ORIGINAL ARTICLE

Comparative bioefficacy of different insecticides against fruit and shoot borer (*Leucinodes orbonalis* Guenee) of brinjal and their effect on natural enemies

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Abstract

Background: Brinjal (*Solanum melongena* Linn.) is the fourth most important vegetable grown after potato, onion, and tomato in India. This vegetable crop is primarily grown by small and marginal farmers and it is an important source of income for them. Brinjal production faces a number of problems which cause enormous yield losses. Fruit and shoot borer (*Leucinodes orbonalis* Guenee) is the most devastating insect pest of brinjal, which causes 60-70% yield loss, besides deteriorating product quality. Due to increasing levels of resistance of *L. orbonalis* to different insecticides, there is an urgent need to test new chemicals. **Objective:** An experiment was carried out at Instructional Farm of Uttar Banga Krishi Viswavidyalaya to evaluate the efficacy of four insecticides, *viz*., carbosulfan 25 EC, emamectin benzoate 5% SG, lamda-cyhalothrin 5% EC, and fenpropathrin 30% EC at different doses during rabi season 2013 and 2014. **Materials and Methods:** The research design was followed in the present investigation is randomized block design with four treatments at different doses including an untreated check. There were three replication were taken for each treatment. **Result:** On the basis of pooled means, the result revealed that the application of carbosulfan 25 EC at 375 g a.i./ha was found most economical, resulting in minimum shoot and fruit infestation 7 days after application (2.00% and 5.93%) and 15 days after application (3.33% and 11.67%), respectively, with a highest marketable yield (9.23 q/ha) followed by fenpropathrin 30% EC at 100 g a.i./ha with the shoot and fruit infestation 7 days after application (3.33% and 8.15%) and 15 days after application (5.33% and 12.89%), respectively. The insecticides also offered good protection against the borer but both were found highly toxic and unsafe for natural enemies. An account of natural enemies was also taken from the plots and highest population was recorded from the control plot (Coccinellid - 8.07, Syrphid fly - 2.21, Dragonfly - 0.74, Damsel fly - 0.57, Spider - 0.62/plant, respectively). However, shoot and fruit infestation was brought down and marketable yield increased to some extent. **Conclusion:** It is, therefore, suggested that the spray of carbosulfan 25 EC, being the most effective and economically viable insecticides, can be utilized as a valuable chemical component in integrated pest management to manage the *L. orbonalis* in brinjal crop.

Key words: Bioefficacy, brinjal, insecticides, *Leucinodes orbonalis*, natural enemies, shoot and fruit damage

INTRODUCTION

Brinjal (*Solanum melongena* Linnaeus) also known as eggplant is referred as the "King of vegetables" originated from India and now grown as a vegetable throughout the tropical, sub-tropical and warm temperate areas of the world. It is a most important vegetable in the Indian Subcontinent[1] that

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accounts for almost 50% of the world's area under its cultivation area under its cultivation.[2] However, in India, the area is estimated as 7.5% of the total area of vegetables with 8% of the total production of vegetables (Indian Horticulture Data Base, 2009). *Leucinodes orbonalis* Guenee is a fruit and shoot borer which is the major problem in the cultivation of eggplant. Yield loss due to its infestation reaching as high as 85-90% has been reported.[3-5] Extreme losses were recorded during the Indian rainy season when weather conditions interfere with protection measures. Unsatisfactory protection was reported in many cases. A large quantity of information is available on the management of *L. orbonalis* including management by chemical methods.[4,6-8] Farmers are currently using too much pesticide and applying them too frequently to control Shoot and fruit borer (FSB). This excessive pesticides usage threatens the farmers and consumers, pollutes the environment, besides making it costly to consumers. At the same time, frequent use of pesticides has made this insect tolerant to the chemicals, making it more difficult to control. The pesticides molecules of new generation have been claimed to be effective as well as safer for non-target organism.[4,8,9] Realizing serious pest status of the shoot and fruit borer, few promising, and widely recommended insecticides were incorporated in the present investigation. Non-target effects were also assessed.

MATERIALS AND METHODS

The field experiment was conducted in the Instructional farm of Uttar Banga Krishi Viswavidyalaya at Pundibari, Cooch Behar, West Bengal, India, during Rabi season of 2013-14 and 2014-15. The present investigation was carried out on the Chitra variety of eggplant. Eggplant seeds were sown on 11th November and 25-day-old seedlings were transplanted at spacing of 45 cm × 45 cm and each plot measure in of 3 m × 3 m. The experiment layed out in a randomized block design with four treatments at different doses including an untreated check. There were three replication for each treatment. The data were analyzed statistically for better interpretation of results. Standard agronomic practices were followed to ensure a good crop stand. Four insecticides, *viz.,* carbosulfan 25% EC at different doses, emamectin benzoate 5% SG, lambda cyhalothrin 5% EC, and fenpropathrin 30% EC (Funded by FMC Pvt., Ltd.) were sprayed against the infestation of shoot and fruit borer to evaluates suitable control measure against the pest and get the higher yield. The insecticides were repeatedly sprayed at 15 days interval with the help of a knapsack sprayer.

The treatments were as follows:

T_1 = Carbosulfan 25% EC at 1000 g ml/ha, T_2 = Carbosulfan 25% EC at 1250 g ml/ha, T_3 = Carbosulfan 25% EC at 1500 ml/ha, T_4 = Emamectin benzoate 5% SG at 200 g/ha, T_5 = Lambda cyhalothrin 5% EC at 300 ml/ha, T_6 = Fenpropathrin 30% EC at 340 ml/ha, T_7 = Untreated control.

Observations on Shoot and Fruit Infestation

After application of treatments, the observations were recorded on infested shoots and fruits caused by *L. orbonalis* from five randomly selected plants/replicate. Observations were recorded at 7th and 15th days after each of the three sprays. The healthy and damaged shoots from each treatment were counted, and percent of shoot damage was calculated. However, assessment of fruit infestation was made by balancing of infested and healthy fruits of each plot at each picking separately. The natural enemies were also counted from each plot. Data obtained from each treatment were pooled and calculated in percent fruit damage. Percent of fruit infestation was calculated by the using of the following formula:

Table 1: Effect of the treatments on the infestation and damage of *L. orbonalis* Guenee

Treatment (T)	Percentage damage on days to treatment						Efficiency over control		Yield (q/ha)
	Before application		7 days after		15 days after		7 days	15 days	
	Shoot	Fruit	Shoot	Fruit	Shoot	Fruit			
T1	6.67 (2.68)	9.63 (3.18)	3.33 (1.98)	8.89 (3.06)	5.33 (2.41)	12.15 (3.55)	51.05	58.97	7.10
T2	6.67 (2.68)	8.89 (3.06)	2.67 (1.78)	8.15 (2.94)	4.67 (2.27)	15.41 (3.98)	52.79	47.93	6.98
T3	7.33 (2.80)	7.67 (2.85)	2.00 (1.58)	5.93 (2.53)	3.33 (1.95)	10.93 (3.38)	59.60	55.91	9.23
T4	6.33 (2.61)	9.63 (3.18)	3.00 (1.87)	9.63 (3.18)	4.67 (2.27)	15.63 (4.01)	44.90	47.35	6.54
T5	6.67 (2.68)	7.41 (2.81)	3.67 (2.04)	8.15 (2.67)	5.33 (2.41)	12.89 (3.65)	54.89	57.83	7.30
T6	7.33 (2.80)	8.89 (3.06)	2.33 (1.68)	6.67 (2.84)	3.67 (2.04)	11.67 (3.48)	55.72	57.94	8.28
T7	6.67 (2.68)	8.23 (2.95)	10.33 (3.29)	12.59 (3.61)	20.00 (4.52)	18.56 (4.36)	-	-	6.47
Mean	6.81	8.62	3.90	8.57	6.71	13.89			7.41
SEM (±)	0.26	0.31	0.27	1.32	0.99	1.09			0.39
LSD (5%)	NS	NS	0.85	4.06	3.06	3.37			1.21

Figures in the parenthesis is square root transformed value. SEM: Standard error of mean, LSD: Least significant difference, *L. orbonalis: Leucinodes orbonalis*

Corrected % shoot/fruit damage reduction= 1 − (n in T after treatment/n in C after treatment) × 100.

Where, n = Number of damaged fruits/shoots; T = Treatment; C = Control.

RESULTS AND DISCUSSION

Results [Table 1] indicated that all the treatments were effective against borer though varied in their efficacies and were significantly superior to the check. At 7 and 15 days after spraying, the shoot infestation percentage was significantly reduced when brinjal plants were treated with T3 (2.00%) and (3.33%) followed by T6 (2.33%) and (3.67%), respectively. After spraying of insecticides, the shoot infestation was maximum shown in T1 (3.33%) and (5.33), respectively, but lower than the untreated plot (10.33%) and (20.00%). The fruit damage was lowest recorded in T3 (5.93%) and (10.93%) at 7 days and after 15 days after application of insecticides followed by T6 (6.67%) and (11.67%). The highest yield of 9.23 q/ha was recorded in T3 closely followed by T6 (8.28 q/ha) and T5 (7.30 q/ha). T1 (7.10 q/ha) and T2 (6.98 q/ha) also produced fairly good yields.

The data [Table 2] on population of predatory insect such as coccinellid beetle, syrphid fly, dragon fly, damsel fly, and spider pooled over periods and sprays revealed that the difference among the treatment was significant. Carbosulfan, fenpropathrin, emamectin benzoate, and lambda cyhalothrin were statistically at par with control. At 7 and 15 days after application of insecticides, the coccinellid beetle (5.67 and 8.33), syrphid fly (2.33 and 2.50), dragon fly (1.25 and 1.33), damsel fly (0.83 and 0.83), and spider (1.83 and 1.50) population was higher in T3 but significantly lower than the control.

Various insecticides are evaluated against brinjal shoot and fruit borer by different researchers during last 10 years and reported variable result. Emamectin benzoate at 200 g/ha reduced fruit borer infestation and recorded higher fruit yield of brinjal.[10] Emamectin benzoate 0.001 and spinosad 0.0045 recorded lowest shoot and fruit infestation and highest marketable fruit yield brinjal. Anonymous[11] reported that spray of lambda cyhalothrin (31.5-50.0 ppm) and deltamethrin (20.0 ppm) provided complete control of *L. orbonalis*, which is contrary to present findings.

CONCLUSION

Overall, it may be concluded that the carbosulfan 25 EC, fenpropathrin 30 EC, lambda- cyhalothrin 5% EC, and emamectin benzoate 5% SG recorded comparatively lower shoot and fruit damage and higher fruit yield and were found to be promising insecticides for the management of brinjal fruit and shoot borer. Among them, carbosulfan 25 EC was less hazardous on the natural enemy.

Table 2: Effects of treatments on natural enemy population

Treatment	Natural enemy population/plot														
	Coccinellid beetle			Syrphid fly			Dragon fly			Damsel fly			Spider		
	Before application	7 days after treatment	15 days after treatment	Before application	7 days after treatment	15 days after treatment	Before application	7 days after treatment	15 days after treatment	Before application	7 days after treatment	15 days after treatment	Before application	7 days after treatment	15 days after treatment
T1	6.00	5.33	8.00	1.83	1.67	1.67	0.67	1.00	0.50	1.00	0.50	0.50	1.00	0.67	0.67
T2	7.67	4.83	7.50	2.00	1.67	2.17	1.00	0.33	0.67	0.83	0.67	0.33	0.67	1.00	0.33
T3	6.67	5.67	8.33	1.33	2.33	2.50	0.83	1.25	1.33	0.50	0.83	0.83	0.67	1.83	1.50
T4	6.00	4.50	7.17	1.33	2.00	2.00	0.83	0.83	0.33	0.67	0.50	0.67	0.67	1.00	0.83
T5	6.33	4.50	7.33	1.50	2.00	1.83	0.67	1.20	0.83	0.67	0.67	0.50	1.00	0.83	0.50
T6	6.83	5.50	8.00	1.67	2.17	2.33	0.67	0.67	1.17	0.83	0.67	0.67	0.67	1.83	0.83
T7	8.67	6.17	10.17	3.00	2.33	3.00	1.00	1.70	1.83	0.83	0.87	1.50	1.00	1.87	1.67
Mean	6.88	5.21	8.07	1.81	2.02	2.21	0.81	0.83	0.74	0.76	0.64	0.57	0.81	0.90	0.62
SEM (±)	0.86	0.49	0.59	0.31	0.19	0.30	0.30	0.27	0.25	0.28	0.27	0.21	0.28	0.25	0.17
LSD (5%)	2.65	1.50	1.82	0.95	0.57	0.93	0.92	0.82	0.77	0.85	0.84	0.65	0.86	0.78	0.51

SEM: Standard error of mean, LSD: Least significant difference

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REFERENCES

1. Srinivasan R, Chun-Chu H. Effects of simulated borer infested shoot pruning on yield parameters of eggplants. J Asia Pacific Entomol 2008;12:41-3.
2. Alam SN, Rashid MA, Rouf FM, Jhala RC, Patel JR, Satpathy S, *et al.* Development of An Integrated Pest Management Strategy for Egg Plant Fruit and Shoot Borer in South Asia. Shanhua, Taiwan: Technical Bulletin AVRDC - The World Vegetable Center; 2003. p. 66.
3. Patnaik HP. Flower and fruit infestation by brinjal fruit and shoot borer, *Leucinodes orbonalis* Guenee – damage potential vs. weather. Veg Sci 2000;27:82-3.
4. Misra HP. New promising insecticides for the management of brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee. Pest Manage Hort Ecosys 2008;14:140-7.
5. Jagginavar SB, Sunitha ND, Biradar AP. Bioefficacy of flubendiamide 480SC against brinjal fruit and shoot borer, *Leucinodes orbonalis* Guen. Karnataka J Agric Sci 2009;22:712-3.
6. Chowdhury OP, Kashyap RK. Effect of some management practices on the incidence of insect pests and yield of Eggplant *(Solanum melongena)* in India. Trop Pest Manage 1992;38:416-9.
7. Sastrosiswajo S. Integrated pest management in vegetable production. ActaHorti 1994;369:85-97.
8. Lopez JD, Latheef MA, Hoffman WC. Effect of emamectin benzoate on mortality, proboscis extension, gestation and reproduction of the corn ear worm, *Helicoverpa zea*. J Insect Sci 2010;10:1536-2442.
9. Tonishi MH, Nakao T, Furuya A, Seo H, Kodama K, Tsubata S, *et al*. Flubendiamide, a novel insecticide highly active against lepidopterous insect pests. J Pestic Sci 2005;30:354-60.
10. Sontakke BK, Das N, Swain LK. Bioefficacy of ememectin benzoate against boll worm complex in cotton. Ann Pl Protec Sci 2007;15:371-6.
11. Kumar P, Devappa V. Bio-efficacy of *Emamectin benzoate* 5% SG (proclaim) against brinjal shoot and fruit borer. Pestology 2006;30:17-9.

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