ISSN 1110-0419

Annals Of Agric. Sc., Moshtohor,
Vol. 43(1): 461-468, (2005).

SUSCEPTIBILITY OF BARLEY GRAIN VARIETIES TO *Sitophilus oryzae* (L.) AND *Sitophilus granarius* (L.) INFESTATION

BY

Gharib, M.S.A*. and El-Lakwah, F.A.**

* Plant Protection Research Institute, Dokki, Giza, Egypt.

** Plant Protection Dept., Fac. of Agric. at Moshtohor, Zagazig Univ. Benha Branch, Egypt.

ABSTRACT

Studies were conducted to determine the susceptibility of two types of the Egyptian barley varieties to two post-harvest insect infestations (*Sitophilus oryzae (L.)* and *Sitophilus granarius* (L). The two types were four old covered varieties (Giza 123, Giza 124, Giza 126 and Giza 2000) and three newly naked varieties (Giza 129, G.130 and Gi31) developed by the Egyptian-France project for the naked barley production The tests were conducted using two different weight levels of each variety (10 gm and 20 gm) under non-choice infestation method at 28 ± 1^{0}C and 60 ±5 % RH. The parameters of the evaluation were progeny number, developmental period, growth indices, weight loss (%), damage (%) and parent mortality after a week. The obtained results showed significant differences between the two barley groups for the tested parameters. With all tested weight levels, the naked varieties were the most susceptible compared to covered varieties. The naked varieties were non-significantly different in the value of growth index and the same was found in covered varieties. In respect to 10 gm level, Giza 129 was the most susceptible while Giza 124 was the most resistant at 10 and 20 gm weight levels for both insects. A value of mean developmental duration was found shorter in the naked varieties and significantly longer in covered varieties. More progeny number was emerged from all naked varieties compared to covered varieties. Similar results were obtained with the other parameters as weight loss (%) and grain damage (%). The results revealed that the grain hull was a strong barrier in delaying adult oviposition and larval development, since both groups have the same nutritional composition. On the other hand, the naked varieties were found more susceptible and vulnerable to attack and damage by both *Sitophilus spp.* than covered varieties

INTRODUCTION

Insects are considered one of the most serious threats and 50 % of the annual losses to cereals could be attributable to insects (FAO, 1948). The stored cereals as wheat, maize, rice, barley and sorghum are vulnerable to damage by adults and immature stages of stored grain insects as *Sitophilus spp*. The infested grains are being bored and reduced in their qualities and of reduced weight and so become unfit for human or animal consumption. A presenting need for alternative control measures that don't require toxic chemicals is varietal susceptibility as a factor of the integrated pest management. Barley is a cereal crop of international and local importance since it represents the fourth location after wheat, maize, and rice as a food for humans and animals and in many food industries. The barley crop is characterized by its huge adaptation to environmental factors as insufficient water and high soil salinity and also is non-competitor to wheat which it could be cultivated in desert lands of dry and rainfall climates.

Barley grain varieties cultivated in Egypt are morphologically different and of two types: The first were naked varieties which has no hulls or with a vestigial one, thus the grain is almost naked, these were developed recently for the first time in Egypt in collaboration with the France cereal experts through a research project named the "production of naked barley varieties". These naked varieties were might fill some of the wheat production gap and using it in bread making. The second were the covered varieties in which the grain has a hull or cover that completely enclose it. Such phenotypic characters found between the two groups are expected to influence the rates of insect reproduction and multiplication. Despite of the recent improvement in grain storage practices, the relative susceptibility of both types of barley varieties for post-embryonic development of both *S. oryzae* and *S. granarius* is still unknown, although losses to other crops as wheat caused by *Sitophilus spp.* has studied by many workers(Golebiowska, 1969; Howe. 1963; Hurlock,1965). Resistance of crop varieties to the important insect pests during storage has been studied by number of workers (Koura and El-Halfawy 1972a, Koura and El-Halfawy 1972b, Koura et al., 1972c and Khattack et al., 1995 and Gharib, 2004a and 2004b). The present work aims to screen susceptibility of two groups of barely varieties to infestation by two *Sitophilus spp.* under two different levels of weights/ variety.

MATERIALS AND METHODS

A culture of *S.oryzae* and *S.granarius* were reared and maintained separately on a grain mixture of the different barely varieties used in the present investigation for a three generations before testing in the Stored Grain Insects Res. Dept. Lab, Plant Protection Res. Institute. About four hundred adults were added to the culture jars containing grains and were reseived again after two weeks to start the new cultures in glass jars at 28 ± 1°C and 60 ± 5 % RH. The seven tested barely grain varieties were purchased from the Barely Breeding Section of the Field Crops Research Institute, ARC, MOA. The tested varieties were: three of the naked varieties named Giza 129, Giza 130 & Giza 131, developed in Egypt by Egyptian –France research cooperation and other four varieties with completely covered grains and named Giza 123, Giza 124, Giza 126 & Giza 2000. All the varieties were free from any symptoms of insect's bored grains and were washed with tape water and left to dry under lab. conditions and then kept in a deep freezer for two weeks to destroy any possible hidden infestation. 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. Two weight groups (10 gm and 20 gm) of each variety were made of the conditioned grains. Both groups of 10 gm and 20 gm were infested with newly emerged adults (20 pairs and 30 pairs respectively). These insects left to oviposit for seven days only and then removed with recording its adult mortality (%). Five replicates were made of each variety for each insect. Other similar replicates were made and left without insect to serve as control. The replicates left under lab. conditions for successive three weeks then examined daily to determine mean developmental period of the first emergence and followed by daily counting of the emerged adults. Weight loss (%) was also calculated relative to control by weight difference. Values of growth index were calculated according to Howe (1971) as follows:

$$\text{Index of susceptibility (SI)} = \frac{\log S}{T} x100$$

Where: S = Number of adult emergence, T = Mean developmental period

Grain damage (%) was calculated by withdrawing a random sample of one hundred grains of each variety/ replicate after adult emergence and determining number of grains showing any insect infestation. Those bored grains due to insect feeding were considered as damaged. Weight loss (%) was calculated from the weight difference before and after insect infestation and compared with control. The obtained data were statistically analyzed by ANOVA test and significant means were separated by Duncan's multiple range test, using a computer program as well as the standard errors were calculated (Duncans,1956).

RESULTS AND DISCUSSION

The obtained results of determining susceptibility of barley grain varieties to *S. oryzae* (L.) are presented in Table 1 and 2 and those of *S.granarius* are shown in Tables 3 and 4. Under 20 gm level (Table 1) data showed less adult mortality (%) of *S.oryzae* on the naked varieties (except Giza131) compared with the converse in the covered varieties which reached its maximum in Giza 126 (43.6) after one week of the initial adult release. The naked varieties showed shorter growth duration and higher and significant values of weight loss (%), progeny number, grain damage and growth index compared with the covered varieties. Data of table 2 showed also a similar degree of varietal susceptibility to *S.oryzae* under 10 gm level, as we mentioned before The naked variety Giza 129 was found to be the most susceptible which produced more progeny (108.3) and higher weight loss (20.0)and the calculated growth index value reached 5.2. The covered varieties showed significantly fewer progeny number, weight loss and less values of the growth index. The development of the *S. granarius* (L.) on barley grain varieties under the two levels of available grain are mentioned in Table 3 and 4. Data of table 3 did not show significant differences among both the naked and covered varieties in respect to all other determined parameters. Giza 129 and Giza 130 were considered the most susceptible varieties since both produced or having a higher and non-significant values of the of growth index (Giza 129=4.98 and Giza 130=5.0) while Giza 124 was found the most resistant variety since it gave the lowest values of the growth index (2.56). Data in Table 4 of using 10 gm level/variety were also a confirmatory and compatible with those mentioned before in Table 3. in which all the naked varieties were also more susceptible to *S. granarius* attack compared with the least susceptible covered varieties. The previous results showed significant wide differences between both naked and covered varieties of the Egyptian barley. The naked varieties were more susceptible to attack by both *Sitophilus spp.* These differences could be due to presence or absence of grain shell or hull in the tested varieties. The shell or the cover of the latter group are hard and solid as well as is not easily removed from the grain and completely cover the grain. Also, the shell presumably also contain fine hairs or minute spines that might increase mortality of the active and flying *S.oryzae* adults (Table 1) compared with non-flying *S. granarius* (Table3) and so the grain shell reduces adult life span. The increase of the adult mortality of *S.granarius* (Table 4) might due to a small available space of the test plastic tubes that make the insects continuously contact with each other and so move on the hard spiny surfaces of the covered varieties and so increase its mortality. Our results agree with those mentioned by Nwanze and Horbber (1975), Wiliams and Mills (1980), Mabata (1987) and Locatelli and Limonite (1998). Nwanze and Horber (1975) found that cowpea seed coat is responsible for resisting larval penetration of *Callosobruchus maculates* (F.). Also, undamaged pericarp of sorghum varieties represents the main resistant factor against insects attack by weevils and moths since it has hard and contains high amounts of fibers that are undigested by insects (Locatelli and Limonite (1998). Mbata (1987) also found that the seed coat of groundnut varieties protect it from insects attack. From this study, it was obvious that Giza 129 was the most susceptible variety to both insects on the basis of the growth index and other parameters, while Giza 124 was the least susceptible variety. The grain cover was the main factor of resistance since it affects the insect's performance as oviposition and motility. Finally, using effective protective control methods to protect stocks of naked barley varieties could be recommended, since it was the most susceptible to weevil's infestation and so are more vulnerable to attack by both insects after a short period (one generation) compared with the covered varieties.

Table (1): Susceptibility of barley varieties due to post-harvest infestation by *Sitophilus oryzae* (L.) adults under 20 gm level.

Variety type	Variety Name	Progeny No.	MDP (days)	Growth Index	Weight loss (%)	Grain Damage (%)	Parent mortality (%)
Naked Varieties	Giza 129	236.4± 23.3a	36.2± 0.5a	6.54± 0.2a	23.9± 1.6a	46.5± 3.7a	8.3± 2.8b
	Giza 130	165.6± 7.5b	39.6± 1.3a	5.59± 0.3ab	15.9± 2.6b	33.5± 04b	10.7± 3.4b
	Giza 131	122.4± 7.6b	40.6± 0.9a	5.05± 0.8b	10.6± 2.7c	34.0± 3.3b	25.3± 3.4ab
Covered Varieties	Giza 123	25.8± 1.8c	40.8± 1.9a	3.48± 0.15c	3.0± 0.4d	9.0± 0.9c	31.7± 3.9ab
	Giza 124	13.0± 3.1c	39.8± 2.6a	2.62± 0.48d	1.75± 0.1d	5.0± 1.2c	43.1± 6.3a
	Giza 126	13.2± 3.1c	40.8± 3.02a	2.72± 0.4d	1.75± 0.1d	6.5± 0.9c	43.6± 5.3a
	Giza 2000	31.0± 3.7c	41.0± 2.4a	3.67± 0.3c	3.7± 0.6d	4.0± 0.73c	23.8± 4.5ab

-The data in the table were statistically analyzed by ANOVA test and the means were separated by Duncan's multiple range test. Vertical means followed by the same letters are not statistically different.

-MDP is duration of development (mean developmental period).

Table (2): Susceptibility of barley varieties due to post-harvest infestation by *S. oryzae* (L.) adults under 10 gm level.

Variety type	Variety Name	Progeny no.	MDP (days)	Growth Index	Weight loss (%)	Parent mortality (%)
aNaked Varieties	Giza 129	108.3±8.5a	39.0±0.45b	5.2±0.6a	20.0±1.6a	10.0±2.2a
	Giza 130	60.0±5.1b	40.7±0.3b	4.36±0.1a	11.4±1.5b	8.3±1.3a
	Giza 131	88.7±9.02a	40.0±0.45b	4.86±0.2a	17.67±1.7a	12.5±1.6a
Covered Varieties	Giza 123	6.67±1.5c	43.0±2.5ab	1.89±0.3b	3.2±0.4c	10.0±0.5a
	Giza 124	12.3±0.0c	48.3±3.6a	1.39±0.2b	1.33±0.01c	18.3±0.4a
	Giza 126	8.3±1.0c	42.0±1.0ab	2.14±0.2b	1.67±0.3c	11.7±0.5a
	Giza2000	10.3±2.6c	43.0±0.6ab	2.29±0.3b	3.0±0.6c	5.0±0.0a

The data in the table were statistically analyzed by ANOVA test and the means were separated by Duncan's multiple range test. Vertical means followed by the same letters are not statistically different.

-MDP is duration of development (mean developmental period).

Table (3): Susceptibility of barley varieties due to post-harvest infestation by *S. granarius* (L.) adults under 20 gm level.

Variety type	Variety Name	Progeny No.	MDP (days)	Growth Index	Weight loss (%)	Grain Damage (%)	Parent mortality (%)
Naked Varieties	Giza 129	82.6± 10.4ab	38.2± 0.86b	4.98± 0.14a	9.6± 0.45b	17.6± 1.5b	3.3± 0.0c
	Giza 130	97.4± 9.9a	39.6± 0.24b	5.0± 0.12a	12.6± 1.4a	22.8± 1.9a	4.98± 1.7c
	Giza 131	69.2± 10.2b	38.2± 0.9ab	4.74± 0.14ab	7.7± 1.2b	20.4± 2.3ab	8.58± 0.81abc
Covered Varieties	Giza 123	23.2± 4.02c	41.8± 0.8ab	3.21± 0.14b	4.2± 0.1c	5.2± 0.8c	5.8± 1.4c
	Giza 124	13.4± 2.7c	43.0± 0.0ab	2.56± 0.2b	2.2± 0.3c	7.6± 1.2c	22.4± 2.1a
	Giza 126	15.0± 1.4c	44.2± 1.2b	2.65± 0.15ab	3.0± 0.27c	5.0± 0.2c	9.1± 2.5a
	Giza2000	16.5± 2.5c	41.0± 0.9ab	2.93± 0.2b	4.3± 1.24c	8.4± 1.2c	14.5± 0.5ab

-The data in the table were statistically analyzed by ANOVA test and the means were separated by Duncan's multiple range test. Vertical means followed by the same letters are not statistically different.

-MDP is duration of development (mean developmental period).

Table (4): Susceptibility of barley varieties due to post-harvest infestation by *S. granarius* (L.) adults under 10 gm level.

Variety type	Variety Name	Progeny no.	MDP (days)	Growth Index	Weight loss (%)	Parent mortality (%)
Naked Varieties	Giza 129	42.3±7.2a	40.3±3.6b	4.03±3.6a	16.9±3.6a	46.7±8.2b
	Giza 130	26.0±0.0a	45.0±4.9b	3.19±0.3a	11.7±0.2b	40.0±7.1b
	Giza 131	32.3±3.6a	47.0±3.3ab	3.19±0.2a	11.97±1.b9	56.7±10.8ab
Covered Varieties	Giza 123	5.5±0.2b	48.5±3.5ab	1.92±0.5b	2.87±0.8c	68.3±0.0ab
	Giza 124	3.7±0.2b	49.0±1.9ab	1.56±0.2b	2.5±0.98c	86.7±7.4a
	Giza 126	6.5±0.1b	40.0±5.1b	2.03±0.9ab	3.0±0.11c	85.0±1.5a
	Giza2000	2.0±0.0b	47.0±4.9ab	1.53±0.05b	1.67±0.3c	85.0±5.0a

The data in the table were statistically analyzed by ANOVA test and the means were separated by Duncan's multiple range test. Vertical means followed by the same letters are not statistically different.

-MDP is duration of development (mean developmental period).

ACKNOWLEDGMENT

This work was conducted and supported by the National Project of Integrated Pest Management for Post-harvest pests, financed by EEC Counterpart Funds.

REFERENCES

Duncan, D.B. (1956): Multiple range and multiple F-tests. Biometrics, 11:1-42

EL-Sayed, A.A. (2003): The naked barley. Technical pamphlet (In Arabic, Egypt), No. 733:1-22.

FAO (1948): Preservation of grains in storage (papers presented at the international meeting on infestation of food stuffs, London, 5 – 12 August, 1947.

Gharib, M.S.A. (2004a): Susceptibility of some wheat grain varieties to *Sitophilus oryzae* (L.) infestation. Egypt. J.Agric.Res. 82(1):131-138

Gharib, M.S.A. (2004b): Screening susceptibility/resistance of some wheat grain varieties to *Rhizopertha dominica* (F.) and *Trogoderma granarium* (Everts) infestation. Egypt. J.Agric.Res. 82(1):139-148

Golebiowska, Z. (1969): The feeding and fecundity of *Sitophilus granarius* L., *Sitophilus oryzae* L. and *Rhizopertha dominica* F. in wheat grain. J. stored Prod. Res., 5: 143- 145.

Howe, R.W. (1963): Random sampling of cultures of grain weevils. Bull. Ent .Res., 54, 135- 146.

Hurlock, E.T. (1965): Some observations on the loss in weight caused by *Sitophilus granarius* to wheat under constant experimental conditions. J stored. Prod. Res., 1: 193- 195.

Howe, R.W. (1971): A parameter for expressing the suitability of environment for insect development. J. Stored Prod. Res. 7: 63 – 65

Khattack, S.U.; Hamed Mohamed; Abdu Sattar and Khan, A.U. (1995): Screening of new wheat geretypes against Khapra beetle, *Trogoderma granarium* Everts. Proceedings of the Pakistan congress of Zoology, 15: 87 – 93 (En, 12 refs.).

Koura, A. and El. Halafway, M.A. (1972a): The susceptibility of certain Egyptian wheat varieties to infestation with the rice weevil, *Sitophilus oryzae* (L.), the granary weevil *S. granaries* L. and the lesser grain borer, *Rhizopertha dominica* (F) Agric. Res. Rev. 45 (2):41–48

Koura, A. and El. Halafway, M.A. (1972b): The susceptibility of certain Egyptian maize (*Zea maize*) to infestation with the rice weevil, *Sitophilus oryzea* (L.) the lesser grain borer *Rhizopertha dominica* (F.), and the hast preference of these insects. Agric. Res. Rev. 45 (2): 49 – 55.

Koura, A.; El. Halafway, M.A. and El .Askalany, S.A. (1972c): The susceptibility of certain varieties of Egyptian rough rice *Oryza sativa* (L.) to infestation with *Sitophilus oryzae* (L.) , *Sitophilus granarius* (L.) and *Rhizopertha dominica* (T.). Agric. Res. Rev. 45 (2): 67 – 75.

Locatelli, D.P. and Limomta (1998): Development of *Ephestia Kuehniella* (Zeller), *Plodia interpunctella* (Hubner) and *Corcyra cephalonica* (stainton) (Lepiddptera: Pyralidae) on Kernels and wheat meal flours of *Fagopyrum esculentum* (Moench) and *Triticm aestirum* (L.). J. Stored Prod. Res. 34 (4): 269 – 276.

Mbata, G.N. (1987): Studies on the susceptibility of groundnut varieties to infestation by *Plodia interpunctella* (Hubner) (Lepidoptera: Pyralidae). J. Stored Prod. Res. 23 (1): 57 – 63.

Nwanze, K.F. and Horber, E. (1975): Laboratory techniques for screening cowpea for resistance to *Callosobruchus maculatus* F. Envir. Ent., 4: 415 – 419.

Williams, J.O. and Mills, R.B. (1980): Influences of mechanical damage and repeated infestation of sorghum on its resistance to *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae) J. Stored Prod. Res. 16 (1); 51: 53

قابلية إصابة بعض أصناف الشعير المصرية بسوسة الأرز وسوسة الحبوب

محروس سليمان غريب* ، فارس أمين محمد اللقوة**

* معهد بحوث وقاية النبات – الدقي – جيزة – مصر

** قسم وقاية النبات-كلية الزراعة بمشتهر-جامعة الزقازيق فرع بنها- مصر.

الشعير من محاصيل النجيليات ويحتل المركز الرابع دوليا من حيث الأهمية بعد القمح والذرة الشامية والأرز حيث يستخدم كغذاء للأنسان والحيوان ويدخل في كثير من الصناعات الغذائية، كما يتميز بقدرته الواسعة على تحمل الظروف المناخية القاسية كندرة المياه وملوحة التربة، حيث يتم زراعته في الصحراء وفي الأراضي التي لاتزرع بالقمح. وأصناف الشعير الموجودة بمصر نوعان هما الأصناف المغطاة والأصناف العارية ، وتلك الأخيرة تم استنباطها للمرة الأولى في مصر بالتعاون مع

خبراء بحوث محاصيل النجيليات الفرنسية لسد الفجوة القمحية والتي تصل إلى ثمانية مليون طن، حيث يمكن سد بعض من تلك الفجوة باستخدام الشعير في صناعة الخبز (نشرة فنية رقم ٧٣٣ لسنة ٢٠٠٢). والحبوب الناتجة من تلك الأصناف تختلف عن بعضها مورفولوجيا.

أجريت دراسات معملية تحت ظروف ثابتة من الحرارة والرطوبة النسبية لدراسة مدى قابلية الإصابة لسبعة أصناف من الشعير المصرية (ثلاثة أصناف عارية والأربعة الأخرى مغطاة الحبة) للإصابة الحشرية بحشرتي سوسة الأرز وسوسة الحبوب. ونفذت التجربة عند مستويين من الوزن / الصنف (١٠جم، ٢٠جم) وتم إصابة كل من المستويين بالحشرات الكاملة منفصلتين. والنتائج قيمت بتحديد بعض الصفات البيولوجية للحشرتين مثل عدد الحشرات الخارجة ومتوسط فترة التطور وقيمة دليل الحساسية (دليل النمو) ونسبة الفاقد في الوزن ونسبة التلف ونسب موت الأباء بعد أسبوع. وأظهرت النتائج وجود بعض الاختلافات المعنوية في كل الصفات المختبرة بين كل الأصناف العارية والأصناف المغطاة.

وجد من نتائج الأصناف الثلاثة العارية وهى جيزة ١٢٩وجيزة ١٣٠ وجيزة ١٣١ أن جيزة ١٢٩ هو الأكثر حساسية وقابلية للإصابة بالحشرتين . وبالنسبة للأصناف مغطاة الحبة وهى جيزة١٢٣ وجيزة ١٢٤ وجيزة ١٢٦ وجيزة ٢٠٠٠ وجد أن جيزة ١٢٤هو الأقل إصابة بالحشرتين . كل الأصناف العارية كانت أعلي حساسية وعرضة للإصابة بدرجة معنوية مقارنة بالأصناف مغطاة الحبة وذلك عند مستويات الوزن المستخدم بناءا على قيم دليل النمو.وبالنسبة لمدة التطور للحشرات تحت الدراسةفوجد أنها قصيرة على الأصناف العارية وطويلة المدة على الأصناف المغطاة. وأظهرت النتائج أيضاً خروج أعداد كبيرة من الذرية للحشرات المرباة علي الأصناف العارية عن الأصناف المغطاة. وبالنسبة للصفات الأخرى مثل الفقد في الوزن (%) ونسبة التلف كانت مختلفة معنويا بين الأصناف العارية والأصناف مغطاة الحبة، كما أظهر التحليل الإحصائي عدم وجود فروق معنوية لها داخل كل مجموعة. وجد أن غلاف الحبة يمثل أكبر عائق لأنه يعمل على تعطيل وضع البيض وبالتالي خروج أعداد قليلة من الحشرات في الأصناف المغطاة مقارنة بالأصناف العارية والتي هي أكثر حساسية ومعرضة للإصابة والتلف من الأصناف المغطاة.