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Field studies on efficacy of novel insecticides against *Helicoverpa armigera* (Hubner) infesting on Chickpea

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ABSTRACT
Field trials were conducted in randomized block design with three replications of seven treatments during *Rabi* season 2012-13. Efficacy of different treatments *viz.*, indoxacarb 14.5 SC @ 0.5 ml/l, profenofos 50 EC @ 2.0 ml/l, imidacloprid 17.8 SL @ 1 m/l, novaluron 10 EC @ 1.5 ml/l, fipronil 5 SC @ 2.0 ml/l and lambda cyhalothrin 5 EC @ 1 ml/l was tested against *Helicoverpa armigera* larvae. The results revealed that indoxacarb 14.5 SC @ 0.5 ml/l was found best with minimum population of *H. armigera* at first spray indoxacarb 14.5 SC @ 0.5 ml/l was found best among all the treatments with the minimum larval population at first spray first spray of 1.53, 0.46, 0.73 larvae/five plants being 89.45, 97.01, 95.83 percent reduction over control at 3 DAS, 5 DAS & 7 DAS respectively. The minimum larval population at second spray of 0.00, 0.26 and 0.00 larvae/five plants by giving 100, 98.74 & 100 percent reduction over control, at 3 DAS, 5 DAS & 7 DAS respectively.

Keywords: *Helicoverpa armigera*, chickpea, novel insecticides, efficacy.

1. Introduction
Gram commonly known as a 'chickpea' or chana is a very important pulse crop that grows as a seed of a plant named *Cicer arietinum* in the Leguminosae family. India is the largest chickpea producer as well as consumer in the world. Chickpea is the world's third most important food legume. Chickpea production has increased during the past 30 years from 6.5 million tons (1978-1980 average) to 9.6 million tons (2007-09) because of increase in grain yields yield from 630 to 850kg/ha during this period. It contains 25% proteins, which is the maximum provided by any pulse and 61.1% carbohydrates [2]. However, high yield is limited by the insect pests attacking chickpea.

The major insect pests *i.e.* termites (*Odontotermes obesus*), cutworms (*Agrotis ipsilon, A. segetum, A. spinifera and Mythimna separata)* appear during seedling stage in certain areas, while *Helicoverpa armigera* appear in great number during vegetative growth and at pod formation stage of chickpea [5]. A single larva may destroy several pods before reaching to maturity and this pest is reported to damage 5 to 40 per cent pods of chickpea crop.

2. Materials and Methods
Experimental details: Treatments and design of layout
The experiment was conducted at Crop Research Farm, Nawabganj, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur in a Randomized Block Design (R.B.D.) with seven treatments, each consisting of three replicates. The total number of plots was 21. The chickpea seeds of variety 'Avrodhi' were sown in plots of size 5 x 4 m^2 with row spacing 40 cm and plant to plant distance 10 cm.

All the insecticides under study were applied as foliar spray using Knapsack sprayer. To determine the efficacy of chemicals, two sprays were conducted on chickpea. First spray was done at pod initiation stage and second spray after 15 days of first spray. The details of treatments with respective dose and method of application has been given in Table 1.

2.1 Counting of larval population
The population of *H. armigera* larvae was recorded on ten randomly selected plants from five inner rows in each plot after one, three and seven days after first and second sprays. Ninth day count was considered pre-treatment count for the second spray.

Table 1: Treatments and their dosages

T.no	Treatment	Trade name	Dose
T1	Imidacloprid 17.8 SL	Confidor	0.5 ml/l
T2	Indoxacarb 14.5 SC	Avaunt	1.0 ml/l
T3	Novaluron 10 EC	Rimon	1.5 ml/l
T4	Fipronil 5 SC	Regent	2.0 ml/l
T5	Profenofos 50 EC	Curacron	2.0 ml/l
T6	Lambda Cyhalothrin 5 EC	Kerate	1.0 ml/l
T7	Control		-

Amount of insecticides required =

$$\frac{\text{Quantity of solution required} \times \text{Percent of solution desire}}{\text{Strength of formulation available}}$$

2.2 Observations on pod infestation.

The infested pods were counted from randomly selected five plants from five inner rows in each plot one day before spraying and 3, 5 and 7 days after first and second spray, with ninth day count becoming pretreatment count for the second spray. The formula used to calculate the percent infestation of pods was

$$\text{Pod Infestation (\%)} = \frac{\text{Number of infested pods}}{\text{Total number of pods}} \times 100$$

The mean original data of percentage e pod damage was calculated as percentage reduction over with the following formula (*Abbott's* 1925)

$$\text{Percent Reduction} = \frac{C - T}{C} \times 100$$

Where,

C: Percentage pod damage of control or larval population on control

T: Percentage pod damage of treated plot or larval population on treatments

3. Summary and Results

3.1 Effect of First spray on larval population of *Helicoverpa armigera* (Hubner)

3.1.1. After three days

Table no-2 revealed that all the treatments had significant effect in minimizing, from 1.53 to 3.33 larvae/five plants after three days of first spraying as compared to14.53 control. Among all the treatments the indoxacarb 14.5 SC @ 1.0 ml/l was found most effective, gave minimum population of 1.53 larvae/five plants, with 89.45 percent reduction over control, followed by profenofos 50 EC @ 2.0 ml/l.

3.1.2 After five days

The statistically analyzed data presented in Table – 2 showed that at five days after first spray mean number of *H. armigera* larvae ranged from 0.46 to 2.53 larvae/five plants. The indoxacarb 14.5 SC @ 0.5 ml/l was found highly effective among all the treatments with of 0.46 larvae/five plants and 97.02 percent reduction over control. The next treatments in order were profenofos 50 EC @ 2.0 ml/l, and imidacloprid 17.8 SL @ 1.0 ml/l were found effective.

3.1.3 After seven days

The data predicted in Table-2 revealed that at seven days after first spray mean number of *H. armigera* larvae ranged from 0.73 to 2.88 larvae/five plants. Indoxacarb 14.5 SC @ 1.0 ml/l was observed most effective treatment by giving 0.73 larvae/five plants with 95.83 percent reduction over control. Followed by Profenofos 50 EC @ 2.0 ml/l, imidacloprid 17.8 SL @ 1.0 ml/l, novaluron 10 EC @ 1.5 ml/l, and fipronil 5 EC @ 2.0 ml/l were gave good results.

Table 2: Effect of treatments on gram pod borer, *H.armigera (*Hub.) infesting chickpea during *Rabi* 2012-13 (First spray)

T. No.	Treatments	After 3 days of spraying	% reduction over control	After5days of spraying	%reduction over control	After 7 days of spraying	%reduction over control
1	Imidacloprid 17.8 SL	2.4	83.48	1.33	91.14	1.733	90.15
		-1.54		-1.15		-1.31	
2	Indoxacarb 14.5 SC	1.53	89.45	0.46	97.01	0.73	95.83
		-1.23		-0.67		-0.85	
3	Novaluron 10 EC	2.66	81.69	1.8	88.46	2.26	87.12
		-1.63		-1.34		-1.5	
4	Fipronil 5% SC	3.13	78.44	2.26	85.47	2.6	85.22
		-1.76		-1.5		-1.61	
5	Profenofos 50 EC	1.93	86.69	0.93	94.01	1.33	92.44
		-1.39		-0.96		-1.15	
6	LambdaCyhalothrin 5EC	3.33	77.06	2.53	83.76	2.86	83.71
		-1.82		-1.59		-1.69	
7	Control	14.53		15.6		17.6	
		-3.81		-3.94		-4.19	
	SE(d) ±	0.077		0.036		0.025	
	CD at 5%	0.075		0.089		0.054	

3.2 Effect of Second spray on larval population of *Helicoverpa armigera* (Hubner)

3.2.1 After three days

The number of larvae of *H. armigera* was recorded at three days after second spray showed in Table-3. Indoxacarb 14.5 SC @ 0.5 ml/l (T2) was found as best among all the treatments being 0.00 larvae / five plants and 100 percent reduction over control. The next effective treatments were profenofos 50 EC @ 2.0 ml/l and imidacloprid 17.8 SL @ 1.0 ml/l which showed reduced 0.13 and 0.46 larvae/five plants and 99.33 and 97.68

percent reductions respectively.

3.2.2 After five days

The number of larvae of *H. armigera* was noticed at five days after second spray were presented in Table-3 showed that all the treatments were statistically superior and found effective to decrease the *H. armigera* larval population ranged from 0.26 to 2.53 larvae/five plants. The minimum population 0.266 larvae/five plants with 98.74 percent reduction over control was observed in indoxacarb 14.5 SC @ 1.0 ml/l , it was most effective than other treatments. After that profenofos 50 EC @ 2.0 ml/l, imidacloprid 17.8 SL @ 0.5 ml/l and novaluron 10 EC @ 1.5 ml/l observed more effective.

3.2.3 After seven days

The data clearly showed that the spraying of indoxacarb 14.5 @ 1.0 ml/l , profenofos 50 EC @ 2.0 ml/l , imidacloprid 17.8 SL @ 0.5 ml/l , novaluron 10 EC @ 1.5ml/l, fipronli 5 EC @ 2.0 ml/l and lambda cyhalothrin 5EC @ 1.0 ml/l were found superior regarding lowering the larval population. Those do not differ significantly. The larval population per five plants was recorded as 0.00, 0.26, 0.66, 1.26, 1.53 and 2.06 respectively. Their percent reduction over control was observed as 100, 98.81, 97.04, 94.38, 93.19 and 90.831 respectively. In control, the maximum number 22.53 larvae/five plants were recorded. This was showed in the Table-3.

Table 3: Effect of treatments on gram pod borer, *H. armigera (*Hub.) infesting chickpea during *Rabi* 2012-13 (second spray)

S. No	Treatments	After 3 days of spraying	% reduction over control	After 5 days of spraying	% reduction over control	After 7 days of spraying	% reduction over control
1	**Imidacloprid 17.8 SL**	0.46 -0.98	97.69	1.13 -1.06	94.64	0.66 -1.07	97.04
2	**Indoxacarb 14.5 SC**	0 -0.7	100	0.26 -0.5	98.74	0 -0.7	100
3	**Novaluron 10 EC**	1.13 -1.27	94.37	1.93 -1.39	91	1.26 -1.32	94.38
4	**Fipronil 5% SC**	1.4 -1.37	93.05	2.26 -1.5	89.29	1.53 -1.42	93.19
5	**Profenofos 50 EC**	0.13 -0.79	99.34	0.66 -0.81	97	0.26 -0.8	98.81
6	**Lambda Cyhalothrin 5EC**	1.86 -1.53	90.73	2.53 -1.59	88.03	2.06 -1.6	90.83
7	**Control**	20.13 -4.54		21.16 -4.6		22.53 -4.79	
	SE(d)	0.03		0.05		0.06	
	CD at 5%	0.08		0.1		0.07	

4. Discussion

Chickpea yield is decreasing day by day due to many factors among which the major factor is direct damage caused by larvae of *H. armigera (Hub.)*

The efficacy of different treatments against *H. armigera* larvae was determined on the basis of number of larvae per five plants. The data revealed that all the treatments were significantly superior over control. The minimum larval population was recorded with indoxacarb 14.5 SC @ 0.5 ml/l at first spray of 1.53, 0.46, 0.73 larvae/five plants being 89.45, 97.01, 95.83 percent reduction over control at 3 DAS, 5 DAS & 7 DAS respectively. The minimum larval population at second spray of 0.00, 0.26 and 0.00 larvae/five plants, by giving 100, 98.74 & 100 percent reduction over control, at 3 DAS, 5 DAS & 7 DAS respectively and it was found at par with the treatments profenofos 50 EC @ 2.0 ml/l, imidacloprid 17.8 SL @ 1 m/l, novaluron 10 EC @ 1.5 ml/l, fipronil 5 SC @ 2.0 ml/l and lambda cyhalothrin 5 EC @ 1 ml/l. The present experimental findings are supported by [1] who reported that indoxacarb as the most effective in reducing the larval population in chickpea crop results are also in agreement with [6] who reported that indoxacarb was the most effective in reducing the larval population of *H. armigera* in sunflower. (Singh SS *et al*. and Deshmukh SG *et al*.) [2, 3] reported that indoxacarb caused minimum larval population in chickpea. Karar *et al.*, (2002) [4] reported that minimum larval population was recorded for lambda cyhalothrin in cotton crop, thus supporting our findings.

5. Conclusion

It may concluded from the present investigation that the incidence of *H. armigera* in chickpea in Uttar Pradesh starting from early stage of flowering till to the harvest. The approaches for chemical management of *H. armigera* were found effective than control. The chemical insecticide indoxacarb 14.5 SC @ 0.5 ml/l were found most effective in controlling *H. armigera* larval population, to reduce the pod infestation and also produce the maximum grain yield, followed by profenofos 50 EC @ 2.0 ml/l, imidacloprid 17.8 SL @ 1 m/l, novaluron 10 EC @ 1.5 ml/l, fipronil 5 SC @ 2.0 ml/l and lambda cyhalothrin 5 EC @ 1 ml/l respectively.

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