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Bangladesh J. Agri. 1986, 11 (2) : 63-69

EFFECT OF SIMULATED RAT DAMAGE ON DEEP WATER RICE IN BANGLADESH

Md. Emdadul Haque, Md. Sayed Ahmed* and Joe E. Brooks

Vertibrate Pest Section, Bangladesh Agricultural Research Institute, Gazipur, Bangladesh

Abstract

The effect of rat damage in deepwater rice in respect of plant response and yield reduction was assessed by mechanically cutting the stems to simulate rat damage. Stems were cut at 3 intensities: 0, 5, 10, 20 and 40% tillers at each growth stage of basal tillering, full elongation and flowering. The study was conducted in farmer's field in a typical deepwater rice environment. Significant yield reductions were obtained at all intensities of damage levels (5 to 40% tiller damage) in comparison to the control (0% damage). Yield losses were significantly higher from stem damages at full elongation and flowering stages than at basal tillering stage. The yield reductions for different damage levels ranged from 6.3 to 58.7% at different growth stages. Plants subjected to damage at full elongation and flowering stages could not compensate the yield losses. Plants cut at elongation stage produced 12.5% compensatory panicles bearings about 65 grains per panicle, about 38% of which was unfilled. One hundred percent of the plants, cut at flowering stage, produced panicles, but all of them were very short (11.5 cm) and unfilled.

Introduction

In Bangladesh deepwater rice is grown on about 1.6 million hectares (Anon., 1983). This is the only cereal crop which can be cultivated during the flood season in low lying areas. Rats cause unpredictable yield losses in deepwater rice (DWR). The greater bandicoot rat, *Bandicoota indica* and the lesser bandicoot rat, *B. bengalensis* are the main species (Ahmed, *et al.* 1984). They cause damage from the basal stage untill harvest. During basal tillering before flood, rats cut the young tillers from the base. In elongation stage, when the flood water near its peak, rats attack the top shoots of the rice plants, next to the node above water level. At harvest rats cut the ripened panicles, eat the grain and also store the cut panicles in their burrows.

*Entomology Division, Bangladesh Rice Research Institute, Gazipur, Bangladesh

In a trial in 1982 rats were found to hoard 57 Kg of rice per hectare in deepwater rice field (Ahmed *et al.* 1983). Investigator (Posamentier, 1981; Catling and Yasin, 1981) found considerable variations in tiller damage by rats (0-14%) in DWR fields. Plant damage varies between fields, seasons and crop stages. In some fields the magnitude of tiller damage was as high as 75%.

Several studies (Poche *et al.*, 1981; Akhter and Fulk, 1978; Guerrero, 1970) were conducted to determine the effect of various simulated damage levels on the yield of upland rice, but no information was available on deepwater rice under actual field situations, perhaps because simulated damage in deepwater rice is difficult to conduct and cannot usually be determined on experiment station plots. The effects of various levels of rat damage on deepwater rice yield and other plant characteristics was examined by mechanically cutting stems under farmers field conditions. The objectives were to determine the effect of stem cutting on yield and different plant responses when performed at various growth stages and at different damage intensities. Such information will be useful in developing damage assessment methods and in planning for field rodent control operations.

Materials and Methods

The study was conducted in farmer's field of Gazaria Upazilla under Dhaka district. The field hired, for the study was of clay loam soil. "Khika bazal", a most common local variety was used. The rice was seeded on April, 1 1983 and harvested on November, 22 1983. Seed rate was 100 Kg/ha. Normal cultural practices were done. Hand weeding was done before flood inundation. To curtail possible rat damage during the experiment, zinc phosphide baits were applied regularly in floating bait-holding stations. Sevin (0.075%) was also applied at mature stage to prevent damage from the rice ear-cutting caterpillar, (*Mythimna seperata*).

Effect on yield: Sixty sub-plots each measuring 2 sq.m (1×2m) and seperated by one meter from each other, were delineated in a randomized complete block design (factorial) with 4-replications. Mechanical cutting of stems (Fig. 1) with scissors to simulate rat damage was done in 5 intensities of 0 (control), 5,10, 20 and 40% of all stems in each sub-plot at each of the three growth stages of basal tillering (pre-flood) full elongation (peak flood) and flowering (flood receding). Within each sub-plot the total number of stems were counted and the appropriate percentage of tillers was cut with scissors. At harvest, the filled ripened panicles of individual sub-plots were collected and counted individually. The panicles were threshed, air dried, weighed to the nearest 0.1 gm, and the moisture content obtained.

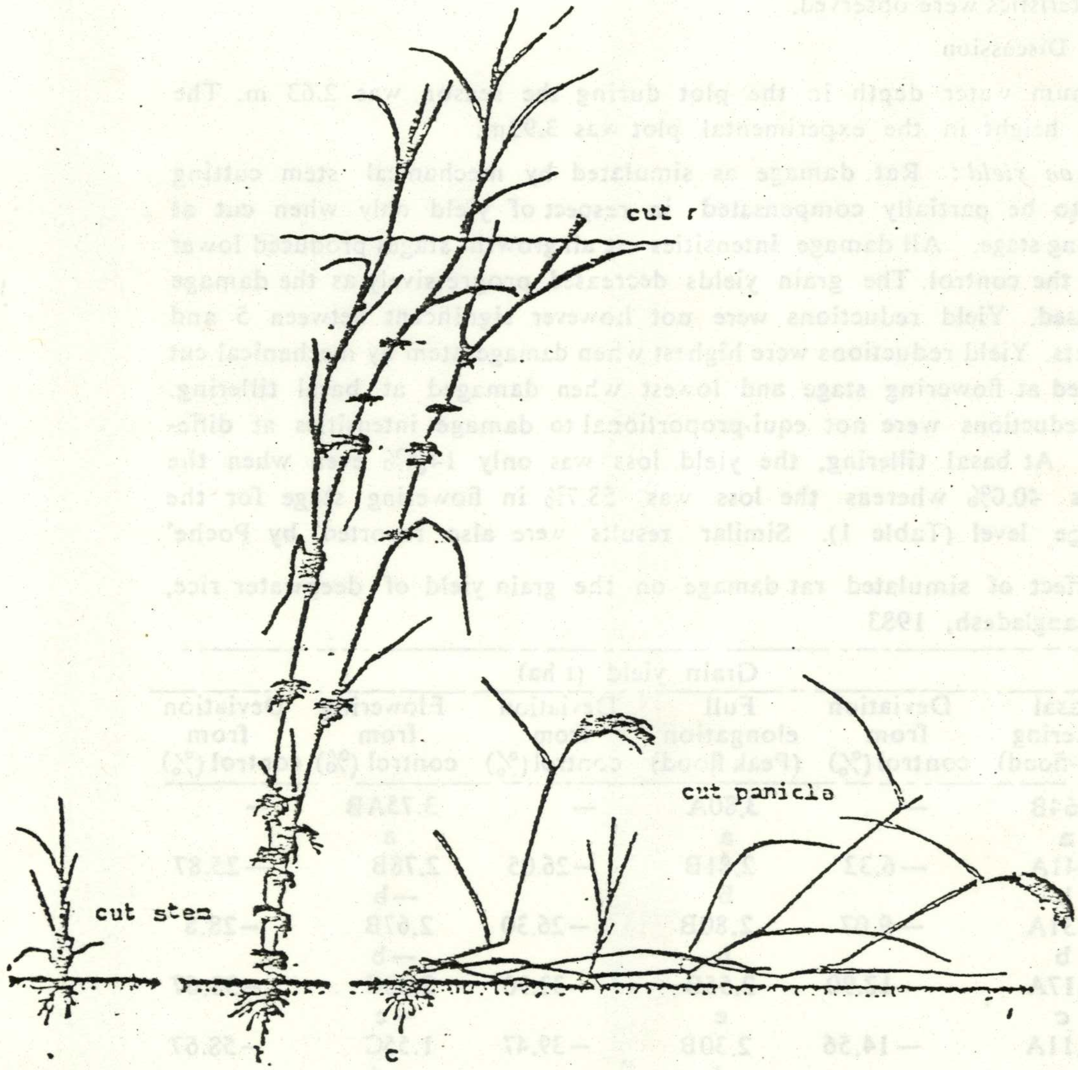

Fig. 1. Mechanical cutting of stems at a. basal tillering (preflood), b. full elongation (peak flood) and c. flowering (flood receding) stages

Effect on plant response : To determine the effect of simulated damage on plant response, seperate observations were taken from the border plots of the same field. Seventy two stems (36 in full elongation and 36 at flowering stage) were tagged and numbered. Mechanical cut was done by scissors at full elongation (18 stems) and flowering stages (18 stems). The rest of the stems were kept as reference. At harvest, the tagged stems were collected and various plant characteristics were observed.

Results and Discussion

Maximum water depth in the plot during the season was 2.63 m. The mean plant height in the experimental plot was 3.92m.

Effect on yield: Rat damage as simulated by mechanical stem cutting was found to be partially compensated in respect of yield only when cut at basal tillering stage. All damage intensities at all growth stages produced lower yields than the control. The grain yields decreased progressively as the damage levels increased. Yield reductions were not however significant between 5 and 10% stem cuts. Yield reductions were highest when damage stem by mechanical cut was performed at flowering stage and lowest when damaged at basal tillering. The yield reductions were not equi-proportional to damage intensities at different stages. At basal tillering, the yield loss was only 14.6% even when the damage was 40.0% whereas the loss was 58.7% in flowering stage for the same damage level (Table 1). Similar results were also reported by Poche'

Table 1. Effect of simulated rat damage on the grain yield of deepwater rice, [1]Gazaria, Bangladesh, 1983

Damage level (%)	Grain yield (t ha)					
	Basal tillering (Pre-flood)	Deviation from control (%)	Full elongation (Peak flood)	Deviation from control (%)	Flowering from control (%)	Deviation from control (%)
0	3.64B a	—	3.80A a	—	3.75AB a	—
5	3.41A b	−6.32	2.81B b	−26.05	2.78B —b	−25.87
10	3.31A b	−9.07	2.80B b	−26.30	2.67B —b	−28.8
20	3.17A c	−12.90	2.55B c	−32.90	2.30C —c	−38.67
40	3.11A c	−14.56	2.30B d	−39.47	1.55C —d	−58.67

[1] Variety: Khilka bazal, Date of seeding: April 1, 1983, Date of harvest: November 22, 1983, Seed rate: 100 Kg/ha.

Dates of simulated damage done: Basal tillering-May 30, 1983; Full elongation-August 29, 1983 and flowering-October 17, 1983.

* Capital letter denotes comparison within each treatment and small letter denotes comparison within each stage.

et al. (1981) when they performed mechanical damage in Aus rice in Bangladesh. The yield loss due to stem damage were 3-4 times higher at elongation and flowering stages than when damaged at basal tillering stage. Even at the 5% damage level at both elongation and flowering stages, the yield loss decreased by an average of 26% compared to only 6% at basal tillering and this loss was statistically significant from the control.

At maturity, there was less chance for rice to recover from the damage. Results of this study indicated that rat damage at the basal tillering stage may stimulate tiller growth and partially compensate in yield. The present study also showed that the actual percentage of stems cut at full elongation and flowering stage may under estimate the yield loss as the situation will probably vary seasonally with respect to the fluctuation of floods.

In general the trends of different levels of stem cutting at various growth stages showed that the later the damage occurred, the greater was the rice yield loss (Fig. 2).

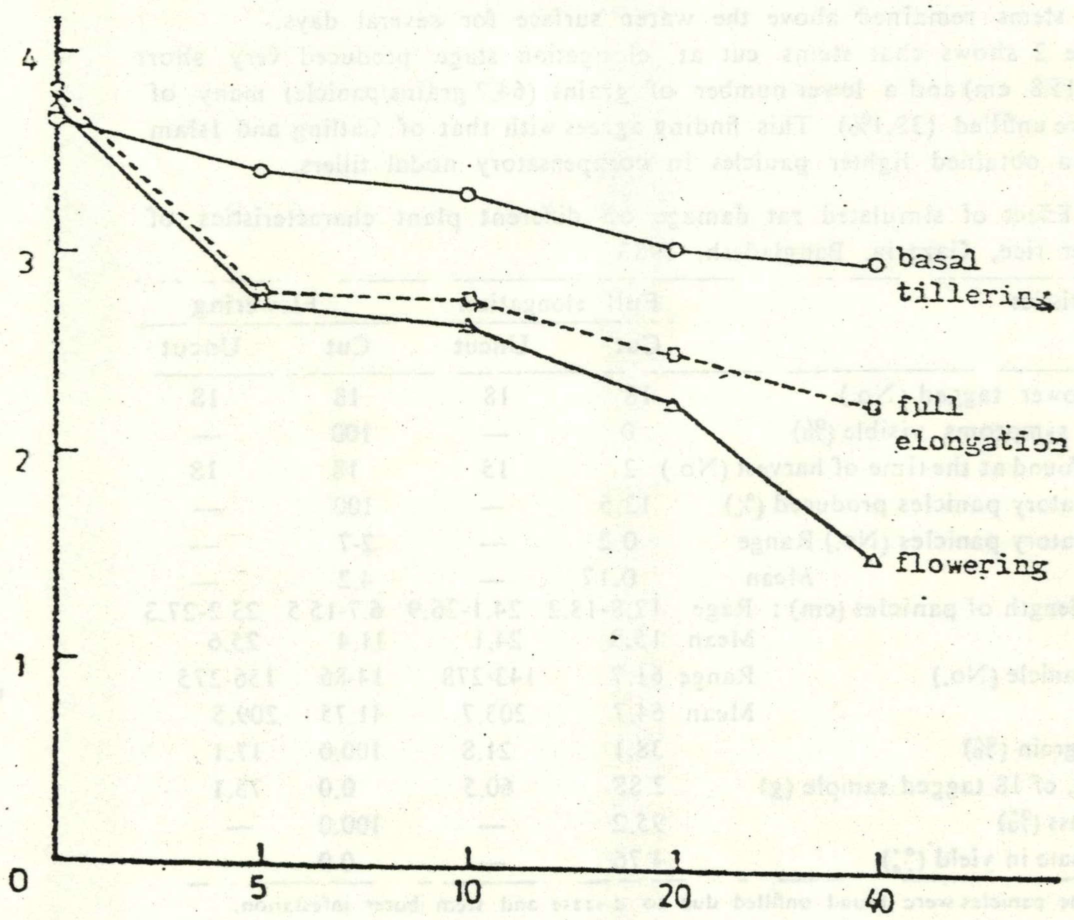

Fig. 2. Yield reduction due to simulated rat damage in deepwater rice in Bangladesh, 1983

Effect on plant response : The results of the effect of simulated rat damage on plant response were quite interesting. Eighteen stems were cut and tagged in the elongation stage, but the cut symptoms were not visible when checked at harvest. The cut stems rotted due to long submergence under flood water. The damage symptoms were however visible at harvest when the mechanical cut was performed at flowering.

Only 12.5% of stems cut at elongation stage produced compensatory panicles (Table 2). However this finding disagrees with that of Poche *et al* (1980). They found 50% of the cut stems, cut at main elongation phase, produced new tillers. The production of compensatory nodal tillers mainly varies with the fluctuation of flood water. If the flood water rise immediately after the damage occurs the cut stems could not produce any nodal tillers due to submergence water; but the cut stems could produce nodal tillers when the stems remained above the water surface for several days.

Table 2 shows that stems cut at elongation stage produced very short panicles (15.8 cm) and a lower number of grains (64.7 grains/panicle) many of which were unfilled (38.1%). This finding agrees with that of Catling and Islam (1979) who obtained lighter panicles in compensatory nodal tillers.

Table 2. Effect of simulated rat damage on different plant characteristics of deep water rice, Gazaria, Bangladesh, 1983

Characteristics		Full elongation		Flowering	
		Cut	Uncut	Cut	Uncut
Stems/Flower tagged (No.)		18	18	18	18
Damage symptoms visible (%)		0	—	100	—
Panicles found at the time of harvest (No.)		2	15	18	18
Compensatory panicles produced (%)		12.5	—	100	—
Compensatory panicles (No.)	Range	0.2	—	2-7	—
	Mean	0.17	—	4.2	—
Average length of panicles (cm) :	Rage	12.8-18.2	24.1-26.9	6.7-15 5	23 2-27.3
	Mean	15.8	24.1	11.4	25.6
Grains/panicle (No.)	Range	61.7	143-278	14-86	156-275
	Mean	64.7	203.7	41.75	209.5
Unfilled grain (%)		38.1	21.8	100.0	17.1
Grain wt. of 18 tagged sample (g)		2.88	60.5	0.0	75.1
Actual loss (%)		95.2	—	100.0	—
Compensate in yield (%)		4.76	—	0.0	—

Rest of the panicles were found unfilled due to disease and stem borer infestation.

Similarly, the 18 stems (panicles) cut and tagged at flowering stage were indentified by cut symptoms at harvest (Table 2). The damaged stems bore 2-7 (mean 4.2) compensatory panicles; but the panicle size was also very short (11.4cm), less than half of the panicle size of the uncut stems (25.6 cm). All compensatory panicles produced unfilled grains. This happened because the nodal compensatory tillers flowered later than the normal stems. If the harvest could be delayed for some days these panicles could probably fill and minimize the loss to some extent. Delaying of harvest could be beneficial where most of the plants were damaged, thus allowing the compensatory panicles to fill with grains.

These findings suggested that the yield loss from rat damage at flowering stage could not be compensated, whereas the damage caused at full elongation stage may be compensated by 4.7% by producing compensatory nodal tillers by the damaged stems. This finding may however vary with varieties, flood situations and seasons.

Acknowledgement

This study was financially supported by BARI and the U.S. Agency for International Development under the project "Agricultural Research, Vertebrate Pest Component, PASA 1BD-0051-1F-2252-03".

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