Efficacy of Novel Insecticides Against *Leucinodes orbonalis* in Brinjal Cultivation

Abstract

This study evaluates the efficacy of different novel insecticides, including Flubendiamide, Emamectin benzoate, Indoxacarb, Chloropyriphos, Spinosad, and Bifenthrin, against *L. orbonalis* in brinjal cultivation. The investigation was conducted at the field experiment farm of R. B. S. College Bichpuri, Agra during the Kharif season of 2023-24, selected for its historical prevalence of *Leucinodes orbonalis* infestations in brinjal crops. Results indicated that Flubendiamide achieved the highest reduction in pest incidence (75.30%), followed by Emamectin benzoate (59.41%) and Indoxacarb (57.09%). The findings underscore the potential of these novel insecticides as effective alternatives to traditional chemical controls, contributing to integrated pest management strategies that minimize environmental impact while enhancing brinjal production.

Keywords: Brinjal, *Leucinodes orbonalis*, Novel insecticides,

Introduction

Brinjal is a widely cultivated vegetable crop, but its yield is severely impacted by *Leucinodes orbonalis*, which infests both shoots and fruits. Traditional pest control methods often rely on chemical insecticides, which can pose risks to human health and the environment. BSFB is the most serious pest in major brinjal cultivating regions due to concealed mode of life (Sardana *et al.*, 2004). As its larvae inhabits inside the plant shoots or fruits by forming tunnels, it not only affects the marketability of its fruit yield but also attribute to the obstacles in the management as the pesticide do not reach the pest directly (Alam *et al.*,2003). Mono culture, off season cultivation, summer hybrids and other newly introduced varieties are the major factors leading to serious proportions of BSFB infestation on brinjal crops (Dhandapani *et al.*, 2003; Chakraborti and Sarkar, 2011). Further, reported fruit losses vary from 20.70 to 88.89 per cent and the maximum shoots infestation ranges from 73.33- 86.66 per cent (Raju *et al.*,2007).As the inhabiting nature of this pest protects it from the control practices, the farmers rely on the over use of chemical insecticide. Rather than giving the satisfactory control, of *L. orbonalis* indiscriminate use of toxic, broad-spectrum pesticides kill the natural enemies of *L. orbonalis*, which results in satisfactory control of the pest before the use of insecticides became widespread (Talekar *et al.*, 2002). The excessive use of chemicals is not only leading to destruction of natural enemies but is also risky, as vegetables retain pesticide residues. The indiscriminate use of chemicals is not desired in vegetables as these are harvested at shorter intervals and waiting period is not followed due to perishable nature of vegetables. Besides, heavy use of pesticides in brinjal resulted in development of resurgence of secondary pests such as whitefly, mites and thrips (Krishna kumar and Krishnamoorthy, 2001).

Comment [MW1]: How available and affordable are these products for the average brinjal grower?

Comment [MW2]: Chlorpyriphos and Bifenthrin may not be novel insecticides.

Comment [MW3]: We used to report number of insects per unit, which will let you see advantages of good pesticides. You chose reduction percentage, which cannot show you the actual number of pests per experimental unit. As I saw it, infestation has never been more than 30%. Is that true?

Comment [MW4]: Brinjal production statistics might offer an advantage (one sentence or two). What rank does it have in your study area compared to other vegetables.

Comment [MW5]: Better add scientific name. For the international reader, using eggplant as additional name might be beneficial.

Materials and Methods

The investigation was conducted at the field experiment farm of R.B.S. College Bichpuri, Agra during the *Kharif* season of 2023-24, selected for its historical prevalence of *Leucinodes orbonalis* infestations in brinjal crops. The study utilized the brinjal variety Kavya, known for its susceptibility to *L. orbonalis*. A selection of novel insecticides was tested, including Insecticide T_1 Indoxacarb 1 ml/lit, T_2 Chloropyriphos 2.5 ml/lit, T_3 Emamectin benzoate 1 ml/lit, T_4 Spinosad 0.5 ml/lit, T_5 Neem oil 5 ml/lit, T_6 Flubendiamide 1 ml/lit, T_7 Bifenthrin 0.5 ml/lit and T_8 Control. Thus, in all eight treatment combinations were compared in randomized complete block design (RCBD) with three replications. Standard agronomic practices were followed, including land preparation, sowing, irrigation, and fertilization, to ensure uniform growth conditions across all experimental plots. The experimental layout consisted of multiple treatments, including various insecticides and a control group (untreated), with each treatment replicated three times to ensure statistical validity. Regular monitoring of *L. orbonalis* populations was conducted using visual inspections and pheromone traps, with the incidence of pest infestation recorded weekly, focusing on both shoot and fruit damage. Insecticides were applied according to the manufacturer's recommendations, using a knapsack sprayer to ensure uniform coverage, particularly during the flowering and fruiting periods when pest activity is typically highest. The results were subjected to statistical analysis using software such as SPSS or R, with a significance level of $p < 0.05$ set for determining the efficacy of the treatments. This methodology provides a comprehensive framework for evaluating the effectiveness of novel insecticides in managing *Leucinodes orbonalis* infestations in brinjal crops, contributing valuable insights to integrated pest management strategies.

Comment [MW6]: What plot size was it tested? It cannot be individual plants in pots because its is RCBD. Field layout must be described (plot size, spacings between plots, blocks and alleys).

Comment [MW7]: Please define incidence in the MM. Was it the number of plants found infested, fruits, or what?

Also, difference between infestation and incidence because you have different data for these two (see your conclusion part).

Result and discussion

Management of brinjal shoot and fruit borer with different novel insecticide. The efficacy of eight treatments including untreated (control), viz., Spinosad 0.5 ml/lit, Flubendiamide 1ml/lit, Emamectin benzoate 1 ml/lit, Bifenthrin 0.5 ml/lit, Indoxacarb 1 ml/lit, Nem oil 5 ml/l and Chlorpyriphos 2.5 ml/l it was evaluated in RBD with three replications. The results obtained are presented here with.

First spray

Three days after application of pesticides, it was observed that all the novel pesticides treatments were found significantly superior over the untreated control, however, their existed a considerable difference among them (Table-1). The maximum reduction of 59.07 per cent in shoot and fruit borer population was recorded in the treatment of Flubendiamide and significantly superior over rest of the treatments. The next most effective treatments were Emamectin benzoate and Indoxacarb which gave 49.65 and 47.81 percent reduction, respectively and were found statistically at par. Chloropyriphos 34.27 percent reduction in shoot and fruit borer population and it was statistically at par with Spinosad and bifenthrin which gave 32.80 and 31.20 percent reduction. The minimum reduction of 24.78 percent was recorded with the

Comment [MW8]: What growth stage were 1st and 2nd spray done? Time gap between the two. Please state in the MM.

Comment [MW9]: What was this reduction from? What were they from which that reduction was calculated?

treatment of Neem oil. These findings are consistent with the results of a study conducted by Patra *et al.* (2009), Narayan *et al.*, (2014) and Sharma *et al.* (2011).

Table 1 Bio-efficacy of different novel-pesticides against brinjal shoot and fruit borer, *Leucinodes orbonalis* during *kharif*, 2023-2024.

S.N.	Treatments	Mean per cent reduction in larva lBFSB population(%)			
		PTP/ Plant	1st Spray		
			3DAS*	7DAS	10DAS
T1	Indoxacarb (1 ml/lit)	4.44	47.81 (43.7)*	54.57 (47.62)	53.50 (47.01)
T2	Chloropyriphos(2.5 ml/lit)	4.40	34.27 (35.83)	40.34 (39.43)	38.03 (38.08)
T3	Emamectin benzoate (1ml/lit)	3.40	49.65 (44.80)	56.69 (48.84)	54.66 (47.68)
T4	Spinoad (0.5 ml/lit)	3.60	32.80 (34.94)	38.02 (38.07)	37.03 (37.48)
T5	Neem oil (5 ml/lit)	2.92	24.78 (29.86)	29.98 (33.20)	27.01 (31.32)
T6	Flubendiamide (1 ml/lit)	3.60	59.07 (50.22)	65.91 (54.28)	62.74 (52.38)
T7	Bifenthrin (0.5 ml/l)	4.60	31.20 (33.83)	36.40 (37.10)	35.19 (36.8)
T_8	Untreated Control	4.20	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
S.E.			0.98	1.01	0.99
C.D. (5%)			3.02	3.11	3.03
*DAS stands for days after spray?					

After seven days of novel pesticides application all the treatments were also proved significantly superior over untreated control with increase in percent reduction of shoot and fruit borer population. The treatment of Flubendiamide proved most effective, reduced 65.91 per cent shoot and fruit borer population and superior over rest of the treatments. Emamectin benzoate reduced 56.69 per cent shoot and fruit borer closely followed by Indoxacarb which gave 54.57 per cent reduction and both the treatments were found statistically at par in their efficacy. Chloropyriphos and Spinosad in 40.34 and 38.02 per cent reduction, respectively were proved moderately effective treatments against shoot and fruit borer and at par in their efficacy. The minimum reduction of 29.98 per cent was recorded with the treatment of Neem oil. Similar trend

Comment [MW10]: PTP? Please define.

Comment [MW11]: It seems that data were collected three times at 3-day intervals, introducing time as an additional factor in your analysis. It would be beneficial to consider a repeated measures analysis to determine whether time significantly influences the mortality of the pest. This approach could help demonstrate whether the number of borers killed increases over time. If time is indeed a crucial factor, presenting this information in a graph rather than a table would enhance clarity and visualization of the trends.

This concept of reduction

Does this indicate that you introduced the borers artificially to assess how their numbers decreased over time? If so, this process should be clearly described in the Materials and Methods section. Conversely, if your study focused on naturally occurring borers, it's essential to include an initial count prior to spraying, as well as counts after the treatment, to provide a comprehensive analysis of the impact.

Comment [MW12]: What is * for?

of novel percent reduction in shoot and fruit borer population was observed after ten days of pesticides application. The maximum reduction (62.74 per cent) in shoot and fruit borer population was recorded in the treatment of Flubendiamide and differed significantly superior over rest of the treatments. Emamectin benzoate and Indoxacarb gave 54.66 and 53.50 per cent reduction and proved next most effective group of pesticides against shoot and fruit borer. Chloropyriphos and Spinosad 38.03 and 37.03 percent reduction in shoot and fruit borer population were found moderately effective against shoot and fruit borer. The Neem oil proved least effective against shoot and fruit borer resulted in only 27.01 per cent reduction in shoot and fruit borer population. Similar results were also reported by Shridhara *et al.*, (2020), Tripura *et al.* (2017); Shirale *et al.* (2012) and Singh *et al.* (2016).

Second spray

The data indicated in the (Table-2) show that all the novel pesticides treatments were significantly superior over untreated control. The maximum reduction in shoot and fruit borer population of 60.74 per cent was recorded in the treatment of Flubendiamide and significantly superior over rest of the treatment. Emamectin benzoate which resulted in 51.39 per cent reduction followed by Indoxicarb (49.69 per cent reduction) and both were statistically comparable to each other in their efficacy. The next effective treatments were chloropyriphos, Spinosad and bifenthrin which gave 35.79, 33.37 and 31.60 per cent reduction, respectively and were found statistically at par. The minimum reduction of 26.04 per cent was recorded from the treatment of Neem oil.

Table 2 Bio-efficacy of different novel-pesticides against brinjal shoot and fruit borer, *Leucinodes orbonalis* during *kharif*, 2023-2024.

S.N.	Treatments	Mean per cent reduction in larva lBFSB population(%)			
		PTP/ Plant	2nd Spray		
			3DAS*	7DAS	10DAS
T1	Indoxacarb (1 ml/lit)	4.44	49.69 (44.82)	57.03 (49.04)	55.86 (48.37)
T2	Chloropyriphos(2.5 ml/lit)	4.40	35.79 (36.74)	44.55 (41.87)	42.23 (40.53)
T3	Emamectin benzoate (1ml/lit)	3.40	51.39 (45.80)	58.22 (49.73)	56.25 (48.59)
T4	Spinoad (0.5 ml/lit)	3.60	33.37 (35.29)	43.82 (41.45)	40.52 (39.54)
T5	Neem oil (5 ml/lit)	2.92	26.07 (30.70)	36.33 (37.07)	35.19 (36.38)
T6	Flubendiamide (1 ml/lit)	3.60	60.74 (51.20)	68.87 (56.09)	67.02 (54.95)

T7	Bifenthrin (0.5 ml/l)	4.60	31.60 (34.14)	41.70 (39.95)	38.20 (38.80)
T_8	Untreated Control	4.20	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
S.E.			**1.08**	**1.17**	**1.16**
C.D. (5%)			**3.32**	**3.61**	**3.51**

*DAS days after spray

The percent reduction after seven days of novel pesticides application got increased with the similar trend and proved significantly superior over control where the reduction in shoot and fruit borer population ranged from 36.22 to 68.87 per cent. The maximum reduction of 68.87 per cent was found in Flubendiamide. The next most effective treatments were Emamectin benzoate and Indoxacarb registered 58.22 and 57.03 per cent reduction, respectively and both differed non-significantly with each other in their efficacy. The treatments Chloropyriphos, Spinosad and bifenthrin gave 44.55, 43.82 and 41.70 per cent reduction, respectively and were found statistically at par. The minimum reduction in shoot and fruit borer population was recorded in Neem oil (36.22 per cent). These results align with the findings of Singh *et al.* (2018) and Singh *et al.* (2018).

After ten days of novel pesticides application reduction in shoot and fruit borer population was ranged from 35.28 to 67.02 per cent. The maximum being, 67.02 per cent in Flubendiamide and differed significantly with other treatments in their efficacy. The next most effective treatments were Emamectin benzoate and Indoxacarb resulted in 56.25 and 55.86 per cent reduction, respectively and were found statistically at par with each other in their efficacy. Chloropyriphos, Spinosad and Bifenthrin which gave 42.23, 40.52 and 38.20 per cent reduction, respectively and were found statistically at par. The minimum reduction of 35.28 per cent was recorded in Neem oil and proved significantly inferior to rest of the bio pesticides treatments. Similar results were also reported by Shridhara *et al.,* (2020), Tripura *et al.* (2017); Shirale *et al.* (2012) and Singh *et al.* (2016). The order of effectiveness of novel pesticides on the basis of per cent reduction in shoot and fruit borer population in both the spray was found to be Flubendiamide 1 ml/lit >Emamectin benzoate 1 ml/lit>Indoxacarb 1 ml/lit >Chloropyriphos2.5 ml/lit >Spinosad 0.5 ml/lit> Bifenthrin 0.5 ml/lit Neem oil 5 ml/lit. Similar results were also reported by Patra *et al.*, (2009) and Shridhara *et al.,* (2020).

Conclusion

The conclusion was that the maximum reduction in the incidence of brinjal shoot and fruit borer on per cent fruit infestation (number basis) was recorded in Flubendiamide (75.30 percent) followed by Emamectin benzoate (59.41 per cent), Indoxacarb (57.09 per cent), Chloropyriphos (41.56 percent), Spinosad (36.89 percent) and Bifenthrin (34.60). Whereas, over all minimum reduction in fruit infestation was recorded Neem oil (20.62 percent). The maximum reduction in the incidence of brinjal shoot and fruit borer on per cent fruit infestation (weight basis) was recorded in Flubendiamide (4.20 per cent) followed by Emamectin benzoate (8.53 per cent), Indoxacarb (8.94 per cent), Chloropyriphos (12.91 percent), Spinosad (13.89 percent) and Bifenthrin (12.09 percent). Whereas, fruit infestation was higher in control (26.02 per cent) followed by Neem oil (20.34 per cent).

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