

Bio-efficacy of some insecticides against *H. armigera* (Hubner) on chickpea (*Cicer arietinum* L.)

P.S. SINGH, R.K. SHUKLA and N.K. YADAV

Department of Entomology and Agricultural Zoology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi-221005, Uttar Pradesh, India; E-mail: pss_ento@yahoo.co.in

(Received: August 28, 2012; Accepted: November 13, 2012)

ABSTRACT

Chickpea 'SAKI9516' was sown on Agricultural Research Farm of Banaras Hindu University during Rabi season 2010-11 and 2011-12 for the bio-efficacy of certain new molecules insecticides viz., HaNPV@ 250 LE/ha, spinosad 45 SC @ 100 g a.i./ha, fenvalerate 20 EC@300 g a.i./ha, quinalphos 25EC@450 g a.i./ha, emamectin benzoate 5SG @ 11 g a.i./ha, azadirachtin 1500 ppm@5ml/lit, cartap hydrochloride 50 SP @ 500 g a.i./ha, fipronil 5 SC@50g a.i./ha and indoxacarb 14.5 EC @ 75 g were applied twice at 15 days interval against gram pod borer, *H. armigera*. Spinosad was found best among all the treatments with 81.2% reduction in larval population over control followed by indoxacarb, fipronil, emamectin benzoate, cartap hydrochloride, fenvalerate, and quinalphos, azadirachtin and HaNPV. After 7 days of spraying of second application spinosad was found best again in reduced 79.8% larval population followed by indoxacarb (with 78.3% reduction in larval populations). The highest yield was obtained in spinosad (1.79 t/ha) while low in azadirachtin (1.06 t/ha). The cost: benefit ratio was high in treatment fipronil (1: 8.2) while low in treatment indoxacarb (1: 5.3).

Key words: Bio-efficacy, Chickpea, *H. armigera*, Insecticides

Insect pests are one of the major constraints which limit the production of chickpea. In India, it is attacked by 57 insect species and about half a dozen of them are considered to be of economic importance. Pod borer [*Helicoverpa armigera* (Hubner)] is the most prominent insect species that causes major economic damage to this crop. The yield loss in chickpea due to pod borer was reported as 10-60 per cent in normal weather conditions, while it was 50-100 per cent in favourable weather conditions, particularly in the states where frequent rains and cloudy weather prevailed during the crop season (Patel 1979). Reports showed that *H. armigera* has developed resistance to all the major insecticides classes and it has become increasingly difficult to control its population in India. *H. armigera* alone accounts for the consumption of half of the total pesticides used in India for the protection of different crops (Suryavanshi *et al.* 2008). For managing the insecticides resistance in better way, different group of insecticides should be preferred in lieu of a single group of insecticides. In this study, an attempt was made to study the bio-efficacy of certain new molecules against *H. armigera* in chickpea.

MATERIALS AND METHODS

The experiments were carried out under field conditions at the Agriculture Research Farm of Institute of Agricultural Sciences, BHU, Varanasi during the years 2010-12 on chickpea variety 'SAKI 9516' in randomized complete block design (RBD) having 10 treatments replicated thrice with plot size 7.2 m² having 4 rows with 4 m long in each plot. The plant spacing between row to row and plants to plant were maintained at 40 cm and 15 cm, respectively. The crop received two sprays, the first being given at pod formation when the population crossed Economic Threshold Level while the second spray was imposed on the basis of insect population. The spray mixture of each treatment was prepared by mixing of required quantity of the insecticides formulations in water to make it equivalent to 500 liters. Insecticides were applied during early hours of the day where wind velocity was suitable for spraying. This helped in avoiding the drift of spray fluid to the adjacent plots. Due care was also taken to spray each plot uniformly and the sprayer was thoroughly washed after spraying of each insecticides.

The number of *H. armigera* larvae was counted on 5 randomly selected plants in each plot. Pretreatment larval count on 5 plants was made a day before spraying while post treatment counts were taken 7 days after applications. The per cent reduction in larval population was calculated on the basis of number of larvae recorded in treated and control plots. The data were statistically analyzed after arc sin transformation. The significance was tested by referring to 'F' tables of Fisher and Yates (1963).

To study the relative efficacy of various chemical treatments, the percentage pod damage and plot yield were recorded after the crop harvest in both cropping years. After harvesting, all the pod of 5 plants of individual plot were collected and pooled together. Finally, 100 pods were picked up randomly and per cent pod damage was recorded. For recording the yield, all the pods from individual treatment were threshed and grain weight obtained were converted into q/h. The cost: benefit ratio was calculated with the help of costs of inputs and yield obtained.

The percentage reduction of the pod borer over untreated check in different treatments was calculated using

Henderson and Tilton's (1955) formula as given below:

$$\text{Per cent efficacy} = 1 - \left[\frac{T_a}{T_b} \times \frac{C_b}{C_a} \right] \times 100$$

Where,

T_a = Population in the treated plot after spray

T_b = Population in the treated plot before spray

C_a = Population in the control plot after spray

C_b = Population in the control plot before spray

RESULTS AND DISCUSSION

Per cent reduction in larval population: The pooled mean after 7 days of 1st application showed that all treatments were found significantly superior to control (Table 1). Spinosad 45 SC @ 100 g a.i./ha was the best treatment that reduced 81.2% larval population; however, it did not differ significantly with indoxacarb 14.5 EC @ 75 g a.i./ha, fipronil 5 SC@ 50 g/ha, emamectin benzoate 5 SG @ 11 g/ha¹, cartaphydrochloride 50 SP @ 500 g a.i./ha, and fenvalerate 20 EC@300 g a.i./ha which reduced larval population by 79.7, 77.9, 76.9, 76.3 and 75.6 per cents, respectively. Quinalphos 25EC @450 g a.i./ha also reduced larval population by 74.4% while azadirachtin 1500 ppm and HaNPV @ 250 LE/ha reduced the population by 52.4 and 48.8%, respectively. The least effective and significantly inferior treatment in comparison to others was HaNPV @250 LE/ha (with 48.8% reduction in population).

However, on the basis of pooled data, the reduction in

larval population at 7 days after second spray showed that all the treatments were found significantly superior to control. Thus, spinosad 45 SC @ 100 g a.i./ha was the best treatment that reduced 79.8% larval population followed by indoxacarb 14.5 EC @ 75 g a.i./ha (with 78.3% reduction in larval population). The other treatments viz., fipronil 5 SC@ 50 g a.i./ha, emamectin benzoate 5 SG @ 11 g a.i./ha, cartap hydrochloride 50 SP @ 500 g/ha, quinalphos 25EC@450 g a.i./ha, fenvalerate 20 EC@300 g a.i./ha, HaNPV @ 250 LE/ha and azadirachtin 1500ppm reduced larval population by 75.2, 74.5, 72.6, 70.1, 70.0, 58.1 and 54.1 percent, respectively. The minimum reduction in larval population noted after second spray in azadirachtin was 54.1%. The present findings were in conformity with the findings of Kambrekar *et al.* (2012), Anandi *et al.* (2011), Deshmukh *et al.* (2010) and Singh *et al.* (2008).

Pod damage: The bio-efficacy of different insecticidal treatment on per cent pod damage by *H. armigera* was evaluated under field condition. On the basis of pooled mean, it showed that all the treatments were found significantly superior to the control. The minimum pod damage was observed in spinosad 45 SC @ 100 g a.i. /ha (2.3%) while maximum damage was observed in azadirachtin 1500 ppm treatment (12.8%). The other treatments showing increased per cent pod damage included indoxacarb (3.6%), cartap hydrochloride (4.7%), fipronil (5.4%), emamectin benzoate (6.1%), fenvalerate (6.0%), quinalphos (8.3%) and HaNPV (10.7%). Present findings were in conformity with the findings of Singh *et al.* (2004) and Singh *et al.* (2008).

Seed Yield: During both years when efficacy was tested in terms of grain yield, all the treatments proved significantly

Table 1. Efficacy of insecticidal treatment on *H.armigera* larval population during 2010-12*

Treatment details	Dosage g a.i./ha	Per cent reduction in larval population over control						Pod damage (%)			Yield t/ha		
		7 days after first spraying			7 days after second spraying			2010-11	2011-12	Mean	2010-11	2011-12	Mean
		2010-11	2011-12	Mean	2010-11	2011-12	Mean						
HaNPV@ 0.5ml/lit.	250 LE	49.2 (44.5)	48.8 (44.3)	48.8 (44.3)	59.4 (50.4)	56.8 (48.9)	58.1 (49.7)	10.9 (19.3)	10.5 (19.2)	10.7 (19.3)	1.11	1.12	1.11
Spinosad@0.44 ml/lit.	100	81.7 (64.7)	81.2 (64.3)	81.2 (64.3)	80.3 (63.6)	79.3 (62.9)	79.8 (63.3)	2.3 (8.7)	2.2 (8.5)	2.3 (8.6)	1.74	1.84	1.79
Fenvalerate @3ml/lit.	300	75.4 (60.3)	75.6 (60.4)	75.6 (60.4)	73.6 (59.1)	66.4 (54.5)	70.0 (56.8)	6.5 (14.8)	5.6 (13.6)	6.0 (14.2)	1.30	1.30	1.30
Quinolphos@3.6 ml/lit.	450	73.9 (59.3)	74.4 (59.6)	74.4 (59.6)	72.1 (58.1)	67.9 (55.5)	70.1 (56.9)	8.8 (17.3)	7.7 (16.1)	8.3 (16.7)	1.42	1.41	1.41
Emamectin Benzoate@0.44 gm/lit.	11	77.2 (61.5)	76.9 (61.2)	76.9 (61.3)	74.0 (53.3)	75.1 (60.0)	74.5 (59.7)	5.6 (13.6)	6.7 (14.9)	6.1 (14.3)	1.41	1.60	1.51
Azadirachtin@5 ml/lit.	1500 ppm	54.2 (47.4)	52.4 (46.4)	52.4 (46.4)	57.8 (49.5)	50.2 (45.1)	54.1 (47.4)	13.3 (21.4)	12.4 (20.7)	12.8 (21.0)	1.06	1.07	1.06
Cartap hydrochloride @ 2gm/lit.	500	76.4 (61.0)	76.3 (60.9)	76.3 (60.9)	72.4 (58.3)	72.8 (58.6)	72.6 (58.4)	4.5 (12.2)	4.9 (12.8)	4.7 (12.5)	1.37	1.61	1.49
Fipronil@2ml/lit.	50	78.5 (62.4)	77.9 (62.0)	77.9 (62.0)	76.2 (57.2)	74.3 (59.5)	75.2 (60.1)	5.4 (13.4)	5.4 (13.4)	5.4 (13.4)	1.55	1.62	1.58
Indoxacarb@1.03ml/lit.	75	79.5 (63.1)	79.7 (63.2)	79.7 (63.2)	78.8 (62.6)	77.8 (61.8)	78.3 (62.2)	4.0 (11.5)	3.2 (10.3)	3.6 (10.9)	1.57	1.67	1.62
Untreated control	-	-	-	-	-	-	-	28.4 (32.2)	28.4 (32.2)	28.4 (32.2)	0.82	0.83	0.83
SEm(±)		1.6	1.6	1.6	1.5	1.5	1.5	0.5	0.5	0.5	0.01	0.01	0.01
CD (P=0.05)		4.8	4.8	4.8	4.5	4.6	4.6	1.4	1.4	1.4	0.03	0.03	0.03
CV (%)		5.4	5.4	5.4	5.3	5.2	5.3	5.0	5.0	5.0	4.9	4.8	4.9

*Figures in parentheses are Arc sine transformation

Table 2. Benefit cost ratio of various insecticidal treatment on chickpea during 2010-12*

Treatments detail	Increase in yield (t/ha) over control			Cost of increased yield over control (₹/ha)#			Total cost of plant protection (₹/ha)*			Net Profit (₹/ha)			ICBR			RANK
	10-11	11-12	Mean	10-11	11-12	Mean	10-11	11-12	Mean	10-11	11-12	Mean	10-11	11-12	Mean	
HaNPV	0.28	0.29	0.29	8520	12138	10329	2100	2300	2200	6420	9838	8129	1:3.1	1:4.3	1:3.7	IX
Spinosad	0.91	1.01	0.96	27420	42294	34857	6936	7136	7036	20484	35158	27821	1:3.0	1:4.9	1:3.9	VI
Fenvarlate	0.48	0.46	0.47	14370	19446	16908	1860	2060	1960	12510	17386	14948	1:6.7	1:8.4	1:7.6	II
Quinolphos	0.60	0.58	0.59	17970	24192	21081	4200	4400	4300	13770	19792	16781	1:3.3	1:4.5	1:3.9	VIII
Emamactin Benzoate	0.59	0.76	0.68	17610	32046	24828	4912	5112	5012	12698	26934	19816	1:2.6	1:5.3	1:3.9	VII
Azadirachtin	0.23	0.23	0.23	7020	10038	8529	1500	1700	1600	5520	8338	6929	1:3.7	1:4.9	1:4.3	V
Cartap hydrochloride	0.54	0.78	0.66	16320	32634	24477	2800	3000	2900	13520	29634	21577	1:4.8	1:9.9	1:7.4	III
Fipronil	0.72	0.78	0.75	21720	32928	27324	2860	3060	2960	18860	29868	24364	1:6.6	1:9.8	1:8.2	I
Indoxacarb	0.75	0.84	0.79	22530	35154	28842	4442	4006	4224	18088	30512	24300	1:4.1	1:6.6	1:5.3	IV
Untreated control	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X

*Includes cost of Sprayer, Labours for two applications. (Charges : Sprayer @₹15/day/sprayer In 2010-11 and @₹20/day/sprayer 2011-12, Labour charges @₹125/day/labour In 2010-11 and @₹200/day/labour in 2011-12), Quantity of water per ha: 500 lit., No. of labours per ha: 2/spray, # Price of chickpea @₹30 /kg (2010-11) and @₹42/kg (2011-12)

superior to control (untreated). The maximum and minimum yield was obtained in both years from the plot treated with spinosad and azadirachtin, respectively. On the basis of mean data, the maximum yield obtained among the all treated plots was under spinosad 45 SC @ 100 g a.i./ha (1.79 t/ha) while the minimum yield was obtained with azadirachtin 1500 ppm (1.06 t/ha). Present findings are in conformity with the findings of Kambrekar *et al.* (2012), Deshmukh *et al.* (2010) and Ladaji (2004) who reported that maximum yield could be obtained with spinosad in comparison to other treatments.

Economics: The cost benefit ratio of various insecticidal treatments on chickpea during both years showed that use of insecticides against *H. armigera* larvae increased the yield. The pooled mean data showed maximum cost benefit ratio (1:8.2) in the plots treated with fipronil 5 SC@ 50 g a.i./ha while the lowest cost benefit ratio (1: 3.7) was obtained in HaNPV @ 250 LE/ha treated plots. Present findings are in conformity with the findings of Singh *et al.* (2004) and Singh *et al.* (2008).

Based on the two years study, it was inferred that spinosad 45 SC @ 100 g a.i./ha was the best treatment so far to due maximum larval population reduction, minimum per cent of pod damage and maximum seed yield. However, the maximum cost: benefit ratio was under fipronil 5 SC@ 50 g a.i./ha.

REFERENCES

Anandhi DMP, Elamathi S and Simon S. 2011. Evaluation of bio-rational insecticides for management of *Helicoverpa armigera* in chickpea: Annals of Plant Protection Sciences. **19**: 207-209.
Chaudhary RRP and Sachan RB. 1999. Comparative efficacy and

economics of some insecticides against gram podborer *Helicoverpa armigera* (Hubner) in chickpea in western plain of Uttar Pradesh. Bhartiya Krishi Anusandhan Patrika **10**: 159-164.

Deshmukh SG, Sureja BV, Jethva DM and Chatar VP. 2010. Estimation of yield losses by pod borer *Helicoverpa armigera* (Hubner) on chickpea. Legume Research **33**: 1, 67-69.

Fisher RA and Yates F. 1963. Statistical tables for biological, agricultural and medical research. 6. Aufl. Oliver & Boyd, London. 146 S. Preis 30 s.

Henderson CF and Tilton EW. 1955. Pests with acaricides against the brown wheat mite. J. Economic Entomology **48**: 157-161.

Kambrekar DN, Somnagouda G, Basavarajappa MP and Halagalimath SP. 2012. Effect of different dosages of Emamectin benzoate 5 SG and Indoxacarb 14.5 SC on pod borer (*Helicoverpa armigera*) infesting chickpea. Legume Research **35**: 13-17.

Ladaji RN. 2004. Management of chickpea pod borer, *Helicoverpa armigera* (Hubner) using indigenous materials and newer insecticides. M. Sc. (Ag) Thesis, UAS, Dharwad (India).

Panse VG and Sukhatme PV. 1985. Statistical methods for Agricultural workers. ICAR, New Delhi. 381 pp.

Patel RK. 1979. Unusual outbreak of gram pod borer on gram in Madhya Pradesh. Science and Root cheek culture **45**: 335-336.

Singh H, Mahajan G and Singh I. 2004. Efficacy of different insecticides against the gram pod borer (*Helicoverpa armigera*) on chickpea (*Cicer arietinum*). Legume Research **27**: 233-234.

Singh S, Choudhary DP, Sharma C, Mahla RS and Mathur YS. 2008. Efficacy of different insecticides against *Helicoverpa armigera* (Hubner) on chickpea *Cicer arietinum*. Indian Journal of Entomology **70**: 177-181.

Suryavanshi DS, Bhede BV, Bosale SV and More DG. 2008. Insecticide resistance in field population of *H. armigera* (Hub.) (Lepidoptera : Noctuidae). Indian Journal of Entomology **70**: 44-46.