Int.J.Curr.Microbiol.App.Sci (2020) *9*(10): 218-226

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 9 Number 10 (2020)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2020.910.028

Evaluation of Non-insecticidal Approaches against Pod Borer, *Helicoverpa armigera* Hubner on Chickpea at S.K. CARS, Kawardha Chhattisgarh

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Keywords

Chickpea, pod borer, NSKE, *(Btk), Beauveria bassiana,* Karanj oil

Article Info

Accepted:
04 September 2020
Available Online:
10 October 2020

A B S T R A C T

The present investigation "Evaluation of non-insecticidal approaches against pod borer, *Helicoverpa armigera* Hubner on chickpea at S.K. CARS, Kawardha Chhattisgarh" was conducted during *rabi* 2016-17 and 2017-18 at Sant Kabir College of Agriculture & Research Station, Kawardha Chhattisgarh. The results revealed with mean pooled data that the mean number of larvae per meter row length was low in NSKE treatment (0.78 larva/mrl) *Bacillus thuringiensis kurstaki (Btk)* (0.92 larva/mrl) and followed by *Beauveria bassiana* (1.05 larva/mrl) over untreated control (1.74). Similarly, after Ist and IInd spray the Karanj oil treatment showed 1.16 larva/mrl of *H. armigera* per meter row length.

Introduction

Chickpea (*Cicer arietinum* L.) is the most important pulse crop grown in India.' It is commonly recognized by the name 'Chickpea' or Bengal gram or Chana and belongs to leguminoseae family. It is probably originated from South Eastern Turkey and from there it spread to other countries of the world therefore it is known as 'King of Pulses' (Khatoon and Prakash, 2004). In India, Chickpea crop is being cultivated in an area of about 9626.16 thousand hectares with a production of 9377.56 thousand million tonnes and productivity of 974 kg/ha. Chickpea covers an area of about 307.40 thousand hectare with a production of 359.90 thousand million tonnes and productivity of 1171 kg/ha in Chhattisgarh (Anonymous, 2017). Chickpea is cultivated as one of the major pulse crops in Kabirdham district of Chhattisgarh acreage 84,100 hectare with productivity of 1040kg /ha (Anonymous,2016). Gram pod borer *H. armigera* (Hubner) (Lepidoptera: Noctuidae) is consider as a major pest of Chickpea. As this insect pest is a major hindrance and becomes a universal concern for the production of chickpea (Wubneh, 2016), which cause high economic losses to the

chickpea crop (Singh and Yadav, 2009). This pest starts infesting the shoot/tips few weeks after crop emergence and feed on buds, flowers and pods till harvesting, causing heavy yield losses. Larvae of *H. armigera* (Hubner) are prodigious foliar feeder as early instars and later move to the developing seeds and fruits leading to drastic reduction in yield. A single larva can consume up to 30-40 pods in its life cycle (Taggar and Singh, 2012). The plant product like NSKE and other neem derivatives, biopesticides made from neem are non-toxic, biodegradable, ecofriendly and have no residual effect can be used along with *Beauveria bassiana* and *Bt* which has no harmful effect on its most potent parasitoid *Campoletis chloridae* (Uchida) and effectual in restricting the development of larval population of *Helicoverpa armigera* on crop.

Materials and Methods

Management practices against chickpea pod borer, *Helicoverpa armigera* (Hubner) were studied locations *viz*., experimental area of S. K. College of Agriculture & Research Station Kawardha (Kabirdham), Chhattisgarh.

Experiment details

Season	***Rabi* (2016-17 and 2017-18)**
Variety	JAKI – 9218
Design	RBD
No. of Treatments	05
Replications	04
Plant spacing	[30(cm) (R X R)] X [15 (cm) (P X P)]
Date of sowing	First week of December
Plot size	20 X 4.5m^2
Fertilizer application	N.P.K. @ 20:50:20 Kg/ha.

Treatment details

	Treatments	**Dose /ha (g or ml)**
T_1	NSKE	5%
T_2	Karanj Oil	2%
T_3	*Bacillus thuringiensis kurstaki (Bt)*	1kg / ha
T_4	*Beauveria bassiana*	2.5Kg/ha
T_5	Untreated control (plain water)	-

In this experiment number of caterpillars of pod borers were counted from randomly selected five different spots of one meter row length area from each plot, pre-treatment on larval population were recorded 1 day before treatment and the post treatment counts were taken after 1, 3, 5, 7, 10 and 15 days after treatment. At the time of harvest five plants from each plot was randomly selected and percent pod damage and grain damage were recorded, by using following formula-

$$\text{Pod damage (\%)} = \frac{\text{Total no.of damaged pod}}{\text{Total no.of pod}} \times 100$$

Yield was calculated under different treatments as given below:

Yield/ ha = Factor × grain yield / plot

Where,

$$\text{Factor} = \left(\frac{10000}{\text{Net plot size}}\right) \text{in sq. m.}$$

Results and Discussion

To evaluate the non-insecticidal approaches against pod borer *Helicoverpa armigera* (Hubner) on chickpea an experiment with 4 botanical insecticides *viz.*, NSKE 5%, Karanj oil 2%, *Bacillus thuringiensis kurstaki (Btk)* 1 kg/ha and *Beauveria bassiana* 2.5 kg/ha was laid out in randomized block design (RBD) with four replication along with an untreated check at S. K. College of Agriculture and Research Station, Kawardha during *rabi* 2016-17 and 2017-18.

Non-insecticidal approaches against pod borer, *H. armigera* Hubner on chickpea during *rabi* 2016-17

Before spray

The results presented in Table 1 revealed that the mean number of larvae per meter row length in all the treatments 24 hrs. prior to application of treatments was non-significant or similar.

First spray

The various treatments with *Helicoverpa armigera* population ranging from 0.87 to 2.57 larva/mrl after 15 DAS (Table 1).

Among the different treatments, NSKE 5% (0.87 larva/mrl) was observed less and at par with *Bacillus thuringiensis kurstaki (Btk)* 1 kg/ha (0.93 larva/mrl) followed by *Beauveria bassiana* 2.5 kg/ha (1.07 larva/mrl), Karanj oil 2% (1.27 larva/mrl) and untreated control (2.57 larva/mrl).

The result revealed that 15 days after first spray the NSKE was the most effective at par with *Bt* followed by *Beauveria bassiana* and Karanj oil was found to be the least effective non-insecticide.

Second spray

Data presented in Table 1 showed that the effects of all the treatments were similar to the effects found in the first spray.

After second spray at 15 days after application maximum control was observed in NSKE (0.60 larva/mrl) at par with *Bacillus thuringiensis kurstaki (Btk)* 1 kg/ha (0.63 larvae/mrl) followed by *Beauveria bassiana* 2.5 kg/ha (0.80 larva/mrl), Karanj oil 2% (0.87 larva/mrl) and untreated control (0.93 larva/mrl).

Overall mean

The overall mean showed that mean number of larvae per meter row length was low in NSKE treatment (0.73 larva) at par with *Bt* (0.87 larva/mrl) followed by *Beauveria bassiana* (1.11 larva/mrl) over untreated control (2.36 larva/mrl).

Similarly, after Ist and IInd spray the Karanj oil treatment showed 1.23 larvae of *H.armigera* per meter row length.

Non-insecticidal approaches against pod borer, *H. armigera* Hubner on chickpea during *rabi* 2017-18

Before spray

The results presented in Table 2 revealed that the mean number of larvae per meter row length in all the treatments 24 hrs. prior to application of treatments was non-significant or similar.

Table.1 Evaluation of non-insecticidal approaches against pod borer, *H. armigera* (Hub.) on chickpea at S. K. CARS, Kawardha during *Rabi* 2016-17

	Treatments	Dose	Mean number of larvae per meter row length												Overall mean
			Pre treatment	1st Spray						2nd Spray						
				1 DAS	3 DAS	5 DAS	7 DAS	10 DAS	15 DAS	1 DAS	3 DAS	5 DAS	7 DAS	10 DAS	15 DAS	
T_1	NSKE	5 %	1.60 (1.61)	0.87 (1.36)	0.67 (1.29)	0.47 (1.21)	0.73 (1.31)	0.93 (1.38)	0.87 (1.36)	1.00 (1.41)	0.53 (1.23)	1.33 (1.52)	0.40 (1.18)	0.33 (1.15)	0.60 (1.26)	**0.73 (1.31)**
T_2	Karanj Oil	2 %	1.20 (1.48)	1.20 (1.48)	1.13 (1.46)	0.86 (1.35)	1.20 (1.48)	1.33 (1.52)	1.27 (1.51)	1.53 (1.59)	1.80 (1.67)	1.73 (1.65)	0.93 (1.39)	0.81 (1.33)	0.87 (1.36)	**1.23 (1.50)**
T_3	*Bacillus thuringiensis kurstaki (Btk)*	1 kg/ha	1.60 (1.61)	0.83 (1.32)	0.67 (1.30)	0.69 (1.30)	0.87 (1.36)	1.07 (1.43)	0.93 (1.39)	1.13 (1.46)	0.80 (1.34)	1.47 (1.56)	0.73 (1.31)	0.60 (1.26)	0.63 (1.27)	**0.87 (1.36)**
T_4	*Beauveria bassiana*	2.5 kg/ha	1.67 (1.63)	0.93 (1.39)	0.73 (1.31)	0.67 (1.29)	1.00 (1.41)	1.47 (1.57)	1.07 (1.44)	1.13 (1.46)	1.04 (1.42)	1.67 (1.63)	1.20 (1.48)	1.60 (1.61)	0.80 (1.34)	**1.11 (1.42)**
T_5	Untreated control (plain water)		1.87 (1.69)	2.13 (1.77)	2.33 (1.82)	2.37 (1.84)	2.43 (1.87)	2.03 (1.76)	2.57 (1.77)	2.27 (1.80)	2.53 (1.88)	2.47 (1.86)	2.40 (1.84)	2.46 (1.86)	2.33 (1.83)	**2.36 (1.85)**
	SE (m)±		**0.06**	**0.03**	**0.03**	**0.02**	**0.04**	**0.03**	**0.04**	**0.04**	**0.03**	**0.02**	**0.02**	**0.03**	**0.02**	**0.05**
	CD 5%		**NS**	**0.09**	**0.09**	**0.07**	**0.12**	**0.09**	**0.13**	**0.11**	**0.10**	**0.09**	**0.08**	**0.09**	**0.08**	**0.15**

Note: Figures in parentheses are Square root transformed value, DAS= Days after spray

Table.2 Evaluation of non-insecticidal approaches against pod borer, *H. armigera* (Hub.) on chickpea at S. K. CARS, Kawardha during *Rabi* 2017-18

	Treatments	Dose	Mean number of larvae per meter row length												Overall mean
			Pre treatment	1st Spray						2nd Spray						
				1 DAS	3 DAS	5 DAS	7 DAS	10 DAS	15 DAS	1 DAS	3 DAS	5 DAS	7 DAS	10 DAS	15 DAS	
T_1	NSKE	5 %	1.67 (1.63)	1.33 (1.53)	1.27 (1.51)	0.80 (1.51)	0.67 (1.29)	0.87 (1.37)	0.82 (1.44)	1.20 (1.48)	0.80 (1.34)	0.33 (1.15)	0.27 (1.13)	0.53 (1.24)	0.80 (1.34)	**0.83 (1.36)**
T_2	Karanj Oil	2 %	1.60 (1.61)	1.27 (1.51)	1.30 (1.53)	0.60 (1.50)	1.07 (1.44)	1.25 (1.49)	1.13 (1.45)	1.00 (1.41)	1.12 (1.44)	0.60 (1.27)	0.80 (1.34)	1.27 (1.50)	1.26 (1.61)	**1.09 (1.43)**
T_3	*Bacillus thuringiensis kurstaki (Btk)*	1 kg/ha	1.87 (1.69)	1.54 (1.63)	1.33 (1.53)	1.00 (1.41)	0.83 (1.32)	1.00 (1.41)	0.87 (1.37)	1.27 (1.51)	0.73 (1.32)	0.53 (1.24)	0.33 (1.15)	0.72 (1.32)	0.93 (1.39)	**0.96 (1.40)**
T_4	*Beauveria bassiana*	2.5 kg/ha	1.73 (1.65)	1.53 (1.59)	1.27 (1.51)	0.87 (1.37)	0.80 (1.34)	0.93 (1.39)	1.10 (1.44)	1.12 (1.46)	0.87 (1.37)	0.93 (1.39)	0.73 (1.32)	0.93 (1.39)	1.07 (1.44)	**0.99 (1.41)**
T_5	Untreated control (plain water)		2.07 (1.75)	1.67 (1.63)	1.40 (1.54)	1.13 (1.45)	0.73 (1.32)	0.73 (1.31)	1.28 (1.46)	1.37 (1.58)	1.20 (1.48)	1.13 (1.46)	0.87 (1.37)	1.10 (1.44)	1.32 (1.54)	**1.12 (1.46)**
	SE (m)±		**0.08**	**0.05**	**0.05**	**0.05**	**0.06**	**0.04**	**0.07**	**0.04**	**0.04**	**0.03**	**0.04**	**0.04**	**0.05**	**0.049**
	CD 5%		**NS**	**0.18**	**0.15**	**0.15**	**0.17**	**0.12**	**0.21**	**0.12**	**0.13**	**0.10**	**0.13**	**0.12**	**0.15**	**0.14**

Note: Figures in parentheses are Square root transformed value, DAS= Days after spray

Table.3 Evaluation of non-insecticidal approaches against pod borer, *H. armigera* (Hub.) on chickpea at S. K. CARS, Kawardha (mean pooled data)

	Treatments	Dose	Mean number of larvae per meter row length												Overall mean
			Pre treatment	1st Spray						2nd Spray						
				1 DAS	3 DAS	5 DAS	7 DAS	10 DAS	15 DAS	1 DAS	3 DAS	5 DAS	7 DAS	10 DAS	15 DAS	
T_1	NSKE	5 %	1.64 (1.62)	1.10 (1.45)	0.97 (1.40)	0.64 (1.27)	0.70 (1.30)	0.90 (1.37)	0.97 (1.40)	1.10 (1.45)	0.67 (1.29)	0.83 (1.35)	0.34 (1.15)	0.43 (1.19)	0.70 (1.30)	**0.78 (1.33)**
T_2	Karanj Oil	2 %	1.40 (1.54)	1.24 (1.49)	1.22 (1.48)	0.74 (1.31)	1.14 (1.46)	1.30 (1.51)	1.20 (1.48)	1.27 (1.50)	1.46 (1.56)	1.17 (1.47)	0.87 (1.36)	1.10 (1.44)	1.24 (1.49)	**1.16 (1.47)**
T_3	*Bacillus thuringiensis kurstaki (Btk)*	1 kg/ha	1.74 (1.65)	1.21 (1.48)	1.00 (1.41)	0.84 (1.35)	0.82 (1.34)	1.04 (1.42)	1.03 (1.42)	1.20 (1.48)	0.77 (1.32)	1.00 (1.41)	0.53 (1.23)	0.67 (1.29)	0.87 (1.36)	**0.92 (1.37)**
T_4	*Beauveria bassiana*	2.5 kg/ha	1.70 (1.64)	1.23 (1.49)	1.13 (1.45)	0.74 (1.31)	0.90 (1.37)	1.20 (1.48	1.14 (1.46)	1.13 (1.45)	0.97 (1.40)	1.30 (1.51)	0.97 (1.40)	1.27 (1.50)	0.94 (1.39)	**1.05 (1.42)**
T_5	Untreated control (plain water)		1.97 (1.72)	1.90 (1.70)	1.87 (1.69)	1.75 (1.65)	1.58 (1.60)	1.38 (1.54)	1.85 (1.68)	1.82 (1.67)	1.87 (1.69)	1.70 (1.64)	1.64 (1.62)	1.77 (1.66)	1.73 (1.65)	**1.74 (1.64)**
	SE (m)±		**0.05**	**0.01**	**0.01**	**0.02**	**0.02**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.02**	**0.01**	**0.03**	**0.06**
	CD 5%		**NS**	**0.03**	**0.03**	**0.08**	**0.09**	**0.03**	**0.03**	**0.04**	**0.03**	**0.03**	**0.08**	**0.03**	**0.09**	**0.18**

Note: Figures in parentheses are Square root transformed value, DAS= Days after spray

Table.4 Percentage pod damage by pod borer, *Helicoverpa armigera* (Hub.) in Chickpea at S. K. CARS, Kawardha

	Treatments	Dose	Percentage pod Damage		
			2016	2017	pooled
T_1	NSKE	5 %	4.13 (11.70)	3.81 (11.24)	3.97 (11.36)
T_2	Karanj Oil	2 %	8.34 (16.77)	7.11 (15.45)	7.73 (15.64)
T_3	*Bacillus thuringiensis kurstaki (Btk)*	1 kg/ha	4.78 (12.56)	4.12 (11.65)	4.45 (12.32)
T_4	*Beauveria bassiana*	2.5 kg/ha	7.44 (15.81)	6.83 (15.13)	7.14 (15.63)
T_5	Untreated control (plain water)		11.89 (20.16)	9.75 (18.14)	10.82 (19.43)
SE (m)±			**0.21**	**0.20**	**0.21**
CD 5%			**0.67**	**0.64**	**0.66**

Table.5 Yield of chickpea at S. K. CARS, Kawardha

	Treatments	Q/ ha.		
		2016-17	2017-18	Pooled
T_1	NSKE	16.26	17.20	16.73
T_2	Karanj Oil	10.42	11.46	10.94
T_3	*Bacillus thuringiensis kurstaki (Btk)*	14.31	15.52	14.91
T_4	*Beauveria bassiana*	11.62	12.12	11.87
T_5	Untreated control (plain water)	8.34	9.04	8.69
SE (m)±		**0.77**	**0.84**	**0.80**
CD 5%		**2.24**	**2.44**	**2.34**

Fig.1 Percentage pod damage by pod borer, *Helicoverpa armigera* Hubner in Chickpea at S. K. CARS, Kawardha

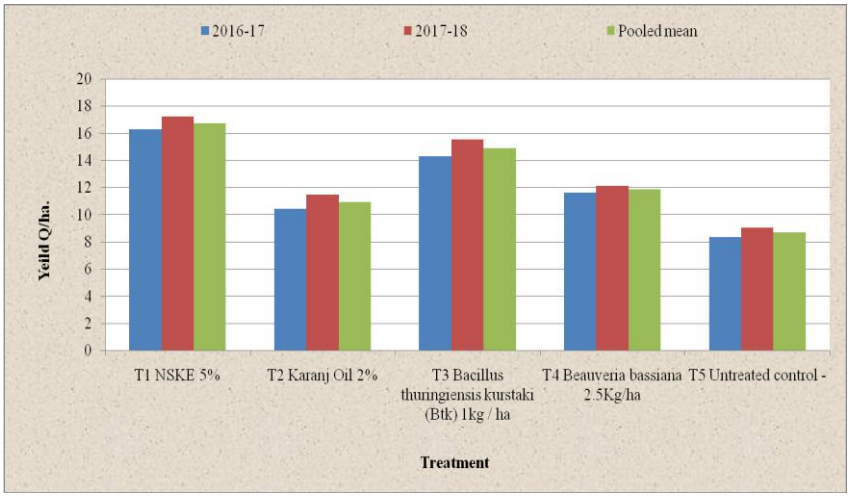
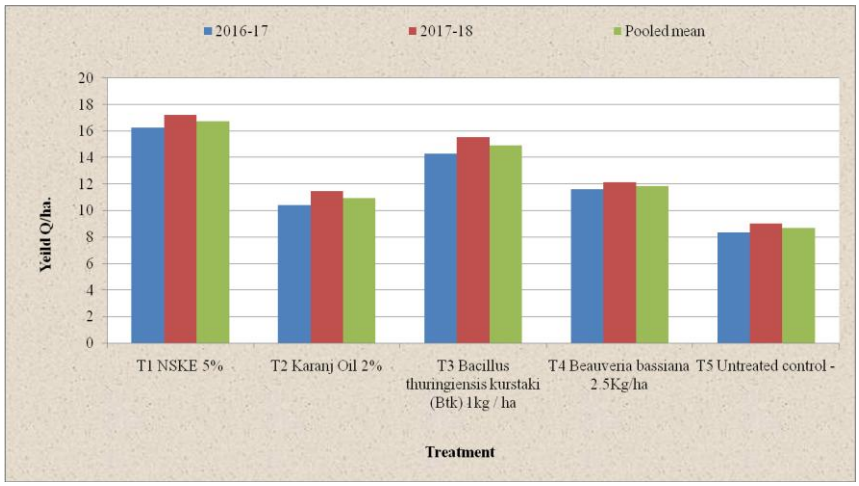


Fig.2 Yield of chickpea at S. K. CARS, Kawardha



First spray

The various treatments with *Helicoverpa armigera* population ranging from 0.82 to 1.28 larva/mrl after 15 DAS (Table 2). Among the different treatments, NSKE 5% (0.82 larva/mrl) was observed and at par with *Bacillus thuringiensis kurstaki (Btk)* 1 kg/ha (0.87 larva/mrl) followed by *Beauveria bassiana* 2.5 kg/ha (1.10 larvae /mrl), Karanj oil 2% (1.13 larva/mrl) and untreated control (1.28 larva/mrl).

The result revealed that 15 days after first spray NSKE was the most effective at par with *Bacillus thuringiensis kurstaki (Btk)* followed by *Beauveria bassiana*, Karanj oil was found to be the least effective non-insecticide.

Second spray

Data presented in Table 2 showed that the effects of all the treatments were similar to the effects found in the first spray. After second spray at 15 days after application maximum control was observed in NSKE (0.80 larva/mrl) at par with *Bacillus thuringiensis kurstaki (Btk)* 1 kg/ha (0.93 larva/mrl) followed by *Beauveria bassiana* 2.5 kg/ha (1.07 larva/mrl), Karanj oil 2% (1.26 larva/mrl) and untreated control (1.32 larva/mrl).

Overall Mean

The overall mean showed that mean number of larvae per meter row length was low in NSKE treatment (0.83 larva) at par with *Bt* (0.96 larva/mrl) followed by *Beauveria bassiana* (0.99 larva/mrl) over untreated control (1.12 larva/mrl). Similarly, after Ist and IInd spray the Karanj oil treatment showed 1.09 larva of *H. armigera* per meter row length.

Non-insecticidal approaches against pod borer, *H.armigera* Hubner on chickpea during 2016-17 and 2017-18 (Mean pooled data)

Before spray

The results presented in Table 3 revealed that the pooled mean of number of larvae per meter row length in all the treatments 24 hrs. Prior to application of treatments was non-significant or similar.

First spray

The various treatments with *Helicoverpa armigera* population ranging from 0.97 to 1.85 larva/mrl after 15 DAS (Table 3). Among the different treatments, NSKE 5% (0.97 larva/mrl) was observed at par with *Bacillus thuringiensis kurstaki (Btk)* 1 kg/ha (1.03 larvae /mrl) followed by *Beauveria bassiana* 2.5 kg/ha (1.14 larva/mrl), Karanj oil 2% (1.20 larva/mrl) and untreated control (1.85 larva/mrl).

The result revealed that 15 days after first spray the NSKE was the most effective at par with *Bacillus thuringiensis kurstaki (Btk)*, followed by *Beauveria bassiana* and Karanj oil was found to be the least effective non-insecticide.

Second Spray

Data presented in Table 3 showed that the effects of all the treatments were similar to the effects found in the first spray. After second spray at 15 days after application maximum control was observed in NSKE (0.70 larvae/mrl) at par with *Bacillus thuringiensis kurstaki (Btk)* 1 kg/ha (0.87 larvae/mrl) followed by *Beauveria bassiana* 2.5 kg/ha (0.94 larvae/mrl), Karanj oil 2% (1.24 larva/mrl) and untreated control (1.73 larva/mrl)

Overall Mean

The overall mean showed that mean number of larvae per meter row length was low in NSKE treatment (0.78 larva/mrl) *Bacillus thuringiensis kurstaki (Btk)* (0.92 larva/mrl) and followed by *Beauveria bassiana* (1.05 larva/mrl) over untreated control (1.74). Similarly, after Ist and IInd spray the Karanj oil treatment showed 1.16 larva/mrl of *H. armigera* per meter row length.

The present findings are in accordance with the findings of Anandhi *et al.,* (2011) who studied, neem seed kernel extract (NSKE) treatments was the best treatments with the highest reduction of pod borer population with 40.0% larval mortality in the first and second spray among the all treatments.

Ahmed *et al.,* (2015) and Zahra *et al.,* (2014) have also concluded that the different treatments of botanicals and microbial had widely varying adverse effects on of *H. armigera and* they observed that treatment of Azadirachtin had higher impact followed by microbial HaNPV, *Bacillus thuringiensis kurstaki (Btk)* and *Beauveria bassiana* during both the experimental years.

Pod damage

The results showed that all the treatments significantly reduced the pod damage due to *H. armigera* (Table 4 and Fig. 1). During 2016 and 2017, there was significantly difference between the treatments with regard to pod damage due to *H. armigera*.

During 2016-17, the pod damage per cent was significantly reduced in treatments with NSKE (4.13%) at par with *Bacillus thuringiensis kurstaki (Btk)* (4.78%) followed by *Beauveria bassiana* (7.44%) and Karanj oil (8.34%). The untreated control plot recorded pod damage of 11.89 per cent due to *H. armigera* during 2017-18, the pod damage per cent was significantly reduced in treatments with NSKE (3.81%) at par with *Bacillus thuringiensis kurstaki (Btk)* (4.12%) followed by *Beauveria bassiana* (6.83%) and Karanj oil (7.11%). The untreated control plot recorded pod damage of 9.75 per cent due to *H. armigera*.

However on the basis of pooled mean data, the pod damage per cent was significantly reduced in treatments with NSKE (3.97%) at par with *Bacillus thuringiensis kurstaki (Btk)* (4.45%) followed by *Beauveria bassiana* (7.14%) and Karanj oil (7.73%). The untreated control plot has recorded pod damage of 10.82 per cent due to *H. armigera*.

Grain yield

In the management study maximum yield of 16.26 Q/ha. was obtained in treatment with NSKE at par with *Bacillus thuringiensis kurstaki (Btk)* (14.31 Q/ha.) followed by *Beauveria bassiana* (11.62 Q/ha.) and Karanj oil (10.42 Q/ha.) as against the lowest yield of (8.34 Q/ha.) in untreated control, during 2016 at S.K. CARS, Kawardha (Table 5 and Fig. 2).

During 2017-18, the maximum yield of 17.20 Q/ha. was obtained in treatment with NSKE at par with *Bacillus thuringiensis kurstaki (Btk)* (15.52 Q/ha.) followed by *Beauveria bassiana* (12.12 Q/ha.) and Karanj oil (11.46 Q/ha.) as against the lowest yield of 9.04 Q/ha. in untreated control.

On the basis of pooled mean data, the maximum yield of 16.73 Q/ha. was obtained in treatment with NSKE at par with *Bacillus thuringiensis kurstaki (Btk)* (14.91 Q/ha.) followed by *Beauveria bassiana* (11.87Q/ha.) and Karanj oil (10.94 Q/ha.) as against the lowest yield of 8.69 Q/ha. in untreated control.

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How to cite this article:

Jai Kishan Bhagat, V. K. Soni and Chandrakar, H. K. 2020. Evaluation of Non-insecticidal Approaches against Pod Borer, *Helicoverpa armigera* Hubner on Chickpea at S.K. CARS, Kawardha Chhattisgarh. *Int.J.Curr.Microbiol.App.Sci.* 9(10): 218-226.
doi: https://doi.org/10.20546/ijcmas.2020.910.028