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## Assessment of quantitative losses in different wheat varieties due to *Sitophilus oryzae*

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### Abstract

Increased wheat demand is driven by a rapidly growing population and a change in food preference away from traditional cereals and towards wheat and wheat products. Rice weevil is widely distributed in the world and its cause's damage to stored products, specially stored grains. Damage caused by pest result in loss of seed weight and vigor. Ten varieties of wheat viz., Raj-1482, Raj-3077, Raj-3765, Raj-3777, Raj-4037, Raj-4079, Raj-4083, Raj-4120, Raj-4238 and Raj-Molyarodhak-1 were screened against *S. oryzae* in relation to per cent grain damage, weight loss and avoidable loss. The percentage of damaged grains and loss in weight of different wheat varieties due to infestation of the weevil from 29.00 to 58.77 and 8.33 to 16.29, respectively, being maximum damaged grains and weight loss in Raj-1482, while minimum grain damage and weight loss in Raj-4037.

**Keywords:** *Sitophilus oryzae* L., wheat

### Introduction

Cereals are the staple and nutritive food but their storage is not safe due to the attack of certain stored grain insect pests. So, there is an urge to protect them safely from qualitative and quantitative loss (Nyambo, 1993; Hagstrum, 1999) <sup>[12, 8]</sup> which can result from environmental conditions favored feeding by insects, wastes production by insects, mites, rodents or by microorganisms which are produced in stored products (Mohale, 2010) <sup>[11]</sup>. Stored grain insect pests can cause reductions in weight, quality, commercial value and seed viability. Seventy percent of these insects are coleopterans (Vina uela, 1993) <sup>[14]</sup> and the most damaging species of storage insects are in the genera *Sitophilus* and *Tribolium* (Marsans, 1987; Khan and Selman, 1988). *Sitophilus oryzae* L. (Coleoptera: Curculionidae) <sup>[10]</sup> commonly called rice weevil has become primary pest of stored grains of warm climatic areas. They cause damage to grains which are stored at 25 -30°C and at low RH as these conditions favored the development of this pest (Batta, 2004) <sup>[3]</sup>. It is the most destructive and widespread cereal pest in the world and got economic importance (Champ & Dyte, 1976) <sup>[4]</sup>. It causes 18.30% losses to stored grains (Adams, 1976) <sup>[1]</sup>. Rice weevil, *Sitophilus oryzae* (L.), (Curculionidae: Coleoptera) is a major pest of cereals like rice, sorghum, wheat, barley and maize both in field before harvest and in storage. The white apodous grub and the reddish brown adults are internal feeders and cause serious quantitative and qualitative losses to cereal grains.

### Materials and Methods

To maintain the stock culture of *S. oryzae*, the sound and healthy wheat grains were cleaned and sieved to remove the fractions of grains or insects if any. The grains were sterilized at 60±5 °C for eight hours in order to eliminate both apparent and hidden infestation of insects and mites, if any. These grains were conditioned at least for a week in an incubator maintaining 27±2 °C and 70±5 per cent relative humidity to raise their moisture content. All the experiments were carried out in Completely Randomized Design with three repetitions.

Initial weight was recorded by taking one hundred sound grains of properly conditioned variety and weighed accurately by using electrical automatic balance; three such replications were weighed. After weighing these grains was transferred to plastic containers (6x9 cm) and three pairs of freshly emerged adults were released. The parent weevils were removed from the containers after 10 days. These containers were kept in an environmental chamber by maintaining constant temperature of 27±2 °C and relative humidity at 70±5 per cent. The emergence of progeny weevils were recorded 25 days after release of parent weevils and continued till all the weevils emerged.

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The final weight was recorded after removal of all exuviae and pupal cases from the damaged material and weight were recorded. For damaged grains, the sample of seeds was spread upon a white sheet and damage seeds were counted. The percentage of damaged seeds was calculated. The per cent grain damage and weight loss were calculated by using the following formula given by Gwinner *et al.* (1996)<sup>[7]</sup>:

$$\text{Per cent Weight Loss} = \frac{(W_{\mu} \times Nd) - (W_d \times N_{\mu})}{W_{\mu} \times (Nd + N_{\mu})} \times 100$$

Whereas,

$W_{\mu}$  = weight of undamaged grains  
 $N_{\mu}$  = number of undamaged grains  
 $W_d$  = weight of damaged grains  
 $N_d$  = number of damaged grain

$$\text{Per cent grain damage} = \frac{\text{No. of insect damaged grains}}{\text{Total number of grains in the sample}} \times 100$$

On the other hand, the per cent avoidable loss in a particular variety with reference to least susceptible variety with minimum loss in weight caused by *S. oryzae* were calculated by using the following formula given by Debjani and Sarup (1990) :

$$\text{Per cent avoidable loss in a} = \frac{\text{ALWSV} - \text{ALWLSV}}{\text{ALWSV}} \times 100$$

Particular susceptible variety

Whereas,

ALWSV= Average loss in weight (gm) of a particular susceptible variety  
 ALWLSV= Average loss in weight (gm) of least susceptible variety

## Results and Discussion

### Grain damage (Table 1)

Data presented in table revealed that the per cent damaged grains ranged from 29.00 to 58.77 per cent in different wheat varieties. Raj-4037 (29.00%) was the least damaged variety followed by Raj-3765 (31.12%) and Raj-4083 (33.75%) and at par with each other. However, Raj-4083 also at par with Raj-Molyarodhk-1 (36.81%) and Raj-4238 (37.33%),

respectively. The highly susceptible variety was recorded Raj-1482 (58.77%) which was at par with Raj-3077 (55.51%) however, Raj-3077 also at par with Raj-3777 (51.52%) followed by Raj-4120 (45.11%) and Raj-4079 (42.58%), respectively. The moderately grain damage was recorded on variety Raj-4079 (42.58%), followed by Raj-4120 (45.11%) and Raj-3777 (51.52%). The later variety was also at par with Raj-3077 (55.51%). The results are in conformity with the findings of Rai and Singh (1979) who found loss in grain weight from 1.63 to 10.73 per cent in different wheat varieties by the attack of *S. oryzae*. Similarly, Yadav and Bhargava (2008)<sup>[15]</sup> and Arve *et al.* (2014) observed that the maximum grain damage and loss in weight were found in highly susceptible varieties of wheat. Gupta *et al.* (1999)<sup>[6]</sup> also found the grain damaged and loss in weight ranging from 11.66 to 75.33 and 8.71 to 41.77 per cent in different maize varieties due to infestation of *S. oryzae*, support the present findings. Similarly, Uttam *et al.* (2004)<sup>[13]</sup> showed significant variation in grain damage and loss in weight on different varieties of barley due to *S. oryzae*.

### Weight loss (Table 1)

Data on percentage of loss in weight of different wheat varieties due to infestation of *S. oryzae* indicated that minimum percentage of loss in weight was observed in Raj-4037 (8.33%) which was at par with Raj-3765 (9.20%) however, Raj-3765 also at par with Raj-4083 (9.80%). The highest net weight loss of 16.29 per cent was observed in grain weight of Raj-1482 which was at par with Raj-3077 (15.87%). The medium loss in weight was recorded in variety Raj-Molyarodhk-1, Raj-4238, Raj-4079, Raj-4120 and Raj-3777 which exhibited 10.96, 11.35, 12.41, 12.58 and 14.10 per cent, respectively, which were at par to each other. The present findings confirmation with the work of Rai and Singh (1979) who found loss in grain weight from 1.63 to 10.73 per cent in different wheat varieties by the attack of *S. oryzae*. Similarly, Yadav and Bhargava (2008)<sup>[15]</sup> and Arve *et al.* (2014) observed that the maximum grain damage and loss in weight were found in highly susceptible varieties of wheat. Gupta *et al.* (1999)<sup>[6]</sup> also found the grain damaged and loss in weight ranging from 11.66 to 75.33 and 8.71 to 41.77 per cent in different maize varieties due to infestation of *S. oryzae*, support the present findings. Similarly, Uttam *et al.* (2004)<sup>[13]</sup> showed significant variation in grain damage and loss in weight on different varieties of barley due to *S. oryzae*.

**Table 1:** Grain damage, weight loss and avoidable loss by *S. oryzae* in different wheat varieties\*

Varieties	Per cent grain damage	Per cent weight loss	Per cent avoidable loss
Raj-1482	58.77 (50.04)**	16.29 (23.79)	48.86 (44.34)
Raj-3077	55.51 (48.15)	15.87 (23.46)	47.51 (43.56)
Raj-3765	31.12 (33.85)	9.20 (17.56)	9.46 (17.91)
Raj-3777	51.52 (45.81)	14.10 (21.97)	40.92 (39.71)
Raj-4037	29.00 (32.52)	8.33 (16.67)	0.00 (0.00)
Raj-4079	42.58 (40.67)	12.41 (20.54)	32.88 (34.93)
Raj-4083	33.75 (35.46)	9.80 (18.15)	15.00 (22.71)
Raj-4120	45.11 (42.14)	12.58 (20.69)	33.78 (35.48)
Raj-4238	37.33 (37.60)	11.35 (19.60)	26.61 (30.99)
Raj-Molyarodhak-1	36.81 (37.29)	10.96 (19.24)	24.00 (29.26)
SEm±	0.99	0.35	0.56
CD at 5%	2.96	1.05	1.66
CV %	4.30	3.03	3.24

\* Data based on three replications

\*\* Percentage transformed to angles; outside values are its back transformation to percentage

**Avoidable loss (Table 1)**

Per cent avoidable losses were calculated with reference to least susceptible variety Raj-4037. The maximum avoidable loss was observed in Raj-1482 (48.86%), while minimum in Raj-3765 (9.46%).

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