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Resistance of Different Stored Wheat Varieties to Khapra Beetle, *Trogoderma granarium* (Everest) and Lesser Grain Borer, *Rhizopertha dominica* (Fabricus)

T.S. Sayed, F.Y. Hirad and G.H. Abro
Department of Entomology, Sindh Agriculture University, Tandojam, Pakistan

Abstract: In present study, twelve varieties of wheat viz., Sarsabz, AZS-4, Zardana, Yekora, Soghat, Sonalika, TJ-0787 Pak-70, Tandojam-83, Mehran-89, Abadgar and Anmol were tested for their resistance to *Trogoderma granarium* (Everst) and *Rhizopertha dominica* (Fabricus) separately. The population growth, percent weight loss and percent grain damage in each variety were taken as criteria for measuring relative resistance of the varieties against these insects. The grain moisture content was correlated to different parameters; also population growth was correlated to percent weight loss and grain damage. Population build up in both insect treatments was observed to be the lowest in variety Mehran-89, whereas the highest population was recorded in the variety, TJ-0787. On the basis of percent grain weight loss, the most resistant variety to both insect species was found to be the Mehran-89, while the least resistant varieties recorded were, TJ-0787 and Sarsabz against *T. granarium* and *R. dominica*, respectively. The remaining varieties were considered as moderately resistant and susceptible. The moisture content played a significant ($p<0.01$) role in population growth, percent weight loss and percent grain damage.

Key words: Varietal resistance, wheat, *Trogoderma granarium*, *Rhizopertha dominica*

INTRODUCTION

Food grain losses occur between storage and consumption. Economic losses in storage are a complex mixture of absolute losses and those depending on social standard (Howe, 1965). Majority of the losses during storage are the result of destructive activities of insect pests and rodents, which besides doing direct damage by feeding on food grains, adding feces and frass to it, there by lowering its nutritional and economic value do an other and an indirect damage, making the grain damp by their respiration process and increasing its temperature making it liable to be attacked by an other forms of pests, the mites, moulds and microorganisms (fungi and bacteria) (Howe, 1965; Hall, 1970; NAS, 1978; Cofie *et al*., 1995; Hubert *et al*., 2004). Insect infestation and microbial infection of food grains may produce toxic metabolites such as toxic *Quinones* sp. produced by Triboluim spp. Which are said to be carcinogenic (Ladisch *et al*., 1967; Smith *et al*., 1971). Similarly food infecting fungi are able to produce many metabolites, such as mycotoxin, aflatoxin B_1, a carcinogenic metabolite of *Aspergillus flavus* which affects the liver (Wild and Hall, 2000), ochratoxin A and citrinin produced by *Pencillium verrucosum* (Frisvad, 1995) which are known to have nephrotoxic effects, some storage fungi also produce allergens and cause serious human health hazards (Hubert *et al*., 2004). Insect infestation also adversely affects the germination of seeds (Howe, 1965; Hall, 1970; NAS, 1978; Atanassov, 1978).

Wheat, *Triticum aestivum* L. is an important crop and a major staple food of people of Pakistan. It accupies first position in area amongst the cereal crops and covers about 65% of food crop area of the country (Khattak *et al*., 2000). Wheat was grown on an area of 8.03 million hectares with production of 19.18 million tones during 2002-03 in Pakistan (MFAL., 2004). Considerable amount of damage is caused by insect pests to stored wheat in Pakistan. The damage caused by insect pests to wheat grain has been estimated at 10 to 20% (Ramzan *et al*., 1991). The amount of damage in quality and quantity and health hazards due to insect infestation when converted into monetary concerns may run into millions of rupees to national exchaquer. This loss could be prevented either by the use of chemical or non chemical methods. Chemical methods pose many

Corresponding Author: T.S. Sayed, Department of Entomology, Sindh Agriculture University, Tandojam, Pakistan

environmental hazards. Therefore, non-chemical methods, which are safe for the environment are encouraged. Use of resistant varieties is one of the environmentally safe methods of pest control in stored product pest management. Khapra beetle, *Trogoderma Granarium* and lesser grain borer, *R. dominica* are considered serious pests of stored wheat in many countries including Pakistan causing enormous loss (Azeem *et al*., 1976; Ramzan and Chahal, 1989; Hamed *et al*., 1989; Khattak *et al*., 1995; Basant *et al*., 1986; Baker *et al*., 1991). Varietal resistance in wheat against *T. granarium* and *R. dominica* has been studied by different workers (Hamed *et al*., 1989; Khattak *et al*., 1995, 2000; EL-Halfawy and Hassan, 1981; Irshad *et al*., 1988; Ramzan *et al*., 1991) which may be governed by a few or a complex of mechanisms involving interactions of various physical, physiological and biochemical factors. Present study was carried out to determine the varietal resistance of wheat varieties against Khapra bettle, *Trogoderma Granarium* and lasser grain borer, *Rhizopertha dominica* in twelve commercially grown varieties. The result will provide information for the benefit of farming and scientific communities in the formation of strategies for evolving insect resistant wheat varieties.

MATERIALS AND METHODS

The present study was carried out to determine the relative resistance of 12 wheat varieties vis, Sarsabz, AZS-4, Zardana, Yekora, Soghat, Sonalika, TJ-0787, Pak-70, Tandojam-83 Mehran-89, Abadgar and Anmol, against Khpra bettle, *T. granarium* and lasser grain borer, *R. dominica*, separately from October 15, 2003 to February 14, 2004. The samples of wheat varieties were obtained from two research organization, Nuclear Institute of Agriculture and Agriculture Research Institute, Tandojam. The material was brought into the laboratory and treated with heat treatment to eliminate any prior infestation before starting the experiment. Sample of each variety weighting 150 g. were put in 300 g capacity glass jars.

Neonate larvae (36 h) of *T. granarium* and newly molted adults of *R. dominica* were obtained from the stalk cultures and a batch of 10 insects of each species was released separately in each jar. The experiment was laid out in completely randomized design with three replications for each treatment. A control without insects was also kept for each treatment. The experiment was conducted in a walk-in environmental chamber maintained at 30±1°C and 60-65% RH. Observations of population growth, grain damage and weight loss were recorded at monthly intervals. For removing frass, the samples were sieved through a 60-mesh sieve. Sound and infested grains were separated and weighted. Percent damage and weight loss were calculated according to the method of Khattak *et al.* (1987). The data obtained were statistically analyzed using ANOVA and DMR test by computer. The coefficient of correlation between various parameters was also determined (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

The results of mean progeny development of *T. granarium* and *R. dominica*, their % damage and % weight loss caused to different wheat varieties (Table 1) revealed that none of the variety was completely immune to pest infestation, however, their resistance varied significantly ($P<0.05$). The maximum and significantly higher progeny of *T. granarium* was recorded in TJ-0787 (504.0), it was followed by varieties Sarsab, Sonalika and AZS-4 with *T. granarium* population of 390.41, 190.58 and 133.0, respectively. The population development of pest was significantly ($P<0.05$) different in each variety. The minimum and significantly lower population (28.83) of pest was recorded in Mehran-83, while the pest population in remaining varieties was higher, significantly different from each other but over- lopping.

The progeny development of *R. dominica* in different varieties of wheat varied significantly. The maximum pest population was observed in TJ-0787 (777.58) followed by 767.06, 694.00 and 692.10 recorded in Sarsabz, Zardana and Yekora, respectively, which were not significantly ($P<0.05$) different from each other (Table 1). Significantly lower progeny of 507.33, 481.33 and 473.10 was recorded in AZS-4, Soghat and Tandojam -83, respectively. Significantly the least population (96.41) was recorded in Mehran-89 followed by Anmol. The remaining varieties had pest population higher than these varieties.

The percent grain damage caused by *T. granarium* shown in (Table 1) varied significantly ($P<0.05$). The highest and lowest grain damage were sustained by the varieties TJ-0787 and Mehran-89 which was 30.60 and 4.33% respectively. Grain damage in remaining varieties was in between these extremes and differed significantly. The damage caused by *R. dominica* also varied significantly ($P<0.05$) in different varieties of wheat. The maximum damage (45.75%) was recorded in Sonalika, while the minimum damage (17.91%) in Mehran-89. The remaining varieties were intermediate in their response to grain damage by *R. dominica*.

Table 1: Progeny development, grain damage and weight loss by *T. granarium* and *R. dominica* in different wheat varieties

	Progeny developed (No.)		Grain damage (%)		Weight loss (%)	
Varieties	*T. granarium*	*R. dominica*	*T. granarium*	*R. dominica*	*T. granarium*	*R. dominica*
Sarsabz	390.41b	767.06a	26.25b	43.08ab	2.65a	12.42a
AZS-4	133.00d	507.33b	17.16c	34.83b	1.76c	7.80c
Zardana	67.08f-h	694.00a	12.83d	42.75ab	1.12d	9.69b
Yekora	61.41f-h	692.10a	11.26de	34.83b	1.17d	9.40b
Soghat	48.91-f-h	481.33b	8.91ef	36.00b	0.95de	6.27c
Sonalika	190.58c	414.41bc	19.25c	45.75a	2.39b	9.07b
TJ-0787	504.00a	777.58a	30.66a	44.35ab	2.78a	9.32b
Pak-70	83.08ef	406.50bc	11.41d	37.41ab	0.63fg	3.72e
Tandojam-83	117.60de	473.10b	10.50de	39.56ab	0.75ef	6.14d
Mehran-89	28.83h	96.41d	4.53g	17.91c	0.43g	1.53f
Abadgar	77.16fg	303.10c	10.75de	36.50ab	0.73ef	4.38e
Anmol	39.66gh	172.58d	7.33f	20.83c	0.49g	3.24e

Means followed by same letters are not significantly (P<0.05) different from each other by DMR

Table 2: Coefficient of correlation between different parameters of *T. granarium* and *R. dominica* and wheat varieties

Parameters	Percent moisture		Progeny development	
	T. granarium	*R. dominica*	*T. granarium*	*R. dominica*
Percent grain damage	0.460**	0.443**	0.936***	0.903***
Percent weigh loss	0.449**	0.428**	0.851***	0.946***
Progeny development	0.477**	0.468**		

** = Significant at P<0.01; *** = Significant at P<0.001 levels

The maximum grain weight loss (2.78%) caused by *T. granarium* was recorded in TJ-0787, while the minimum weight loss was 0.43%, which was observed in Mehran-89. The grain weight loss in different varieties caused by *T. granarium* varied significantly (P<0.05). Similarly, the grain weight loss sustained by different wheat varieties due to infestation of *R. dominica* also varied significantly (P<0.05). The maximum weight loss (12.42%) was recorded in Sarsabz followed by 9.69, 9.40 and 9.32% in Zardana, Yekora and TJ-0787, respectively, while the minimum weight loss was found in Mehran-89 which was 1.53% (Table 1).

The correlation studies carried out between different parameters of *T. granarium* and *R. dominica* and wheat varieties (Table 2) revealed that there was a highly significant (P<0.01) positive correlation between percent grain damage and percent moisture and progeny development, percent weight loss and percent moisture and progeny development and percent moisture of grain of different wheat varieties.

Physico-Chemical properties of grain of different wheat varieties vary significantly (Khattak *et al*., 2000) which have important bearing on the degree of resistance against storage insect pests. Storage insect pests also respond differently to different varieties of wheat, depending upon their biology and feeding behaviors. In present study, the highest *T. granarium* and *R. dominica* populations were recorded in variety TJ-0787 which could be regarded as comparatively the most susceptible variety, while Mehram-89 having supported the least pest population of both pest species may be considered the comparatively resistant variety. Bains *et al.* (1971) reported that suspectibility of wheat varieties was associated with softness of germplasm of grain and high carbohydrate content, while Mamedov and Shapiro (1978) observed that wheat varieties possessing high lysine contents were the most susceptible. Basant *et al.* (1986) studied resistance of 20 wheat varieties against *R. dominica* and found Sonalika one amongst the susceptible varieties. Similar results were obtained in present study. Sharma *et al.* (1988) screened wheat varieties against *T. granarium* and found cholesterol level of insets higher on resistant varieties. Khattak *et al.* (2000) determined the progeny of *T. granarium* in different lines of wheat and found significant differences in number of insects, developed in different wheat lines.

Varieties Mehran-89 and Anmol suffered significantly the least grain damage and weight loss compared with other varieties in present study. Insect progeny, damage and losses have been considered important parameters for varied resistance of stored grains (Khattak *et al*., 2000). Pringale (1954) recorded 2.7 to 48.5% grain damage in wheat due to *T. granarium S. oryzae* and some other insect pests. Loss of weight ranged from 6.01 to 22.8% in stored wheat due to infestation of *T. granarium* (Badawy and Hassain, 1965).

Variable wheat grain weight loss due to infestation of *T. granarium* and *R. dominica* in different varieties was recorded by Shah (1969). Azeem *et al.* (1976) investigated the relative susceptibility of some wheat varieties to *T. granarium* and *R. dominica* and reported the loss of 7.33 to 18.66% in different varieties. Irshad and Baloch

(1985) reported that 3.6 to 22.5% loss of wheat occurred during storage at different places. Irshad *et al.* (1988) studied loss in public storage in Rawalpindi region and observed that insects which caused most damage were *T. granarium*, *R. dominica*, *S. oryzae* and *T. castanenum*. Khattak *et al.* (2000) determined damage and weight loss in wheat lines and reported a maximum of 92.91% damage and 54.83% weight loss in BWL-91033 line of wheat.

In present study moisture content of grains was one of the important factors in the development of insect pest progeny, grain damage and weight loss in different wheat variety grains with significantly coefficient of correlation (Table 2). Moisture considered a Key to the safe storage of stored grains (Hall, 1970). Findings of present study are supported by studies of Hameed (1983) who found a direct correlation between moisture content of wheat and susceptibility. Baker *et al.* (1991) recorded about 3 fold increase in *R. dominica* frass production on wheat genotypes at 25°C with grain moisture of 14.2% compared with 11.7%, whereas Khattak *et al.* (2000) reported that there was a negative correlation between grain moisture and weight loss.

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