Efficacy of biorationals and botanical formulations against *Helicoverpa armigera* Hub. in sunflower

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ABSTRACT

Field investigations were conducted to check the efficacy of biorational and botanical formulations against capitulum borer, *Helicoverpa armigera* Hub. infesting sunflower. The results revealed that significant differences existed between the treatments at two days after first spray and third and seventh days after second spray. At three days after second spray, lowest population of *H. armigera* was recorded in spinosad and profenophos treatments (0.05 per plant), followed by garlic chilli kerosene extract (GCKE) (0.11 larvae per plant) and V-*Bt* (*Bacillus thuringiensis*) (0.16 larvae per plant), however, untreated check recorded the highest *H. armigera* larval population (4.53/plant). Among the different biorationals, the V-*Bt* treatment recorded highest seed yield (3528 kg/ha.), volume weight (55.14 g/100ml) and oil content (37.78 %). The cost: benefit analysis revealed that the highest benefit: cost ratio was recorded in *Parthenium* leaf extract treatment (37.29), whereas, intermediate C: B ratios were recorded in Neem seed kernel extract (20.17) > Pongamia seed kernel extract (12.54) > profenophos (8.81) > spinosad (8.36) > IPM module (5.34) > *Ha*NPV (3.85) > V-Bt (2.49) > GCKE (1.48) > panchagavya (0.29) > Bt-Halt (0.04), in that decreasing order. The findings throw light on the fact that biorationals viz., *Bacillus thuringiensis*, NSKE and PSKE, show promise in the suppression of *H. armigera*, besides being economical and ecofriendly.

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INTRODUCTION

Sunflower (*Helianthus annuus*) is an annual crop plant 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, among which Karnataka occupies first position, accounting for an area of 3.840 lakh ha. with a production of 1.930 lakh tonnes and productivity of 503 kg per ha (Anonymous, 2012). In India, sunflower crop is damaged by different species of insect pests, of which the polyphagous pests like capitulum borer (*Helicoverpa armigera* Hubner), green semilooper (*Thysanoplusia orichalcea* Fab.), Bihar hairy caterpillar (*Spilosoma = 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 (Rana *et al.*, 2004).

The highly polyphagous pest *H. armigera* is reported feed on 181 host plants including important crop plants such as pulses, cotton, vegetables etc. (Manjunath *et al*., 1985). Botanical pesticides possess a complex of compounds which cause different behavioural and physiological responses on insects unlike traditional chemical pesticides which are based on usually a single active ingredient. Previously available information for managing *H. armigera* using traditional and botanical insecticides should be provided. These botanical pesticides are nontoxic to human beings and beneficial insects, especially pollinators in case of sunflower ecosystem. Keeping this in view biorationals and botanical formulations are envisaged to offer the most feasible option to the farmer, hence the present investigation was conducted at the Zonal Agricultural Research Station, GKVK, Bangalore, during 2012-13.

MATERIALS AND METHODS

Biorational formulations were evaluated capitulum borer *H. armigera* on sunflower under field conditions at the most effective dose during 2012-13 at the ZARS, University of Agricultural Sciences,

GKVK, Bengaluru. The field trial was laid out in a randomized complete block design (RCBD) with three replications by maintaining a plot size of 4.2m x3.0m. by leaving a gangway of 1m all around the individual treatment plots. The sunflower cultivar KBSH-44 was sown with a spacing of 60 x 30 cm, by adopting all the recommended package of practices for sunflower of UAS, Bengaluru, except plant protection measures (Anon., 2014). The individual treatments were imposed with a knapsack sprayer using spray fluid @ 650 lit per ha. The spray was imposed twice, the first one was imposed at 54 days after sowing (DAS) and 2nd spray was imposed at 67 DAS, which was based on peak incidence of *H. armigera*. The observations from different biorationals that were evaluated against H. *armigera* were subjected to Randomized complete block design analysis for further interpretations.

RESULTS AND DISCUSSION

There was no significant difference between the treatments (df22, P= 0.11) with respect to number of *H. armigera* larvae per plant before imposition of the treatments (Table 1). Significant differences (df22, P=0.23) were observed between the treatments with respect to larval population which ranged between 0.05 to 1.67 per plant. All the treatments were significantly superior (df22, P=0.23) than untreated check in reducing the pest population. The chemical treatments spinosad and profenophos recorded the lowest larval population (P<0.05) followed by GCKE and V-*Bt* (P<0.05), which wre on par with the two recomended chemical check.

No significant differences (df 22; P=0.025) were observed between the treatments. The larval population ranged between 0.55 to 2.14 per plant. However, among the biorationals treatments, lower larval population was recorded in V-*Bt* and NSKE (0.82/ plant), *Ha*NPV(significant at 22 df with a P-value of 0.025) and GCKE. The lowest Minimum larval population was recorded in the recomended chemical check spinosad. Significant differences were observed between the treatments with respect to the larval population at third day after second spray, it ranged from 0.55 to 4.53 per plant. All the biorationals were on par with each other and also with untreated check treatments. However, significantly lowest larval population was recorded in the recomended chemical check spinosad and the highest larval population was recorded in untreated check. Statistically significant differences were observed between the treatments with respect to larval population of *H. armigera.* The larval population in the different treatments ranged between 0.16 to 1.55 per plant. The larval population was significantly lower in V-Bt, Bt-Halt, NSKE, *Ha*NPV, IPM module and GCKE which were all on par with each other. The significantly lowest larval population was recorded in spinosad and highest larval population was recorded in *Parthenium* leaf extract.

At twenty two days after second spray

Differences in the larval population between the treatments were statistically non-significant. The larval population ranged between 0.94 to 2.16 per plant (Table 1). There was no significant difference (P= 0.13) between the treatments before spray. But, there was a significant difference between the treatments at two days after first spray and third and seventh day after second spray. However, there was no significant differences were recorded between treatments, at nine days after first spray and 22nd days after second spray.

There was no significant difference (P= 0.13) among the treatments with respect to the seed yield. However, the V-Bt treatment recorded highest seed yield of 3528, which could be attributed to significantly lower pest incidence in this treatment at two and nine days after first spray and seven days after second spray. The next best treatment with respect to yield were spinosad (3416 kg/ha.), followed by NSKE. The other treatments *viz*., profenophos, IPM module, PSKE and panchgavya gave intermediate seed yields *viz*., 3222, 3121, 3079 and 3024 kg /ha. Lowest seed yield was recorded in untreated check which could be due to higher pest population and damage in the untreated plots as compared to the other treatments. However, GCKE, *Ha* NPV, Bt-Halt and *Parthenium* leaf extract gave intermediate seed yields (Table 2).

Table 1. Effect of bio-rational formulations on *H. armigera* in sunflower

Treatments	No. of *H. armigera* larvae / plant					
	Pre-spray	**2 days after 1st spray**	**9 days after 1st spray**	**3 days after 2nd spray**	**7 days after 2nd spray**	**22 days after 2nd spray**
T_1-Panchagavya 3% (30 ml/l)	1.33	0.50^{ab}	1.35	4.28^{b}	1.39^{c}	1.71
T_2-Bt-Halt (5g/l)	1.00	0.39^{ab}	1.27	3.27^{b}	0.27^{b}	1.44
T_3-Neem Seed Kernel Extract (NSKE) 5%	1.33	0.44^{ab}	0.82	4.22^{b}	0.28^{ab}	1.28
T_4-*Parthenium hysterophorus* leaf extract 5% (50ml/l)	1.33	0.72^{b}	1.01	4.04^{b}	1.55^{d}	2.16
T_5-Garlic-Chilli Kerosene Extract (GCKE) 3% (30ml/l)	1.67	0.11^{a}	0.99	3.00^{b}	0.50^{ab}	1.54
T_6-*Pongamia* Seed Kernel Extract (PSKE) 5%	1.33	0.72^{b}	1.05	4.04^{b}	0.72^{abc}	1.04
T_7-*Helicoverpa armigera* NPV 250 LE (0.5ml/l)	1.33	0.39^{ab}	0.83	2.72^{b}	0.38^{ab}	0.94
T_8-V-Bt (5g/l)	1.00	0.16^{ab}	0.82	4.46^{b}	0.27^{ab}	1.66
T_9-Profenophos 50 EC (0.05%)*	1.00	0.05^{a}	1.05	3.61^{b}	0.61^{abc}	1.94
T_{10}-Spinosad 45 SC (0.0045)*	1.00	0.05^{a}	0.55	0.55^{a}	0.16^{a}	1.10
T_{11}-IPM module **	1.33	0.39^{ab}	1.05	3.61^{b}	0.44^{ab}	1.11
T_{12}-Untreated check (UTC)	1.67	1.67^{c}	2.14	4.53^{b}	0.83^{bc}	1.99
F-test	NS	*	NS	*	*	NS
SEm ±	-	0.08	-	0.20	0.08	-
CD at P=0.05	-	0.23	-	0.58	0.24	-
CV (%)	4.51	11.34	11.15	16.23	11.31	9.05

** Recommended check: IPM module: Imidacloprid seed treatment 70WS (@5g/kg seed) + NSKE @ 5% (@45 and 55DAS) + Ha NPV 250 LE (@55 and 65 DAS).* Recommended chemical check.

The present findings are agreement with the results of Bharathi (2005), reported that sole application of panchagavya was less effective, which agrees with the present findings to some extent. Similarly, Jagadish *et al*. (2006) found that the IPM module (seed treatment with imidacloprid (5g/kg) + two sprays of NSKE 5% + two sprays of *Ha* NPV at 250LE/ ha.) gave a significant decrease in population of all sucking pests and defoliators, besides higher incidence of predators, lower incidence of *H. armigera*. Same author Jagadish *et al*. (2010) recorded the Neem seed kernal extract, (5%), prosopan (10 ml/lit) and both the insecticidal checks were significantly superior than the other treatments, for the suppression of *H. armigera*. Significant differences were observed among the treatments with respect to the volume weight of seeds (g/100 mL). The V-*Bt* treatment recorded significantly highest volume weight and lower volume weights were recorded in untreated check, followed by panchagavya, IPM module, profenophos and spinosad (Table 2), thus indicating that most of the biorationals treatments significantly enhanced the volume weight of sunflower seeds. However, V-*Bt* treatment recorded the highest oil content (37.78%), followed by the other treatments. Lower oil content was recorded in PSKE, followed by GCKE, *Parthenium* leaf extract, panchagavya and Bt-Halt *viz*., 36.78, 36.79, 36.91 and 36.96 per cent, respectively (Table 2). The cost: benefit analysis of treatments revealed that the highest benefit cost ratio was recorded in *Parthenium* leaf extract treatment, whereas, intermediate C: B ratios were recorded in NSKE (20.17) > PSKE (12.54) >

Table 2. Effect of biorational formulations on seed yield, volume weight, oil content and cost benefit ratio of sunflower

Treatments	Seed yield (kg/ha)	Volume weight (g /100ml)	Oil content (%)	Cost : Benefit ratio
T_1-Panchagavya 3% (30 ml/l)	3024	47.02[ab]	36.91	0.29
T_2-Bt-Halt (5g/l)	2881	49.68[b]	36.96	0.04
T_3-Neem Seed Kernel Extract (NSKE) 5%	3346	51.11[b]	37.15	20.17
T_4-*Parthenium hysterophorus* leaf extract 5% (50ml/l)	2956	50.31[b]	36.79	37.29
T_5-Garlic-Chilli Kerosene Extract (GCKE) 3% (30ml/l)	2718	49.63[b]	36.79	1.48
T_6-*Pongamia* Seed Kernel Extract (PSKE) 5%	3079	50.07[b]	36.72	12.54
T_7-*Helicoverpa armigera* NPV 250 LE (0.5ml/l)	2799	50.33[b]	37.19	3.85
T_8-V-Bt (5g/l)	3528	55.14[c]	37.78	2.49
T_9-Profenophos 50 EC (0.05%)*	3222	48.74[ab]	37.77	8.81
T_{10}-Spinosad 45 SC (0.0045)*	3416	48.89[ab]	37.56	8.36
T_{11}-IPM module **	3121	47.91[ab]	37.51	5.34
T_{12}-Untreated check (UTC)	2605	45.06[a]	37.12	0.00
F-test	NS	*	(NS	-
SEm ±	-	1.57	-	-
CD at p=0.05	-	4.60	-	-
CV (%)	15.80	5.49	1.20	-

** Recommended check: IPM module: Imidacloprid seed treatment 70WS (at 5g/kg seed) + NSKE @ 5% (at 45 and 55DAS) + *Ha* NPV 250 LE (at 55 and 65 DAS), * Recommended chemical check.

profenophos (8.81) > spinosad (8.36) > IPM module (5.34) > *Ha* NPV (3.85) > V-Bt (2.49) > GCKE (1.48) > panchagavya (0.29) > Bt-Halt (0.04) in that decreasing order (Table 2). The present findings are agreement with Jagadish *et al*. (2006) who reported the IPM module (seed treatment with imidacloprid (5g/kg) + two sprays of NSKE 5 % + two sprays of HaNPV at 250LE/ ha.) gave a significant highest grain yield and cost: benefit ratio (1:2.32) and it was also superior to chemical control in sunflower. Similarly, in the present investigation, most the biorationals treatments have given superior ICBR values and it could be concluded that V-*Bt* formulation of *Bacillus thuringiensis*, NSKE and PSKE have shown promise not only in the effective suppression of *H. armigera* but also by giving superior benefit: cost ratios as compared to the recommended checks.

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