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Loss assesssment of Sugarcane due to Rat and Jackal in Sripur

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ABSTRACT

Rats, *Rattus rattus* (Linnaeus) and *Bandicota bengalensis* (Gray), and the jackal, *Canis* aureus Linnaeus, are the major vertebrate pests damaging sugarcane in Bangladesh. However, little is known about the variability and distribution of damage of these species or factors that may affect damage. We examined 25 one-km^2 blocks in the Sripur area for sugarcane damage with respect to percent of damage caused by rat and jackal. Potential effect of the sugarcane variety, proximity of sugarcane fields to houses, and whether the canes were erect or lodged (bent) on the amount of damage were observed. Rat and jackal damaged a mean of 11.72% and 0.71% of sugarcane stalks, respectively. Significantly more sugarcane was lost to rat damage ($\underline{x}$ = 1287.71 kg/ha) than to that of jackal ($\underline{x}$ = 99.72 kg/ha) ($P < 0.001$), with respective economic losses valued at Taka 1730.68/ha and Taka 134.02/ha. No differences were found in rat or jackal damage among the 4 varieties of newly planted sugarcane or proximity to houses. Rat caused more damage of the newly planted sugarcane ($\underline{x}$ = 1287.7 kg/ha) than ratoon cane ($\underline{x}$ = 182.5 kg/ha). It was observed that bent stalks were more vulnerable to rat damage ($\underline{x}$ = 1117.0 kg/ha) than erect stalks ($\underline{x}$ = 145.8 kg/ha).

INTRODUCTION

Changes in cropping pattern and intensity of cultivation due to increasing populations, incursion into and destruction of wildlife habitat is occurring in Bangladesh. Consequently, the nature and intensity of crop damage by vertebrate wildlife species are changing. Sugarcane is the principal cash crop grown in Sripur Thana of Gazipur District, and it is very vulnerable to damage by rat and jackal. It provides excellent cover after attaining a certain height and density, a readily available high energy food source, and it covers large areas for extended period of time. Haque *et al.* (1985) reported 24.4% jackal and 7.5% rat damage to sugarcane in Sripur, with 32.0% and 14.3% weight losses in damaged stalks by jackal and rat respectively.

Damage by rodent and jackal is known to affect both weight and sugar content of cane (Hampson, 1984; Haque *et al.*, 1985). Early reports of rat damage to sugarcane in Hawaii found 25-40% of total cane damaged and sugar loss of about 6% (Elliott, 1925; Pemberton, 1925). Rodent losses in range of 10-30% of stalks damaged and 5-25% of sugar yield are still common (Hampson, 1984).

The objectives of this study are to estimate percent of sugarcane stalks damaged, determine number and weight of internodes damaged to calculate kg/ha losses, to estimate economic value of lost sugarcane production due to rat and jackal damage, and evaluate several factors that may influence levels of damage.

MATERIALS AND METHODS

Sugarcane damage by rat and jackal was evaluated from February to April, 1991, in a 25-km^2 area of Sripur Thana, approximately 30 km north of Bangladesh Agricultural Research Institute (BARI) campus, Joydebpur, in central Bangladesh (24.2^0 N latitude, 90.5^0 E longitude). This is predominantly a rice and sugarcane cropped area interspersed with small patches of sal forest (*Shorea robusta*) and bamboo (*Bambusa* spp.). Sugarcane is present throughout the year with harvest being staggered from December to April. Monsoon flooding (July-September) is confined to old river channels in this upland area.

The study area was divided into 25 one-km^2 blocks. A road network in each block facilitated movement among blocks by motor vehicle. Individual blocks were examined three days a week to find fields where farmers were harvesting and cleaning sugarcane stalks. One sugarcane field per block was selected for data collection. Selection was not necessarily random, but rather the first field within a block to begin harvest.

The percent of stalks damaged was estimated by randomly selecting 1000 harvested canes from the sample field and examining them for rat or jackal damage. Weight of cane loss was determined by examining all cane harvested from the field for one day. The number and weight of internodes damaged by and jackal was recorded separately. An internode of similar diameter and length for each damaged internode was taken from undamaged cane through eye estimation and weighed; the weight difference between damaged and undamaged internodes was considered the weight lost due to damage. If the farmer considered the whole cane damaged, the weight of a comparable whole cane was used. The harvested area was measured to the nearest meter by tape to convert the weight loss estimates to losses per hectare (kg/ha). Other variables that may influence the amount of rat and jackal damage were recorded: varieties of sugarcane (Misrimala, Fatatady, Isd 2/54, Isd 16) and the ratoon (cane growing from the remains of last year's stalk), whether or not the cane was erect or lodged (bent), proximity of the field to houses, and the number of active rat burrows in the field.

A multifactor analysis of variance (ANOVA) was used to determine if differences existed in the levels of rat and jackal damage between factors (variety of sugarcane, whether the cane was erect or bent and proximity to housing). Because of the unequal cell sizes in the ANOVA the general linear models (GLM) procedure of SAS was used for analysis (SAS, 1988: 549-640). Where the GLM indicated a significant F value ($P < 0.05$) for the overall model, multiple comparisons of means tests (Bonferonni and Tukey tests) were performed (SAS, 1988-593:599).

RESULTS AND DISCUSSION

Rat damage to sugarcane was widespread but highly variable among blocks ranging from 0.6 to 41.0% ($\bar{x}$ = 11.7, SD = 11.3) (Table 1). Conversely, jackal damage was scattered and observed only in 7 out of 25 blocks ranging from 0.2 to 7.0% ($\bar{x}$ = 0.7, SD = 1.8) (Table 1).

Table 1. Newly planted sugarcane stalk damage (%) and losses (kg/ha and Taka/ha) due to rat and jackal, Sripur, Bangladesh, 1991.

Block	Harvested areas (m^2)	% Stalk damage		Weight loss (kg/ha)		Taka/ha loss[a]	
		Rat	Jackal	Rat	Jackal	Rat	Jackal
11	272	10.6	0.0	1470.6	0.0	1976.5	0.0
12	157	10.0	0.0	683.6	0.0	919.0	0.0
13	237	40.8	0.0	5485.2	0.0	7372.2	0.0
14	310	1.1	0.0	27.4	0.0	36.9	0.0
15	176	13.6	0.0	1605.1	0.0	2157.3	0.0
21	273	18.0	0.0	1611.7	0.0	2166.2	0.0
22	241	16.4	0.2	1991.7	83.0	2676.8	111.5
23	178	25.7	0.0	3370.8	0.0	4530.3	0.0
24	159	26.5	0.0	2830.2	0.0	3803.8	0.0
25	345	10.0	0.0	366.2	0.0	492.2	0.0
31	257	3.4	3.1	389.1	768.5	523.0	1032.8
32	281	6.5	1.5	418.2	89.0	562.0	119.6
33	240	0.6	7.0	24.6	916.7	33.0	1232.0
34	375	6.3	0.0	1240.0	0.0	1666.7	0.0
35	240	7.7	0.0	427.1	0.0	574.0	0.0
41	134	10.3	0.0	1343.3	0.0	1805.4	0.0
42	148	5.4	0.0	405.4	0.0	544.9	0.0
43	368	17.2	0.0	434.8	0.0	584.3	0.0
44	349	1.2	0.2	57.3	6.6	77.0	8.9
45	196	4.5	0.4	535.8	53.6	720.0	72.0
51	270	3.0	0.0	231.5	0.0	311.1	0.0
52	312	41.0	5.4	6444.9	575.6	8662.0	773.7
53	161	6.2	0.0	559.0	0.0	751.3	0.0
54	306	4.5	0.0	102.9	0.0	138.4	0.0
55	312	2.6	0.0	136.2	0.0	183.1	0.0

[a]Loss calculated by farmer's estimation of 9.6 kg Gur (raw sugar product from sugarcane juice) per 100 kg sugarcane at 14 Taka/kg Gur. 100 kg cane = 56 kg juice = 9.6 kg "Gur".

Table 2. Ratoon sugarcane stalk damage (%) and losses (kg/ha and Taka/ha) due to rat and jackal, Sripur, Bangladesh, 1991.

Block	Harvested areas (m^2)	% Stalk damage		Weight loss (kg/ha)		Taka/ha loss[a]	
		Rat	Jackal	Rat	Jackal	Rat	Jackal
11	453	0.0	0.0	0.0	0.0	0.0	0.0
13	206	2.6	0.0	308.3	0.0	414.3	0.0
14	214	0.4	0.0	25.5	0.0	34.3	0.0
23	442	3.0	0.0	68.8	0.0	92.4	0.0
24	435	7.6	0.0	579.3	0.0	778.6	0.0
32	341	1.5	0.2	56.0	34.6	75.3	46.5
33	200	0.5	0.0	51.0	0.0	68.5	0.0
34	103	3.5	0.3	173.8	68.0	233.6	91.3
42	643	0.0	0.4	0.0	9.8	0.0	13.2
43	453	0.0	0.0	0.0	0.0	0.0	0.0
44	100	0.0	0.0	0.0	0.0	0.0	0.0
45	813	0.0	0.0	0.0	0.0	0.0	0.0
52	372	0.0	0.0	0.0	0.0	0.0	0.0
53	761	13.5	0.0	229.3	0.0	308.2	0.0
55	271	3.1	0.0	230.6	0.0	310.0	0.0

[a]Loss calculated by farmer's estimation of 9.6 kg Gur (raw sugar product from sugarcane juice) per 100 kg sugarcane at 14 Taka/kg Gur. 100 kg cane = 56 kg juice = 9.6 kg "Gur".

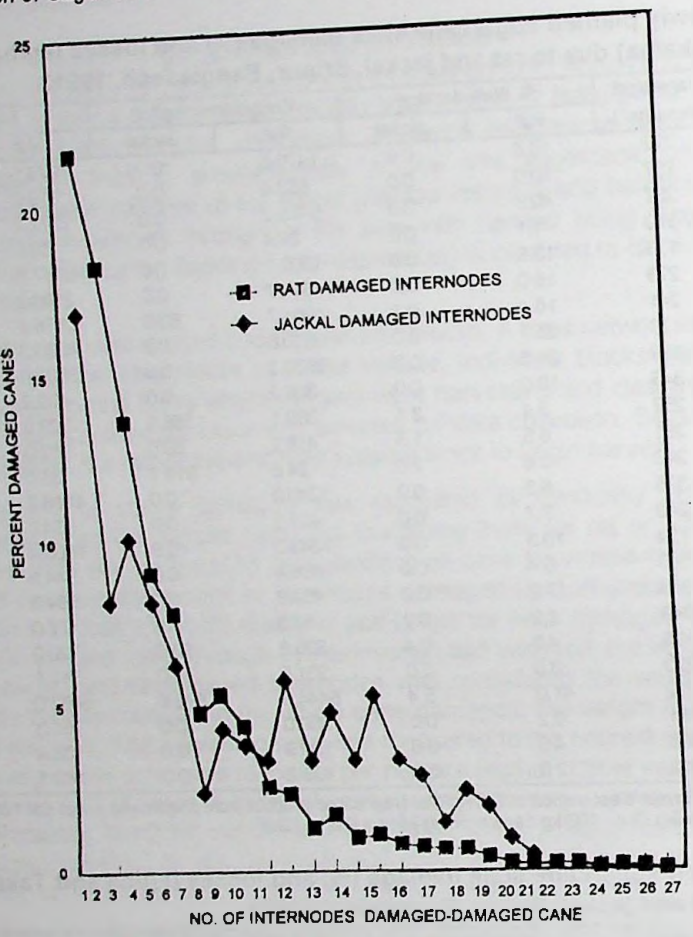

Figure 1. Number and percent distribution of damage grades in rat and jackal damaged of sugarcane stalk.

Rat caused more damage in kg/ha weight loss than that of jackal (t = 4.957, df = 48, P < 0.001). Weight loss of rat-damaged stalks (n = 3834) varied from 24.6 to 6444.9 kg/ha (Mean = 1287.7, SD = 1662.6); mean economic value lost to rat damage was Taka 1730/ha (SD = 2234.5) (Table 1). Weight loss of stalks damaged by jackal (n = 207) varied from 0.0 to 916.67 kg/ha (Mean = 99.7, SD = 252.6); mean economic value lost to jackal damage was Taka 134/ha (SD = 339.5) (Table 1). The economic loss calculated by farmer's estimation of 100 kg cane produce 56 kg of juice, after bowing produce 9.6 kg "Gur" and price of per kg Gur was Tk. 14.00 (M.E. Haque, personal communication with farmers).

Rat damage to single sugarcane internodes occurred most frequently (21.7%) (Figure 1). Damage to multiple internodes per cane dropped sharply with approximately 70% of the damaged canes having five of fewer internodes damaged. A similar trend was observed for jackal damage where canes with single internode were damaged comprising 16.4% of the canes sampled (Figure 1). Damage to five or fewer internodes

totaled approximately 50% of damaged cane indicating jackal tended to damage more internodes per cane than rat.

No differences were found in rat damage for the model containing variety of sugarcane, proximity to houses, or whether cane was erect or bent ($F = 1.39$; df = 6,34; $P = 0.248$). Differences did exist when 4 planted varieties were pooled and compared to the retoon sugarcane ($F = 4.02$; df = 2,38; $P = 0.026$). The Bonferroni comparison showed mean rat damage for ratoon sugarcane ($\bar{x} = 182.5$ kg/ha, SD=365.0) differed significantly ($P < 0.05$) from planted varieties ($\bar{x} = 1287.7$ kg/ha, SD = 1662.6). Damage to bent cane ($\bar{x} = 1117.0$ kg/ha, SD = 1568.0) was greater than to erect cane ($\bar{x} = 145.8$ kg/ha, SD = 369.3).

No difference were found in jackal damage for the model containing variety of sugarcane, proximity to houses, or whether the cane was erect or bent ($F = 1.89$; df = 6,34; $P = 0.111$). Of individual variables, only variety of sugarcane ($F = 1.98$; df = 4,34; $P = 0.124$) may warrant further investigation. Pooling the 4 planted varieties (Misrimala, Fatatady, Isd 2/54 and Isd 16) and comparing them with the ratoon sugarcane yielded no difference ($F = 1.17$; df = 3,37; $P = 0.336$).

The percent rat and jackal damage to sugarcane stalks in the present study differs from that reported by Haque *et al.* (1985) at Sripur, where they found 24.4% of stalks were jackal-damaged and only 7.5% rat-damaged. Such differences of damage are not clear but may be related to differences in sampling techniques and seasonal variation in population of rat and jackal. Rat damage occurred in all fields but was clumped in nature. More samples per field and multiple fields sampled per block may be required to determine the true nature and distribution of damage. Alternatively, rat populations may be increasing with increasing sugarcane plantation areas and little effort directed at rodent control, while jackal populations are decreasing due to increasing human habitation and destruction of Gazari forest, jungle and bamboo thickets (R.K. Pandit, personal observation).

The 11.7% rat damage to sugarcane stalks in the present study is within the range of 10-30% reported by Hampson (1984). Percent sugarcane weight loss to rats in India has varied from 8-10% (Butani, 1965), to 19.2% (Gupta *et al.*, 1968), upwards to 25-75% (Patel and Arakeri, 1957; Bindra and Sagar, 1968).

That jackal damaged more internodes per cane than rat is probably academic when the nature of the damage is considered. Rat chew up sugarcane stalks between the nodes giving it boat shaped area. Usually the basal 1-5 internodes were attacked on upright stalks, but on lodged stalks the number of damaged internodes was often higher. Rat damaged stalks were rarely dried up which on crushing may produced some sugar. Jackal damage to sugarcane stalks is much more severe, in that they crush internodal portions with their jaws to obtain juice. This action invariably destroyed the stalk, hence it made little difference whether single or multiple internodes were damaged.

Based upon our sampling and sample sizes, we could detect no difference in rat or jackal damage with respect to newly planted sugarcane varieties or proximity to houses. Differences were found in the amount of rat damage to the newly planted sugarcane stalks versus those of ratoon stalks. This may be due to a softer rind and more sweeter of the newly sugarcane, although Poche *et al.* (1987) found no difference in the amount of jackal damage based upon rind hardness or sugar content. Bent stalks also received more rat damage than erect stalks. Higher losses of sugarcane from lodged crops have

also been reported from Australia (Hitchcock and Kerkwyk, 1975), India (Kahn, 1977), and Hawaii (Doty, 1945).

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