SUSCEPTIBILITY OF SOME WHEAT GRAIN VARIETIES TO *SITOTROGA CEREALELLA* (OLIVIER) INFESTATION

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Abstract

Sitotroga cerealella (Olivier) is a world wide primer pest of stored grains owing to its high mobility, ability to colonize intact grains as well as infest grains both before and after harvest. The present study aimed to evalute the susceptibility of 13 wheat varieties to attack by this pest. Screening was based on comparing values of susceptibility index (SI), weight loss(%), germination (%)of the tested grain varieties. Also, a correlation were made between SI and the mean grain weight and germination. The obtained results could be categorized into three main groups: the first include the highly susceptible varieties, since it has significant high values of SI as Sedes1and Giza164 (6.43 and 6.14, respect.). These high values are supported by high values in the progeny with a shorter growth duration. The 2nd are representing the least susceptible varieties, which in contrast, has the lowest values of SI and characterized by fewer progeny number with longer growth period. These include BeniSwaif1, Giza168, BeniSwaif3. The 3rd group included rest of the tested varieties, have intermediate SI values and their related parameters. Correlation among grain size and values of SI was non-significant indicating that no relatioship between them, while a significant correlation between SI and germination(%). It is clear that from the obtained findings that there is no completely immune variety, and accordingly application of other safe complementary approches to protect our wheat stocks produced yearly should be cosidered.

INTRODUCTION

The primary purpose of the grain storage is to increase the net value by holding grain until prices are more favorable(Anderson *et al.*, 1995). However, storing grain can also cause the overall quality of the commodity to decrease, thereby is offsetting positive economic returns. Common storage problems include mold and insect infestations (Cuperus *et al.*, 1990) and insects represent the worst problem (Kenkel *et al.*, 1990). In recent years, there has been an increasing interest for developing grain varieties resistant to stored grain insects. Insect resistant varieties would be of special value in developing countries where insecticides are not generally used and where they may be lack of technical knowledge (Seif El-Nasr and Mills, 1985) and avoiding or reducing problems connected with insecticide residues and insecticide resistant strains of insects. Wheat varieties have different levels of resistance or attractiveness to infestation by stored grain insects (Singh and Mathew 1973; Phadke and Bhatia 1975; Amos *et al.*, 1986; McGaughey *et al.*,1990; Cortez-

Rocha *et al.*, 1993). These differences have been explained by many different structural and compositional properties, including kernel hardness, physical characteristics or, chemical composition of the endosperm (Gomez *et al.*, 1983; Mills, 1976; Sinha *et al.*, 1988).

The Angoumois grain moth, *Sitotroga cerealella* (Olivier) is a worldwide pest of stored grains, and the most lepidopteran pest of stored grains. Its pest potential is great owing to its high mobility, ability to colonize intact grains as well as its ability to infest grain both before and after harvest (Weston *et al.,* 1993). The aim of the present work is to evaluate the ability of Egyptian wheat varieties to be infested by *Sitotroga cerealella* in the laboratory.

MATERIALS AND METHODS

1. Stock culture of the test insects: A culture of the *Sitotroga cerealella* (Olivier) was maintained and reared in the Stored Grain Res. Dept. Lab., Plant Protection Res. Instit. on a mixture of the different wheat varieties at 28± 1°C and 60±5 % RH for three generations. Newly laid eggs of *Sitotroga cerealella* were obtained by transferring a group of newly emerged moth adults by an aspirator into 1 kg glass jars containing zigzag-folded strips of black paper. The moths left to oviposit for two days. The laid eggs were separated using a fine camel hair brush and cleaned from frass and scales and incubated in small plastic vials at the rearing conditions until hatching. The separated eggs were used to start new cultures. The latter could also started by releasing adult pairs in glass jars containing the diet at 28± 1°C and 60 ±5 % RH.

2. Source of wheat varieties: Thirteen tested wheat grains varieties were obtained from the Wheat breeding Section of the Field Crop Research Institute, ARC. All the varieties were washed with tap water and left to dry under lab. conditions. All the tested varieties were disinfected by freezing in a deep freezer for two weeks. Sub-samples required for testing were conditioned within an incubator for two weeks at 28± 1°C and 60±5 % RH to equilibrate their moisture content before experimentation.

3. Method of testing susceptibility: Ten replicates, each of fifty seeds were taken from each variety and weighed. This weighed number of grains were put in small glass tubes, five replicates were infested, each with about 25 first instar larvae, that are newly hatched(less than 0- 24 h old) while the other replicates served as control. The tubes were covered with double muslin cloth and held by rubber bands and incubated inside the incubator. After three weeks, the tubes were daily inspected for adult emergence. This to record date of the first adult emergence and counting the emerged adults until no adult emergence.

Determination of susceptibility/ resistance of the tested varieties was determined by calculating the suitability of each diet (variety) to insect development according to the method described by Dobie (1974) and known as susceptibility index (SI) as follows:

$$\text{Susceptibility index(SI)} = \frac{\text{Log S}}{\text{D}} \times 100$$

Where: S= adult emergence (%)
D= mean developmental period (days).

Also, after no adult emergence, the seeds were re-weighed again to calculate the percentage of weight loss ocurred. The seed replicates of each variety were thereafter mixed together and viability of a random selected seed sample/variety was conducted by germination tests, in two replicates of 50 grains each, placed in two 9-cm diameter Petri dishes with water-moistened cotton pad. The number of germinated grains was recorded after one week. Control replicates of each variety were made. Replicates of 50 sound grains were weighed and the mean individual grain weight of each variety was calculated and correlated with SI values.

4. The statistical analysis: The data were analyzed by analysis of variance test(ANOVA) and means separated by Duncan multiple range test, using a computer program of SAS Institute methods as well as the standard error of the means was calculated. A correlation was made between seed weight of the variety, germination(%) and values of SI.

RESULTS AND DISCUSSION

Data concerning the studied biological parameters of the moth such as the susceptibility index, mean developmental period, number of emerged adults and weight loss(%), as well as the germination(%) on the different wheat varieties are shown in Table 1. The obtained results revealed significant differences among the values of the determined characters. The values of susceptibility index were arranged ascendingly. The tested varieties could be differentiated into three groups. The 1st include Sedes1 and Giza164, are the most susceptible ones, since they showed the largest values of the susceptibility index(6.43 and 6.14) with insignificant differences. This result is confirmed by high values of the progeny and shorter developmental periods. The 2nd group included BeniSwaif1, BeniSwaif3 and Giza168, are found the most resistant varieties since they produced the lowest and non-significant values of SI as well as weight loss (%). The 3rd included the rest of the varieties, are intermediate and showed non-significant differences.

The study indicated that there was a direct relation between the susceptibility of the variety and number of adults developed on it. More adults developed on the susceptible variety and this agree with our results and ascertained by work of Khokhar and Gupta 1974. Adult emergence so, is a good criterion of susceptibility of wheat varieties to the moth. The correlation made between the mean weight of the individual grain weight of each variety and SI value(Table2) did not seem to have direct bearing on the susceptibility. The larger-weight kernel is BeniSwaif1 (3.04 g/ 50 grains with mean grain wt. of 0.061 g) has a lowest value of SI (3.41) and while Giza 167(2.19 g/50 grains with a mean grain weight of 0.44 g) is moderately susceptible and its SI value was 5.45 while on the other hand a significant correlation was found between SI and germination (%) . This finding is conflicted with those mentioned by Khare and Agrwal, 1963 and Sinha et al.1988.

In respect to developmental period, in our results, it ranged from 26.6 days (Sids1) to 32.8 days (BenSwaif1), agreed with those of Shazali and Smith, 1985 and others as Cogburn et al.1980. Reasons of resistance of cereal varieties to grain moth infestation were explained by higher amount of lipids (Flores et al.1970) or high amylose content(Cogburn et al.1980) besides many phenotypic characters. From the foregoing results, it is evident that, there is no completely immune variety, and Sedes1 and Giza164 were easily vulnerable to infestation and damage by Sitotroga cerealella (Olivier).

We also conclude that, although there is a wide range of susceptibility in the tested varieties to moth infestation, some varieties retarded insect development by

prolonging its development(Giza163, Durum Sohage1, Gemiza7, Giza168 and BeniSwaif3) while others shortened developmental periods as Sedes1, Giza164 and Giza167. It is clear that from the obtained findings that there is no completely immune variety, and accordingly application of other safe complementary approches to protect our wheat stocks produced yearly should be cosidered.

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Table 1. Susceptibility of 13 wheat grain varieties to development and damage by Sitotroga cerealella (Olivier) at 28±1°C and 60±5%RH.

Wheat Variety	MDP (days)	Adult emergence (%)	Suscepti. Index (SI)	Weight Loss (%)	Germ. (%)	Mean wt. of 50 grains (one grain wt.)
Sids 1	26.6 +0.9e	52.0±5.6a	6.43±0.3a	11.5±1.25b	57	2.45 (0.045)
Giza 164	27.0±1.0de	44.8±3.2abc	6.14±.3.0ab	9.96±0.8bc	38	2.56 (0.051)
Sakha 69	3٠.6±0.8bc	47.2±3.9ab	5.5±0.3bc	9.39±0.3bc	61	2.49 (0.050)
Giza 167	29.6±1.3 cd	40.0±2.8abcd	5.45±.3bc	6.84±0.7bcd	57	2.19(0.044)
Sohag 3	٢1.4±0.24abc	39.2±5.4abcd	5.03±0.2cd	18.5±2.9a	47	2.37(0.047)
Sohag Durum 1	33.4±0.9ab	32.8±2.3cde	4.64±0.2cde	6.56±0.72bc	31	2.5(0.050)
Sohag 2	31.6±0.24abc	28.8±2.9de	4.59±0.2de	6.2±1.4bcd	55	2.72(0.054)
Giza 163	34.2±1.7a	34.4±4.3bcde	4.51±0.2de	7.02±0.34bcd	48	2.46 (0.049)
Sakha 93	31.5±0.3abc	24.0±2.8ef	4.4±0.2de	11.6±2.6bc	49	2.5(0.052)
Gemmiza 7	33.2±0.8ab	27.2±4.4def	4.28±0.3de	7.95±3.5cd	42	2.53 (0.051)
Giza 168	33.0±1.2ab	27.0±9.0def	4.2±0.1def	5.12±2.6cd	60	2.25(0.045)
Beni Swaif 3	32.3±0.8abc	21.0±1.9ef	4.1±0.2ef	4.5±1.5cd	63	2.58(0.052)
Beni Swaif 1	32.75±0.5ab	14.0±2.6 f	3.41±0.2f	2.08±0.5d	85	3.04(0.061)

-Data was analyzed statistically by analysis of variance and means separated by Duncan multiple range test. -Different symbols after standard error indicates a significant difference.

Table2. Correlation analysis and Pearson Correlation Coefficients between SI values and germination and meanseed weight.

Parameters	Germination (%)	Susceptibility Index(SI)	Seed weight (gm)
Germination(%)	1.00000 0.0584	0.00030 0.9992	0.53701 0.0
Susceptibility Index(SI)	0.00030 0.4623	1.00000 0.0	-0.022383 0.9992
Seed weight (gm)	0.53701 0.0584	-0.22383	1.00000

حساسية حبوب بعض أصناف القمح المصرية للإصابة بفراشـــــــة الحبـــــــوب

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فراشـــة الحـــبوب مـــن الحشـــرات الأولية الخطيرة لأنها تصيب الحبوب السليمة فى الحقل والمخـــزن بســـبب قدرتهـــا الشـــديدة على الطيران وقدرتها على إصابة الحبوب السليمة فى الحقل والمخـــزن. يهـــدف البحـــث إلى تقييم حساسية ثلاث عشرا صنفا من القمح المصري للإصابة فراشة الحبوب.

وتـــم تقيـــيم حساسية الأصناف على أساس عدد من الصفات البيولوجية للحشرة ، ومنها قيمة دلـــيل الحساســـية، وعدد الحشرات الخارجة، وفترة التكوين وكل من نسبة الفاقد فى الوزن والتلف الحـــادث نتيجة تغذية الحشرات الكاملة وأطوارها غير الكاملة ثم في نهاية التجربة تم تقدير الإنبات للبذور المصابة بهذه الحشرة لمعرفة تأثير هذه الإصابة على حيوية الجنين كما تم دراسة العلاقة بين حجم الحبة(متوسط وزن الحبة) ونسبة الإنبات وقيم دليل الحساسية.

أظهـــرت النتائج وجود فروق معنوية واضحة في الصفات المذكورة. والنتائج يمكن تقسيمها إلى ثلاثة مجموعات:

١.الأصـــناف عالية الحساسة وتشمل سدس١ وجيزة١٦٤ على أساس قيمة دليل الحساسية(٦.٤٣و ٦.١٤على التوالي) و هذه القيم مدعمة بقيم عالية فى عدد الذرية الخارجة من البذور، بجانب قصر واضح فى فترة النمو

٢. الأصـــناف المقاومة نسبيا وتشمل بنى سويف١، جيزة ١٦٨، وبنى سويف ٣، وهذه أظهرت قيم منخفضة فى دليل الحساسية المحسوب وقيمة الفاقد فى الوزن.

٣. المجموعـــة الأخـــيرة وتشمل بقية الأصناف ،وهى متوسطة الحساسية وأظهرت اختلافات غير معنوية في قيمة دليل الحساسية والمتغيرات الأخرى.

بالنسبة للعلاقة بين حجم الحبة وقابليتها للإصابة معبرا عنها بقيم دليل الحساسية ، فقد أظهر التحليل الإحصـــائي عدم وجود علاقة بينهم، ووجود علاقة معنوية بين دليل الحساسية والقدرة علي الإنبات. ولـــم تظهـــر الدراسة الحالية أصناف منيعة تماما للحشرة ، وتوصى الدراسة الحالية بعمل دراسات أخرى واستخدام طرق تكميلية أخرى لحفظ المخزون القومي من الحبوب بطريقة آمنة.