

Effects of Different Borers on the Weight and Recovery Loss in Sugarcane

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ABSTRACT

An experiment was set up to estimate the effects of borers feeding on weight and recovery losses caused by top shoot borer, stem borer and rootstock borer at Regional Sugarcane Research Station, Thakurgaon during the cropping season 2005-2006. Results revealed that with distinct variation among the varieties mean weight losses were 12.12% and 34.75% for top shoot borer (TSB), 15.08% and 32.56% for stem borer (SB) and 15.027% and 47.02% for rootstock borer (RSB) at 10% and 100% infestation level respectively. With varietal deviation losses in mean percent recovery were 16.51, 16.86 and 27.09 at 100% infestation by TSB, SB and RSB, respectively. The result shows that though weight and recovery loss due to borer infestation is different for different varieties but losses increased with the increase in infestation.

Key words: Sugarcane, borers, weight, recovery, loss.

INTRODUCTION

In Bangladesh, sugarcane is a major cash crop but its production per unit area is considerably lower than many other sugarcane producing countries of the world. Sugarcane pests especially borers are serious problem in cane cultivation. Among major borers, top shoot borer (*Scirpophaga excerptalis* Walker), stem borer (*Chilo tumidicostalis* Hampson) and rootstock borer (*Emmalocera depressella* Swinhoe) are the most destructive. Alam (1967) reported that these pests alone can cause damage ranging from 20–60% under field conditions. Considerable yield losses which are estimated to be around 20% in cane yield and 15% in sugar recovery have also been reported (Avasthy, 1983). Due to their infestation, losses in yield incurred every year are estimated to be 21-48% by top shoot borer (Karim and Islam, 1977), 8.2-12.6% by stem borer, *Chilo tumidicostalis* Hampson (Khanna *et al.*, 1957), 8.55% (Miah *et al.*, 1986) and upto 10% by rootstock borer (Gupta and Avasthy, 1952). Justification of management of any pest depends on the importance or economic loss caused by the pest. Economic loss may be expressed in terms of yield loss and sucrose loss or both. The yield loss and sucrose loss varies with the rate of infestation. Little work has been done on this aspect in Bangladesh. It is now worthy know how much weight and recovery incurred at what level of infestation. It is also required to ascertain at what rate of infestation the control measures should be taken to achieve economic harvest. Therefore, the present study was undertaken to find out weight and recovery losses due to borers' attack at different rate of infestation using three promising apparently resistant to susceptible varieties of sugarcane.

MATERIALS AND METHODS

The experiment was conducted at RSRS Thakurgaon during the cropping season 2005-2006. Three promising apparently resistant to susceptible varieties viz. Isd 2-54, Isd 16 and Isd 31 were planted in an area of 0.75 ha of land which was allowed for natural infestation by Top shoot

borer (TSB), Stem borer (SB) and Rootstock borer (RSB). Planting was done through conventional sett placement in the trenches. Fertilizer application (FRG, 2005), irrigation, weeding, mulching and earthing-up were done as and when necessary (Rahman and Pal, 2003).

No pest control measures were applied. At harvest, samples of 10 canes were collected containing uniformly infested and healthy canes comprising 0-100% infested cane. The investigation consists of 11 treatments including one control (healthy canes). The treatments were replicated thrice for weight and sucrose analysis and statistical analysis was done for comparison.

The treatments were as follows for each of the target pests:

- T₀- 0% infested cane (10 healthy canes)
- T₁- 10% infested cane (9 healthy canes + 1 infested cane)
- T₂- 20% infested cane (8 healthy canes + 2 infested canes)
- T₃- 30% infested cane (7 healthy canes + 3 infested canes)
- T₄- 40% infested cane (6 healthy canes + 4 infested canes)
- T₅- 50% infested cane (5 healthy canes + 5 infested canes)
- T₆- 60% infested cane (4 healthy canes + 6 infested canes)
- T₇- 70% infested cane (3 healthy canes + 7 infested canes)
- T₈- 80% infested cane (2 healthy canes + 8 infested canes)
- T₉- 90% infested cane (1 healthy cane + 9 infested canes)
- T₁₀- 100% infested cane (10 infested canes)

RESULTS AND DISCUSSION

It was observed that substantial yield loss occurs due to attack of top shoot borer (TSB) in all tested varieties viz., Ild 2-54, Ild 16 and Ild 31. In case of Ild 2-54, no significant differences were observed in weight loss among different levels of infestation but over 40% onward infestations showed considerable weight loss which varied from 27.33 to 37.33% (Table 1). In case of Ild 16, no significant differences were observed in weight loss among different infestation levels but infestations of 20% onward showed remarkable weight loss where infestation of 70% onward gave more than 34% weight loss. The weight loss at 100% infestation level was 53.36% in this variety. In case of Ild 31, no significant differences in weight loss were observed among different levels of infestation but infestation of 40% onward showed 2.62 to 13.57% weight loss. From Table 1 it is observed that mean weight losses were 12.12% and 34.75% for top shoot borer at 10% and 100% level of infestation in tested varieties. Higher the levels of top shoot borer infestation more the loss in weight in all the 3 varieties.

Loss in cane weight due to the TSB varies from 6.50 to 50.17 % and 21 to 48 % as reported by Khalequzzaman and Mannan (1980) and Karim and Islam (1977), respectively. Gupta *et al.* (1965) reported the progressive increase in weight loss with the increase in the degree of infestation. The variation in yield loss is also attributed to variety and stage of the crop attacked (Siddiqi, 1960a; Agarwal *et al.*, 1974). Raja Rao (1953) reported 27% yield loss at 100% incidence of borer at Maharashtra and it varied from 18.5-44.8% in different varieties (Phadke and Patil, 1970). It has also been observed that the loss in weight in different varieties varied from 21-37% (Doss, 1954, Venkataraman, 1961). Begum *et al.* (2006) reported that weight loss due to attack of top shoot borer was 25.67% in clone I 154-93 and 12.33% in Ild 16. Kalra and Chaudhary (1964) reported that top shoot borer alone caused yield loss from 4.7 to 30.0% which is comparable to the results of weight loss due to TSB in the present finding.

Table 1. Loss in weight due to different rates of top shoot borer infestation in different varieties at RSRS, Thakurgaon, 2005-2006.

Treatments	Loss in weight due to top shoot borer infestation						
	Mean weight			Percent loss in weight			
	Isd 2-54	Isd 16	Isd 31	Isd 2-54	Isd 16	Isd 31	Mean
0% infestation	7.50	8.85	6.85	-	-	-	
10% infestation	6.25	7.30	6.70	16.67	17.51	2.18	12.12
20% infestation	5.95	7.45	6.95	20.67	15.81	-1.45	11.68
30% infestation	6.15	6.75	7.07	18.00	23.72	-3.21	12.84
40% infestation	6.20	6.55	7.92	17.33	25.98	-15.62	9.23
50% infestation	5.45	6.55	6.37	27.33	25.98	7.01	20.11
60% infestation	5.75	6.40	6.40	23.33	27.68	6.56	19.19
70% infestation	5.45	6.35	6.00	27.33	28.24	12.40	22.66
80% infestation	5.20	5.79	6.40	30.67	34.57	6.56	23.93
90% infestation	4.70	4.95	6.67	37.33	44.06	2.62	28.00
100% infestation	4.70	4.10	5.92	37.33	53.36	13.57	34.75
LSD (5%)	NS	NS	NS	-	-	-	

The results showed no significant differences in recovery between healthy canes and levels of TSB infested canes upto 50% of infestation for Isd 2-54 where percent recovery varied from 7.75-8.52 (Table 2). Again there was no significant difference among the loss of recovery due to TSB attack among the infestation rates of 50% to 100% with losses ranged from 6.88-7.56. In case of Isd 16, no significant differences were observed in the loss of recovery between healthy canes (8.12) and 10%, 20%, 40% and 60% TSB infested canes where percent loss of recovery ranged from 7.23-7.69. In case of Isd 31, no significant differences were observed loss in percent recovery between healthy canes (6.62) and TSB infested canes of 10%, 30% and 60% where percent recovery loss of 7.12, 6.89 and 6.71, respectively. Mean percent recovery loss varied from 0.49 to 16.51% in 20 to 100% rates of infestation among the three varieties (Table 2). Begum *et al.* (2006) reported that sucrose loss of 3.67% was observed in Isd 16 due to TSB infestation which is close to the present study. The loss in sugar recovery due to top borer infestation varied from 0.2-4.1 units (Raja Rao, 1953; Gupta and Avasthy, 1954; Doss, 1956; Rajani, 1960; Siddiqi, 1960b; Ventataraman, 1961; Kalra and Chaudhary, 1964 and Gupta *et al.*, 1965). The recoverable sucrose loss due to TSB infestation obtained in this study has similarity with above reports. Alam *et al.* (2006) reported that mean weight losses were 12.29 to 46.68% for top shoot borer (TSB) at 10% and 100% infestation level, respectively. He also reported that losses in mean percent recovery were 8.44% at 100% infestation by TSB. All of these reports have similarities with the present investigation.

Table 2. Loss in recovery due to different rates of top shoot borer infestation in different varieties at RSRS, Thakurgaon, 2005-2006.

Treatments	Loss in recovery due to top shoot borer infestation						
	Mean recovery			Percent loss in recovery			
	Isd 2-54	Isd 16	Isd 31	Isd 2-54	Isd 16	Isd 31	Mean
0% infestation	8.52 a	8.12 a	6.62 bcd	-	-	-	
10% infestation	8.47 a	7.69 ab	7.12 ab	0.59	5.29	-7.55	-0.55
20% infestation	8.35 ab	7.06 bcd	7.52 a	2.00	13.05	-13.59	0.49
30% infestation	8.30 ab	7.03 bcd	6.89 abc	2.58	13.42	-4.07	3.98
40% infestation	7.75 abc	7.23 abcd	6.54 bcde	9.03	10.96	1.20	7.06
50% infestation	7.56 acd	7.12 bcd	6.15 cde	11.26	12.31	7.09	10.22
60% infestation	7.26 cd	7.43 abc	6.71 bcd	14.78	8.49	-1.35	7.31
70% infestation	6.88 d	6.68 cd	6.11 de	19.24	17.73	7.70	14.89
80% infestation	7.09 cd	6.71 cd	6.33 cde	16.78	17.36	4.38	12.84
90% infestation	6.96 cd	6.59 cd	6.12 cde	18.30	18.84	7.55	14.90
100% infestation	6.99 cd	6.39 d	5.94 e	17.95	21.30	10.27	16.51
LSD (5%)	0.8003	0.9187	0.7654	-	-	-	

* Figures accompanied by the same letter are not significantly different at 5% level as per LSD test.

It reveals from the Table 3 that weight loss occurred due to attack of stem borer (SB) in all test varieties viz., Isd 2-54, Isd 16 and Isd 31 but no significant difference in first two varieties at 0-100% infestation. In case of Isd 31, all levels of infested canes (10-90%) had significantly lower weight loss compared to healthy canes which showed 27.11 to 37.28% weight loss. Loss of weight due to SB infestation was significantly lower in variety Isd 31 at 90 and 100% infestation level. Mean weight loss varied from 25.68 to 32.56% at 10 to 100% rates of infestation among three varieties.

The yield loss and sucrose loss varies with the level of infestation. Gupta and Singh (1951) reported that the reduction in cane yield ranged from 17-33% at 29% due to infestation of internodes by stalk borer, *Chilo auricilius* Dudgeon in India. Begum *et al.* (2006) reported that weight loss due to attack of stem borer ranged from 17 to 43% in some sugarcane clones with 33.67% weight loss in Isd 16 which was comparable to the present results. Alam *et al.* (2006) reported that mean weight losses were 12.01 to 34.51% for stem borer (SB) at 10% and 100% infestation level respectively. He also reported that losses in mean percent recovery were 10.95% at 100% infestation by SB. All of these findings were more or less comparable to those of the present investigation.

Table 3. Loss in weight due to different rates of stem borer infestation in different varieties at RSRS, Thakurgaon, 2005-2006

Treatments	Loss in weight due to stem borer infestation						
	Mean weight			Percent loss in weight			
	Isd 2-54	Isd 16	Isd 31	Isd 2-54	Isd 16	Isd 31	Mean
0% infestation	7.05	7.20	8.85 a	-	-	-	
10% infestation	6.30	6.70	6.40 b	10.63	6.94	27.68	15.08
20% infestation	5.30	5.75	6.01 b	24.82	20.13	32.09	25.68
30% infestation	5.40	6.10	6.00 b	23.40	15.27	32.20	23.62
40% infestation	5.05	5.60	6.45 b	28.36	22.22	27.11	25.90
50% infestation	5.30	6.15	5.80 b	24.82	14.58	34.46	24.62
60% infestation	5.05	5.14	5.85 b	28.36	28.61	33.89	30.29
70% infestation	4.75	5.85	6.55 b	32.62	18.75	31.63	27.67
80% infestation	3.90	5.35	5.85 b	44.68	25.69	33.89	34.75
90% infestation	3.85	4.80	5.55 bc	45.39	33.33	37.28	38.67
100% infestation	5.00	5.65	4.70 c	29.27	21.52	46.89	32.56
LSD (5%)	NS	NS	0.9506	-	-	-	

* Figures accompanied by the same letter are not significantly different at 5% level as per LSD test.

No significant differences were observed in recovery between healthy canes and 10%, 20%, 30%, 40% and 60% infestation levels of SB infested canes for Isd 2-54 where mean recovery varied from 7.69-7.95 (Table 4). The lowest (6.93) recovery loss was obtained due to SB infestation of 100% and this was not significantly different from that (7.09) of 90% infestation. In case of Isd 16, no significant differences were also observed in recovery between healthy (9.17) canes and at levels of 10, 20, 30, 40, 50, 60 and 70% SB infested canes where mean recovery ranged from 8.86-9.11. Recovery percent at 80 to 100% SB infestation level (8.34, 8.28 and 7.96) were not significantly differed from each other. But in case of Isd 31, no significant differences were observed in percent recovery between healthy canes and all level of SB infested canes. Mean percent recovery loss ranged from 1.92-16.86 at 10 to 100% levels of SB infestation among three varieties. Gupta and Singh (1951) reported that loss in sugar recovery ranged from 1.7-3.70 unit at 29% infestation of internodes by stalk borer, *Chilo auricilius* Dudgeon in India. Shenhmar *et al.* (1998) reported that 9.85 sugar recovery in healthy canes whereas stalk borer infested cane showed 9.78, 9.35, 9.30 and 6.26 recovery at 5, 10, 15 and 40% infested internodes with 0.71, 5.07, 5.58, 36.44% loss in sugar recovery, respectively. Begum *et al.* (2006) reported that sucrose loss of 2.97% was observed in Isd 16 due to SB infestation.

Table 4. Loss in recovery due to different rates of stem borer infestation in different varieties at RSRS, Thakurgaon, 2005-2006.

Treatments	Loss in recovery due to stem borer infestation						
	Mean recovery			Percent loss in recovery			
	Isd 2-54	Isd 16	Isd 31	Isd 2-54	Isd 16	Isd 31	Mean
0% infestation	7.99 a	9.17 a	7.58	-	-	-	
10% infestation	7.95 a	9.11 a	7.23	0.50	0.65	4.61	1.92
20% infestation	7.69 abc	8.99 a	7.17	3.75	1.96	5.40	3.70
30% infestation	7.78 ab	8.89 ab	6.78	2.62	3.05	10.55	5.41
40% infestation	7.73 abc	8.86 abc	6.80	3.25	3.38	10.29	5.64
50% infestation	7.44 bcd	9.03 a	6.46	6.88	1.52	14.77	7.72
60% infestation	7.79 ab	8.89 ab	6.57	2.50	3.05	13.32	6.29
70% infestation	7.47 bcd	8.94 a	6.47	6.50	2.50	14.64	7.88
80% infestation	7.38 cd	8.34 bcd	6.26	7.63	9.05	17.41	11.36
90% infestation	7.09 de	8.28 cd	6.65	11.26	9.70	12.26	11.07
100% infestation	6.93 e	7.96 d	5.75	13.26	13.17	24.14	16.86
LSD (5%)	0.3859	0.5853	NS	-	-	-	

* Figures accompanied by the same letter are not significantly different at 5% level as per LSD test.

Weight loss was also experienced due to rootstock borer (RSB) infestation in all the 3 varieties (Table 5). In case of Isd 2-54, significantly higher weight loss (6.41) was observed at infestation level of 10% which was statistically similar to that of infestation rate of 20% (5.90). But the later was not significantly different from those recorded at infestation level of 30% (5.28), 40% (5.35) and 50% (5.30). The percent weight loss was the highest (47.12%) at 100% level infestation in variety Isd 2-54. In case of Isd 16, onward 30% level of infestation differed significantly over healthy canes. No significant differences were observed in weight loss among 60-100% infestation levels. The highest percent weight loss was observed at 90% infestation level which was 50.89%. In case of Isd 31, significantly the highest weight loss was observed (57.41) at 100% infestation level. No significant differences were observed in weight loss between 40 and 50% infestation levels. Significant differences were observed in weight loss among 60 to 100% infestation levels and differed significantly among each other. Mean percent weight loss ranged from 15.02 to 47.02 among different levels of infestation in three varieties.

The above result revealed that great loss in weight occurs due to attack of TSB, SB and RSB in varieties Isd 2-54, Isd 16 and Isd 31. Abdullah and Sardar (1995a) reported 18.4% weight loss in Isd 16 due to RSB infestation compared to healthy cane. Begum *et al.* (2006) reported that weight loss due to rootstock borer was 13.23% in Isd 16. These results are comparable with the result of weight loss due to RSB in the present study.

Table 5. Loss in weight due to different rates of rootstock borer infestation in different varieties at RSRS, Thakurgaon, 2005-2006.

Treatments	Loss in weight due to rootstock borer infestation						
	Mean weight			Percent loss in weight			
	Isd 2-54	Isd 16	Isd 31	Isd 2-54	Isd 16	Isd 31	Mean
0% infestation	6.79 a	8.35 a	10.45 a	-	-	-	-
10% infestation	6.41 ab	7.10 ab	7.89 b	5.59	14.97	24.49	15.02
20% infestation	5.90 bc	7.20 ab	7.57 c	13.10	13.77	27.55	18.14
30% infestation	5.38 cd	6.10 bc	7.77 b	20.76	26.94	25.64	24.45
40% infestation	5.35 cd	5.65 bcd	7.10 d	21.20	32.33	32.05	28.53
50% infestation	5.30 cd	5.80 bc	7.22 d	21.94	30.53	30.90	27.79
60% infestation	4.39 ef	5.50 cd	6.47 f	35.34	34.13	38.08	35.85
70% infestation	4.06 ef	5.05 cd	6.65 e	40.20	39.52	36.36	38.69
80% infestation	4.85 de	4.20 d	6.26 g	28.57	49.70	40.09	39.45
90% infestation	3.60 f	4.10 d	5.45 h	46.98	50.89	47.84	48.57
100% infestation	3.59 f	5.30 cd	4.45 i	47.12	36.52	57.41	47.02
LSD (5%)	0.8572	1.596	0.1726	-	-	-	-

* Figures accompanied by the same letter are not significantly different at 5% level as per LSD test.

Significantly the highest recovery (7.59) of healthy cane (0% infestation) was recorded in variety Isd 2-54 which was statistically higher than that of any other level of infestation by RSB. No significant differences were observed in recovery at all levels of RSB infested canes for Isd 2-54 where percent recovery varied from 5.49-6.27 (Table 6). Highest recovery loss of 27.66% was observed at 100% level of infestation in this variety. In case of Isd 16, significantly the highest recovery was observed in healthy cane (8.55) which is significantly different from all other rates of infestation by RSB. The second highest recovery was (7.35) found in canes having 10% infestation and it was also statistically higher than that on any other infestation level. Third highest recovery was measured (6.43) in canes having 20% infestation but it was not significantly different from those of 30% (6.26), 50% (5.85), 70% (6.256), 80% (5.76) and 90% (6.07) level of infestation. In case of Isd 31, significant differences were observed in percent recovery between healthy canes and all level of RSB infested canes except 10% infestation level where percent recovery ranged from 6.02-6.76. The highest recovery loss of 18.09% was observed at 70% level of infestation. Mean percent recovery loss ranged from 11.04 to 27.09 among different levels of infestation in three varieties. Ali *et al.* (2001) reported that some times root borer attack became so severe (60-70%) that crop is damaged very badly which reduced the sugar recovery up to 1-2%. Gupta and Avasthy (1952) reported 0.3% sucrose loss in the juice of root borer infested canes in Uttar Pradesh whereas Agarwal and Prasad (1954) reported 2.9% sucrose loss in Bihar. Begum *et al.* (2006) reported that a loss of 1.92% recovery was observed due to RSB infestation in Isd 16. Abdullah and Sardar (1995b) reported 8.51% loss in sugar recovery due to RSB infestation in Isd 16 compared to healthy canes which has similarity with the results of the present study. Alam *et al.* (2006) stated that the mean weight losses were 10.07 to 55.28% for rootstock borer (RSB) attack at 10% and 100% infestation level, respectively. He also obtained that loss in mean percent recovery was 8.48% at 100% infestation by RSB. These results have more or less similarities with the result of recovery loss due to RSB in the present study.

The result indicated that recovery loss due to pest infestation is different for different infested varieties and level of infestation and it decreased with the decreasing rate of infestation.

Table 6. Loss in recovery due to different rates of rootstock borer infestation in different varieties at RSRS, Thakurgaon, 2005-2006.

Treatments	Loss in recovery due to rootstock borer infestation						
	Mean recovery			Percent loss in recovery			
	Isd 2-54	Isd 16	Isd 31	Isd 2-54	Isd 16	Isd 31	Mean
0% infestation	7.59 a	8.55 a	7.35 a	-	-	-	
10% infestation	6.17 bc	7.35 b	7.32 a	18.70	14.03	0.40	11.04
20% infestation	6.27 b	6.43 cd	6.76 b	17.39	24.79	8.02	16.73
30% infestation	6.19 bc	6.26 cd	6.26 d	18.44	26.78	14.82	20.01
40% infestation	5.97 bc	6.56 c	6.27 d	21.34	23.27	14.69	19.77
50% infestation	5.84 bc	5.85 de	6.17 e	23.05	31.57	16.05	23.56
60% infestation	5.92 bc	6.57 c	6.61 c	22.00	23.15	10.06	18.40
70% infestation	5.81 bc	6.26 cd	6.02 f	23.45	26.78	18.09	22.77
80% infestation	5.99 bc	5.76 de	6.14 e	21.08	32.63	16.46	23.39
90% infestation	5.88 bc	6.07 cde	6.21 de	22.52	29.01	15.51	22.35
100% infestation	5.49 c	5.49 e	6.04 f	27.66	35.78	17.82	27.09
LSD (5%)	0.7589	0.6684	0.07046	-	-	-	

* Figures accompanied by the same letter are not significantly different at 5% level as per LSD test.

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