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RESEARCH ARTICLE

Bio-efficacy of newer insecticides against gram pod borer *Helicoverpa armigera* (Hubner) on chickpea (*Cicer arietinum* L.)

■ **S. Patel, V. K. Garg and S. Balpande**

SUMMARY

Six insecticides namely Emamectin benzoat 5% SG, Spinetoram 11.7% SC, Spinosad 45.0% SC, Flubendiamide 48 % SC, Chlorantraniliprole 18.5% SC, Novaluron 10% EC were evaluated against Gram Pod Borer (*Helicoverpa armigera* Hubner) larvae. The Gram Pod Borer (GPB) larval population was counted on five randomly selected plants, 24 hrs. before spray and at 3, 7 and 10 days after spray. The two-year experiment was conducted during *Rabi* 2018-19 and 2019-20 at the Rehti Farm of school of agriculture, Mhow, experimental field of Department of Entomology, BRAUSS, (MP). All the Chemical insecticides significantly reduced the GPB larval population. The Pooled GPB population varied from 2.23 to 2.57 larvae/ plant during *Rabi* season at one day prior to first spray. The population was significant lower with, Chlorantraniliprole 18.5% SC, followed by Spinetoram 11.7% SC, Spinosad 45.0% SC, Flubendiamide 48 % SC and Emamectin benzoat 5% SG these five insectiicdes are showing best management effects on the GPB larvae and pod damage .Novaluron 10% EC gave are least effective on larval population and pod damage. The highest chickpea grain yield (19.13q/ha) was obtained with Chlorantraniliprole 18.5% SC.

Key Words : Chickpea, *H. armigera*, Damage, Grain yield, Chlorantraniliprole, Emamectin benzoat, Spinetoram, Spinosad, Flubendiamide, Novaluron

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Chickpea (*Cicer arietinum* L.) an important food legume crop is rich in protein (20 to 25%) and several essential amino acids. In the world, chickpea is cultivated in about 10.4 million hectares and producing 8.57 million tones of seeds with a productivity of 824 kg ha^{-1}. As many as 45 countries, including India, growing chickpea, but dozen of countries together contribute 96 per cent to the global production. India grows chickpea on about 10.22 million hectares of land

and producing 9.83 million tones of seeds with a productivity of 967 kg ha^{-1} (Anonymous, 2014). Major chickpea producing states in India are Madhya Pradesh, Uttar Pradesh, Maharashtra, Andhra Pradesh, Rajasthan, Gujarat and Karnataka which together contribute 93 per cent of the production from 92 per cent of area (Ali and Kumar, 2005). In Madhya Pradesh, chickpea is cultivated in about 3.11million hectares of land, producing 2.68 million tones of grains with a productivity of 864 kg ha^{-1} which is lower than the national productivity of 967 kg ha^{-1}. The Pod borer, *Helicoverpa armigera* (Hubner) is a predominant species causing economic damage to chickpea. 10 to 60 per cent yield loss in chickpea due to pod borer is observed in normal weather conditions (Vaishampayan and Veda, 1980), while it enhances up to 50 to 100 per cent in favorable weather conditions, *ie.* frequent rain and cloudy weather during the crop season (Garg *et al.,* 2015). There is an urgent need to select safer insecticides and efficient enough to keep the pests below economic injury level. With these points in view, the present two *Rabi* seasons study to evaluate few insecticides against larvae of *H. armigera* in chickpea under field conditions.

MATERIAL AND METHODS

A testing trail was conducted at experimental field of Department of Entomology, Rehti Farm of school of agriculture Mhow, BRAUSS, (MP) during 2018-19 and 2019 in Randomized Block Design (RBD) with seven treatments including untreated control with three replications. The plot size was 5.0 × 6.0 m^2, row to row and plant to plant distance of 30 cm and 10 cm, respectively on evaluation of newer insecticides against gram pod borer on. The seeds of variety JG-14 were sown on November 12th2018 and November 11th 2019.All the six Chemical treatments were applied as foliar spray. The untreated (control) plot was also maintained for the comparison with water spray. The first spray was given on economic threshold level of the pod borer, whereas, the second spray was given after one fortnight of the first spray.

Observations were recorded before twenty-four hours of each spray as pretreatment and after 3, 7 and 10 days upto two spraying. Larval counts and pod damage were recorded from five randomly selected and tagged plants per treatment. Pod damage was converted in percentage. Based on these observations mean data was worked out and statistically analyzed after suitable

Table-1: Bio efficacy evaluation of newer insecticides against gram pod borer (*H. armigera*) larval population and pod dame (Pooled data)

Treatments	Form. /ha. (gm/ml)	larval population/ plant										% pod damage	Yield (q/ha)
		First spray					Second spray						
		DBS	3 DAS	7 DAS	10 DAS	Mean	DBS	3 DAS	7 DAS	10 DAS	Mean		
Emamectin benzoate 5% SG	220 gm	2.33 (1.68)	0.07 (0.75)	0.23 (0.86)	0.63 (1.06)	0.82 (1.15)	2.77 (1.81)	0.07 (0.75)	0.13 (0.79)	0.43 (0.97)	0.63 (1.06)	1.57 (7.20)	17.19
Spinetoram 11.7% SC	500 ml	2.23 (1.65)	0.00 (0.71)	0.03 (0.73)	0.47 (0.98)	0.68 (1.09)	2.70 (1.79)	0.00 (0.71)	0.07 (0.75)	0.27 (0.88)	0.43 (0.96)	0.90 (5.44)	15.98
Spinosad 45.0% SC	187ml	2.33 (1.68)	0.00 (0.71)	0.10 (0.77)	0.53 (1.01)	0.74 (1.11)	2.73 (1.80)	0.00 (0.71)	0.07 (0.75)	0.20 (0.84)	0.47 (0.98)	0.86 (5.31)	18.02
Flubendiamide 48 % SC	100 ml	2.27 (1.66)	0.07 (0.75)	0.23 (0.86)	0.67 (1.08)	0.81 (1.14)	2.77 (1.81)	0.07 (0.75)	0.27 (0.88)	0.37 (0.93)	0.67 (1.08)	1.55 (7.15)	16.72
Chlorantraniliprole 18.5% SC	125 ml	2.57 (1.75)	0.00 (0.71)	0.10 (0.77)	0.40 (0.95)	0.77 (1.13)	2.63 (1.77)	0.00 (0.71)	0.00 (0.71)	0.17 (0.82)	0.29 (0.89)	0.72 (4.87)	19.13
Novaluron 10% EC	750 ml	2.40 (1.7)	0.10 (0.77)	0.23 (0.86)	0.80 (1.14)	0.88 (1.18)	2.67 (1.78)	0.10 (0.77)	0.23 (0.86)	0.50 (1.00)	0.77 (1.13)	1.93 (7.99)	15.13
UTC (Water)		2.47 (1.72)	2.47 (1.72)	2.57 (1.75)	2.70 (1.79)	2.55 (1.75)	3.03 (1.88)	3.13 (1.91)	3.30 (1.95)	3.43 (1.98)	3.23 (1.93)	8.94 (17.40)	9.75
S.E. ±		0.038	0.028	0.027	0.024	0.021	0.011	0.021	0.031	0.026	0.019	0.10	0.70
C.D. (P=0.05)		NS	0.086	0.084	0.075	0.07	NS	0.067	0.093	0.081	0.061	0.31	2.13

( ) Figures in parenthesis are square root transformed value, DBS= day before spraying, DAS= days after spraying. NS=Non-significant

transformation.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Larval population of *H. armigera* (H.) :

During both season before 24 hr of first application of insecticides, *H. armigera* larval population was uniformly distributed among different treatments, the differences amongst them being non-significant. All the pooled data of first spray proved significantly better than the untreated control in managing the *H. armigera* (H.) infesting Chickpea crop during both *Rabi* crop seasons. At three days after spray (DAS), the Spinetoram 11.7% SC@500ml/ha, Spinosad 45.0% SC and Chlorantraniliprole 18.5% SC (0.00 larvae/ plant all three, respectively) were recorded 100 per cent control of GPB larval population. The maximum larval population was recorded in Novaluron 10% EC (0.10 larvae/ plant) except UTC (2.47 larvae/ plant). However, the pooled minimum *H. armigera* population at 7 DAS was recorded in Spinetoram 11.7% SC @ 500 ml/ha. (0.3 larvae/plant), but it was at par with Spinosad 45 SC @ 187 ml/ha and Chlorantraniliprole 18.5% SC @ 125ml/ha (0.10 larvae/ plant, respectively) and the maximum larval population was recorded in untreated control (2.57 larvae/plant). After 10 DAS, minimum larval population was recorded in plot treated with Chlorantraniliprole 18.5% SC @ 125ml/ha (0.40 larvae/plant) while it was at par with Spinetoram 11.7% SC@ 500ml/ha (0.47 larvae/plant) and Spinosad 45.0% SC @187ml/ha (0.53 larvae/plant), the maximum larval population was recorded in Novaluron 10% EC (0.80 larvae/ plant) except UTC (2.70 larvae/ plant). The pooled mean data of first spraying revealed that minimum larval population was recorded in the Spinetoram 11.7% SC @ 500 ml/ha (0.68 larvae/plant) which was at par with Spinosad 45.0% SC @ 187ml/ha (0.74 larvae/plant), Chlorantraniliprole 18.5% SC@ 125ml/ha (0.77 larvae/plant), Flubendiamide 48 % SC @ 100ml/ha (0.81 larvae/plant) and Emamectine benzoate 5% SG@220gm/ha (0.82 larvae/plant) followed by Novaluron 10% EC @750ml/ha (0.80 larvae/plant), the overall maximum larval population was recorded in UTC (water) (2.55 larvae/plant) (Table 1).

In the second spray of insecticides at 3 DAS, all the treatments were at par with each other and untreated control (2.47 larvae/plant) was recorded maximum larval population. However, at the pooled 7 DAS, the minimum pooled larval populations were found in Chlorantraniliprole 18.5% SC @125ml/ha (0.0 larvae/plant) and it was as at par with Spinetoram 11.7% SC @ 500ml/ha (0.07 larvae/plant), Spinosad 45.0% SC @187ml/ha (0.07 larvae/plant) and Emamectin benzoate 5% SG @ 220gm/ ha (0.13 larvae/plant) followed by Novaluron 10% EC @750ml/ha (0.23 larvae/plant). The maximum larval population per plant was noticed in UTC (water) (3.30 larvae/plant). After 10 DAS, minimum larval population was recorded in plot treated with Chlorantraniliprole 18.5% SC @125ml/ha (0.17 larvae/plant) and its proved again superior in terms of GPB larval population and which was at par with Spinosad 45.0% SC (0.20 larvae/ plant) and Spinetoram 11.7% SC (0.27 larvae/plant) followed by Flubendiamide 48 % SC (0.37 larvae/plant). The maximum larval population was recorded in UTC (water) (3.43 larvae/plant).The pooled mean data of first spraying revealed that the all the treatments were found statistically better as compared to untreated control. However, among the treatments Chlorantraniliprole 18.5% SC @125ml/ha was found significantly superior (0.29 larvae / plant) over rest of the treatments followed by Spinetoram 11.7% SC@ 500ml/ha (0.43 larvae/plant) whereas overall maximum larval population was recorded

Table 2 : Pooled data of chemical insecticide expenditure and cost of cultivation of pooled data of (Rs. /ha)

Treatment		Total cost of cultivation (Rs. ha^{-1})	Grain yield (q/ ha.)	Gross returns (Rs. ha^{-1})	Net income (Rs. ha^{-1})	B:C Ratio
T_1	Emamectin benzoate 5% SG	26824.00	17.19	81632.97	54808.97	1:3.04
T_2	Spinetoram 11.7% SC	33424.00	15.98	75880.27	42456.27	1:2.27
T_3	Spinosad 45.0% SC	32174.00	18.02	85583.63	53409.63	1:2.66
T_4	Flubendiamide 48 % SC	28924.00	16.72	79411.75	50487.75	1:2.75
T_5	Chlorantraniliprole 18.5% SC	29674.00	19.13	90824.57	61150.57	1:3.06
T_6	Novaluron 10% EC	28004.00	15.13	71859.69	43855.69	1:2.57
T_7	UTC [water]	25424.00	9.75	46306.93	20882.93	1:1.82

in UTC (water) (3.23 larvae/plant). The findings of earlier scientist Chitralekha *et al.* (2018), Chandrashekara *et al.* (2016), Kambrekar *et al*. (2012) and Rahman *et al.* (2006) were strongly supported to present result.

Per cent pod damage :

The pooled data of per cent pod damage were presented in Table 1, indicated that the minimum pod damage was recorded in plot treated with Chlorantraniliprole 18.5 % SC (0.72 %) and it was significantly differed from each other. The Spinosad 45.0 % SC (0.86 %) was found next best and it was at par with Spinetoram 11.7 % SC (0.90 %) followed by Flubendiamide 48 % SC (1.55 %). The maximum pod damage was recorded in plot treated with Novaluron 10 % EC (1.90%) except UTC (water) (8.94%), these results were agreed with those of previously scientific finding *viz.*Chaukikar *et al.* (2017), Chandrashekara *et al.* (2016), Kambrekar *et al*. (2012), Singh and Yadav (2006) and Deshmukh *et al.* (2010).

Economic of chemical insecticides :

The pooled data of insecticidal treatments were presented in Table 2 and data revealed that the maximum cost of cultivation was recorded in Spinetoram 11.7% SC (33424 Rs. /ha.) and the minimum cost of cultivation was found in Emamectin benzoate 5% SG (26624 Rs. / ha.) except untreated control. The maximum Grain yield (q/ ha.), Gross returns (Rs. /ha), Net income (Rs. /ha) and B:C Ratio was calculated in Chlorantraniliprole 18.5% SC(19.13 q/ ha.,90824.57 Rs. /ha, 61150.57 Rs. / ha and 1:3.06, respectively) and the minimum Grain yield and Gross returns (Rs. /ha) was gained in Novaluron 10% EC (15.13 q/ ha. and 71859.69 Rs. /ha, respectively) but the minimum net income and B:C ratio was recorded in Spinetoram 11.7% SC (42456.27 Rs./ha. 1:2.27, respectively) apart from untreated control. The observations of previous workers Patil and Jamadagni (2008) and Deshmukh *et al.* (2010) are accordance with present result.

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