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Biofficacy of Different Insecticides against Pod Borer, *Helicoverpa armigera* (Hubner) in Chickpea Crop

Avula Ajith Kumar [aφ] and Anoorag R. Tayde [a*#]

[a] *Department of Entomology, Faculty of Agriculture, Sam Higginbottom University of Agriculture Technology and Sciences (SHUATS), Prayagraj, Uttarpradesh-211007, India.*

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The present investigation was carried out at Central Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, U.P. during *Rabi,* 2021- 2022. The experiment was conducted in Randomized Block Design (RBD) with eight treatments and 3. replications. The insecticides like Emamectin benzoate 5 SG(Treta) dose @ 0.4gm/Litre, Spinosad 45% SC (Tracer) dose @0.5ml/Litre, Neem oil 0.2% (Neem Aura) dose @2ml/Litre, Karanj oil 0.2% (RV Essential Karanj Oil) dose @2ml/litre, Chlorantriniliprole 18.5 SC (Coragen) dose @0.5ml/Litre, Flubendamide 480SC (Fame) dose @0.4ml/Litre, Profenophos 50 EC (Celcron) dose @2ml/Litre were applied. The mean larval population per plant was recorded one day before and 3, 7 and 14 days after each spray. Among insecticidal treatments the lowest larval population of *Helicoverpa armigera* on chickpea was recorded in spinosad 45SC@0.5ml/L followed by Flubendiamide 480 SC@0.4ml/L, Emamectin Benzoate 5SG@ 0.4gm/L, chlorantraniliprole 18.5 SC@0.5ml/L and profenophos 50EC@2ml/L. The next effective are botanicals namely., neem oil 0.2%@2ml/L and karanj oil 0.2%@2ml/L was found to be least effective but comparatively superior over the control. The highest yield (24.3 q/ha) was also obtained with application of recorded in spinosad 45SC @ (0.5ml/L) while maximum C:B (1:4.76) was achieved with spray of Flubendiamide 480SC @0.4ml/L.

[φ] *M.Sc Scholar;*
[#] *Assistant Professor;*
**Corresponding author: E-mail: anurag.tayde@shiats.edu.in;*

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1. INTRODUCTION

Chickpea, *Cicer arietinum*, crop is a member of the Leguminosae family. It is the only cultivated crop within the *Cicer*. Two types of chickpea cultivars are recognized globally- kabuli and desi [1]. Chickpea is an important *Rabi* and best suited to areas having low to moderate rainfall with mid-cold weather [2]. India is the major chickpea producing country and contributing for over 75% of total world chickpea production [3,4]. Chickpea is one of the most important pulse crops grown in 10.2 million hectares with an average production of 7.9 million tonnes and an average productivity of 995 kg/ha of which about 80 per cent is grown in India (FAO, 2016) and India ranks fifth in area and fourth in production among the food grains [5] Madhya Pradesh contributes highest (39%), followed by Maharashtra (14%), Rajasthan (14%), Andhra Pradesh (10%), Uttar Pradesh (7%), Karnataka (6%) and other remaining states and UTs of India (10%) to the total chickpea area and production (Preeti *et al*., 2021). Among the many biotic factors responsible for low yield, damage due to insect-pests is the major limiting factor [6]. *Helicoverpa armigera* is one of the serious pests of chickpea, which feeds more than 150 crops throughout the world [7]. Among these, pod borer *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) is most important and accounts for about 90 to 95% of the total loss caused by all the insect-pests. The *Helicoverpa armigera* lifecycle stages are egg, larva, pupa and adult. The female moths lay eggs on tender parts of the plant, a single moth can lay up to 500-890 eggs. The freshly laid eggs of *H. armigera* are yellowish-white in colour [8-11]. The apical area of egg is smooth and the rest of the surface sculptured in the form of longitudinal ribs [12-15]. Larva of *H. armigera* had six distinct instars in chickpea [16]. The yield loss in chickpea due to pod borer has been estimated to be 10 to 60% under normal weather conditions and 50 to 100% in favorable weather conditions, particularly when there are frequent rains and cloudy weather during the cropping season [17].

2. MATERIALS AND METHODS

The experiment was conducted at the experimental research plot of the Department of Entomology, Central Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences during *rabi* season of 2021-2022 in Randomized Block Design with three replications and eight treatments using a variety NBEG- 49(Nandyal) with 2 × 2 m plot size for evaluation of efficacy of chemical and botanical insecticides against pod borer *Helicoverpa armigera* in chickpea crop. The soil of the experimental site was well drained and medium high. Research field situated at 25°27" North latitude 80°05" East longitudes and at an altitude of 98 meter above sea level the maximum temperature reaches up to 42°C in summer and drops down to 4°C in winter. Agronomical practices were followed to raise the crop. Each treatment was sprayed twice at when larval population reaches its ETL level (3 to 5 larvae per plant). The observation on population of *Helicoverpa armigera* were recorded visually per plant from five randomly selected and tagged plants in each plot. The insecticides viz. Emamectin benzoate 5 SG dose@ 0.4gm/L, Spinosad 45% SC dose @0.5ml/L, Neem oil 0.2% dose@2ml/L, Karanj oil 0.2% dose@2ml/l, Chlorantriniliprole 18.5 SC dose@0.5ml/L, Flubendamide 480SC dose@0.4ml/L, Profenophos 50 EC dose@2ml/L were sprayed at and total two sprays were given. Larval population was counted 24 hours before spray 3,7 and 14 days after spraying from tagged plants The crop was harvested and threshed plot wise. The grain was cleaned, dried and weighed. The cost of insecticides used in this experiment was recorded during rabi season. The cost : benefit was also worked out. Total cost (insecticidal cost + labour) and income was calculated per hectare.

3. RESULTS AND DISCUSSION

The results revealed that all insecticidal treatments significantly reduced larval population of pod borer, pod damage and increased the grain yield as compared to control. As per the data mentioned in Table 1 after 3^{rd}, 7^{th} and 14^{th} days of first spray Among all the treatments, the least mean larval population of pod borer was recorded in spinosad 45SC (1.18) followed by Flubendiamide 480SC (1.33) followed by emamectin benzoate 5SG (1.38) followed by chlorantraniliprole 18.5SC (1.58), profenophos 50EC (1.89), Neem oil 0.2% (2.07) and Karanj oil 0.2% (2.15).The lowest larval population of *helicoverpa armigera* Was recorded in Spinosad Because After two sprayings Due to toxicity of

Table 1. Effect of treatments on larval population after first and second spray

Treatments	Dose	Mean larval population per 5 plants								Overall Mean	Yield q/ha	C:R (Rs.)
		First spray				Second spray						
		1DBS	3DAS	7DAS	14DAS	1DBS	3DAS	7DAS	14DAS			
Emamectin benzoate 5SG		3.47	1.2^{ef}	1.33^{d}	1.6^{cd}	2.53	1.4^{de}	1.8^{cd}	2.13^{cde}	1.58^{d}	21.5	1:4.38
Spinosad 45SC		3.6	0.93^{g}	1.27^{d}	1.33^{d}	2.60	1.2^{e}	1.53^{d}	1.73^{e}	1.33^{d}	24.3	1:4.14
Neem oil 0.2%		3.4	1.73^{bc}	2b	2.47^{b}	2.53	2.27^{b}	2.33^{b}	2.6^{bc}	2.23^{b}	14.8	1:2.89
Karanj oil 0.2%		3.53	1.93^{b}	2.2^{b}	2.33^{b}	2.73	2.4^{b}	2.4^{b}	2.73^{b}	2.33^{b}	13.2	1:2.72
Chlorantraniliprole 18.5SC		3.6	1.4^{de}	1.53^{cd}	1.8^{c}	2.8	1.67^{cd}	2bc	2.2bcde	1.77^{cd}	20.7	1:3.53
Flubendiamide 480SC		3.6	1.07^{fg}	1.4^{d}	1.53^{cd}	3.07	1.33^{e}	1.73^{cd}	2de	1.51^{d}	23.1	1:4.76
Profenophos 50EC		3.47	1.53^{cd}	1.87^{bc}	2.27^{b}	2.33	1.93^{c}	2.27^{b}	2.53^{bcd}	2.06^{bc}	16.4	1:3.19
Control		3.67	4a	4.4^{a}	4.47^{a}	4.73	5.2^{a}	5.4^{a}	5.53^{a}	4.83^{a}	8.3	1:1.79
S.Ed (±)		0.20	0.12	0.16	0.17	0.22	0.13	0.20	0.26	0.54		
C.D (P=0.05)			0.26	0.35	0.36		0.28	0.42	0.56	0.437		

- *Labour charges=200₹/day (4 labours)*
- *Cost of yield= 6500₹/q*

the chemicals and the dose used in the spraying are the major reasons of lowest larval population.The botanical insecticides were found least effective but superior over control (4.29). The insecticidal treatment (Spinosad 45SC) (1.18) was at par with (Flubendiamide 480SC) (1.33) which was also at par (Emamectin benzoate 5SG) (1.38) and (Chlorantraniliprole 18.5SC) (1.8). The treatment (Neem oil 0.2% (2.07) was at par with (Karanj oil 0.2%) (2.15). Similar insecticidal trends results were also observed after second spray The similar findings were also made by Gayathri and Kumar [18], Mahajan et al., [19] and Chandra et al*.* (2018).

The highest yield was recorded and cost: benefit with application of spinosad 45SC (24.3 q/ha) and Rs. 1:4.14, respectively Flubendiamide 480SC with yield (23.1 q/ha) and C: B (Rs. 1:4.76), Emamectin benzoate 5SG (21.5q/ha) and (Rs. 1:4.38), Chlorantraniliprole 18.5SC (20.7 q/ha) and (Rs.1:3.53), Profenophos 50EC (16.40 q/ha) (1:3.19) Because these chemicals are highly toxic to the pod borer,so the pest infestation also very low in the chemicals treated plants. cost benefit ratio, neem oil 0.2% (14.80 q/ha) (1:2.89) cost benefit ratio and karanj oil 0.2% (13.20 q/ha) and (Rs. 1:2.72) as compared to control (8.3 q/ha) (1:1.79) cost benefit ratio. These findings are also supported by Babariya et al., [20] and Venkataiah et al., [17].

4. CONCLUSION

From the critical analysis of the present findings, it can be concluded that, among all the treatments Spinosad 45SC is most effective out of all the treatments. It also gave the highest marketable yield with 16 q/ha. It was followed by Flubendiamide 480SC, Emamectin Benzoate 5SG, Chlorantraniliprole 18.5SC and it was followed by Profenophos 50EC, Neem oil 0.2% and Karanj oil 0.2% is least effective in reducing the larval population among all the treatments. When cost benefit ratio was worked out, interesting result was achieved. The best and most economical treatment was Flubendiamide 480SC with 1:4.76 Cost benefit ratio followed by Emamectin benzoate 5SG (1:4.38), Spinosad 45SC (1:4.14). These plant products also help in reducing pollution in the environment as such more trials are required in future to validate the findings. Hence it can be suitably incorporated as treatments in IPM programme.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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