

SUSCEPTIBILITY OF SOME WHEAT AND RICE VARIETIES TO *Sitophilus oryzae* (L.) AND *Rhizopertha dominica* (F.) INFESTATION

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ABSTRACT

Susceptibility of four varieties of wheat (Egypt 1, Egypt 2, Gemmiza 11 and Sids 12), and five rice varieties (Egypt 1, Egypt 2, Giza 179, Sakha 105 and Sakha 106) for infestation by *Sitophilus oryzae* (L.) and *Rhizopertha dominica* (F.) were evaluated in the laboratory at $28 \pm 1^\circ\text{C}$ and $65 \pm 5\%$ R.H.

The results showed significant differences between various wheat varieties in the growth index of *S. oryzae*, it was comparatively higher in the varieties Gemmiza 11 and Egypt 1 than varieties Egypt 2 and Sids 12. Also, Egypt 1 was the least susceptible to *R. dominica* with lowest percent of weight loss (3.80%).

In case of rice varieties data revealed that, Giza 179 and Egypt 2 varieties were the least susceptible to *S. oryzae* by lowest values of growth index (0.38 and 0.90, respectively) and corresponding values of weight loss (0.16 and 0.38% ,resp.), with significant differences when compared with all varieties. While, Sakha 105 variety was most resistance to *R. dominica* by growth index (1.27) and least value of weight loss (0.29%). A significant effect of grain moisture contents on susceptibility/resistance against *S. oryzae* and *R. dominica*.

INTRODUCTION

The stored cereals are infested during storage by large number of insect pests. Since a number of wheat and rice varieties are cultivated, the infestation degree of storage pests may also vary, also (Chatterjee, 1955) reported that, all wheat varieties not equally infested by different stored grain pests.

Varieties of wheat and rice are expected to influence the rate of reproduction and multiplication of rice weevil, *Sitophilus oryzae* (L.) and the lesser grain borer, *Rhizopertha dominica* (F.) (Koura and EL- halafawy, 1967); (Sinha, 1971); (Coombas, 1972). In addition, several authors (Khattak and Shafique, 1986; Rodrigues *et al.*, 1990) have tested Susceptibility different wheat varieties to *S. granaries*. Weight losses caused by insects in cereal grain during storage can reach 50% of total harvest in some countries (Fornal *et al.*, 2007). Also, (Malagon and Trachaz, 1985) evaluated the weight loss in wheat caused by *R. dominica*.

Resistance of a variety of cereal grain depends upon its characteristics chemical composition, moisture contents and suitability for egg laying and multiplication of the pest (Khokhar and Gupta, 1974). Also, studies of (Baranardo, 1972) concluded that antibiosis and preference of different varieties are involved in resistance to *S. oryzae* adults. Grain characteristics such as phenolic, protein and amylase content were associated with different responses to the attack of stored product insects (Chanbag *et al.*, 2008).

The present study aims to evaluate the relative susceptibility of four wheat varieties and five rice varieties to infestation with *Sitophilus oryzae* and *Rhizopertha dominica*.

MATERIALS AND METHODS

Stock culture of the used insects:-

A Stock culture of *Sitophilus oryzae* (L.) and *Rhizopertha dominica* (F.) were reared and multiplied for five generations on a mixture of wheat or rice varieties in Stored Grain Insect Department, Plant Protection Research Institute.

Source of wheat and rice varieties:-

Four varieties of wheat grains and five varieties of un-husked rice grains were obtained from the Field Crop Research Institute, ARC.

All varieties used were previously sterilized by keeping inside a deep freezer for two weeks, all tested varieties were washed with tap water and left to dry under lab. conditions and incubated at $28 \pm 1^\circ\text{C}$ and $65 \pm 5\%$ R.H. for two weeks to equilibrate their moisture contents.

Experimental procedures:-

Fifty grams of whole grains were accurately weighed and putted in small glass jar (5cm diam. and 7.5 cm length), 25 newly emerged adults of each tested insect species were introduced to glass jars, which were covered with muslin cloth and tied by rubber bands. The adults were left for one week then removed; jars were kept under the experiment conditions. All replicates inspected daily after one month to record F1- progeny (Bashir, 2002). Four replicates for each variety of the wheat or rice grains were used. The replicates were re-weighed to determine the loss in weight (%), a growth index was calculated according to Howe, 1971 as follow:-

$$\text{Growth index} = (\log F)/D \times 100$$

Where

F = total number of the emerged adults.

D = the mean of developmental period.

Chemical analysis: - Total carbohydrates were estimated according to (Dobois *et al.*, 1956), total protein were determined by a method of (Bradford, 1976) and total phenols was determined by a method as modified by (Singleton and Rossi, 1965).

The statistical analysis:-

The obtained data were analyzed by ANOVA test and significant means were separated by Duncan's multiple rang test using a computer program of SPSS 14.0.

RESULTS AND DISCUSIONS

Wheat grains susceptibility:-

Susceptibility of some wheat varieties to *S. oryzae* and *R. dominica* illustrated in Table (1). Data of *S. oryzae* showed a significant differences between the growth indexes of various wheat varieties, it was comparatively higher in the varieties of Gemmiza 11 and Egypt 1 than Egypt 2 and Sids 12

varieties, which produced a lower number of progeny and a longer developmental periods.

Table (1): Growth and damage of *S. oryzae* and *R. dominica* on grains of wheat cultivars at 28 + 1 C and 65 + 5 % R.H.

Cultivars	MDP	F1- Progeny	Growth index	Weight loss
<i>S. oryzae</i>				
Egypt 1	33.25±1.5 c	112.00±23.4 a	6.14±0.4 a	3.78±0.51b
Egypt 2	38.00±1.2 b	20.75±5.3 b	3.43±0.3 b	2.32±0.25 c
Gemmiza11	32.50±1.0 c	145.25±41.0 a	6.63±0.5 a	5.46±1.7 a
Sids 12	42.75±4.2 a	38.75±15.5 b	3.55±0.7 b	3.92±0.07 b
LSD 5 %	1.81	38.48	8.8	0.98
<i>R. dominica</i>				
Egypt 1	39.00±5.8c	84.75±10.1a	5.01±0.7c	3.80±1.2b
Egypt 2	35.5±4.1b	144.75±16.5ab	6.14±0.7b	4.88±1.3ab
Gemmiza11	31.25±1.0b	166.00±19.7b	7.10±0.3a	6.10±2.4ab
Sids 12	32.75±1.0a	197.75±11.6b	7.46±0.7a	6.80±2.0a
LSD 5%	5.56	23.09	0.94	2.78

Means followed by the same letter(s) in the column do not differ significantly

The adults of *S. oryzae* caused highest weight loss (%) in Gemmiza 11 variety (5.46%), while the least weight loss (2.32%) was achieved with Egypt 2 variety, which the least susceptible variety to *S. oryzae*.

In case of *R. dominica*, the average number of emerged adults ranged from 84.75 to 197.75, the highest number (197.75) was produced with the most susceptible variety Sids 12 by growth index (7.46), the corresponding weight loss (%) in wheat grains was (6.80 %), while, the lowest (3.80 %) was regarded in Egypt 1 variety which the least susceptible to *R. dominica*. Gharib, M.S.A (2003) showed that Gemmiza 11 and Giza 168 provide shorter developmental periods of *S. oryzae* adults.

Rice grains susceptibility:-

The obtained results in Table (2) revealed that, the growth index and damage of *S. oryzae* and *R. dominica* on rice varieties. Data indicated that varieties of Giza 179 and Egypt 2 were the least susceptible to *S. oryzae* since the growth index value were (0.38 and 0.90) with significant differences when compared with all varieties, meanwhile, Egypt 1 variety was the most susceptible with the largest value of growth index 3.75. Regarding to the developmental periods there were no significant differences between rice varieties.

As regarded to weight loss, the least susceptible variety (Giza 179) gave a lowest amount of weight loss (0.16 %) with significant differences compared with the all un- husked rice varieties.

In addition, data in Table (2) indicated that the susceptibility index of *R. dominica* on rice varieties varied greatly from 1.27 for Sakha 105 to 2.86 for Giza 179 variety, Sakha 105 variety was most resistance to *R. dominica*, but, Giza 179 variety was most susceptible one.

Statistically, a significant difference was observed between the variety Giza 179 and all other varieties which received nearly similar mean developmental periods.

Table (2): Growth and damage of *S. oryzae* and *R. dominica* on grains of rice cultivars at 28 + 1°C and 65 + 5 % R.H.

Cultivars	MDP	F1- Progeny	Growth index	Weight loss
<i>S. oryzae</i>				
Egypt 1	40.75±1.5n.s	33.75±3.9 a	3.75±0.2 a	0.55±0.18a
Egypt 2	43.75±2.9n.s	2.50±0.6 c	0.90±0.3 c	0.38±0.06a
Giza 179	42.50±3.0n.s	1.50±0.6 c	0.38±0.4c	0.16±0.03b
Sakh 105	41.50±1.7n.s	20.25±3.2 b	2.87±0.6 b	0.63±0.06a
Sakh 106	41.50±1.7n.s	22.50±4.2 b	3.25±0.3ab	0.64±0.36a
LSD 5 %	30.40	4.45	0.66	0.28
<i>R. dominica</i>				
Egypt 1	64.75±3.6 a	10.50±2.5b	1.72±0.5bc	0.66±0.2a
Egypt 2	66.25±2.1a	13.50±2.4ab	1.94±0.6 b	0.59±0.1a
Giza 179	40.00±0.0 b	14.25±2.4a	2.86±0.2a	0.67±0.3a
Sakha 105	64.00±4.6 a	6.50±1.3 c	1.27±0.2c	0.29±0.11a
Sakha 106	62.00±4.0 a	16.25±2.5a	1.94±0.2b	0.56±0.04ab
LSD 5%	4.98	3.4	0.58	0.27

Means followed by the same letter(s) in the column do not differ significantly

The lowest percent of weight loss (0.29 %) was recorded in Sakha 105 variety, while, the maximum percent (0.67 %) in Giza 179 variety.

Chemical composition of grains:

The chemical compositions results of wheat and rice grain varieties presented in Tables (3) showed that, the moisture contents in wheat and rice grain varieties had significant effect on relative susceptibility / resistance against *S. oryzae* and *R. dominica*. Hameed *et al.*, (1984) who observed that the moisture contents in store grains indicated significant effect on relative susceptibility / resistance against stress and grains insect pest. In addition to the main factors responsible for variations in the susceptibility of tested varieties, the chemical compositions of grains such as protein, phenols and carbohydrates are also important. While, the obtained results showed no clear relation was found between chemical compositions and susceptibility of different wheat or rice grain varieties. Rashad *et al.*, (2005) reported that, the correlation of wheat grains weight loss with population of *R. dominica* increase and moisture contents was highly positive.

Table (3): Chemical compositions of wheat and rice grains varieties

Contents Cultivar	Total Carbohydrates	Total Proteins	Total Phenols	Moisture contents (%)
Wheat				
Egypt 1	543.0 c	107.0 c	1371.0 c	13.2 c
Egypt 2	647.7 a	156.7 a	2460.0 a	13.9 b
Gemmiza 11	507.7 d	112.7 c	1453.0 c	14.6 a
Sids 12	605.7 b	140.3 b	2346.7 b	14.4 a
LSD 5%	24.97	8.78	110.75	0.35
Rice				
Egypt 1	640.7 b	57.0d	2098.3 d	13.1 a b
Egypt 2	737.0 a	83.7a	2604.0 b	12.9a b
Giza179	743.7 a	77.7ab	2853.3 a	12.9 a b
Sakha 105	628.7 b	69.0b c	2333.3 c	12.7b
Sakha 106	734.0 a	60.3 c d	2274.7 c d	13.4 a
LSD 5%	20.45	9.38	180.98	0.41

Means followed by the same letter(s) in the column do not differ significantly

REFERENCES

- Baranardo, B.N.(1972): Varietal resistance of corn the rice weevil *Sitophilus oryzae* (L.).Philippine Entomol. 2(3):195-203.
- Bashir, T.(2002):Reproduction of *Rhyzopertha dominica* (F.)(Coleoptera :Bosrichidae) on different host grain. Pak.J.Biol.Sci.5 (1):91-93.
- Bradford, M.M.(1976): A rapid and sensitive method for the quantitation of microgram quantities of proteins utilizing the principle of protein –dye binding. Anal. Biochem.,72:248-245.
- Chanbang, Y.Arther, F.H.,Wilde, G.E.andTron, J.E.(2008):Hull characteristics as related to susceptibility of different varieties of rough rice to *Rhyzopertha dominica*(F.)(Coleoptera:Bosrichidae).J.Stor.prod.Res.44: 205-212.
- Chatterjee, S.(1955): Relative resistance of some national Pusa varieties of Wheat to *Trogoderma granarium* Everts. Ind. J. Ent. 17(1): 125-127.
- Coombs ,C.W.,(1972):The interpretation of experiments assessing the susceptibility of stored product cereals to attack by *Sitophilus* spp. (Coleoptera : Curculionidae). J. Stor. Prod. Res. 8: 81-82.
- Dobios, M.,Gilles, K.A.,Hamilton, J.K.,Rebers, P.A.and Smithm,F. (1956):Colerimetric method for determination of Sugars and related substances. Analyt.Chem.m28:350-356.
- Fornal, J., Jelinki, T., Sadowska,J.,Niewiada,A.Waechalenski,J.R., and Blaszcak, W (2007): Detection of granary weevil *Sitophilus granarius* (L.) eggs and internal stage analysis. J.Stor.prod.Res.43:142-148.
- Gharib ,M.S.A.(2003) : Susceptibility of some wheat grain varieties to *Sitophilus oryzae* (L.) infestation .Egypt J. Agric.Res. 82 (1): 131-138.
- Hameed ,A.,H.A. Quyyam and A..Ali , (1984):Biochemical factores affecting susceptibility of four wheat varieties to *Trogoderma granarium* Events.Pakistan Entomol.,6: 57-60.
- Howe, R.W.(1971): A parameter for expressing the suitability of environment for insect development. J.Stor.prod.Res.7:63-65.
- Kattak, S.U. and Shafique, M(1986): Varietal susceptibility studies of ten Wheat cultivars flour to *Tribolium castaneum* Herbst. (Coleoptera : Tenebrionidae). Pakistan J.Zool.18:257-261.
- Khokhar, D.S. and Gupta, D.S. (1974):Relative resistance of some varieties of wheat to *Sitophilus oryzae* (L.) and *Rhyzopertha dominica* (F.) at different temperatures. Bull. Grain Technol. 12(2):117-123.
- Koura, A. and M. A. El- Halafway (1967): The susceptibility of certain Egyptian wheat varieties to infestation with the rice weevil *Sitophilus oryzae* (L.), granary weevil, *Sitophilus granarius* (L.) and the lesser grain borer *Rhyzopertha dominica* (F.). Agric.Res.Rev.45(2):41-48.
- Malagon, M.E. and Trochaz, P.A. (1985): Evaluation of weight loss in stored wheat caused by the lesser grain borer *Rhyzopertha dominica* (F.) and observation on its life cycle under laboratory conditions . Acta. Agron, 35: 78-90.

- Rashad R.,K. , Anila N.,S., and Mansour, H.(2005): Interactive response of two wheat varieties and three insect pests. International J.,of Agric.,&Biol.,7(1): 152-153.
- Rodrigues Cobos, C.,Haubruge,E.and Gasper,C. (1990): susceptibility of grains to several varieties of Wheat *Triticum sativum* (L.) to *Sitophilus granaries* (L.) (Coleoptera:Curculionidae). Med. Fac. Land bouw. Rijk univ. Gent.55:395-404.
- Singleton,V.L, and Rossi, j. A. (1965): Colorimetry of total Phenolics with phosphomolybdic – phosphotungstic acid reagents.
- Sinha, R.N. (1971): Multiplication of some stored product insects on varieties of Wheat Oates and Barley . J. Eco. Ent.64(1) :98-102.

حساسية بعض أصناف القمح والأرز للإصابة بحشرتى سوسة الأرز وثاقبة الحبوب الصغرى

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تم تقييم حساسية أربعة أصناف من القمح وهى مصر 1 ، مصر 2 ، جميزة 11 ، سدس 12 وخمسة أصناف من الأرز وهى مصر 1، مصر 2، جيزة 179، سخا 105، سخا 106 فى المعمل على درجة حرارة 28 ± 1 م ورطوبة نسبية 65 ± 5 ، وأظهرت النتائج وجود اختلافات معنوية بين أصناف القمح لحشرة سوسة الأرز حيث كان دليل النمو للحشرة على صنفى جميزة 11 و مصر 1 أعلى منها على صنفى مصر 2 و سدس 12. كما وجد أن صنف مصر 1 كان أكثر حساسية للإصابة بحشرة ثاقبة الحبوب الصغرى وأعطت أعلى نسبة فاقد فى وزن الحبوب (3.08 %).

أما فى حالة أصناف الأرز فقد أظهرت النتائج المتحصل عليها أن صنفى جيزة 179 ومصر 2 كانت أقل حساسية للإصابة بسوسة الأرز وأعطت أقل قيم لمعدل النمو (0.38 ، 0.90 %) ، ونسب فقد فى وزن حبوب الأرز (0 ، 16 ، 0 ، 38 ، 0 %) على التوالى ، وكان الاختلاف معنويا بالمقارنة بكل أصناف الأرز. بينما كان الصنف سخا 105 هو أكثر الاصناف مقاومة للإصابة بحشرة ثاقبة الحبوب الصغرى حيث أعطى أقل قيمة لمعدل النمو (1 ، 27) وأقل نسبة فقد فى وزن حبوب الأرز (0 ، 29 %) . كما وجد تأثير معنوى للمحتوى الرطوبى للحبوب على حساسية أو مقاومة الحبوب ضد الاصابة بحشرتى سوسة الأرز وثاقبة الحبوب الصغرى .