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Efficacy of Certain Chemicals and Neem Products against *Helicoverpa armigera* (Hubner) on chickpea (*Cicer arietinum* L.)

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Abstract
A field experiment was conducted during *Rabi* season of 2014-2015 at the central research farm of Sam Higginbottom Institute of Agriculture, Technology and Sciences, Deemed-to-be-University, Allahabad to evaluate the efficacy of certain chemicals and neem products against pod borer, *Helicoverpa armigera* (Hubner) on chickpea (*Cicer arietinum* L.) The occurrence of pod borer commenced from 6th standard week (February second week) with an average population of 0.25 larvae/plant. The pod borer population increased and gradually reached its peak level of 6.25 larvae/plant at 13th standard week (March last week) there after declined trend was observed as temperature increased. It was observed that the temperature between 27-35 ^{0}C favored the multiplication of gram pod borer. The per cent population reduction of gram pod borer *H. armigera* on third, seventh and fourteenth days after spraying revealed that all treatments are superior over control. Among the treatments spinosad 45 SC found superior over all the treatments followed by cypermethrin and indoxacarb after first and second sprays, respectively. Highest reduction in larval population (72.12%) was observed with spinosad 45 SC @ 0.5 ml/l. Minimum pod damage of 11.98% and highest yield of 1745 Kg/ha was registered in spinosad. Highest cost benefit ratio (C:B) was recorded in spinosad (1:2.36) followed by cypermethrin (1:1.94), indoxacarb (1:1.84), chlorpyriphos (1:1.60), profenophos (1:1.34), NSKE (1:1.20) and neem oil (1:0.90).

Keywords: Chemicals, neem products, chickpea, *Helicoverpa armigera*, cost benefit ratio, pod damage, per cent population reduction

1. Introduction

Chickpea, *Cicer arietinum* (L.) family Leguminaceae (Fabaceae) is originated in South-eastern Turkey and spread to other parts of the world. According to De Candolle, the fact that gram has a Sanskrit name "Chanaka" which indicates that the crop was under cultivation in India longer than in any other country in the world. (Gowda *et al.,* 2007) [1] It is adapted to relatively cooler climates. The largest area of adaptation is in the Indian sub-continent. In recent years its cultivation has spread to Australia. Gram commonly known as chickpea or Bengal gram is the most important pulse crop of India. In India it is also known as 'King of pulses' India is the largest producer with 75% of world acreage and production of gram. India produces 5.3 MT of chickpea from 6.67 million ha with an average production of 844 kg per ha. (www.iipr.res.in)

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. (Pachundkar *et al.,* 2013) [2] On an average in 2013, it covers 10.91 million ha area with an annual production of 9.78 million tonnes and yield of 896kg per hectare (FAOSTAT, 2013) [3] and production of gram in India 2014-15 is 8280.00 thousand tonnes Based on 2nd Advance Estimates. Directorate of Economics and Statistics (DES)

The gram pod borer, *Helicoverpa armigera* (Hubner) is a key pest of chickpea and causes serious yield loss in most places where ever chickpea is grown is reported to have developed resistance to many commonly used insecticides. (Hossain *et al.,* 2010) [4] The gram pod borer attacks over 200 crop species belonging to 45 families globally, thus leading to yield loss tune to US $ 2 billion annually. In India the loss tune to 200 million US $ on pigeon pea and chickpea. (Rummana *et al*., 2010) [5].

2. Materials and Methods

The field trial was laid out at the university farm in randomized block design with eight treatments including an untreated control, each with three replications. The "Radhe" variety of chickpea was used and a healthy crop was raised by following all the recommended agronomical practices. The plot size was 2m x 2m and the spacing between rows and plants was maintained at 30 and 15 cm, respectively. Sprays were initiated on reaching 4-5 larvae per plant and pod damage by the borer and repeated three times during the crop season as and when the pod damage exceeded 10-20 percent. Spraying was done with the help of a knapsack sprayer.

Observations on larvae and pod damage by the borer were recorded daily on 5 randomly selected plants per plot during the vegetative stage of crop and later on number of damaged and total pods, from these data the percentage of pod damage was worked out and the data before subjecting to statistical analysis. The economics of the insecticidal treatments was also determined through cost benefit ratio analysis.

Seasonal incidence also observed in separate three plots of size 2m x 2m at different places within university farm. Observations were taken daily, to observe incidence of key pest of chickpea.

2.1 Preparation of insecticidal solution:

The insecticidal spray solution of desired concentration as per treatment was freshly prepared every time at the time of expermientation just before the start of spraying operations. The spray solution of desired concentration was prepared by adopting the following formula-

$$V = \frac{C \times A}{a.i.\%}$$

Where,

V = volume/ weight of commercial insecticide ml. or gm.

C = Concentration required.

A = Volume of solution to be prepared.

% a.i. = Percentage of active ingredient.

Pod damage analysis and percentage reduction in pod damage

Pod damage percentage was calculated using the following formulae (Hussain, 2007) [6]:

$$\% \text{ pod damage} = \frac{\text{No. of affected pods}}{\text{Total no. of pods}} \times 100$$

$$\% \text{ reduction in pod damage over control} = \frac{\text{Pod damage in control} - \text{pod damage in treatment}}{\text{Pod damage in control}} \times 100$$

Increase in yield over control

$$\% \text{ increase in yield over control} = \frac{\text{Grain yield in treatment} - \text{Grain yield in control}}{\text{Grain yield in control}} \times 100$$

Cost benefit ratio

The value of C: B of different treatments will be calculated by following formula.

$$C:B = \frac{\text{Net returns}}{\text{Cost of treatment}}$$

Where,

C: B - Cost Benefit Ratio

3. Results and Discussion

The results presented in Table.1 revealed that 3 days after first spray, spinosad (0.015 ml/l) was most effective showing maximum per cent larval population reduction 59.96, followed by chlorpyriphos (1ml/l.) 52.50 and cypermethrin (1ml/l.) 41.40, Plots treated with profenophos (1ml/l) 32.20, indoxacarb (0.5ml/l.) 28.41, NSKE (5%) 25.06 and neem oil (1%) 19.86 percent population reduction. Seven days after first spray, chlorpyriphos (1ml/l.) was the best treatment with 71.73% population reduction, followed by cypermethrin (68.00%), spinosad (65.88%), indoxacarb (65.77%), NSKE (54.80%), neem oil (52.19%) and profenophos (40.19%). Fourteen days after first spray also revealed, chlorpyriphos (1ml/l.) was the best treatment with 82.12% population reduction, followed by cypermethrin (80.00%), spinosad (78.90%), indoxacarb (76.06%), NSKE (67.92%), profenophos (66.10%) and neem oil (56.81%).

The results revealed 3 days after second spray, spinosad (0.015 ml/lit.) was most effective showing maximum per cent larval population reduction 68.80%, followed by cypermethrin (66.15%), indoxacarb (63.64%), profenophos (63.40%), NSKE (62.95%), neem oil (59.73%) and chlorpyriphos (50.99%). Seven days after second spray still spinosad (0.015 ml/lit.) was best treatment with 77.15% population reduction, followed by indoxacarb (74.32%), cypermethrin (72.77%), profenophos (69.16%), NSKE (67.80%), neem oil (67.11%) and chlorpyriphos (60.34%). Fourteen days after second spray also revealed, spinosad (0.015 ml/l.) was best treatment with 82.06% population reduction, followed by NSKE (80.63%), indoxacarb (80.23%), cypermethrin (77.10%), profenophos (76.95%), neem oil (70.92%) and chlorpyriphos (66.01%).

The results revealed the mean of first spray, chlorpyriphos was recorded highest reduction of pod borer population (68.78%) followed by spinosad (68.24%), cypermethrin (63.13%), indoxacarb (56.74%), NSKE (49.26%), profenophos (46.16%) and neem oil (42.95%). Neem oil was least effective among all the treatments, mean of second spray, spinosad was recorded highest reduction of pod borer population (76.00%) followed by indoxacarb (72.73%), cypermethrin (72.00%), NSKE (70.46%), profenophos (69.83%), neem oil (65.92%) and chlorpyriphos (59.11%). Chlorpyriphos was least effective among all the treatments.

Two sprays revealed that spinosad 45 SC @ 0.5 ml/l was found to be more effective than other chemical insecticides. Spinosad recorded the per cent pod damage reduction by 72.12% followed by cypermethrin 25 EC @ 1 ml/l, indoxacarb 15SC @ 0.5 ml/l, chlorpyriphos 20EC @ 2 ml/l, NSKE 5% @ 5 ml/l, Profenophos 40EC @ 1ml/l and neem oil@ 3ml/l recorded the per cent pod damage reduction by, 66.43, 64.73, 63.94, 59.86, 57.99 and 54.43 per cent respectively. Neem oil recorded least effective among the treatments but significant and superior over control.

All the treatments were found to be significantly superior over control. Spinosad was more effective in percentage damage reduction of pods with 72.12% reduction over control. Rashid *et al.* (2003) [7] reported that spinosad gave the highest percentage of reduction of pod and seed damage and its results are supported by Ahmed *et al.* (2004) [8], Venkateshalu *et al.* (2009) [9] and Tariq *et al.* (2005) [10], and cypermethrin was found to be next effective treatment (67.56%).

The results pertaining to seasonal incidence of key pest of chickpea were presented in Table. 2. The occurrence of chickpea pod borer, *H. armigera* commenced from 6th standard week (February second week) with an average 0.25 larvae/plant. The pod borer population increased and gradually reached peak level of 6.25 larvae/plant at 13th standard week (March last week). Thereafter, declined trend was observed. Reddy *et al.* (2009) [11] experimented the incidence of the pod borer in chickpea commenced from second week of February *i.e.* in the early part of 1st fortnight of February. The larval population started increasing and reached its maximum during 4th week of March. These findings are in close association with Pandey *et al.* (2012) [12] as well.

Finally the results pertaining to pod damage percentage, yield data and subsequent economic analysis (Tables 3&4.) revealed that minimum pod damage of 11.98% and higher grain yield of 1745 kg/ha was obtained from spinosad treated plots. Singh and Yadav (2007) [13] reported maximum grain yield was recorded in spinosad with minimum pod damage and its results are supported by Wakil *et al.* (2008) [14]. Higher cost benefit ratio of 1:2.36 was obtained from spinosad treated plots. Sreekanth *et al.* (2013) [15] reported that highest grain yield and cost benefit ratio was obtained in the treatment of spinosad and proved to be best among treatments and its results are supported by Anandhi *et al.* (2011) [16].

Table 1: Efficacy of certain chemicals and neem products against chickpea pod borer, *Helicoverpa armigera* (Hub.) during *Rabi* season 2014-15

Treatment	% reduction of larval population					% reduction of larval population							
	Pre- treat. (1st Spray)	DAS*				Pre- treat. (2nd Spray)	DAS*				DAS*		
		3	7	14	Mean		3	7	14	Mean	1st Spray Mean	2nd Spray Mean	Overall Mean
Chlorpyriphos 20 EC	5.20	52.50	71.73	82.12	68.78	3.53	50.99	60.34	66.01	59.11	68.78	59.11	63.94
Cypermethrin 25 EC	5.00	41.40	68.00	80.00	63.13	3.93	66.15	72.77	77.10	72.00	63.13	72.00	67.56
Indoxacarb 15 SC	4.47	28.41	65.77	76.06	56.74	4.40	63.64	74.32	80.23	72.73	56.74	72.73	64.73
Profenophos 40EC	4.13	32.20	40.19	66.10	46.16	3.47	63.40	69.16	76.95	69.83	46.16	69.83	57.99
Spinosad 45 SC	5.07	59.96	65.88	78.90	68.24	4.07	68.80	77.15	82.06	76.00	68.24	76.00	72.12
NSKE 5%	4.27	25.06	54.80	67.92	49.26	4.13	62.95	67.80	80.63	70.46	49.26	70.46	59.86
Neem oil 1%	4.33	19.86	52.19	56.81	42.95	4.47	59.73	67.11	70.92	65.92	42.95	65.92	54.43
Control	4.90	0.00	0.00	0.00	0.00	3.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F-test	NS*	S*	S	S	S	NS	S	S	S	S	S	S	S
S.Ed (±)	0.727	0.779	0.232	0.161	0.644	0.488	0.330	0.198	0.268	0.612	0.644	0.612	0.628
C.D.(P= 0.05)	1.540	5.78	2.73	1.95	3.72	1.483	2.56	2.76	1.35	2.36	3.72	2.36	3.24

*DAS- days after spray, NS- Non significant, *S – Significant

Table 2: Seasonal incidence of chickpea pod borer, *Helicoverpa armigera* (Hub.) and weather parameters during *Rabi* season, 2014-2015.

Standard week number	Date	No. of larvae/ plant	Temperature		Humidity %		Rainfall (mm)	Wind Velocity	Sunshine (hr/day)
			Max	Min	Morning	Evening			
47th	19-25 Nov.	0.00	30.02	11.88	82.71	44.57	0.00	0.64	7.8
48th	26-2 Dec.	0.00	31.05	11.62	82.71	41.85	0.00	0.52	8.44
49th	3-9 Dec.	0.00	29.54	10.37	84.28	45.14	0.00	0.69	8.28
50th	10-16 Dec.	0.00	27.51	9.54	87.00	56.42	1.20	0.73	6.22
51st	17-23 Dec.	0.00	22.25	7.84	91.28	58.57	0.00	1.77	3.51
52nd	24-30 Dec.	0.00	17.20	8.2	93.42	62.57	0.00	0.83	1.10
1st	31-6 Jan.	0.00	20.65	12.74	92.28	56.42	4.71	1.46	0.00
2nd	7-13 Jan.	0.00	19.71	9.65	91.28	68.57	0.00	1.40	0.00
3rd	14-20 Jan.	0.00	15.71	7.92	94.57	67.14	0.00	1.29	0.00
4th	21-27 Jan.	0.00	18.62	11.64	93.42	69.14	3.28	1.25	0.00
5th	28-3 Feb.	0.00	23.62	12.90	92.28	51.57	1.51	1.43	2.65
6th	4-10 Feb.	0.25	27.08	11.17	91.28	54.42	0.74	2.10	3.08
7th	11-17 Feb.	0.60	28.20	11.94	94.57	48.14	0.00	0.79	6.45
8th	18-24 Feb.	1.02	30.85	13.34	93.42	49.42	0.00	1.68	15.68
9th	25-3 Mar.	1.35	29.58	14.71	89.57	60.57	9.62	2.16	13.35
10th	4-10 Mar.	3.10	33.20	15.11	89.85	50.42	0.00	1.73	12.20
11th	11-17 Mar.	4.65	33.37	15.02	86.71	45.14	0.02	1.78	11.25
12th	18-24 Mar.	5.37	34.31	16.45	87.57	45.71	0.00	2.66	13.25
13th	25-31 Mar.	6.25	34.14	18.37	91.14	44.14	1.20	3.09	10.32
14th	1-7 Apr.	2.25	38.76	20.24	89.00	40.23	0.00	5.23	9.73
15th	8-14 Apr.	1.06	39.25	21.00	87.00	38.74	0.00	4.02	9.32
		r=	0.593	0.651	-0.108	-0.440	-0.074	0.499	0.611
		t=	3.209	3.738	-0.472	-2.133	-0.323	2.509	3.366
		F- test	S*	S	NS*	S	NS	S	S

*S - Significant
*NS- Non significant

Table 3: Efficacy of certain chemicals and neem products on Pod damage and Yield of chickpea (*Cicer arietinum* L.)

Treatment No.	Treatments	Pod damage (%)	% Decrease in pod damage over UTC*	% Increase in yield over UTC*	Yield (Kg/ ha)
T_1	Chlorpyriphos 20 EC	21.14	49.77	165.14	1392
T_2	Cypermethrin 10EC	13.40	68.16	211.42	1635
T_3	Indoxacarb 14.5 SC	14.04	66.64	190.28	1524
T_4	Profenophos 40 EC	23.97	43.05	132.38	1220
T_5	Spinosad 45 SC	11.98	71.53	232.38	1745
T_6	NSKE 5%	24.48	41.83	114.47	1126
T_7	Neem oil 1%	30.86	26.68	88.57	990
T_0	Control	42.09			525
	F-Test	S			
	S.Ed(±)	0.97			
	C.D.	2.08			

*UTC – untreated check

Table 4: Economics of chickpea pod borer management using certain chemicals and neem products.

Tr. No.	Treatment	Yield q/ha	Cost of yield Rs/q	Total cost of yield Rs.	Cost of cultivat-ion Rs.	Treat- ment cost Rs.	Total cost Rs.	Net returns Rs.	C:B ratio*
T_1	Chlorpyriphos 20 EC	13.92	4200	58464	20720	1720	22440	36024	1:1.60
T_2	Cypermethrin 10EC	16.35	4200	68670	20720	2600	23320	45350	1:1.94
T_3	Indoxacarb 14.5 SC	15.24	4200	64008	20720	1800	22520	41488	1:1.84
T_4	Profenophos 50 EC	12.20	4200	51240	20720	1160	21880	29360	1:1.34
T_5	Spinosad 45 SC	17.45	4200	73290	20720	1080	21800	51490	1:2.36
T_6	NSKE 5%	11.26	4200	47292	20720	740	21460	25832	1:1.20
T_7	Neem oil 1%	9.90	4200	41580	20720	1050	21770	19810	1:0.90
T_0	Control	5.25	4200	22050	20720	------	20720	1330	1:0.06

*C: B- cost benefit ratio

4. Conclusion
From the thorough analysis of the present findings it can be concluded that chickpea pod borer population was increased with maximum temperature, minimum temperature, morning and evening relative humidity and decreased with increasing maximum temperature above 35 °C, wind velocity and sunshine hours. Insecticides like spinosad and cypermethrin can be suitably incorporated in integrated pest management schedule against *Helicoverpa armigera* (Hub.) as an effective tool as their recommended field doses are very low. The neem products also achieve certain range of mortality but are less effective than new insecticide molecules because they are highly specific, low toxicity, not photostable and it takes more time to kill the insect.

5. References

1. Ahmed S, Zia K, Shah NUR. Validation of Chemical Control of Gram Pod borer, *Helicoverpa armigera* (Hub.) with New Insecticides International Journal of Agriculture & Biology. 2004; 6(6):978-980.
2. Ali A, Choudhury RA, Ahmad Z, Rahman F, Khan FR, Ahmad SK. Some biological characteristics of *Helicoverpa armigera* on chickpea. Tunisian Journal of plant protection. 2009; 4(1):99-106.
3. Anandhi DMP, Elamathi S, Sobita Simon. Evaluation of insecticides for management of *Helicoverpa armigera* in chick pea. Annals of Plant Protection Sciences. 2011; 19(1):207-209.
4. Gowda DKS, Patil BV, Yelshetty S. Evaluation of comparative efficacy of Dusts and Emulsifiable concentration formulations against gram pod borer in chickpea ecosystem Karantaka Res. 2007; 20(2):276-278.
5. Hossain A. Efficacy of some synthetic and biopesticides against chickpea pod borer, *Helicoverpa armigera* (Hub.) in chickpea, Cicer arietinum Tropical Agricultural Research and Extension. 2007; 10(1):74-78.
6. Hossain A, Haque A, Ahmad M, Prodhan MZH. Development of an Integrated Management Approach for Pod Borer, Helicoverpa armigera (Hubner) On Chickpea Bangladesh J. Agril. Res. 2010; 35(2):201-206.
7. Pandey BM, Tripathi MK, Lakshmi V. Seasonal incidence of Gram pod borer *Helicoverpaa armigera* (Hub.) On chickpea in Varanasi area J. Exp. Zool. 2012; 15(2):667-669.
8. Tariq M, Malik MA, Iqbal N. Management of *Helicoverpa armigera* with different insecticides. Pak. J Agri. Sci., 2005; 42(1-2):75-77
9. Pachundkar N, Kamble P, Patil P, Gagare P. Management Of Gram Pod Borer *Helicoverpa armigera* In Chickpea With Neem Seed Kernel Extract as a Natural Pest Management Practice in Bhojdari Village International Journal of Current Research. 2013; 5(10):234-235.
10. Rashid A, Saeed HA, Siddiqi SZ, Arshad M. Comparative efficacy of various Insecticides to Control Gram Pod Borer *Helicoverpa armigera* (Hubner) on chickpea Asian Journal of Plant Sciences. 2003; 2(4):403-405.
11. Reddy V, Anandhi P, Elamathi S, Varma S. Seasonal Occurrence of Pulse Pod Borer *Helicoverpa armigera* (Hub.) On Chick pea at Eastern U.P. Region Agric. Sci. Digest., 2009; 29(2):60-62.
12. Rummana A, Choudhury A, Parvez Q, Sayed HP, Galib. Antifeedent Response of Two Medicinal Plants against *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) on chickpea, Cicer arietinum Middle-East Journal of Scientific Research. 2010; 5(5):329-335.
13. Singh SS, Yadav SK. Efficacy and economics of some modern insecticides, bio pesticides and neem based formulation against pod borer, *Helicoverpa armigera* in pigeon pea. Indian Journal of Entomology. 2007; 68(2):139-143.
14. Sreekanth M, Seshamahalakshmi M. Field studies on the relative toxicity of biopesticides to *Helicoverpa armigera* (Hubner) and *Maruca vitrata* on pigeonpea (*Cajanus*

cajan L.) Journal of Biopest. 2010; 5(2):191-195.
15. Venkateshalu A, Nadagouda S, Hanumantharaya L. Bioefficacy of Proton, A Plant product against fruit borer, *Helicoverpa armigera* (Hubner) on chilli Karnataka J. Agric. Sci. 2009; 22(3):557-558.
16. Wakil W, Ashfaq M, Ghazanfar U, Akhtar S, Malhi ZA. Laboratory bioassay with neem (*Azadirachta indica* A. Juss) products to control *Helicoverpa armigera* (Hubner) feed on chickpea Pak. Entomol., 2008; 30(1):51-54.