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## Relative susceptibility of four wheat cultivars against angoumois grain moth *Sitotroga cerealella* (Olivier) (Lepidoptera: Gelechidae)

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**Abstract**

The present study was conducted during 2009 at the month September-December to evaluate the susceptibility of four wheat cultivars against Angoumois grain moth, *Sitotroga cerealella* (Olivier) at  $28 \pm 2$  °C, L: D 12:12 hours in laboratory. The results were evaluated on the basis of developmental period, total progeny, percent damage, percent weight loss, grain size and to record their correlation for susceptibility. The results revealed that none of the cultivar was completely immune to the attack of this pest. However their response varied significantly. Weight loss being main index of susceptibility, cultivar Uqab (24.67) was recorded susceptible followed by Saleem 2000 (21.99) and Ghaznawi (10.48) and the Fakhre-Sarhad (8.347) was recorded tolerant. The cultivar Fakhre-Sarhad was significantly tolerant against *Sitotroga cerealella* compared to the tested cultivars. Further research should be done to screen and evaluate more cultivars against *S. cerealella*.

**Keywords:** Wheat, *Sitotroga cerealella*, cultivars, susceptibility, resistance, life cycle

**1. Introduction**

Wheat (*Triticum aestivum* L.) belong to family *Graminae* is one of the most important cultivated crops in the world. As a food component wheat is the prime source of protein and energy for living being [18]. In Pakistan wheat consumption is very high even ranked first among all cereals. Green revolution and autonomy in food production is a symbol of wheat cultivation on large area. With the introduction of modern techniques in agriculture wheat production highly elevated [4]. Wheat is produced about 90 percent throughout the world and most of this production is consumed by humans. The cultivation of wheat crop in Pakistan is on several million hectares areas to generate income for the agriculture community [2].

It is assessed that due to insect pest 5-10 percent loss occur during storage of the world wheat production. In tropical countries where temperature and humidity is high in summer season the losses increased up to 50 percent [18]. These losses have been reached up to 50% in tropical countries, where humidity and temperature run high in summers [3]. Every year 10-15 percent post-harvest of wheat crop occurs in Pakistan. Insects larvae and adult are present in almost 75 percent samples collected from different areas [8, 5].

Several insect pest attack wheat during storage in Pakistan, i.e., lesser grain borer, *Rhyzopertha dominica* (F). Khapra beetle, *Trogoderma granarium* Everts, granary weevil, *Sitophilus granarius* L., red flour beetle, and *Tribolium castaneum* (Herbst) [19, 23]. Among these insect pest Angoumois grain moth, *Sitotroga cerealella* (Olivier) is the serious threat to stored rice, maize and wheat [12, 20, 9, 7, 19]. *Sitotroga cerealella* female lay eggs singly or in group on grains in the field and thus the wheat infestation starts. The infestation of wheat with *S. cerealella* starts in the field as females lay their eggs singly or in groups on grains [11]. In the milk stage inside the grains the larvae start feeding and pass their life and detection of infection at this stage is very difficult. The *S. cerealella* adult insect make a visible hole at one end and coming out from the grain. The emerge adults are active and fly to infest other storages, therefore cause deterioration of seeds through fungal disease development which reduce germination [1]. Arthropods sample recorded from stored products at five different locations in Romania during 1989-91. It was observed that *S. cerealella* was one of the most harmful pests of stored product among arthropods [10]. In Pakistan, the pest has been reported to cause damage in most of cereals incurring heavy losses to the commodity [2, 14].

The rearing of the gelechiidae stored products pest, *S. cerealella* was examined on wheat, maize and rice grains to study the effect of rearing media on progeny production. The results indicated that more progeny were produced when *S. cerealella* was reared on wheat [6].

The present study was designed to know the relative susceptibility of four wheat cultivars to *Sitotroga cerealella*. To determine developmental period, Total progeny, Percent weight loss, percent damage, Grain size and to record their correlation for susceptibility. Because the relevant information is very meager to crop with the safe storage practice and avoid environmental pollution.

## 2. Materials and Methods

The present study was conducted to investigate relative susceptibility of four wheat cultivars to Angoumois grain moth, *S. Cerealella* in the laboratory of Department of Plant protection, The University of Agriculture Peshawar during 2009 at the month of September-December. The four wheat cultivars Ghaznawi, Saleem 2000, Fakhre-Sarhad and Uqab were obtained from the department of plant breeding and genetics, The University of Agriculture Peshawar.

### 2.1 Disinfestation of wheat grains

Healthy, sound and fully matured grains were used in this experiment. The 300gm sample of each cultivars were obtained. The collected samples were free from all sorts of infestation and foreign material. All the samples (duly labeled) were placed for conditioning over a period of 15 days at 5°C and 7 days at 5°C in freezer, to kill any individual invading grains. After conditioning samples were placed at ambient temperature for 2 days in captivity. Five lots, each of 35g was made from each sample. These five lots were designated as 4 replicates and a master control (without insects) were placed in 10/5 cm glass jar with perforated lid on the top.

### 2.2 Labeled as

1T<sub>1</sub>, 1T<sub>2</sub>, 1T<sub>3</sub>, 1T<sub>4</sub> & 1T<sub>5</sub> (Control)  
2T<sub>1</sub>, 2T<sub>2</sub>, 2T<sub>3</sub>, 2T<sub>4</sub> & 2T<sub>5</sub> (Control)  
3T<sub>1</sub>, 3T<sub>2</sub>, 3T<sub>3</sub>, 3T<sub>4</sub> & 3T<sub>5</sub> (Control)  
4T<sub>1</sub>, 4T<sub>2</sub>, 4T<sub>3</sub>, 4T<sub>4</sub> & 4T<sub>5</sub> (Control)  
5T<sub>1</sub>, 5T<sub>2</sub>, 5T<sub>3</sub>, 5T<sub>4</sub> & 5T<sub>5</sub> (Control).

### 2.3 Experimental procedure

Before starting the trial the number of grains in each jar/replicate were counted and recorded accordingly into register (Grain Size) i.e. total number of grains per 35 gm of the sample. Culture of *S. cerealella* was maintained at 28±2 °C and 60±5% RH with 12.12(L.D) Cycle. Thirty eggs of *S. cerealella* nearly hatching (red colored) were placed in each jar/replicate, except control. This stuff was kept under control environment laboratory as stated above. The date of seeding was put on each jar. The jars were checked daily for adult emergence after 20 days of initial seeding. This observation was recorded twice a day i.e. Morning and afternoon. The date of first adult emergence was recorded in each jar to know the developmental period. The data was continued for a week after the first adult emergence. The developmental period was calculated by subtracting the seeding date from emergence date (no of days). The adults were immobilized with chloroform impregnated cotton plug. The number of first adult emergence was counted and the dead adults were removed. The experiment was continued up to 2 generations i.e. total 65-70 days. Second generation data was also recorded and added to the first one, this is called total

progeny. At the time of termination, each sample was passed through 60 mesh sieve for separation of frass and grains. The dust was discarded, while weight of remaining grains were taken. The grains having holes were separated from sound grains (without holes) and weighted.

The percent damage and percent weight loss was calculated according to the formulae of [16] as follow:

$$\% \text{ Damage} = \frac{\text{wt. of control sample} - \text{wt. of sound grain}}{\text{wt. of control sample}} \times 100$$

$$\% \text{ Weight loss} = \frac{\text{wt. of control sample} - [(\text{wt. of sound grain} + \text{wt. of damage grain})]}{\text{wt. of control sample}} \times 100$$

### 2.4 Statistical Analysis

The data was analyzed by ANOVA and DMR test. Means of all replicates were calculated and were compared by applying least significant difference (LSD test). Co-efficient of correlations between percent weight loss and other parameters were also determined.

## 3. Results

The result of developmental period and total progeny of *Sitotroga cerealella* on four wheat cultivars are presented in (Table 1). The longer developmental period was (25.00 days) recorded in Fakhre-Sarhad followed by Ghaznawi (24.50 days), Saleem 2000 (23.00 days), while it was shorter in Uqab (20.50 days). The statistical analysis showed that the developmental period of Fakhre-Sarhad and Ghaznawi was significantly higher than Uqab, while it was non-significant with Saleem 2000.

The result of total progeny of *Sitotroga cerealella* was higher in Uqab (117.5) followed by Ghaznawi (87.00), Saleem 2000 (80.50), while it was lower in Fakhre-Sarhad (25.75). The statistical analysis of the data showed that the total progeny in Uqab was non-significant to Ghaznawi and Saleem 2000, while significantly higher than the Fakhre-Sarhad.

The result for multiple comparisons of percent damage and percent weight loss are presented in (Table 2). Percent damage was higher in Uqab (48.38) followed by Saleem 2000 (43.87), Ghaznawi (28.08), while it was recorded lower in Fakhre-Sarhad (21.65). The statistical analysis of data showed that the percent damage was significantly higher in Uqab than Fakhre-Sarhad, while it was non-significant with Saleem 2000 and Ghaznawi.

The percent weight loss by *S. cerealella* was observed as higher in Uqab (29.67) followed by Saleem 2000 (21.99), while the lowest percent weight loss was observed in Ghaznawi (10.48) and Fakhre-Sarhad (8.347). The statistical analysis of data indicated that the percent weight loss in Uqab was non-significant with Saleem 2000 and Ghaznawi. However it was significantly different from Fakhre-Sarhad.

The results of the grain size and statistical analysis are given in (Table 1). The table showed that the larger grain size (No. of grains/35g) was observed in Fakhre-Sarhad, while smaller grain size was recorded in Uqab. The statistical analysis revealed that grain size was significantly larger in Fakhre-Sarhad than rest of the cultivars.

**Table 1:** Mean developmental period and total progeny of *Sitotroga cerealella* on different wheat cultivars and grain size of wheat cultivars.

Cultivars	Developmental Period	Total Progeny	Grain Size
Ghaznawi	24.50 A	87.00 A	842.3 B
Saleem 2000	23.00AB	80.50 A	823.5 B
Fakher Sarhad	25.00 A	25.75 B	1184. A
Uqab	20.50 A	117.5 A	818.0 B
LSD (0.05) =	3.774	48.49	

Mean Value in the same column followed by similar letters are not significantly different at 5% level of probability ANOVA followed by LSD Test.

**Table 2:** Percent damage and percent weight loss of wheat cultivars infested by *Sitotroga cerealella*.

Cultivars	Percent Damage	Percent Weight Loss
Ghaznawi	28.08 AB	10.48 B
Saleem 2000	43.87 AB	21.99 AB
Fakher Sarhad	21.65 B	8.347 B
Uqab	48.38 A	24.67 A
LSD (0.05) =	24.99	16.07

Mean values in the same column followed by similar letters are not significantly different at 5 % level of probability. ANOVA followed by LSD Test.

The results on co-efficient of correlation are presented in (Table 3), indicated that correlation between developmental period and total progeny, developmental period and percent

damage and developmental period and percent weight loss was highly significant and negative. The correlation between developmental period and grain size was positive and non significant.

The correlation of total progeny was positive and highly significant with percent damage and percent weight loss, while the correlation between total progeny and grain size was negative and highly significant.

The correlation between percent damage and percent weight loss was positive and highly significant, while the correlation of percent damage with grain size was negative and highly significant. The correlation of percent weight loss with grain size was negative and highly significant.

**Table 3:** Coefficient of correlation between some life cycle parameters of *Sitotroga cerealella*, losses to wheat grains of wheat cultivars.

	Developmental Period	Total Progeny	Percent damage	Percent weight loss	Grain size (Number of grain/35gm)
Developmental period	-	-0.729	-0.782	-0.797	0.498
Total progeny	-	-	0.776	0.715	-0.840
Percent Damage	-	-	-	0.958	-0.714
Percent weight loss	-	-	-	-	-0.645

#### 4. Discussion

Susceptibility of stored grains to storage insects depends upon multiply factors. Some of the important ones are variety, insect species and grain size [13]. Within variety there could be variations like texture, smooth or rough surface and chemical constituents of the grains [16].

The present studies were undertaken on four different wheat cultivars against *S. cerealella*. All the cultivars were different in grain size and chemical composition, hence their response varied significantly to the attack of this insect. The results indicated that lowest progeny was recorded in Fakhre-Sarhad and the highest was observed in Uqab. The developmental period was prolonged in Fakhre-Sarhad, while it was shortest in Uqab. Therefore our results are close conformity with [1], who reported that the number of emergence is a better indicator of seed resistance than the number of eggs present on the seed. Similarly [15] tested that the none of cultivar was completely resistance to attack of *S. cerealella*. In the present study the different cultivar showed different rate of susceptibilities to attack of *Sitotroga cerealella*.

Insect emergence was more on Uqab, while less in Fakhre-Sarhad the possible reason for this could be that of larger grain size of the former cultivars as competed to the later. The present results are comparable to the results of [17] who found that the weight of large grains of maize and wheat was reduced mere by the attack of *S. cerealella* than that of small grains and more eggs were laid by females developing from larvae that development in large grains than by those from larvae in small grains.

The results of the present investigation revealed that none of the cultivars were completely immune to the attack of *S.*

*cerealella*, however, their response to the attack of this pest varied significantly. The present findings are comparable to results of [13] that studied the susceptibility of some wheat varieties to Angoumois grain moth *S. cerealella* under controlled laboratory conditions and found that none of cultivars were completely immune to the infestation of this pest.

#### 5. Conclusion and Recommendations

On the basis of percent weight loss by *S. cerealella* the cultivars can be arranged in the following ascending order.

Fakhre-Sarhad < Ghaznawi < Saleem 2000 < Uqab

It is concluded from the above discussion that considering percent weight loss as parameter factor of susceptibility in the four cultivars to *S. cerealella*, cultivar Uqab was the most Susceptible, while cultivar Fakhre-Sarhad was significantly tolerant, also the cultivar Ghaznawi showed good tolerance to the pest and have bright future prospects.

The comparative susceptibility of various wheat cultivars to *S. cerealella* in the present studies has great future prospects of safe storage. This information, of course, to all concerned agencies is a valuable contribution towards stored grains research and wheat food self-sufficiency programmed in Pakistan, which will further strengthen our economy by reducing insect losses through evolving insect resistant cultivars.

Now a day *Trichogramma* spp (Egg parasite) are encouraged as biocontrol for controlling of many serious Lepidopterist pests i.e. *Helicoverpa* spp and etc. these parasites are reared on laboratories in *S. cerealella* eggs. Therefore it is suggested that Uqab, the most susceptible cultivar and best for mass

production of *S. cerealella* is recommended for *Trichogramma* rearing. Further research should be done to screen and evaluate more cultivars against *S. cerealella*. It is suggested that breeders should concentrate efforts on evolving cultivars that have potential yield and more insect resistance.

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