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Studies on efficacy of different novel insecticides for the control of brinjal shoot and fruit borer, *Leucinodes orbonalis* (Guenee) in brinjal

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ABSTRACT

An attempt was made to evaluate the efficacy of novel insecticides against brinjal fruit borer, Leucinodes orbonalis at Student Instructional Farm of C.S.A.U.A&T., Kanpur, during Rabi season 2015-16 on var. Type-3. Among the various treatments like imidacloprid 17.8 SL @ 1.0 ml/lit., indoxacarb 14.5 SC @1.0 ml/lit., profenofos 50 EC @ 2.0 ml/lit., spinosad 45 SC @ 0.4 ml/lit., thiamethoxam 25 WG @ 0.1 gm/lit., acephate 75 SP @ 0.7 gm/lit. and untreated control, among them imidacloprid 17.8 SL was found most effective in reducing the mean shoot infestation and fruit infestation followed by indoxacarb 14.5 SC, profenofos 50 EC, spinosad 45 SC, thiamethoxam 25% WG and acephate 75 SP.

Keywords: *Imidacloprid; Leucinodes orbonalis; Brinjal.*

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INTRODUCTION

India is the second largest producer of vegetables after China. In Indian agriculture, vegetable farming occupies an important place because of their nutritional, medicinal and economical values. The area under brinjal cultivation was estimated to be 711.3 ('000'ha) with total production of about 13557.8 (000 mt) with the productivity of 19.1 (mt/ha) during 2013-14. The crop occupied 7.6 per cent of the whole vegetable area with production up to 8.3 per cent of entire vegetable grown in country [1]. The egg plant or brinjal *(Solanum melongena L.)* is a plant of family solanaceae. It is a native of India -Burma region, and was known to be grown in India since ancient time. Brinjal is susceptible to adverse environmental conditions like severe frost as well as long and warm growing season. A mean temperature of 20-30°C is most favorable for its successful production in northern plains. Like any other crops, brinjal is also attacked by a number of insect pests at various stages of its growth, which act as a limiting factor in the profitable cultivation of this crop. The crop is attacked by about 140 species of insect and non-insect pests belonging to 50 families [8, 11] listed 53 insects, whereas [7] listed 36 insects attacking on brinjal. Out of which numerous insect pests *viz.,* shoot and fruit borer, leaf hopper *(Amrasca biguttvla bigultula),* aphid *(Aphis gossypii*), hadda bettle *(Epilachnaspp.)* and brinjal stem borer *(Euzophera particella*) have been reported as important pests of brinjal [4, 6]. Among these, shoot and fruit borer *L. orbonalis* (Lepidoptera: Pyralidae) is most destructive and the major limiting factor in quantitative as well as qualitative harvest of brinjal fruits. This pest is widely distributed in Malaysia, Mayanmar, Sri Lanka, India, Pakistan, Germany and East Africa [1]. *L. orbonalis* causes damage in brinjal crop, both at vegetative as well as reproductive stage. The young larvae of this pests bore into petioles, midribs of large leaves and tender shoots, resulting in dropping. Later they bore into fruits .Crop losses by *L. orbonalis* have been reported to an extant of 20.70 to 88.70 per cent in various parts of India. Losses caused by this pest are as high as 20.7 per cent in Delhi [15], 70 per cent in West Bengal [3] and 13.28 to 88.89 per cent in Haryana [9, 12]

reported 54 to 66 per cent damage by this pest. Hence there is need for continuous evaluation for identifying their effectiveness, against insect pest and safety to non-target insect species.

MATERIAL AND METHODS

The field experiment was conducted in *Kharif* season during 2015-16, at Student Instructional Farm (SIF) C.S.A.U.A&T, Kanpur. The experiment was laid out in randomized block design having 3×3m2 plots and separated by 1 m irrigation channel with 7 treatments and 3 replication. The transplanting was done on 16 August, 2015 var. Type-3.

Selection of insecticides:

The registered formulation of insecticides *viz.,* profenofos 50 EC (2 ml/lit.), indoxacarb14.5 SC (1 ml/lit.), imidacloprid17.8 SL (1 ml/lit.), acephate 75 SP (0.7 gm/lit.), thiamethoxam 25% WG (0.1 gm/lit.), spinosad 45 SC (0.4 ml/lit.) and control.

Spraying of insecticides:

First spraying was applied after 30 days of transplanting followed by spraying of an interval of 15 days. 5 sprays of insecticides were applied. According the concentration of insecticides on the basis of active ingredient the desired amount of each insecticide was measured by micro pipette and electronic balance and then mixed with required amount of water. The formulation was diluted with water just at the time of spraying was done with the help of atomizer.

Observation

Efficacy of insecticides against *Leucinodes orbonalis:* Guenee

The first spray of each treatment was applied after 30 days of transplanting and repeated five times having 15 days interval. Observations were recorded on healthy and infested shoot and fruit on five randomly selected plants in each plot. However the performance of each treatment against fruit borer was assessed by recording the number of infested and healthy shoot/fruit from 5 randomly selected plants at each picking.

Statistical Analysis

The experiment was laid out in Randomized Block Design with 3 replications and values are transformed using angular transformation. The statistical analysis was made to determine the standard error and critical difference at 5% level of significance. Standard error and critical difference were calculated by following formula.

Standard error = $\sqrt{\frac{2MES}{R}}$

MES= error mean sum of square, error variance

R = Replication

Critical difference (C.D.) @ 5% = SE (d) × t 5%

Evaluation of yield in association of various treatments:

The fruit yield was recorded separately for all plots during each picking into kg/plot and q/ha for analyzing and comparison. The observations were analysed statistically to compare the effects of treatments. The per cent increase yield over control was calculated by following formula:

Percent increase yield over control = $\frac{T-C}{T}$ **×100**

(Abbot's, 1925)

Where,

C= per cent fruit infestation in control plot, T= per cent fruit infestation in treated plot by different insecticides

Incremental Cost Benefit ratio (ICBR).

Fruit yield of different treatments was recorded and cost benefit ratio was calculated on the basis of net income obtained from additional yield.

BCR= $\frac{Yeild\ in\ unprotected\ crop}{Yeild\ in\ protected\ crop}$ **× 100**

RESULTS

Efficacy of novel insecticides against shoot and fruit borer, *Leucinodes orbonalis*

Effect **on shoot damage:** Among different insecticides on the incidence of *L. orbonalis* in brinjal is presented in table.1, result showed that all the treatment was significantly superior in reducing the infestation of shoot as compared to control.

Table -1. Effect of various treatments on shoot damage caused by *L. orbonalis* 15 and 45 days after spraying.

Sl. No.	Common name	Dose/lit.	15 DAS		45 DAS	
			Mean % shoot damage	% reduction over control	Mean % shoot damage	% reduction over control
T1	Profenofos	2 ml	11.46 (19.78)	33.94	12.43 (20.64)	36.19
T2	Indoxacarb	1 ml	10.31 (18.72)	40.57	11.87 (20.15)	39.06
T3	Imidacloprid	1 ml	9.86 (18.30)	43.17	10.31 (18.72)	47.07
T4	Acephate	0.7 gm	13.29 (21.37)	23.40	15.46 (23.13)	20.63
T5	Thiamethoxam	0.1 gm	11.57 (19.88)	33.31	14.42 (23.31)	25.97
T6	Spinosad	0.4 ml	11.25 (19.59)	35.15	13.29 (21.37)	31.77
T7	Control	-	17.35 (24.61)	-	19.48 (26.18)	-
SE(d)		-	1.120	-	0.769	-
CD @ 5%		-	2.441	-	1.677	-

DAS: Days After Spraying. (Note: figure in parenthesis are angular transformed values.)

First spray (15 DAT): The first spray was given after 30 days of transplanting and data were recorded 15 days after spraying. The minimum shoot damage (9.86 per cent) was recorded in the plot treated with imidacloprid 17.8 SL followed by indoxacarb l4.5 SC where 10.31 per cent shoot damage was recorded. Imidacloprid 17.8SL proved significantly superior over indoxacarb 14.5 SC, spinosad 45 SC was also effective which gave 11.25 per cent shoot damage and statistically inferior to indoxacarb 14.5 SC & Imidacloprid 17.8 SL. The next treatments in order of effectiveness were profenofos 50 EC, thiamathoxam 25WG and acephate75SP in which 11.46, 11.57, and 13.29 per cent shoot damage was recorded, respectively. The maximum shoot damage (17.35 %) was recorded in control plot. Per cent reduction of fruit infestation was highest in imidacloprid 17.8 SL (43.17%) treated plots after 15 days of 1st insecticidal spray followed by indoxacarb 14.5 SC (40.57%) > spinosad 45 SC (35.15%) > profenofos 50 EC (33.94%) > thiamathoxam 25 WG (33.31%) > acephate 75 SP (23.40%).

Second spray (45 DAT): The second insecticidal spray was applied after 15 days of 1st spraying and data were presented in Table.1. The result showed that all the treatments were found significantly superior over control. The minimum shoot damage (10.31%) was recorded with imidacloprid 17.8 SL followed by indoxacarb 14.5 (11.87%) rest of the treatments *viz.,* profenofos 50 EC, spinosad 45 SC, thiamathoxam 25WG and acephate 75 SP in which 12.43, 13.29, 14.42, and 15.46 per cent shoot damage were recorded respectively, as compared with 19.48 percent shoot damage in control. Per cent reduction of fruit infestation was highest in imidacloprid 17.8 SL (47.07%) treated plots after 15 days of 2nd insecticidal spray followed by indoxacarb 14.5 SC (39.06%) > profenofos 50 EC (36.19%) > spinsad 45 SC (31.77%) > thiamathoxam 25 WG (25.97%) > acephate 75 SP (20.63%).

Effect on Fruit Damage:

The data on fruit infestation was recorded after 15 days of 3rd spraying which are presented in Table 2.

Third spray (60 DAT): After third insecticidal treatments all the treatments was found significantly superior over control. Among them imidacloprid 17.8 SL was most effective which gives 10.68 per cent fruit damage and it was closely at par with indoxacarb 14.5 SC and profenofos 50 EC (11.97 and 13.26 %), respectively. The other treatments *i.e.,* acephate 75 SP, thiamathoxam 25 WG , and spinosad 45 SC in which fruit damage was recorded from 13.86, 14.08 and 14.34 per cent, which are also statistically superior to control. The highest fruit damage 21.19 per cent was recorded in control plot. Per cent reduction of fruit infestation was highest in imidacloprid 17.8 SL (49.59%) treated plots after 15 days of 3rd insecticidal spray followed by indoxacarb 14.5 SC (43.51%) > profenofos 50 EC (37.42%) > acephate 75SP (34.59%) > thiamathoxam 25 WG (33.55%) > spinosad 45SC (32.33%).

Table -2. Effect of various treatments on fruit damage caused by *L. orbonalis* 75, 90 and 105 days after spraying.

Sl. No.	Common name	75 DAS		90DAS		105 DAS	
		Mean % fruit damage	% reduction over control	Mean % fruit damage	% reduction over control	Mean % fruit damage	% reduction over control
T1	Profenofos	13.26 (21.35)	37.42	11.70 (19.98)	54.43	10.39 (18.80)	62.87
T2	Indoxacarb	11.97 (20.23)	43.51	10.84 (19.20)	57.78	9.24 (17.69)	66.98
T3	Imidacloprid	10.68 (19.07)	49.59	10.31 (18.72)	59.85	8.72 (17.16)	70.56
T4	Acephate	13.86 (21.85)	34.59	15.13 (22.88)	41.08	12.01(20.27)	57.09
T5	Thiamethoxam	14.08 (22.03)	33.55	14.02 (21.31)	45.40	11.34 (19.67)	59.48
T6	Spinosad	14.34 (22.24)	32.33	12.84 (20.99)	50.00	10.84 (19.22)	61.27
T7	Control	21.19 (21.406)	-	25.68 (31.17)	-	27.99 (31.93)	-
SE(d)		0.523	-	0.895	-	0.879	-
CD @ 5%		1.139	-	1.952	-	1.916	-

(Note: figure in parenthesis are angular transformed values.)

Fourth spray (75 DAT): A quite similar trend irrespective of fruit damage was recorded after the fourth spray of insecticides. All the treatments were significantly superior over control. The data were depicted in table-2. After 15 days of fourth spraying, imidacloprid 17.8 SL gave the best performance and recorded lowest fruit damage (10.31%) as compared to other treatments whereas, indoxacarb 14.5 SC, profenofos 50 EC , spinosad 45 SC ,thimathoxam 25 WG, gives10.84, 11.70, 14.34 and 14.08 per cent fruit damage, respectively. The acephate 75 SP was found least effective (15.13%) fruit damage but it was statistically superior over control plot in managing the brinjal fruit borer damage. Here again the maximum damage of fruits was observed in control plot *i.e.,* 25.68 per cent. Per cent reduction of fruit infestation was highest in imidacloprid 17.8 SL (59.85%) treated plots after 15 days of 4th insecticidal spray followed by indoxacarb 14.5 SC (57.78%) > profenofos 50 EC (54.43%) > spinosad 45 SC (50.00%) > thiamathoxam 25 WG (45.40%) > acephate 75 SP (41.08%).

Fifth spraying (90 DAT): Fifth insecticidal spray was applied after 15 days of 4th spray and data were recorded & presented in Table.2. A similar trend was observed as in third and fourth applications of insecticides in terms of reduction in infestation of fruits. After insecticidal application, all the treatments were significantly superior over the control. The minimum fruit damage (8.72%) was recorded with imidacloprid 17.8 SL at par with indoxacarb 14.5 SC (9.24%) fruit damage whereas other treatments *viz.,* profenofos 50 EC**,** spinosad 45 SC, thiamethoxam 25 WG and acephate 75 SP with 10.39, 10.84, 11.34 and 12.01 per cent fruit damage, respectively. At the last spraying again the maximum fruit damage (25.68 per cent) was recorded in control plot. Per cent reduction of fruit infestation was highest in imidacloprid 17.8 SL (59.85%) treated plots after 15 days of 5th insecticidal spray followed by indoxacarb 14.5 SC (57.78%) > profenofos 50 EC (54.43%) > spinosad 45 SC (50.00%) > thiamathoxam 25 WG (45.40%) > acephate 75 SP (41.08%).

DISCUSSION

It is quite oblivious from the result on the effect of insecticide that all the treatments proved statistically superior over control at all the time intervals and each spray. Imidacloprid 17.8 SL proved itself most effective, which was closely followed by indoxacarb 14.5 SC and profenofos 50 EC. The effectiveness of imidacloprid and indoxacarb against *L. orbonalis* has also been reported by various workers: Bhargav *et al.* [5], reported that imidacloprid (15 to 20 g a.i. ha^{-1}) applied at 60, 75 and 90 days after transplanting against *L. orbonalis* reduced the pest population at lowest levels and also gives highest yield of healthy fruits (170.2 q ha^{-1}) in brinjal. Mishra and Dash [10] reported alternate spraying of azadirachtin 1500 ppm @ 1 lit./ha & imidacloprid @ 0.025 kg a.i. ha^{-1} in sequence at 10 to 15 days interval after 40 days of transplanting was most effective in controlling *L. orbonalis* in brinjal. These findings are also approved by Patil *et al.* [13] who reported that thiomethaxam showed the infestation of *L*. *orbonalis* (1.30%) followed by imidacloprid (1.66%) and NSKE (1.86%) in brinjal. Patra *et al.* [14] also reported that shoot as well as fruit infestation (8.89 &13.13%) of *L. orbonalis* was recorded in brinjal plots treated by indoxacarb 14.5 SC @ 50 g a.i. ha^{-1}. The highest marketable yield was recorded by indoxacarb & emamectin benzoate with 126.90 & 121.3 q ha^{-1}, respectively.

CONCLUSION

The lowest mean shoot and fruit infestation was observed after spraying with imidacloprid 17.8 sl @ 1 ml/lit., followed by indoxacarb 14.5 SC @ 1 ml/lit., whereas other treatments such as profenofos 50 EC @ 2 ml/lit., spinosad 45 SC @ 0.4 ml/lit., thiamethoxam 25% WG @ 0.1 gm/lit. and acephate 75 SP @ 0.7 gm/lit., was found superior over control.

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