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Evaluation of different insecticide use strategies for the management of shoot and fruit borer in Brinjal

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Abstract
Field experiments for control of brinjal shoot and fruit borer (*Leucinodes orbonalis* Guene) were conducted during *kharif* season of 2014-15, 2015-16 and 2016-17. Three strategies *viz.;* sequential, rotational and ready mix strategy were evaluated. In sequential strategy the treatment consists of chlorantraniliprole 18.5 SC 37.00 g a.i./ha; emamectin benzoate 5 SG @ 12.50 g a.i./ha; spinosad 45 SC @ 112.60 g a.i./ha; chlorpyriphos 20 EC @ 200.00 g a.i./ha; cypermethrin 25 EC @ 62.50 g a.i./ha and these treatments were rotated (followed by each other) in rotational strategy; ready mix insecticide (chlorpyriphos 50% + cypermethrin 5% EC) @ 550 g a.i./ha and untreated control were evaluated. From the three years pooled data, it was observed that the rotational strategy was found effective in reducing the pest infestation which recorded least per cent shoot damage (4.98%) with least fruit damage (9.37% and 7.95%, both on number and weight basis respectively) and 355.81 q/ha marketable fruit yield of brinjal with 1:10.55 ICBR and 1:3.02 B:C ratio.

Keywords: *Leuicinodes orbonalis*, insecticide strategies, *Solanum melongena* L

1. Introduction
Brinjal or egg plant, *Solanum melongena* L. is an important solanaceous crop of sub-tropics and tropics. Although it is traditionally a summer crop but grown throughout the year under irrigated condition in our country. The crop suffers heavily due to infestation of sucking pests, *viz.;* aphids, jassids and whitefly. Similarly, shoot and fruit borer, *Leucinodes orbonalis* Guene is the serious pest of brinjal found throughout the country. Incidence of the pest has been reported in the *kharif* season to be 70-92% which is higher than in summer (Singh 1983) [7]. It is known to damage shoot and fruits of brinjal in all stages of its growth and yield loss due to pest is 92% Singh and Pandita, (2009) [8] Several pesticides have been evaluated and reported to be effective for the control of brinjal pests by different workers. Frequent and enormous use of synthetic pyrethroids, organophosphates has posed the resistance problem, resurgence of the pest (s) and health hazard (Mehrotra, 1990) [2]. Hence, keeping the point in view, the present investigation of different strategies (sequential, rotational and ready mix) were evaluated for three years for the management of shoot and fruit borer of brinjal which has prime importance

2. Materials and Methods
A field trial with eight treatments (Table 1) along with three replications were carried out in Randomized Block Design during *kharif* 2014, 2015 and 2016 at All India Coordinated Research Project on Vegetable Crops, at MPKV., Rahuri for the management of shoot and fruit borer of brinjal. Cv. Krishna hybrid was transplanted every year in the month of August in a plot size of 4.50 × 3.60 m. with plant spacing of 75 × 75 cm. Each insecticidal treatment from sequential strategy and mixture strategy were applied at five times. Whereas, from rotational strategy each insecticide was applied sequentially one after another by using 500 lit of water per hector with the help of hand operated knapsack sprayer. The treatments illustrated in (Table-1). The evaluated performance of each treatment was assessed by recording infested shoots along with total shoots. Whereas, fruit borer infestation was assessed by recording total number of healthy and infested fruits on number and weight basis. Total ten pickings were made and yield was recorded per plot then it was converted to quintal/hector. The data on per cent fruit damage was transformed to arc sin values and statistical analysis was done by following Panse and Sukhatme (1989) [3].

3. Results and Discussion

The pooled results of three years, presented in (Table 3) revealed that, all the insecticidal treatments were found significantly superior over untreated control in reducing infestation of shoot damage and fruit borer damage in fruits on number as well as weight basis and obtaining good marketable yield of brinjal fruits.

(A) Shoot damage: The treatment (T_6) Rotational strategy, recorded least per cent shoot damage (4.98%) as against (21.23%) in untreated control. However, the treatments with chlorantraniliprole 18.5 SC @ 37.00 g a.i./ha and spinosad 45 SC @ 112.60 g a.i./ha from sequential strategy were found at par with this treatment and observed the shoot damage 5.55 and 5.63%; respectively.

(B) Fruit borer: The treatment (T_6) Rotational strategy, also recorded lowest per cent fruit damage (9.37%) on number basis and (7.95%) on weight basis as against (32.05 and 31.11) per cent in untreated control respectively. However, this treatment was also found at par with the treatments of chlorantraniliprole 18.5 SC @ 37.00 g a.i./ha and spinosad 45 SC @ 112.60 g a.i./ha, from sequential strategy and recorded the fruit damage in the range (9.97-10.33%) on number and (8.53-9.26%) on weight basis, respectively.

(C) Yield: In respect of yield, the treatment with Rotational strategy also recorded maximum marketable fruit yield of brinjal (355.81 q/ha) as against (234.16/q) in untreated control with 1:10.55 ICBR and B:C ratio 1:3.02. Whereas, the treatments chlorantraniliprole 18.5 SC @ 37.00 g a.i./ha and spinosad 45 SC @ 112.60 g a.i./ha from sequential strategy also found at par with this treatment and recorded (352.17 and 350.70 q/ha) yield of brinjal; respectively with 1:6.79 and 1:5.47 ICBR, also B:C ratio 1:2.85 and 1:2.75,respectively.

Table 1: Evaluation of different insecticide use strategies for the management of shoot and fruit borer in brinjal

Sr. No.	Treatments	2014-15					2015-16				
		Av.% shoot damage	Av.% fruit damage		Yield (q/ha)	ICBR	Av.% shoot damage	Av.% fruit damage		Yield (q/ha)	ICBR
			Number basis	Weight basis				Number basis	Weight basis		
1	Chlorantraniliprole 18.5 SC @ 37.00 g a.i./ha	4.89 (12.77)*	10.00 (18.42)	8.60 (17.01)	346.32	1:6.61	5.77 (13.89)	9.70 (18.11)	8.00 (16.41)	352.02	1:6.62
2	Emamectin benzoate 5S G @ 12.50 g a.i./ha	6.32 (14.55)	12.40 (20.61)	11.50 (19.80)	320.00	1:7.59	7.13 (15.48)	13.00 (21.12)	12.10 (20.35)	317.98	1:6.86
3	Spinosad 45 SC @ 112.60 g a.i./ha	5.10 (13.04)	10.40 (18.81)	9.47 (17.91)	344.84	1:5.28	6.00 (14.15)	10.00 (18.42)	8.67 (17.10)	350.61	1:5.33
4	Chlorpyriphos 20 EC @ 200.00 g a.i./ha	7.15 (15.50)	15.22 (22.95)	14.20 (22.12)	317.78	1:22.30	8.10 (16.53)	16.00 (23.57)	15.40 (23.07)	315.76	1:20.09
5	Cypermethrin 25 EC @ 62.50 g a.i./ha	6.87 (15.16)	13.00 (21.12)	12.57 (20.76)	289.63	1:18.27	7.20 (13.55)	14.13 (22.08)	13.17 (21.27)	291.60	1:16.83
6	Chlorantraniliprole 18.5 SC @ 37.00 g a.i./ha followed by Emamectin benzoate 5S G @ 12.50 g a.i./ha; Spinosad 45 SC @ 112.60 g a.i./ha chlorpyriphos 20 EC @ 200.00 g a.i./ha; cypermethrin 25 EC @ 62.50 g a.i./ha.	4.30 (11.93)	9.20 (17.65)	8.10 (16.51)	350.37	1:10.40	5.17 (13.11)	8.93 (17.38)	7.80 (16.21)	355.20	1:10.25
7	Chlorpyriphos 50% + cypermethrin 5% EC @ 550 g a.i./ha (ready mix)	5.80 (13.91)	11.60 (19.89)	10.12 (18.50)	323.70	1:17.22	6.30 (14.52)	12.00 (20.26)	10.53 (18.93)	319.90	1:15.29
8	Untreated Control	20.00 (26.56)	30.17 (33.31)	29.50 (32.89)	230.37	--	22.00 (27.97)	32.00 (34.45)	31.40 (34.07)	237.02	--
	S.E.±	0.50	0.61	0.67	3.85	--	0.41	0.55	0.59	5.03	--
	C.D. at 5%	1.51	1.85	2.02	11.78	--	1.26	1.67	1.78	15.32	--

* Figures in parentheses are arcsin transformed values

Table 2: Evaluation of different insecticide use strategies for the management of shoot and fruit borer in brinjal.

Sr. No.	Treatments	2016-17				
		Av.% shoot damage	Av.% fruit damage		Yield (q/ha)	ICBR
			Number basis	Weight basis		
1	Chlorantraniliprole 18.5 SC @ 37.00 g a.i./ha	6.00 (14.15)	10.20 (18.61)	9.00 (17.44)	358.16	1:7.08
2	Emamectin benzoate 5S G @ 12.50 g a.i./ha	7.42 (15.77)	12.60 (20.79)	11.82 (20.01)	321.90	1:7.28
3	Spinosad 45 SC @ 112.60 g a.i./ha	5.80 (13.93)	10.60 (19.00)	9.65 (18.10)	356.68	1:5.70
4	Chlorpyriphos 20 EC @ 200.00 g a.i./ha	8.40 (16.84)	14.40 (22.90)	13.15 (21.25)	319.16	1:21.44

5	Cypermethrin 25 EC @ 62.50 g a.i./ha (4 sprays)	7.73 (16.09)	13.20 (21.29)	12.87 (21.00)	292.08	1:17.57
6	Chlorantraniliprole 18.5 SC @ 37.00 g a.i./ha followed by Emamectin benzoate 5S G @ 12.50 g a.i./ha; spinosad 45 SC @ 112.60 g a.i./ha chlorpyriphos 20 EC @ 200.00 g a.i./ha; cypermethrin 25 EC @ 62.50 g a.i./ha.	5.47 (13.51)	10.00 (18.42)	7.95 (16.36)	361.86	1:10.99
7	Chlorpyriphos 50% + cypermethrin 5% EC @ 550 g a.i./ha (ready mix)	6.75 (15.05)	11.87 (20.14)	10.83 (19.21)	323.90	1:16.38
8	Untreated Control	21.70 (27.76)	34.00 (35.67)	32.40 (34.69)	235.10	--
	S.E.±	0.61	0.47	0.48	4.22	--
	C.D. at 5%	1.85	1.42	1.47	12.73	--

* Figures in parentheses are arcsin transformed values

Table 3: Evaluation of different insecticide use strategies for the management of shoot and fruit borer in brinjal

Sr. No.	Treatments	Pooled of three years (2014-15 – 2016-17)					
		Av.% shoot damage	Av.% fruit damage		Yield (q/ha)	ICBR	B:C ratio
			Number basis	Weight basis			
1	Chlorantraniliprole 18.5 SC @ 37.00 g a.i./ha	5.55 (13.60)	9.97 (18.38)	8.53 (16.95)	352.17	1:6.79	1:2.85
2	Emamectin benzoate 5S G @ 12.50 g a.i./ha	6.96 (15.27)	12.67 (20.84)	11.80 (20.05)	319.96	1:7.27	1:2.71
3	Spinosad 45 SC @ 112.60 g a.i./ha	5.63 (13.71)	10.33 (18.72)	9.26 (17.30)	350.70	1:5.47	1:2.75
4	Chlorpyriphos 20 EC @ 200.00 g a.i./ha	7.88 (16.29)	15.20 (22.95)	14.25 (22.15)	317.57	1:21.28	1:2.88
5	Cypermethrin 25 EC @ 62.50 g a.i./ha	7.27 (15.64)	13.44 (21.50)	12.87 (21.01)	291.10	1:17.57	1:2.66
6	Chlorantraniliprole 18.5 SC @ 37.00 g a.i./ha followed by Emamectin benzoate 5S G @ 12.50 g a.i./ha; spinosad 45 SC @ 112.60 g a.i./ha chlorpyriphos 20 EC @ 200.00 g a.i./ha; cypermethrin 25 EC @ 62.50 g a.i./ha.	4.98 (12.85)	9.37 (17.82)	7.95 (16.36)	355.81	1:10.55	1:3.02
7	Chlorpyriphos 50% + cypermethrin 5% EC @ 550 g a.i./ha (combination product)	6.28 (14.49)	11.82 (20.10)	10.49 (18.88)	322.50	1:16.30	1:2.89
8	Untreated Control	21.23 (27.43)	32.05 (34.48)	31.11 (33.88)	234.16	--	--
	S.E.±	0.32	0.30	0.33	1.71	--	--
	C.D. at 5%	0.95	0.93	1.00	5.20	--	--

* Figures in parentheses are arcsin transformed values

Pawar *et.al.*, (1987) [5] and Sharma *et.al.*, (2016) [6] have reported effectiveness of synthetic pyrethroids viz; deltametherin @ 10 g a.i./ha and cypermethrin @ 30 g a.i./ha for shoot and fruit borer in brinjal. Sinha and Nath (2012) [9] observed that profonophos @ 0.1% and spinosad @ 0.01% were most effective in reduction of shoot infestation of *L. orbonalis*. Wankhede and Kale (2010) [11] revealed that emamectin benzoate 5 SG showed moderate level of efficacy providing 62.8% reduction of brinjal shoot and fruit boer population over control.

Whereas, deltamethrin 1% + triazophos 35% (ready mix insecticide) has not been reported so far against shoot and fruit borer of brinjal, earlier it was found most effective against bollmorm complex of cotton (Dhawan *et.al.* 1991; Pawar and Mali, 1997) [1, 5]. However, Walunj *et.al.*, (1998)[10] reported deltamethrin 1% + triazophos 35% @ 450 g a.i./ha to be significantly superior and observed least fruit damage with higher yields of brinjal fruits. The results of present findings, the rotational strategy is comparable with earlier reports of synthetic pyrethroids and organophosphate compounds.

4. Conclusion

The present study envisaged the usage of rotational strategy Chlorantraniliprole 18.5 SC @ 37.00 g a.i./ha followed by Emamectin benzoate 5S G @ 12.50 g a.i./ha; Spinosad 45 SC @ 112.60 g a.i./ha chlorpyriphos 20 EC @ 200.00 g a.i./ha; cypermethrin 25 EC @ 62.50 g a.i./ha. which found effective for control of shoot and fruit borer with good marketable yield of brinjal fruits (355.81 q/ha) with 1:10.55 ICBR and B:C ratio 1:3.02.

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