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Studies on Management of Fruit and Shoot Borer [*Leucinodes orbonalis* (Guenee)] Using Chemicals and Neem Oil in Brinjal *Solanum melongena* L.

Maloth Poornachander [a*φ] and Anoorag R. Tayde [a#]

[a] *Department of Entomology, SHUATS, Prayagraj, U.P., India.*

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

The experiment was conducted at the research plot of the Department of Agricultural Entomology and Central Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, during *Rabi* from November to February 2021-22 in Randomized Block Design (RBD) with three replications. Eight treatments were evaluated against **,** *Leucinodes orbonalis* i.e., Chlorantraniliprole 18.5% EC, Spinosad 45% SC, Flubendiamide 20 WG, Indoxicarb 14.5% SC, Emamectin benzoate 5 SG, Lambda cyhalothrin 4.9% CS, Neem oil 0.15% EC and control in RBD with three replication. The best and most economical treatment was Chlorantraniliprole (1:10.06) which was par with Spinosad (1:8.51) followed by Flubendiamide (1:8.44), Indoxacarb (1:8.04), followed by *Emamectin benzoate* (1:7.12) and Lambda cyhalothrin (1:6.85), Neem oil (1:6.36) as compared to control (1:4.63).The data on the percent infestation of shoot and fruit borer on brinjal 3rd, 7th and 14th day after first spray reveal that all the chemical treatments were significantly superior over control. Ratio was Chlorantraniliprole 18.5% EC (10.85%, 7.29%), Spinosad 45% SC (11.95%, 9.12%), Flubendiamide 20 WG (13.76%, 9.79%), Indoxacarb 14.5% SC (14.05%, 10.47%), Emamectin benzoate 5 SG (15.59%, 13.46%), Lambda cyhalothrin 4.9% CS (17.09%, 13.46%), Neem oil 0.15% EC (19.97%, 17.43%). The yields among the treatment were significant.The highest yield was recorded in Chlorantraniliprole 18.5% EC (222.50 q/ha), followed by Spinosad 45% SC (198.33 q/ha).

[φ] *M.Sc. Scholar;*
[#] *Assistant Professor;*
**Corresponding author E-mail: poornachander1999@gmail.com;*

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1. INTRODUCTION

"Vegetable cultivation is one of the most profitable and dynamic branches of agriculture. Vegetables are an important constituent of the human diet. Botanically brinjal is known as (*Solanum melongena* Linneaus) chromosome number (2n=24) popularly known as eggplant belongs to family Solanaceae and India isits center of origin and diversity. Brinjal is an important dietary vegetable crop. Brinjal (*Solanum melongena* Linnaeus) also known as eggplant is referred to as the king of vegetables and now grown as a vegetable throughout the tropical, sub- tropical and warm temperate areas of the world. It is the most important vegetable in the Indian Subcontinent that accounts for almost 50% of the world's area under its cultivation. Under sustainable farming, brinjal provides regular daily income to meet the day-to-day expenditure" [1].

"Under sustainable farming, brinjal provides regular daily income to meet the day-to- day expenditure" [2]. "It has become an important economical source for farmers and field laborers. Brinjal, *Solanum melongena* L. is one of the popular vegetable grown as a poor man's crop in India; it is also grow extensively under diverse agro-climatic conditions throughout the year" [3].

"So far, *L. orbonalis* is considered as a major pest of brinjal as a shoot and fruit borer in the established crop in the main field**.** The main difficulty in evolving a suitable control measure against this pest is that it belongs to one of the most serious categories of insect pest internal feeder. Once the larva bores into petiole and midrib of leaves and tender shoots, it causes dead hearts. In later stages, it also bore into flower bud and fruits rendering them unfit for human consumption" (Anonymous).

"The Larvae of this pest cause 12-16% damage to shoots and 20-60% damage to fruits. The pest is very active during the rainy and summer season and often causes more than up to 95% in India. It is also reported that the infestation of fruit borer causes a reduction in Vitamin "C" content to an extent of 68 % in the infested fruits" [4]. "The yield loss in brinjal due to the pest complex is to the extent of 70-80 per cent. Among the insect pests the most obnoxious detrimentaland ubiquitous pest of brinjal is shoot and fruit borer (BSFB), *L. orbonalis* (Guenee), it alone causes damage as high as 85.90% and even up to 100% damage" [5].

1.1 Objectives

1. To evaluate the efficacy of chemicals and neem oil on incidue per centage of shoot and fruit borer, *L. orbonalis.*
2. To calculate the cost benefit ratio of the treatments.

2. MATERIALS AND METHODS

The experiment was conducted at Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj (U.P) during the *rabi* season of 2021-2022 with a recommended package of practices excluding plant protection. Research field situated at $25^0$27" North latitude $80^0$05" East longitudes and at an altitude of 98 meter above sea level the maximum temperature reaches up to 42^0C in summer and crops down to 4^0C in winter. The Brinjal seedlings of variety 'Dhruva' were transplanted after 30 days at 60 cm x 45 cm spacing. The experiment was laid down in Randomized Block Design (RBD) with eight treatments replicated thrice with each plot size of 2m X 2m and proper irrigation was provided. The treatments comprising of, Chlorantraniliprole 18.5% SC, Spinosad 45% SC, Flubendiamide 20 WG, Indoxicarb 14.5% SC, Emamectin benzoate 5 SG, Lambda cyhalothrin 4.9% CS and Neem oil 0.15% EC were applied two times using knapsack sprayer in 15 days of interval. From each plot five plants were selected randomly and labeled for recording observations. As soon as the infestation of pest on shoot was initiated, the observations on total number of shoots and number of infested shoots and fruit infestation of five observational plants from each treatment replication wise were recorded at 3^{rd}, 7^{th} and 14^{th} days after imposing treatments. The data recorded in the different treatments were subjected to statistical analysis after suitable transformation by following standard procedures of RBD experiment. After the last picking, total of all pickings of individual plots produce were calculated to work out the yield of the treatments. Yield of healthy fruits was converted into quintal per hectare.

The observations on the per cent infestation were recorded visually per plant from five randomly selected and tagged plants in each plot. The insecticides were sprayed at recommended doses when larval population reaches its ETL level. Larvae count was taken 24 hours before spraying at tagged plant at 5 tagged plants per treatment, which was further converted into per plant population and subsequent observation was recorded at 3rd, 7th and 14th days after spraying on same plants.

Preparation of insecticidal spray solution: The Insecticidal spray solution of desired concentration as per treatment was freshly prepared every time at the site of experimentation just before the start of spraying operations. The spray solutionof a desired concentration was prepared by adopting the following formula

V = (C x V) / a.i%

Where:

V = Volume/ weight of formulated insecticide required
C = Concentration required.
A = Volume of solution to be prepared.
% a.i. = given percentage of active ingredient.

The healthy marketable yield obtained from different treatments was collected separately and weighted. The cost of insecticides used in this experiment was recorded during *rabi* season. The cost of botanicals used was obtained from nearby market. The total cost of plant protection consisted of cost of treatment, sprayer, rent and labour charges for the spray. There are two sprays throughout the research period and the overall plant protection expenses was calculated. Total income was realized by multiplying the total yield per hectare by the prevailing market price, while the net benefit is obtained by subtracting the total cost of plant protection from the total income. Benefit over the control for each sprayed treatment was obtained by subtracting the income of the control treatment from that of each sprayed treatment.

Cost benefits of treatments: Gross returns were calculated by multiplying total yield with market price of the produce. Cost of cultivation and cost of treatments was deducted from the gross returns, to find out returns and cost benefit of ratio by following formula.

BCR = Gross returns / Cost of treatments

Where;

BCR = Benefit Cost Ratio

3. RESULTS AND DISCUSSION

Among insect pests infesting brinjal shoot and fruit borer [*Leucinodes orbonalis*] is major ones that damages tender shoots and fruits. Its larvae inside brinjal fruit and making fruit unfit for human consumption *L. orbonalis* is the most destructive pests causing economic damage to the crop at all the growth stages. The deformity in shape and remain stunted in growth freshly hatched larvae bore into tender shoots and tunnel downwards. As a results formation of buds, flowers and fruits, the larvae bore inside and feed on inner tissues. However, various new molecules with different mode of action are available in the market which required to be tested for the control of *L. orbonalis* in brinjal. Hence, the experiment was planned to evaluate the efficacy of various synthetic insecticides against *L. orbonalis* in brinjal during *rabi* season.

Effect of different insecticides on the incidence of *Leucinodes orbonalis* showed that all the treatments were significantly superior in reducing the infestation of shoot and fruit borer resulting in increasing the yield, significantly as compared to control. The first spray was given after 30 days of transplanting. The percent infestation of shoot and fruit borer on brinjal after first spray (Shoot) revealed that all the chemical treatments were significantly superior over control. Among all the treatments lowest per cent shoot, infestation was recorded in Chlorantraniliprole 18% EC (10.85%), followed by Spinosad 45% SC (11.95%), Flubendamide 20 WG (13.76%), Indoxacarb 14.5% SC (14.05%), Emamectim benzoate 5 SG (15.59%) and Lambda cyhalothrin 4.9% CS (17.09%), The treatment Neem oil 0.15% EC (19.97%) was least effective among all the treatments and maximum shoot damage was recorded in control plot (24.49%) (Table 1).

The second spray was applied after 15 days of first spray and data on percent fruit damage was recorded. The pooled data for second spray shows minimum percent fruit damage in Chlorantraniliprole 18% EC (7.29%), Spinosad 45% SC (9.12%), Flubendamide 20 WG (9.79%), Indoxacarb 14.5% SC (10.47%), Emamectim benzoate 5 SG (13.46%), and Lambda cyhalothrin 4.9% CS (13.46%), The treatment Neem oil 0.15% EC (17.43%) was least effective among all the treatments. The highest fruit damage was recorded in Control plot (24.94%) (Table 1).

Table 1. Comparative efficacy of selected insecticides with neem oil against fruit and shoot borer [*Leucinodes orbonalis*] on brinjal

Sl. No.	Treatments	% Infestation of brinjal shoot and fruit borer							Yield (q/ha)	C:B ratio
			First spray				Second spray			
		1 DBS	3 DAS	7 DAS	14 DAS	3 DAS	7 DAS	14 DAS		
T1	Chlorantraniliprole@18.5% EC	20.81	11.65^{d}	07.33^{e}	13.58^{ab}	07.33^{e}	05.18^{e}	09.38^{B}	222.50	1:10.06
T2	Spinosad @45% SC	19.77	11.92^{d}	09.38^{de}	14.56^{d}	08.69^{de}	08.30^{de}	10.39^{e}	198.33	1:8.51
T3	Flubendamide @ 20 WG	19.76	13.97^{cd}	11.83^{cd}	15.48^{d}	10.04^{de}	07.08^{d}	12.27^{e}	179.16	1:8.44
T4	Indoxacarb @ 14.5 % SC	18.51	14.30^{cd}	12.39^{c}	15.48^{cd}	10.37^{d}	09.28^{cd}	11.76^{de}	163.33	1:8.04
T5	Emamectin benzoate @ 5 SG	21.83	14.84^{cd}	12.50^{c}	19.43^{cd}	13.17^{c}	12.10^{bc}	15.13^{de}	143.33	1:7.12
T6	Lambda cyhalothrin @4.9 % CS	20.24	17.58^{bc}	13.49^{c}	20.22^{bc}	13.49^{c}	12.34^{b}	14.57^{c}	136.66	1:6.85
T7	Neem oil 0.15% EC	23.08	20.23^{ab}	17.76^{b}	21.93^{b}	18.10^{b}	14.50^{b}	19.70^{cd}	127.50	1:6.36
T8	Control	20.43	22.97^{a}	24.56^{a}	25.95^{a}	23.82^{a}	24.77^{a}	26.24^{a}	90.00	1:4.63
	F-test	NS	S	S	S	S	S	S		
	S. Ed (±)	01.84	02.28	01.29	02.15	01.29	01.31	01.55		
	C.D. (P = 0.5)	-	04.89	02.78	04.61	02.78	02.83	03.33		

All of the pesticides were discovered to be extremely effective and greatly over control. The lowest documented level of brinjal shoot and fruit borer infection was found in Chlorantraniliprole 18% EC (222.50q/ha) Tripura, A et al. [6]. Spinosad 45% SC (198.33 q/ha) this finding were associated with Samota and Jat [7]. Flubendamide 20 WG (179.16 q/ha) and Indoxacarb 14.5% SC (163.33 q/ha). These findings were supported by Mahata, S., et al. [8], Emamectim benzoate 5 SG (143.33 q/ha) Dey, S. [9], and Lambda cyhalothrin 4.9% CS (136.66 q/ha) Sen, et al. [10]. The treatment Neem oil 0.15% EC (127.50 q/ha), validated these finding Sharma and Tayde [11] and the control (90q/ha) (Table 1).

When the cost-benefit ratio was calculated, an intriguing result was obtained; the best and most cost-effective treatment, Chlorantraniliprole 18% EC (1:10.06), among those investigated, is identical to those found by Pawar et al. [12]. The results of Spinosad 45% SC (1:8.51) and Flubendamide 20 WG (1:8.44) are comparable to those of Jat, H.K., et al. [13] and Shanmugam et al. [14] respectively. Emamectim benzoate 5 SG (1:7.12) and Indoxacarb 14.5% SC (1:8.04) are similar to findings from Biswas, M., et al. [15]. lambda cyhalothrin 4.9% CS (1:6.85), Neem oil 0.15% EC (1:6.36), treatments that are similar to those found by Sen, et al. [10], Sanjana and Tayde [16], and control (1:4.63) (Table 1).

4. CONCLUSION

From the present study, the results it showed that chlorantraniliprole 18.5% EC is most effective treatment against brinjal fruit and shoot borer producing maximum yield and recorded highest cost benefit ratio compared to other treatments. While Spinosad 45% SC, Flubendamaide 20 WG, Indoxicarb 14.5% SC, Emamectin benzoate 5 SG has shown average results Lambda cyhalothrin 4.9% SC, Neem oil 0.15% EC, has least effectiveness and in botanicals Neem oil found to be least effective in managing *Leucinodes orbonalis.* Botanicals are the part of integrated pest management in order to avoid indiscriminate use of pesticides causing pollution in the environment and not much harmful to beneficial insects.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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