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Hari Krishna
Department of Entomology, NDUA&T Kumarganj, Faizabad Uttar Pradesh, India

AK Singh
Department of Entomology, NDUA&T Kumarganj, Faizabad Uttar Pradesh, India

Pankaj Kumar
Department of Entomology, NDUA&T Kumarganj, Faizabad Uttar Pradesh, India

Suraj Kumar
Department of Entomology, NDUA&T Kumarganj, Faizabad Uttar Pradesh, India

Correspondence
AK Singh
Department of Entomology, NDUA&T Kumarganj, Faizabad Uttar Pradesh, India

Management of pod borer complex in field pea using combinations of botanicals and insecticides

Hari Krishna, AK Singh, Pankaj Kumar and Suraj Kumar

Abstract
Among the various insecticides evaluated against pod borer complex in field pea, Neem soap 5% + Rynaxypyr 20 SC @ 25 g a.i. ha^{-1} treated plot showed 100 per cent reduction in larval population and gave the highest crop yield of 19.55 q/ha. The efficacy of treatments in order of superiority were Neem soap 5% + Rynaxypyr 20 SC @ 25 g a.i./ha > Neem soap 5% + Indoxacarb 14.5 SC @ 60 g a.i./ha > Neem soap 5% + Indoxacarb 14.5 SC @ 50 g a.i./ha > Neem soap 5% + Rynaxypyr 20 SC @ 20 g a.i./ha > Neem soap 5% + Emamectin benzoate 5 SG @ 10 g a.i./ha > Neem soap 5% + Emamectin benzoate 5 SG @ 7 g a.i./ha > Neem soap 5% @ 5 ml/l water. The maximum Cost: Benefit ratio of 1: 15.56 was obtained from Neem soap 5% + Rynaxypyr 20 SC @ 25 g a.i./ha.

Keywords: Field pea, pod borer complex, botanicals

Introduction
In India during 2017 the field pea was grown on an area of 0.90 m ha with production of 0.74 m tonnes and productivity of 8.21 q/ha. In Uttar Pradesh during the year 2017 the total area under pea cultivation was 0.286 m ha, production 0.285 m tonnes and productivity of 9.97 q /ha (Anonymous, 2017) [1]. The productivity of pea is low as compared to cereals. One of the main reasons for the low yield is attack by many insect-pests at various stages of the crop. The crop has been recorded to harbour a large number of insect-pests of which *Agrotis* spp. *Plusia aurichalcea*, *Autographa nigrisigna*, *Ophiomyia phaseoli*, *Chromatomyia horticola*, *Aphis craccivora*, *Acyrthosiphum pisum*, *Etiella zinckenella*, and *Helicoverpa armigera* are noteworthy The crop is attacked by many insect-pests among which pea pod borer and stem fly are serious pests in Uttar Pradesh (David and Ramamurthy) [4] Bijjur and Verma (1997) [3] reported 57 species of insects attacking pea crop with an annual monetary loss of 540 million Indian Rupees. Pea pod borer is a major pest of field pea causing as high as 50.9% pod infestation with 77.64% seed damage resulting in 23.9% loss in the grain yield (Bachatly and Malak) [2]. Yadav and Chauhan (2000) [9] observed that *Etiella zinckenella* caused 3.5% to 30.8% pod damage in pea crop in Uttar Pradesh alone. It is distributed throughout India with particular reference to Uttar Pradesh, Bihar, Madhya Pradesh and Punjab (Mathur and Upadhyay, 2006) [6].
I such situation information on the damage dynamics of pod borer causing economic damage and application of chemicals against the pest was necessary. Keeping in view of aforesaid facts and knowing the seriousness of problem, the present study was undertaken to manage the pod borer complex in field pea using combinations of botanicals and insecticides.

Materials and Methods
Experiment was conducted at Students' Instructional Farm of NDUA&T Kumarganj, Faizabad during *Rabi* 2017-18 using variety Rachna in Randomized Block Design in 20 m^2 plot size with three replications. Spacing of 30 cm between row to row and 10 cm between plant to plant were maintained. All agronomical practices were adopted to raise a good crop. Larval population of pod borer complex were recorded at weekly intervals on 5 randomly selected plants/plot starting with 50% flowering till harvest. The spray of treatments were applied as and when infestation reached at ETL i.e. 1.5 larvae/ m row length. In addition the seed yield was recorded after harvest of the crop. The cost effectiveness was determined by working out cost: benefit ratio. The statistical analyses of data were performed for analysis of variance as outlined by Panse and Sukhatme (1978) [7].

From the above analysis, standard error of mean (SEm±) as well as, critical difference was calculated at 5% level of probability calculated to test the significance of mean for the treatment differences.

Results and Discussion

The data on the effect of various treatments on the larval population of pod borer complex presented in Table-1 indicated that the larval population was homogenously distributed throughout experimental plots before the application of treatments. All treatments were significantly superior over the control when observations were made on first day after treatments. Neem soap 5% + Rynaxypyr 20 SC @ 25g a.i. / ha (T_4) and Neem soap 5% + Indoxacarb 14.5 SC @ 60 g a.i. /ha (T_6) showed maximum reduction (75.00%) in larval population and were significantly superior over other treatments followed by Neem soap 5%+ Emamectin benzoate 5 SG @ 7g a.i. / ha (T_1), Neem soap 5% + Rynaxypyr 20 SC @ 20 g a.i. /ha (T_3), Neem soap 5% + Indoxacarb 14.5 SC @ 50 g a.i. /ha (T_5) and Neem soap 5% @ 50 ml/ L (T_7) water in which reduction of larval population was 25.00 % Neem soap 5% + Emamectin benzoate 5 SG @ 10g a.i. / ha (T_2) was found least effective in which no reduction of larval population was found. Data recorded 3 days after spray revealed that all treatments were effective and significantly superior over control. Maximum reduction of 100.00 per cent in larval population was obtained in Neem soap 5% + Rynaxypyr 20 SC @ 25g a.i. / ha (T_4) and it was significantly superior over the remaining treatments. The next effective treatments were Neem soap 5% + Emamectin benzoate 5 SG @ 7g a.i / ha (T_l), Neem soap 5% + Emamectin benzoate 5 SG @ 10 g a.i. /ha (T_2), Neem soap 5% + Rynaxypyr 20 SC @ 20 g a.i. /ha (T_3), Neem soap 5% + mdoxacarb 14.5 SC @ 50 g a.i. lha (T_5) and Neem soap 5% + lndoxacarb 14.5 SC @ 60 g a.i. /ha (T_6) in which larval population reduction was 77.77 per cent. Treatment T_7 (Neem soap 5% @ 50 ml/ L water) was found least effective with 66.66 per cent reduction in larval population. Data recorded 7 days after spray revealed that Neem soap 5% + Emamectin benzoate 5 SG @ 10g a.i. / ha (T_2), Neem soap 5% + Rynaxypyr 20 SC @ 20 g a.i. lha (T_3), Neem soap 5% + Rynaxypyr 20 SC @ 25 g a.i. /ha (T_4), Neem soap 5% + Indoxacarb 14.5 SC @ 50 g a.i. lha (T_5) and Neem soap 5% + Indoxacarb 14.5 SC @ 60 g a.i. /ha (T_6) were again the most effective treatments with 100.00 per cent population reduction and were significantly superior over the remaining treatments. It was followed by T_1 (Neem soap 5% + Emamectin benzoate 5 SG @ 7 g a.i. /ha) in which 83.33 per cent reduction in larval population was found. Neem soap 5% (T7) @ 50 m1/ L water was the least effective treatment with 75.00 per cent reduction in larval population. All treatments produced significantly higher yield than untreated check. Neem soap 5% + Rynaxypyr 20 SC @ 25g a.i. / ha (T_4) produced maximum yield of 19.55 q/ha and was at par with Neem soap 5% + Indoxacarb 14.5 SC @ 60 g a.i. /ha (T_6). Treatments Neem soap 5% + Indoxacarb 14.5 SC @ 50 g a.i. /ha (T_5), Neem soap 5% + Rynaxypyr 20 SC @ 20g a.i. / ha (T_3) and produced respectively 18.65, 17.92 and 17.74 q/ha gain yield and were at par with each other. Treatment T_2 (Neem soap 5% + Emamectin benzoate 5 SG @ 10g a.i. / ha) and T_1 (Neem soap 5% + Emamectin benzoate 5 SG @ 7 g a.i. /ha) with respectively yield of 16.84 and 15.93 at par with each other. The present findings are in accordance with the findings of Yadav *et al.*, (2001 a) [10] who found that the Rynaxypyr treated plot recorded lowest pod damage of 3.11 per cent and 3.67 per cent after 7 and 14 days of treatment on pea. The present findings are in partial agreement with the findings of Dhaka *et al.*, (2011 b) [5] who found that the Indoxacarb had the comparable lower number of larvae as well as pod borer and seed infestation. Table- 2 present findings are also in accordance with the findings of Rekha and Mallapur (2007) [8] who found Emamectin benzoate as the best treatment for the contol of *Etiella zinckenella* in *Lublub purpureus* crop. However, in the present study Emamectin benzoate 5 SG @ 10 g a.i. /ha along with 5% Neem soap was at par with Rynaxypyr 20 SC @ 25g a.i. / ha which was the best treatment. The effect of different treatments on the seed yield by using the chemicals in the present investigation has not been studied by other workers and hence the result could not be compared.

Table 1: Efficacy of management using combination of botanicals and insecticides against pod borer complex:

T. No.	Treatments	Dosage	Larval population/10 plants				% reduction in larval population (DAS)		
			Before one day of spray	After 1 day of spray	After 3 days of spray	After 7 days of spray	1	3	7
T1	Neem soap 5% + Emamectin benzoate 5 SG	7 g a.i./ha	1.50	1.50 (1.41)	1.00 (1.22)	1.00 (1.22)	25.00	77.77	83.33
T2	Neem soap 5% + Emamectin benzoate 5 SG	10 g a.i./ha	2.00	2.00 (1.58)	1.00 (1.22)	0.00 (0.71)	0.00	77.77	100.00
T3	Neem soap 5% + Rynaxypyr 20 SC	20 g a.i./ha	1.50	1.50 (1.41)	1.00 (1.22)	0.00 (0.71)	25.00	77.77	100.00
T4	Neem soap 5% + Rynaxypyr 20 SC	25 g a.i./ha	1.50	1.00 (1.22)	0.00 (0.71)	0.00 (0.71)	75.00	100.00	100.00
T5	Neem soap 5% + Indoxacarb 14.5 SC	50 g a.i./ha	2.00	1.50 (1.41)	1.00 (1.22)	0.00 (0.71)	25.00	77.77	100.00
T6	Neem soap 5% + Indoxacarb 14.5 SC	60 g a.i./ha	1.75	1.00 (1.22)	1.00 (1.22)	0.00 (0.71)	75.00	77.77	100.00
T7	Neem soap 5%	50 ml/ L water	1.50	1.50 (1.41)	1.50 (1.41)	1.50 (1.41)	25.00	66.66	75.00
T8	Control (Water spray)		2.00	2.00 (1.58)	4.50 (2.23)	6.00 (2.55)			
	S.Em±			0.05	0.05	0.02			
	CD at 5%			0.06	0.16	0.07			

Table 2: Economics and Cost: Benefit- ratio of treatments

T. No	Treatments	Dosage	Cost of treatment Rs/ha	Yield (q/ha)	Saved yield due to treatment (q/ha)	Benefit due to treatment (Rs/ha)	Net income (Rs./ha)	Cost: benefit ratio
T1	Neem soap 5% + Emamectin benzoate 5 SG	7 g a.i./ha	2551.00	15.93	3.93	23580.00	21029.00	1: 9.24
T2	Neem soap 5% + Emamectin benzoate 5 SG	10 g a.i./ha	2580.00	16.84	4.84	29040.00	26460.00	1: 11.25
T3	Neem soap 5% + Rynaxypyr 20 SC	20 g a.i./ha	2870.00	17.74	5.74	34440.00	31570.00	1: 12.00
T4	Neem soap 5% + Rynaxypyr 20 SC	25 g a.i./ha	2910.00	19.55	7.55	45300.00	42390.00	1: 15.56
T5	Neem soap 5% + Indoxacarb 14.5 SC	50 g a.i./ha	2640.00	17.92	5.92	35520.00	32880.00	1: 13.45
T6	Neem soap 5% + Indoxacarb 14.5 SC	60 g a.i./ha	2690.00	18.65	6.65	39900.00	37210.00	1: 14.83
T7	Neem soap 5%	50 ml/ L water	950.00	12.48	0.48	2880.00	1930.00	1: 3.03
T8	Control (Water spray)			12.00				
	S.Em±			0.486				
	CD at 5%			1.45				

Conclusion

All the seven insecticidal treatments tested were found effective and significantly superior over untreated check and reduced the damage of field pea during the *Ravi*, 2018-19. Most effective treatment was Neem soap 5% + Rynaxypyr 20 SC @ 25g a.i. / ha folloved by Neem soap 5% + Indoxacarb 14.5 SC @ 60 g a.i. /ha which yielded 21.55 q/ ha and 20.65 q/ ha grains respectively.

Neem soap 5% @ 50 ml/ L water was found least effective and produced only 14.48 q/ha grains.

The maximum cost benefit ratio of 1:15.56 was obtained from treatment Neem soap 5% + Rynaxypyr 20 SC @ 25g a.i. / ha followed by Neem soap 5% + Indoxacarb 14.5 SC @ 60 g a.i. /ha with 1:14.83. The minimum cost benefit ratio of 1:3.03 was recorded in the treatment Neem soap 5% @ 50 ml/ L.

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