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RESEARCH PAPER

Bio-efficacy of newer molecules against pod borer complex of Indian bean, *Lablab purpureus* (L.) Sweet

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Abstract : The bioefficacy of six newer insecticides molecules was evaluated against pod borer complex in Indian bean crop revealed that the treatment of spinosad (0.01%) proved most effective followed by indoxacarb (0.01%). The treatments of endosulfan (0.05%), cartap (0.10%) and malathion (0.05%) were existed in moderately effective group, however, the treatment of *Neem* oil (0.5%) was proved least effective. The order of effectiveness of insecticides against prod borer complex was : spinosad > indoxacarb > endosulfan > cartap > malathion > *Neem* oil.

Key Words : *Lablab purpureus*, Pod borer, Insecticides

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INTRODUCTION

The Indian bean, *Lablab purpureus* (L.) Sweet (Family : Fabaceae) originated from India and its wild form are found all over the sub-continent. It is a perennial twining or creeping rainy season herb that is generally cultivated as annual. The mature and dark coloured seeds of Indian bean have trypsin inhibitor (Butani and Jotwani, 1984). Insect-pests are one of the major limiting factors for production of Indian bean. The crop is attacked by as many as 55 species of insects and mites, among them, the pod borers are considered to be the most important group causing crop loss to the tune of 80 to 100 per cent (Katagihallimath and Siddappaji, 1962). The pod borer complex include avare pod borer, *Adisura atkinsoni* (Moore); gram pod borer, *Helicoverpa armigera* Hubner; spotted pod borer, *Maruca testulalis* Geyer; bean pod borer moth / pea pod borer, *Etiella zinckenella* Treitschke; soybean pod borer, *Lampiodes boeticus* L. and black cowpea seed moth, *Cydia ptychora* Meyrick. These borer causes substantial damage to flowers by webbing and boring into the pods.

MATERIAL AND METHODS

The experiment was laid out in a simple Randomized Block Design (RBD) with seven treatments (insecticides) including untreated control, each replicated four times. The plot size was 1.8 x 1.5 m^2 keeping of row to row and plant to plant distance of 60 and 30 cm, respectively.

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Table A : Details of insecticides used

Sr. No.	Insecticides	Formulation	Concentration (%) / dosage
1.	Indoxacarb	14.5 EC	0.01
2.	*Neem* oil*	-	0.50
3.	Spinosad	45 SC	0.01
4.	Cartap	50 SP	0.10
5.	Endosulfan	35 EC	0.05
6.	Malathion	50 EC	0.05
7.	Untreated check	-	-

* = *Neem* oil spray solution was made with 50 ml of *Neem* excel ® + 10 g of soap nut powered sachet/loose or any suitable emsulsifer + 10 litres of water (Mix well in the knapsack sprayer and spray on the target site)

A distance of 1.0 m, was kept between the plots to avoid the drift of insecticides. The Indian bean cv LOCAL-1-1 was used for the experiment, sown on 20, July 2009. The recommended package of practices was followed to raise the crop.

All the treatments were applied as foliar spray by using pre-calibrated knapsack sprayer. Total three spray were applied at 15 days interval starting from sufficient infestation observed.

Observations :

The pod infestation of borers were recorded one day before treatment and subsequent observations were made at weekly pickings. The damage due to pod borer complex was recorded by observing bored pods (hole made by borers) as well as healthy pods (no holes). These observations were recorded on five ear marked plants per plot. The avoidable losses and increase in yield of fruits over control was calculated for each treatment by using the following formula :

$$\text{Avoidable losses (\%)} = \frac{\text{Highest yield in the treated plot} - \text{Yield in the treatment}}{\text{Highest yield in the treated plot}} \times 100$$

$$\text{Increase in yield (\%)} = \frac{\text{Yield in the treatment} - \text{Yield in control}}{\text{Yield in control}} \times 100$$

This formula did not give the exact losses / increase in yield because even in the best treatment, some damage occurred. However, this is considered to be the most feasible method for working out the percentage loss due to the insect pests in any treatment (Pradhan, 1964).

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

First spray :

The data presented in Table 2 and 3 revealed that after one week of first spray all the treatments were found significantly superior over control against pod borer complex on Indian bean based on pod damage both number and weight basis. The treatment of spinosad proved most effective with minimum pod infestation (3.49 on number and 3.39 on weight basis) followed by indoxacarb (3.70 and 3.62%)and both were statistically at par in their efficacy. The next effective treatments were endosulfan (4.80 and 4.66%), cartap (4.99 and 4.90%) and malathion (5.18 and 5.09%). However, all these were comparable to each other. The treatment of *Neem* oil (6.69 and 6.60%) proved least effective. Similarly, after two weeks of first spray the treatment of spinosad (6.45 and 6.36%) were statistically at par with indoxacarp (6.80 and 6.69%). The treatment of endosulfan (8.58 and 8.50%), cartap (9.10 and 9.01%) and malathion (9.18 and 9.10%) were observed in middle order with respect to bioefficacy against pod borer complex of Indian bean. However, these were comparable to each other and moderate in their efficacy. *Neem* oil (11.56 and 11.48%) stood significantly inferior over rest of the treatment.

Second spray :

The data presented in Table 2 and 3 revealed all the treatments were found significantly superior over control. The treatment of spinosad was found most effective resulted in minimum pod infestation (4.01 and 3.90%, respectively) followed by indoxacarb (4.12 and 4.03%, respectively), however, both were comparable to each other. The treatment of endosulfan (5.42 and 5.30%, respectively), cartap (5.59 and 5.51%, respectively) and malathion (6.02 and 5.91%,

respectively) ranked next best group of insecticides. The treatment of *Neem* oil (7.75 and 7.66%, respectively) proved significantly inferior over rest of the treatments. All the treatments were also found significantly superior over control after two weeks of second spray. The treatment of spinosad (7.50 and 7.41%, respectively) was found most effective followed by indoxacarb and resulted in 7.87 and 7.77 per cent pod damage and both were statistically at par. The next effective treatment was endosulfan (10.11 and 9.98%, respectively) and stood statistically at par with cartap (10.56 and 10.45%, respectively) and malathion (10.66 and 10.56%, respectively). The treatment of *Neem* oil (13.45 and 13.36%, respectively) was found to be least effective.

Third spray :

After one week of third spray all the treatments were found significantly superior over the control. The treatment of spinosad (2.60 and 2.51%) proved most effective which was statistically at par with indoxacarb (2.99 and 2.89%). The treatments of endosulfan (3.87 and 3.79%), cartap (4.32 and 4.27%) and malathion (4.98 and 4.59%) ranked second best group of insecticides and were moderate in their efficacy. The treatment of *Neem* oil (6.96 and 6.87%) was least effective treatment. similar trend of pod damage was also observed after

Table 1 : Effect of tested insecticides against pod borer complex on pod yield of Indian bean in 2009

Sr. No.	Insecticides	Formulations	Conc. (%) / dosages	Mean pod yield (q ha^{-1})*
1.	Indoxacarb	14.5 SC	0.01	75.25
2.	*Neem* oil	-	0.5	55.37
3.	Spinosad	45 SC	0.01	78.67
4.	Cartap	50 SP	0.10	66.50
5.	Endosulfan	35 EC	0.05	71.57
6.	Malathion	50 EC	0.05	62.82
7.	Control	-	-	45.58
	S.E.±	-	-	1.64
	C.D. (P=0.05)	-	-	4.88

* Mean of four replications

Table 2: Bio-efficacy of newer molecules against pod borer complex on Indian bean cv. LOCAL-1-1 in 2009 (Number basis)

Sr. No.	Treatments	Conc. (%) / dosages	Per cent pod infestation* days after spray								
			First spray			Second spray			Third spray		
			One week	Second week	Mean	One week	Second week	Mean	One week	Second week	Mean
1.	Indoxacarb 14.5 SC	0.01	3.70	6.80	5.25	4.12	7.87	5.97	2.99	3.98	3.48
			(11.09)**	(15.12)		(11.71)	(16.29)		(9.96)	(11.51)	
2.	*Neem* oil	0.5	6.69	11.56	8.26	7.75	13.45	10.60	6.96	7.85	7.40
			(14.99)	(19.88)		(16.16)	(21.51)		(15.30)	(16.27)	
3.	Spinosad 45 SC	0.01	3.49	6.45	4.97	4.01	7.50	5.75	2.60	3.62	3.11
			(10.77)	(14.71)		(11.55)	(15.89)		(9.28)	(10.97)	
4.	Cartap 50 SP	0.10	4.99	9.10	7.04	5.59	10.56	8.07	4.32	5.60	4.96
			(12.91)	(17.56)		(13.68)	(18.96)		(11.96)	(13.68)	
5.	Endosulfan 35 EC	0.05	4.80	8.58	6.75	5.42	10.11	7.76	3.87	4.98	4.42
			(12.66)	(17.03)		(13.46)	(18.54)		(11.43)	(12.89)	
6.	Malathion 50 EC	0.05	5.18	9.18	7.23	6.02	10.66	8.34	4.98	5.95	5.46
			(13.15)	(17.73)		(14.20)	(19.05)		(12.89)	(14.12)	
7.	Control	-	11.29	14.89	13.09	17.06	23.93	20.49	24.14	18.23	21.85
			(19.63)	(22.70)		(24.39)	(29.29)		(29.43)	(25.27)	
	S.E.±		0.53	0.64		0.63	0.78		0.68	0.63	
	C.D. (P=0.05)		1.57	1.92		1.87	2.33		2.04	1.90	

* Per cent pod infestation of four replications ** Figures in parentheses are angular transformed values

two weeks of third spray. The treatment of spinosad (3.62 and 3.51%) followed by indoxacarb (3.98 and 3.89%) and both were comparable to each other. The next group of effective treatments was endosuflan (4.98 and 4.89%) followed by cartap (5.60 and 5.52%) and malathion (5.95 and 5.87%). The treatment of *Neem* oil (7.85 and 7.73%) proved significantly inferior over rest of the treatments.

The mean data of three spray for the control of pod borers on Indian bean crop on the basis of per cent pod damage revealed that the treatment of spinosad was found most effective followed by indoxcarb. The present results are in agreement with that of Rekha and Mallapur (2007); Mallikarjuna *et al.* (2009) and Kulheri *et al.* (2009) who found spinosad as highly effective against pod borers.

Effect of tested insecticides on pod yield of Indian bean :

The data presented in Table 1 revealed that all the plots treated with different insecticides gave significantly higher pod yield over control. The maximum pod yield of 78.67 q ha^{-1} was obtained from the plots treated with spinosad followed by indoxacarb 75.25 q ha^{-1}. The next best treatment was endosulfan 71.57 q ha^{-1} followed by cartap and malathion with 66.50 and 62.82 q ha^{-1} pod yield, respectively. The minimum pod yield of 55.37 q ha^{-1} was obtained from the plots treated with *Neem* oil.

Table 3 : Bio-efficacy of newer molecules against pod borer complex on Indian bean cv. LOCAL-1-1 in 2009 (Weight basis)

Sr. No.	Treatments	Conc. (%) / dosages	Per cent pod infestation* days after spray								
			First spray			Second spray			Third spray		
			One week	Second week	Mean	One week	Second week	Mean	One week	Second week	Mean
1.	Indoxacarb 14.5 SC	0.01	3.62	6.69	5.15	4.03	7.77	5.90	2.89	3.89	3.39
			(10.97)**	(14.99)		(11.58)	(16.18)		(9.79)	(11.37)	
2.	*Neem* oil	0.5	6.60	11.48	9.04	7.66	13.36	10.51	6.87	7.77	7.30
			(14.89)	(19.80)		(16.07)	(21.44)		(15.19)	(16.14)	
3.	Spinosad 45 SC	0.01	3,39	6.36	4.87	3.90	7.41	5.65	2.51	3.51	3.02
			(10.61)	(14.61)		(11.39)	(15.80)		(9.11)	(10.80)	
4.	Cartap 50 SP	0.10	4.90	9.01	6.95	5.51	10.45	7.98	4.27	5.52	4.89
			(12.79)	(17.47)		(13.57)	(18.86)		(11.92)	(13.59)	
5.	Endosulfan 35 EC	0.05	4.66	8.50	6.58	5.30	9.98	7.64	3.79	4.89	4.34
			(12.46)	(16.95)		(13.30)	(18.41)		(11.22)	(12.77)	
6.	Malathion 50 EC	0.05	5.09	9.10	7.09	5.91	10.56	8.23	4.89	5.87	5.38
			(13.04)	(17.56)		(14.07)	(18.96)		(12.77)	(14.02)	
7.	Control	-	11.20	14.78	12.99	16.95	23.84	20.39	24.06	18.14	21.10
			(19.55)	(22.61)		(24.31)	(29.23)		(29.37)	(25.21)	
	S.E.±		0.50	0.62		0.61	0.75		0.65	0.60	
	C.D. (P=0.05)		1.49	1.84		1.80	2.23		1.95	1.81	

* Per cent pod infestation of four replications ** Figures in parentheses are angular transformed values

Table 4 : Assessment of avoidable losses caused by pod borer complex on Indian bean cv. LOCAL-1-1 in 2009

Sr. No.	Treatments	Conc. (%) / dosages	Yield of healthy pods (q ha^{-1})	Total avoidable loss (q ha^{-1})	Per cent avoidable loss	Total increase in yield over control (q ha^{-1})	Per cent increase in yield over control
1.	Indoxacarb 14.5 SC	0.01	75.25	3.42	4.35	29.67	65.09
2.	*Neem* oil	0.5	55.37	23.30	29.62	9.79	21.48
3.	Spinosad 45 SC	0.01	78.67	0.00	0.00	33.09	72.60
4.	Cartap 50 SP	0.10	66.50	12.17	15.47	20.92	45.90
5.	Endosulfan 35 EC	0.05	71.57	7.10	9.03	25.99	57.02
6.	Malathion 50 EC	0.05	62.82	15.85	20.15	17.24	37.82
7.	Control	-	45.58	33.09	42.06	0.00	0.00

The present finding get support from the observations of Rekha (2006) and Rekha and Mallapur (2007) who found higher yield from the plots treated with spinosad and indoxacarb.

Assessment of losses and increase in pod yield :

In crop season the treatment of spinosad was found most effective in protecting the Indian bean crop as such avoidable losses in the treatment was taken zero (Table 4). Taking this plot as completely protected and untreated control as unprotected, the per cent avoidable losses was computed as 42.06. In the treatment of indoxacarb and endosulfan the total avoidable losses were 3.42 and 7.10 q ha^{-1} and per cent avoidable losses were 4.35 and 9.03, respectively. The treatments of cartap and malathion had total avoidable losses of 12.17 and 15.85 q ha^{-1} and per cent avoidable losses of 15.47 and 20.15, respectively. The maximum total avoidable losses 33.09 q ha^{-1} and per cent avoidable losses (42.06) were recorded from control plot followed by *Neem* oil in which total avoidable losses were 23.30 q ha^{-1} and per cent avoidable losses were 29.62.

The maximum increase in yield over control was recorded from the plots treated with spinosad in which total increase in yield over control was 33.09 q ha^{-1} and per cent increase in yield over control was 72.60 and was followed by indoxacarb and endosulfan where total increase in yield over control was 29.67 and 25.99 q ha^{-1} and per cent increases in yield over control was 65.09 and 57.02, respectively. The total increase in yield over control and per cent increase in yield over control in the treatment of cartap and malathion were 20.92 and 17.24 q ha^{-1} and 45.90 and 37.82 per cent, respectively. The minimum total increase in yield over control (9.79 q ha^{-1}) and per cent increase in yield over control (21.48) was recorded from the plots treated with *Neem* oil.

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