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Seasonal incidence and efficacy of some insecticides against shoot and fruit borer *Leucinodes orbanalis* (Guenee) on Brinjal

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Abstract
In present investigation on seasonal incidence and efficacy of some insecticides against shoot and fruit borer on Brinjal in cultivar Banarshi round was conducted during *kharif* season 2015 in Central Research Farm, SHUATS, Naini, Prayagraj (Allahabad). The occurrence of shoot and fruit borer commenced from 34^{rd} standard week (August fourth week) on shoot with an average population of 0.87% infestation. Infestation on fruit starts in 38^{th} standard week (September third week) with an average population 4.31% infestation. The shoot and fruit borer infestation increased and gradually reached its peak level of infestation 6.21% in 41^{st} standard week (October second week) and there after declined trend was observed as temperature decreased. Shoot and fruit borer population increased with increasing maximum temperature and positively correlated with maximum temperature. Three application of seven insecticides *viz*; Emamectin benzoate 5SG (0.3g/lt), Spinosad 45 SC (0.22ml/lt), Cypermethrin 10 EC (2ml/lt), Acephate 75SP (0.5g/lt), Indoxacarb 14.5 EC (0.34ml/lt), Lambda chyalothrin 5EC (0.27ml/lt) and Delfin 5WP (0.3g/lt) were evaluated against shoot and fruit borer. Minimum percent of shoot infestation, percent fruit infestation and B:C ratio were observed in Emamectin benzoate with (6.67%, 7.02% and 1:5.67) respectively. Which are followed by Spinosad (9.71%, 8.58% and 1:5.34) <Cypermethrin (11.47%, 11.15% and 1:.4.72) <Acephate (12.45%, 12.45%, and 1:4.54) <Indoxacarb (13.57%, 14.54%, and 1:4.30) Lambda chyalothrin (15.24%, 17.87% and 1:4.24) <Delfin (18.43%, 22.45% and 1:3.81) < untreated control (water spray) (30.43%, 36.27% and 1:2.15) respectively.

Keywords: Benefit cost ratio, Incidence, Brinjal shoot and fruit borer

Introduction
Brinjal is one of the most important or summer season vegetable crops in our country. Brinjal is often infested by a plethora of insect pests among which shoot and fruit borer is the most devastating pest. The larvae tunnel inside the plant shoots or fruit and adversely affecting marketable fruit yield (Kalawate and Dethe 2012). The presence of holes and larval excreta in tunnels made in the fruit, favour the development of secondary infection by microorganisms as well as the entry of insect scavengers, resulting in fruit decay. Holes made by the first and second instar larvae partially heal up with the increase in fruit size and there will be reduction in vitamin C content to an extent of 68 percent in the infested fruits. The yield loss due to the pest is to the extent of 70-92 percent. The infested fruits become unfit for consumption due to loss of quality and hence, lose their market value (Ayyanar *et al*., 2014) [4].

Materials and Methods
The experiment was conducted during *kharif* 2015 in Central Research Farm SHUATS, Naini, Prayagraj (Allahabad). The experiment was laid out in a Randomized Block Design with eight treatments including control (untreated) in three replications. The seeds of Brinjal variety Banarashi round variety were sown in nursery. Forty five days old seedlings were transplanted in the plots measuring 2m x 1m with row to row and plant to plant distance of 0.60 m and 0.30m respectively. Observations on shoot and fruit borer on five randomly selected and tagged plants in each plot were recorded before first spray for shoot infestation and third, seven and fourteen days after second and third spray for fruit borer infestation.

Preparation of Insecticidal Spray Solution
The spay solution of a desired concentration was prepare by adopting the following formula –

$$V = \frac{C \times A}{\% \, a.i.}$$

Where
V = Volume / Weight of Commercial insecticide ml.
C = Concentration required.
A = Volume of Solution to be prepared
% a.i. = Percentage of active ingredient in commercial product.

Observation to be recorded

Seasonal incidence

The pest population observation was recorded at 7th day's interval, from the initiation of the pest infestation and was continued up to harvest. The incidence and population dynamics of shoot and fruit borer was recorded from the five randomly selected and tagged plants by correlating with weather parameter.

Efficacy of treatments

The population of shoot and fruit borer was recorded before 1st day spray and on 3rd, 7th and 14th days after insecticidal application. The populations of shoot and fruit borer was recorded on five randomly selected and tagged plants from each plot and then converted into percent of infestation by following formula:

$$\% \text{ Shoot/fruit infestation} = \frac{\text{No. of shoot/fruit infested}}{\text{Total no. of shoot/fruit}} \times 100$$

Result and Discussion

Seasonal incidence

Studies on the incidence of shoot and fruit borer population with weather parameters are given in Table 1. The occurrence of shoot and fruit borer commenced from 34th standard week (August fourth week) on shoot with an average 0.87% infestation. The borer population increased and gradually reached peak level of 6.21% of larval population at 41st standard week (October second week) and decline in the trend was noticed this may be due to fail in congenial weather parameters.

Efficacy of treatments

The data on the percent shoot infestation of first spray revealed that all the chemical treatments were significantly superior over control. Among the treatments lowest percent infestation of shoot and fruit borer was recorded in Emamectin benzoate (6.20%) which was on par with Spinosad (8.74%), Cypermethrin (10.00%), Acephate (11.68%), Indoxacarb (12.76%), Lambda cyhalothrin (14.10%) and Delfin. Delfin was least effective over all the treatments (Table 2).

These results are in support with Kaur *et al.* (2014) [10], Wankhede *et al*. (2010) [21], Kalawate and Dethe (2012) who reported that Emamectin benzoate was found to be superior in reducing the population of shoot and fruit borer. Tayde and Simon (2010) [19], Budhavat and Magar (2014) [6], Devi *et al.* (2014) [8] found that spinosad was best in controlling shoot and fruit borer. Deshmukh and Bhamare (2006) [7] also reported that cypermethrin is best in controlling the pest population of shoot and fruit borer**.** Beemrote *et al*. (2012) [5] found that Indoxacarb is superior in controlling the shoot and fruit borer.

The data on the percent fruit infestation of shoot and fruit borer on second and third spray overall mean revealed that all the treatments were significantly superior over control. Among all the treatments lowest percent infestation of fruit was recorded in Emamectin benzoate (7.02%) followed by spinosad (8.58%), Cypermethrin (11.15%), Acephate (12.45%), Indoxacarb (14.54%), Lambda cyhalothrin (17.87%) and Delfin (22.45%). Delfin was least effective over all the treatments.

These results are in support with Anil and Sharma (2010) [2], Kumar and Devappa (2006) [12] who reported that Emamectin benzoate was superior in reducing the population of shoot and fruit borer. Adiroubane and Raghuraman (2008) [1], Mainali *et al*. (2015) [14], Devi *et al*. (2014) [8] found that spinosad was best in controlling shoot and fruit borer. Tiwari *et al*. (2009) [20], Kumar *et al*. (2012) [13] also reported that cypermethrin is best in controlling the pest population of shoot and fruit borer. Koli *et al*. (2009) [11] reported that Acephate is moderately effective in controlling the shoot and fruit borer population. Saimandir *et al*. (2012) [15], Sinha *et al.* (2010) [17] also reported that Indoxacarb is effective in controlling the shoot and fruit borer.

Cost benefit ratio

The yields among the treatment were significant. The highest yield was recorded in T_1 Emamectin benzoate (260.43q/ha) followed by Spinosad (245.21q/ha), Cypermethrin (212.79q/ha), Acephate (203.66q/ha), Indoxacarb (194.76q/ha), Lambda cyhalothrin (190.33q/ha) and Delfin (184.42q/ha) as compared to control (94.32q/ha). Among the treatment studied best and most economical treatment was T_1 Emamectin benzoate (1:5.67) followed by T_2 (1:5.34), T_3 (1:4.72), T_4 (1:4.54), T_5 (1:4.30), T_6 (1:4.24), T_7 (1:3.81) as compared to control T_0 (1:2.15). The highest yield and cost benefit ratio was recorded in Emamectin benzoate (260.43q/ha, 1:5.67) (Table 2). This is supported by the reports of Anwar *et al*. (2015) [3], Shah *et al*. (2012) [16].

Table 1: Seasonal incidence of shoot and fruit borer of Brinjal during *Kharif* 2015.

Standard week	% Infestation	Temperature		Humidity		Rainfall	Wind velocity (km/hr.)	Sunshine (hr./day)
		Max.	Min.	Max.	Min.			
29	0.00	32.70	27.67	92.14	65.85	6.28	1.59	4.42
30	0.00	33.68	24.22	90.42	63.71	1.11	2.00	3.82
31	0.00	35.34	28.02	90.71	58.71	0.42	2.77	5.45
32	0.00	34.08	27.74	90.57	55.42	2.20	1.33	5.82
33	0.00	35.97	27.51	92.42	53.42	5.00	1.28	5.34
34	0.87	33.22	27.00	92.85	58.28	12.48	2.22	4.80
35	1.75	35.45	27.42	90.71	54.85	11.85	2.55	5.74
36	2.97	36.42	27.20	89.71	45.42	0.00	1.68	7.97
37	3.63	37.48	27.37	86.71	47.14	0.00	2.17	8.70
38	4.31	35.65	28.05	86.28	55.71	0.60	1.71	7.11
39	4.92	36.42	27.80	90.71	47.14	0.20	1.84	7.17

40	5.83	36.11	27.85	89.00	50.14	0.00	1.56	8.45
41	6.21	35.77	27.82	90.85	51.57	0.00	1.35	8.68
42	5.57	35.85	23.88	78.28	51.40	0.00	0.96	8.57
43	4.54	36.00	20.57	93.00	50.71	0.00	0.71	8.65
44	3.36	35.25	19.71	91.57	29.71	0.64	0.51	6.65
45	2.78	33.57	20.08	90.71	57.00	0.00	0.48	8.30
r		0.829	0.375	-0.622	-0.256	-0.630	-0.444	-0.681
t		5.739	1.566	-3.077	-1.026	-3.140	-1.917	-3.600
Results		S	NS	NS	NS	S	NS	S

Table 2: Efficacy of certain chemical insecticides against shoot and fruit borer in *kharif* season on Brinjal.

Treatments		Percent shoot Infestation (%)	Percent fruit Infestation (%)		Pooled mean	Yield (q / ha)	B : C Ratio
		1^{st} spray	2^{nd} spray	3^{rd} spray			
T_0	Control (water spray)	30.43 (33.48)*	35.19 (36.39)*	37.35 (37.67)*	36.27 (37.02)*	94.32	1:2.15
T_1	Emamectin benzoate 5 SG	6.67 (14.97)*	6.72 (15.02)*	7.31 (15.69)*	7.02 (15.35)*	260.43	1:5.67
T_2	Spinosad 45 SC	9.71 (18.16)*	8.70 (17.15)*	8.45 (16.90)*	8.58 (17.02)*	245.21	1:5.34
T_3	Cypermethrin 10EC	11.47 (19.80)*	11.37 (19.71)*	10.92 (19.30)*	11.15 (19.50)*	212.79	1:4.72
T_4	Acephate 75 SP	12.45 (20.66)*	12.39 (20.61)*	12.51 (20.71)*	12.45 (20.66)*	203.66	1:4.54
T_5	Indoxacarb14.5 EC	13.57 (21.62)*	13.70 (21.72)*	15.38 (23.09)*	14.54 (22.40)*	194.76	1:4.30
T_6	Lambda cyhalothrin 5 EC	15.24 (22.98)*	17.21 (24.51)*	18.53 (25.50)*	17.87 (25.00)*	190.33	1:4.24
T_7	Delfin 5 WP	18.43 (25.42)*	20.38 (26.84)*	24.51 (29.67)*	22.45 (28.45)*	184.42	1:3.81
F- test		S	S	S	S		
S. Ed. (±)		0.258	0.209	0.228	0.218		
C. D. (P = 0.05)		0.546	0.443	0.483	0.463		

*Figures in parenthesis are arc sin transformed values

Conclusion

The shoot and fruit borer population on Brinjal increased with maximum temperature and decreased with decline in maximum temperature during 34^{th} standard week (August fourth week) on shoot and 45^{th} standard week (November first week) on fruit. Emamectin benzoate 5SG@ 0.3gm/lt. was found to be the most effective treatment against shoot and fruit borer. It also gave the highest cost benefit ratio under the Prayagraj (Allahabad) agro climatic conditions. The present findings are limited to one crop season under Prayagraj (Allahabad) Agro climatic conditions as such more trials are required in future to validate the findings.

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