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Field efficacy of certain insecticides against pod borer, *Helicoverpa armigera* (Hubner) on chick pea in Prayagraj

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Abstract
An experiment on chickpea was conducted to determine the "Field efficacy of certain insecticides against pod borer, *Helicoverpa armigera* (Hubner) feeding on chick pea in Prayagraj" during *rabi* season of 2019-2020 at the Central Research Field, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. Efficacy of seven insecticides viz., Flubendiamide 20% WG @ 0.3g/lit, Spinosad 45% SC @ 0.5ml/lit, Indoxacarb 14.5% SC @ 1 ml/lit, Nisco sixer plus @ 2 ml/lit, Novaluron 10% EC @ 1.5 ml/lit, Nisco sixer plus + Novaluron 10% EC @ 1+ 0.75 ml/lit and Chlorantraniliprole 18.5% SC @ 0.5 ml/lit were evaluated against the pest. Observations on gram pod borer population were recorded from fifteen randomly selected plants in each plot before spray and after 3, 7 and 14 days of spraying. The results revealed that all treatments are significantly superior over control. Among all the treatments Spinosad 45% SC was found best with maximum percent reduction of (78.23%) followed by Chlorantraniliprole 18.5% SC (73.08%). Flubendiamide 20% WG (64.96%), Nisco sixer plus (59.18%), Novaluron 10% EC (58.01%), Nisco sixer plus+ Novaluron 10% EC (54.21%), Indoxacarb 14.5% SC (51.33%) was found to be least effective among all insecticides.

Keywords: chick pea**,** *Helicoverpa armigera*, percent population reduction, efficacy, insecticides

Introduction
Chickpea (*Cicer arietinum* L.), a member of Fabaceae, is a self-pollinated crop and is second most important food legume crop after common bean. It is an ancient cool season food legume crop cultivated by man and has been found in middle eastern archaeological sites dated 7500-6800 BC Zohary and Hopf (2000) [20]. In India, chickpea is known by various names like *chana* or *gram* or *Bengal gram* or *chani* in Haryana, Rajasthan, Uttarakhand, Uttar pradesh, Madhya Pradesh, Chattisgarh, Bihar, Jharkhand, etc.; *chole* in Punjab, Jammu and Kashmir and Delhi; *chola* in Westbengal; *Harbara* in Maharastra; *Boot* in Orissa; *Sanagulu* in Andhra pradesh; *Kadale* in Karnataka; *kadalai* in Tamil nadu; and *kadala* in Kerala, indicating its wide spread cultivation and knowledge of utilization.
It is one of the most important food legume plants in sustainable agriculture system because of its low production cost, wider adaptation, ability to fix atmostpheric nitrogen and fit in various crop rotations Singh (1997) [15]. Nutrional value per 100g of chickpea contains carbohydrates (27.42 g), protein (8.86g), total fat (2.59 g), dietary fibre (7.6g), folates (172 mcg), niacin (0.526 mg), pantothenic acid (0.245 mg), pyridoxine (0.215 mg), riboflavin (0.063), thiamine (0.200 mg), vitamin C (1.3 mg), vitamin A (27 IU), vitamin E (0.35 mg), vitamin K (4.0 mcg), sodium (7.0 mg), potassium (291 mg), calcium (49 mg), iron (2.89 mg), magnesium (48 mg), phosphorous (168 mg), zinc (1.53 mg) (USDA National Nutrient Database 2018) [19].
India is the largest producer of chickpea (*Cicer arietinum* L.) with 67 percent of the global production and occupies nearly 31 percent of area in the country contributing over 37 per cent to the national pulse production (Reena *et al*., 2009) [12]. Two types of chickpea cultivars are recognized globally-*kabuli* and *desi*. *Desi* chickpeas are characterized by flowers of varying colours, angular to round seeds with dark seed coat, anthocyanin pigmentation and semi spreading to erect, semierect or semi-spreading growth habit, whereas kabuli types generally have owl- or ram-shaped beige-coloured seeds, white flowers, smooth seed surface, lack of anthocyanin pigmentation and semi spreading to erect growth habit (Pundir *et al*. 1985) [9]. Major chickpea producing states in India are Madhya Pradesh, Uttar Pradesh, Maharashtra, Andhra Pradesh, Rajasthan, Gujarat and Karnataka, together they contribute 93 percent of the production from 92 percent of area (Ali, 2005) [2].

Chickpea crop is attacked by a number of insect- pests from seedling to its maturity. The major insect-pests attacking chickpea crop are *Helicoverpa armigera*, *Spodoptera litura*, *Agrotis ipsilon*, *Plusia orichalchea* and *Bemisia tabaci* during winter and summer seasons. Among these Gram pod borer, *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) is a major and prominent pest in different chickpea growing areas of the country (Begum *et al*., 1992) [3] and it is considered as major cause for low production of the crop (Shrivastava and Shrivastava, 1990) [13].

The gram pod borer, *Helicoverpa armigera* is a potential and polyphagous pest, with various characteristic features like high fecundity, migratory behavior, high adaptations to various agroclimatic conditions and development of resistance to various insecticides, extensively damaging many crops including chickpea (Kambrekar *et al.*, 2009) [6]. The caterpillar not only defoliates the tender leaves but also makes holes in the pods and feed upon the developing seeds the anterior body portion of the caterpillar remains inside the pod and rest half or so hanging outside. When seeds of one pod are finished, it moves to the next. Unless the pest is controlled in the initial stages of infestation it takes the heavy toll of the crop. Worldwide losses due to *Helicoverpa armigera* have been estimated over US $300 million annually (Kaur *et al*. 2007) [7]. In India, yield losses caused by *Helicoverpa armigera* are in the range of 20-30 percent and sometimes rise to 75 percent in chickpea which is increased even to 90 percent in Bangladesh (Rahman, 1989) [10]. In Nepal, it is increasingly becoming a severe threat of spring season tomato for the last few years (Pandey *et al.* 1996) [8].

Materials and Methods

The field trial was laid out at the Central Research Field in randomized block design with eight treatments including an untreated control, each with three replications. The "Type 32" variety of chickpea was used and a healthy crop was raised by following all the recommended agronomical practices. The plot size was 2m x 2m and the spacing between rows and plants was maintained at 30 and 15 cm, respectively. Sprays were initiated on reaching 4-5 larvae per plant and pod damage by the borer and repeated three times during the crop season as and when the pod damage exceeded 10-20 percent. Spraying was done with the help of a knapsack sprayer. Observations on larvae and pod damage by the borer were recorded daily on 5 randomly selected plants per plot during the vegetative stage of crop and later on number of damaged and total pods, from these data the percentage of pod damage was worked out and the data before subjecting to statistical analysis.

Preparation of insecticidal spray solution:

The insecticidal spray solution of desired concentration as per treatments was freshly prepared every time at the site of experiment just before the start of spraying operations. The quantity of spray materials required for crop was gradually increased as the crop advanced in age. The spray solution of desired concentration was prepared by adoption the following formula (Singh *et al*., 2011) [14].

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

where,
V = Volume of a formulated pesticide required.
C = Concentration required.
A = Volume of total solution to be prepared.
% a.i. = given Percentage strength of a formulated pesticide.

Pod damage analysis and percentage reduction in pod damage

Pod damage percentage was calculated using the following formulae (Hussain, 2007) [5]

$$Percent\ pod\ damage = \frac{no.of\ affected\ pods}{total\ no\ of\ pods}\ x\ 100$$

$$\%\ reduction\ in\ pod\ damage\ over\ control = \frac{pod\ damage\ in\ controlpod\ damage\ in\ treatment}{pod\ damage\ in\ control} x100$$

Results and Discussion

The results presented in Table.1 revealed that three days after first spray, Spinosad (0.5ml/lit) was most effective showing maximum percent larval population reduction 75.76, followed by Chlorantraniliprole (0.5ml/lit) 71.3 and Flubendiamide (0.3g/ilt) 58.06, Plots treated with Nisco sixer plus (2ml/lit) 53.13, Novaluron (1.5ml/lit) 51.26, Nisco Sixer Plus +Novaluron (1+ 0.75ml/lit) 49.36 and Indoxacarb (1ml/lit) 45.63 percent population reduction. Seven days after first spray, Spinosad (0.5ml/lit) was the best treatment with 81.83% population reduction, followed by Chlorantraniliprole (76.96%), Flubendiamide (68.93%), Nisco sixer plus (63.63%), Novaluron (62.43%), Nisco Sixer Plus +Novaluron (60.6%) and Indoxacarb (56.33%). Fourteen days after first spray also revealed, Spinosad (0.5ml/lit) was the best treatment with 71.6% population reduction, followed by Chlorantraniliprole (65.9%), Flubendiamide (57.5%), Nisco sixer plus (53.26%), Novaluron (52.63%), Nisco Sixer Plus +Novaluron (51.43%) and Indoxacarb (47.86%).

The results revealed three days after second spray, Spinosad (0.5ml/lit) was most effective showing maximum percent larval population reduction 74.8, followed by Chlorantraniliprole (0.5ml/lit) 68.43 and Flubendiamide (0.3g/ilt) 60.66, Plots treated with Nisco sixer plus (2ml/lit) 55.33, Novaluron (1.5ml/lit) 53.56, Nisco Sixer Plus +Novaluron (1+ 0.75ml/lit) 46.93. and Indoxacarb (1ml/lit) 44.6 percent population reduction. Seven days after second spray, Spinosad (0.5ml/lit) was the best treatment with 79.93% population reduction, followed by Chlorantraniliprole (72.13%), Flubendiamide (70.03%), Nisco sixer plus (62.93%), Novaluron (62.9%), Nisco Sixer Plus +Novaluron (54.06%) and Indoxacarb (52.33%). Fourteen days after second spray also revealed, Spinosad (0.5ml/lit) was the best treatment with 85.6% population reduction, followed by Chlorantraniliprole (83.93%), Flubendiamide (74.8%), Nisco sixer plus (69%), Novaluron (65.5%), Nisco Sixer Plus +Novaluron (63.16%) and Indoxacarb (61.43%).

Table 1: Efficacy of different insecticides against *Helicoverpa armigera* on chickpea

Treatment	% reduction of larval population					2nd spray	% reduction of larval population				
	1st spray	DAS*					DAS*				Overall
	1 DBS*	3	7	14	Mean	1 DBS*	3	7	14	Mean	mean
Flubendiamide 20% WG	3.68	58.06	68.93	57.5	61.46	3.4	60.66	70.03	74.8	68.46	64.96
Spinosad 45% SC	3.64	75.76	81.83	71.6	76.36	3.17	74.8	79.93	85.6	80.1	78.23
Nisco Sixer Plus	3.48	53.13	63.63	53.26	56.63	3.33	55.33	62.93	69	61.73	59.18
Indoxacarb 14.5% SC	3.64	45.63	56.33	47.86	49.9	3.68	44.6	52.33	61.43	52.76	51.33
Novaluron 10% EC	3.5	51.26	62.43	52.63	55.4	3.66	53.56	62.9	65.5	60.63	58.01
Nisco Sixer Plus + Novaluron 10% EC	3.53	49.36	60.6	51.43	53.76	3.33	46.93	54.06	63.16	54.66	54.21
Chlorantraniliprole 18.5% SC	3.68	71.3	76.96	65.9	71.36	3.15	68.43	72.13	83.93	74.8	73.08
Control	3.53	00.00	00.00	00.00	00.00	3.62	00.00	00.00	00.00	00.00	00.00
F-test	NS	S	S	S	S	NS	S	S	S	S	S
CV	-	4.49	4.87	4.11	4.73	-	4.75	3.48	4.16	5.41	2.9
C. D. (5%)	-	3.97	5	3.60	4.40	-	4.2	3.46	4.58	5.37	3.8

DAS*= Days After Spray, DBS*= Days Before Spray, NS= Non-Significant, S= Significant

The results revealed the mean of first spray, Spinosad (0.5ml/lit) was recorded highest reduction of pod borer population 76.36% population reduction, followed by Chlorantraniliprole (71.36%), Flubendiamide (61.46%), Nisco sixer plus (56.63%), Novaluron (55.4%), Nisco Sixer Plus + Novaluron (53.76%) and Indoxacarb (49.9%) was least effective among all the treatments. Mean of second spray, Spinosad recorded highest reduction of pod borer population 80.1% population reduction, followed by Chlorantraniliprole (74.8%), Flubendiamide (68.46%), Nisco sixer plus (61.73%), Novaluron (60.63%), Nisco Sixer Plus +Novaluron (54.66%) and Indoxacarb (52.76%) was least effective among all the treatments

Overall mean of two sprays revealed that Spinosad 45% SC (0.5ml/lit) was found to be more effective than other chemical insecticides. Spinosad recorded the per cent pod damage reduction by 78.23 followed by Chlorantraniliprole 18.5% SC (0.5ml/lit) 73.08 and Flubendiamide 20% WG (0.3g/ilt) 64.96, Plots treated with Nisco sixer plus (2ml/lit) 59.18, Novaluron 10% EC (1.5ml/lit) 58.01, Nisco Sixer Plus +Novaluron 10% EC (1+ 0.75ml/lit) 54.21 percent population reduction. Indoxacarb 14.5% SC (1ml/lit) 51.33 recorded least effective among the treatments but significant and superior over control.

All the treatments were found to be significantly superior over control. Spinosad was more effective in percentage damage reduction of pods with 78.23% reduction over control. These findings are in accordance with the findings Ram *et al*. (2017) [11] reported that among all the treatments lowest number of gram pod borer was recorded in Spinosad Chandra *et al.* (2016) [4] stated that minimum pod damage of 11.98% and highest yield of 1745 kg/ha was registered in spinosad. Sudha *et al.* (2018) [17] proved that plots treated with chlorantraniliprole 20 SC and flubendiamide 20 WG was most effective in reducing the incidence of *Helicoverpa armigera*. Suneel *et al*. (2015) [18] findings concluded that the new generation insecticides like flubendiamide, chlorantriniliprole, and spinosad were found effective against lepidoptera caterpillars viz., *Spodoptera exigua* and *Helicoverpa armigera*. Ahmed *et al.* (2004) [1] stated that spinosad @60 ml/acre was the most effective against *Helicoverpa armigera* on chickpea and caused minimum pod damage followed by indoxacarb@150 ml/acre. Sreekanth *et al.* (2014) [16] findings clearly indicated that new generation insecticides like chlorantriniliprole, flubendiamide and spinosad were found effective against gram pod borer, *Helicoverpa armigera*.

Conclusion

From the thorough analysis of the present findings it can be concluded that Insecticides like Spinosad 45%SC, Chlorantraniliprole 18.5% SC, Flubendiamide 20%WG can be suitably incorporated in integrated pest management scheduled against Helicoverpa armigera (Hubner) as an effective tool as their recommended field doses are very low.

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