Pak. J. Agri. Sci., Vol. 39(1), 2002

STUDIES ON THE RELATIVE SUSCEPTIBILITY OF WHEAT VARIETIES TO *SITOTROGA CEREALELLA* (OLIV.)

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The susceptibility of six wheat varieties to *Sitotroga cerealella* (Oliv.) was studied under laboratory conditions. The results obtained on the basis of moth emergence, percent damaged grains and percent grain weight loss showed that owing to least damaged grains the variety MH-97 was considered less susceptible whereas Inqlab-91 was highly damaged. A significant correlation between the moth emergence and developmental period of insect with grain size, damage and other biochemical factors concerning grains was also found, however, correlation pattern was not uniform for all variables in different varieties under investigation.

Key words: susceptibility to *S. cerealella*, wheat varieties

INTRODUCTION

The stored wheat is attacked by a number of pest insect species under available storage facilities in Pakistan. Besides many coleopterous beetles, Angoumois grain moth (*Sitotroga cerealella* Oliv.) has become a serious problem (Ahrnad, 1982; Khattak et al., 1996). Cereals and their varieties vary in susceptibility and attraction to stored grain insects depending upon their physico-chemcial structures. These have an effect on the biology of pest insect species. The shape. size. density, protein, carbohydrate and fat contents of the grain, presence of enzyme inhibitors (proteinase inhibitors) and antioxidants were reported to be the most important factors in terms of susceptibility to stored grain insects (Chatterji et aI., 1977; Khattak and Shafique, 1981; Khattak et aI., 1996; Ram and Singh, 1996). Probably no attention has been given to aspects related to biochemical resistance of the grain to S. *cerealella* in Pakistan (Khattak and Shafique, 1981; Tirmizy et aI., 1989; Khattak et aI., 1996). The present studies on the susceptibility/resistance of different prominent local wheat varieties to the infestation of S. *cerealella* were undertaken with an objective to determine the possible damage by S. *cerealella* to the stored wheat varieties.

MATERIALS AND METHODS

The grains of six wheat varieties viz. Chakwal-86, Inqlab-91, Parwaz-94. Punjab-96, MH-97 and Aqab-2000 were obtained from the Wheat Directorate, Ayub Agricultural Research Institute, Faisalabad. Samples of all the varieties were conditioned for two weeks before experimentation. Also, moisture content and grain size were determined pre-treatment.. Freshly laid eggs of S. *cerealella* were obtained from the Entomology Division, Nuclear Institute for Agriculture and Biology, Faisalabad. The eggs were counted with the help of a binocular microscope and papers carrying 100 eggs each were placed in each 200 g sample of all the test varieties placed in glass jars covered at the top with a muslin cloth. The experiment was designed in four replications with a control allotted to each variety. All the samples seeded with eggs were kept at 28±2°C and 65±5% R.H. Moth emergence started 22 days after seeding and continued to 35 days. Moths were counted after first generation, because thereafter, many of the moth carcasses were impossible to count.. The experiment was continued to second generation and moth emergence was counted up to 70 days. Moth counts of first and second generation were combined. Percent damage and weight loss were calculated according to the method of Khattak et al. (1996). Protein, fat, crude fibre and moisture contents were determined according to A.O.A.C. (1984). The data were subjected to statistical analysis. DMR test was used to test the significance of the means by MStat computer programme.

RESULTS

The results (Table I) revealed that percent weight loss was significantly lower in variety MH-97 (2.82%) followed by Aqab-2000 (4.38%) and Chakwal-86 (4.70%), while it was significantly higher in Inqlab-91 (12.91 %) followed by Punjab-96 (10.82%) and Parwaz-94 (8.95%). The results regarding percent damage and number of moths emerged were almost of the same order as observed in percent weight loss. The variety MH-97 was significantly less damaged, while Inqlab-91 was significantly more susceptible. Similarly, minimum number of moths (354) were recorded in MH-97 followed by Aqab-2000 (426), however, the maximum number was in Inqlab-91 (1941). The data on grain size (number in 50g grains) indicated that the varieties Punjab-96 and Inqlab-91 had less number in 50g grains and the developmental period was significantly shortened, whereas the variety Parwaz-94 had large grains but did not differ significantly from Inqlab-91 in developmental period. The. protein and moisture contents were high in varieties Inqlab-91 and Punjab-96, with low fat contents as compared to MH-97

The results (Table 2) indicated that the developmental period of S. *cerealella* showed negative correlation with percent damaged grains in all varieties except MH-97, whereas moth emergence of S. *cerealella* showed positive correlation with percent damaged grains in all varieties except in Inqalab 91. However, there was no uniform pattern of correlation between the variables in all the varieties.

Table 1. Comparison of varieties for moth emergegence, developmental period, number in 50g grains, grain damae:e, weight loss, moisture content, crude fibre, Protein and fat contents

Varieties	No. of moth Emerged	Developmental period (days)	No. in 50g grains	Damaged grains (%)	Weight loss (%)	Moisture (%)	Crude fibre (%)	Protein (%)	fat (%)
Chakwal-86	764 d	31.00 a	1463 b	11.69 d	4.70 d	7.07 d	1.962 e	11.90 b	1.90 b
Inqlab-Sl	1941 a	22.75 d	1278 e	33.81 a	12.91 a	8.95 a	1.910 e	12.02 a	1.62 d
Parwaz-94	1127 e	23.75 d	1346 d	22.04 e	8.95 e	8.85 a	2.030 b	11.85 he	1.88 b
Puniab-96	1723 b	26.75 be	1261 l'	30.19 b	10.82 b	8.90 a	1.920 e	12.02 a	1.84 he
MH-97	354 l'	26.00 e	1375 e	5.73 l'	2.82 e	8.50 b	2.173 a	11.64 b	2.05 a
Aqab-2000	426 e	28.75 b	1488 a	8.62 e	4.38 d	7.95 e	2.178 a	11.80 e	1.81 e

Figures followed by different letter(s) are significantly different at 5% level of significance (DMR test).

Table 2. Linear correlation coefficients between developmental period and moth emergence of *S. cerealella* (Oliv.) and grains characteristics

	Developmental period					
	Wheat varieties					
	Chakwal-86	Inqalab-91	Parwaz-94	Puniab~96	MH-97	Aqab-2000
Damaged grains (%)	-0.15	-0.92	-0.80	-0.38	0.38	-0.30
Grain size	-0.94	0.01	-0.04	-0.26	0.87	-0.04
Protein	0.94	-0.42	0.75	-0.63	0.26	-0.54
Fat	0.86	0.28	-0.13	0.65	-0.45	0.19
Crude fibre	0.86	0.24	0.00	-0.09	0.36	-0.10
Moisture contents	-0.43	0,32	-0.05	0.76	-0.74	-0.26
	Moth emergence					
Damaged grains (%)	0.86	-0.84	0,49	0.84	0.06	0.84
Grain size	0.38	-0.39	0.87	-0.00	0.76	0.08
Protein	-0.57	-0.10	-0.62	0.15	-0.15	0.06
Fat	-0. I9	0.65	-0.90	-0.54	-0.78	-0.94
Crude fibre	-0.66	0.19	0.02	-0.62	-0.12	-0.16
Moisture contents	0.74	0.07	0.92	-0.75	-0.74	-0.28

DISCUSSION

The index of susceptibility of the wheat varieties to S: *cerealella* as given in literature is percent weight loss, percent damage and adult emergence (El-Dessouki and El-Kifle, 1976; Sardar, 1976; Chatterji et al., 1977; Cogburn, 1977; Khattak and Shafique, 1981; Mohapatra and Khare, 1989). There. is no rationale behind the various indices evaluated. It appears to be the choice of a research worker and feasibility' of experimental conditions. However, the present studies encompass all these three factors i. e. percent damage, percent weight loss and adult emergence to determine the susceptibility of wheat varieties. Therefore, these results fully support the research findings of the earlier workers for their evaluation parameters, and they have stressed upon combination of these factors to be studied simultaneously (lrshad, 1988; Khattak et aI:, 1996, 2000).

The physico-chemical nature of the grains such as size, structure, texture, colour and chemical constituents are related with these evaluation parameters in the susceptibilitY/resistance of wheat varieties to S: *cerealella.* In this regard, grain size substantiates the above hypothesis. The varieties Inqlab-91 and Punjab-96, with larger grain size (less number of grain/SOg) were found to be significantly more susceptible to S. *cerealella* than the varieties Chakwal-86, MH-97 and Aqab-2000 with smaller grain size. These results are in conformity with those of Khattak and Shafique (1981); Khattak et al. (1996). Large-sized grain varieties are usually loosely packed, having more space for moths' movement and a greater surface area for oviposition. That is why they are most preferred and hence most susceptible (Khattak et al., 1996). Concerning the biochemical nature of wheat, the wheat grain with less protein contents are resistant to damage by S. *cerealella* (Chatterji et al. 1977; Khattak et al., 1996). Moisture content of grain has been found to be a significant determinant of damage by insects of stored grains (Tabassum et al., 1993). However, these studies did not explain physiological basis of resistance to susceptibility to insect pests. A detailed study of life history can explain the importance of these factors in resistance / susceptibility by insects. The possible explanation can be obtained by observing fecundity, number of generations and length of different life stages, and on mortality criteria on varieties with different biochemical constituents. The results of present studies are supported by previous findings, for example, MH-97 with less protein content (11.0%) was comparatively resistant than Inqalab-91 (12.2% protein contents).

There was nouniforin pattern of correlation between developmental period and moth emergence of S. *cerealella* in wheat grain with characteristics such as protein, fat, crude fibre and moisture content of the grain. Therefore, it can be stated that the effect of these characteristics on the biology of the insect is insignificant and some other characters should be looked into for overt relationship between biology of the insect and biochemical constituents of the wheat grain.

The ultimate susceptibility of wheat grains to S. *cerealella* could. not be attributed to one factor, but rather multiple factors may be responsible in one way or the other. A little change in the status of these factors may result in an additive, complementary or antagonistic effect (Pandey et aI., 1980; Tirmizy et aI., 1989; Khattak et aI., 1996).

In light of the above results, it is recommended that the breeders should concentrate more efforts on the evolution of insect resistant varieties. Necessary genetic changes are to be incorporated through induced mutations to resist attack during storage. This will help in reducing the insect losses to a great extent..

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