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Efficacy of botanicals and bio-pesticide against *Helicoverpa armigera* in chickpea

Anil Kumar, MK Tripathi, Umesh Chandra and Ram Veer

Abstract
The experiment was conducted at Agriculture farm, Department of Entomology, Tilak Dhari post Graduate College, Jaunpur during *Rabi* season 2010-11 and 2011-12. Studies on Neem Seed Kernel extracts @ 5% performed best among the treatments followed by, Bt. 1 kg/ha, Neem oil @ 2 %, Nimbecidine @ 2 %, HaNPV @450LE/ha and Neem leaf Extract @ 5 % with 1.90, 4.70, 4.80, 4.90, 5.20, 5.30, and 5.4 mean larval population of *Helicoverpa armigera* larvae per meter length, respectively in that order NSKE @5% were significantly superior over other treatments. The efficacy of various treatments at this stage was in order of Neem Seed Kernel Extract @5% > Bt. 01 Kg/ha > Neem oil @ 2 %> Nimbecidine @ 2% > Neem leaf extracts @5% > NPV@450LE/ha. Spray of NSKE @ 5% proved significantly lower pod damage of 13.45 % and 12.76% in 2010-11and 2011-12 followed by and Bt. 1 kg /ha 14.10 in the first year and 13.38% in the second year.

Keywords: Pod borer, management, botanicals, treatments and insecticides

Introduction
India ranks first in the production and consumption of chickpea (*Cicer arietinum* L.) in the world. Chickpea is a most important pulse crop of India which is mostly grown under dry land condition with heavy cloudy soil. It is a rich source of nutritional values in the diet of Indian people because of containing 21.5 per cent protein, 64.5 per cent carbohydrates and 4.5 per cent fat which is comparatively deficient in the cereals and oilseeds. Its green leaves and pods are used as green vegetables and germinated grains for breakfast and other delicious dishes by the people in their daily meals (Parmar *et al.*, 2015) [4].

Gram pod borer is a polyphagous insect belonging to the family Noctuidae and Order-Lepidoptera. It is also known as cotton bollworm, corn earworm, tomato fruit borer, and false budworm. It attacks more than 180 cultivated species from cereals, legumes, vegetables, fruits, forage and wild species.

The chickpea crop is attacked by a number of insect- pests from seedling to its maturity. The major insect- pests attacking chickpea crop are *Helicoverpa armigera*, *Spodoptera litura*, *Agrotis ipsilon*, *Plusia orichalchea* and *Bemisia tabaci* during winter and summer seasons. The chickpea pod borer, *Helicoverpa armigera* is polyphagous in nature which causes damage to several crops such as pigeon-pea, groundnut, cotton, vegetables, pearl millets, sorghum, maize, sunflower etc. The young larvae often feed upon the tender foliage before attacking the pods by causing heavy losses to crop and sometimes whole crop failed due to severe infestation (Lohar and Rahoo, 1993; Nizamani, 1998) [3, 2].

Use of chemical pesticides has resulted in immediate high returns to farmers. However, their heavy and extensive use has created various health and environmental problems. To avoid these problems, use of environmentally safer bio-pesticides is gaining momentum these days.

Materials and methods
The experiment was conducted at Agirculture farm, Department of Entomology, Tilak Dhari post Graduate College, Jaunpur during *Rabi* season 2010-11 and 2011-12. The pest population was continuously monitored and treatments were applied, when the population of gram pod borer reached above the economic threshold level (1-2 larvae/plant). The post treatment counts of *Helicoverpa armigera* larvae were recorded at 3,7,10 days after spraying. Per cent mortality of the larvae and data on infested pods for the individual treatments were also recorded using following formula.

$$\text{Per cent mortality} = \frac{\text{Number of dead larvae after spray}}{\text{Total number of larvae before spray}} \times 100$$

$$\text{Per cent infested pod} = \frac{\text{Number of infested pods}}{\text{Total number of pods}} \times 100$$

Results and Discussion

During 2010-11

Data based on the initial count of the *Helicoverpa* larvae before spray is given in Table. Larval population was homogeneously distributed throughout the experimental field at the time of application of biopesticides on the crop.

When observations were recorded on third day, after the spray, all the treatments were found significantly superior over control. Neem Seed Kernel extracts @ 5% performed best among the treatments followed by, Bt. 1 kg/ha, Neem oil @ 2 %, Nimbecidine @ 2 %, HaNPV @450LE/ha and Neem leaf Extract @ 5 % with 4.70, 4.80, 4.90, 5.20, 5.30,and 5.4 mean larval population of *Helicoverpa armigera* larvae per square meter, respectively in that order.

Table 1: Effect of various bio-pesticides on larval population of *H. armigera* Hub. In chickpea during *Rabi* 2010-11

2010-11				
Treatment	**Before spray**	**3 days after spraying**	**7 days after spraying**	**10 days after spraying**
T_1: NSKE @ 5%	6.8(2.79)	4.7(2.38)	2.6(1.89)	3.5(2.12)
T_2: Bt @ 1Kg	6.5 (2.74)	4.8(2.40)	2.9(1.97)	3.9(2.23)
T_3: Neem Leaf Extract @ 5%	6.7 (2.77)	4.9(2.42)	3.0(2.0)	4.0(2.23)
T_4: Neem Oil @ 2%	6.4 (2.72)	5.2(2.48)	3.2(2.7)	4.3(2.30)
T_5: Nimbecidine @ 2%	6.8 (2.79)	5.3(2.50)	3.3(2.7)	4.5(2.34)
T_6: HNPV @450 LE/ha	6.9 (2.81)	5.4(2.52)	3.6(2.14)	4.6(2.36)
T_7: Control	6.6 (2.75)	6.3(2.70)	6.5(2.73)	7.0(2.82)
SEm±	0.074	0.049	0.042	0.036
CD at 5%	NS	0.146	0.121	0.112

Values within parentheses are $\sqrt{(x+0.05)}$

Neem Seed Kernel extracts @ 5% was significantly superior over other treatments.

On the seventh day, after spraying, all the treatment was found effective and significantly superior over control. Neem Seed Kernel extracts @ 5%with 2.60 mean larval population was found most effective and significantly superior over other control. It was followed by, Bt. 1 kg/ha, Neem oil @ 2 %, Nimbecidine @2 %, HaNPV @450LE/ha and Neem leaf Extract @ 5 % with 2.90, 3.2, 3.3, 3.6, 5.30,and 5.4 mean larval population of *Helicoverpa armigera* larvae per square meter, respectively in that order. NSKE @5% were significantly superior over other treatments. The efficacy of various treatments at this stage was in order of Neem Seed Kernel Extract @5%> Bt. Kg/ha> Neem oil @ 2 %> Nimbecidine @ 2%> Neem leaf extracts @5%> NPV@450LE/ha.

On the tenth day, after spraying, all the treatment was found effective and significantly superior over control. Neem Seed Kernel extracts @ 5%, with 3.5 mean larval population was found most effective and significantly superior over other control. It was followed by Bt. 1 kg/ha, Neem leaf Extract @ 5 %, Neem oil @ 2 %, Nimbecidine @2 %, HaNPV @ 450LE/ha and with, 3.90, 4.0, 4.3, 4.5, and 4.60 mean larval population of *Helicoverpa armigera* larvae per rsquare meter, respectively in that order. NSKE @5% were significantly superior over other treatments. The efficacy of various treatments at this stage was in order of Neem Leaf Kernel Extract @5% > Bt. Kg/ha > Neem oil @ 2 %> Nimbecidine @ 2% > Neem leaf extracts @5% > NPV@450LE/ha.

During 2011-12

Data based on the initial count of the *Helicoverpa* larvae before spray is given in Table. Larval population was homogeneously distributed throughout the experimental field at the time of application of bio pesticides on the crop.

When observations were recorded on third day, after the spray, all the treatments were found significantly superior over control. Neem Seed Kernel extracts @ 5% performed best among the treatments followed by Bt. 1 kg/ha, Neem oil @ 2 %, Nimbecidine @ 2 %, HaNPV @450LE/ha and Neem leaf Extract @ 5 % with 4.60, 4.80, 4.90, 5.1, 5.30,and 5.5 mean larval population of *Helicoverpa armigera* larvae per square meter, respectively in that order. NSKE @5% were significantly superior over other treatments.

Table 2: Effect of various bio-pesticides on larval population of *H. armigera* Hub. In chickpea during *Rabi* 2011-12

2011-12				
Treatment	**Before spray**	**3 days after spraying**	**7 days after spraying**	**10 days after spraying**
T_1: NSKE @ 5%	6.5(2.73)	4.6(2.36)	2.8(1.94)	3.6(2.14)
T_2: Bt @ 1Kg	7.0(2.82)	4.8(2.40)	3.0(2.0)	3.7(2.16)
T_3: Neem Leaf Extract @ 5%	6.4(2.74)	4.9(2.42)	2.9(1.97)	3.3(2.07)
T_4: Neem Oil @ 2%	6.2(2.68)	5.1(2.46)	3.2(2.04)	3.9(2.21)
T_5: Nimbecidine @ 2%	6.6(2.75)	5.3(2.50)	3.3(2.07)	3.5(2.12)
T_6: HNPV @450 LE/ha	6.3(2.70)	5.5(2.54)	3.5(2.12)	4.5(2.34)
T_7: Control	6.1(2.66)	6.2(2.68)	6.3(2.70)	6.2(2.68)
SEm±	0.072	0.041	0.039	0.034
CD at 5%	NS	0.124	0.118	0.112

Values within parentheses are $\sqrt{(x+0.05)}$

On the seventh day, after spraying, all the treatment was found effective and significantly superior over control. Neem Seed Kernel extracts @ 5%, with 2.8 mean larval population was found most effective and significantly superior over other control. It was followed by Neem leaf Extract @ 5 %, Bt. 1 kg/ha, Neem oil @ 2 %, Nimbecidine @2 %, HaNPV @450LE/ha and with 2.9, 3.0, 3.2, 3.3 and 3.5 mean larval population of *Helicoverpa armigera* larvae per square meter, respectively in that order. NSKE @5% were significantly superior over other treatments. The efficacy of various treatments at this stage was in order of Neem Leaf Kernel Extract @5% > Neem leaf extracts @5% > Bt. Kg/ha > Neem oil @ 2 %> Nimbecidine @ 2% > > NPV@450LE/ha.

On the tenth day, after spraying, all the treatment was found effective and significantly superior over control. Neem leaf Extract @ 5 % with 3.3 mean larval population was found most effective and significantly superior over other control. It was followed by Nimbecidine @2 %,Neem Seed Kernel extracts @ 5%, Bt. 1 kg/ha, Neem oil @ 2 %, HaNPV @450LE/ha and with 3.5, 3.6, 3.7, 3.9 and 4.5 mean larval population of *Helicoverpa armigera* larvae per square meter, respectively in that order. Leaf Extract @ 5 % was significantly superior over other treatments. The efficacy of various treatments at this stage was in order of Neem leaf Extract @ 5 %> Nimbecidine @2 %,> 2 %, Neem Seed Kernel extracts @ 5%> Bt. 1 kg/ha %> Neem oil @ 2 % > NPV @ 450LE/ha.

Overall, mean pod damage of 9.7% was recorded with the application of NSKE@5%. Application of NSKE@5% proved significantly lower pod damage of 13.45 % and 12.76% in 2010-11and 2011-12, respectively, over all the treatments followed by Bt@1Kg/ha (14.10 in the first and 13.38 % in the second year) and Neem Leaf Extract @5% (14.32 in the first and 13,93% in the second year).

Present findings the larval population was homogeneously distributed throughout the experimental field at the time of application of bio pesticides on the crop. When observations were recorded on third day, after the spray, all the treatments were found significantly superior over control. by Neem Seed Kernel extracts @ 5% performed best among the treatments followed Bt. 1 kg/ha, Neem oil @ 2 %, Nimbecidine @2 %, Ha NPV @450LE/ha and Neem leaf Extract @ 5 % with 1.90, 4.70, 4.80, 4.90, 5.20, 5.30,and 5.4 mean larval population of *Helicoverpa armigera* larvae per square meter, respectively in that order. NSKE @5% were significantly superior over other treatments. present findings are also in accordance with the findings of (Verma, 2014) [9] reported comparative efficacy of endosulfan 35 EC, NSKE, garlic leaf extracts, onion leaf extracts, marigold leaf extracts, papaya leaf extracts and HNPV @ 450 LE/ha against the larval population of gram pod borer, *Helicoverpa armigera* on chickpea. The present investigations are also in partial agreement with the finding of Butani and Mittal (1993) [1] reported that the efficacy of neem seed kernel suspension and several conventional insecticides was determined against *Heliothis armigera* [*Helicoverpa armigera*] on gram [chickpeas on the seventh day, after spraying, all the treatment was found effective and significantly superior over control. Neem Seed Kernel extracts @ 5%was 2.6 and 2.8 mean larval population of *Helicoverpa armigera* larvae per meter square found most effective and significantly superior over other control. It was followed by, Bt. 1 kg/ha, Neem leaf Extract @ 5 %, Neem oil @ 2 %, Nimbecidine @2 % and HaNPV @450LE/ha during 2010-11 and 2011-12 with 2.90 and 3.0, 30 and2.9, 3.2 and 3.2, 3.3and 3.3 mean larval population of *Helicoverpa armigera* larvae per square meter, respectively in that order. NSKE @5% were significantly superior over other treatments. The present investigation is also in accordance with the findings of Yadav *et al.* (2006) [10] found that the efficacy of biopesticides and insecticides against gram pod borer (*Helicoverpa armigera*) on chickpea. The treatments were Nimbicidine 0.33 EC (*Azadirachta*); Bio virus H (NPV) Biolep (*Bacillus thuringiensis*). All treatments significantly reduced pod damage after 5 days of spraying compared with the control. The present findings are also in accordance with the findings of Shekhara (2014) observed that among different biorationals used, azadirachtin 3% WSP @ 400 g/ha sprayed plot recorded lowest larval population of 0.33, 0.50 and 0.00 per ten plants at seven days after first, second and third sprays, respectively

On the tenth day, after spraying, all the treatment was found effective and significantly superior over control. Neem Seed Kernel extracts @ 5%, with 3.5 and 3.6 mean larval population was found most effective and significantly superior over other control. It was followed by Bt. 1 kg/ha, Neem oil @ 2 %, Nimbecidine @2 %, HaNPV @450LE/ha. NSKE @5% were significantly superior over other treatments. The present investigations are also in accordance with the findings of Verma *et al.* (2015) [8] reported that Neem Seed Kernel Extract (5%) alon with Flubendiamide 39.39 SC @ 50 ml/ha effectively reduce the *H. armigera* larval population as compared with the control plot when used in regular sprays in vegetative and pod formation stages.

The efficacy of various treatments at this stage was in order of > Neem seed Kernel Extract @5%> Bt. Kg/ha> Neem leaf extracts @5% > Neem oil @ 2 %> Nimbecidine @ 2%> > NPV@450LE/ha.

Table 3: Pod damage per cent caused by *H. armigera* Hub. On chickpea

Treatment	Pod damage (%)	
	2010-11	2011-12
T_1: NSKE @ 5%	13.45	12.76
T_2: Bt @ 1Kg	14.10	13.38
T_3: Neem Leaf Extract @ 5%	14.32	13.93
T_4: Neem Oil @ 2%	15.00	13.56
T_5: Nimbecidine @ 2%	15.32	14.28
T_6: HNPV @450 LE/ha	15.43	15.43
T_7: Control	19.40	18.80
SEm±	0.029	0.184
CD at 5%	0.084	0.559

Spray of NSKE @ 5% proved significantly lower pod damage of 13.45 % and 12.76% in 2010-11and 2011-12 followed by and Bt. 1 kg /ha 14.10 in the first year and 13.38% in the second year. The present findings are supported by Singh and Ali (2005) and Singh *et al.* (2006) [7, 6].

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