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Efficacy of Virus based Biopesticide Formulation against Gram Pod borer, *Helicoverpa armigera* in chickpea

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ABSTRACT

The field experiments were carried out during the *rabi* 2020-21 season at farmer's field in Amritsar and Gurdaspur districts. Efficacy of biopesticides namely Helicop 2% AS (HaNPV formulation) at 250, 375 and 500 ml/haalong with standard checks DOR Bt-1 at 2000 g/haand Coragen 18.5 SC (chlorantraniliprole) @ 125 ml/ha were evaluated against gram pod borer, *H. armigera* in gram. The experiment was laid out in Randomised Block Design (RBD) with 6 treatments including untreated control each replicated three times. Helicop 2% AS showed increased efficacy in suppressing the larval population of *H. armigera* with increase in the concentration of the insecticide and days after application. Highest suppression (77.78%) of larval population was observed @ 500 ml/ha after 10 days of first spray of Helicop 2% AS. Similar trend for reduction in larval population was observed after 7 days of second spray also. It was noticed that 58.12, 80.66 and 90.32 per cent reduction in larval population occurred 7 days after second spray when Helicop 2% AS used @ 250, 375 and 500 ml/ha, respectively. Reduction in larval population was 87.04 per cent when DOR Bt 1 was used @ 2000 g/ha. No significant differences in reducing the larval population were observed when Helicop 2% AS @ 500 ml/ha, DOR Bt 1@ 2000 g/ha and Coragen 18.5 SC @ 125 ml/ha used after 7 days of second spray, although all the treatments differed significantly as compared to control.Hence, Helicop 2% AS may be used as an alternative control measures @ 500 ml/ha for the management of *H. armigera* in gram. Its use must be recommended early in the season when the larvae are young and two sprays may be recommended for better results.

Key Words: Biopesticides, Chickpea,Coragen 18.5 SC, Gram pod borer, Helicop 2% AS.

INTRODUCTION

Chickpea is one of the most important pulse crops of India among the various grain leguminous crops. There are two types of chickpea based on seed size, colour and shape known as desi and Kabuli. There are many factors which influence the production of chickpea but the most important limiting factor is the occurrence of different insect pest's population (Sarwar *et al,* 2011). Among all the insect pests, *H. armigera* is one the most destructive pest of chickpea. *H. armigera* constitutes a worldwide pest of great economic importance on this crop. It also causes damage to Cotton, Sorghum, Pea, Chillies, Groundnut, Tobacco, Okra, Maize, Tomato and Soybean etc.

It is a polyphagous species and is also an important pest of pulses. The caterpillar feeds on tender foliage and young pods by making holes in the host and eat the developing seeds by inserting the half portion of their body inside the pod. As a result, holes on pods, absence of seeds in pods and defoliation in early stages are the symptoms of the attack. Before pod formation, the larvae bore into the pods, feed inside the seed and cause considerable loss to the seed yield. The population of *H. armigera* increases greatly during the pod formation stage causing substantial damage to pods therefore at this stage control measures become necessary (Patel *et al,* 2010).

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Reports of high level of resistance to the conventional insecticides in *H.armigera* have resulted in renewed interest in the research for exploring the opportunities of using biopesticides. Biological agents provide an alternative to chemicals for economically viable and ecologically sustainable management of chickpea pod borer (Patil *et al,* 2017). Plant materials such as azadirachtin are known to be environmentally safer and more cost-effective compared to synthetic pesticides (Kamanula *et al,* 2011). Bt-based microbial insecticides can be used for managing pod borer populations and they provide an eco-friendly alternative to the generally hazardous broad-spectrum chemical insecticides (Ahmed *et al,* 2012). Most natural pod borer populations have at least some degree of infection by species-specific nuclear polyhedrosis viruses (NPVs). In India, extensive studies evaluating NPVs have resulted in the development of technologies for successful application of indigenous NPV preparations to combat pod borer in chickpea. Keeping in view, the present study was undertaken to evaluate the bioefficacy of HaNPV biopesticide Helicop 2% AS against *H. armigera* in chickpea. This biopesticide is registered with Central Insecticide Board and have a label claim against gram caterpillar in gram. Also, HaNPV biopesticide Helicop 2% AS will provide an eco-friendly and safe alternative to chemical insecticides against gram caterpillar in gram and will also enhance the choice of farmers in selecting the non-chemical approach for its management.

MATERIALS AND METHODS

The field experiments were carried out during the *rabi* 2020-21season at farmer's field in Amritsar and Gurdaspur districts. Efficacy of biopesticides namely Helicop 2% AS (HaNPV formulation) at 250, 375 and 500 ml/haalong with standard checks DOR Bt-1 at 2000 g/haand Coragen 18.5 SC (chlorantraniliprole) @ 125 ml/ha were evaluated against gram pod borer, *H. armigera* in gram. The experiment was laid out in Randomised Block Design (RBD) with 6 treatments including untreated control each replicated three times. The plot size was kept at 25 m^2 with row to row spacing of 30cm. The gram variety PBG7 was used in the experiment which was sown in the third week of October, 2020. Two foliar sprays of all the treatments were given by using knap sack sprayer, first at pod initiation and second 10 days thereafter. The observations were recorded on the larval population per 5 plants before, 3, 7 and 10 days after each spray. The pod damage was recorded at the time of harvest wherein random samples of 200 pods per plot per replication were collected to observe the number of damaged pods. The data were converted into per cent damaged pods. Grain yield data were also recorded from each plot after harvest and adjusted to per hectare basis. The data were pooled and analysed statistically.

RESULTS AND DISCUSSION

The average larval population of *H. armigera* varied between2.67 to 3.33 per 5 plants in different treatments, including untreated control before spray, the differences being non-significant (Table 1.). Based on pooled mean, all treatments were significantly better than untreated control three days after first spray. The larval population in chemical control was lowest (0.33/ 5 plants) as compared to other treatments. Helicop 2% AS showed increased efficacy in suppressing the larval population of *H. armigera* with increase in the concentration of the insecticide and days after application. Highest suppression (77.78%) of larval population was observed @ 500 ml/ha after 10 days of first spray of Helicop 2% AS. The reduction in larval population was 55.09, 44.91 and 90.11 per cent in Helicop 2% AS @ 500 ml/ha, DOR Bt-1 and chemical control, respectively. Similar trend was observed 7 and 10 days after first spray. The reduction in larval population was 68.93, 59.13 and 100 per cent at 7 days after first spray and 77.78, 59.34 and 92.67 per cent at 10 days after first spray, respectively. Significantly higher larval population of *H. armigera* was recorded in untreated control (Table 1). After second spray also, all the treatments

Table 1. Effect of HaNPV biopesticide, Helicop 2% AS against *Helicoverpa armigera* in gram on larval population after first spray.

Sr. no.	Treatment	Dose /ha	Before spray			3 Days After first spray				7 Days After first spray				10 Days After first spray			
			Amritsar	Gurdaspur	Pooled mean	Amritsar	Gurdaspur	Pooled mean	% Reduction over control	Amritsar	Gurdaspur	Pooled mean	% reduction over control	Amritsar	Gurdaspur	Pooled mean	% reduction over control
1.	Helicop 2% AS (HaNPV)	250 ml	3.00	2.33	2.67	2.67 (1.91)	1.67 (1.61)	2.17 (1.78)	35.03	2.33 (1.82)	1.00 (1.41)	1.67 (1.62)	54.5	3.00 (2.00)	1.67 (1.62)	2.34 (1.81)	48.00
2.	Helicop 2% AS (HaNPV)	375 ml	2.67	3.00	2.84	2.00 (1.73)	1.67 (1.63)	1.84 (1.68)	44.91	1.33 (1.52)	1.33 (1.52)	1.33 (1.52)	63.76	2.00 (1.73)	2.00 (1.73)	2.00 (1.73)	55.56
3.	Helicop 2% AS (HaNPV)	500 ml	2.67	2.67	2.67	2.00 (1.72)	1.00 (1.41)	1.5 (1.57)	55.09	0.67 (1.28)	1.00 (1.38)	0.84 (1.33)	68.93	0.67 (1.27)	1.33 (1.52)	1.00 (1.4)	77.78
4.	DOR Bt 1	2000 g	3.33	3.33	3.33	1.67 (1.63)	2.00 (1.73)	1.84 (1.68)	44.91	1.00 (1.38)	2.00 (1.72)	1.5 (1.55)	59.13	1.33 (1.52)	2.33 (1.82)	1.83 (1.67)	59.34
5.	Coragen 18.5SC	125 ml	3.00	2.67	2.84	0.33 (1.14)	0.33 (1.14)	0.33 (1.15)	90.11	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	100.0	0.33 (1.14)	0.33 (1.14)	0.33 (1.14)	92.67
6.	Untreated control	-	3.33	3.00	3.17	3.67 (2.16)	3.00 (1.99)	3.34 (2.08)	-	3.67 (2.16)	3.67 (2.16)	3.67 (2.16)	-	4.33 (2.30)	4.67 (2.35)	4.5 (2.33)	-
7.	CD (p=0.05)		NS	NS	NS	1.15	1.24	1.01	-	1.2	1.17	1.41		1.04	1.80	1.50	

Figures in parentheses are square transformations

Table 2. Effect of HaNPV biopesticide, Helicop 2% AS *against Helicoverpa armigera* in gram on larval population after second spray.

Sr. no.	Treatment	Dose/ha	3 Days After second spray				7 Days After second spray				10 Days After second spray			
			Amritsar	Gurdaspur	Pooled mean	% reduction over control	Amritsar	Gurdaspur	Pooled mean	% reduction over control	Amritsar	Gurdaspur	Pooled mean	% reduction over control
1.	Helicop 2% AS (HaNPV)	250 ml	2.67 (1.91)	1.00 (1.38)	1.84 (1.67)	62.00	3.33 (2.08)	1.00 (1.41)	2.17 (1.75)	58.12	3.67 (2.16)	1.00 (1.41)	2.34 (1.79)	51.66
2.	Helicop 2% AS (HaNPV)	375 ml	1.33 (1.52)	1.00 (1.41)	1.17 (1.47)	75.88	0.67 (1.27)	1.33 (1.52)	1.00 (1.41)	80.66	0.67 (1.28)	1.33 (1.52)	1.00 (1.41)	79.30
3.	Helicop 2% AS (HaNPV)	500 ml	0.33 (1.14)	0.67 (1.28)	0.5 (1.22)	89.65	0.33 (1.14)	0.67 (1.28)	0.5 (1.22)	90.32	0.67 (1.28)	1.00 (1.41)	0.84 (1.35)	82.71
4.	DOR Bt 1	2000 g	1.00 (1.41)	1.33 (1.52)	1.17 (1.47)	75.88	0.67 (1.28)	0.67 (1.28)	0.67 (1.29)	87.04	1.00 (1.38)	1.00 (1.38)	1.00 (1.41)	79.30
5.	Coragen 18.5SC	125 ml	0.00 (1.00)	0.00 (1.00)	0 (1.00)	100.00	0.00 (1.00)	0.00 (1.00)	0 (1.00)	100	0.33 (1.14)	0.33 (1.14)	0.33 (1.15)	93.17
6.	Untreated control	-	4.33 (2.31)	5.33 (2.52)	4.83 (2.41)	-	5.00 (2.44)	5.33 (2.52)	5.17 (2.48)	-	5.33 (2.51)	4.33 (2.31)	4.83 (2.41)	-
7.	CD (p=0.05)		0.9	1.05	1.68	-	1.17	0.89	2.02	-	1.33	1.01	2.27	-

Figures in parentheses are square transformations

Table 3. Effect of HaNPV biopesticide, Helicop 2% AS against *Helicoverpa armigera* in gram on pod damage (%), yield and natural enemies.

Sr. no.	Treatment	Dose/ ha	Pod damage (%)		Pooled mean	% reduction over control	Yield (q/ha)		Pooled mean	% increase over control	Spiders/ 5 plants		Pooled mean
1.	Location		Amritsar	Gurdaspur			Amritsar	Gurdaspur			Amritsar	Gurdaspur	
2.	Helicop 2% AS (HaNPV)	250 ml	7.33 (15.70)	10.33 (18.74)	8.83 (17.22)	54.32	16.17 (23.70)	15.77 (23.39)	15.97 (23.55)	14.9	1.67	1.67	1.67
3.	Helicop 2% AS (HaNPV)	375 ml	6.67 (14.89)	8.33 (16.77)	7.50 (15.87)	61.20	18.33 (25.34)	16.30 (23.80)	17.32 (24.57)	24.60	1.67	1.67	1.67
4.	Helicop 2% AS (HaNPV)	500 ml	5.33 (13.26)	6.67 (14.89)	6.00 (14.15)	68.96	19.83 (26.43)	17.23 (24.52)	18.53 (25.47)	33.30	1.33	1.33	1.33
5.	DOR Bt 1	2000 g	5.00 (12.87)	6.33 (14.56)	5.67 (13.74)	70.67	20.17 (26.67)	17.83 (24.97)	19.00 (25.82)	36.69	1.67	1.67	1.67
6.	Coragen 18.5SC	125 ml	0.67 (3.83)	1.33 (6.53)	1.00 (5.66)	94.83	22.43 (28.25)	21.07 (27.31)	21.75 (27.78)	56.48	0.33	1.33	0.83
7.	Untreated control	-	16.33 (23.81)	22.33 (28.17)	19.33 (26.01)	-	14.10 (22.04)	13.70 (21.72)	13.90 (21.88)	-	2.33	2.33	2.33
8.	CD (p=0.05)		2.37	2.00	3.63	-	0.58	0.41	1.79	-	NS	NS	NS

Figures in parentheses are Angular transformations

Table 4. Economics of HaNPV biopesticide, Helicop 2% AS over control against *Helicoverpa armigera* in gram.

Treatment	Dose (g or ml/ ha)	Yield (q/ha)	Additional yield over control (q/ha)	Gross returns (Rs./ha)	*Cost of treatment (Rs./ha)	Net additional returns over control (Rs/ha)
Helicop 2% AS (HaNPV)	250 ml	15.97	2.07	10325.16	1250	9075.16
Helicop 2% AS (HaNPV)	375 ml	17.32	3.42	17058.96	1625	15433.96
Helicop 2% AS (HaNPV)	500 ml	18.53	4.63	23094.44	2000	21094.44
DOR Bt 1	2000 g	19.00	5.1	25438.8	2700	22738.8
Coragen 18.5 SC	125 ml	21.75	7.85	39155.8	3875	35280.8
Untreated Control	-	13.90	-	-	-	-

Average price of gram (2019-20 and 2020-21) = Rs. 4988/- per quintal

*For two sprays: Cost of insecticide +labour cost; Helicop 2% As (HaNPV) @ Rs. 1500 per litre; DOR Bt 1 @ Rs. 550 per Kg; Coragen18.5 SC: Rs, 13500 per litre

were found significantly superior as compared to the untreated control (Table 2). Further, 62.00, 75.88 and 89.65 per cent reduction in larval population was observed 3 days after second spray when Helicop 2% AS was used @ 250, 375 and 500 ml, respectively. Complete reduction in larval population was observed in chemical control after 3 days of second spray.About 75.88 per cent reduction in larval population was observed when DOR Bt 1 was used @ 2000 g/ha as compared to 89.65 per cent reduction in larval population when Helicop 2% AS was used @ 500 ml/ha, although no significant differences in reducing the larval population were observed when both these two formulations were used at the described concentrations after 3 days of second spray. Similar trend for reduction in larval population was observed after 7 days of second spray also. Likewise, 58.12, 80.66 and 90.32 per cent reduction in larval population was observed 7 days after second spray when Helicop 2% AS was used @ 250, 375 and 500 ml, respectively. Reduction in larval population was 87.04 per cent when DOR Bt 1 was used @ 2000 g/ha. No significant differences in reducing the larval population were observed in the treatments when Helicop 2% AS @ 500 ml/ha, DOR Bt 1@ 2000 g/ha and Coragen 18.5 SC @ 125 ml/ha were used after 7 days of second spray, although all the treatments differed significantly as compared to control.Meena *et al* (2018) also found 59.45 and 67.04 per cent reduction in larval population after 7 days of first and second spray, respectively when Helilure (HaNPV) was used @ 250 LE/ha in gram. Kavitha *et al* (2013) found 4.22, 2.24 and 0.78 larvae/plant when Helicide (HaNPV) was used @ 250 LE/ha after 1st, 2nd and 3rd spray, respectively.Also,HaNPV recorded least per cent pod damage (7.17), grain damage (4.05 %), seed damage (2.22 %), seed mass loss (4.27 %), maximum grain yield (1416.66 kg/ha), yield gain (76.35 %) and additional yield over control (613.33 kg/ha) which was found to be on par with insecticidal check (Endosulfan).Kumar *et al* (2019) found 5.4 and 3.6 mean larval population of *H. armigera* larvae per meter length after 3 and 7 days of spraying HaNPV in chickpea.

Reduction in pod damage was observed with increase in concentration of Helicop 2% AS. Pod damage of 8.83, 7.50 and 6.00 per cent was

observed when Helicop 2% AS was used @ 250, 375 and 500 ml/ha. Pod damage of 5.67 per cent was observed when DOR Bt 1 was used @ 2000 g/ha. No significant differences in per cent pod damage were observed in any of the treatment and at any concentration but all the treatments differed significantly as compared to control. Significantly higher pod damage (19.33%) was observed in untreated control. A pod damage of 11.83 per cent was observed when Helilure (HaNPBV) was used @ 250 LE/ha in gram (Meena *et al,* 2018). Similar, results were obtained by (10) who observed equal performance of Bt and HaNPV in terms of pod damage and grain yield in chickpea fields. Thakre *et al* (2003) revealed that HaNPV was most effective in reducing pod damage by lepidopteran pests and also by the pod borer complex.

The yield among various treatments as well as untreated control differed significantly. The yield of 15.97, 17.32 and 18.53q/hawere obtained when Helicop 2% AS was used at 250, 375 and 500 ml/ha dose (Table 3). Similarly, yield of 19.0 q/ha was obtained when DOR Bt 1was used at 2000 g/ha dose. The yield was significantly higher in chemical control (21.75 q/ha). As far as grain yield is concerned, it was observed that Helicop 2% AS gave promising results in obtaining higher grain yield when used at the higher concentration of 500 ml/ha. Significantly less grain yield (13.90 q/ha) was obtained in untreated control. The spider population in all the biopesticide treatments did not differ significantly from untreated conrol (Table 3). Meena *et al* (2018) found grain yield of 11.41 q/ha when Helilure (HaNPV) was used @250 LE/ha in gram. The results were in agreement with that of Siddegowda and Yelshetty (2005) who reported highest grain yield in HaNPV treated plot which was significantly superior over other treatments and control.

Economics of HaNPV biopesticide, Helicop 2% AS over control against H. armigera was also calculated. Net additional returns over control (Rs. 21094/ ha) was obtained when Helicop 2% AS was used at the highest concentration of 500 ml/ha. Highest net additional returns (Rs. 35280q/ha) was obtained in chemical control.

CONCLUSION

Helicop 2% AS may be used as an alternative control measures @ 500 ml/ha for the management of *H. armigera* in gram. Its use must be recommended early in the season when the larvae are young and two sprays may be recommended for better results.

REFERENCES

Ahmed K, Khalique F, Durrani S A and Pitafi K D (2012). Field evaluation of bio-pesticide for control of chickpea pod borer *Helicoverpa armigera*, a major pest of chickpea crop. *Pakistan J Zool* **44** (6): 1555–1560.

Bhat N J and Patel R K (2002). Bio-efficacy of various insecticides against *Helicoverpa armigera* on chickpea. *Indian J Entomol* **64:** 27-34.

Deka NK, Prasad D and Chand P (1987). Succession and incidence of insect pests in chickpea, *Cicer arietinum* L. *Giornale Italiano di Entomol* **3:** 421-428.

Kavitha K,Reddy D J and Rahman S J (2013).Field evaluation of different eco-friendly inputs against gram pod borer, *Helicoverpa armigera* (Hubner)on pigeonpea in Andhra Pradesh. *Prog Res* **8** (Special): 858-862.

Kamanula J, Sileshi GW, Belmain SR, Sola P, Mvumi BM, Nyirenda GKC, Nyirenda SPN and Stevenson PC (2011). Farmers' insect-pest management practices and pesticidal plant use for protection of stored maize and beans in Southern Africa. *Int J Pest Mgmt* **57** (1): 41–49.

Kharkwal MC, Jain HK and Sharma B (1988). Induced mutations for improvement of chickpea, lentil, pea and cowpea. In: Improvement of grain legume production using induced mutations. *IAEA Vienna* **1:**89-109.

Kumar A, TripathiMK, Chandra U and Veer R (2019). Efficacy of botanicals and bio-pesticide against *Helicoverpa armigera* in chickpea. *J Entomol Zoo Studies* **7:** 54-57.

Meena R K, Naqvi A R, Meena, D S and Shivbhagvan (2018). Evaluation of bio-pesticides and indoxacarb against gram pod borer on chickpea. *J EntomolZoo studie s***6:** 2208-2212.

Patel I S, Patel P S, Patel J K and Acharya S (2010). Pod boring pattern of gram pod borer, *Helicoverpa armigera* Hub. in chickpea varieties. *Insect Environ* **16**(1):41–42.

Patil SB, Goyal A, Chitgupekar SS, Κυμαρ Σ ανδ Ελ–Βουησσινι M (2017). Sustainable management of chickpea pod borer.A review. *Agron Sustain Dev* **37** (20). https://doi.org/10.1007/s13593-017-0428-8

Sarwar M , Ahmad N and Toufiq M (2011). Identification of susceptible and tolerant gram (*Cicerarietinum* L.) genotypes against gram pod borer, *Helicoverpa armigera* (Hubner). *Pakistan J Bot* **43:** 1265-70.

Siddegowda D K and Yelshetty S (2005). Evaluation of microbial agents against gram pod borer, *Helicoverpa armigera* (Hubner). *Karnataka J Agri Sci* **18:** 44-46.

Thakre, S M, Sarode S V and Katole, S R (2003). Management of pod borer complex of pigeonpea with botanicals and microbials. *J Appl Zoological Res* **14:** 23-26.

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