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Annem Siva Sankar
M.Sc. Scholar, Department of Entomology, SHUATS, Prayagraj, Uttar Pradesh, India

Ashwani Kumar
Associate Professor, Department of Entomology, SHUATS, Prayagraj, Uttar Pradesh, India

Corresponding Author:
Annem Siva Sankar
M.Sc. Scholar, Department of Entomology, SHUATS, Prayagraj, Uttar Pradesh, India

Evaluation of certain insecticides to control shoot and fruit borer, *Leucinodes orbonalis* Guenee on brinjal (*Solanum melongena* L)

Annem Siva Sankar and Ashwani Kumar

Abstract
The present investigation entitled was carried out at Mahewa, Prayagraj, Uttar Pradesh, India. The experiment was conducted during *kharif* season of 2021-22 in Randomized Block Design (RBD) on three replications. Two applications of eight treatments *viz.,* Spinosad 45SC (T1), Flubendiamide 480SC (T2), Neem oil 0.2% (T3), Indoxacarb 14.5SC (T4), Emamectin benzoate 5SG (T5), Cartap Hydrochloride 25SG (T6), Chlorantraniliprole 18.5SC (T7) and untreated Control (T8). Among all the treatments minimum percent shoot infestation, percent fruit infestation and B:C ratio were observed in Spinosad 45SC (10.756%, 11.581% and 1:5.64). Flubendiamide 480SC (15.756%, 17.143% and 1:5.31) is found to be the next best treatment followed by Emamectin Benzoate 5SG (16.86%, 18.348% and 1:4.74), Chlorantraniliprole 18.5SC (18.493%, 18.406% and 1:4.54) and Indoxacarb 14.5SC (19.821%, 20.547% and 1:4.16), Cartap Hydrochloride 25SG (21.501%, 20.622% and 1:3.73) and Neem oil 0.2% (23.892%, 23.467% and 1:3.55) is found to be least effective but comparatively superior over the control (27.534%, 34.725% and 1:2.59) respectively.

Keywords: Brinjal shoot and fruit borer, evaluation, insecticides, *Leucinodes orbonalis*

Introduction
Vegetable cultivation is one of the most profitable and dynamic branches of agriculture. Vegetables are an important constituent of the human diet. Brinjal is an important dietary vegetable crop. Brinjal (*Solanum melongena* Linnaeus) also known as eggplant is referred to 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 the most important vegetable in the Indian Subcontinent that accounts for almost 50% of the world's area under its cultivation. Kolhe (2017) [8] Under sustainable farming, brinjal provides regular daily income to meet the day-to-day expenditure. Murugesan (2009) [10] It has become an important source of income for both farmers and field labourers, service charges for the machinery, serving as a vehicle for reducing poverty in rural areas. Nawale (2018) [11] Brinjal occupies an important position among the other regular vegetable crops that are available throughout the year and popular vegetable grown as a poor man's crop in India. Brinjal, *Solanum melongena* L. is one of the major vegetables in India extensively grown under diverse agro-climatic conditions throughout the year. Singh (2018) [16].

Brinjal (*Solanum melongena* L.) is one of the popular vegetables favoured by the people of many countries *viz*., Central, South and South East Asia, some parts of Africa and Central America Harish *et al*. (2011) [6]. Apart from India, the other major brinjal growing countries are China, Turkey, Japan, Italy, Indonesia, Iraq, Syria, Spain, and Philippines. Brinjal is one of the most commonly grown vegetable crop in the country Yadav and Tayde (2018) [18].

Leucinodes orbonalis Guenee (Pyralidae: Lepidoptera) is the most important insect pest of brinjal and the apparent yield loss varying from 20-90% in various parts of the country Raju *et al*. (2007) [14] 85–90% have been reported Patnaik (2000) [12] Jagginavar *et al*. (2009) [7]. The Larvae of this pest cause 12-16% damage to shoots and 20- 60% damage to fruits. The pest is very active during 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 reduction in Vitamin C content to an extent of 68% in the infested fruits Anwar *et al*. (2015) [1].

Materials and Methods

The experiment was conducted during *kharif* season 2021 at the Central Research Farm (CRF) of Sam Higgins bottom University of Agriculture, Technology and Sciences, Naini, Prayagraj, Uttar Pradesh, India, in a randomized block design with eight treatments replicated three times using Banaras purple round (Local variety) in allot size of 2m×2m at a spacing of 60×60 cm with a recommended package of practices excluding plant protection. Seven treatments were evaluated against**,** *Leucinodes orbonalis* i.e., Spinosad 45% SC @ 0.5 ml/l (T1), Flubendiamide 480SC @ 0.4 ml/l (T2), Neem oil 0.2% 2 ml/l (T3), Indoxacarb 14.5SC @ 0.25 ml/l (T4), Emamectin benzoate 5 SG @ 0.4 gm/l (T5), Cartap Hydrochloride 25SG @ 2 ml/l (T6), Chlorantraniliprole 18.5SG 0.5 ml/l (T7) and control plot (T0) The population of brinjal shoot and fruit borer was recorded before 1-day spraying and on 3rd day, 7th day and 14th day after insecticidal application. The populations of brinjal shoot and fruit borer was recorded on 5 randomly selected and tagged plants from each plot and then it was converted into per cent of infestation by following formula.

$$\text{Per cent shoot damage} = \frac{\text{No. of Shoots effected}}{\text{Total no. of shoots}} X100$$

$$\text{Per cent fruit damage} = \frac{\text{No. of fruits affected}}{\text{Total no. of fruits Cost benefit ratio}} X100$$

Based on the yield data, the gross returns and net returns were calculated for each treatment. The benefit cost ratio (BCR) was determined by dividing the additional returns with the additional cost of imposing the respective treatment on hectare basis.

$$\text{B.C.R} = \frac{\text{Gross Returns}}{\text{Total Cost of Protection}}$$

Results and Discussion

The results of the experiment Evaluation of different insecticides against brinjal shoot and fruit borer (*Leucinodes orbonalis* Guenee) to study cost benefit ratio during *kharif* season of 2021. The data so obtained through observation on various aspects were subjected to statistical analysis wherever necessary and the compiled mean data are tabulated in the following pages. Results obtained are presented aspect wise here under.

The data on the per cent infestation of shoot borer on brinjal 3rd, 7th and 14th day after first spray revealed that all the chemical treatments were significantly superior over control. Among all the treatments Spinosad 45SC (10.756%) was the most effective chemical. Flubendiamide 480SC (15.756%) recorded the lowest percent infestation of shoot and fruit borer. Next to that Emamectin benzoate 5SG recorded 16.86% infestation. And the next effective were Chlorantraniliprole 18.5SC (18.493%) which was followed by Indoxacarb 14.5SC (19.821%). Cartap Hydrochloride 25SG (21.501%) and Neem oil 0.2% (23.892%) was found to be least effective but superior over control (27.534%).

Table 1: Efficacy of selected insecticides against *L. orbonalis* on brinjal during Kharif season of 2021 (First spray)

Treatments		Per cent shoots infestation of *L. orbonalis*				
		One day before spray	First spray			
			3 DAS	7 DAS	14 DAS	Mean
T1	Spinosad 45SC	22.337	8.723	10.567	12.980	10.756
T2	Flubendiamide480SC	22.487	15.070	15.633	16.567	15.756
T3	Neem oil 0.2%	24.663	23.323	23.640	24.713	23.892
T4	Indoxacarb14.5SC	26.497	19.257	19.563	20.643	19.821
T5	Emamectin benzoate 5SG	25.940	15.207	16.570	18.803	16.86
T6	Cartap Hydrochloride25SG	28.773	21.040	20.433	23.030	21.501
T7	Chlorantraniliprole 18.5SC	25.447	18.213	17.360	19.907	18.493
T0	control	23.510	25.543	27.987	29.073	27.534
Overall Mean		20.49	NS	S	S	S
F- test		NS	2.10	1.05	1.68	1.79
S. Ed. (±)		0.81		2.26	3.60	3.83
C. D. (P = 0.05)		-	22.337	8.723	10.567	12.980

The data on the per cent infestation of fruit borer on brinjal 3rd, 7th and 14th day after second spray revealed that all the chemical treatments were significantly superior over control. Among all the treatments lowest per cent fruit, infestation was recorded Spinosad 45SC (11.581%) was the most effective chemical. Flubendiamide 480SC (17.143%) recorded the lowest percent infestation of shoot and fruit borer. Next to that Emamectin benzoate 5SG recorded 18.348% infestation. And the next effective were Chlorantraniliprole 18.5SC (18.407%) which was followed by Indoxacarb 14.5SC (20.547%). Cartap Hydrochloride 25SG (20.622%) and Neem oil 0.2% (23.467%) was found to be least effective but superior over control (34.725%).

Table 3: Economics of cultivation:

S. No	Treatments	Yield of q/ha	Cost of yield / ₹/qtl	Total cost of yield (₹)	Common cost (₹)	Treatment cost (₹)	Al cost(₹)	C:B ratio
1	Spinosad 45SC	162.4	1800	292320	47848	3960	51808	5.64
2	Flubendiamide 480 SC	145.3	1800	261540	47848	1400	49248	5.31
3	Neem oil 0.2%	100.8	1800	181440	47848	3200	51048	3.55
4	Indoxacarb 14.5SC	114.5	1800	206100	47848	1580	49428	4.16
5	tin Benzoate5SG	130.7	1800	235260	47848	1800	49648	4.74
6	Hydrochloride25SG	106.1	1800	190980	47848	3320	51168	3.73

7	antraniliprole18.5SC	127.2	1800	228960	47848	2540	50388	4.54
8	Control	69	1800	124200	47848	0	47848	2.59

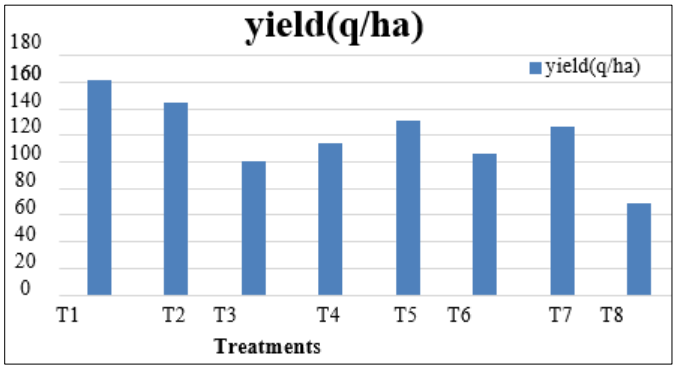

Fig 1: Graphical representation of economics of different treatments

Discussion

All the treatments are found to be superiorly over control on first and second spray and revealed that Spinosad 45 SC was more effective in per cent infestation of fruit and shoot borer with (10.75 & 11.58%) infestation over control respectively. Similar findings made by Chandar *et al.*, (2020) [3] (10.98) After that, Flubendiamide 480 SC is found to be more effective treatment in reducing per cent infestation of shoot and fruit borer with (15.75 & 17.14)which is in line with the findings of Kushwaha and Painkra (2016) [9] shoot infestation of first spray (3.06) and fruit infestation(3.56), Sharma *et al.*, (14.03) reported that Chlorantraniliprole 18.5 SC was found most effective in reducing first spray (18.49) and fruit infestation (16.21) per cent infestation of *Leucinodes orbonalis* as well as increasing the yield in similar findings with Patra *et al*. (2016) [13] (7.96). Profenofos 50 EC (17.84 and 14.39%) is found to be the next effective treatment followed by Cypermethrin 25 EC (18.64 and 15.41%) is found to be more effective treatment in reducing per cent infestation of shoot and fruit borer with which is in line with the findings of (7.41). The result of is in lmidacloprid SL (19.15 and 16.63%) followed by Neem oil 0.2% (19.56% & 17.41%) is found to beleast effective among all the treatments these findings are supported by Bhagawan and Kumar (2017) [2] (9.83) Cost benefit ratio and Brinjal yield:

The yields among the treatments were significant. The highest yield was recorded in Spinosad 45SC (162.4 q/ha), followed by Flubendiamide 480SC (145.3 q/ha), Emamectin Benzoate 5SG (130.7 q/ha), Chlorantraniliprole 18.5SC (127.2 q/ha), Indoxacarb 14.5SC (114.5 q/ha), Cartap Hydrochloride 25SG (106.1 q/ha) and Neem oil 0.2% (100.8 q/ha), as compared to control plot (69 q/ha). These findings are supported by Tripura *et al*. (2017) [17] who concluded that Chlorantraniliprole recorded highest marketable fruit yield of 250.30q/ha and Gupta *et al.* (2017) [5] 16concluded that spinosad recoreded the maximum fruit yield 280.42 q/ha and Choudhury *et al.* (2021) [4] revealed that spinosad-treated plot attained the highest yield of 8.65 t /ha.

The highest increased yield over control was recorded in Spinosad 45SC (93.4 q/ha), followed by Flubendiamide 480SC (76.3 q/ha), Emamectin Benzoate 5SG (61.7 q/ha), Chlorantraniliprole 18.5SC (58.2 q/ha), Indoxacarb 14.5SC (45.5 q/ha), Cartap Hydrochloride 25SG (37.1 q/ha) and Neem oil 0.2% (31.8 q/ha).

When cost benefit ratio was worked out, interesting result was achieved. Among the treatments studied, the best and most economical treatment was Spinosad 45SC (1:5.64), followed by Flubendiamide 480SC (1:5.31), Emamectin Benzoate 5SG (1:4.74), Chlorantraniliprole 18.5SC (1:4.54), Indoxacarb 14.5SC (1:4.16), Cartap Hydrochloride 25SG (1:3.73) and Neem oil 0.2% (1:3.55), as compared to control plot (1:2.59). These findings are supported by Kushwaha and Painkra (2016) [9] revealed in his findings with Flubendiamide (1:4.91), Chlorantraniliprole (1:5.48) and indoxacarb (1:4.44) cost benefit ratio and Sharma *et al.* (2017) [15] revealed that the spinosad showed 1:7.63 and emamectin benzoate with 1:7.54 and neem oil with 1:6.01 cost benefit ratio.

Conclusion

From the critical analysis of the present findings of, The present investigation entitled Evaluation of certain insecticides to control shoot and fruit borer, *Leucinodes orbonalis* Guenee on brinjal (*Solanum melongena)*It is concluded that among all the treatment Spinosad 45SC is most effective out of seven treatments. It also gave the highest cost benefit ratio and marketable yield i.e. 1:5.64 and 162.4 q/ha. It was followed by Flubendiamide 480SC, Emamectin Benzoate 5SG, Chlorantraniliprole 18.5SC, Indoxacarb 14.5SC, Cartap Hydrochloride 25SG and Neem oil 0.2%is least effective among the treatments. Future study may be conducted to validate the findings.

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