ISSN 1110-0419

Annals Of Agric. Sc., Moshtohor,
Vol. 45(4): 1697-1703,.(2007).

SUSCEPTIBILITY OF SOME CHICKPEA SEED VARIETIES TO INFESTATION BY *CALLOSOBRUCHUS MACULATUS (F.)* AND *CALLOSOBRUCHUS CHINENSIS (L.)*

BY

Abdel-Aziz, A.E
Plant protection Research Institute, Agriculture Research Center, Doki, Giza, Egypt.

ABSTRACT

The present study was conducted to estimate the susceptibility of six promising varieties of chickpea to infestation by cowpea weevils, *Callosobruchus maculatus* (F.) and *Callosobruchus Chinensis* (L.). Five Pairs of each insect were provided to twenty grams of seeds from each variety and each insect. Five replicates were done. For evaluating the varietal susceptibility, No. of eggs / female, percent hatching, No. of emerged adults and adult emergence (%), developmental period (M.D.P), loss of weight (%), susceptibility indices and damage(%), were recorded.

Results showed obvious significant variation in the susceptibility of both *C. maculatus* and *C. chinensis* at the different varieties. Chickpea varieties showed higher susceptibility to infestation by *C. maculatus* than *C. chinensis*. Also, varieties which had high content of carbohydrates and protein were more susceptible to infestation by *C. maculatus* than *C. chinensis*.

INTRODUCTION

In recent years, searching for environmentally safe methods to control pests has been carried out using alternative of pesticides as well as plant extract, oils *i.e*, also use of biological materials.

Host plant resistance is one of the relative recent methods of pest control (Mahgoub. 1987). It is proved that this method is promising to prevent the injury and to avoid problems caused by insecticides. Varietal resistance of bruchids was reported by many investigators as Nwanze and Horber 1975, Abo Hegazi and Ahmed 1976b, Ahmed *et al.*, 1979, Williams and Mills 1980, Baker *et al.*, 1989, Mahgoub and Khalifa 1991, Sanaa *et al.*, 1995, Ofuy and Credlant 1995, Locatelli and Limonite 1998, Abdel-Latif and Nemat, 2003.

The present work determines the susceptibility of certain chickpea varieties to post-harvest infestation by *Callosobruchus maculatus* F. and *Callosobruchus Chinensis* L. under laboratory conditions.

MATERIALS AND METHODS

1- Insect cultures:

Laboratory strain of the cowpea weevils *Callosobruchus maculatus F.* and *Callosobruchus chinensis L.* were used in the experiments. Cultures of insects were reared on mixtures of chickpea varieties at 28± 2°C and 65± 5% R.H. in the laboratory.

2- Chickpea varieties:

Chickpea seeds varieties were purchased from the Legume Research Dep. Agricultural Research Center, Giza, Egypt.

The present investigation was carried out on six chickpea varieties namely Giza 1, 2, 3, 88, 195 and Giza 531. All varieties were free from symptoms of insects damage and then kept in a deep freezer for two weeks to kill any possible hidden infestation.

3- Biological Experiment:

Newly emerged adults of five pairs (5 females and 5 males) were confined with twenty grams of seeds from each chickpea variety in small glass jars (5 cm diameter × 7.5 cm high). Five replicates for each variety were infested and similar five replicates were left as control.

The jars were covered with muslin cloth held with rubber band, the jars were incubated at 28± 2°C and 65± 5% R.H., all tested adults were removed 15 days after infestation, to allow enough time for eggs hatching and the first instars larvae penetration into the seeds. The number of eggs deposited per female and eggs hatchability were counted. The jars were reinsulated for another two weeks and checked daily for adult F1-progeny emergence. The emerged adults were removed daily from each glass jars and counted. The developmental period was estimated from the time of egg laying up to adult emergence from the seeds.

4- Susceptibility index (SI):

The total number of emerged adults from each replicate was counted and the percentage of adult emergence was calculated in relation to the number of hatched larvae penetrated into the seeds as follows:

$$\text{Adult emergence} \frac{\text{total number of emerged adults}}{\text{total number of pentrated larvae}} \times 100$$

The duration of developmental period of the immature stages were taken as criteria for calculating the susceptibility index according to (How, 1971 and Dobie, 1974) as follow:

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

Where S = adult emergence %, T= developmental period

The values of obtained susceptibility indices were categorized into five ranks according to Mensah, 1986 as follow:

A. The values between 0.0 – 2.5 are considered resistant (R).
B. The values between 2.6 – 5.0 are considered moderately resistant (M.R).
C. The values between 5.1 – 7.5 are considered moderately susceptible (M.S).
D. The values between 7.6 – 10.0 are considered Susceptible (S).
E. Those > 10.0 are considered highly susceptible (H.S).

Grain damage (%) was calculated by withdrawing a random sample of 50 seeds variety replicates after ceasing adult emergence and seeds with any insect feeding were counted. Those seeds showing any signs of insect feeding were considered as damaged. Weight loss (%) was calculated from the weight difference after insect infestation and change to dry weight loss (%) after subtracting the counted water, as follow:

$$\text{Weight loss (\%)} = \frac{\text{Initial dry weight - Final dry weight}}{\text{Initial dry weight}} \times 100$$

Data were statistically analyzed by ANOVA using SAS computer program and significant means were separated by Duncans multiple range test.

RESULTS AND DISCUSSION

The susceptibility of six seed varieties of chickpea to infestation by *C.maculatus* is shown in table (1). Data showed significant variations in total number of eggs / female Giza 531, Giza 1, Giza 2& Giza 3 had received the highest number of eggs, while Giza 88 and Giza 195 received smaller number of eggs. On the other hand the hatchability percentages were high in all varieties except of Giza 88 and Giza 195.

Percentages of adult emergence in Giza 88 were very low compared with another varieties. At the same time significant differences in percentages of adults emergences were obtained for Giza 531, 2 and 3. While the development period (days) of *C. maculatus* ranged from 24.2 to 25.1 days for all varieties and was not significant. Loss of weight percentage was significant between following varieties (Giza 1 & Giza 531 and Giza2, Giza 3 & Giza 195 while, high significant in variety Giza88.Regarding the SI values,Giza88 is considered resistant (R), but Giza 195 is moderately resistant (MR), While Giza 1, Giza 2, Giza 3 and Giza 531 moderately susceptible (MS).

Results revealed high damaged in Giza 531 (71.4), while in case of Giza 195 and Giza 88 very low damage (22.7&11.5) were recorded and moderately damage in Giza1, Giza 2 and Giza 3 (56, 58.4&57.2) was shown.

Table (2) presents the susceptibility of six chickpea varieties to *Callosobruchus chininsis*(L.). Data indicated significant variations in total number of eggs / female for Giza 1 and Giza 2 which received the highest number of eggs (24.8&24.6), while Giza 3, Giza 195 and Giza 531 received lower number of eggs, but Giza 88 received the lowest number of eggs / female (6.4 eggs/ female).

Table (1): Susceptibility of some chickpea seed varieties to infestation with the cowpea weevils *Callosobruchus maculatus (F.)* at 28± 2°C and 65± 5% R.H.

Chickpea Genotype	*No. of eggs/ female*	*No. of haiched*	*Hatching (%)*	*No. of emerged adults*	*Adult emergence (%)*	*M.D.P (days)*	*Loss of weight (%*	*S.I*	*Damage (%)*
Giza 1	42.8 a	34.2 a	79.9 a	19.2 bc	56.1 D	25.1 a	16.36 a	5.07 ab (MS)	56.0 b
Giza 2	41.6 a	34.2 a	82.2 a	24.2 ab	70.8 b	24.2 a	8.6 b	5.66 a(MS)	58.4 b
Giza 3	39.6 a	34.8 a	87.9 a	25.4 ab	72.9 b	24.8 a	9.0 b	5.46 a (MS)	57.2 b
Giza 88	19.2 b	15.0 b	78.1 b	3.0 D	20.0 c	24.6 a	0.72 c	1.42 c (R)	11.5 d
Giza 195	17.6 b	13.8 b	73.9 bc	11.2 cd	81.2 a	24.6 a	6.84 b	4.04 b (MR)	22.7 c
Giza 531	49.2 a	40.4 a	82.1 a	34.4 a	85.1 a	24.2 a	17.72 a	6.26 a (MS)	71.4 a

Data in the table were statistically analyzed by ANOVA test and means separated by Duncan's multiple range test ** vertical means with the same letters are not significantly different.

Table (2): Susceptibility of some chickpea seed varieties to infestation with the cowpea weevils *Callosobruchus chinensis (L.)* at 28± 2°C and 65± 5% R.H.

Chickpea Genotype	*No. of eggs/ female*	*No. of haiched*	*Hatching(%)*	*No. of emerged adults*	*Adult emergence (%)*	*M.D.P (days)*	*Loss of weight (%*	*S.I*	*Damage (%)*
Giza 1	24.8 a	19.0 ab	76.6 a	14.0 a	73.0 a	30.2 a	4.72 a	3.80 a (MR)	42.3 b
Giza 2	24.6 a	20.4 a	82.9 a	15.2 a	74.5 a	29.6 a	5.36 a	3.97 a (MR)	43.1 b
Giza 3	20.0 ab	15.0 bc	75.0 a	11.2 ab	74.7	30.2 a	4.36 a	3.44 a (MR)	40.8
Giza 88	6.4 c	3.0 d	47.6 c	1.2 c	40.0 c	18.8 b	0.22 b	0.24 b (R)	7.5 d
Giza 195	17.2 b	13.4 c	77.9 a	10.6 b	79.1 a	29.2 a	3.42 a	3.49 a (MR)	18.2 c
Giza 531	19.4 ab	14.0 bc	72.2 b	11.0 ab	76.6 a	28.8 a	4.12 a	3.52 a (MR)	61.5 a

Data in the table were statistically analyzed by ANOVA test and means separated by Duncan's multiple range test ** vertical means with the same letters are not significantly different.

The hatchability percentages were high in all varieties except Giza 88 which showed lower hatchability (47.6). Number of emerged adults in various varieties was significant. Mean developmental period (days) of *C. chinensis* ranged from 28.8, 29.2, 29.6, 30.2, 30.2 days from Giza 531, Giza 195, Giza 2, Giza 3 and Giza 1, respectively, but of Giza 88 was 18.8 days only. Loss of weight was no significant in all varieties, except Giza 88 very low loss weight was recorded.

Regarding the susceptibility values, Giza 1, Giza 2, Giza3, Giza 195 and Giza 531 were moderately resistant, while Giza 88 was resistant to infestation by *C. chinensis.* On the other hand the seed damaged was high in Giza531(61.5%) and very low in Giza88 (7.5%).

Data in Table 1 and 2 showed significant differences between *C. maculatus* and *C. chinensis* at infestation to chickpea varieties for all parameters. Also, Chickpea verities were most susceptible to infestation by *C. maculatus* than *C. chinensis* except Giza 88 variety was resistant to both *C. maculatus* and *C. chinensis.* While, Giza 195 was only moderate resistant for two insects.

The chemical composition of studied genotypes of chickpea seeds (total carbohydrates and total protein) is shown in table (3).

Table (3): Studies of total carbohydrates and total proteins in chickpea genotypes influencing infestation by *Callosobruchus maculatus (F.)* and *Callosobruchus chinensis (L.)*

Chickpea Genotype	*Total carbohydrates (mg glucose / gram)*	*Total proteins (mg / gram)*
Giza 1	6203.6± 8.14	8.92±0.08
Giza 2	51039±307.55	8.70±0.15
Giza 3	4952±157.4	5.91±0.32
Giza 88	6363±71.04	7.80±0.25
Giza 195	5135.67±151.4	6.60±0.09
Giza 531	6963.67±55.32	11.9±0.20

The total carbohydrates content fluctuated between 4952 and 6963.67 µg/gm with the highest value in Giza 531 seed it is the main source of energy for insect development inside the seed during storage. The crude protein content fluctuated between 5.91 and 11.9 mg/gm with the highest value in Giza 531 seeds. These results show that variety Giza 531 high in total protein and carbohydrates, which was very susceptibile to infestation by both *C. maculatus* and *C. chinensis.*

The results agree with those mentioned by Nwanze and Horber (1975) working on cowpea seed varieties with seed coats that resist the initial larval penetration of cowpea beetle and so limit the insect population increase. Williams and Mills (1980) and Locatelli and Limonite (1998) demonstrated that the undamaged pericarp of sorghum varieties represents the main resistant factor

against damage by grain weevils and moths respectively, since the pericarp contains high amount of fibers. This study indicated that the varieties which contain high carbohydrates and protein contents are highly susceptible to *C. maculatus* and *C. chinensis.*

REFERENCES

Abdel-Latif, A.M. and Nemat, A. Naguib (2003): Susceptibility of some faba bean and lentil seed varieties to Callosobruchus maculatus (F.) infestation and their relation with physic-chemical and viability properties. The 1st Int. Egyptian Romania Conf., Zagazig, Egypt, Dec,6 - 8th 2003.

Abo-Hegazi, A. M. T and Ahmed, M.Y.Y. (1976b): The association between seed coat color and brightness of field bean *(Vicia faba F.)* and resistance to legume beetles, the 4th Conf. of pest control, NRC, Cairo.

Ahmed, K., Khallque, F., Atzal, M. Tahir, M. and Malik, B.A. (1979): Variability in chickpea (*Cicer arietinum* L.) genotypes for resistance to *Callosobruchus maculatus (F.)*. J. Stored prod. Res., 25(3): 97 – 99.

Baker, A.; Tarcy, S.; Suzanne Nielsen, Richard E. Shade and Sing, B.B. (1989) Physical and Chemical attributes of cowpea lines resistant and susceptible to *Callosobruchus maculatus (F.)* (Coleopterai Bruchidae). J. Stored Prod. Res.,25(1) 1-8.

Brker, J.E. (1979): Requirements for the essential dietary amino acids of larvae of the rice weevil. Environ, Entomol., 8:451 – 453.

Dobie, P. (1974): The laboratory assessment of inherent susceptibility of maize varieties to post harvest infestation by *Sitophilus zeamais* Motsch. (Coleoptera: Curculionidae). J. Stored Prod. Res., 10: 183 – 197.

Howe, R.W (1971) A parameter for expressing the suitability of an environment for insect development. J. Stored Prod. Res., 7(1): 63 – 65.

Locatelli, D.P. and Limonite, L. (1998): *Development of Ephestia kuehniella* (Zeller), *Plodia interpunctella* (Hubner) and *Corcyra cephallonica* (Stainton) (Lepidoptera: Pyralidae) on Kernels and wheat meal Flours of *Fagopyrum esculentum* (Moench) and *Tritiaum aestirum* (L.). J. Stores Prod. Res. 34(4): 269 – 276.

Mahgoub, S. A. (1987): Studies on the rice weevil, *Sitophilus Oryazae* (L.) and the cowpea beetle *Callosobruchus maculatus* (F.). Ph. D thesis, Fac. Agric., Cairo Univ.

Mahgoub, S.A. and Khalifa, S.A (1991): comparative susceptibility of seeds of certain faba bean varieties to Callosobruchus maculatus F. J. Agric. Res., 71 (3): 679-684.

Mensah, Giza. W. K. (1986): Infestation potential of *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae) on cowpea cultivars stored under sub-tropical conditions. Insect Sci. Aplic., Vol. 7 No.6 791 – 794 .

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

Ofuya, T.I. and Credlant, P.E. (1995): Differences on the Susceptibility varieties of cowpea to *Bruchidius atrolineatus* (Coleoptera: Bruchidae). Bull. Ent. Res., 85(2) 259-265.

Sanaa, M. Mahgoub; Salwa. Abdel-Baki and Tolba, A.M. (1995): Comparative susceptibility of *Phaselus vulgarism* L. beans to *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae). Menofiya J. Argic. Res., Vol. 20 (3), 1125 – 1134.

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 .

دراسة حساسية بعض أصناف الحمص للإصابة بحشرتي خنفساء اللوبيا نوع *C. chinensis.* و *C. maculatus*

عبد العزيز السيد عبد العزيز

معهد بحوث وقاية النباتات- مركز البحوث الزراعية- الدقي- جيزة.

تهدف هذه الدراسة إلى تقدير حساسية ستة أصناف من الحمص للإصابة بنوعين من حشرات خنفساء اللوبيا *C. maculatus* و *C. chinensis*.

تم تجهيز خمسة أزواج من كل حشرة وتم وضعهم على ٢٥ جم من البذور لكل صنف وتم عمل خمسة مكررات لكل صنف .

ودرست بعض الصفات البيولوجية للحشرتين وهي عدد البيض الموضوع للأنثى وعدد الفاقس وكذلك النسبة المئوية للفقس وكذلك عدد الخلفة الناتجة ونسبتها المئوية بالنسبة للفقس ومتوسط فترة التطور وقيمة دليل الحساسية (دليل النمو) ونسبة النقص في الوزن وكذلك نسبة التلف في البذور. كما تم تحليل بذور أصناف الحمص المختبرة تكنولوجياً لتحديد محتواها من الكربوهيدرات والبروتين.

وأوضحت النتائج وجود اختلافات معنوية في الصفات تحت الدراسة لهذه الأصناف لكلا الحشرتين. كذلك أوضحت النتائج أن أصناف الحمص أكثر حساسية للإصابة بحشرة خنفساء اللوبيا نوع *C. maculatus* عن النوع *C. chinensis* أيضاً وجد من تقدير محتوى البذور من الكربوهيدرات والبروتين أن الأصناف عالية المحتوى منهم تكون أكثر حساسية للإصابة بكلتا الحشرتين .