"Effect of selected biopesticides and chemicals against pod borer [*Helicoverpa armigera* (L.)] on chickpea (*Cicer arietinum* L.)."

ABSTRACT

The research work was undertaken at Central Research Farm (CRF) Sam Higginbottom University of Agriculture Technology and Sciences (SHUATS), Naini, Prayagraj during *Rabi* season in 2022 consists of eight treatments including control *viz.* Chlorantraniliprole 18.5 SC @ 0.3ml/lit, Emamectin benzoate 1.9 EC @5ml/lit, *Bacillus thurigiensis* $1x10^9$ CFU/ml @2.5g/lit, Spinosad 45 SC @0.3ml/lit, Indoxcarb 14.5 SC@0.5ml/lit, *Metarhizium anisiopilae* $1x10^9$ CFU/ml @2.5gm/lit, *Beauvaria bassiana* 1.15 % WP @ 2.5gm/lit and untreated control in Randomized Block Design (RBD) with three replications. Data was taken on the mean larval population of chickpea pod borer *Helicoverpa armigera* on third, seventh and fourteen days after spraying revealed that the treatment Chlorantraniliprole 18.5 SC (2.36) found to be superior followed by Spinosad 45 SC (2.70), Emamectin benzoate 1.9EC (2.77), Indoxcarb 14.5 SC (2.98), *Bacillus thurigiensis* $1x10^9$ CFU/ml (3.17), *Beauvaria bassiana* 1.15% WP (3.45), *Metarhizium anisiopilae* $1x10^9$ CFU/ml (3.79) was found to be least effective among all the treatments as compared to control (5.64). When yield and cost benefit ratio worked out the result showed that among the treatments, the best and most economical treatment Chlorantraniliprole 18.5 SC (26.83 q/ha) (1:3.49), followed by Spinosad 45SC (23.08 q/ha) (1:2.83), Emamectin benzoate 1.9EC(20.03q/ha) (1:2.66), *Bacillus thurigiensis* $1x10^9$ CFU/ml (17.50 q/ha) (1:2.32), Indoxcarb 14.5 SC (17.66 q/ha) (1:2.29), *Beauvaria bassiana* 1.15 % WP (12.00 q/ha) (1:1.60), *Metarhizium anisiopilae* $1x10^9$ CFU/ml (11.08 q/ha) (1:1.47) and untreated plot (9.08) (1:1.27) ratio.

Keywords: Biopesticides, Chemicals, *Cicer arietinum,* Economics, Efficacy, *Helicoverpa armigera*.

INTRODUCTION :-

Chickpea *(Cicer arietinum* L.), a member of Fabaceae, belongs to family "Leguminosae", subfamily "Papilonidae" having diploid number of chromosomes 2n=16 is an important pulse crop. It is a self-pollinated crop and is second most important food legume crop after common bean. It is an ancient cool season food legume crop cultivated by man and has been found in middle eastern archaeological sites dated 7500- 6800 BC. In India, chickpea is known by various names like chana or gram or Bengal gram or chani in Haryana, Rajasthan, Uttarakhand, Uttar pradesh, Madhya Pradesh, Chattisgarh, Bihar, Jharkhand, etc.; chole in Punjab, Jammu and Kashmir and Delhi; chola in West bengal; Harbara in Maharastra; Boot in Orissa; Sanagulu in Andhra pradesh; Kadale in Karnataka; kadalai in Tamil nadu; and kadala in Kerala, indicating its wide spread cultivation and knowledge of utilization. **(Gayatri and Kumar, 2021**)

Chickpea is used for human consumption as well as for feeding to animals. Its seeds eaten as green vegetable, fried, roasted, as snack food and ground to obtain flour and dhal. (**Lavanya *et al.*, 2022)** which has been considered as 'King of Pulses'. It is generally grown under rainfed or residual soil moisture conditions in Rabi season and the plant grows to 20-50 cm height and has small, feathery leaves on either side of the stem. **(Spoorthi *et al.*, 2017)**

The various ecological factors, responsible for low yield of chickpea in India, the insect pests are most important. listed 54 species of insect pests on chickpea of these the gram pod borer, *Helicoverpa armigera* (Hub), a pest of national importance in India, is one of the limiting factor in the successful cultivation of chickpea. Pod borer larvae feed on both foliage and pods of chickpea, yield losses are mainly due to pod damage. **(Kumar *et al.*, 2018)**

In India, the extent of losses due to *H. armigera* in chickpea is up to 27.9 per cent in North West Plain Zone, 13.2 per cent in North East Plain Zone, 24.3 per cent in Central Zone and 36.4 per cent in South Zone. The crops have been noticed to suffer an avoidable loss of 9 to 60 per cent by this insect. In Uttar Pradesh alone 15.3 per cent of the chickpea crop worth Rs.462.5 million is lost annually due to *H. armigera* attack, 17.2 per cent in Karnataka and 28.5per cent in Delhi. reported that the yield losses of chickpea grain due to *H. armigera* were 75.90 per cent and in some places the losses were up to 100 per cent. **(Singh *et al.*, 2015)**

MATERIALS AND METHODS :-

The experiment was conducted during the *Rabi* season 2022 in Central Research farm (CRF), Uttar Pradesh, India. All the facilities necessary for cultivation, including labour was made available in the department. The site selected was uniform, cultivable with typical Sandy loam soil having good drainage. The experiment was conducted in Randomized Block Design (RBD) with eight treatmentsincluding control with three replications. The plot size taken was 2m×1m. The crops of Chickpea(*Cicer arietinum* L.) were used for sowing by maintaining 45 cm inter-row and15 cm intra-row distance with the seed rate of 70-100 kg/ha. The spray solution was applied withthe help of a handcompression sprayer. Spraying was done at dawn and desk time and there mustnot be much windcurrents.

The Biopesticides and Chemicals used for spraying are Chlorantraniliprole 18.5 SC @ 0.3ml/lit, Emamectin benzoate 1.9 EC @5ml/lit, *Bacillus thurigiensis* $1x10^9$ CFU/ml @2.5g/lit, Spinosad 45 SC @0.3ml/lit, Indoxcarb 14.5 SC@0.5ml/lit, *Metarhizium anisiopilae* $1x10^9$ CFU/ml @2.5gm/lit, *Beauvaria bassiana* 1.15 % WP @ 2.5gm/lit and untreated control.

The numbers of larva were counted on 5 randomly selected plants in each plot. The pre-treatment count was made a day before the first spray and second spray whereas, the post-treatment counts were made on 3^{rd}, 7^{th} and 14^{th} day after each spray. The larval population over control againstgram pod borer was calculated by considering the mean of three observations recorded at 3^{rd}, 7^{th}, and14^{th} day after first and second spray.

RESULT AND DISCUSSION:

The data after first spray table 1, reveled that all the treatment were significantly superior over control. Among the treatments most effective treatment in controlling larval population of gram pod borer was recorded in Chlorantraniprole 18.5 SC (2.73 larvae per 5 plants) followed by Spinosad 45 SC (2.99), Emamectin banzoate 1.9EC (3.06), Indoxcarb 14.5 SC (3.26), *Bacillus thuringiensis* 1×10^9 CFU/ml (3.48) and *Beauvaria bassiana* 1.15% WP (3.70), *Metarhizium anisiopilae* 1×10^9 CFU/ml (4.04) was found to be least effective among all the treatments as compared to control(5.31).

The data after second spray table 1, reveled that all the treatment were significantly superior over control. Among all the treatment most effective treatment in reducing larval population of pod borer was recorded in Chlorantraniprole 18.5 SC (1.99 larvae per 5 plants) followed by Spinosad 45 SC (2.42), Emamectin banzoate 1.9EC (2.48), Indoxcarb 14.5 SC (2.70), *Bacillus thuringiensis* 1×10^9 CFU/ml (2.86) and *Beauvaria bassiana* 1.15% WP (3.20), *Metarhizium anisiopilae* 1×10^9 CFU/ml (3.55) was found to be least effective among all the treatments as compared to control (5.97).

When the treatment studied, the best and most economical treatment found was Chlorantraniliprole 18.5 SC with a cost benefit ratio of (1:3.49), followed by Spinosad 45 SC (1:2.83), Emamectin benzoate 1.9 SC (1:2.66), *Bacillus thuringiensis* 1 X 10^9 CFU/ml (1:2.32), Indoxcarb 14.5 SC (1:2.29), *Beauvaria bassiana* 1.15% WP (1:1.60) and *Metarhizium anisiopilae* 1×10^9 CFU/ml (1:1.47) was found minimum cost benefit ratio among the treatments over untreated control (1:1.27).

Table no-1 Efficacy of certain biopesticides and chemicals on larval population of gram pod borer (*H. armigera*) on chickpea after first, second spray and C:B ratio.

Treatments		larval population of gram pod borer (*H. armigera*) on chickpea										Yield (q/ha)	C: B Ratio
		1st spray					2nd spray						
		One day before spray	3rd DAS	7 DAS	14 DAS	Mean	3 DAS	7 DAS	14 DAS	Mean	Overall mean (1&2 spray)		
T_1	Chlorantraniprole 18.5% SC @0.3ml/lit	5.46	3.00^{e}	2.53^{f}	2.66^{f}	2.73^{g}	2.33^{f}	1.80^{g}	1.86^{g}	1.99^{f}	2.36^{e}	26.83	1:3.49
T_2	Emamectin banzoate 1.9% SC @5ml/lit	5.33	3.33^{de}	2.86^{de}	3.00^{e}	3.06^{ef}	2.73^{e}	2.26^{ef}	2.46^{ef}	2.48^{e}	2.77^{cde}	20.03	1:2.66
T_3	*Bacillus thuringiensis* 1 X 10^{9}CFU/ml @2.5g/lit	5.20	3.80^{c}	3.26^{c}	3.40^{d}	3.48^{d}	3.13^{cd}	2.66^{d}	2.80^{d}	2.86^{d}	3.17^{bcd}	17.50	1:2.32
T_4	Spinosad 45% SC @0.3ml/lit	5.33	3.26^{de}	2.73^{ef}	3.00^{e}	2.99^{f}	2.73^{e}	2.20^{f}	2.33^{f}	2.42^{e}	2.70^{de}	23.08	1:2.83
T_5	Indoxcarb 14.5%SC @ 0.5ml/lit	5.40	3.40^{d}	3.13^{cd}	3.26^{d}	3.26^{e}	2.93^{de}	2.53^{de}	2.66^{de}	2.70^{de}	2.98^{cde}	17.66	1:2.29
T_6	*Metarhizium anisiopilae* 1×10^{9} CFU/ml @2.5g/lit	5.46	3.26^{b}	3.86^{b}	4.00^{b}	4.04^{b}	3.73^{b}	3.40^{b}	3.53^{b}	3.55^{b}	3.79^{b}	11.08	1:1.47
T_7	*Beauvaria bassiana* 1.15% WP @2.5g/lit	5.13	3.86^{c}	3.60^{b}	3.66^{c}	3.70^{c}	3.40^{bc}	3.00^{c}	3.20^{c}	3.20^{c}	3.45^{bc}	12.00	1:1.60
T_8	Control	5.13	5.20^{a}	5.33^{a}	5.40^{a}	5.31^{a}	5.66^{a}	5.93^{a}	6.20^{a}	5.97^{a}	5.64^{a}	9.08	1:1.27
Overall Mean		5.30	3.63	3.41	3.54	3.57	3.33	2.97	3.13	3.14	3.35		
F- test		NS	S	S	S	S	S	S	S	S	S		
S. Ed. (±)		0.17	0.18	0.14	0.12	0.19	0.16	0.14	0.10	0.15	0.31		
C. D. (P = 0.05)		N/A	0.381	0.297	0.261	0.212	0.354	0.302	0.215	0.325	0.745		

The data on mean population after first and second spray revealed that all the insecticides were found very effective and significantly superior over untreated control. Among all treatments minimum population of pod borer larva was found in Chlorantraniprole 18.5 SC (2.36) same results was reported by **Barwa *et al.*, (2022)**, Spinosad 45 SC which was found to be the next effective treatment with larval number (2.70) which was also reported by **Meena *et al.*,(2022)** , Emamectin banzoate 1.9EC was found the next best effective treatments with the larval number (2.77) which is in supported by the findings of **Sai *et al.*, (2021).**

When the cost benefit ratio worked out data revealed that among all the treatments the higher cost benefit ratio was obtained from Chlorantraniprole 18.5 SC (1:3.49) similar results were reported by **Chitralekha *et al.*, (2018)** followed by Spinosad 45 SCwith a cost benefit ratio of (1:2.83) which was reported by **Kale and Men (2008)**followed by Emamectin banzoate 1.9EC with a cost benefit ratio of (1:2.66) **Yadav and Verma (2007)** also reported the effectiveness of Emamectin banzoate 1.9EC.

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