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SUSCEPTIBILITY OF SOME EGYPTIAN WHEAT VARIETIES TO THE INFESTATION WITH THE *Rhyzopertha dominica* (Fabricius) and *Tribolium castaneum* (Herbst)

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ABSTRACT

Susceptibility of wheat varieties to the infestation with some insect pests. *The Rhyzopertha dominica* in the non-choice test, Sids1, Beny-sewif-5 and Giza-168 gave the highest weight after damage (49.90g) from the total of 50 g of each variety Sids-1, Beny-sewif-5 and Giza-168 While Sids-12 gave the lowest weight after damage and represented by 48.97g. with significantly differences between different wheat varieties Moreover, the highest percentages weight losses were observed in Sids-12(2.0%) and the least ones were observed in Sids-1, Beny-sewif-5 and Giza-168 represented by 0.20% in one generation After two generations the same trend were observed. In the free choice test, Beny-sewif-5 and Sohag-5 gave the highest weights after damage and represented by 49.90g. in both generations While the Sids-12 gave the lowest weight after damage and represented by 48.50g and 47.60g after one and two generations respectively with significantly differences between different wheat varieties. Sids-12 gave the highest weight loss represented by 2.06 and 5.0% in one and two generations. In non-choice test, the same trend was recorded with *Triticum caestivum* as previously mentioned with *Rhyzopertha dominica* and gave the weights of 49.70 and 49.08g in both of two generations. While the Sids-1 gave the highest weight loss and represented by 3.50% and 5.50% after one and two generations with significantly differences between varieties. In free Choice test, the Beny-sewif-5 and Giza-168 gave the highest weights after damage and represented by 49.55 and 49.35g after one and two generations with significantly differences between varieties. Moreover the Sids-1 and Sids-12 gave the highest weight losses and represented by 3.60% and 5.90% after one and two generations with significantly difference between varieties.

INTRODUCTION

Wheat (*Triticum caestivumL.*) belonging to the family Gramineae, is a staple food in the world and said to be originated from South Western Asia. Food storage pests seem to have been associated with grain stores since time immemorial. Storage pests have been identified in grain stores found in the tomb of Tut, ankhamun (1345 BC) and other ancient sites. The problem of

insect pests in wheat is more serious at post-harvest stage than in the field. In Egypt wheat occupies an important belt among cultivated area during the winter season. It is essential to increase wheat production to meet the increase in wheat consumption (**Abdel-Rahman, 1997**). This important crop in Upper Egypt is usually liable to be attacked by several species of stored product insects, particularly the granary weevil, *S. granarius*, and Lesser grain borer *R. dominica* and rust-red flour beetle *T. castaneum* , these pests can be developed on wheat, rye, barley, oats, corn and rice (**Andersen, 1934**). Adults cause damage by destroying kernels mainly germs, producing debris and raising temperature and water contents, facilitating the invasion of secondary insect pests, mites, bacteria and fungi. Larvae develop inside the kernels and consume about 64% of their contents (**Campbell and Sinha, 1976**). The losses due to the stored product pests are approximately 10-15% worldwide annually (**Hodges *et al*., 1996; Rajendran, 2002 and Neethirajan *et al*., 2007**). In some countries cereal grain losses during storage can reach to about 50% of the total harvest, in addition to a reduction in quality and monetary value (**Fornal *et al*., 2007**). Therefore, scientific knowledge of stored product insects and safe effective methods for their control are of concern to every one responsible for reducing post-harvest food losses and maintaining a high quality of stored crops. On the other hand, some investigators revealed that all the stored grain pests exhibit the pheromenon of preference/non-preference for the grains of different varieties (**Sarin and Sharma, 1983**). Subsequently, different wheat varieties must be tested for their susceptibility to the infestation by the granary weevil (**Mebarkia *et al*., 2010 and Mahmoud *et al.*, 2011**). Susceptibility of some stored grains to certain insects have been reported by several authors (**Mahmoud *et al.*, 2011, Awadalla *et al*., 2013, Arve *et al.*, 2014 and Metwaly *et al.*, 2015**). The aim of the present study is to study the preference of *S. granarium*, *R. dominica* and *T. castaneum* to different wheat varieties.

MATERIALS AND METHODS

Relative susceptibility of certain wheat varieties (grains) to *R. dominica* and *T. castaneum* were carried out under laboratory conditions at Plant Protection Department Faculty of Agriculture Sohag University. Newly emerged of *S. granaries*, *R. dominica* .and *T. castaneum* were introduced into the buckets containing the dis – infested wheat. The Susceptibility experiments were carried out on 7 varieties of wheat namely: Sids-1, Sids-12, Shandwee1-1, Sohag-4, Beny-sewif-5, Sohag-5, Giza-168. All varieties were obtained from

the Crop Research Institute, Shandweel Agriculture Research Station, Sohag. Sufficient quantities of wheat grains were firstly sieved to remove stone, dust and insects. The grains were then sterilized by freezing for 7day at 18-22^{o}c. All grains were maintained in an incubator at a constant temperature of 30 ± 1^{o}C and 65 ± 5% RH for two weeks in order to obtain equilibration moisture content with this R.H. (**Ezz, 1976**). To evaluate the relative susceptibility of the tested grain varieties, two sets of experiments were conducted. The first was a free choice infestation test and the second was a non-choice infestation test. In a free choice experiments glass Jars accommodating with seven varieties of wheat grains the granary weevil, *R. dominica* and *T. castaneum* were used as a choice chamber used 28 Petri dishes (15 cm in diameter) each containing 50g of a grain wheat varieties were placed within these Jars /using four dishes per Jars with a given variety in each dish to give four replicates. About three hundred adults of each tested insects (150 pairs /10 days old) were placed in the center part of each jar to give a free choice for adult females to oviposit on any wheat variety.The experiments was conducted at 28 ± 1^{o}C and 65 ± % RH Adult insects were removed after ten days of treatment. After 45 days the percentage of damage and grain losses were estimated in each dish. In non-choice test method a pre-determined insects were introduced to each Jar (***Abebe et al.*, 2009**) Twenty grams of each wheat variety were put in to plastic Petri dishes. Ten emerged unsexed adult insects aged between zero and 5days were then introduced into the Petri dishes containing the grains. The insects were allowed to oviposit on the wheat grains for ten days of treatment after which they were removed. After 45 days the percentages of damage and grain losses were estimated in each dish. Analysis of variance and **Duncans multiple range test (1955)** were performed to rank the varieties according to their Susceptibility to the insect. Weight losses were determined since the introduction of insects with the grain of wheat for each variety until adult emergence of the F1and F2 generations. It was calculated as follows:

$$\text{Weight loss}\% = \frac{\text{Weight of healthy grains before infestation} - \text{Weight of damaged grains after infestation}}{\text{Weight of healthy grains before infestation}} \; x\; 100$$

RESULTS AND DISCUSSION

Effect of certain wheat varieties on the percentages of weight after damage and weight losses.

Non–choice test

Data in Table (1) present the in influence of different varieties of wheat on the weight after damage and percentages of weight losses caused by *R. dominica* under laboratory

conditions. Regarding to the weight after damage, sids-1, Beny-swif-5 and Giza-168 gave the highest weight after damage (49.90g) followed by Sohag-5 (49.88g) and Sohag-4(49.80 g). The highest percentage weight losses were observed in Sids-12 (2.06%) followed by Shandweel-1 (1.16%). Moreover, the least percentage losses were observed in Sids-1(0.2%) Beny-swif-5 (0.2%) and Giza-168 (0.2%) after one generation, While, after two generation, the weights after damage in Sohag-5,Giza-168 and Beny-swif-5 were the highest ones (49.65,49.55g and 49.40g), While, the least weight after damage was recorded in variety Sids-12. On the contrary, the highest percentage weight losses were observed in Sids-12 (5.0%) followed by Sids-1 (3.2%), and the least percentage weight loss was observed in Sohag-5(0.7%). **Awadalla *et al*., (2013),** determine the varietal preferences of *R. dominica* under laboratory conditions. Regarding to non-choice tests on different wheat varieties, data revealed that, Sakha 93, Sakha 94 and Shandweel were the most preferred wheat varieties, while Seds12, Gemeiza 11 and Egypt 2 were the least preferred ones. On the other hand, Sakha 105 was the most preferred rice variety, while Giza 181and Giza 177 were the least preferred ones. In respect to the free choice tests on different wheat varieties, the results indicated that, Sakha 93 and Shandweel were the most preferred wheat varieties, while Seds12, Gemeiza11 and Egypt2 were the least preferred wheat varieties. On the other hand, Sakha 105 was the most preferred rice variety, while Giza181, Giza177 and Egyptian Jasmin were the least preferred rice varieties.

Table (1): Effect of different wheat varieties on the percentages of weight after damage and weight losses caused by *R. dominica* where weight before damage (50) gram after one and two generations.

Wheat varieties	Means			
	After one generation		After two generations	
	Weight after damage/g	Weight Loss%	Weight after damage/g	Weight Loss%
Sids-1	49.90^{a}	0.20^{d}	48.40^{c}	3.20^{b}
Sids-12	48.97^{d}	2.06^{a}	47.50^{d}	5.00^{a}
Shandwee1-1	49.42^{c}	1.16^{b}	48.90^{b}	2.20^{c}
Sohag-4	49.80^{b}	0.40^{c}	49.35^{a}	1.30^{d}
Beny- sewif-5	49.90^{a}	0.20^{d}	49.40^{a}	1.20^{d}
Sohag-5	49.88^{ab}	0.24^{cd}	49.65^{a}	0.70^{d}
Giza-168	49.90^{a}	0.20^{d}	49.55^{a}	0.90^{d}

The same column mean followed by the same letter are not significantly different at 0.05 level of probability.

Free choice test

Data presented in Table (2) showed the influence of certain varieties of wheat on the weight after damage and percentages of weight losses caused by to *R. dominica* reared on wheat varieties under laboratory conditions Regarding to the weight after damage, Beny-swif-5 and Sohag-5 gave the highest weight after damage (49.9g and 49.90g) followed byGiza-168 and Sohag-4 (49.88g and 49.80g). While, Sids-12 was the least weight after damage (48.95g), after one generation. Conversely, the highest percentage of weight loss worse absorbed in Shandweel-1 (0.6%) followed by Sids-1 (0.5%) and Sohag-4 (0.4%). Moreover, the least percentage weight losses were recorded in Beny-swif-5, Sohag-5 and Giza-168 as after one and two generations, the highest weight after damage were found in Beny-swif-5, Sohag-5 and Giza-168 and Beny-swif-5 (49.90, 49.55g and 49.55g), respectively, followed by Sohag-4 (49.88g) and Shandweel-1 (49.65g), while, Sids-12 gave the least weight after damage (47.60g). On the contrary, the highest percentages of weight losses were observed in Sids-1(3.16%) and Sids-12 (3.16%). Ssohag-5 gave the least percentage weigh loss (0.2%) after two generations.

Table (2): Effect of different wheat varieties on the percentages of weight after damage and weight losses caused by *R. dominica* where weight before damage (50) gram after one and two generations.

Wheat varieties	Means			
	After one generation		After two generations	
	Weight after damage/g	Weight Loss%	Weight after damage/g	Weight Loss%
Sids-1	49.75^{ab}	0.50^{bc}	48.42^{b}	3.16^{a}
Sids-12	48.95^{c}	2.10^{a}	47.60^{c}	4.80^{a}
Shandwee1-1	49.70^{b}	0.60^{b}	49.65^{b}	0.70^{b}
Sohag-4	49.80^{ab}	0.40^{c}	49.88^{a}	0.24^{c}
Beny- sewif-5	49.90^{a}	0.20^{d}	49.55^{b}	0.90^{b}
Sohag-5	49.90^{a}	0.20^{d}	49.90^{a}	0.20^{c}
Giza-168	49.88^{ab}	0.24^{cd}	49.55^{b}	0.90^{b}

The same column mean followed by the same letter are not significantly different at 0.05 level of probability.

Khokhar and Gupta (1974) determined the relative resistance of ten varieties of wheat to *S. oryza* and *R. dominica,* in three different temperatures and reported that non of the varieties was found immune to either of the two insects. However, varietiesHD-1944, C-281 and Kalyanona were found, to be tolerant and variety Larma Rajo was susceptible to both pests. **Metwaly *et al.*, (2015),** studied the susceptibility of Egyptian flour wheat varieties to *R. dominica* and *T. confusum*. Free choice test for attraction insect adults was used in

the first experiment at time interval ranged from 0.125 to 5 days post infestation. Results showed that the lowest attracted numbers of *R. dominica* adults were 5.00 individuals and the highest ones were 22.67 for SAKL8 and SIDS1 varieties. The varieties can be arranged descendently according to the attracted numbers of *R. dominica* females as follow: SAKL8, SAKL1, BACANORA, DEBEIRA, GIZA168, GIZA164, SIDS6 and SIDS1. similar results were obtained for *T. confusum*. Statistical analysis demoed significant differences between the numbers of the eight varieties. In the second experiment, the numbers of F1 and the duration of offspring of each stage were determined. Based on the Dobie Index (D.I.) for *R. dominica*, SAKL8, DEBEIRA, BACANORA and SAKL1 were found to be resistant varieties. While the SIDS1 and SIDS6 varieties have a moderate resistant. In the case of *T. confusum* all varieties showed a degree of resistance, except SAKL8 and SIDS1 showed a moderate resistant. The BACANORA cultivar showed the lowest D.I. value in the two tested insect species. **Singh *et al.*, (2003)** evaluate the extent of damage caused by *R. dominica* on different cultivars of wheat (Lok-1,Hi-1077,GW-173, Raj-3077,DL-8033 Kalyansona, HD-2236 and GW-190) at different time intervals after release of the tested insects. They reported the maximum weight loss in Raj-3077(11.50%), and the minimum in Kaliansona (5.50%) after 30days interval. The percentage of losses ranges from 7.33 to 14.65 and 12.00 to 21.25 in different cultivars after 45 and 60 days intervals, respectively. On the bases of weight losses Kaliansona showed some degree of tolerance, while, Raj-3077 proved susceptibility in *R.dominica.*

Non-choice test

Effect of different wheat varieties on the percentage of weight damage and weight losses caused by *T. castaneum* after one and two generations.Data presented in Table (3).showed the influence of certain varieties of wheat on the weights after damage and percentages of weight losses caused by to *T. castaneum* reared on certain wheat grains under laboratory condition after one generation, Regarding to the weight after damage the Beny-swif-5, Giza-168 and Sohag-5 were the highest weight after damage (49.70, 49.50g and 49.40g), respectively. Meanwhile, Sids-1, Shandweel-1 and Sids-12 (3.5, 3.24% and 3.1%), respectively. On the other hand, Beny-swif-5 gave the least percentage weight loss (0.6%) after one generation, and two generations, regarding the weight after damage, Giza-168 and Sohag-5 gave the highest weight after damage (49.08 and 49.03g) followed by Beny-swif-5 (48.97g) and Sohag-5 (49.03g).Sids-1 gave

the least weight after damage (47.25g).On the contrary, the highest percentages of weight losses were observed in Sids-12 (5.0%) followed by Sids-12 (5.3%) then Sohag-4(4.24%) Meanwhile, Giza-168 gaves the least percentage of weight loss (1.84%) after two generations**. Wakil *et al.*, (2003),** studied the nutritional losses of wheat due to the attack of *T. granarium, T. castaneum, S. oryzae* and *R. dominica*. Their results revealed more nutritional losses in laboratory infested wheat grains as compared to the infested samples taken from the public stores. They also reported a positive correlation among the damaged wheat protein and fat contents, whereas, negative correlation was exhibit between carbohydrate contents and insect damage.

Table (3): Effect of different wheat varieties on the percentages of weight after damage and weight losses caused by *T. castaneum* where weight before damage (50) gram after one and two generations.

Wheat varieties	Means			
	After one generation		After two generations	
	Weight after damage/g	Weight Loss%	Weight after damage/g	Weight Loss%
Sids-1	48.25^{b}	3.50^{a}	47.25^{c}	5.50^{a}
Sids-12	48.45 ^{b}	3.10^{a}	47.35^{c}	5.30^{a}
Shandwee1-1	48.38^{b}	3.24^{a}	48.05^{b}	3.90^{b}
Sohag-4	48.90^{ab}	2.20^{ab}	47.88^{b}	4.24^{b}
Beny- sewif-5	49.70^{a}	0.60^{b}	48.97^{a}	2.60^{c}
Sohag-5	49.40^{a}	1.20^{b}	49.03^{a}	1.94^{c}
Giza-168	49.50^{a}	1.00^{b}	49.08^{a}	1.84^{c}

The same column mean followed by the same letter are not significantly different at 0.05 level of probability.

Free choice test

Data presented in Table (4) showed the influence of certain wheat varieties on the weight damage and percentage of weight losses caused by *to T. castaneum* according to free choice test. After one generation data revealed that Beny-swif-5, Giza-168 and Sohag-4 varieties have the highest weight after damage (49.55, 49.50g and 49.45/50g, respectively) with low weights (0.90, 1.00 and 1.10%). However, the high lose percentage was occurred for Sids-1 (3.60%) followed by Sohag-5 (3.3%) and Sids-12 (3.29%). The same trend was repeated after the second generation as the lowest lose percentage was recorded for Giza-168 (1.3%) followed Beny-swif-5 (2.75%) and Sohag-4 (2.5%) varieties. However, Sids-1 variety gave high weight loss of (5.90%) followed by Sids-12 (5.5%), Sohag-5 (3.9%) and Shandweel-1 (3.7%). These results are in agreement with those obtained by **Awadalla *et al.*, (2014)** who determine the varietal preference

of the red flour beetle, *T. castaneum* under laboratory conditions. Regarding to non-choice tests on different wheat varieties, data revealed that, Sakha 93 and Shandweel were the most preferred wheat varieties, while Seds12 was the least preferred one. On the other hand, Sakha 105 was the most preferred rice varieties, while Giza 181and Giza 177 were the least preferred ones. In respect to free choice tests on different wheat varieties, the results indicated that, Sakha 93 and Shandweel were the most preferred wheat varieties, while Sides 12 was the least preferred ones. On the other hand, Sakha 105 was the most preferred rice variety, while Giza 181, Giza 177 and Egyptian Jasmin were the least preferred rice varieties.

Table (4): Effect of different wheat varieties on the percentages of weight after damage and weight losses caused by *T. castaneum* where weight before damage (50) gram after one and two generations.

Wheat varieties	Means			
	After one generation		After two generations	
	Weight after damage/g	Weight Loss%	Weight after damage/g	Weight Loss%
Sids-1	48.20^{c}	3.60^{a}	47.05^{d}	5.90^{a}
Sids-12	48.38^{c}	3.24^{a}	47.25^{d}	5.50^{a}
Shandwee1-1	49.05^{b}	1.30^{b}	48.15^{c}	3.70^{b}
Sohag-4	49.45^{a}	1.10^{c}	48.75^{b}	2.50^{c}
Beny- sewif-5	49.55^{a}	0.90^{c}	49.00^{ab}	2.00^{cd}
Sohag-5	48.35^{c}	3.30^{a}	48.05^{c}	3.90^{b}
Giza-168	49.50^{a}	1.00^{c}	49.35^{a}	1.30^{d}

The same column mean followed by the same letter are not significantly different at 0.05 level of probability.

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