B. bassiana* (Bb 112) to eggs of green lacewing, *C. zastrowi sillemi*

Treatment	Dose	Egg hatchability * (No.)			Total no. of eggs hatched (N = 120)	Egg hatchability (%)
		1 DAT	2 DAT	3 DAT		
Oil based formulation of *B.bassiana* (Bb 112)	10^4 spores ml^{-1}	0.00	55.25 (7.43)^{ab}	60.50 (7.78)^{ab}	115.75	96.46
	10^5 spores ml^{-1}	0.00	51.50 (7.18)^{b}	60.25 (7.76)^{bc}	111.75	93.13
	10^6 spores ml^{-1}	0.00	44.25 (6.65)^{c}	58.50 (7.65)^{c}	102.75	85.63
	10^7 spores ml^{-1}	0.00	39.50 (6.28)^{d}	51.50 (7.18)^{d}	91.00	75.83
	10^8 spores ml^{-1}	0.00	31.50 (5.61)^{e}	48.75 (6.98)^{e}	80.25	66.88
Control	(Tween 80)	0.00	56.00 (7.48)^{a}	62.50 (7.91)^{a}	118.50	98.75
SE (d)		NS	0.09	0.06	-	-
CD (P = 0.05)		-	0.18	0.13	-	-

In a column, means followed by the common letter(s) are not significant in LSD @ 5% level of significance

* Mean of four replications; Values in the parentheses are square root transformed values
DAT – Days after treatment

Statistical analysis

The data on percentage were transformed into arcsine values and the population number into √X+0.5 before statistical analysis. The data obtained from laboratory experiment was analysed in completely randomized design. The mean values were separated using Duncan's Multiple Range Test (DMRT). The corrected per cent mortality was worked out using the Abbott's formula (Abbott, 1925).

RESULTS AND DISCUSSION

C. zastrowi sillemi exposed to oil based formulation of *B. bassiana* (Bb 112) showed highest per cent of egg hatchability at lower dose. Egg hatchability was 96.46 per cent in the lowest dose of Bb 112 (10^8 spores ml^{-1}) which is on par with second lowest dose and control. However, at higher dose of 10^8 spores ml^{-1}, it caused relatively less egg hatchability of 66.88 per cent (Table 1). Grub survival of *C. zastrowi sillemi* was 95.71 per cent at 10^4 spores ml^{-1} and it declined with increased spore load which is on par upto 10^5 spores ml^{-1} (91.19 per cent) (Table 2).

B. bassiana and *M. anisopliae* have a wide host range, but they were considered safe to non-target organisms, including insects due to their poor persistence at infective levels in the environment (Goettel *et al*., 2008). The present findings are in accordance with Thungrabeab and Tongma (2007), who reported that *B. bassiana* Bb.5335 and *M. anisopliae* Ma.7965 have the potential use as biological control agents against insect pests because they were relatively safe on non target insects such as natural enemies *viz., Coccinella septempunctata* L., *Chrysoperla carnea* (Stephens) and *Dicyphus tamaninii* Wagner and beneficial soil insect *Heteromurus nitidus* Templeton. The results from the experiment indicate that

Table 2. Relative safety of oil based formulation of *B. bassiana* (Bb 112) to grubs of green lacewing, *C. zastrowi sillemi*

Treatment	Dose	Grubs surviving (No.s)* DAT (N = 30)							Survival (%)
		1	2	3	4	5	6	7	
Oil based formulation of *B.bassiana* (Bb112)	10^4 spores ml^{-1}	30.00 (5.52)	29.50 (5.48)^a	28.50 (5.39)^b	28.25 (5.36)^a	28.25 (5.36)^a	28.25 (5.36)^a	28.25 (5.36)^a	95.71
	10^5 spores ml^{-1}	30.00 (5.52)	28.25 (5.36)^b	27.50 (5.29)^c	27.00 (5.24)^a	26.25 (5.17)^b	26.25 (5.17)^b	26.25 (5.17)^b	91.19
	10^6 spores ml^{-1}	30.00 (5.52)	27.50 (5.29)^b	26.25 (5.17)^d	25.75 (5.12)^{ab}	25.00 (5.05)^c	25.00 (5.05)^c	25.00 (5.05)^c	87.86
	10^7 spores ml^{-1}	30.00 (5.52)	26.50 (5.20)^c	23.75 (4.92)^e	22.50 (4.80)^{bc}	22.25 (4.77)^d	22.00 (4.77)^d	22.00 (4.74)^d	80.48
	10^8 spores ml^{-1}	30.00 (5.52)	24.50 (5.00)^d	19.25 (4.44)^f	18.50 (4.36)^c	17.75 (4.27)^e	17.75 (4.27)^e	17.75 (4.27)^e	69.29
Control	(Tween 80)	30.00 (5.52)	30.00 (5.52)^a	30.00 (5.52)^a	29.00 (5.43)^a	29.00 (5.43)^a	29.00 (5.43)^a	29.00 (5.43)^a	98.10
SE (d)		NS	0.04	0.03	0.16	0.04	0.03	0.04	-
CD (P=0.05)		-	0.08	0.07	0.34	0.08	0.07	0.08	-

In a column, means followed by the common letter(s) are not significant in LSD @ 5% level of significance

* Mean of four replications; Values in the parentheses are square root transformed values

DAT – Days after treatment

the oil formulation of *B. bassiana* (Bb 112) is highly safe at lowest dose and relatively safe at highest dose tested under laboratory condition. Whereas, under field conditions, vagarious of climate will be there and hence the product reaching the beneficial organism may be much limited. However, large scale field trials are to be carried out to draw conclusion about the safety.

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