

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

M.A. Gharib

Plant Protection Research Institute, Agricultural Research Center, Dokki, Giza, Egypt

(Manuscript received 6 April 2004)

Abstract

Sitotroga cerealella (Oliier) 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 evaluate 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 Sedesland 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 BeniSwafl, Giza168, BeniSwafl3. 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 relationship 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 approaches to protect our wheat stocks produced yearly should be considered.

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-Hasr 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., 1980; 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. Inst. 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 Dobe (1974) and known as susceptibility index (SI) as follows:

\[
\text{Log } S = \frac{\text{Susceptibility index}}{D} \times 100
\]

Where: 
- **S** = adult emergence (%)
- **D** = mean developmental period (days).
Also, after no adult emergence, the seeds were re-weighted again to calculate the percentage of weight loss occurred. 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 Giza165, 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(Table 2) 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 3.45 while on the other hand a significant correlation was found between SI and germination (%). This finding is in conflict 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 (Sides1) to 32.8 days (BenSwaif1), agreed with those of Shazali and Smith, 1985 and others as Cogburn et al.1960. 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.1960) 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 (Oliver).

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 Sohegy1, Gemiza7, Giza168 and Ben5Walf3) while others shortened developmental periods as Sede1, Giza164 and Giza157. It is clear that from the obtained findings that there is no completely immune variety, and accordingly application of other safe complementary approaches to protect our wheat stocks produced yearly should be considered.

ACKNOWLEDGEMENTS

The author deeply expresses his sincere thanks to Prof. Dr. M. El-Nagar, Director of Plant Protection Research Institute, Agric. Res. Center for providing me with all the facilities. Thanks are also to Staff member of my division and to Prof. Dr. Abo Setta, for help in the statistical analysis.

REFERENCES


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

<table>
<thead>
<tr>
<th>Wheat Variety</th>
<th>MDP (day)</th>
<th>Adult emergence (%)</th>
<th>Susceptibility Index (SI)</th>
<th>Weight Loss (%)</th>
<th>Germ. (%)</th>
<th>Mean wt. of 50 grains (one grain wt.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sids 1</td>
<td>26.6±0.9e</td>
<td>52.0±5.6a</td>
<td>6.4±0.1.3a</td>
<td>11.5±1.2b</td>
<td>57</td>
<td>2.45 (0.045)</td>
</tr>
<tr>
<td>Giza 164</td>
<td>27.0±1.0de</td>
<td>44.8±3.2abc</td>
<td>6.1±3.0ab</td>
<td>9.9±0.8bc</td>
<td>38</td>
<td>2.56 (0.051)</td>
</tr>
<tr>
<td>Salha 69</td>
<td>3.6±0.8bc</td>
<td>47.2±3.9ab</td>
<td>5.5±0.3bc</td>
<td>9.3±0.3bc</td>
<td>61</td>
<td>2.49 (0.050)</td>
</tr>
<tr>
<td>Giza 167</td>
<td>29.6±1.3cd</td>
<td>40.0±2.8bcd</td>
<td>5.4±3.0bc</td>
<td>6.8±0.7bcd</td>
<td>57</td>
<td>2.19 (0.044)</td>
</tr>
<tr>
<td>Sohag 3</td>
<td>71.4±0.74abc</td>
<td>39.2±5.4abc</td>
<td>5.0±0.2cd</td>
<td>18.5±2.9a</td>
<td>47</td>
<td>2.37 (0.047)</td>
</tr>
<tr>
<td>Sohag Dunum 1</td>
<td>33.4±0.9ab</td>
<td>32.8±2.3cde</td>
<td>4.6±0.2cde</td>
<td>6.5±0.7bc</td>
<td>31</td>
<td>2.50 (0.050)</td>
</tr>
<tr>
<td>Sohag 2</td>
<td>31.6±0.24abc</td>
<td>28.8±2.9cde</td>
<td>4.5±0.2cde</td>
<td>6.2±1.8bcd</td>
<td>55</td>
<td>2.72 (0.054)</td>
</tr>
<tr>
<td>Giza 163</td>
<td>34.2±1.7a</td>
<td>34.4±3.1cde</td>
<td>4.5±1.2cde</td>
<td>7.0±0.5bcd</td>
<td>46</td>
<td>2.46 (0.049)</td>
</tr>
<tr>
<td>Salha 93</td>
<td>31.5±0.3abc</td>
<td>24.6±2.8ef</td>
<td>4.4±0.2de</td>
<td>11.5±2.6bc</td>
<td>49</td>
<td>2.50 (0.052)</td>
</tr>
<tr>
<td>Germiza 7</td>
<td>33.2±0.8ab</td>
<td>27.2±4.4def</td>
<td>4.2±0.3de</td>
<td>7.9±3.5cd</td>
<td>42</td>
<td>2.53 (0.051)</td>
</tr>
<tr>
<td>Giza 168</td>
<td>33.0±1.2ab</td>
<td>27.6±9.0def</td>
<td>4.2±0.1def</td>
<td>5.1±2.6cd</td>
<td>60</td>
<td>2.25 (0.045)</td>
</tr>
<tr>
<td>Beri Swafl 3</td>
<td>32.3±0.8abc</td>
<td>21.6±1.0ef</td>
<td>4.1±0.2ef</td>
<td>4.5±1.5cd</td>
<td>63</td>
<td>2.58 (0.052)</td>
</tr>
<tr>
<td>Beri Swafl 1</td>
<td>32.75±0.5ab</td>
<td>14.3±2.6f</td>
<td>3.4±2.02f</td>
<td>2.0±0.5d</td>
<td>85</td>
<td>3.04 (0.061)</td>
</tr>
</tbody>
</table>

- 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.

Table 2. Correlation analysis and Pearson Correlation Coefficients between SI values and germination and meanseed weight.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Germination (%)</th>
<th>Susceptibility Index(SI)</th>
<th>Seed weight (gm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germination(%)</td>
<td>1.00000</td>
<td>0.0584</td>
<td>0.53701</td>
</tr>
<tr>
<td>Susceptibility Index(SI)</td>
<td>0.000030</td>
<td>0.4623</td>
<td>0.0</td>
</tr>
<tr>
<td>Seed weight (gm)</td>
<td>0.53701</td>
<td>-0.22383</td>
<td>1.00000</td>
</tr>
</tbody>
</table>
حسابية حيوب بعض أصناف القمح المصري للإصابة
بفراشة الحبوب

معروس سليمان أحمد غريب

معهد بحوث وكالة النباتات، مركز البحوث الزراعية، الدقي، الجيزة - مصر.

فرشة الحبوب من العضلات الأولية الخطيرة لأنها تسبب الحبوب السلبية في الحقل والمزارع بسبب قدراتها الشديدة على الطيران وقوتها على إصابة الحبوب السليمة في الحقل والمزارع. يهدف البحث إلى تقليح حساسية ثلاث عش سنًا من القمح المصري للإصابة فراشة الحبوب.

وتم تقليح حساسية الأصناف على أساس عدد من الصفات البيولوجية للحشرة، ومنها قيمة
-bo اللذة الحساسية، وعدد الحشرات الخارجية، وقطرة التكوين لكل من نقطة اللذة في الورق والكلفة الحشرات نتيجة تغذية الحشرات الكلامية، وطيف حشرات نفاذية تحمي تقييم الإثبات.

للتوزح، المصابة بهذه الحشرة محرومة تأثير هذه الإصابة على حيوية الحبوب كما تم دراسة العلاقة بين حجم الجناح (الوزن الحي) ونسبة الإثبات وقيمة لحية الحساسية.

أظهرت النتائج وجود فروق معنوية واضحة في الصفات المصيرة، والتي يمكن تقييمها

في ثلاثة مجموعات:

1. الأصناف عالية الحساسة وتتمثل منها 11،12،13 (1.14) ذات عمر 15 يومًا و15 يومًا (على التوالي) و هذه النمادجة يتم علاجها في الوقت كاملاً، بينما نتنبئ بالإثبات.
2. الأصناف عالية الحساسة وتتمثل منها 14،15،16 (1.17) ذات عمر 14 يومًا، وهي تتمثل في

3. المجموعة الأخيرة وتتمثل منها 17،18،19 (1.20) ذات عمر 13 يومًا، وهي تتمثل في

بالنسبة للعلاقة بين حجم الحبوب والقابلية للإصابة محرومة عند حصول دليل الحساسية، فقد أظهر النتاء

الإحصائي عادة وجود علاقة بينهما، يوجد علاقة معنوية بين دليل الحساسية ومقدار على الإثبات.

وقد تظهر النتائج حالة أصناف مثيرة تمامًا للحشرة، وتوصى برعاية الجائحة بعمل دراسات

أخرى واستخدام طرق كيميائية أخرى لتفقد المعذور القلم من الحبوب بطريقة أمنة.