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Assessment of Damage due to Larger Grain Borer (*Prostephanus truncatus* Horn) on Stored Paddy Rice (*Oryza sativa* L. Poaceae)

[1]L.S. Mulungu, [2]M.R. Jilala, [3]M.W. Mwatawala and [4]J.K. Mwalilino
[1]Pest Management Centre, Sokoine University of Agriculture, Box 3110, Morogoro, Tanzania
[2]District of Agriculture Department, Ministry of Agriculture and Food Security, Box 83, Geita, Mwanza, Tanzania
[3]Department of Crop Science and Production, Sokoine University of Agriculture, Box 3005, Morogoro, Tanzania
[4]Department of Physical Science, Sokoine University of Agriculture, P.O. Box 3038, Morogoro, Tanzania

Corresponding Author: L.S. Mulungu, Pest Management Centre, Sokoine University of Agriculture, Box 3110, Morogoro, Tanzania Tel: +255 23 2604621 Fax: +255 23 2601485

ABSTRACT

The aim of this Study was to determine the effect of Larger Grain Borer (*Prostephanus truncatus* Horn) on stored paddy rice. The study was conducted at Sokoine University of Agriculture, Department of Crop Science and Production Laboratory from November, 2005 to March, 2006. Rice varieties TXD 85, TXD 88, TXD 220 and TXD 306 were used. The experimental design was Complete Randomized Design (CRD) with four replications. Ten live *P. truncatus* were introduced into bottles containing 3000 seeds of paddy rice and allowed to feed. Data collected were number of live insects, damaged and undamaged seeds, percentage damage, weight loss and germination rates of infested seeds. Results showed that there was a significant ($p \leq 0.05$) difference in number of live *P. truncatus* among paddy rice varieties at the end of storage time. Varieties TXD 85 and TXD 88 had fewer live *P. truncatus* than TXD 220 and TXD 306. However, results show that rice varieties did not differ significantly ($p \geq 0.05$) weight loss. Significant ($p \leq 0.05$) effect of *P. truncatus* on percentage germination rate of paddy rice seeds was observed. The infested paddy rice seeds showed low germination rates compared to uninfested seeds. Infested variety of TXD 306 had relatively lowest germination rate compared to other infested varieties indicating relatively resistant to a pest.

Key words: Feed, germination, insects, seeds, varieties

INTRODUCTION

Rice, *Oryza sativa* L. (Poaceae) is a widely grown cereal crop in the world. It is a primary staple food for more than two billion people in Asia and for over seven hundred million people in Africa and Latin America (Swaminathan, 1984; IRRI, 1985). Among the major food crops, it is the only one that is almost exclusively a human food and constitutes half of the diet (Swaminathan, 1984). Rice provides about 80% of the calories for one third of the caloric intake of one billion people (Chang, 1984). In Tanzania, the production of rice has been increasing from 868,000 metric tonnes in 2001 to 1,240,000 metric tonnes in 2007. This corresponds to an increase in harvested area from 401,070 to 665,000 ha. Total cereal production in 2004 stood about 5 million tonnes,

which is about 0.22% of the world production. Rice is consumed by the majority of Tanzanians especially the urban dwellers and it is the second most consumed staple food after maize (*Zea mays* L.).

Despite its importance, the rice industry faces many constraints including those storage pests. Crop grain production and consumption often falls below demand as a result of post harvest losses due to pests. The storage pests can cause losses to paddy either directly through consuming of the crop grain or indirectly by creating favourable environment for the establishment of other pests (Chowdhury and Pathak, 1990). These direct and indirect effects of storage pests could make the rice seeds unfit for feeding and planting (Rahman *et al*., 2003; Isman, 2006). Among the pests encountered in stored paddy rice worldwide is Rice Weevil *Sitophilus oryzae* (Linnaeus) (Coleoptera: Curculionidae). However, *Prostephanus truncatus* Horn (Coleoptera: Bostrichidae) has been recently reported to attack stored paddy rice in Tanzania. The pest is known to attack stored maize resulting into high losses (Panthenius, 1988; Schmutterer, 1990; Hodges, 1994; Farrell *et al*., 1996; Borgemesiter *et al*., 2003; Isman, 2006). The insect attacks cassava (*Manihot esculenta* Crantz) (Markham *et al*., 1991; Espinal *et al*., 1996) and forest trees (Nangayo *et al*., 1993; 2002; Borgemesiter *et al*., 1998). It was first introduced to Tanzania in early eighties from Central America (Dustan and Magazini, 1981) and later spread to many parts of Africa posing a threat of food security to rural populations (Nangayo *et al*., 2002). Its introduction in Tanzania elevated maize losses in store to 50% (Golob, 1984) from the previous average of 5% (Golob and Hodges, 1982). Nangayo *et al*. (2002) estimated losses in stored paddy rice caused by *S. oryzae* to be 10-30%. At present, there are no estimated losses caused by *P. truncatus* in rice. Further more, little is known about the effect of *P. truncatus* on the germination of the infested paddy rice. The objective of this study, therefore, was to evaluate the losses caused by *P. truncatus* on different stored paddy varieties and consequently on germination rate.

MATERIALS AND METHODS

Description of the study area and season: The experiment was conducted at the Sokoine University of Agriculture (SUA), Department of Crop Science and Production Laboratory, Morogoro, Tanzania (06°50 = S, 37°38 = E and 525 m a.s.l.), from November, 2005 to March, 2006.

Paddy rice seeds: Cleaned, well-sieved paddy rice seeds of four varieties viz: TXD 85, TXD 88, TXD 220 and TXD 306, were used. These improved paddy rice varieties (Luzi-Kihupi *et al*., 1998) were bought at farm gates in Morogoro region (Mkindo area, Mvomero district - 06°14 = S, 37°33 = E, 380 m a.s.l.). These seeds were adequately dried up to 12% moisture content. The paddy seeds used had not previously treated with any chemical. The seeds were then graded manually by removing all seeds infested by any storage pest. The undamaged grains of each variety were placed in a refrigerator at -20°C for two weeks so as to sterilize the seeds.

Larger grain borer: Adults *Prostephanus truncatus* were collected from the infested maize crop seeds and then raised in the 1 L jars containing maize grains in order to get enough number of the insects at 28-29°C and 65-70% relative humidity (Farrell, 2000).

Experiment 1: Evaluation of effect of *P. truncatus*

Experimental layout: Studies were conducted in a Completely Randomized Design (CRD) with four replications. A total of sixteen bottles with 100 g (~ 3000 seeds) of paddy rice varieties were laid out. Ten adult *P. truncatus* insects were transferred to each bottle. The bottles were covered with perforated lid to protect the seeds from attacks by other insects.

Data collection: Data collected included; number of live insects, number of damaged and undamaged grains, percentage damaged grains and weight losses.

Experiment 2: Germination rate: After ten weeks, the bottles from experiment 1 were opened and tested for germination rate. The control treatment (undamaged seeds) was added for comparison. Seeds were soaked in water overnight. Water was drained and paddy rice grains were spread on moist sisal sack and covered also with moist sisal sack. The grains were left for 7 days. The sisal sack was kept constantly moist by sprinkling some water. Germinated seeds were counted in each treatment and germination percentages were calculated and compared to those in control.

Data analysis: The collected data were subjected to Analysis of Variance (ANOVA) (SAS, 1990) and the comparisons of significant differences of mean values were done through means separation test using $LSD_{0.05}$ test method.

RESULTS AND DISCUSSION

Results have shown the effect of *P. truncatus* feeding damage on stored paddy rice. These losses have been assessed in a number of ways (Parkin, 1956) including reduction in weight, number of damaged grains and number of live insects and have shown significant varietal effects for live *P. truncatus* ($F = 18.11$, $df = 3, 66$, $p \leq 0.05$) and on percentage damage ($F = 1.99$, $df = 3, 66$, $p \leq 0.05$). The number of live *P. truncatus* was higher in TXD 220 and TXD 306 varieties indicating that these paddy rice varieties favor the growth and development of *P. truncatus* than other varieties (Table 1). The reason could be two varieties have softer seed coats, a character which Pingale *et al.* (1957) indicated to be a reason for higher infestation of rice by the rice weevil. Similarly, the higher number of live *P. truncatus* in these paddy varieties resulted into relatively higher percentage damage and weight loss (Table 1). Resistance in paddy rice to storage insects has been attributed to various physio-chemical characteristics of rice seeds. The larval development of *T. castaneum* and *T. granarium*, for example, was inhibited by the tough siliceous hull of paddy. Cogburn (1974) reported that intact hulls of rough paddy rice totally excluded rice weevils from feeding or oviposition.

A significant effect of *P. truncatus* on germination rate for paddy rice seeds was observed ($F = 26.74$, $df = 4, 6$, $p \leq 0.05$). All infested paddy rice seeds showed low germination rates compared to uninfested (control) seeds (Table 2). In general, however, the germination rate of all rice varieties

Table 1: Effect of variety on variables investigated for effect of *P. truncatus* on stored paddy rice

	Variables		
Variety	No. of live insect	Percentage damage of paddy rice seeds	Weight loss (g) of paddy rice seeds
TXD 85	6.56	3.00	3.46
TXD 88	7.00	3.50	3.48
TXD 220	7.83	3.60	3.38
TXD 306	8.83	7.40	3.96
Mean	7.56	4.40	3.60
$LSD_{0.05}$	0.67	4.00	NS

NS: Not significant different

Table 2: Effect of variety on germination rates on stored paddy infested with *P. truncatus*

Treatments	Percentage damage of paddy rice seeds	Percentage germination
Control (Uninfested)	0.00	99.30
TXD 85	3.00	97.25
TXD 88	3.50	97.08
TXD 220	3.60	96.76
TXD 306	7.40	96.30
Mean	4.40	97.34
$LSD_{0.05}$	2.30	0.73

was higher indicating that the time for experiment was short for a pest influence. It can be noted here, however, that varieties with higher numbers of live insects had low germination rates (Table 2). The TXD 306 and TXD 220 had higher number of insects and lower germination rate as compared to control, TXD 85 and TXD 88, indicating that the level of damage to stored product (which in turn influences the germination of grain) is a function of insect number (Golob and Hodges, 1982) and time taken to store (Rahman *et al*., 2003).

The feeding damage of *P. truncatus* affects germination of paddy rice because the uninfested treatment showed higher germination rates as compared to the infested treatments. This study, therefore, revealed that the paddy rice varieties TXD 220 and TXD 306 are susceptible to *P. truncatus* than other varieties. Varieties TXD 85 and TXD 88 show some resistant characteristics due to high germination rates. The uninfested treatment showed higher germination rates as compared to the infested treatment. The attack on rice by *P. truncatus* could be due to various reasons. The most immediate one is that, the pest attacks rice when other preferable hosts such as maize and cassava are absent. A major host shift from cereals to legumes has been reported in the rice weevil population. According to Dent *et al*. (2003) some cereal feeding population of *S. oryzae* have extended the ranges of acceptable foodstuff because the cereal was absent or by choice. Such a situation can occur if the potential hosts are found in similar ecological settings, for example, when cereals are replaced by legumes (Dent *et al*., 2003).

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