

## EVALUATION OF PHYSICAL LOSSES OF THREE WHEAT VARIETIES CAUSED BY *RHYZOPERTHA DOMINICA* (F.) (COLEOPTERA: BOSTRICHIDAE)

**Abstract:** *Rhyzopertha dominica* (F) is primary pest of stored cereals especially wheat under tropical conditions. The extent of physical damages caused by *R. dominica* to three common Pakistani wheat varieties was studied. The varieties involved were Sehar -2006, Inqalab-91 and Shafaq. There was recorded significant production of frass material and weight loss in all tested varieties after pest infestation, adversely affecting the quantity of wheat. There was also recorded significant increase in population of *R. dominica* in the inoculated substrates. The highest level of cereal degradation was recorded for Inqalab-91 followed by Sehar-2006 and Shafaq. It is suggested that Shafaq could be used for long term storage purposes and breeding programs due to its relative resistance against *R. dominica*. The results of present studies are likely to be helpful for stake holders and go downs owners in making effective management decisions to control *R. dominica* thus contributing in sustainable wheat supply.

### Introduction

The world's most widely cultivated cereal crop is Wheat, *Triticum aestivum* L. (Family: Gramineae) (Kumar *et al.*, 2011). It is staple food for human beings worldwide, because it has high nutritional value (Waiss *et al.*, 1987). Pakistan is an agricultural country and wheat (*Triticum aestivum* L.) is the major agricultural commodity. It contributes 3.0 percent to GDP and grown over wide area of the country (NARC, 2011).

Most of the wheat produced has to be stored for future use because it is cultivated for only a short period of the year. Stored wheat undergoes severe damages due to living and non- environmental factors (Kent & Evers, 1993). Insect pests are the major constraint among living factors causing significant physical and biochemical losses to stored grains (Madrid *et al.*, 1990; Hussain *et al.*, 1996; Khan *et al.*, 2010). About 10 to 20% losses are reported in Pakistan by more or less than 23 insect species. Among these, *Rhyzopertha dominica*, *Sitotroga cerealella*, *Tribolium castaneum* and *Sitophilus spp.* are most abundant (Khan *et al.*, 2010). These insects attack on stored wheat in a coordinate manner and cause significant reduction in weight.

The lesser grain borer, *Rhyzopertha dominica* (Coleoptera: Bostrichidae) is highly destructive cosmopolitan pest of stored wheat (Haines, 1991). *R. dominica* can tolerate a wide range of environmental conditions. Its growth rate reached up to 20 times per month under optimum conditions (34°C and 70% relative humidity). It is internal feeding pest that leave the wheat kernels as hollow husks deteriorating their quality and quantity. Besides these, it makes the stored commodity susceptible to attack of other pests and can invade in other stored cereals of nearby location (FGIS, 1997).

Due to its notorious nature *R. dominica* has been under study by many scientists. Jood and Kapoor (1992) investigated the effects of *R. dominica* using different cereals and recorded significantly decreased protein and starch digestibility. Some scientists reported deterioration of organoleptic characteristics of infested wheat (Jood *et al.* 1993). There are also reports on significant depletion of total lipids, phospholipids and galactolipids while uric acid increased significantly (Jood *et al.*, 1996). Sayed *et al.* (2006) recorded significant reduction in weight of wheat grains after infestation with *R. dominica*. Perusal of literature revealed that *R. dominica* should preferably controlled to avoid quantity and thus capital losses by stake holders. None of the control strategies would be cost effective if the extent of losses is not known so present investigation was carried out to determine frass material, weight loss and population increase of *R. dominica* in three varieties of wheat viz., Sehar-2006, Inqalab-91 and Shafaq under storage conditions.

## Materials and Methods

### Collection of wheat

Seeds of three wheat varieties viz., Sehar-2006, Inqalab-91 and Shafaq were collected from wheat Directorate, Ayub Agricultural Research Institute Faisalabad, Pakistan. One kg of each variety was taken and subjected to fumigation with Aluminum phosphide for one week to nullify the possibility of previous infestation if any. The samples were cleaned by passing through 1/8 and 1/12 inches mesh sieves and tamped for fifteen days. Working samples weighing 200 grams from each variety were drawn for experimentation.

### Collection of insect pests

*R. dominica* were collected from a stock culture of uniform age reared under controlled environmental conditions of a stability chamber at 28°C temperature and 68% relative humidity (Greenspan, 1977) for one year to be used for further experimentation.

### Sampling protocols

The experiment was laid out in completely randomized design (Two factorial CRD) with three replicates. For this purpose, 200 g sieved grains of each variety were placed in 250g glass jars, each having a capacity of controlled laboratory conditions (28°C and 68% RH). Twenty five adults were released into each of 9 experimental jars containing wheat varieties. One jar of each variety maintained without pest served as control. The mouth of each jar was covered with muslin cloth and tightened by rubber bands. Data were recorded after 45 days for increase in population, weight loss and production of frass material. Before weighing the sample, the insects and frass were removed through sieving using mesh sizes of 24, 14 and 5. The separated grains were weighed for loss in weight. Percent weight loss was calculated by the following formula:

$$\text{Per cent weight loss} = \frac{\text{WCS} - (\text{WS} + \text{DGS})}{\text{Weight of control sample}} \times 100$$

Where

WCS = Weight of control sample

WS+DGS = Weight of sound + damaged grains of test sample.

### Data analysis

The data obtained were subjected to the analysis of variance (ANOVA) and HSD Tukey Test. Correlation was sort out using Pearson correlation.

## Results and Discussion

The results of present studies showed that grain weight loss and frass weight was significantly ( $P < 0.05$ ) higher in infested wheat as compared to control samples. Maximum weight loss was recorded for Inqalab-91 (6%) followed by Sehar-06 (3.78%) and Shafaq (1.60%). All the three tested varieties recorded similar pattern for frass weight as well. Furthermore, population of beetles in different wheat varieties increased significantly reaching up to 331 beetles in Inqalab-91 (Table 1).

The findings of present study are in accordance with many earlier workers who carried out investigations on physical damage of wheat infested by insect pests of different types. Syed *et al.*, (2006) evaluated the comparative resistance of wheat varieties infested by *R. dominica* and *T. granarium*. They reported that varieties with higher progeny development recorded higher grain damage and weight loss. Furthermore, these parameters were directly related with varietal preference of the pests under study. Later on, Ahmedani *et al.*, (2011) carried out studies on quantitative losses and physical damage caused to nine cultivars of wheat by khapra beetle infestation. There were recorded lower values for progeny development, weight loss and frass material for Inqalab-91 as compared to our finding. It suggests that *R. dominica* might be more damaging pest than khapra beetle.

We carried out an analysis of the correlation matrix between all the tested parameters of three wheat varieties to

better assess the results obtained. The most significant variables were retained in the error threshold of 5% according to the Pearson correlation. The correlation matrix recorded a strong correlation between all tested physical parameters. Population increase, Frass weight and weight loss were positively correlated (Table 2).

These findings are in good agreement with those of Khan and Kulachi (2002) who reported a strong positive correlation between the progeny development and weight loss of wheat grains while working with *R. dominica*, *T. granarium* and *T. castaneum*. Ali *et al.*, (2009) also reported similar trend of correlation between weight loss and population increase for ten varieties of wheat but they selected *T. castaneum* for studies.

There were recorded significantly maximum changes in all the tested parameters for Inqlab-91 followed by Sehar-06 and Shafaq. These results indicate Inqlab-91 as most susceptible cultivar for the attack of *R. dominica*. Batta *et al.* (2007) studied the susceptibility of wheat genotypes to *Rhizopertha dominica* (F.) and suggested that resistance of these varieties can be correlated to some biochemical factors. However, Toew *et al.* (2000) reported that kernel hardness, diameter and weight (physical factors) did not correlate significantly to *R. dominica* progeny production and thus susceptibility of wheat cultivars.

Table 1. The Physical parameters of three wheat varieties infested with *Rhizopertha dominica*

Wheat Varieties	Population increase*		Weight loss (%)*		Frass weight (g)*	
	Control	Treated	Control	Treated	Control	Treated
Sehar-06	0.00	207.0	0.00	3.78	0.00	2.83
Inqlab-91	0.00	331.7	0.00	6.00	0.00	5.07
Shafaq	0.00	105.0	0.00	1.60	0.00	0.67

Data were expressed as mean significant at  $P < 0.05$ - $P < 0.001$ , vs control where \*= $0.001$  \*\*= $0.05$  and\*\*\*= $0.01$ .

Table 2. The correlation matrix between all the tested parameters.

Variables	Population growth	Frass weight	Weight loss
Pg	1		
Fw	<b>0.993**</b>	1	
Wl	<b>0.985**</b>	<b>0.997**</b>	1

\*\* . Correlation is significant at the 0.01 level (2-tailed).

### Conclusion

*Rhizopertha dominica* caused severe quantitative damages to stored wheat thus making it filthy and untradeable. It is recommended that proper control strategies should be adopted keeping in view the extent of losses. Furthermore, susceptible varieties like Inqlab-91 should be used immediately after cultivation.

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