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Research Article

Effect of granular insecticides against sugarcane stem borer (*Chilo infuscatellus*) and sugarcane root borer (*Emalocera depresella*) at district Mardan

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Abstract

To evaluate the effect of granular insecticides against sugarcane stem borer and root borer, a study was conducted on farmer's field at Shergarh, District Mardan during the cropping season of 2021. Sugarcane variety CP-77/400 was sown with a row to row distance and plant to plant distance of 24cm and 1cm respectively. Granular insecticides, Refree, Furadon, Ferterra, Virtako, Phorate and Rector super were applied once along with control. Results revealed that application of insecticides provided statistically significant results in comparison to the control and minimized infestation of borers. Minimum mean percent dead heart infestation (2.93), cumulative internode damage (3.01), maximum cane diameter (2.39 cm), cane weight (1.71 kg), cane length (2.56 m) were recorded for plots treated with rector super whereas maximum mean dead heart infestation (4.13), cumulative internode damage (6.01) and minimum cane diameter (2.14 cm), cane weight (0.91 kg), cane length (2.17 m) were recorded for plots treated with phorate. Maximum yield (56386 kg/ha) and cost benefit ratio (1: 75.04) was reported for plots treated with rector super whereas minimum yield (41857 kg/ha) and cost benefit ratio (1: 8.21) was recorded for phorate treated plots. Rector super was recorded as the most effective granular insecticide as compared to others treatments and therefore recommended to be incorporated in integrated pest management studies for effective management of sugarcane stem and root borers.

Keywords: Borers Management; Granular Insecticides; Sugarcane

Introduction

Sugarcane (*Saccharum officinarum* L.), which belongs to family Poaceae, widely cultivated throughout the world. It is an important crop in Indian subcontinent for its nutritional component and economic benefits [1]. It is a major crop of Pakistan and contributes 2.9% in total value addition of agriculture [2]. Sugarcane crop is an important crop in Indian subcontinent for its nutritional component and economic benefits [3]. Sugarcane is vulnerable to numerous insect pests. Approximately 2660 pests from 10 orders have been

recorded in this crop [4]. Important insect pest includes leaf hoppers, termites, borers, grasshoppers and whiteflies and their infestation can cause serious losses in yield [5].

Among borers, root and stem borers are serious pest of sugarcane crop. Stem borer is an important pest and its infestation can cause damage of more than 35 percent in the crop. It lay eggs on the lower side of the leaf, on hatching the caterpillar starts feeding on the leaves. The larvae nourish in the shoot and cut off the rising point, resulting in drying of the whole plant. The deceased shoot is also named "dead-heart" [6].

Root borer is also a serious pest of sugarcane and lay its eggs on stem, ground or leaves, the caterpillar make tunnel into the stalk underneath the soil surface. As they nourish they cut correct crossways the stalk causing dead hearts. The new larva usually makes a minor hole in the early plant root and arrives it. Dead-hearts can cause severe damage in terms of weight and sugar content [7]. Keeping in view the importance of borers, the present study was carried out to evaluate the effectiveness of granular insecticide against sugarcane stem borer and root borer.

Materials and Methods

To investigate the effect of different granular insecticides on sugar cane stem borer and root borer a sugarcane variety CP-77/400 was cultivated at Sherghar, District Mardan during 2021. The experiment was laid out in Randomized Complete Block Design (RCBD) having seven treatments replicated thrice. Treatments include Refree 0.3% G (Fipronil) 8kg / Acre, Furadan 3% G (Carbofuran) 14kg / Acre, Ferterra 0.4% G (Chlorantraniliprole) 4kg / Acre, Virtako 0.6% G (Thiamethoxam+Chlorantraniliprole) 4kg / Acre, Phorate 5 G (Thimet) 15kg / Acre and Rector super 0.35% G (Fipronil + Emamectin) 8kg / Acre. All the granular Insecticides were applied in soil at the time of sowing over the sets followed by irrigation. Data was recorded after 30, 45, 60, 75, 90 days of sowing. Statistix 8.1 software was used to perform analysis of variance on the recorded data, and the least significant test with at 5% level of significance was used to separate the treatment means (F-ratio).

Results

Percent dead heart

As presented in (Table 1), granular insecticides have a significant impact on the percent dead heart caused by sugarcane stem and root borer. The data showed that all the insecticides have reduced the percent dead heart in-comparison to control. Mean percent dead heart infestation in all the tested granular insecticides showed that T_6 has statistically minimum dead heart infestation (2.93) followed by T_4 (3.39), T_1 (3.67), T_3 (3.68), T_2 (3.86), T_5 (4.13) whereas statistically maximum mean percent dead heart infestation (17.63) was recorded for T_7. It is concluded from (Table 4.1) that all the granular insecticides provided minimum percent infestation in comparison to control. Among tested granular insecticides minimum percent dead heart infestation was recorded for T_6 and maximum percent dead heart infestation was recorded for T_5.

Percent internode damage

Data regarding the percent internode damage caused by root borer revealed that all the treated plots were superior in minimizing the internode damage as compared to the control. Significantly lowest internode damage was recorded in rector super (1.07) followed by virtako (1.57). Percent internode damage caused by stem borer revealed that all the treated plots were effective in minimizing the internode damage as compared to the control. Significantly lowest internode damage was recorded in rector super (1.94) followed by virtako (2.49). The internode damage of (2.98), (3.16), (3.31) and (3.67) was observed in refree, ferterra, furadan and phorate respectively (Table 2).

Table 1. Effect of granular insecticides on the percent dead heart damage by borers in sugarcane crop at Shergarh, District Mardan during 2021

Treatments	Percent Dead heart					
	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	Mean
T_1	3.23 d	5.65 b	3.12 d	3.11 b	3.23 bc	3.67 bc
T_2	5.23 b	4.12 c	4.32 b	2.75 b	2.9 bc	3.86 bc
T_3	3.77 cd	3.26 c	4.27 bc	3.78 b	3.3 b	3.68 bc
T_4	4.55 bc	3.67 c	3.12 d	3.44 b	2.18 c	3.39 cd
T_5	4.29 c	6.77 b	4.45 b	2.98 b	2.19 c	4.13 b
T_6	2.45 e	3.91 c	3.22 cd	2.97 b	2.12 c	2.93 d
T_7 (Control)	7.88 a	13.18 a	19.27 a	21.19 a	26.67 a	17.63 a
LSD $_{(0.05)}$	0.77	1.27	1.07	1.4	1.11	0.61

DAS: Days after sowing.
Means value in columns with different letters are significantly different at p =0.05 using LSD test

Table 2. Effect of granular insecticides on the percent internode damage by borers in sugarcane crop

Percent internode damage by borers and % reduction over control					
Treatments	Root borer	% decrease over control	Stem borer	% decrease over control	Cumulative internode damage
Refree	2.09 b	62.61	2.98 c	52.54	5.07 c
Furadan	2.12 b	62.08	3.31 bc	47.29	5.43 b
Ferterra	2.1 b	62.43	3.16 c	49.68	5.26 bc
Virtako	1.57 c	71.91	2.49 d	60.35	4.06 d
Phorate	2.34 b	58.14	3.67 b	41.56	6.01 b
Rector super	1.07 d	80.86	1.94 e	69.1	3.01 d
Control	5.59 a	0.00	6.28 a	0.00	11.87 a
LSD $_{(0.05)}$	0.31	-	0.46	-	1.25

Means value in columns with different letters are significantly different at p =0.05 using LSD test

Cane diameter, cane weight and cane length

Data in (Table 3) showed that application of different granular insecticides have a non-significant effect on cane diameter of sugarcane, however maximum cane diameter (2.39) was recorded for rector super, followed by virtako (2.31), refree (2.25), ferterra (2.22), furadan (2.16) and minimum cane diameter among treatments was recorded for phorate (2.14). Maximum cane weight (1.71) was reported for rector super, followed by virtako (1.53), refree (1.47), ferterra (1.35), furadan (1.35) and minimum cane diameter among treatments was recorded for phorate (0.91). Maximum cane length (2.56) was noted for rector super, followed by virtako (2.37), refree (2.28), ferterra (2.19) and minimum cane length among treatments was recorded for furadan and phorate (2.17).

Yield kg ha^{-1}

Data presented in (Table 4) revealed that application of different granular insecticides have a statistically significant effect on yield of sugarcane. Maximum yield of sugarcane (56386 kg/ha) was recorded in rector super followed by virtako (48050 kg/ha), refree (46429 kg/ha), ferterra (45360 kg/ha), furadan (42964 kg/ha) and minimum yield (41857 kg/ha) was recorded for phorate and minimum yield of (36071 kg/ha) was recorded in control. After removal of damaged sugarcane tillers maximum marketable yield (52393 kg/ha) was observed for rector super, followed by virtako (42262 kg/ha), refree (39629 kg/ha), ferterra (38661 kg/ha), furadan (36624 kg/ha) and minimum yield (34850 kg/ha) was recorded for phorate.

Table 3. Effect of Granular Insecticides on the Cane diameter (cm), Cane Weight (kg) and Cane length (m)

Treatments	Cane Diameter (cm)	Single cane weight (kg)	Single cane length (m)
Refree	2.25 a	1.47 ab	2.28 ab
Furadan	2.16 a	1.35 b	2.17 b
Ferterra	2.22 a	1.36 b	2.19 b
Virtako	2.31 a	1.53 ab	2.37 ab
Phorate	2.14 a	0.91 c	2.17 b
Rector super	2.39 a	1.71 a	2.56 a
Control	2.06 a	0.78 b	2.13 b
LSD $_{(0.05)}$	0.65	0.25	0.35

Means value in columns with different letters are significantly different at p =0.05 using LSD test

Table 4. Effect of granular insecticides on yield of sugarcane crop in Shergarh, District Mardan

Treatments	Yield kg (kg/ha) (Overall)	% Increase over control	Yield kg (kg/ha) (Marketable)
Refree	46429 b	28.71	39629 b
Furadan	42964 bc	19.10	36624 bc
Ferterra	45360 bc	25.75	38661 b
Virtako	48050 bc	33.2	42262 b
Phorate	41857 bc	16.04	34850 bc
Rector super	56386 a	56.31	52393 a
Control	36071 c	-	27643 c
LSD $_{(0.05)}$	9688.7		9953.4

Means value in columns with different letters are significantly different at p =0.05 using LSD test

Cost benefit ratio

Our findings revealed that all the tested granular insecticides had positive CBR values. Rector super was the most profitable granular insecticide with maximum CBR value of (1: 75.04), followed by, refree (1: 31.09), virtako (1: 28.86), ferterra (1: 20.43) and furadan (1: 13.56), whereas the minimum CBR value (1: 8.21) was recorded for phorate. The high CBR values shows that if a proper management strategy is adopted, the farmer can gain maximum profit. However the economic analysis of the current study can only be compared to the other research studies carried out on sugarcane crop in the area of Shergarh because average price of sugarcane crop and cost of control varies with time and region (Table 5).

Discussion

Our studies show that application of fipronil can reduce the dead heart infestation. Similar results were reported by [8]. They observed the effect of fipronil on the percent dead heart caused by sugarcane stem borer and root borer. Their findings revealed that minimum percent dead heart and maximum yield was recorded in plots treated with fipronil. [9] also studied the impact of fipronil on infestation by dead heart and showed more than 60 percent reduction in dead hearts in respect to control. Our findings are in line with [10]. Who found Fipronil was as the most effective in increasing the yield and reducing percent deadhearts and internode borer incidence. Fipronil reduced the internode borer incidence and percent deadhearts significantly by 3.54% and 79.52% respectively. The yield was also recorded maximum in fipronil. The cost benefit ratio was also recorded maximum in plot treated with fipronil Similar results were also obtained by [11, 12] who observed fipronil was more effective in reducing the internode borer infestation.

Chlorantraniliprole also provided significant reduction infestation by borer and enhanced yield. **[13]** reported similar results. They studied the effect of fipronil, chlorantraniliprole, carbofuran and phorate on sugarcane stem borer and documented maximum cane length (2.40 m) and cane weight (1.53 kg) for fipronil, however maximum cane diameter (3.03) was recorded in chlorantraniliprole treated plots, whereas least cane weight, cane length and cane diameter was recorded for plots treated with phorate. **[14]** applied granular insecticides fipronil and reported that it can reduce dead heart infestation and increase yield. Our results were also in agreement with that of **[15]**, who observed the effect of fipronil and chlorantraniliprole on borers. Their findings revealed that fipronil reduced the infestation of borer's upto 60 percent, which is similar to that of our study. They also documented higher single cane weight for chlorantaniliprole followed by fipronil. **[16]** documented the effect of chlorantraniliprole on sugarcane stem borer and found lowest percent infestation and maximum yield outcome for the mentioned insecticide. Our results are at par with that of **[17]**. They showed that all the treatments recorded significantly lower percent of dead hearts as compared to control. The treatment Ferterra 0.4 G after 1st and 2nd spray application found the most effective in lowering the percent deadhearts. **[18]** revealed that fipronil and carbofuran were found better in lowering the percent dead hearts, (13.45-20.45) and (12.10-19.45) respectively as compared to untreated plot. They recorded maximum cane diameter (2.91 cm), cane length (2.76 m). Single cane weight (1.61 kg) and maximum cost benefit ratio (1: 16) for chlorantraniliprole respectively over control. **[19]** showed that Carbofuran 3G showed significantly to be the effective in reducing the number of dead heart plants and plant damage. The treatment also caused an increase in yield as compare to control plot. According to the current studies, the grain yields of each treatment varied greatly from one another. When compared to plots treated with carbofuran, the Fipronil-treated plots had the highest yield.

Table 5. Cost benefit ratio of granular insecticides used for management of insect pest of sugarcane crop during cropping season of 2021

Treatment	Marketable yield kg/ha (A)	Gross income (B) Rs ha^{-1}	Cost of control (C) Rs ha^{-1}	Return over control D=B-C	Net increase over control E=D-C	CBR F=D/C
Refree	39629	356661	2580	80231	77651	31.09
Furadan	36624	329616	3920	53186	49266	13.56
Ferterra	38661	347949	3500	71519	68019	20.43
Virtako	42262	380358	3600	103928	100328	28.86
Phorate	34850	313650	4530	37220	32690	8.21
Rector super	52393	471537	2600	195107	192507	75.04
Control	27643	276430	-	-	-	-

Average Price of sugarcane per kg = Rs. 9 ; Labour cost = Rs. 800 ha^{-1} ; Refree @ Rs. 89 per kg = Rs. 1780 ha^{-1}Furadan @ Rs. 156 per kg = Rs. 3120 ha^{-1}; Ferterra @ Rs. 135 per kg=Rs. 2700 ha^{-1}; Virtako @ Rs. 140 per kg= Rs. 2800 ha^{-1} ; Phorate @ 186.5 per kg = 3730 ha^{-1} ; Rector Super @ 90 per kg = Rs. 1800 ha^{-1}

Conclusion and Recommendations

From the present studies it is concluded that all the tested granular insecticides were effective in minimizing the infestation caused by sugarcane stem borer and root borer in comparison to control. Regarding the parameters documented during this study the most effective granular insecticide was rector super followed by virtako, refree, ferterra, furadon and phorate.

Authors' contributions

Conceived and designed the experiments: F Muhammad & J Sarwar, Performed the experiments F Muhammad, MH Safi & A Khurshid Analyzed the data: F Amin & M Shah, Wrote the paper: F Muhammad & M Hasnain.

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