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BIOEFFICACY OF NEWER INSECTICIDES AGAINST GRAM POD BORER, *HELICOVERPA ARMIGERA* (HUBNER) ON CHICKPEA

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ABSTRACT
A field experiment was conducted at Research Farm, Agricultural Research Station, Badnapur (VNMKV, Parbhani) and Maharashtra, India during *Rabi* 2014-15 to determine the efficacy of different treatments in chickpea. The study revealed the treatment with emamectin benzoate 5 WG @ 15.0 g a.i./ha was found as best treatment with minimum larval population of *H. armigera i.e.* 0.37, 0.27 and 0.13 larvae per plant; lowest pod damage *i.e.* 8.30, 6.89 and 5.83 per cent at one, three and seven days after spray; with least grain damage *i.e.* 3.33 per cent, maximum grain yield (2196 kg per ha) and cost benefit ratio (1:3.72). The least effective treatment was lamda-cyhalothrin 5 EC @ 25.0 g a.i./ha with maximum population of *H. armigera* larvae *i.e.* 1.23, 0.93 and 0.63 larvae per plant; pod damage *i.e.* 11.16, 8.69 and 7.80 per cent at one, three and seven days after spraying; grain damage (7.33 per cent) and lowest grain yield (1748 kg per ha) as well as cost benefit ratio (1:2.02). The results revealed the emamectin benzoate 5 WG @ 15.0 g a.i./ha was found as best treatment with novel mode of action.

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is the third most important pulse crop in the world, after dry beans and field peas (FAOSTAT, 2008). The major insect pests of chickpea *viz.,* termites (*Odontotermes obesus*), cutworms (*Agrotis ipsilon*, *A. segetum*, *A. spinifera* and *Mythimna separata*) appear during seedling stage in certain areas; while gram pod borer, *Helicoverpa armigera* (Lepidoptera: Noctuidae) appear in great number during vegetative growth and at pod formation stage of chickpea (Lal, 1996). It attacks tender foliage, flowers and pods of chickpea. Being a multivoltine polyphagous pest, it attacks more than 181 plant species including chickpea, pigeonpea, tomato, okra and cotton *etc.* (Manjunath *et al.*, 1989) and has become a pest of national importance by causing great economic losses to chickpea (Ahmed and Awan, 2013; Kumar and Singh, 2014; Jat and Ameta, 2013). The wider host range, multiple generation, migratory behavior and high fecundity of gram pod borer made difficult to manage. The substantial yield loss due to *H. armigera* is 9 to 60 per cent (Sithananthan *et al.*, 1984). The yield losses of chickpea grain due to *H. armigera* were 75-90 per cent and in some places losses were up to 100 per cent (Lal, 1996). Chickpea pod borer causes yield losses over US $ 2 billion in the semi arid tropics despite application of insecticides costing US $ 500 million annually (ICRISAT, 2005). For management of gram pod borer, agrochemicals are still the first choice of farmers. The chemical control is still considered as the last resort for its management due to their quick known effect (Sreekanth *et al.*, 2014). Farmers, use chemical pesticides indiscriminately, which leads to increased cost of plant protection resulting in lower profitability. A number of insecticides have been reported to be effective for controlling *H. armigera* in different crops (Ujagir, 2000; Ahmed *et al.*, 2004; Ghosh *et al.*, 2010; Meena and Raju, 2014; Dhaka *et al.*, 2015). Exploring new insecticides with lesser residues, lower environmental threat, novel mode of action and more remunerative has become imperative. Therefore, in present investigation newer insecticides with novel mode of action were evaluated to find out an effective and remunerative insecticide for the management of gram pod borer, *H. armigera* in chickpea.

MATERIALS AND METHODS

A field experiment was conducted at Research Farm, Agricultural Research Station, Badnapur (VNMKV, Parbhani) and Maharashtra, India during *Rabi* 2014-15 to determine the efficacy of different treatments in chickpea. The chickpea Cv. BDNG-798 raised in 2.25 m × 2.0 m plots with a spacing of 45 cm × 15 cm between rows and plants with standard agronomic practices. The experiment was laid in randomized block design (RBD) with eight treatments and three replications. Application of insecticides was initiated at the stage of pod formation . In total two sprays of each insecticide were given at 15 days interval with high volume knapsack sprayer using spray fluid @ 500 liter per ha for each spray. The observations on larval population and pod damage were recorded from randomly selected five tagged plants in each plot at one day before spray (DBS) and one, three and seven days after each spray (DAS) as per the method suggested by Dhaka *et al.* (2011) and Singh *et al.* (2015), respectively. Per cent grain damage was recorded in respect of *H. armigera* at harvest and grain yield in different treatments was recorded from net plot area and converted in to ha basis. Per cent pod and grain damage was calculated with following formula suggested by Kumar *et al.* (2013).

$$\text{Percent damage} = \frac{\text{Number of damaged pods or grains}}{\text{Total number of pods or grains}} \times 100$$

Economics of all the treatments were worked out by considering price of chickpea produce, cost of insecticides and labour charge, respectively. Cost benefit ratio (CBR) was worked out to find out the best cost effective insecticidal treatment with novel mode of action (Singh *et al.*, 2014; Chavan *et al.*, 2015). Also, the observations on natural enemy population were recorded from randomly selected five plants at one day before and one, three and seven days after each spray (Singh and Verma, 2006). Thus the data generated from various insecticidal treatments along with untreated check was subjected to statistical analysis to draw meaningful conclusions. The observations on phytotoxicity *viz.,* injury on leaf tips, wilting, vein clearing, necrosis, epinasty and hyponasty were recorded on one, three and seven days after each spray using 1 to 10 score recommended by Central Insecticide Board. Per cent leaf injury was calculated with following formula suggested by Nishantha *et al.* (2009).

$$\text{Per cent leaf injury} = \frac{\text{Total grade points}}{\text{Maximum grade} \times \text{Number of leaves observed}} \times 100$$

1-10 score recommended by Central Insecticide Board to measure the intensity of leaf injury due to insecticides (Nishantha *et al.*, 2009)

Score	Per cent leaf injury	Score	Per cent leaf injury
0	No adverse effect	6	51-60
1	1-10	7	61-70
2	11-20	8	71-80
3	21-30	9	81-90
4	31-40	10	91-100
5	41-50		

RESULTS AND DISCUSSION

The mean data on gram pod borer larval population of first and second spray is presented in Table 1. The data revealed the population of *H. armigera* larvae was non-significant on one day before spray indicating uniform distribution of pest on chickpea crop. All the treatments were effective in reducing *H. armigera* population over untreated control. Among all the treatments, emamectin benzoate 5 WG @ 15.0 g a.i./ha emerged as most effective treatment which recorded lowest population of *H. armigera* larvae *i.e.* 0.37, 0.27 and 0.13 larvae per plant at one, three and seven days after spray, respectively. This was followed by chlorantraniliprole 20 SC @ 25.0 g a.i./ha (0.60, 0.30 and 0.17 larvae per plant), closely followed by emamectin benzoate 5 SG @ 11.0 g a.i./ha (0.80, 0.43 and 0.27 larvae per plant), emamectin benzoate 5 WG @ 7.5 g a.i./ha (1.00, 0.67 and 0.67 larvae per plant), emamectin

Table 1: Larval population of *H. armigera* in different insecticidal treatments on chickpea

Treatment	Larval population (larva per plant)*			
	1 DBS	1 DAS	3 DAS	7 DAS
Emamectin benzoate 5WG @ 5 g a.i/ha	1.07(1.25)	1.27(1.33)	0.77(1.13)	0.50(1.00)
Emamectin benzoate 5WG @ 6.25 g a.i/ha	1.33(1.35)	1.10(1.26)	0.70(1.10)	0.40(0.95)
Emamectin benzoate 5WG @ 7.5 g a.i/ha	1.30(1.34)	1.00(1.22)	0.67(1.08)	0.37(0.93)
Emamectin benzoate 5WG @ 15.0 g a.i/ha	1.27(1.33)	0.37(0.93)	0.27(0.88)	0.13(0.82)
Emamectin benzoate 5SG @ 11.0 g a.i/ha	1.30(1.34)	0.80(1.14)	0.43(0.96)	0.27(0.88)
Lambda-cyhalothrin 5EC @ 25.0 g a.i./ha	1.37(1.37)	1.23(1.32)	0.93(1.20)	0.63(1.06)
Chlorantriniliprole 20SC @ 25.0 g a.i./ha	1.03(1.24)	0.60(1.05)	0.30(0.89)	0.17(0.82)
Control	1.20(1.30)	1.47(1.40)	1.43(1.39)	1.17(1.29)
SE (m) ±	0.02	0.03	0.02	0.02
CD at 5%	NS	0.08	0.06	0.07
CV%	3.05	4.19	3.59	4.49

*Figures of population in parenthesis are "x + 0.5 values

Table 2: Pod and grain damage due to *H. armigera* in different insecticidal treatments on chickpea

Treatment	Pod damage (per cent)**				Grain Damage
	1 DBS	1 DAS	3 DAS	7 DAS	(per cent)**
Emamectin benzoate 5WG @ 5 g a.i/ha	9.88(18.34)	11.20(19.55)	8.09(16.54)	7.15(15.45)	6.67(15.05)
Emamectin benzoate 5WG @ 6.25 g a.i/ha	10.86(19.28)	10.29(18.72)	7.68(16.11)	7.03(15.34)	6.00(14.18)
Emamectin benzoate 5WG @ 7.5 g a.i/ha	11.16(19.55)	9.76(18.24)	7.59(16.00)	6.76(15.12)	5.33(13.31)
Emamectin benzoate 5WG @ 15.0 g a.i/ha	10.99(19.37)	8.30(16.74)	6.79(15.12)	5.83(13.94)	3.33(10.47)
Emamectin benzoate 5SG @ 11.0 g a.i/ha	9.91(18.34)	9.41(17.85)	7.33(15.68)	6.57(14.89)	4.67(12.52)
Lambda-cyhalothrin 5EC @ 25.0 g a.i./ha	11.18(19.46)	11.16(19.55)	8.69(17.15)	7.80(16.22)	7.33(15.68)
Chlorantriniliprole 20SC @ 25.0 g a.i./ha	9.14(17.56)	9.42(17.85)	7.00(15.34)	6.40(14.65)	4.00(11.54)
Control	9.50(17.95)	12.81(20.96)	10.21(18.63)	9.25(17.66)	10.00(18.43)
SE (m) ±	0.65	0.49	0.38	0.23	1.08
CD at 5%	NS	1.42	1.11	0.67	3.14
CV%	6.00	4.55	4.08	2.59	13.65

**Figures of percentage in parenthesis are angular transformed values

Table 3: Economics of different insecticidal treatments used against *H. armigera*

Treatments	Yield (kg/ha)	Increase in yield over control (kg/ha)	Cost of insecticide (two sprays) (Rs. /ha)	Total cost of plant protection (Rs./ha)	Additional yield over control (Rs./ha)	Incremental benefit (Rs./ha)	CBR
Emamectin benzoate 5WG @ 5.00 g a.i/ha	1844	204	1500	2300	9180	6880	1:2.99
Emamectin benzoate 5WG @ 6.25 g a.i/ha	1887	247	1875	2675	11115	8440	1:3.15
Emamectin benzoate 5WG @ 7.50 g a.i/ha	1946	306	2250	3050	13770	10720	1:3.51
Emamectin benzoate 5WG @ 15.00 g a.i/ha	2196	556	4500	5300	25020	19720	1:3.72
Emamectin benzoate 5SG @ 11.00 g a.i/ha	2072	432	3476	4276	19440	15164	1:3.55
Lambda-cyhalothrin 5EC @ 25.0 g a.i/ha	1748	108	810	1610	4860	3250	1:2.02
Chlorantriniliprole 20SC @ 25.0 g a.i/ha	2180	540	4500	5300	24300	19000	1:3.58
Control	1640	-	-	-	-	-	-
SE (m) ±	0.93	-	-	-	-	-	-
CD at 5%	2.69	-	-	-	-	-	-
CV%	8.30	-	-	-	-	-	-

Cost of insecticides: Emamectin benzoate 5WG = 750 Rs/100 g, Emamectin benzoate 5SG = 790 Rs/100 g, Lambda-cyhalothrin 5EC = 405 Rs/500 ml and Chorantraniliprole 20SC = 180 Rs/10 ml; Labour charges = 200 Rs./spray/person @ two persons and Market value of chickpea grains = 45 Rs./kg.

Table 4: Population of *C. chlorideae* in different insecticidal treatments

Treatment	*C. chlorideae* (number per plant)			
	1 DBS	1 DAS	3 DAS	7 DAS
Emamectin benzoate 5WG @ 5 g a.i/ha	0.27(0.88)	0.13(0.80)	0.23(0.86)	0.23(0.86)
Emamectin benzoate 5WG @ 6.25 g a.i/ha	0.10(0.77)	0.20(0.84)	0.17(0.82)	0.10(0.77)
Emamectin benzoate 5WG @ 7.5 g a.i/ha	0.20(0.84)	0.23(0.86)	0.20(0.84)	0.10(0.77)
Emamectin benzoate 5WG @ 15.0 g a.i/ha	0.27(0.88)	0.07(0.75)	0.10(0.77)	0.17(0.82)
Emamectin benzoate 5SG @ 11.0 g a.i/ha	0.13(0.80)	0.10(0.77)	0.03(0.73)	0.03(0.73)
Lambda-cyhalothrin 5EC @ 25.0 g a.i./ha	0.17(0.82)	0.07(0.75)	0.07(0.75)	0.20(0.84)
Chlorantriniliprole 20SC @ 25.0 g a.i./ha	0.20(0.84)	0.10(0.77)	0.10(0.77)	0.10(0.77)
Control	0.20(0.84)	0.33(0.91)	0.23(0.86)	0.30(0.89)
SE (m) ±	0.04	0.04	0.04	0.03
CD at 5%	NS	NS	NS	NS
CV%	9.24	7.88	8.18	7.68

Figures of population in parenthesis are "x + 0.5 values

Table 5: Phytotoxicity of different insecticidal treatments under study

Treatment	Injury on leaf tips	Vein clearing	Wilting	Necrosis	Epinasty	Hyponasty
Emamectin benzoate 5WG @ 5.00 g a.i/ha	0	0	0	0	0	0
Emamectin benzoate 5WG @ 6.25 g a.i/ha	0	0	0	0	0	0
Emamectin benzoate 5WG @ 7.50 g a.i/ha	0	0	0	0	0	0
Emamectin benzoate 5WG @ 15.00 g a.i/ha	0	0	0	0	0	0
Emamectin benzoate 5SG @ 11.00 g a.i/ha	0	0	0	0	0	0
Lambda-cyhalothrin 5EC @ 25.0 g a.i/ha	0	0	0	0	0	0
Chlorantriniliprole 20SC @ 25.0 g a.i/ha	0	0	0	0	0	0
Control	-	-	-	-	-	-

benzoate 5 WG @ 6.25 g a.i/ha (1.10, .070 and 0.40 larvae per plant) and emamectin benzoate 5 WG @ 5 g a.i/ha (1.27, 0.77 and 0.50 larvae per plant) having at par effect with each other,Lamda-cyhalothrin 5 EC @ 25.0 g a.i./ha was least effective against *H. armigera* larval population and recorded 1.23, 0.93 and 0.63 larvae per plant at one, three and seven days after spraying, respectively, but superior over control. The results of present investigation related to larval population of *H. armigera* in different insecticidal treatments under study are in accordance with Singh *et al*. (2015), who reported that the treatment with flubendiamide 480 SC @ 75 ml/ha was found best with minimum population of *H. armigera* at first spray with 1.67 (3 DAS) and 2.33 larvae per five plants (7 DAS) and at second spray with 2.00 (3 DAS) and 2.67 larvae per five plants (7 DAS), respectively. Chavan *et al*. (2015) wherein the minimum larval incidence of *H. armigera* 0.95 and 0.36 larva per meter row length was recorded in rynaxypyr 20 SC at 3 and 7 days after spraying, respectively. This was followed by flubendiamide 48 SC (1.47 and 0.78 larvae per meter row length) and emamectin benzoate 5 SG (1.55 and 0.89 larvae per meter row length) as against conventional insecticide profenophos 50 EC which recorded 2.09 and 1.49 larvae per meter row length. Similarly, Hosamani *et al*. (2013) found that chlorantraniliprole 20 SC @ 20 g a.i./ha recorded

0.69 larvae per meter row length and it was on par with its higher dosage treatments @ 30 and 25 g a.i./ha which recorded 0.48 and 0.50 larvae per meter row length, respectively and these treatments were at par with emamectin benzoate 5 SG @ 11 g a.i./ha and spinosad 45 SC @ 22.5 g a.i./ha which recorded 0.61 and 0.77 larvae per meter row length, respectively and were superior to all other treatments during 2008-09.

The mean data on per cent pod damage due to *H. armigera* of first and second spray is presented in Table 2. The data revealed the pod damage was non-significant on one day before spray indicating uniform distribution of pest and its damage on chickpea crop, respectively. All the treatments were found significantly superior to the control in respect of pod damage. The lower pod damage was recorded from emamectin benzoate 5 WG @ 15.0 a.i./ha *i.e.* 8.30, 6.89 and 5.83 per cent at one, three and seven days after spray, respectively and maximum pod damage was recorded in the treatment of lamda-cyhalothrin 5 EC @ 25.0 a.i./ha *i.e.* 11.16, 8.69 and 7.80 per cent, respectively. All other treatments were showed moderate per cent pod damage included emamectin benzoate 5 SG @ 11.0 g a.i./ha (9.41, 6.35 and 6.57 per cent), chlorantriniliprole 20 SC @ 25.0 a.i./ha (9.42, 7.00 and 6.40 per cent), emamectin benzoate 5 WG @ 7.5 g a.i./ha (9.76, 7.59 and 6.76 per cent), emamectin benzoate 5 WG @ 6.25 g a.i./ha (10.29, 7.68 and 7.03 per cent) and emamectin benzoate 5 WG @ 5 g a.i./ha (11.20, 8.09 and 7.15 per cent) having at par effect with each other. The results of present investigation related to per cent pod damage due to *H. armigera* in different insecticidal treatments under study are in accordance with Hossain *et al*. (2010), who reported that the lowest pod damage (2.55 per cent) was observed in the treatment where lamda-cyhalothrin applied three times at 7 days interval from flowering stage as compared to NSKE. Raghvani and Poshiya (2006), reported that novaluron 100 g a.i./ha registered lower pod damage (4.83 per cent) followed by emamectin benzoate 11 g a.i./ha (5.13 per cent) and spinosad 60 g a.i./ha (6.83 per cent). Pod damage for the other insecticides under study was varied from 7.16 to 8.62 per cent.

The data on effect of different insecticides on chickpea grain damage due to *H. armigera* is presented in Table 2. The chickpea grain damage varied from 3.33 to 10.00 per cent. The least grain damage was recorded in treatment application of emamectin benzoate 5 WG @ 15.0 g a.i./ha *i.e.* 3.33 per cent and found most effective in reducing chickpea grain damage due to gram pod borer. This was followed by chlorantraniliprole 20 SC @ 25.0 g a.i./ha (4.00 per cent), emamectin benzoate 5 SG @ 11.0 g a.i./ha (4.67 per cent), emamectin benzoate 5 WG @ 7.5 g a.i./ha (5.33 per cent), emamectin benzoate 5 WG @ 6.25 g a.i./ha (6.00 per cent), emamectin benzoate 5 WG @ 5 g a.i./ha (6.67 per cent) and lambda-cyhalothrin 5 EC @ 25.0 g a.i./ha (7.33 per cent), respectively; and having at par effect with each other. The highest grain damage was recorded from untreated control plot *i.e.* 10.00 per cent.

The data on grain yield and economics of different insecticides used under study is presented in Table 3. All the treatments were significantly superior over control (untreated) regarding grain yield and cost effectiveness, respectively. The maximum grain yield was recorded from plots receiving treatment of emamectin benzoate 5 WG 15.0 g a.i/ha and chlorantriniliprole 20 SC @ 25.0 a.i./ha *i.e.* 2196 and 2180 kg per ha, respectively; while the minimum yield was obtained with the treatment of lambda-cyhalothrin 5 EC @ 25.0 g a.i/ha *i.e.* 1748 kg per ha but superior over control. All other treatments *viz*., emamectin benzoate 5 SG @ 11.0 g a.i./ha (2072 kg per ha), emamectin benzoate 5 WG @ 7.5 g a.i./ha (1946 kg per ha), emamectin benzoate 5 WG @ 6.25 g a.i./ha (1887 kg per ha) and emamectin benzoate 5 WG @ 5 g a.i./ha (1844 kg per ha) were shown intermediate grain yield and having at par effect with each other . The results of present investigation related to grain yield in different insecticidal treatments under study are in accordance with Chavan *et al*. (2015), who reported that the highest grain yield (2590 kg per ha) was recorded with rynaxypyr 20 SC followed by flubendiamide 48 SC (2365 kg per ha) and emamectin benzoate 5 SG (2292 kg per ha), respectively; as compare to profenophos. Similarly, Sarwar (2012) observed that endosulfan given best results followed by lambda-cyhalothrin, fenpropathrin, neemokill and the check plots in increasing grain yield (1846.66, 1725.00, 1535.00, 1405.00 and 1211.66 gram per 6 m^2, respectively). Similarly, Hossain *et al*. (2010) found that the seed yield was maximum with lamda-cyhalothrin (1338 kg per ha) sprayed thrice which was identical to sprayed twice (1280 kg per ha).

In respect of cost benefit ratio (CBR) of various insecticidal treatments, maximum cost benefit ratio (1:3.72) was obtained from the plots receiving emamectin benzoate 5WG @ 15.0 g a.i/ha and lowest cost benefit ratio was obtained from plots receiving lambda-cyhalothrin @ 25.0 a.i./ha (1:1.04), respectively. Remaining all other treatments *viz*., chlorantriniliprole 20 SC @ 25.0 a.i./ha (1:3.58), emamectin benzoate 5 SG @ 11.0 g a.i./ha (1:3.54), emamectin benzoate 5 WG @ 7.5 g a.i./ha (1:3.51), emamectin benzoate 5 WG @ 6.25 g a.i./ha (1:3.15) and emamectin benzoate 5 WG @ 5 g a.i./ha (1:2.99) were shown intermediate cost benefit ratios. The results of present investigation related to economics of different insecticidal treatments under study are in accordance with Chavan *et al*. (2015), who reported that the highest ICBR was recorded in flubendiamide 48 SC (1:19.22) followed by rynaxypyr 20 SC (1:11.1), profenophos 50 EC (1:7.8), emamectin benzoate 5 SG (1: 4.2) and lufenuron 5.4 EC (1:3.5), respectively. Hossain *et al*. (2010) reported that the highest marginal benefit cost ratio (3.19) was recorded from lamda-cyhalothrin sprayed twice as compared to lamda-cyhalothrin sprayed thrice as well as NSKE.

The mean data on population of *Campoletis chlorideae* at one day before and one, three and seven days after spraying is presented in Table 4. It is clear from the data that, the population of *C. chlorideae* was non-significant in all the treatments and recorded more or less similar population as compared to untreated control; there by indicating the safeness of insecticides against *C. chlorideae* population at one, three and seven days after spray application during 1st and 2nd spraying. The results are in accordance with Singh and Verma (2006), who reported that the application of different insecticides *viz*., novaluron, emamectin benzoate and spinosad was found no adverse effect on predators and parasites, respectively.

The data presented in Table 5 indicates phytotoxicity effect of different insecticidal treatments. It is clear from the data that, none of the treatments showed any type of phytotoxic effect on chickpea at different doses of insecticides and their schedules used in the experiments. The results of present investigation related to phytotoxicity of different insecticidal treatments under study are in accordance with; Kambrekar *et al*. (2012), who reported that no phytotoxic effect caused due to application of emamectin benzoate 5 SG @ 13 g a.i./ha and emamectin benzoate 5SG @ 11 g a.i./ha on chickpea crop. Nishantha *et al*. (2009) found that none of the insecticidal treatment including E2Y45 (= chlorantriniliprole) showed any phytotoxic effect to pigeonpea plant at different doses of insecticides and their schedules used in the experiments. Singh and Verma (2006) observed no phytotoxicity in plots treated with novaluron, emamectin benzoate and spinosad, respectively. Similarly, Raghvani and Poshiya (2006) reported that the treatment emamectin benzoate 5 SG @8, 9 and 10 g a.i./ha showed no phytotoxic effect on chickpea crop.

The insecticides *viz*., emamectin benzoate 5 WG @ 15.0 g a.i/ha and chlorantraniliprole 20 SC @ 25.0 g a.i/ha were identified as most effective against *H. armigera* in the present study may be utilized for *H. armigera* management in farmers fields due to maximum *H. armigera* reduction, minimum per cent pod and grain damage, maximum chickpea grain yield and cost benefit ratio, respectively. These insecticides can fit in integrated pest management (IPM) modules due to no phytotoxicity effect and safeness to natural enemies, respectively.

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