Evaluation of biopesticides against the capitulum borer *Helicoverpa armigera* on sunflower

Jayewar, N. E and M. M. Sonkamble

ABSTRACT

The different biopesticides were tested against the natural incidence of the capitulum borer *Helicoverpa armigera* on sunflower crop var. Morden during *kharif* 2010 in the experimental farm of Marathwada Agricultural University, Oilseeds Research Station at Latur. The experiment was undertaken in a randomized block design (RBD) with seven treatments *viz., B. bassiana* SC formulation @ 250 mg/L, DOR *Bacillus thuringiensis*(Bt) formulation @ 2.5 g/L, HaNPV (DOR isolate) @ 2 x 10^8 POBs/mL Commercial neem formulation 0.5 %, NSKE 5 %,PSE 5%, Profenophos 0.05 % and Untreated Control in three replications with 4.2 x 4.5 m^2 plots and row to spacing of 60 x 30 cm. In all two sprayings were undertaken so as to evaluate the effectiveness of the treatment and it was observed that the larval incidence at 1, 3 and 7 days after both spraying was lowest in plots sprayed with Profenophos . However the next best treatments in the order of effectiveness for the control of *Helicoverpa* were *HaNPV* @ 2 x 10^8 POBs/mL, NSKE 5 %, DOR *B. bassiana* 250 mg, DOR *Bt* 5 @ 2.5 gm/litre, PSE 5 % and Neem formulation 0.5%. All the biopesticides proved safer to natural enemy but treatment of Profenophos was lethal to them, however, highest yield was recorded with the same (1140 kg/ha) but it is at par with other biopesticides.

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INTRODUCTION

Sunflower (*Helianthus annus*) is an annual oilseeds crop which contains 39 to 49 per cent oil in the seed. The cultivated Sunflower is largely confined to south Indian peninsula viz., Karnataka, Andhra Pradesh, Maharashtra and Tamil Nadu of which Maharashtra state occupies an area of 2.66 lakh hectares with production of 1.83 Lakh tons and productivity of 687 kg/ha and Osmanabad, Latur and Beed are the major Sunflower growing districts of the Marathwada region with an area of 1.97 lakh hectares and production of 0.61Lakh tons productivity of 556 kg/ha. (Anonymous, 2011) The low production and productivity of this crop is mainly attributed to biotic tresses like incidence of pests and diseases.

Earlier sunflower was considered as pest free crop but as this is a photo-insensitive crop it is grown all-round the year *i.e.* in all three seasons which led to increase of pest incidence on sunflower. Now up to twenty insect pests were observed to feed on sunflower, but among these polyphagous pests like capitulum borer (*Helicoverpa armigera* Hubner), green semilooper (*Thysanoplusia orichalcea* Fab.), Bihar hairy caterpillar (*Spilarctia obliqua* Walker), tobacco caterpillar, *Spodoptera litura* Fab., cabbage semilooper (*Trichoplusia ni* Hubner), cutworm (*Agrotis* spp.) and leafhopper (*Amrasca biguttula biguttula* Ishida) are of major economic importance (Basappa, 1995).The crop losses in seed yield due to these pests is around 24.93 percent (Anonymous, 2013). Among these, capitulum borer (*H. armigera*) is highly polyphagous with about 181 host plants including important crop plants such as pulses, cotton, vegetables, etc. (Manjunath *et al.,* 1985). Capitulum borer causes direct damage to receptacle, ovaries, developing seeds of sunflower (Bhat and

Virupakshappa, 1993) and even a single larvae per capitulum could cause economic damage (Margal, 1990). Therefore to have effective control measure for capitulum borer is the need of the hour. Various control methods available are cultural management, mechanical management, botanical control, biological control and chemical control (Anonymous, 2014), although chemical control method provides immediate control but causes various environmental and health hazards. So these biological control alternatives for management of Capitulum borer *H. armigera* were tried in the present experiment to manage the pest effectively and maximize seed yield because it was safe, economical and advocated as the first line of attack.

MATERIALS AND METHODS

The present research work was undertaken at Oilseeds Research Station, Latur during *kharif* 2010 on black cotton soil. The experiment was conducted in randomized block design with seven treatments and three replications. The variety of Sunflower *viz.,* Morden with a spacing of 60 x 30 cm in a 4.20 x 4.50 sq.m. plot. The dose of fertilizer at the rate of 30 kg N, 30 kg P and 350 kg K ha^{-1} was given prior to sowing and 30 kg N after sowing.

Treatment and Details of treatment

The treatments were, T_1- *B. bassiana* SC formulation @ 250 mg/L, T_2- DOR Bt 5 @ 2.5 gm/L, T_3- *HaNPV* @ 2 x 10^8 POBs/mL, T_4-PSE 5%, T_5- NSKE 5 %, T_6-commercial neem formulation 0.5 %, T_7-profenophos 0.05 % and T_8-untreated control (water spray).

Preparation of spray solution

The spray solution of desired concentration was freshly prepared every time at the site of experimentation just before the starting of spraying operations. The quantity of spray material required for coverage of crop was gradually increased as the crop advanced in age. The spray solution of a desired concentration was prepared by adopting the following formula:

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

where,

V= volume / weight of insecticides or biopesticide in mL g^1.

C= concentration required.

A= quantity of spray solution required in mL.

% a.i.= percentage of active ingredient in product.

Spraying / bioagent application

The insecticidal or biopesticide solutions were prepared by taking the required quantity of insecticides or biopesticide in a given quantity of water. The total quantity of spray solution was used @ 500 liters $hectare^{-1}$. The application of insecticides or biopesticide was made after pest has reached ETL. The spraying operations were undertaken in the morning with the help of manually operated Gatur sprayer.

Methods of recording observations

Five observation plants were selected randomly from the net plot of each treatment in each replication. They were properly labeled. The observations on total number of larvae were recorded on each leaf from top, middle and bottom canopy and capitulum of the observation plants. The ETL of pest (1larva $leaf^{-1}$) was considered as optimum pest and pre count was recorded. The observations on population of larvae were also recorded at 1, 3 and 7-days after application of treatment. Then the data were converted into mean values using square root transformation. The observations on total number of Predatory coccinellids were recorded at grub stage on each leaf from top, middle and bottom canopy of the observation plants weight seed produced was recorded from each net plot. The treatment wise total yield was calculated.

RESULTS AND DISCUSSIONS

The results obtained during the course of experimentations are presented under all the treatments were significantly superior in reducing larval population over untreated control at all the days of observations after first and second sprays. However, the incidence of larva on Sunflower observed lowest in treatment T_7 - Profenophos @ 0.05% at1, 3 and 7-days after first application and second application of treatment which is followed by *HaNPV* @ 2 x 10^8 POBs/mL, NSKE 5 %, DOR *B. bassiana* 250 mg, DOR Bt 5 @ 2.5 gm/L, PSE 5 % and commercial Neem formulation 0.5%. All the biopesticides proved safer to natural enemies Coccinellids and predatory pentamoid bugs but treatment of profenophos was lethal to them.

Sunflower being a cross pollinated crop, pollinators and their activity are most important for seed sating and final seed yield, the effect of the treatments on foraging activity of honey bees was also recorded but no significant difference was observed in the treatment.

Highest seed yield was recorded in the T_7 - Profenophos @ 0.05% followed by *Ha NPV* @ 2 x 10^8 POBs/mL , DOR *B. bassiana* 250 mg NSKE 5 %, , DOR Bt 5 @ 2.5 gm/L PSE 5% and commercial neem formulation 0.5% which were statistically at par with each other seed yield production. Lowest seed yield was recorded in treatment untreated control.

Table 1. Evaluation of bio-pesticides against head borers.

Treatments	**Average head borer at first spray**			
	BS	**1DAS**	**3 DAS**	**7 DAS**
B. bassiana @ 250 mg/L	2.3	1.0	1.1	1.3
DOR Bt 5 @ 2.5 gm/L	2.3	1.2	1.2	1.4
HaNPV (DOR isolate) @ 2 x 10^8 POBs/mL	2.3	0.9	1.0	0.8
PSE 5 %	2.5	1.3	1.4	1.6
NSKE 5 %	2.4	1.0	1.1	1.2
Commercial neem formulation 0.5 %	2.6	1.5	1.5	1.7
Profenophos @ 0.05%	2.2	0.2	0.4	0.7
Control	2.0	2.2	2.5	2.9
S.E.±		**0.1**	**0.1**	**0.1**
CD (P=0.05)	**NS**	**0.3**	**0.3**	**0.3**
CV (%)		**13.1**	**11.5**	**13.8**

Table 2. Evaluation of biopesticides against head borers.

Treatments	**Average head borer at 2^{nd} spray**			
	BS	**1DAS**	**3 DAS**	**7 DAS**
B. bassiana @ 250 mg/L	1.5	0.9	0.6	0.2
DOR Bt 5 @ 2.5 gm/L	1.8	1.0	0.7	0.5
HaNPV (DOR isolate) @ 2 x 10^8 POBs/mL	1.8	0.8	0.3	0.1
PSE 5 %	1.8	1.1	0.9	0.6
NSKE 5 %	1.8	0.9	0.6	0.4
Commercial neem formulation 0.5 %	1.9	1.2	1.0	0.7
Profenophos @ 0.05%	1.6	0.2	0.1	0.0
Control	1.7	2.2	1.9	1.5
S.E.±		**0.1**	**0.1**	**0.1**
CD (P=0.05)	**NS**	**0.3**	**0.3**	**0.2**
CV (%)		**13.6**	**12.5**	**13.2**

Table 3. Biosafety of treatments to natural enemy.

Treatments	Average natural enemy at first spray			
	BS	**1DAS**	**3 DAS**	**7 DAS**
B. bassiana @ 250 mg/L	1.33	1.13	1.20	1.30
DOR Bt 5 @ 2.5 gm/L	1.35	1.28	1.32	1.37
HaNPV (DOR isolate) @ 2 x 10^8 POBs/mL	1.33	1.31	1.47	1.46
PSE 5 %	1.28	0.97	0.90	1.13
NSKE 5 %	1.15	1.00	1.12	1.25
Commercial neem formulation 0.5 %	1.32	0.90	0.91	1.08
Profenophos @ 0.05%	1.37	0.37	0.20	0.00
Control	1.34	1.48	1.53	1.61
S.E.±		**0.059**	**0.054**	**0.059**
CD (P=0.05)	**NS**	**0.180**	**0.164**	**0.180**
CV (%)		**8.22**	**7.55**	**8.22**

Table 4. Yield response to bio-pesticides (yield kg/ha)

Treatments	Yield Kg /ha				
	RI	**RII**	**RIII**	**Total**	**Mean**
B. bassiana @ 250 mg/litre	1282	855	1026	3162	1054
DOR Bt 5 @ 2.5 gm/litre	940	1026	940	2906	969
HaNPV (DOR isolate) @ 2 x 10^8 POBs/ml	1111	940	1197	3248	1083
PSE 5 %	1026	940	855	2821	940
NSKE 5 %	1026	855	1111	2991	997
Commercial neem formulation 0.5 %	940	1026	684	2650	883
Profenophos @ 0.05%	1026	1111	1282	3419	1140
Control	427	684	769	1880	627
S.E.±					**89.9**
CD (P=0.05)					**266.8**
CV (%)					**16.4**

Present results were discussed in the light of following workers. Jagdish *et al.* (2010) studied the influence of six biopesticides in comparison profenophos 0.05 %, endosulphan 35 EC and untreated control against *H. armigera* and *S. litura*, reported that NSKE 5% and Profenophos 0.05 % were most effective in obtaining larval mortality of *H. armigera* and were statistically on par with each other.

Kati (2010) evaluated *B. bassiana* SC formulation @ 250 mg/L, DOR *Bacillus thuringiensis* (*Bt*) formulation @ 2.5 g/L, HaNPV (DOR isolate) @ 2 x 10^8 POBs/mL Commercial neem formulation 0.5 %, NSKE 5 %, PSE 5%, Profenophos 0.05 % and untreated control in three replications against

H. armigera in field condition and reported that profenophos @ 0.05% at 3 and 7-days after first application and second application of treatment was most effective which is followed by *HaNPV* reducing head borer infestation and maximizing seed yield.

Mane *et al*. (2013) evaluated *B. bassiana* SC formulation , Neem formulation, *HaNPV* and other biopesticides in comparision with quinalphos 25 EC and profenophos 50EC @ 0.05 % and untreated control against *H. armigera* in field condition and reported that Profenophos @ 0.05% at 3 and 7- days after first application and second application of treatment was most effective which is followed by *HaNPV* in reducing head borer infestation and maximizing seed yield and these treatments where at par with each other.

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