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BIO-EFFICACY OF INSECTICIDES AGAINST GRAM POD BORER (*HELICOVERPA ARMIGERA)* INFESTING PIGEON PEA

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ABSTRACT

A field experiment was conducted to investigate the efficacy of different insecticides against gram pod borer, *Helicoverpa armigera* (Hubner) infesting pigeonpea at Biological Control Research Farm, Anand Agricultural University, Anand, Gujarat during *kharif-rabi*, 2024-25. All seven insecticides were effective against larval population of *H. armigera*. Treatment of chlorantraniliprole 18.5 SC, followed by emamectin benzoate 0.0025%, was the most effective insecticide against *H. armigera*. Chlorfluazuron 0.015% and broflanilide 0.003% were moderately effective, whereas, isocycloseram 0.010%, bifenthrin 0.016% and tetraniliprole 0.010% were the least effective among all insecticides. Both, at the green pod stage and at harvest, the lowest percentage of pod damage (6.60%) was recorded in plots treated with chlorantraniliprole 0.006%. The highest seed yield (1768 kg/ha) was recorded in plots treated with chlorantraniliprole 0.006%.
***Keywords* :** Gram pod borer, pigeonpea, *Helicoverpa. armigera,* bio-efficacy.

Introduction

Globally, pigeonpea [*Cajanus cajan* (L.) Millspaugh] is a major legume crop grown widely in tropical and subtropical areas. It is India's second most important pulse crop, after chickpea (Verma *et al*., 2017). Maharashtra, Karnataka, Uttar Pradesh, Gujarat, Jharkhand and Telangana are major pigeonpea producing states (Anonymous, 2023). During the year 2023-24, Gujarat state produced 2.91 lakh tonnes of pigeonpea from 2.27 lakh hectares with an average productivity of 1279 kg/ha. The major pigeonpea growing districts in Gujarat state are Bharuch, Junagadh, Panchmahal, Vadodara, Narmada, Ahmedabad and Chhotaudepur (Anonymous, 2025). Insect pests are one of the main limiting factors in the low yield of pigeonpea. From the seedling to the harvest stage, pigeonpea is attacked by a wide variety of insects. In India, approximately 300 species of insects from 61 families and 8 orders are known to infest this crop. An estimated 27 to 100 per cent of crops may be lost as a result of these insect pests (Verma *et al*., 2017). Among them, the most economical pests that attack at the flowering and podding stage is the gram pod borer, *Helicoverpa armigera* (Amin *et al*., 2022). Damage to pods due to the pod borer complex was reported to be 20 to 72 per cent in pigeonpea (Priyadarshini *et al*., 2013). Pod borers cause huge annual losses, especially to the poorest farmers who cannot afford chemical control. For the management of insect pests, including, *H. armigera*, insecticides are widely used. Insecticides are typically the top recommendation and choice for farmers, particularly for valuable crops like pigeonpea. Hence, the present experiment was conducted to evaluate the bio-efficacy insecticides against *H. armigera* in pigeonpea.

Materials and Methods

To evaluate the efficacy of insecticides against gram pod borer, *H. armigera* a field experiment was conducted at Biological Control Research Farm, AAU, Anand, Gujarat during *kharif-rabi*, 2024-25. The experiment was laid out in a Randomized Block Design (RBD) comprising eight treatments replicated thrice. Pigeonpea variety GT 106 (Gujarat Tur 106), was sown by dibbling in the fourth week of July, 2024, with 90 cm spacing between two rows and 20 cm between two plants. The size of gross and net plot was 4.5 × 5.0 m and 2.7 × 4.6 m, respectively. All recommended agronomical practices were followed to raise the crop.

Total seven insecticides *viz*., chlorfluazuron 5.4 EC 0.015%, bifenthrin 10 EC 0.016%, emamectin benzoate 5 SG 0.0025%, chlorantraniliprole 18.5 SC 0.006%, broflanilide 30 SC 0.003%, tetraniliprole 18.18 SC 0.010% and isocycloseram 9.2 DC 0.010%, along with control were evaluated against *H. armigera*. The first foliar application of insecticides was made at the appearance of the pest, followed by the second spray at 15 days after the first spray. The spray application of insecticides was done using a manually operated knapsack sprayer fitted with a hollow cone nozzle. Approximately, 500 litres of spray solution was used to cover one ha area. To record observations on the larval population of *H. armigera*, five plants were randomly selected from each net plot. Each plant was critically observed and the number of larvae of *H. armigera* was counted before the first spray as well as 3, 7, 10 and 14 days after each spray. At the green pod stage and before the harvest of the crop, 100 pods were randomly plucked from each net plot. The plucked pods were segregated into healthy and damaged and their numbers were counted. Based on these, per cent pod damage was worked out. The seed yield of pigeonpea was recorded for each net plot area and converted to a hectare basis. The data on larval population, pod damage and seed yield, after suitable transformation, were subjected to Analysis of Variance Technique (ANOVA).

Results and Discussion

Bio-efficacy of insecticides against *H. armigera*

The data on the larval population of *H. armigera* recorded in different insecticidal tretaments are presented in Table 1. Before the first application, no significant differences in larval population were observed among the treatments, suggesting a uniform level of infestation of *H. armigera* across all experimental plots.

The data on the larval population of *H. armigera* recorded after 3, 7, 10 and 14 days of the first spray were pooled and presented in Table 1, which revealed significant differences among the different treatments. The treatment of chlorantraniliprole 0.006% recorded lowest (0.31 larva/plant) larval population of *H. armigera*, which was at par with emamectin benzoate 0.0025% (0.36 larva/plant). The treatment of chlorfluazuron 0.015% (0.50 larva/plant) was the next most effective treatment and it was at par with emamectin benzoate 0.0025% as well as broflanilide 0.003% (0.56 larva/plant) and isocycloseram 0.010% (0.67 larva/plant). Among the evaluated insecticides, the highest (0.75 larva/plant) larval population was recorded in the plots treated with tetraniliprole 0.010%, which remained at par with bifenthrin 0.016% (0.73 larva/plant) and isocycloseram 0.010%. Control plots recorded significantly the highest larval population, which was 1.43 larvae/plant.

Table 1: Bio-efficacy of insecticides against *H. armigera* in pigeonpea

Tr. No.	Treatments	Conc. (%)	No. of larva(e) /plant			
			Before spray	**After 1st spray**	**After 2nd spray**	**Overall pooled**
T_1	Chlorfluazuron 5.4% EC	0.015	1.22 (0.99)	1.00^{bc} (0.50)	0.92^{a} (0.35)	0.96^{bc} (0.42)
T_2	Bifenthrin 10% EC	0.016	1.30 (1.19)	1.11^{de} (0.73)	1.11^{b} 0.73)	1.11^{d} (0.73)
T_3	Emamectin benzoate 5% SG	0.0025	1.27 (1.11)	0.93^{ab} (0.36)	0.91^{a} (0.33)	0.92^{ab} (0.35)
T_4	Chlorantraniliprole 18.5% SC	0.006	1.29 (1.16)	0.90^{a} (0.31)	0.89^{a} (0.29)	0.90^{a} (0.31)
T_5	Broflanilide 30% SC	0.003	1.27 (1.11)	1.03^{cd} (0.56)	0.97^{a} (0.44)	1.00^{c} (0.50)
T_6	Tetraniliprole 18.18% SC	0.010	1.27 (1.11)	1.12^{e} (0.75)	1.15^{b} (0.82)	1.14^{d} (0.80)
T_7	Isocycloseram 9.2% DC	0.010	1.22 (0.99)	1.08^{cde} (0.67)	1.10^{b} (0.72)	1.09^{d} (0.69)
T_8	Control	-	1.27 (1.11)	1.39^{f} (1.43)	1.72^{c} (2.46)	1.56^{e} (1.93)
S. Em. ±		Treatment (T)	0.07	0.03	0.03	0.02
		Period (P)	-	0.02	0.02	0.02
		Spray (S)	-	-	-	0.01
		T × P	-	0.06	0.06	0.04
		T × S	-	-	-	0.03
		P × S	-	-	-	0.02
		T × P × S	-	-	-	0.06
F test			NS	Sig.	Sig.	Sig.
C.V. (%)			9.48	9.48	9.78	9.59

Notes: (1) Figures outside the parentheses are $\sqrt{x + 0.5}$ transformed values and those inside the parentheses are retransformed values

(2) Treatment means followed by the same letter are not significantly different by DNMRT at 5% level of significance

(3) NS: Non-significant, Sig: Significant

The periodical data on larval population of *H. armigera* recorded after the second spray were pooled and presented in Table 1, indicating significant differences among the treatments. The lowest (0.29 larva/plant) population of *H. armigera* was recorded in plots treated with chlorantraniliprole 0.006%, which remained at par with emamectin benzoate 0.0025% (0.33 larva/plant), chlorfluazuron 0.015% (0.35 larva/ plant) and broflanilide 0.003% (0.44 larva/plant). The treatments of isocycloseram 0.010% (0.72 larva/plant), bifenthrin 0.016% (0.73 larva/plant) and tetraniliprole 0.010% (0.82 larva/plant) were less effective as compared to other insecticidal treatments. The population in control plots was 2.46 larvae/plant, which was significantly the highest among all the treatments.

The pooled data on larval population of *H. armigera* across different periods and sprays are presented in Table 1, indicating that the differences among treatments were significant. Furthermore, all the insecticidal treatments were effective against *H. armigera*. Chlorantraniliprole 0.006% (0.31 larva/ plant) was the most effective treatment against the larval population of *H. armigera*. However, it was at par with emamectin benzoate 0.0025% (0.35 larva/plant). The treatment of chlorfluazuron 0.015% (0.42 larva/plant) was the next most effective treatment, which was at par with emamectin benzoate 0.0025% and broflanilide 0.003% (0.50 larva/plant). Among the insecticidal treatments, the highest larval population was recorded in the plots treated with tetraniliprole 0.010% (0.80 larva/plant), which was at par with bifenthrin 0.016% (0.73 larva/plant) and isocycloseram 0.010% (0.69 larva/plant). The control plots recorded significantly highest (1.93 larvae/plant) larval population.

Present findings align with those of Patel (2015), who reported that chlorantraniliprole 18.5 SC was the most effective against the pod borer, *H. armigera*, in pigeonpea. Rani *et al*. (2018) observed a significant reduction in the larval population of *H. armigera* in pigeonpea plots treated with chlorantraniliprole 20 SC. According to Warad *et al*. (2021), chlorantraniliprole 18.5 SC was the most effective treatment for managing *H. armigera* in pigeonpea. Veeranna *et al*. (2023) also found that chlorantraniliprole 18.5 SC at 0.3 ml/L, followed by emamectin benzoate 5 SG at 0.4 g/L, were significantly more effective in controlling the gram pod borer, *H. armigera* pigeonpea.

Effect of Different Insecticides on Pod Damage

Data on pod damage recorded at green pod stage and at harvest are presented in Table 2. At the green pod stage, significantly the lowest (6.60%) per cent pod damage was recorded in the plots treated with chlorantraniliprole 0.006%. The treatment of emamectin benzoate 0.0025% (10.60%) was the second most effective treatment, which remained at par with chlorfluazuron 0.015% (12.19%), broflanilide 0.003% (13.30%) and isocycloseram 0.010% (14.60%). The pod damage in the control plots was 35.60 per cent, which differed significantly from the rest of the treatments.

At harvest, the treatment of chlorantraniliprole 0.006% recorded the lowest pod damage (7.92%), which was at par with emamectin benzoate 0.0025% (11.88%). The next most effective treatment was chlorfluazuron 0.015% (14.23%) however, it was at par with all insecticidal treatments, except chlorantraniliprole 0.006%. Control plots recorded 37.92 per cent pod damage, which was significantly the highest among all treatments.

Patel (2015) reported that the plots treated with chlorantraniliprole 18.5% SC had the least pod damage caused by the pod borer, *H. armigera* in pigeonpea. According to Patange and Chiranjeevi (2017) lowest pod damage due to the pod borer complex was recorded in the treatment of chlorantraniliprole 18.5 SC. Warad *et al.* (2021) also reported that the chlorantraniliprole 18.5% SC resulted in the least pod damage caused by pod borer in pigeonpea. Thus, the present findings are in conformity with earlier findings.

Effect of Insecticides on Seed Yield of Pigeonpea

The data on seed yield of pigeonpea obtained in different treatments are presented in Table 3. The highest (1768 kg/ha) seed yield was recorded in plots treated with chlorantraniliprole 0.006%, which remained at par with remaining insecticidal treatments, except tetraniliprole 0.010% (1483 kg/ha). Control plots (1187 kg/ha) recorded significantly the lowest seed yield of pigeonpea. Based on seed yield, the treatments were ranked in descending order as follows: chlorantraniliprole 0.006% (1768 kg/ha) > emamectin benzoate 0.0025% (1722 kg/ha) > chlorfluazuron 0.015% (1652 kg/ha) > broflanilide 0.003% (1629 kg/ha) > isocycloseram 0.010% (1573 kg/ha) > bifenthrin 0.016% (1541 kg/ha) > tetraniliprole 0.010% (1483 kg/ha) > control plots (1187 kg/ha).

Sreekanth *et al.* (2013) reported that the highest grain yield of pigeonpea was recorded in plots treated with chlorantraniliprole 18.5% SC. Taggar *et al.* (2019) also reported that the application of chlorantraniliprole 18.5 SC @ 150 ml/ha, resulted in the highest grain yield of pigeonpea. Warad *et al.* (2021) observed that the chlorantraniliprole 18.5% SC achieved the highest pigeonpea yield. Thus, the present findings corroborate earlier findings.

Table 2: Effect of different insecticides on pod damage and seed yield of pigeonpea

Tr. No.	Treatments	Conc. (%)	Pod damage (%)		Seed yield (kg/ha)
			At green pod stage	At harvest	
T_1	Chlorfluazuron 5.4% EC	0.015	20.43^{bc} (12.19)	22.16^{bc} (14.23)	1652^{ab}
T_2	Bifenthrin 10% EC	0.016	23.81^{cd} (16.30)	25.56^{c} (18.60)	1541^{ab}
T_3	Emamectin benzoate 5% SG	0.0025	19.00^{b} (10.60)	20.16^{ab} (11.88)	1722^{ab}
T_4	Chlorantraniliprole 18.5% SC	0.006	14.89^{a} (6.60)	16.34^{a} (7.92)	1768^{a}
T_5	Broflanilide 30% SC	0.003	21.39^{bcd} (13.30)	23.00^{bc} (15.27)	1629^{ab}
T_6	Tetraniliprole 18.18% SC	0.010	24.83^{d} (17.63)	26.29^{c} (19.62)	1483^{b}
T_7	Isocycloseram 9.2% DC	0.010	22.46^{bcd} (14.60)	23.77^{bc} (16.25)	1573^{ab}
T_8	Control	-	36.63^{e} (35.60)	38.01^{d} (37.92)	1187^{c}
S. Em. ±			1.23	1.43	0.10
F test			Sig.	Sig.	Sig.
C.V. (%)			9.31	10.11	9.01

Notes: (1) Figures outside the parentheses are arcsine transformed values and those inside the parentheses are retransformed values

(2) Treatment means followed by the same letter are not significantly different by DNMRT at 5% level of significance

Conclusion

The plots treated with chlorantraniliprole 0.006%, followed by emamectin benzoate 0.0025%, recorded the lowest larval population of *H. armigera*. Pod damage at green pod as well as harvest stage was lowest in chlorantraniliprole 0.006% and it was followed by emamectin benzoate 0.0025%. Chlorantraniliprole 0.006% also recorded the highest seed yield of pigeonpea.

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