

RESISTANCE IN WHEAT GENOTYPES TO KHAPRA BEETLE, *TROGODERMA GRANARIUM* EVERTS (COLEOPTERA: DERMESTIDAE)

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ABSTRACT

Grains of twenty wheat genotypes were offered to Khapra beetle, *Trogoderma granarium* Everts to assess resistance under laboratory conditions ($35 \pm 2^\circ\text{C}$ and $65 \pm 5\%$ RH). The resistance was checked by free choice oviposition by the female beetles, adult progeny development and subsequent weight loss of grains. The results revealed that beetle population was significantly the lowest (53.00) with the minimum grain weight loss (3.72%) in E 6 followed by E 17, E 19 and E 18 indicating resistance to *T. granarium*. The highest number of adults (532.33) developed on E 14 inflicting maximum weight loss (35.48%) followed by E 15, E 12, E 1 and E 9. The correlation between adult population and grain weight loss in wheat genotypes was positive and highly significant ($r = 0.998$). Insect resistant wheat genotypes may help alleviate storage losses and may be used in wheat breeding programmes.

Key Words: Wheat genotypes, resistance, *Trogoderma granarium*, adult progeny, grain weight loss.

INTRODUCTION

Wheat is the most important cereal crop in Pakistan. It was grown on 8.4 million hectares with the production of 21.28 million tones during 2005-2006 (MINFAL, 2006). During harvest season, wheat is procured by public and private agencies for storage and sale. While most of the wheat grain is retained by the farmers for their own consumption and for seed purpose. Wheat is vulnerable to many insect pests during storage. Among these, lesser grain borer, *Rhyzopertha dominica* (F). Khapra beetle, *Trogoderma granarium* Everts, granary weevil, *Sitophilus granarius* L., Angoumois grain moth, *Sitotroga cerealella* (Olivier) and red flour beetle, *Tribolium castaneum* (Herbst) are very important (Khattak *et al.*, 2000; Toews *et al.* 2000; Ebeling, 2002; Atwal, and Dhaliwal, 2005; Shafique *et al.*, 2006). It is estimated that 5-10% of world's grain production is lost due to ravages of insects. The losses may reach 50% in tropical countries where summer is hot and humid and storage facilities are improper and inadequate (Adams, 1998; Ahmad and Ahmad, 2002). Use of insecticides/fumigants to control storage insects give residues and lead to insect resistance. Resistance/tolerance in grains to insect pests is a good alternative which is environment friendly and causes no cost to farmers. Twenty genotypes of wheat were, therefore, evaluated for resistance to khapra beetle, *T. granarium* under laboratory conditions.

MATERIALS AND METHODS

The studies on wheat genotypes for resistance to Khapra beetle, *Trogoderma granarium* Everts were conducted at Nuclear Institute for Agriculture & Biology (NIAB), Faisalabad during 2006-2007. Grains of twenty wheat entries (Table 1) supplied by Plant Genetics Division of Nuclear Institute of Agriculture (NIA), Tando Jam were used for this experiment under laboratory conditions ($35 \pm 2^\circ\text{C}$ and $65 \pm 5\%$ RH). The grain samples were cleaned and preconditioned at 5°C for two weeks. Insects reared in the laboratory were utilized for resistance studies. Grain sample (20g) of each entry was kept on glazed paper and placed in a circle in Perspex chamber and 16 two-day old adult pairs of *T. granarium* per sample were released in the chamber for free choice oviposition.

The experiment was replicated three times. After two weeks, the dead beetles were removed. The grains with eggs/larvae were shifted in glass jars of 150 g capacity and covered on top with perforated tin lids. After completion of 2 generations (120 days), *T. granarium* adult progeny produced (dead/alive) in each sample was counted and recorded. The weight loss of each infested sample was determined after sieving the frass through 12 mesh screen as follows:

Weight loss % = $(\text{Fresh sample weight} - \text{Infested sample weight} / \text{fresh sample weight}) \times 100$.

The data recorded on adult progeny of *T. granarium* and weight loss of wheat 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 insect progeny and grain weight loss was computed (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

The results on *Trogoderma granarium* adults developed and consequent weight loss of wheat genotypes (Table-2) varied significantly ($P < 0.05$). The adult progeny of *T. granarium* was significantly low (53.00) with minimum weight loss (3.72%) of grains in E 6 followed by E 17, E 19 and E 18 showing resistance to the test insect. Contrary to that, significantly high number of adults (532.33) developed in E 14 inflicting maximum weight loss (35.48%) of grains followed by E 15, E 12, and E 9. The grain of these wheat entries exhibited susceptibility to Khapra beetle. The correlation (Table 3) between adult progeny of *T. granarium* and grain weight loss ($r = 0.998$) was positive and highly significant.

Resistance in cereal grains to storage insects has been assessed on the basis of different parameters such as insect low oviposition preference on grain, egg hatch, insect progeny development and weight loss of grains (Riaz *et al.*, 1992., Toews *et al.*, 2000, Shafique and Chaudry, 2007). The resistance in grains of wheat entries E6, 17, 19 and 18 was

indicated by low adult progeny development of *T. granarium* and low weight loss of grain samples (Riaz *et al.*, 1992., Khattak *et al.*, 2000). Contrary to that susceptibility in wheat entries 14, 15, 12, 1, 9, 8, 5 and 4 was indicated by high number of adult progeny of *T. granarium* and high weight loss of grains. Resistance in stored grains depends on multiple factors such as insect species, varieties and their physiochemical factors (Hamed *et al.*, 1989; Khattak *et al.*, 1995), Toews *et al.*, 2000, Shafique and Ahmad 2005). Undamaged seed coat in maize (Li and Arbogast, 1991), hardness of kernels in wheat, rice and maize (Ram and Singh, 1996, Shafique and Ahmad, 2003, Li and Arbogast, 1991), wrinkled seed shape and brown colour in chickpea (Shafique and Ahmed, 2005) inhibited insects feeding/oviposition and development of larvae. The results manifest that seed coat/kernel hardness (due to amylose content) and antinutritional factors (phenolic compounds, tannins etc.) were responsible for antibiosis which caused slow development, reduced size and weight and mortality of insect pests. As a result, insects developed more slowly on resistant genotypes than on susceptible ones.

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Table.1. Wheat genotypes from received Cimmyt as 26 Ewsyt were planted at Nuclear Institute of Agriculture, Tando Jam during year 2005-2006. After harvest of the crop, wheat seed was supplied as described in the table

Entry (E) No.	Code No.	Details
1.	Sarsabz	Sarsabz Local check variety of NIA
2.	26ESWYT-2	OPALA-INIA
3.	26ESWYT-3	LONG MAI-26
4.	26ESWYT-4	NING CHUN4
5.	26ESWYT-7	RAYON F-89
6.	26ESWYT-8	SERI/RAYON
7.	26ESWYT-12	SKAUZ*2/FCT
8.	26ESWYT-13	SNB//CMH 79A.955/3*CNO79/3/ATTLA
9.	26ESWYT-14	CROC-1/AE.SQUARROSA(205)//KAUZ/3/SASIA
10.	26ESWYT-15	CROC-1/AE.SQUARROSA(205)//KAUZ/3/ATTLA
11.	26ESWYT-16	PASTOR/3/VORONA/CNO79/KAUZ
12.	26ESWYT-17	CNDO/R143/ENTE/MEXI 2/3/
13.	26ESWYT-18	CNDO/R143/ENTE/MEXI 2/3
14.	26ESWYT-20	MINO-1
15.	26ESWYT-21	MINO-2
16.	26ESWYT-22	CHEN/AE.SQUARROSA(TAUS)//BCN/3.BAV92
17.	26ESWYT-23	PARA2//JUP/BJY/3/VEE/JUN/4/2*KAUZ/5/BOW/
18.	26ESWYT-24	RABE//6/WRM/4/FN/3*TH//K58/2*N/3/AUS-6869/5/
19.	26ESWYT-25	CNDO/R143/ENTE/MEXI/2/3/
20.	26ESWYT-27	CROC1/AE.SQUARROSA(224)//OPATA/3/KAUZ*2/

Table. 2. *Trogoderma granarium* adult progeny developed and grain weight loss of wheat genotypes

Entry (E)No.	Adult progeny (number)	Grain weight loss (%)
1.	405.33 bc	24.75 cd
2.	308.00 fg	19.62 fg
3.	283.67 g	18.42 g
4.	325.67 ef	21.58 ef
5.	343.33 def	22.51 de
6.	53.00 k	3.72 l
7.	159.00 j	10.97 ij
8.	362.00 de	24.01 cd
9.	380.33 cd	25.77 c
10.	240.00 hi	15.55 h
11.	272.33 gh	17.97 g
12.	444.33 b	29.36 b
13.	214.00 i	14.55 h
14.	532.33 a	35.48 a
15.	517.00 a	34.31 a
16.	173.67 j	11.90 i
17.	83.67 k	5.34 kl
18.	132.67 j	8.97 j
19.	93.00 k	6.40 k
20.	146.33 j	9.69 ij

* Values sharing similar letters in each column are not significantly different ($P < 0.05$).

Table.3. Correlation coefficient (r) between adult progeny of *Trogoderma granarium* and weight loss of wheat genotypes

Variables	Adult progeny (number)	Grain weight loss (%)
Adult progeny (number)	-	0.998**

**Significant at 1% level

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