

EFFECT OF DIFFERENT CONTROL METHODS ON THE INFESTATION OF BORERS IN SUGARCANE PLANT AND RATOON CROPS

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ABSTRACT

Different control methods viz. mechanical, cultural, biological and chemical were tested individually and in combination against borers in both plant and ratoon crops of sugarcane during 2001 through 2003 at Sugar Crops Research Institute Mrardan. Data were recorded on the basis of percent infestation of borers from April to September, while cane yield (tons/ ha) was recorded at the time of harvest. Cane samples of each treatment were analyzed in sugar analysis laboratory for commercial cane sugar percentage (CCS %) to calculate sugar yield (t/ha). The results showed that, all the control methods significantly reduced borers infestation and improved cane and sugar yields as compared to check plots. Significantly lowest borers infestation and highest cane and sugar yields were recorded in those plots where all control methods were applied in combination.

INTRODUCTION

Sugarcane crop is a multiple source of food, fodder and cash need of the growers and readily available energy in human diet. This crop is grown in three provinces of Pakistan namely Sindh, Punjab and NWFP. Total area of sugarcane in Pakistan during 2003-04 was 10,75,000 hectares with production of 5,37,76,000 tons. Out of which NWFP has 1,05,000 hectares with production of 47,45,000 tons (Malik and Gurmani 2005). Among the factors contributing to lower yield in our country, the attack of insect pests is of great importance. Various insect pests like termites, borers, pyrilla, whitefly, bugs and mites etc. attack this crop and cause heavy losses in terms of low yield and quality. Sugarcane borers make tunnels in stubbles and internodes due to which food supply to aerial parts of stem and leaves become stopped. Moreover these tunnels pave way for diseases. With out some effective measures, the crop cannot be protected from the ravages of insect pests specially borers. According to Gupta and Singh (1997), damage due to 3rd and 4th brood of sugarcane borers may result more than 25% reduction in weight. Irshad and Shah (1982) recommended strong earthing-up and cutting of infested tops for the control of gurdaspur borer in sugarcane. Gupta and Roy (1982) Rana *et al* (1992) and Khan and Jan (1994) reported that, Furadon 3-G and Basudin 10-G@ 25 Kg/ha not only significantly reduced stem and root borers but also increased the cane yield. Sardana (2000) stated that, by adopting various techniques like flooding of fields, use of light traps, application of imidacloprid insecticide and release of biological control agent (*Trichogramma chilonis*) effectively managed root borer in sugarcane. Saroj and Jaipal (2000) applied six ecology based approaches in combination i.e. timing irrigation and urea application, mechanical removal of borers damaged plants, earthing-up, release of egg parasitoid and foliar nitrogen

application in sugarcane and reported that, commutative use of these tactics significantly reduced borers infestation and increased cane yield compared to check plots. Madan (2001) suggested that earthing-up in May and June and balanced use of fertilizers to sugarcane crop help in the control of borers. Anwar *et al.* (2004) recommended harvest of crop below the soil level to kill hibernating larvae, collection and burning all stubbles after ploughing, rotavate all the stubbles to kill all types of insects including borers larvae. Khan and Khan (2006) tested various IPM techniques i.e. cultural, mechanical, biological and chemical control methods individually and in combination for borers control in sugarcane plant and ratoon crops. Results showed that all treated plots significantly reduced shoot, gurdaspur and root borers infestation compared to check plots and increased cane and sugar yields. Gul and Saeed (2006) tested different control methods namely mechanical, cultural, biological and chemical individually and in combination and reported that all the control methods significantly controlled root borer and increased cane and sugar yield in ratoon crop throughout NWFP.

Keeping in view the importance of sugarcane borers, this experiment was carried out to study the effect of different control methods on sugarcane borers and cane and sugar yields in both sugarcane plant and ratoon crops.

MATERIALS AND METHODS

The experiment was conducted at Sugar Crops Research Institute, Mardan. Variety Mardan-93 was sown in September as plant crop during 2001 and 2002 and their ratoon crops were maintained for 2002-2003 and 2003-2004. The experiment comprised of six treatments including check was laid out in

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randomized complete block design having four replications. Plot size was maintained as $20 \times 6.75 \text{ m}^2$. The experiment was repeated twice for confirmation of the results. Different IPM strategies were applied in both plant and ratoon crops as under.

Mechanical Control

Plants infested by stem and root borers (dead hearts) and gurdaspur borer (dry tops) were rouged from April to September during first week of each month. Infested plants along with borers larvae and egg clusters of all borers along with leaves were collected from April to September during first week of each month and fed to the livestock.

Cultural Control

Balanced application of fertilizers as DAP and SOP in plant crop (2.0 bags each/acre at sowing time), Urea in both crops (1.5 bags during hoeing and earthing-up) was applied. Irrigation at ten days interval during March to June and twenty days interval during July to September. Strong earthing-up during May was maintained.

Biological control

In these plots, egg parasite *Trichogramma chilonis* was released @ 12000 parasitized eggs/acre pasted on ivory cards were applied from April to September in 1st week of each month. This parasite was cultured on eggs of *Sitotroga cerealella* in the Lab. as per required procedure.

Chemical Control

Carbofuran 3G was applied @ 8 kg/acre during last week of March and then at earthing-up in May. T1+T2+T3+T4

All the four i.e mechanical, cultural and biological were applied in combination at proper time.

Check

After treatments, infestation of stem borer (April to June) and gurdaspur borer (July to September) was recorded by counting the number of infested plants at monthly interval during last week of each month. For root borer infestation ten stubbles were examined randomly in each plot after harvest of the crop. Square-root transformation technique was applied to percent borers infestation data as suggested by Gomez and Gomez (1984)

Cane yield in tons/ha was recorded at the time of harvest. Commercial Cane Sugar percentage (CCS %) data was recorded after cane juice analysis of each treatment in sugar analysis laboratory at Sugar Crops Research Institute Mardan as per method developed by Chen, 1985. For this purpose samples of 20 canes randomly were collected from each treatment at the

time of harvest. Sugar yield tons/ha was calculated with the help of the following formula.

$$\text{Sugar yield} = \frac{\text{Cane yield} \times \text{CCS}\%}{100}$$

Data obtained were statistically analyzed and LSD test was used as test statistics

RESULTS AND DISCUSSION

Results of the experiment conducted at Sugar Crops Research Institute (SCRI) Mardan to check the infestation of shoot borer *Chilo infuscatellus* Snellen (Crambidae; Lepidoptera), gurdaspur borer *Acigona steniellus* Hampson (Crambidae; Lepidoptera) and root borer *Emmalocera depressella* Swinhoe (Pyralidae ; Lepidoptera) using Mechanical control (T1), Cultural control (T2), Biological control (T3), Chemical control (T4), combination of T1, T2, T3 and T4 (T5), the untreated check (T6) and the resultant effect of these treatments on cane yield (tons/ha), Commercial Cane Sugar (CCS %) and sugar yield (t/ha) are presented in tables I and II for plant and ratoon crops respectively as under.

Plant Crop

Infestation of shoot borer (dead hearts), gurdaspur borer (dry tops), root borer in stubbles (after harvest), cane and sugar yield (t/ha) were significantly different while (CCS %) was found non-significant.

Results present in Table-1 revealed that mean infestation of shoot borer at tillering stage (April to June) during 2001 and 2002 was 0.22, 0.29, 1.39, 1.69, 1.70 and 3.04 % respectively in T5, T1, T4, T3, T2 and T6. Analysis of the data showed that infestation in T5 was significantly lowest (0.22 %) closely followed by T1 (0.29 %). There was no significant difference between T2 and T3. All the plots where different control were applied singly or in combination were significantly different from (T6) check plot, where highest infestation (3.04 %) was recorded. Table-I further show that, mean infestation of gurdaspur borer (dry tops) during July to September at millable cane stage was 0.41, 0.54, 1.85, 2.09, 2.51 and 3.90 % in T5, T1, T4, T3, T2 and T6 respectively. The data revealed that, significantly lowest percent infestation (0.41 %) was recorded in T5, This was closely followed by T1 with 0.54 %. All treated plots had significantly better results than T6 (check plots). The percent infestation of root borer in stubbles after harvest of the crop was 2.08, 2.17, 2.25, 2.69, 2.83 and 4.14, respectively in T5, T4, T1, T3, T2 and T6. Significantly lowest infestation (2.08 %) was recorded in T5 as compared to all other treatments. However T2 and T3 were non-significant. Similarly T4 were also non-significant. The untreated check (T6) plots showed significantly highest infestation than all other treatments. Mean cane yield

(Table-II) was significantly highest (109.80 t/ha) in plots treated as T5 followed by T4, T2, T3, T1 and T6, respectively with 107.91, 104.81, 103.24, 98.59 and 93.83. Cane yield between T5 and T4, T2 and T4 and also between T3 and T2 was non significant, however these treatments proved better and significantly different from T1. T6 proved to be significantly inferior in cane yield than all other treatments. Commercial Cane Sugar percentage (CCS %) did not differ significantly among all the treatments. Significantly highest sugar yield (12.97 t/ha) was recorded in T5. This was followed by T4, T2, T3, T1 and T6, respectively with 12.64, 11.72, 11.63, 11.23 and 9.78 (t/ha). Analysis of the data showed non significant differences in T2, T3 and T1. T5 and T4 were also non significant in this regard. Significantly lowest sugar yield 9.78 was recorded in check (T6) plots as compared to other treated plots.

Ratoon Crop

Infestation of shoot borer, gurdaspur borer, root borer in stubbles, cane and sugar yield were significantly different but (CCS %) was found non significant (Table-I).

Results presented in Table-I show that mean infestation of shoot borer during April to June was 1.17, 1.38, 2.41, 2.83, 3.03 and 4.75 %, respectively in T5, T1, T3, T2, and T6. Analysis of the data revealed significantly lowest (1.17 %) infestation in T5, while the highest (4.75%) was recorded in check (T6). Results further revealed that mean infestation of gurdaspur borer (dry tops) during July to September was 1.31, 1.64, 2.27, 2.63, 3.31 and 5.13 % in T5, T1, T4, T3, T2 and T6, respectively. Analysis of the data showed significantly lowest infestation (1.31%) in T5 and highest (5.13%) in check (T6). Root borer infestation in stubbles after harvest of the crop was 4.03, 4.17, 4.60, 4.67, 4.96 and 7.55 %, in T5, T3,

T4, T1, T2 and T6, respectively. Analysis of the data showed that, significantly lowest infestation (4.03 %) was recorded in T5, while highest (7.55%) was recorded in the untreated plot (T6) as compared to all other treatments. Table-II shows that maximum cane yield (73.37 t/ha) was recorded in T5 followed by 62.42, 61.56, 60.44, 59.78 and 56.04 (t/ha) in T4, T2, T3, T1 and T6, respectively. Analysis of the data revealed non significant difference in T2, T3 and T4, similarly T1, T2, T3 and T4 were also non significant. CCS % was ranged from 12.55 to 13.65 % in T6 and T5. Sugar yield was highest (8.76 t/ha) in T5 followed by 8.13, 8.04, 7.98 and 7.02 (t/ha) in T2, T3, (T1+T4) and T5 respectively. Analysis of the data showed non significant differences between T5 and T2, T3 and T4 and also among T1, T4 and T6. These findings are in agreement with those of Irshad and Shah (1982), Jena *et al* (1997), Madan *et al* (1998 and 2001), Jan (1998), Jalani *et al* (2000), Anwar *et al* (2004), Gul and Saeed (2006) and Khan and Khan (2006). These workers also tested the above mentioned control methods and achieved best results in terms of best borers control with improved yield capabilities.

CONCLUSIONS

It is concluded that all control methods such as cultural, mechanical, biological and chemical individually and in combination significantly reduced infestation of shoot, gurdaspur and root borers as compared to untreated plots during the growing period of plant and ratoon crops. On over all basis mechanical, cultural, biological and chemical control when applied in combination proved significantly best control of borers and increased cane yield. Keeping in view the above study, these control methods should be disseminated among the growers to avoid economic losses in sugar industry

Table-I: - Percent Infestation of Sugarcane Borers in Different Control Methods at Sugar Crops Research Institute Mardan

Treatments	Shoot borer (April-June)			Gurdaspur borer (July-September)			Root borer in stubbles after harvest		
	2001	2002	Mean	2001	2002	Mean	2001	2002	Mean
<i>Plant Crop</i>									
Mechanical control (T1)	0.14 d	0.45 d	0.29 d	0.48 c	0.61 d	0.54 e	2.13 c	2.37 d	2.25 c
Cultural control (T2)	1.55 bc	1.86 b	1.70 b	2.45 b	2.58 b	2.51 b	2.85 b	2.81 b	2.83 b
Biological control (T3)	1.74 b	1.64 bc	1.69 b	1.96 b	2.23 bc	2.09 c	2.81 b	2.58 c	2.69 b
Chemical control (T4)	1.18 c	1.60 c	1.39 c	1.86 b	1.85 c	1.85 d	2.14 c	2.20 d	2.17 c
T1+T2+T3+T4 (T5)	0.10d	0.35 d	0.22 d	0.15 c	0.68 d	0.41 e	2.12 c	2.05 d	2.08 d
Check (T6)	2.86 a	3.23 a	3.04 a	3.81 a	3.99 a	3.90 a	4.21 a	4.07 a	4.14 a
<i>Ratoon Crop</i>									
	2002	2003	Mean	2002	2003	Mean	2002	2003	Mean
Mechanical control (T1)	1.36 c	1.40 d	1.38 e	0.98 d	2.30 d	1.64 e	4.47 c	4.88 bc	4.67 c
Cultural control (T2)	2.96 b	3.11 b	3.03 b	3.49 b	3.14 b	3.31 b	4.90 b	5.02 b	4.96 b
Biological control (T3)	2.94 b	2.73 c	2.83 c	2.70 c	2.56 c	2.63 c	4.18 c	4.17 d	4.17 e
Chemical control (T4)	2.30 b	2.52 c	2.41 d	2.27 c	2.27 c	2.27 d	4.48 bc	4.73 bc	4.60 d
T1+T2+T3+T4 (T5)	1.03 d	1.31 d	1.17 f	1.36 cd	1.27 d	1.31 f	3.95 c	4.11 e	4.03 f
Check (T6)	4.78 a	4.72 a	4.75 a	5.31 a	4.95 a	5.13 a	7.19 a	7.91 a	7.55 a

Figures in columns having same letters are non-significant at $\alpha = 0.05$

Table-II: - Effect of Different Control Methods on Cane and Sugar Yield (Tons Ha⁻¹) and Ccs %

Treatments	Cane yield			CCS (%)			Sugar yield		
	2001	2002	Mean	2001	2002	Mean	2001	2002	Mean
Plant Crop									
Mechanical control (T1)	98.29 d	98.90 e	98.59 d	11.42 a	11.38 a	11.40 a	11.22 c	11.25 c	11.23 c
Cultural control (T2)	109.18 b	100.44 cd	104.81 bc	11.18 a	11.20 a	11.19 a	12.20 b	12.24 c	11.72 c
Biological control (T3)	106.26 c	100.23 e	103.24 c	11.24 a	11.30 a	11.27 a	11.94 c	11.32 bc	11.63 c
Chemical control (T4)	108.99 b	106.83 b	107.91 ab	11.58 a	11.88 a	11.73 a	12.61 b	12.68 b	12.64 ab
T1+T2+T3+T4 (T5)	110.46 a	109.14 a	109.80 a	11.76 a	11.87 a	11.81 a	12.98 a	12.98 b	12.97 a
Check (T6)	93.77 e	93.83 e	93.80 e	10.61 a	10.26 a	10.43 a	9.94 d	9.94 a	9.78 d
Ratoon Crop									
	2002	2003	Mean	2002	2003	Mean	2002	2003	Mean
Mechanical control (T1)	68.14 d	51.43 e	59.78 b	13.30 a	13.45 a	13.37 a	9.06 a	6.91 c	7.98 c
Cultural control (T2)	69.36 b	53.77 c	61.56 ab	13.15 a	13.30 a	13.22 a	9.12 a	7.15 ab	8.13 a
Biological control (T3)	68.27 d	52.61 d	60.44 ab	13.30 a	13.35 a	13.32 a	9.07 a	7.02 ab	8.04 ab
Chemical control (T4)	69.00 bc	55.84 b	62.42 ab	13.55 a	13.65 a	13.60 a	8.34 a	7.62a b	7.98 c
T1+T2+T3+T4 (T5)	70.69 a	76.14 a	73.37 a	13.60 a	13.70 a	13.65 a	9.56 a	7.96 a	8.76 a
Check (T6)	63.29 e	48.80 f	56.04 c	12.51 a	12.60 a	12.55 a	7.91 a	6.14 d	7.02 cd

Figures in columns having same letters are non-significant at $\alpha = 0.05$

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