# SCREENING OF RICE GENOTYPES FOR RESISTANCE TO STORAGE INSECTS

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## ABSTRACT

Eight rice genotypes were screened for resistance to lesser grain borer, *Rhyzopertha dominica* (F). and Angoumois grain moth, *Sitotroga cerealella* (Olivier) on free choice oviposition by the female insects and subsequent development under laboratory conditions (27 ± 2°C and 60 ± 5% RH). The resistance in paddy of genotypes was assessed on the basis of adult progeny developed and weight loss of infested samples. The results revealed that adult progeny of both insects species and weight loss of infested samples were significantly low in IR 6-25A followed by IR-6, Shadab, Sarshar and Shua-92.Whereas, significantly high number of adults developed in Basmati-2.0, Basmati 15-14 and Super Basmati with high weight loss of paddy samples. The correlation coefficient between adult progeny of *R. dominica* and paddy weight loss (r = 0.980) and moth progeny of *S.cerealella* and paddy weight loss (r = 0.990) were positive and highly significant. The paddy of resistant genotypes helps alleviate post-harvest storage losses and should be incorporated in breeding programme.

**Key Words:** Paddy, rice genotypes, resistance, lesser grain borer, Angoumois grain moth, adult progeny, grain weight loss.

## INTRODUCTION

Rice (*Oryza sativa L.*) is the second important cereal and cash crop of Pakistan. About one third of its production is exported annually while the rest is consumed in the country. After harvesting and processing, rice is stored as paddy and white or polished rice. A number of insects damage rice during storage among which Angoumois grain moth, *Sitotroga cerealella* (Olivier), lesser grain borer, *Rhyzopertha dominica* (F), rice weevil, *Sitophilus oryzae* L., red flour beetle *Tribolium castaneum* (Herbst) and Khapra beetle, *Trogoderma granarium* Everts are very important (Lindgren *et al*., 1955; Cogburn *et al*., 1983; Lohar *et al*., 1997; Ebeling, 2002; Shafique and Ahmad, 2003). The tough siliceous hull of paddy, renders it less prone to the attack of storage insects (Promeranz, 1987), however, infestation of *S. cerealella* and *R. dominica* cause paddy weight loss, breakage of kernels and loss in milling yield (Cogburn, 1977). The storage losses of grains vary from 5-10%. These losses go high to 50% due to improper storage conditions in hot and humid summer season (Maqsood *et al.,* 1988). Keeping in view the economic importance of rice, rough rice genotypes were screened for resistance to two storage insects under laboratory conditions.

## MATERIALS AND METHODS

The studies on screening of rice genotypes for resistance to lesser grain borer (*Rhyzopertha dominica* F.) and Angoumois grain moth (*Sitotroga cerealella* Olivier) were conducted at Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad during 2006. Paddy of eight rice genotypes (IR-6, Shadab, IR6-25A), Shua-92, Sarshar, Super Basmati, Basmati 2.0 and Basmati 15-14), supplied by Plant Genetics Division of Nuclear Institute of Agriculture (NIA), Tando Jam was used for the experiments under laboratory conditions (27 ± 2°C and 60 ± 5% RH). Paddy samples were cleaned and preconditioned at 5°C for two weeks. Insects reared in the laboratory were utilized for paddy grain resistance studies as explained below.

### 1. *Lesser grain borer (LGB):*

Paddy sample (25 g) of each genotype, kept on glazed paper, was placed in an octagonal Perspex chamber and 740 one-week old adults of LGB were released in the center for free choice feeding/oviposition. The experiment was replicated three times in CRD. After 7 days, the beetles were removed and the paddy samples with eggs of beetle were shifted to glass jars of 150 g capacity and covered on top with perforated tin lids. After

completion of 2 generations (90 days), adult progeny produced in each sample was counted and recorded. The grain weight of each infested sample was recorded after sieving the frass through 12 mesh screen. Percent weight loss was determined using control samples.

**2. *Angoumois grain moth (AGM):***

Paddy sample (25g) of each genotype was placed on glazed papers and put in the Perspex chamber. One-day old moths (32 pairs) of AGM were collected from stock culture and released in the chamber from top hole for free choice oviposition on paddy grains. The experiment was replicated three times. After 7 days, the moths (dead/live) were removed. The paddy samples with eggs of moths were kept in glass jars of 150g capacity and covered on top with perforated tin lids. After completion of experimental period (90 days), the total moth progeny produced including the moth carcasses were counted. Each sample was sieved through 12 mesh screen and the dust passed through was discarded. The samples were reweighed to determine weight loss. Per cent weight loss of paddy was determined by subtracting the value of infested samples from that of the controls.

The data recorded on adult progeny of insects species and weight loss of paddy samples were subjected to analysis of variance (ANOVA) and significant means were compared using Duncan's new multiple range test at 5% level of significance. Coefficient of correlation (r) between different parameters in each experiment was determined (Steel and Torri, 1980).

## RESULTS AND DISCUSSION

Adult progeny of lesser grain borer and Angoumois grain moth developed and consequent weight loss of paddy in different rice genotypes (Table-1) varied significantly ($P < 0.05$). The results showed that adult progeny of both insects species and weight loss of infested samples were significantly low in IR6-25A followed by IR-6, Shadab, Sarshar and Shua-92. Contrary to that, significantly high number of adults developed in Basmati-2.0, Basmati 15-14 and super Basmati with high weight loss of paddy samples. The correlation coefficient between adult progeny of lesser grain borer and paddy weight loss ($r = 0.980$) and moth progeny of Angoumois grain moth and paddy weight loss ($r = 0.990$) were positive and highly significant (Table-2).

The results clearly indicated that paddy of rice genotypes varied significantly in response to adult progeny production of LGB and AGM and weight loss of infested samples. The resistance in grains to storage insects has been attributed to low insect population development and consequently low weight loss of grain samples (Cogburn, 1977; Prakash, 1982; Ishtiaq *et al*., 1997; Lohar *et al*., 1997; Shafique and Ahmad, 2003; Shafique and Chaudry, 2007). Therefore, paddy grains of IR6-25A, IR-6, Shadab, Sarshar and Shua-92 showed resistance to both insect species as significantly low insect population and weight loss of grains were recorded. Contrary to that rice genotypes Basmati-2.0, Basmati 15-14 and Super Basmati appeared to be susceptible to test insect pests during storage as significantly high number of adults of test insects developed on the paddy of these varieties inflicting high weight loss of grains.

Resistance in paddy to storage insects has been attributed to various physico-chemical characteristics of rice grains. The larval development of *T. castaneum* and *T. granarium* was inhibited by the tough siliceous hull of paddy (Shafique and Ahmad, 2004, unpublished data). Cogburn (1974) reported that intact hulls of rough rice (paddy) totally excluded rice weavils from feeding or oviposition. However, 10% neonate larvae of *R. dominica* and 29% that of *S. cerealella* succeeded to complete development in rice with intact hulls. Hull morphology was thus considered an unreliable base of resistance as the effectiveness varied with species of insects (Cogburn *et al*., 1983). Russel and Cogburn (1977) concluded that more than one mechanisms were operating against the insects and that insects developed more slowly on resistant varieties than on susceptible ones.

In the present study, paddy of IR6-25A, IR6, Shadab, Sarshar and Shua-92 showed resistance to *R. dominica* and *S. cerealella.* The resistant genotypes of rice can certainly be helpful to reduce qualitative and quantitative losses by storage insects. Post harvest storage studies of grains for resistance to insects should be made a part of breeding programme to alleviate grain losses.

**Table. 1 Adult progeny development of lesser grain borer (LGB) and Angoumois grain moth (AGM) and weight loss of paddy rice**

| Rice genotypes | LGB | | AGM | |
|---|---|---|---|---|
| | Adult developed (number) | Grain weight loss (%) | Moths emerged (number) | Grain weight loss (%) |
| IR 6 | 36.33 d | 2.61 d | 70.00 e | 5.33 e |
| Shadab | 32.33 de | 2.57 d | 71.00 e | 5.35 e |
| IR 6-25A | 18.00 e | 1.91 d | 39.67 f | 2.40 f |
| Shua-92 | 35.33 d | 2.54 d | 90.33 d | 7.03 d |
| Sarshar | 33.00 de | 2.34 d | 57.67 ef | 4.20 e |
| Super Basmati | 68.00 c | 7.81 c | 222.33 c | 15.37 c |
| Basmati 2.0 | 235.67 a | 20.31 a | 354.33 a | 28.13 a |
| Basmati 15-14 | 122.67 b | 9.58 b | 290.67 b | 19.05 b |

* Values sharing similar letters in each column are non-significant ($P < 0.05$).

**Table. 2 Correlation coefficient (r) between insects adult progeny developed on paddy rice and weight loss of grains**

| Lesser grain borer (LGB) | | Angoumois grain moth (AGM) | |
|---|---|---|---|
| Variables | Grain weight loss (%) | Variables | Grain weight loss (%) |
| Adult progeny development (number) | 0.980** | Moths emerged (number) | 0.990** |

**Significant at $P < 0.01$

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