ESTIMATION OF YIELD LOSSES IN RICE DUE TO RODENT DAMAGE THROUGH SIMULATION

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Abstract: The rodent damage through simulation (1-16%) at active tillering and panicle initiation stages inflicted significant reduction in the grain yield. A progressive increase in yield loss was observed as the per cent tiller damage increases and also with the progress in age of the crop. Significant yield reduction in grain yield was observed at and after 1.0% tiller damage at active tillering stage in all the seasons except in *Kharif,* 2003. The calculated mean yield loss at 1.0% yield reduction in kg/ha was 45-46.

Key Words: Rice, simulated rodent damage, grain yield loss.

Introduction: Rodents may significantly affect crop production and livelihoods of farmers in both developed and developing countries. In India, rodents are considered to be serious impediment to rice crop irrespective of the rice production system (Parshad, 1999). Pre- harvest yield loss of rice was estimated as 5-15% (Rao, 2003). Hart (2001) reported that the overall losses of grain to rodents in India were approximately 25% in the field before harvest and 25-30% post harvest.

The predominant rodent species damaging rice crop in Andhra Pradesh is lesser bandicoot rat, *Bandicota bengalensis*. The rice crop is vulnerable to rodent attack right from nursery to harvest. The intensity or extent of damage depends upon the infestation levels and stage of the crop. The damage is frequently severe at booting stage rather then tillering stage. The damage caused at tillering stage is compensated considerably by the crop but it is not after the booting stage results in total yield loss (Ranga Reddy, 1989). Islam and Hossain (2003) reported that rice plants suffered yield losses proportional to the loss of panicles or panicle bearing tillers as a result of rodent damage at reproductive stage. But the association between crop damage and yield loss is unclear and needs to be determined. Hence, the present study was conducted to estimate the yield loss through different levels of simulated tiller damage.

Materials And Methods: To understand the relationship between rodent damage and yield loss, a field trial in Randomized Block Design was laid out at Agricultural Research Station, Maruteru with varieties Swarna (MTU 7029) in *Kharif* and Prabhat (MTU 3626) in *Rabi*. The experiment was carried out for two consecutive years (*Kharif* 2002, 2003 and *Rabi* 2002-03 and 2003-04) with eleven treatments and each replicated thrice. The treatments include 1, 2, 4, 8 and 16% levels of simulated tiller damage and a control without simulation. The simulations were made at two different stages i.e. 30 and 60 days after transplanting (DAT) in *Kharif* and at 25 and 50 DAT in *Rabi* seasons (i.e. active tillering and panicle initiation stages). Thirty days old seedlings during *Kharif* and twenty one days old seedlings in *Rabi* were transplanted with a spacing of 20 x 15 cm and 15 x 15 cm in *Kharif* and *Rabi* respectively. The crop was raised by adopting all the agronomic practices recommended for the area. All the treatments were protected from the other insect pests and diseases. The entire experiment was also protected from natural rodent attack by erecting a polythene barrier throughout the crop growth period. The rodent damage was simulated by cutting the tillers with a sickle, 5-10 cm above the ground level. The grain yield from each net plot was recorded by leaving the two border rows and expressed as kg/plot. The data was subjected to statistical analysis. The % yield reduction over control and yield loss in kg/ha were computed by using the following formulas:

$$\%\ \text{Yield reduction over control} = \frac{\text{Yield in treatment} - \text{Yield in control}}{\text{Yield in control}} \times 100$$

$$\text{Yield loss in } \frac{\text{kg}}{\text{ha}} = \text{Yield in } \frac{\text{kg}}{\text{ha}} \times \frac{\%\text{Yield loss}}{100}$$

Results And Discussion: The results indicated that there was significant reduction in grain yield at different levels of simulated tiller damage at both the stages of the crop, during both the seasons (*Kharif* and *Rabi*) in both the years (Tables 1 and 2).

***Kharif*:** During *Kharif* 2002, significant yield reduction was observed from 2.0% simulated tiller damage at 30 DAT (T2) onwards. Control plot without simulation (T11) recorded significantly highest grain yield and it was followed by 1.0% simulated tiller damage at 30 DAT (T1). The lowest grain yield was observed at 16.0% simulated tiller damage made at 60 DAT. The per cent yield reduction over control at different levels of simulated tiller damage was ranged from 2.58 to 28.41%.

During *Kharif* 2003, significant yield reduction was observed at 8.0% simulated tiller damage at 60 DAT (T9) (Table 1). The per cent yield reduction over control at different levels of simulated

tiller damage in *Kharif* 2003 was low when compared to *Kharif* 2002. It was ranged from 0.95 to 24.29%. This might be because of lower incidence of other insect pests and diseases. The observed yield loss in kg/ha at different levels of simulated tiller damage was ranged from 141.50 to 1145.00 in *Kharif* 2002 and it was from 49.83 to 1019.75 kg/ha in *Kharif* 2003. Ranga Reddy (1994) reported 2.68 to 100 per cent tiller damage due to rodents in Godavari delta and the resultant yield loss was 60-2345 kg/ha.

Rabi: In *Rabi* also simulated tiller damage at different levels significantly reduced the grain yield. During *Rabi* 2002-03, a significant yield reduction was observed at 1.0% simulated tiller damage at 25 DAT (T1). Whereas, during *Rabi* 2003-04 it was observed at 2.0% simulated tiller damage at 25 DAT (T2). The per cent yield reduction over control was ranged from 7.47 to 36.04% in *Rabi* 2002-03 and it was 3.47 to 33.96% in *Rabi* 2003-04. The observed yield loss in kg/ha at different levels of simulated tiller damage was ranged from 418.87 to 1398.27 in *Rabi* 2002-03 and it was from 183.47 to 1228.43 kg/ha in *Rabi* 2003-04.

In all the seasons, a progressive increase in yield loss was observed with the per cent increase in simulated tiller damage and also with the age of the crop. Ranga Reddy (1989) also reported similar results that removal of shoots and damage to the plants at active tillering stage was compensated better than at panicle initiation and flowering stages. A significant yield reduction was observed at and after 1.0% tiller damage during active tillering stage in all the seasons except in *Kharif*, 2003. This was not in agreement with the findings of Kishore and Rao (2011), who reported 4.0% tiller damage at active tillering stage, was the threshold level for rodents in paddy for both the seasons. In the present study, the mean yield loss in kg/ha at 1.0% yield reduction was 45-46 kg. This was in agreement with the findings of Singleton *et al.* (2005), reported that for every 1.0% increase in tiller damage by rats there was a decrease of 58 kg/ha in rice yield.

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Table 1. Grain yield at different levels of simulated rodent damage in rice during *Kharif* 2002 and 2003

Simulated tiller damage levels	Grain yield (Kg/net plot*)		% yield reduction over control		Yield loss in Kg/ha	
	Kharif 2002	*Kharif* 2003	*Kharif* 2002	*Kharif* 2003	*Kharif* 2002	*Kharif* 2003
T1-1.0%	17.375[a]	16.617[ab]	2.58	0.95	141.50	49.8
T2-2.0%	16.437[b]	17.040[ab]	7.84	2.99	406.77	160.82
T3-4.0%	16.244[b]	17.317[ab]	8.92	1.41	457.37	77.07
T4-8.0%	15.854[b]	16.377[ab]	11.11	6.77	555.99	350.00
T5-16.0%	15.086[c]	16.433[ab]	15.42	6.45	734.30	334.60
T6-1.0%	15.273[c]	15.017[abc]	14.37	14.51	692.78	684.80
T7-2.0%	14.348[d]	15.800[abc]	19.55	10.05	885.43	501.23
T8-4.0%	14.079[d]	14.950[abc]	21.06	14.89	935.93	702.67
T9-8.0%	13.839[e]	14.517[bc]	22.41	17.36	978.95	795.50
T10-16.0%	12.768[f]	13.300[bc]	28.41	24.29	1145.00	1019.75
T11-Control (without simulation)	17.836[a]	17.567[a]	-	-	-	-
F test	Sig	Sig				
CD (0.05)	0.690	2.90				
CV (%)	2.64	9.1				

Net plot size= 31.68 m^2; Means followed by a common letter were not significantly different by (P=0.05) DMRT

Table 2. Grain yield at different levels of simulated rodent damage in rice during *Rabi* 2002-03 and 2003-04

Simulated tiller damage levels	Grain yield (Kg/net plot*)		% yield reduction over control		Yield loss in Kg/ha	
	Rabi 2002-03	*Rabi* 2003-04	*Rabi* 2002-03	*Rabi* 2003-04	*Rabi* 2002-03	*Rabi* 2003-04
T1-1.0%	19.867[b]	18.733[a]	7.47	3.47	418.87	183.47
T2-2.0%	19.543[bc]	17.857[b]	9.07	7.98	500.29	402.20
T3-4.0%	18.597[c]	17.313[b]	13.47	10.78	707.03	526.77
T4-8.0%	17.740[cd]	16.600[c]	17.46	14.46	874.00	677.49
T5-16.0%	17.543[d]	16.600[c]	18.38	14.46	910.00	677.49
T6-1.0%	16.643[de]	15.583[de]	22.56	19.70	1059.74	866.45
T7-2.0%	16.460[e]	15.883[d]	23.42	18.15	1088.04	813.65
T8-4.0%	15.820[e]	15.083[ef]	26.39	22.28	1178.35	948.48
T9-8.0%	15.881[e]	14.433[f]	26.11	25.63	1170.34	1044.08
T10-16.0%	13.746[f]	12.816[g]	36.04	33.96	1398.27	1228.43
T11-Control (without simulation)	21.493[a]	19.406[a]	-	-	-	-
F test	Sig	Sig				
CD (0.05)	0.964	0.686				
CV (%)	3.22	2.5				

Net plot size= 35.43 m^2; Means followed by a common letter were not significantly different by (P=0.05) DMRT

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