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Evaluation of Wheat Varieties for Resistance to Angoumois Grain Moth, *Sitotroga cerealella* (Olivier) (Lepidoptera: Gelechiidae)

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Abstract.- Grains of twelve promising wheat varieties were evaluated for resistance to Angoumois grain moth, *Sitotroga cerealella* (Olivier) under laboratory conditions (25±2°C and 60±5% RH). The resistance in genotypes was based on the progeny of moths emerged and weight loss of grains. The results revealed that moth population was significantly the lowest with minimum grain weight loss in Chakwal-86 and Blue Silver followed by Pasban-90 and Parwaz-94 indicating resistance to *S. cerealella*. Highest number of moths emerged in Iqbal-99 (159.67) inflicting maximum weight loss (13.75%) followed by Kohistan-97, MH-97, D-97 and Chenab-99. The correlation between moths emerged and grain weight loss in wheat varieties was positive and highly significant (r=0.961). Insect resistance studies during post-harvest storage should be given due consideration in future wheat breeding programmes.

Key words: Wheat grain storage, angoumois grain moth, insect resistance

INTRODUCTION

Wheat being the most important food crop of Pakistan was cultivated on an area of about 8 million hectares with the production of 19.2 million tonnes during 2002-2003 (Baloch, 2003). The procurement and storage of wheat is dealt by public and private agencies to meet food requirement of people round the year. Most of the wheat is retained by the farmers for their own consumption and for seed. The storage capacity in the public sector is inadequate (4.34 million tonnes) (Ahmad and Ahmad, 2002). In addition, the high moisture content of grains (>12%), high atmospheric temperature (25 to 35°C) and relative humidity (>60%) during storage make the environment conducive for proliferation of insect species (Adams, 1998; Ahmad *et al*., 1998; Dars *et al*., 2001). As a result, insects develop rapidly and inflict enormous losses ranging from 5 to 30 percent. Important stored grain insects are beetles (*Trogoderma granarium* Everts, *Rhyzopertha dominica* F.), weevils (*Sitophilus oryzae* L., *S. granarius*) and moths (*Sitotroga cerealella* Oliv.) etc. (Atwal, 1978; Iqbal *et al*., 1998; Khattak *et al*., 2000; Toews *et al*., 2000; Shafique and Ahmad, 2003). Insecticidal / fumigants control of these pests give residues and develop insect resistance. To reduce grain losses in stores, resistant or less susceptible varieties are of particular interest for resource poor developing countries. Lot of variation has been reported in grains for resistance to storage insects (Shafique and Ahmad, 2003). Twelve promising wheat varieties were, therefore, evaluated for resistance to Angoumois grain moth, *Sitotroga cerealella* (Olivier) under controlled laboratory conditions.

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MATERIALS AND METHODS

The studies were conducted at Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad during 2003. Twelve promising wheat varieties (Chakwal-86, Blue Silver, Pasban-90, Inqlab-91, Parwaz-94, Punjab-96, D-97, MH-97, Kohistan-97, Auqab-99, Chenab-99 and Iqbal-99) procured from Wheat Research Institute (WRI), Faisalabad were screened for resistance to Angoumois grain moth, *Sitotroga cerealella* (Olivier) under laboratory conditions (25±2°C and 60±5% RH). Clean wheat samples were preconditioned at 5°C for two weeks. Four samples (20 g each) of each wheat variety were kept in 150 g capacity glass jars covered on top with fine perforated tin lids. Two hundred eggs (one day old) of *S. cerealella* were glued to white cards (3.5x8.5 cm) and placed in 3 jars of each wheat variety, while fourth one was kept as untreated control. On

hatching, larvae entered wheat grains. After 12 days, the cards were examined under binocular microscope and hatched eggs were recorded. When adult emergence started, moth population was recorded with 2-3 days intervals till the completion of one generation (*i.e.* from 30 to 45 days) in various wheat varieties. Percent adult recovery was calculated from hatched larvae and grain weight loss (%) in infected wheat samples was determined according to the method of Khattak *et al*. (1987). The data on egg hatch, moth emergence, adult recovery and grain weight loss were subjected to analysis of variance and means were compared using Duncan's multiple range test at 5% level of significance. Coefficient of correlation (r) between various parameters studied were computed (Steel and Torrie, 1980).

RESULTS

The number of eggs hatched, moth emergence, percent adult recovery of Angoumois grain moth (*Sitotroga cerealella*) and grain weight loss in different wheat varieties (Table I) varied significantly ($P \leq 0.05$). Moth progeny and adult recovery were significantly the lowest with minimum weight loss in Chakwal-86 and Blue Silver followed by Pasban-90 and Parwaz-94 indicating resistance to the insect pest attack. Contrarily, the highest number of moth emergence (159.67) and adult recovery (93.89%) was recorded in Iqbal-99 inflicting maximum grain weight loss (13.75%) followed by Kohistan-97, KH-97, D-97 and Chenab-99.

The correlation (r) (Table II) between hatched larvae and moth emergence (-0.747) hatched larvae and percentage adult recovery from hatched larvae (-0.803) and hatched larvae and grain weight loss (-0.659) were negative. These negative associations indicated that larval development was drastically hampered at early stage in some wheat varieties. Thereby, less moth emergence and consequently low grain weight loss was recorded. The correlation (r) between *S. cerealella* moths emerged in wheat varieties and adult recovery from hatched larvae (0.996) and between moths emerged and grain weight loss (0.961) caused by developing larvae were positive and significant. Similarly, the correlation between moth recovery and grain weight loss (0.951) was also positive and significant. The higher moth emergence and grain weight loss in some wheat varieties (Iqbal-99, MH-97, Auqab-99 and Kohistan-97) exhibited susceptibility to the insect.

DISCUSSION

Cereal grains resistance to storage insects have been assessed by many parameters such as insect oviposition preference for grain, egg hatch, insect progeny and grain weight loss (Shafique and Ahmad, 2003). Difference in number of moth progeny and grain weight loss were recorded in wheat varieties. This clearly showed that wheat genotypes varied significantly for resistance to *S. cerealella* larvae. The minimum moth progeny was produced in Chakwal-86 and Blue Silver followed by Parwaz-94 and Pasban-90 and likewise lesser grain weight loss was recorded. However, none of the varieties showed complete resistance to the insect. Grains of Iqbal-99, Kohistan-97, MH-97, D-97 and Chenab-99 harbourd high number of moth progeny and consequently suffered high weight loss. Many workers found differential reproduction of stored insect species in different varieties of wheat (Ram and Singh, 1996; Toews *et al*., 2000; Khattak *et al*., 2000). Egg hatch had negative correlation with moth emergence/adult recovery and weight loss. It showed that many hatched larvae died in their early development and did not reach adult stage. Consequently, low weight loss occurred in wheat varieties. This resistance, therefore, appears to be due to antibiosis to the neonate larvae.

Wheat grain resistance to storage insects is a complex phenomenon which can be attributed to various physico-chemical characteristics of a variety, insect species and abiotic factors (El-Dessuki and El-Kifl, 1976; Khattak and Shafique, 1981; Hamed and Khattak, 1997; Khattak *et al*., 2000; Ahmad and Ahmad, 2002). Toews *et al*. (2000) suggested that small kernels from the same wheat cultivar produced larger progeny of *Rhyzopertha dominica* compared with large kernels. Hardness could be one of the parameters of kernels which may influence the ability of stored grain insect, such as *Sitophilus oryzae* (L.), to reproduce

Table I.- Resistance in wheat varieties to Angoumois grain moth, *Sitotroga cerealella* (Oliv.).

Wheat varieties	Egg hatch (number) out of 200 eggs	Moths emergence (number)	Adult recovery from hatched larvae (%)	Grain weight loss (%)
Chakwal-86	179.33 a	83.67 c	46.69 d	5.52 h
Blue Silver	179.67 a	87.00 c	48.46 d	6.50 gh
Pasban-90	179.33 a	127.00 b	70.85 c	8.67 f
Inqlab-91	178.00 ab	135.00 b	75.83 bc	10.70 de
Parwaz-94	173.33 abc	121.33 b	70.17 c	7.55 fg
Punjab-96	167.33 c	134.67 b	80.49 b	9.64 e
D-97	171.33 abc	158.00 a	92.24 a	12.88 abc
MH-97	169.67 abc	158.33 a	93.30 a	13.28 ab
Kohistan-97	172.67 abc	159.00 a	92.08 a	13.53 a
Auqab-99	168.67 bc	157.00 a	93.06 a	12.00 bcd
Chenab-99	166.67 c	152.00 a	91.21 a	11.47 cd
Iqbal-99	170.00 abc	159.67 a	93.89 a	13.75 a

Mean values sharing similar letters in each column are non-significant ($P \leq 0.05$).

Table II.- Correlation coefficient (r) between various parameters of *S. cerealella* (Oliv.) and wheat varieties.

Parameters	Moths emergence (number)	Adult recovery from hatched larvae	Grain weight loss (%)
Egg hatch (number)	-0.747**	-0.803**	-0.659*
Moth emergence (number)	-	0.996**	0.961**
Adult recovery from hatched larvae (%)	-	-	0.951**

*Significant at 5% level; **Significant at 1% level.

in wheat (McGaughey *et al*., 1990). However, Toew *et al*. (2000) reported that physical factors (Kernel hardness, diameter and weight) and protein did not correlate significantly to *R. dominica* progeny production in wheat cultivars. Schoonhoven *et al*. (1976) concluded that resistance in maize karnels to the maize weevil was due to non-preference and lack of feeding stimulus. Undamaged pericarp acted as barrier (hardiness) against feeding and subsequent oviposition. The antifeedant effect of phenolic compounds caused resistance in maize (Ranason *et al*., 1992) and rice (Shibuya, 1984) to storage insects. Therefore, elite wheat genotypes should be tested for resistance to stored grain insects. High yielding and storage insect resistant varieties would be helpful to curtail the use of pesticides during post-harvest stage. It is recommended that studies on the reaction of grains to storage insects is made a part of variety release proposal.

REFERENCES

ADAMS, C.A., 1998. Deterioration of stored feed grains. *Poult. Int.*, **37**: 32-36.

AHMAD, M. AND AHMAD, A., 2002. Storage of food grains. *Farm. Outl.*, **1**: 16-20.

AHMAD, M., IRSHAD, M. AND SHAHID, M., 1998. Loss assessment in stored wheat in three villages of Gilgat. *Pakistan J. Zool*., **30**: 41-46.

ATWAL, A.S., 1978. *Insect pests of stored grain and their products*. Kalyani Publisher, New Delhi, India. pp. 367-390.

BALOCH, Q.B., 2003. Wheat perspective. *Farm. Outl.*, **3**: 3-5.

DARS, F., RUSTAMANI, M.A., KHURO, R.D. AND BALOCH, H.B., 2001. Effect of wheat grain moisture on infestation of red flour beetle, *Tribolium castaneum* (Herbst.). *Pakistan J. Zool*., **33**: 189-192

EL-DESSOUKI, S.A. AND EL-KIFL, A.H., 1976. *Sitotroga cerealella* Oliv. (Lep., Gelechiiae) infestation and its influence on certain chemical and physical properties of stored wheat in Egypt. *Z. angew. Ent*., **80**: 83-88.

HAMED, M. AND KHATTAK, S.U., 1997. Evaluation of resistance in wheat genotypes to Angoumois grain moth, *Sitotroga cerealella* (Oliv.). *The Nucleus*, **34**: 165-168.

IQBAL, M., KHATTAK, S.U., KHALIL, S.K., HUSSAIN, N. AND HAMED, M., 1998. Combined infestation and losses caused by three storage insects in Pak-80 wheat variety. *The Nucleus*, **25**: 23-26.

KHATTAK, S.U.K. AND SHAFIQUE, M., 1981. Susceptibility of some wheat varieties to Angoumois grain moth, *Sitotroga cerealella* (Olivier) (Lepidoptera: Gelechiidae). *Pakistan J. Zool*., **13**: 99-103.

KHATTAK, S.U., HAMED, M., KHATOON, R. AND MOHAMMAD, T., 1987. Relative susceptibility of different mung bean varieties to pulse beetle, *C. maculates* (F.). *J. Stored Prod. Res*., **23**: 139-142.

KHATTAK, S.U., SAHAR, K., KARIM, U., AHMAD, S., AMAN, U.K. AND JABBAR, A., 2000. Appraisal of rain fed wheat lines against khapra beetle, *Trogoderma granarium* Everts. *Pakistan J. Zool*., **32**: 131-134.

McGAUGHEY, W.H., SPEIRS, R.D. AND MARTIN, C.R., 1990. Susceptibility of classes of wheat grown in United States to stored grain beetles. *J. econ. Ent*., **83**: 1122-1127.

RAM, C. AND SINGH, U.S., 1996. Resistance to *Trogoderma granarium* in wheat and associated grain characteristics. *Indian J. Ent*., **58**: 66-73.

RANASON, J.T., GALE, J., DE BEYSSAC, B.C., SEN, A., MILLER, S.S., PHILOGENE, B.J.R., LAMBER, J.D.H., FUCHER, R.G., SERRATOS, A. AND MIHM, J., 1992. Role of phenolics in resistance to maize grain to stored insects, *Prostephanus truncates* (Horn) and *Sitophilus zemais* (Motsch.). *J. Stored Prod. Res*., **28**: 119-126.

SCHOONHOVEN, A.V., HORBER, E. AND MILLS, B., 1976. Conditions modifying expression of resistance of maize kernels to the maize weevil. *Environ. Ent.*, **5**: 163-168.

SHAFIQUE, M. AND AHMAD, M., 2003. Susceptibility of milled rice genotypes to Angoumois grain moth, *Sitotroga cerealella* (Oliv.) (Lepidoptera: Gelechiidae). *SAARC J. Agric*., **1**: 193-197.

SHBUYA, N., 1984. Phenolic acids and their carbohydrate esters in rice endosperm cell walls. *Phytochemistry,* **23**: 2233-2237.

STEEL, R.G.D. AND TORRIE, J.G., 1980. *Principles and procedures of statistics,* McGraw Hill Book Inc., New York.

TOEWS, M.D., CUPERUS, G.W. AND PHILLIPS, T.W., 2000. Susceptibility of eight U.S. wheat cultivars to infestation by *Rhyzopertha dominica* (Coleoptera: Bostrichidae). *Environ. Ent*., **29**: 250-255.

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