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Research Article

Field Efficiency of Certain Biopesticides and Neem Products Against *Helicoverpa armigera* (Hubner) on Chickpea (*Cicer arietinum*L.)

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ABSTRACT
A field study was conducted to evaluate the efficiency of four microbial insecticides viz. *Beauveria bassiana;* HaNPV (*Helicoverpa armigera Nuclear Polyhedrosis virus*); (*Bacillus thuringiensis*var.*kurstaki 2* gm/L); HaNPV+Bt; neem oil; neem cake and D.D.V.P EC 76% @0.05% at Research Farm SHIATS,Allahabad during rabi season of 2011-2012. The experiment was laid out in randomized block design with seven treatment and replicated thrice. The observation larval populations of *H. armigera* were recorded one day before treatment was recorded at 3,7, and 10 days after treatments. The larva population of *H. armigera* appeared in the third week of February (8 the Standard week) and reached its peak of 14.65 larvae in first week of April and decline rapidly with maturation of crop. There was only one peak in the larval population observation in the 1st week. *Bacillus thuringiensis* was the most effective chemical by D.D.V.P.76%@0.05% . Among the microbial insecticides. HaNPV ,was the most effective followed by HaNPV+Bt and neem cake . The combination treatments were less effective than the individual treatment neem oil and *B. bassiana* were the least effective treatment in reducing the larval population of *Heliverpa armigera*.

Keywords:*Helicoverpa armigera*, Chickpea, bio-agent, neem products and D.D.V.P.76%.

INTRODUCTION
The chickpea pod borer, *H. armigera* (Lepidoptera: Noctuidae), is globally distributed, polyphagous pest anda major biotic constraint of chick pea production (Pawar, 1998). The alternative to these chemical insecticides, the mycopesticide shave either low or no resistance problem, are host specific, economic and ecologically friendly (Ferron*et al.,* 1991).*Beauveria bassiana* has also been reported to be an effective fungus against *H. armigera* and other insect pests under both laboratory and field conditions (Sandhu *et al.,* 2001; Tefera and Pringle, 2004; Ngugen*et al*.,2007; GC *et al*., 2008, Rijal*et al.*, 2008).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. Use of baculo viruses, *Bacillus thuringenesis*(Bt.) and plant products Ravi *et al*. (2008), Nihad, (2015).

MATERIALS AND METHODS
Field preparation and the sowing of chick pea seeds
All crop residues and weeds were removed and the soil was thoroughly ploughed. Seeds of chickpea, (*Cicer arietinum* L.) variety "PUSTA-362" were sown 10 cm deep at 40 cm spacing between plants and with30 cm space between rows, and with 10 plants per row. Weeding was done at 20 and 30 days after sowing (DAS).
Experimental design
A randomized complete block design with 7 treatments and 3 replications was used in the present study. Treatments included *Bacillus thuringiensis* (Bt) var. *kurstaki*50000 IU/mg WP at 2 gm/L, Nuclear poly-hedrosis virus of *Helicoverpaarmigera*0.43%Aqueous Suspenion Entomopathogen, *B. bassiana* at 1 × 107 conidia/ml, Neem cake, Neem oil based azadirachtin 0.15%w/w(1500PPM) and Dichlorvos 76% 0.05% EC and water as control.
Insecticide application, observation and data analysis
Two sprays of insecticide were applied at the vegetative, flowering to pod setting stage and in the pod setting stage and onwards, respectively. Throughout the study, 10 plants were sampled from each treatment for observation. The number of larvae per plant or pod were recorded at 1, 7 and 10 days after treatment (DAT) during the vegetative, the flowering and the pod setting stage of the chick pea. The number of pods damaged or destroyed by *H. armigera* were counted to determine the percentage of pods damages at 98, 108, 115 and 122 DAS. All insect scoring and *H. armigera* larvae population density observations were carried out as described by Lateef and Reed (1983), and the population reduction compared to the control was calculated using the following equation by Fleming and Retnakaran (1985).
$LP = (1 - \frac{Ta \times Cb}{Tb \times Ca})100$ Where,
LP = *H. armigera* larvae population reduction (%)
Ta = *H. armigera* larvae population in

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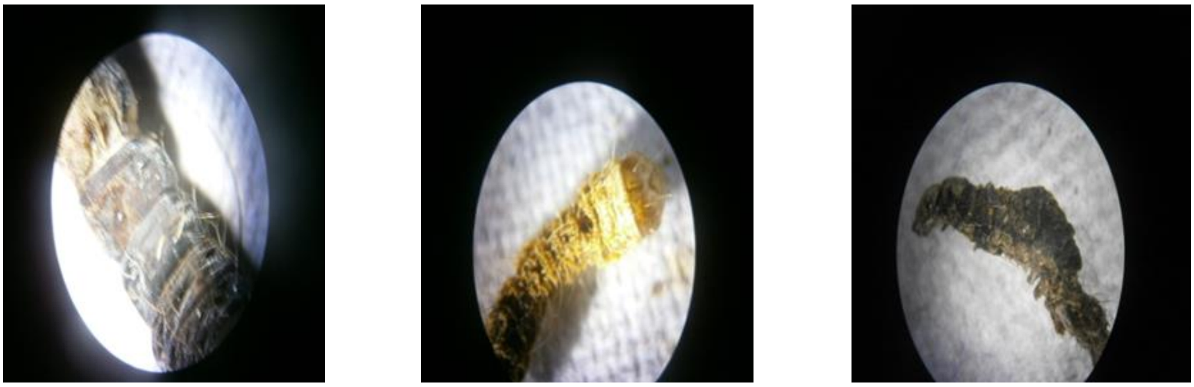
Table 1: Efficacy of treatments against *H. armigera* after 1st spray.

Treatments	Before	3 DAS	percentage population reduction	7 DAS	percentage population reduction	10 DAS	percentage population reduction	Mean	Mean LP
T_0	8.61	9.28	-	10.89	-	11.62	-	13.47	-
T_1	15.29	6.72	47.86	7.08	53.19	6.36	60.59	11.82	53.88
T_2	12.22	8.12	38.34	7.33	52.57	9.95	39.66	12.54	43.53
T_3	12.44	10.06	24.97	5.13	67.39	13.41	20.12	13.68	37.49
T_4	9.23	7.79	21.69	6.63	43.20	6.62	46.85	10.09	37.25
T_5	9.69	4.15	60.26	6.91	43.61	10.96	16.19	10.57	40.02
T_6	10.69	5.72	50.35	8.83	34.69	12.00	16.82	12.41	33.95
T_7	8.69	6.12	35.32	6.65	40.11	8.28	30.12	9.91	35.18
Mean	10.86	7.25		7.43		9.90		11.81	
F- test	NS	S		S		S			
S. Ed. (±)	1.995	0.067		0.138		0.607			
C. D. (P = 0.05)	4.230	0.142		0.292		1.288			



A) Impacted *Bacillus thuringiensis* B) Impacted HaNP C) Impacted *Beauveria bassiana*

Figure 1: Bio-agent infected *Helicoverpa armigera.*

treatment after spray
Tb = *H. armigera* larvae Population in treatment before spray
Ca = *H. armigera* larvae Population in control after spray
Cb = *H. armigera* larvae Population in control before spray

The weights of dried chickpea grains from each plot were recorded and the yield was converted into yield per hectare. The percent increase in yield over the control was calculated using the following equation.

$$y = \frac{T - C}{C} \times 100$$

Where,
Y = Chick pea yield increase (%)
T = Chick pea yield from treatment plot
C = Chick pea yield from control plot

RESULTS

Effect of treatments with control agents on H. armigeralarvae

Effect of treatment on larvae of H. armigera for 1st spray.

The overall efficacy of the three observations made at 3,7 and 10 days after 1st spray (Table 1) showed that *Bacillus thuringiensis* was most effective and significantly superior over all the other treatment with 53.88 % mean reduction of larval population over the control. The next best treatment were HaNPV and Neem cake with 43.53 and 40.02% reduction of larval population over the control and were significantly superior over the other treatments. The treatments that followed in the descending order of the efficacy were *Beauveria bassiana* and HaNPV+Bt with a mean larval population reduction of 37.49 and 37.25 % respectively over the control and significantly different were D.D.V.P.76%0.05% and Neem oil with a mean larval population reduction 35.18 and 33.95% over the control respectively. However, all the treatment were effective and significant in reducing the larval population of *H. armigera* after 1st spray (Figure 1).

Effect of treatment of larvae of H. armigera for 2nd spray

The overall efficacy of the three observations made at 3, 7 and 10 days after 2nd spray (Table 2) showed that D.D.V.P.76%0.05% was most effective and significantly superior over all the other treatments with 38.80 % mean reduction of larval population over the control. The next best treatment was HaNPV+Bt with 34.55% reduction of larval population over the other treatments. The treatments were followed in the descending order of the efficacy were Neem oil, Neem cake and HaNPV with a mean larval population reduction of 33.20, 30.71 and 27.31% respectively over the control and were on par with each other. The order of efficacy among the other treatments were *Bacillus thuringiensis* and *B. bassiana* (2.5kg/ha) with mean larval population reduction of 20.84and 18.99

Table 2: Efficacy of treatments against *H. armgiera* after 2nd spray.

Treatments	Before	3 DAS	percentage population reduction	7 DAS	percentage population reduction	10 DAS	percentage population reduction	Mean	Mean PL
T_0	12.29	13.85	-	14.65	-	12.99	-	17.93	-
T_1	9.36	7.62	31.69	8.82	25.25	9.88	5.57	11.89	20.84
T_2	9.95	8.26	30.35	7.53	39.97	9.83	11.62	11.86	27.31
T_3	10.15	8.33	31.14	9.16	28.41	11.64	2.58	13.09	18.99
T_4	9.26	8.83	19.99	6.68	42.78	6.12	40.87	10.30	34.55
T_5	10.96	4.93	62.26	10.93	20.89	11.15	8.99	12.66	30.71
T_6	11.00	4.51	65.60	10.67	23.06	10.95	10.95	12.38	33.20
T_7	9.28	5.83	47.29	6.82	41.70	7.53	27.41	9.82	38.80
Overal Mean	10.28	7.77		9.41		10.01		12.49	
F- test	NS	S		S		S			
S. Ed. (±)	1.740	0.576		0.573		0.286			
C. D. (P = 0.05)	3.689	1.221		1.214		0.606			

% over the control respectively. However, all the treatments where effective and significantly in reducing the larval population of *H. armigera*

DISCUSSION

All the microbial insecticides exhibited poor performance at 3 DAT but at 7 DAT their efficacy was increased and HaNPV and *Bacillus thuringiensis* was the most effective insecticides in both the sprays among the microbial insecticide after first sprays. Among the microbial insecticides after first spray the NPV was effective though the efficacy was significantly different from chemical insecticides. But after 2nd spray the NPV was on par with Bt in reducing the larval population. The present finding are in the agreement with Khanapara*et al.* (2011); Subramanian *et al.* (2010); Jagadish*et al.*(2010);Bhagwat and Whightman (2001); Chery*et al.* (2000) who reported that NaNPV was effective in controlling the larva of *H. armigera*.

B. bassiana was less effective at 3 DAT but its efficacy increased at 7 DAT, later on its efficacy gradually decreased. This may be due to the time required for the fungus to produce infection in the insect, Prasad *et al,* (2010) reported that *B. basssiana* infected the *H. armgiera* larva in different routes and could able to produce mortality. Khanapara*et al.*, (2011); Prasad *et al.* (2010) reported the effectiveness of *B bassiana* in controlling the *H. armigera.*

Neem oil was the medium effective treatment among the individual treatments in both the sprays. This may due to low survival due to lack of moisture and variability in the virulence of Bhushan, (2011), Jagadish*et al*. (2010), RangaRao*et al*. (2007) reported that can be effective used for control of *H. armgiera* which in contradiction to the present finding.

Among the combination treatments HaNPV+Bt was found to be effective followed by Neem cake was found to be least effective in both the sprays. All the combination treatment were less than the chemical insecticides, however the combination treatment HaNPV+Bt was more effective than the respective individual treatments reported Khanapara and Kapadia, (2011).

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