Research Article

Evaluating the toxicity potential of some insecticides against sugarcane black bug, *Cavelerius excavatus* (Hemiptera: Lygaeidae)

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Abstract

A study was conducted on the toxicity potential of six insecticides (Lesenta 80% WG, Trunk 20% SC, Karate 2.5 EC, Route 57 EC, Refree 5% SC and Thimet 5G) against the sugarcane black bug (*C. excavatus*) at two different locations in tehsil Kot Addu District Muzaffargarh, Pakistan. Seven treatments including control with three replications were maintained following Randomized Complete Block Design (RCBD). The treatments were applied at their recommended doses and mortality data were recorded before and after 24 followed by 48, 72 and 168 hours of application. The results revealed that all the insecticides significantly suppressed the target pest population compared to control. Route 57 EC (Malathion) was revealed as most effective insecticide due to causing highest mortality in both locations 84.29% and 84.44% followed by Trunk 20 % SC (Clothionadion) with 80.03% and 79.88% mortality of the target pest after 168 hours of application. Whereas Karate 2.5 EC (Lambda cyhalothrin) was evaluated as least effective with 51.95% and 52.97% mortality at both locations, respectively. Our results suggest that Route 57 EC (Malathion) @ 500 ml per acre is effective against sugarcane black bug and can be used for the chemical management of this pest.

Keyword: Black bug; Efficacy; Insecticides; Malathion; Sugarcane

Introduction

Agriculture is the backbone of country and has main role in poverty reduction by providing 38.5% employment and sharing 18.5% to Gross Domestic Product [1]. Sugarcane is one of the important cash crop of Pakistan. It is cultivated on an area of 1.1 million hectares with total production of 62.8

million tones by contributing 0.6% to GDP and 3.1% to agriculture's value addition [2, 3]. There is lot of constraints between the potential yield and the average yield (47 t ha⁻¹) that the farmers are obtaining in Pakistan [4]. In terms of sugarcane production and area the country occupies fifth and sixth position respectively [5].

Like cotton crop the farmers of this crop are also facing lot of problems, both yield and area are declining due to many factors such as water shortage, less economic returns, higher cost of production and low sugar recovery. Among these reasons the main problem for low yield is insect pest infestation on this crop [6]. Worldwide the crop is attacked by more than 1500 species of insect pests [7] and about 48 species of insects pests are reported from Indo-Pakistan [8] while some important insect pests have been documented from Pakistan [9] as well as from Sindh [10]. Important insect pest attacking the crops are the borers, bugs and leafhoppers.

Black bug (*Cavelerius excavatus*) (Dist.) is a widely distributed pest and suck cell sap by residing in the whorl of sugarcane crop [11]. Recently, it has become a serious pest of sugarcane in some areas in Pakistan such as Kot Bhahi Khan Sugarcane Farm, Yousaf Sugar Mill Shahpur Sargodha. Both adults and Nymphs cause damage by sucking cell sap from the plants. The leaves of the affected plants turn yellow with brown patches. The growth of the plant and quality of the juice is adversely affected [12]. Adults and nymphs of *C. excavatus* sucks the cell sap gregariously from the young plants [11]. The

adult black bugs move freely and in this way infestation progressed from one plant to other while young ones are less mobile. In case of heavy attack the plant desiccate and even death of plant can occur. The growth of plant is severely affected by feeding of 4-6 bugs/plant for 4-6 days [13]. As this pest attain the status of regular pest and its occurrence gaining attention from sugarcane farmers for its exclusion. Farmers mostly rely on the use of synthetic chemicals for its management. Keeping in view, the present study was conducted to evaluate the toxicity potential of different insecticides against *C. excavatus* under the agro-climatic conditions of tehsil Kot Addu District Muzaffargarh, Pakistan.

Materials and methods

The trials were conducted simultaneously at the farmer's fields located in two sugar mills areas i.e. Fatima Sugar Mill and Shiekhu Sugar Mill of tehsil Kot Addu District Muzaffargarh during the year 2017. The sugarcane variety HSF 240 was sown during September, 2016. The experiment was laid out under RCBD with seven treatments along with three replications. Total six insecticides were evaluated for their efficacy against black bug (Table 1).

Table 1. Details of insecticides used in the experiment

Treatments	Trade name	Common name	Recommended dose/ acre
T1	Lesenta 80% WG	Imidacloprid+Fipronil	45 gm
T2	Trunk 20% SC	Clothianidion	100 ml
T3	Karate 2.5EC	Lambda cyhalothrin	330 ml
T4	Route 57EC	Malathion	500 ml
T5	Refree 5% SC	Fipronil	480 ml
T6	Thimet 5G	Phorate	10 kg
T7	Control		

These insecticides were obtained from local pesticide market and applied at their recommended doses by using knap sack sprayer. An area of 41 m x 40.5 m (1 kanal) was devoted to each treatment replication. The insecticides were applied at both

locations when *C. excavatus* population reached at economic threshold level (10/sheath). In control plot no spray was applied. All agricultural practices like hoeing, irrigation and fertilizer application was kept uniform throughout the experiment

in all treatments. The data of black bug population were recorded before 24 hours and after 24, 48, 72, 168 hours of application. For data recording, 25 plants from each replication were selected randomly by taking five plants from each of the four corners and fifth from the middle of the plot. Selected

plants outer leaves were removed and black bug in the leaf sheath were collected on the white paper sheet and then counted. Percentage reduction in *C. excavatus* population was calculated through Abbot's formula;

$$\text{Percentage population reduction} = \frac{A - B}{A} \times 100$$

Where A= Pre-treatment black bug population,

B= Post treatment black bug population.

The data was analyzed by using statistical software Statistix 8.1. Black bug mean population data from different plots were analyzed by using analysis of variance (ANOVA) to compare the effectiveness of different insecticides. Differences in means were calculated by least significant difference test.

Results and discussion

The mean populations of black bug in different treatments before 24 hours and after 24, 48, 72 and 168 hours of spray at Fatima and Shiekhu Sugar Mills are shown in (Table 2 & 3), respectively. The insecticidal treatments were found significantly different from each other. Percentage reductions in population after insecticidal application at Fatima and Shiekhu Sugar Mill are shown in (Fig. 1 & 2), respectively. Highest black bug population reduction (29.9%) after 24 hours of spray in Fatima sugar mill plots was seen in plots treated with Route (Malathion) with 10.40 black bug/ sheath followed by Trunk (Clothinadion) with 16.1 Black bugs/sheath and percent reduction of 27.9%. Similarly, in Shiekhu sugar mill plots treated with Route and Trunk shown maximum percent reduction of 19.4% and 16.50% in population of Black bug with 14.50 black bugs/sheath and 18.4 black bugs/sheath, respectively. The least effective insecticide after 24 hours of applications at Fatima Sugar Mill was Karate (Lambda cyhalothrin) with 12.9% reduction

(14.1 black bug/sheath) followed by Thimet (Phorate) with 18.5% reduction (10.2 black bug/sheath), respectively. While in Shiekhu Sugar Mill, Lesenta (Imidacloprid+Fipronil) and Karate (Lambda cyhalothrin) were least effective by decreasing population to 15.76 and 14.6 black bug/sheath with percent reduction of 7.4% and 10.2%, respectively. After 48 hours of spray at Fatima sugar mill black bug population in Route (Malathion), Trunk (Clothinadion) and Refree (Fipronil) treated plots were 6.76, 10.3 and 10.6 black bug/sheath with percent reduction of 54.4%, 53.9% and 38.8%, respectively. While Trunk (Clothinadion) and Refree (Fipronil) treated plots were statistically non-significantly different from each other. Black bug population in Thimet treated plots was 7.1/sheath (43.28% reduction) and was found better than Refree (Fipronil) as compared to 24 hours. Least effective insecticide was Karate (Lambda cyhalothrin) that decreases population to only 15.61%. In Shiekhu sugar mill black bug population per sheath after 48 hours of spray in Route (Malathion), Trunk (Clothinadion), Refree (Fipronil) and Lesenta (Imidacloprid+Fipronil) treated plots were 10.56, 14.43, 13.46 and 12.96 black bug/sheath with percent reduction of 41.30%, 34.49%, 27.86% and 23.87%, respectively, Refree (Fipronil) and Trunk (Clothinadion) treated plots were found non-significantly different from each other. Among all the tested insecticides, Karate was recorded the least effective in controlling black bug population with 22.09% reduction.

After 72 hours of spray at Fatima Sugar Mill, black bug population in Route (Malathion) and Trunk (Clothionadion) treated plots were 5.06 and 8.1 black bug/ sheath with 65.89% and 63.73% percent reduction while 6.20 (65.56%) and 10 (54.61%) in Shiekhu sugar mill plots, respectively. All these insecticidal treated plots were statistically significantly different from each other. Refree (Fipronil) and Phorate (Thimet) also showed promising results at Fatima Sugar Mill by reducing black bug population to 56.73% and 58.46%, respectively. Insecticidal efficacy of Trunk (Clothionadion) was better after 3rd day of spray by decreasing pest population with percent reduction of 63.73% and 54.61% at Fatima and Shiekhu Sugar mills, respectively as compared to 24 hours of spray.

Further decrease in population of black bug was observed with increase in time at both locations. After 168 hours of spray, Route (Malathion) gave maximum reduction of 84.29% and 54.44% followed by Trunk (Clothionadion) and Refree (Fipronil) whereas Karate (Lambda cyhalothrin) was least effective with minimum percent reduction of 51.95% and 52.97% at Fatima and Shiekhu sugar mills, respectively.

The present findings showed that Route (Malathion) followed by Trunk (Clothionadion) performed best among the different insecticides against black bug population. As the work on black bug population was little and lack of sufficient reviews only few previous studies reported the comparative effectiveness of different insecticides against this pest. These results are partially in line with the findings of Trdan *et al.* [14] who reported that Malathion was the most effective at reducing the damage on

white cabbage plants caused by cabbage stink bugs. Jaipal [15] reported that insecticide application of Endosulfan (Thiodan, 35%EC) at 500 ml a.i. ha⁻¹. was more effective in reducing infestation followed by treatments where trash was burnt or removed. Tewari and Yadav [16] determined efficacy of various insecticides (Viraat, Marshal, Acephate, Endosulfan, Acetamiprid, Carina, Polytrin and Karate) in controlling black bug and mealy bug infesting sugarcane. All the tested insecticides provided efficient control of the pest compared to the control, with acephate and acetamiprid treatment resulting in the highest mortality of the black bug (93.33 and 98.33%) and mealy bug (95.00 and 96.66%) in 1999-2000 and 2000-01, respectively. Zada *et al.* [12] conducted experiment on sugarcane black bug and observed that average infestation of the black bug were 43.81%, 75.17% and 64.06% in biological, chemical and untreated plots. Shivashankara [17] showed that soil application of pre-mix insecticide imidacloprid+acephate @3000 g/ha was most effective followed by its next doses @2500 g/ha and @2000 g/ha in reduction of black bug population during both the seasons. Pandey *et al.* [18] conducted experiment to find out the efficacy of new insecticides i.e. Triazophos and Profenophos+Cyper with two standards Chlorpyriphos and Quinolphos. The result revealed that the application of Profenophos 40%+Cyper 4% @ 1000 ml/ha causes 54.38% mortality at 48 hr 79.04% at 72 hr and 91.90% at 7 days intervals followed by 53.38%, 71.90% and 88.61% at 48 hr, 72 hr and at 7 days intervals respectively with application of Preofenophos 40% + Cyper 4% @ 750 ml/ha.

Table 2. Mean numbers of black bug/sheath before 24 hours and after 24, 48, 72 and 168 hours of spray at Fatima Sugar Mill area farmer field

Treatments	Insecticide Name	Black bug population / sheath (Mean $\pm$ S.E)				
		Pre-Treatment	Post Treatment			
		Before 24 Hours	After 24 Hours	After 48 hours	After 72 hours	After 168 hours
T ₁	Lesenta 80% WG	14.33 $\pm$ 1.27cd	11.3 $\pm$ 0.17de	9.1 $\pm$ 0.23cd	7.2 $\pm$ 0.33c	5.8 $\pm$ 0.87bc
T ₂	Trunk 20% SC	22.33 $\pm$ 0.66a	16.1 $\pm$ 1.03ab	10.3 $\pm$ 0.36c	8.1 $\pm$ 0.15bc	4.46 $\pm$ 0.41cd
T ₃	Karate 2.5EC	16.23 $\pm$ 0.44bc	14.1 $\pm$ 0.46bc	13.70 $\pm$ 0.85b	9.20 $\pm$ 0.49b	7.80 $\pm$ 0.45b
T ₄	Route 57EC	14.83 $\pm$ 0.55bcd	10.4 $\pm$ 0.3e	6.76 $\pm$ 0.29d	5.06 $\pm$ 0.08d	2.33 $\pm$ 0.12d
T ₅	Refree 5% SC	17.33 $\pm$ 0.48b	13.2 $\pm$ 0.17cd	10.6 $\pm$ 0.33c	7.5 $\pm$ 0.40bc	5.2 $\pm$ 0.11c
T ₆	Thimet 5G	12.51 $\pm$ 1.26d	10.2 $\pm$ 0.58e	7.1 $\pm$ 0.20d	5.20 $\pm$ 0.11d	4 $\pm$ 0.52cd
T ₇	Control	15.20 $\pm$ 0.7bc	17.43 $\pm$ 1.01a	21.66 $\pm$ 2.02a	27 $\pm$ 1.73a	29.33 $\pm$ 1.76a
F(DF=3,6)		13.33*	19.07*	33.39*	145.48*	140.97*
P Value		0.0001	0	0	0	0
LSD		2.64	1.98	2.73	1.96	2.43

Means in a column sharing same letter are not significantly different at p<0.05

Table 3. Mean numbers of black bug/sheath before 24 hours and after 24, 48, 72 and 168 hours of spray at at Shiekhu Sugar Mill area farmer field

Treatments	Insecticide Name	Black Bug population/sheath (Mean $\pm$ S.E)				
		Pre-Treatment	Post treatment			
		Before 24 Hours	After 24 Hours	After 48 hours	After 72 hours	After 168 hours
T ₁	Lesenta 80% WG	17.03 $\pm$ 0.84b	15.77 $\pm$ 0.43bc	12.96 $\pm$ 0.12bc	10.00 $\pm$ 0.57bc	7.00 $\pm$ 0.72bc
T ₂	Trunk 20% SC	22.03 $\pm$ 0.47a	18.40 $\pm$ 0.80a	14.43 $\pm$ 0.39b	10.00 $\pm$ 1.52bc	4.43 $\pm$ 0.33d
T ₃	Karate 2.5EC	16.3 $\pm$ 1.25b	14.63 $\pm$ 0.31c	12.70 $\pm$ 0.35bc	10.90 $\pm$ 0.49b	7.66 $\pm$ 0.42b
T ₄	Route 57EC	18.00 $\pm$ 0.85b	14.50 $\pm$ 0.87c	10.56 $\pm$ 0.90c	6.20 $\pm$ 0.56c	2.80 $\pm$ 0.11d
T ₅	Refree 5% SC	18.66 $\pm$ 0.75b	16.60 $\pm$ 1.30abc	13.46 $\pm$ 0.86b	9.26 $\pm$ 1.36bc	5.10 $\pm$ 1.05cd
T ₆	Thimet 5G	16.03 $\pm$ 0.52b	14.13 $\pm$ 0.76c	12.10 $\pm$ 1.70bc	9.46 $\pm$ 0.31bc	4.96 $\pm$ 1.15cd
T ₇	Control	16.83 $\pm$ 1.67b	18.17 $\pm$ 0.08ab	20.40 $\pm$ 0.81a	25 $\pm$ 0.57a	31.60 $\pm$ 0.94a
F(DF=3,6)		4.88*	4.33*	11.64*	24.18*	159.89*
P Value		0.0096	0.0148	0.0002	0	0
LSD		2.88	2.59	2.84	3.83	2.45

Means in a column sharing same letter are not significantly different at p<0.05

Figure 1. Percentage reduction of Black Bug population after 24, 48, 72 and 168 hours of spray at Fatima Sugar Mill area farmer field

Figure 2. Percentage reduction of black bug population after 24, 48, 72 and 168 hours of spray at Shiekhu Sugar Mill area farmer field

Conclusion

From present study it is concluded that Sugarcane black bug population in insecticidal treated plot is significantly reduced compared to control plot. However the insecticides Malathion (Route 57 EC) and Clothianadion (Trunk 20 % SC) proved more

promising and can be recommended to sugarcane growers for the control of Sugarcane black bug by Agriculture extension workers.

Authors' contributions

Conceived and designed the experiments: I Raza, Performed the experiments: M Nasir &

M Salman, Analyzed the data: QA Haneef, Contributed materials/ analysis/ tools: I Raza & M Salman, Wrote the paper: MU Asif, M Nasir & QA Haneef

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