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RESEARCH ARTICLE

Studies on management of *Helicoverpa armigera* (Hub.) in chickpea (*Cicer arietinum* L.)

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ABSTRACT

Investigations on management of *H. armigera* (Hub.) on chickpea were conducted at Experimental Farm, College of Agriculture during *Rabi* season in 2005-06. Out of nine insecticidal treatments evaluated for pod borer control, lambda cyhalothrin (0.005%) and profenophos (0.05%) were found most effective in crop protection. Endosulfan (0.07%), acephate (0.05%), cartap hydrochloride (0.05%), NPV (350 LE/ha) and Bt (0.03%) were found moderately effective in reducing pod borer population. Azadirchtin (0.15% and NSKE (5.0%) were least effective. The minimum pod damage (4.72%) was recorded treatment lambda cyhalothrin followed by profenophos treatment (4.98%). The maximum pod damage of 11.73 per cent was in NSKE treatment, while it was 26.03 per cent in control. The maximum yield was obtained in the treatment of lambda cyhalothrin (15.37 q ha^{-1}), while minimum yield with NSKE (12.35 q ha^{-1}) treatment. The yield in untreated control was 10.27 q ha^{-1}.

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INTRODUCTION

Chickpea or gram (*Cicer arietinum* L.) is one of the most important pulse crops grown in the world. Although all the pulses occupy a unique position in Indian agriculture as well as throughout the world, chickpea is considered as "king of pulses". It is also known as Bengal gram, "Chana" or gram, originated from South Western Asia. It is a *Rabi* season crop cultivated throughout India. The main gram growing states are Madhya Pradesh, Uttar Pradesh, Rajasthan, Bihar, Haryana, Maharashtra and Punjab. It occupies 7.28 m ha area and production is 5.77 million tonnes annually with the productivity of 792 kg ha^{-1} (Anonymous, 2004). The major growing districts in Rajasthan are Kota, Sriganganagar, Chittorgarh, Alwar, Tonk, Jalawar, Pali, Jaipur, Sawai Modhopur, Bikaner, Churu, Sikar and Hanumangarh (Anonymous, 2005).Chickpea is a rich source of nutrients *i.e.* protein (17-21%), carbohydrate (61-63%) and fat (4-5%). It also contains calcium, iron, niacin, vitamin B and vitamin C. It provides the valuable protein supplement to the diet of the predominately vegetarian human population, besides it contributes to the national income. It is also considered to have medicinal value for blood purification and is beneficial for diabetic patients. Amongst the several constraints affecting the yield, insect pests were recognized as most important. Among the various insect pests of chickpea, the gram pod borer, *Helicoverpa armigera* (Hubner) is the most biotic constraint (Srivastava and Srivastava, 1990). *H. armigera* is widely distributed species occurring in the middle east Asia, India, Australia and Africa. It assumed major pest status across number of crops because of its high fecundity, migratory behaviour, high adaptation to various climatic conditions and development of resistance to a range of insecticides. Although it attacks chickpea throughout the crop growth, the damage caused during the flowering and pod formation stages result in substantial yield loss. *Helicoverpa* (*Heliothis) armigera* commonly called as gram pod borer, tomato fruit borer, cotton boll worm or American bollworm, is a typical polyphagous pest of sporadic nature, damaging more than 150 plant species, among which are the important crops like pulses, vegetables, cereals, oilseeds, cotton and wild plants (Jayraj, 1982). Chickpea is the most preferred host of *H. armigera,* which suffers losses to the tune of 25 to 75 per cent (Tripathi and Sharma, 1984).

MATERIAL AND METHODS

The experiment was laid out in a Randomized Block Design with 10 varieties/genotypes including RSG-44 with three replications. The plot size was kept 2 × 3 m^2 and row to row and plant to plant distance was maintained as 30 cm and 10 cm. The crop was sown in third week of October, 2005. Population of *H. armigera* (Hub.) was recorded at weekly intervals on chickpea crop during morning hours between 8.00 A.M. to 10.00 A.M. without disturbing the pest. The observations on the incidence of *H. armigera* (Hub.) infesting chickpea were recorded on five randomly selected tagged plants in each plot by counting the larval population. The varieties/genotypes were allowed to have a natural infestation. The observations of larval population of the gram pod borer were recorded soon after the appearance of the pod borer. Weekly observations were recorded till harvesting of the crop. Observation of grain yield was also recorded at harvest.

RESULTS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under following heads :

Effect of insecticidal treatments on reduction of larval population :

An experiment with an aim to test bioefficacy of nine insecticides against gram pod borer, effect on pod damage and grain yield in chickpea was carried out at Experimental Farm, College of Agriculture, Bikaner during *Rabi* season 2005-06. Ten treatments using five chemical insecticides and four biopesticides with an untreated control were tested on chickpea variety RSG-44. Two sprays of each treatment were given as described in materials and methods. The pod borer larval population was recorded one day prior to treatment application (pre-spraying) and after 1, 3, 7 and 15 days of spraying. The results have been presented in Table 1, 2 and 3.

First insecticidal application (first spray) :

After appearance of the pest, first spray was given.

Larval population prior to application of insecticides :

The mean data of larval population of *H. armigera* one day prior to treatment (pre spraying) are presented in Table 1, which revealed that it ranged from 1.33 to 1.67 larvae per five plants. There was non-significant difference observed in larval population among all the treatments.

Larval population one day after the application of insecticides:

The data presented in Table 1 it reveal that all the insecticidal treatments at one day interval proved significantly superior over control in reducing the pod borer population. One day after the treatments of profenophos (0.05%) and lambda cyhalothrin (0.005%) brought 87.83 and 84.72 per cent larval reduction, respectively. Both were statistically at par to each other. These treatments proved significantly better over rest of the treatments in reducing the larval population of *H. armigera*. The next effective treatments were endosulfan (0.07%) and acephate (0.05%) which resulted in 78.31 and 75.33 per cent larval population reduction, respectively and were observed at par to each other in their efficacy. The treatment of cartap hydrochloride (0.05%) was found

Table 1 : Comparative bioefficacy of insecticides against gram pod borer, *H. armigera* (Hub.) in chickpea during *Rabi*-2005-06 (first spray)

Treatments	Conc. (%/LE†)	Pre-treatment larval population	Per cent reduction in larval population*m days after sprays		
			1 DAS	3 DAS	7 DAS
1. Endosulfan	0.07	1.47	78.31** (62.45)	83.73 (66.22)	78.07 (62.12)
2. Acephate	0.05	1.60	75.33 (60.25)	82.18 (65.09)	76.77 (61.27)
3. Lambda cyclothrin	0.005	1.67	84.72 (67.04)	88.84 (70.50)	84.48 (66.91)
4. Cartap hydrochloride	0.05	1.47	60.51 (51.08)	71.96 (58.10)	78.26 (62.21)
5. Profenophos	0.05	1.60	87.83 (69.62)	85.84 (67.95)	82.59 (65.36)
6. Azadirachtin	0.15	1.34	18.79 (25.69)	29.28 (32.76)	39.47 (38.92)
7. NSKE	5.0	1.33	16.21 (23.72)	21.76 (27.81)	32.75 (34.90)
8. NPV	350†	1.40	21.43 (27.56)	30.56 (33.56)	53.31 (46.90)
9. B.t.	0.03	1.34	18.25 (25.28)	29.19 (32.63)	51.97 (46.13)
10. Control	-	1.53	0.00	0.00	0.00
S.Em ±		NS	1.16	1.27	1.29
C.D. (P=0.05)			3.5	3.8	3.87

*Average of three replications, NS = Non-significant significantly superior over the treatments of NPV (350 LE/ha), azadirachtin (0.15%), Bt (0.03%) and NSKE (5.0%). The treatment of NSKE was observed least effective in reducing only 16.21 per cent of larvae. However, NSKE was observed significantly inferior among all the treatments except Bt The order of effectiveness, one day after insecticidal spray were found to be profenophos (0.05%) > lambda cyhalothrin (0.005%) > endosulfan (0.07%) > acephate (0.05%) > cartap hydrochloride (0.05%) >NPV (350 LE/ha) > azadirachtin (0.15%) > Bt (0.03%) > NSKE solution (5.0%).

Larval population three days after the application of insecticides:

The figures of larval population presented in Table 1 reveal that all insecticidal treatments were significantly superior over the untreated control. The most effective insecticide was lambda cyhalothrin followed by profenophos which resulted in 88.84 and 85.84 per cent reduction of pod borer, respectively. Both the treatments were at par. The treatments of endosulfan, acephate, cartap hydrochloride, NPV, azadirachtin and Bt registered larval reduction in between 83.73 per cent to 29.19 per cent. The minimum reduction was observed in the treatment of NSKE (21.76%) which was significantly inferior among all the treatments. The order of effectiveness of insecticides, third day after insecticidal spray was found to be lambda cyhalothrin (0.005%) > profenophos (0.05%) > endosulfan (0.07%) > acephate (0.05%) > cartap hydrochloride (0.05%) >NPV (350 LE/ha) > Bt (0.03%) > azadirachtin (0.15%) > NSKE solution (5.0%).

Larval population reduction seven days after insecticidal application :

At seven days interval also, the treatment of lambda cyhalothrin (84.48%) was found most effective followed by profenophos (82.59%) (Table 1). Both the treatments were comparable to each other. The treatment of cartap hydrochloride, endosulfan, acephate provided 78.26, 78.07 and 76.77 per cent larval reduction, respectively and ranked in next best group of insecticides. All these treatments were found at par. The treatments of NSKE proved least effective (32.75%). The azadirachtin, Bt and NPV proved significantly superior to NSKE with a reduction per cent population as 39.47, 51.97 and 53.31. The order of effectiveness of these treatments, seven days after the application was observed to be lambda cyhalothrin (0.005%) > profenophos (0.05%) > cartap hydrochloride (0.05%) >endosulfan (0.07%) > acephate (0.05%) > NPV (350 LE/ha) > Bt (0.03%) > azadirachtin (0.15%) > NSKE solution (5.0%).

Second spray :

All the treatments were better than control. The second spray was given after fortnight of the first spray.

Larval population prior to application of insecticides :

The pre-treatment number of larvae of gram pod borer *H. armigera* was recorded one day prior to second spray. It ranged from 1.00 to 1.80 per five plants. The mean gram pod borer population exhibited non-significant difference among all the treatments (Table 2).

Larval population one day after the insecticidal spray :

The data presented in Table 2 indicate that all the insecticides proved significantly better in reducing the larval population at one day interval than control. However, significant difference existed among the treatments. The treatment of lambda cyhalothrin proved most effective followed by profenophos and endosulfan. The treatment of lambda cyhalothrin, profenophos and endosulfan were comparable to each other and resulted in 84.22, 82.36 and 80.27 per cent larval reduction one day after application of insecticides. The treatment of acephate, cartap hydrochloride

Table 2 : Comparative bioefficacy of insecticides against gram pod borer, *H. armigera* (Hub.) on chickpea during *Rabi*-2005-06 (second spray)

Treatments	Conc. (%/LE†)	Pre-treatment larval population	Per cent reduction in larval population* days after spray		
			1 DAS	3 DAS	7 DAS
Endosulfan	0.07	1.27	80.27 (63.63)**	85.72 (67.81)	82.50 (65.64)
Acephate	0.05	1.47	77.22 (61.59)	83.76 (63.33)	79.58 (63.16)
Lambda cyhalothrin	0.005	1.33	84.82 (67.09)	92.53 (74.25)	86.97 (68.98)
Cartap hydrochloride	0.05	1.13	63.31 (52.74)	73.26 (58.87)	78.98 (62.71)
Profenophos	0.05	1.40	82.36 (65.17)	87.03 (68.90)	88.19 (69.92)
Azadirachtin	0.15	1.00	18.47 (25.41)	33.49 (35.28)	45.12 (42.20)
NSKE	5.0	1.07	18.15 (25.19)	32.73 (34.87)	43.64 (41.34)
NPV	350†	1.20	27.21 (31.43)	34.78 (36.13)	58.46 (49.87)
Bt	0.03	1.06	22.76 (28.42)	33.71 (35.47)	56.2448.59)
Control	-	1.80	0.00	0.00	0.00
S.E. ±		NS	1.24	1.49	1.53
C.D. (P=0.05)			3.72	4.48	4.59

*Average of three replications, NS = Non-significant, ** Figures in parenthesis are angularly transformed values and NPV recorded 27.21 to 77.22 per cent larval reduction. All these treatments were significantly different in reducing larval population. The treatment of NSKE (18.15%) proved least effective followed by azadirachtin (18.47%) and Bt (22.76%). The treatment of NSKE solution, azadirachtin and Bt were at par and significantly superior than control. The order of effectiveness of these treatments one day after the spray was found to be lambda cyhalothrin (0.005%) > profenophos (0.05%) > endosulfan (0.07%) > acephate (0.05%) > cartap hydrochloride (0.05%) > NPV (350 LE/ha) > Bt (0.03%) > azadirachtin (0.15%) > NSKE solution (5.0%).

Population of pod borer three days after application of insecticides :

Three day after application of insecticidal treatments, it was observed that the effectiveness of insecticides in reducing the larval population was in same trends (Table 2). The maximum larval reduction was recorded in lambda cyhalothrin (92.33%) which was found significantly superior over rest of the treatments. The next effective treatments were profenophos, endosulfan and acephate which provided 87.03, 85.72 and 83.76 per cent larval reduction, respectively in third days after insecticidal sprays. These were at par to each other. The treatments of cartap hydrochloride provided 73.26 per cent larval reduction and ranged as less effective insecticide. However, significant difference existed among all treatment. The treatments of NPV (34.78), Bt (33.71), NSKE (32.73) and azadirachtin (33.49) per cent reduction proved least effective, and were significantly at par. The treatments in decreasing order of efficacy were lambda cyhalothrin (0.005%) > profenophos (0.05%) > endosulfan (0.07%) > acephate (0.05%) > cartap hydrochloride (0.05%) > NPV (350 LE) > Bt (0.03%) > azadirachtin (0.15%) > NSKE solution (5.0%).

Larval population of gram pod borer seven days after spray of treatment :

At seven days interval, the treatment of profenphos was found most effective followed by lambda cyhalothrin and endosulfan (Table 2). However, former two treatments were comparable to each other and registered 88.19 and 86.97 per cent larval reduction, respectively seven days after insecticidal spray. Similarly later two treatments were also at par to each other. The treatments of acephate and cartap hydrochloride existed in next best group of treatments by providing 79.58 and 78.98 per cent larval reduction. The treatments of NPV (58.46%) and Bt (56.24%) existed in less effective group of insecticides. The treatments of NSKE and azadirachtin proved least effective insecticides by providing 43.64 and 45.12 per cent larval reduction and were comparable to each other. However, both these treatments were observed significantly better than control. The order of these insecticides after seven days was found to be profenophos (0.05%) >lambda cyhalothrin (0.005%) > endosulfan (0.07%) > acephate (0.05%) > cartap hydrochloride (0.05%) > NPV (350 LE/ha) > Bt (0.03%) > azadirachtin (0.15%) > NSKE solution (5.0%).

Over all efficacy of insecticidal application :

On the basis of two spray given in the year 2005-06 against gram pod borer, *H. armigera* revealed that the treatment of lambda cyhalothrin followed by profenophos was found most effective. The treatments of endosulphan, acephate and cartap hydrochloride ranked in middle order of efficacy in reducing the gram pod borer population. The treatment of NSKE, followed by azadirachtin, Bt and NPV were found least effective in the present investigation.

Effect of insecticides on pod damage :

The data presented in Table 3 reveal that all the

Table 3 : Comparative bioefficacy of insecticides on the infestation of gram pod borer, *H. armigera* (Hub.) on basis of pod damage and yield of chickpea during *Rabi* 2005-06

Treatments	Conc. (%/LE†)	Pod damage (%)	Yield (q ha^{-1})	Per cent yield increase over control
Endosulfan	0.07	6.65 (14.95)**	14.70*	43.13
Acephate	0.05	7.29 (15.66)	14.50	41.18
Lambda cyhalothrin	0.005	4.72 (12.47)	15.37	49.66
Cartap hydrochloride	0.05	8.53 (16.98)	13.93	35.64
Profenophos	0.05	4.98 (12.89)	15.10	47.03
Azadirachtin	0.15	11.20 (19.54)	12.83	24.93
NSKE	5.0	11.73 (20.03)	12.35	20.25
NPV	350†	10.14 (18.54)	13.33	29.80
Bt	0.03	10.72 (19.10)	13.00	26.58
Control	-	26.03 (30.67)	10.27	-
S.E. ±		0.47	0.197	-
C.D. (P=0.05)		1.40	0.58	-

*Average of three replications, ** Figures in parenthesis are angularly transformed values insecticides proved significantly better in lowering the pod damage in comparison to control. The treatment of lambda cyhalothrin recorded lowest pod damage (4.72%) followed by profenophos (4.98%). However, both the treatments were comparable to each other and significantly superior to rest of the treatments. The treatment of endosulfan and acephate registered 6.65 and 7.29 per cent pod damage, respectively and both the treatments were superior to rest of the treatments except lambda cyhalothrin and profenophos.

The treatment of cartap hydrochloride ranked next to acephate and registered 8.53 per cent pod damage which was significantly superior to NPV, Bt, azadirachtin and NSKE. The treatments of NSKE and azadirachtin recorded 11.73 and 11.20 per cent pod damage, respectively being at par to each other. However, these treatments were significantly better in lowering the pod damage in comparison to control (26.03%).The order of effectiveness of insecticides for crop protection on the basis of pod damage of chickpea was lambda cyhalothrin (0.005%) > profenophos (0.05%) > endosulfan (0.07%) > acephate (0.05%) > cartap hydrochloride (0.05%) > NPV (350 LE/ha) > Bt (0.03%) > azadirachtin (0.15%) > NSKE solution (5.0%).

Effect of insecticidal treatments on yield of chickpea :

It is evident from Table 3 that all the insecticides brought higher yield of chickpea as compare to control (10.27 q ha^{-1}). The maximum yield was obtained in the treatment of lambda cyhalothrin (15.37 q ha^{-1}) followed by profenophos (15.10 q ha^{-1}). However, both the treatments were at par and emerged as highly effective in increasing the yield. The next effective insecticides which increased the yield were endosulfan (0.07%) and acephate (0.05%) which resulted in 14.70 and 14.50 q ha^{-1} yield in the present investigation. The cartap hydrochloride (0.05%), NPV (350 LE) and Bt (0.03%) brought grain yield in between 13.00 to 13.93 q ha^{-1}.

The minimum grain yield was obtained in the treatment of NSKE (12.35 q ha^{-1}) followed by azadirachtin (12.83 q ha^{-1}). Both the treatments were at par and significantly superior to untreated control which registered 10.27 q ha^{-1} grain yield. The order of effectiveness of insecticides for crop protection on the basis of grain yield was lambda cyhalothrin (0.005%) > profenophos (0.05%) > endosulfan (0.07%) > acephate (0.05%) > cartap hydrochloride (0.05%) > NPV (350 LE) > Bt (0.03%) > azadirachtin (0.15%) > NSKE solution (5.0%)> control.

The treatment of NPV was found most effective among the bio-pesticides in the present findings but does not corroborate with the findings of Odak *et al.* (1982), Ali *et al.* (1993), and Kulat *et al.* (1999) who reported NPV as less effective against gram pod borer as compared to Bt Azadirachtin was found as less effective as reported by Sharma (1998) also.

REFERENCES

Ali, M.L., Miali, M.D. and Karim, M.A. (1993). Efficacy of two bio-insecticides in controlling *Helicoverpa armigera* (Hub.) in chickpea. *Legume Res.*, **16** : 91-94.

Anonymous (2004). *Agriculture statistics at a glance.* IFFCD, NEW DELHI (INDIA).

Anonymous (2005). Profuction prospects of *Rabi* 2004-05 and programme for *Kharif* 2005. Agriculture in Rajasthan, Department of Agriculture.

Jayraj, S. (1982). Biological and ecological studies of *Heliothis.* Proceedings of the international workshop on Heliothis management ICRIST centre Patancheru, A.P. Indian, November, 15-20, 1981 pp. 17-28.

Kulat, S.S., Nimbalkar, S.A., Radke, S.G. and Tambe, V.J. (1999). Evaluation of biopesticides and neem seed kernel extract against *Helicoverpa armigera* on chickpea. *Indian J. Ent.*, **61**(1) : 19-21.

Meena, S.R. (2000). Biology and management of gram pod borer, *Heliothis armigera* (Hubner) on gram [*Cicer arietinum* (L.)]. M.Sc. Thesis, Rajasthan Agricultural University, Bikaner, RAJASTHAN (INDIA).

Meena, V.R. (1999). Management of gram pod borer *Heliothis armigera* (Hub.) infesting gram. M.Sc. Thesis, Rajasthan Agricultural University, Bikaner, RAJASTHAN (INDIA).

Odak, S.C., Shrivastava, N. and Nema, K.K. (1982). Incidence of pod borer *Heliothis armigera* (Hubner) on different genotypes of gram (*Cicer aritinum*). *Pulses Newsletter,* **2** : 50-51.

Sharma, S.D. (1998). Management of gram caterpillar, *Helicoverpa armigera* (Hubner) in Kalizira in high hill region of Himachal Pradesh. *Indian J. Pl. Prot.*, **26**(1) : 18-20.

Srivastava, C.P. and Srivastava, R.P. (1990). Antibiosis in chickpea, *Cicer arietinum* (L.) to gram pod borer, *Helicoverpa armigera* (Hub.). *Entomon*., **15**(1-2) : 89-93.

Tripathi, S.R. and Sharma, S.K. (1984). Biology of *Helicoverpa armigera* (Hubner) in arai belt of eastern Uttar Pradesh, India. (Lepidoptera : Noctuidae). *Giarnale italiana di Entomologia*, **2** : 215-222.