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Sensitivity of different grain varieties to Angoumois grain moth, *Sitotroga cerealella* (Oliv.) (Lepidoptera: Gelechiidae)

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Abstract

The evaluation of the relative sensitivity of fifteen cultivars of graminaceous crops against *Sitotroga cerealella* (Oliv.) was conducted. Two tests (free choice and non-choice) were carried out in the research lab at 28±1 °C, and 75± 10% RH. The results showed highly significant differences between various graminaceous grains in their sensitivity to *S. cerealella* infestation. In the free choice test, the genotypes were categorized into two groups: Sorghum varieties, Maize (SC-10), and Barley (Giza-123) were found to be the most sensitive, while, Bread wheat (Giza-171, Sakha -95, and Shandweel-1) and Durum wheat (Masr-1), were less sensitive. Regarding weight loss Barley, Giza-123 (18.13±2.53) followed by Barley, Giza-132 (16.88±3.52) and Sorghum, Local- 2(14.43±4.09) experienced the highest weight loss. Maize (SC-10), Rice (Sakha- 101), Maize (SC-131), Sorghum (Local- 1), Rice (Giza -181) and Bread wheat (Giza-11) had lower weight loss. Adult emergence in Sorghum varieties was significantly higher than in the other graminaceous crops. Adult emergence from Barley varieties was lower than from Sorghum varieties, but higher than from the other graminaceous crops. In the non-choice test, Sorghum varieties showed the highest percentages of infestation (57.00±2.00% and 48.00±5.66%). Bread wheat (Suds 12, Giza11, Giza 171, Sakha 95, Shandweel- 1), Durum wheat (Beni Suef -5), Rice (Giza 181), and Rice (Sakha 101) had the least infestation. The greatest percentage weight loss was observed in Sorghum Local 1 (13.55±3.31%) followed by Sorghum Local 2 (11.63±4.09%) and Barley Giza132 (11.36±1.13%), whereas, Bread wheat (Giza11, Shandweel 1, Sakha 95 , Giza 171); Durum wheat (Beni Suef -5 and Masr-1), Rice (Sakha 101), and Maize (SC10) had the least weight loss. Adults emerged in Sorghum Local 1, Barley Giza132 and Sorghum Local 2 were higher than in the other graminaceous crops (41.00±3.46), (32.75±0.96) and (24.00±1.83) respectively. Adults emerged in Bread wheat (Giza11, Giza 171, Sakha 95 and Shandweel 1), Durum wheat (Beni Suef -5), Maize (SC10) and Rice (Giza 181) were lower. These details are important for host plant resistance breeding programs for plant breeders.

Keywords: *Sitotroga cerealella*, graminaceous Grains, choice, non-choice test, infestation.

INTRODUCTION

One of the essentials of human existence is food, along with the deeds of stars and communities. Cereals are the world's most important food crop since they provide the majority of the calories that humans consume (Vasileska and Rechkoska, 2012; Bruinsma, 2017). Over 60% of the calories consumed worldwide come from three types of seeds: maize, wheat, and rice. These seeds also make up a considerable portion of the food supply (FAO 2023). Among the most extensively grown grain crops worldwide are corn, wheat, rice, and barley (Ye and Fan, 2021; Wang *et al*. 2018). Because of their high levels of protein, fat, carbohydrates, vitamins, and minerals, these agricultural products are vital components of the human diet (Oso and Ashafa, 2021). Due to their high economic importance, cereals are cultivated all over the world and serve as the primary food supply in regions with temperate climates (Reynolds and Braun 2022, De Sousa *et al*., 2021). It is accessible to the entire population and eaten by both people and household animals (Ranum *et al.* (2014). 800 million tons of wheat were produced worldwide in 2022, with wheat accounting for 30.6% of all cereal cultivation land (with 26.7% going to maize and 22.6% to rice) (FAO 2023). Moreover, Shehata *et al.* (2023) report that wheat output in Egypt is projected to reach 16.92 million tons between 2005 and 2020, highlighting the crop's importance as the primary cereal crop. Because these crops include nutritional elements, their cereals are vulnerable to attack by insect pests while being stored. When insect pests eat cereals, it negatively impacts the cereals' marketability, making them unfit for human consumption and causing significant financial losses (Wang *et al*., 2021). It is well recognized that graminaceous crops are the most significant and essential for feeding the world's population. The most significant food sources on the planet are cereal grains, which include rice, corn, wheat, barley, oats, rye, sorghum, and millet (Hamed and Nadeem, 2012). Grains are infested and attacked by many insect pests during growth until storage in the store (Shiferaw *et al*., 2011) insect pests cause a lot of post-harvest losses in many of the stored grains and this led to concern significant for consumers, farmers and the food industry (Majumder *et al*., 2016). It has many important to the life of human; grains have same carbohydrates, vitamins, minerals, fats, protein and fiber. The insects cause a lot of losses in store it was almost 20% in developing countries and almost 9% in developed countries (Pimentel *et al*., 1991). Numerous elements, which can be divided into two primary groups, influence storage losses: biotic variables (insects, pests, rodents, fungi) and abiotic factors (temperature, humidity, rain). Insects and pests are thought to be the most significant biotic variables and account for 30–40% of wheat crop losses (Kumar and Kalita, 2017). Cereal grains suffer significant losses during storage due to insect infestations, especially on tropical farmland. Since stored grain and stored products pose a severe threat, entomologists worldwide have long sought to effectively control and eradicate stored grain pests from food commodities. The most significant issue with cereal grains, legumes, and oil seeds in storage, especially in towns and villages like Egypt, is losses from pest infestation.The granary weevil (*Sitophilus granaries*), rice weevil (*Sitophilus oryzae)*, maize weevil (*Sitophilus zeamais*), lesser grain borer (*Rhyzopertha dominica*), and Angoumois grain moth (*Sitotroga cerealella* (Oliv.), a grain moth that destroys wheat and corn, are the five insect pests that are commonly known to infest stored grains (Kumar, 2017). Although *Sitotroga. cerealella* (Oliv.) (Lepidoptera: Gelechiidae), is also regarded as a critical pest affecting grains, the Pyralidae family contains the majority of the pests that impact grains. *S. cerealella* is a severe major pest of grains that have been stored in various regions of the world, particularly Egypt's stored wheat and rice (Boshra, 2007). One of the most common species in stored cereal grains is the Angoumois grain moth, *S. cerealella* (Prakash *et al.,* 1984). In the more arid regions, *S. cerealella* supplants as the primary pest. Numerous grains that are kept in storage are severely affected by it, such as rice (Akter *et al*., 2013), sorghum (Hassan *et al*., 2014), wheat (Ghodjani *et al*., 2023), barley (Karimi-Pormehr *et al*., 2018), and maize (Demissie *et al*., 2015). The pest is external feeder as it feeds on germ and endosperm from outside and attacks whole seed and damages the germ portion. It is usually carried over from field to the storage site through infested grains. It bores into the grains and consumes 30-50% contents of the grain (Bushra *et al*., 2013). This moth infestation begins in the field when the grain is in the milk stage and can escalate to dangerous proportions (Boshra, 2007). It then moves to the grain stores and persists in stored goods under post-harvest circumstances (Hill, 1983; Bushra and Aslam, 2014). It consumes whole grains of cereal, including sorghum, rice, wheat, barley, and millet (Shukle and Wu 2003, Hamed and Nadeem 2012). This insect, which infests grains both in storage and in the field, is the most dangerous and destructive of all the pests that affect commodities that are kept in storage worldwide (Trematerra, 2015; Shukle and Wu, 2003). Grain seeds are first infected with *S. cerealella* in the field right before harvest, and the infection spreads to the store, where the population grows quickly. (Weston and Rattlingourd, 1999). The larvae of *S. cerealella* cause serious damage to kernals by feeding on them and producing fecal matter cause high crop damages on cereal grains (Shukle and Wu 2003; Throne and Weaver 2013; (Reed, 2018).

MATERIALS AND METHODS

Culture of the insect for experimental purposes:

The population of *S. cerealella* was obtained from the Laboratory of Insect Biology, Department of Plant Protection, College of Agriculture, Sohag University. The insects were raised on sterilized grains at 29±1 ^{0}C, and 75± 10 relative humidity, and 12-hr L/D photoperiod. All adults used in the test were newly emerged unmated; to obtain a sufficient number of newly emerged adults, aplastic jars (16 cm diameter ×25cm deep) were used as the oviposition cage for *S. cerealella* adults. Each jar containing 10 pairs of newly emerged adults (♂: ♀=1:1) was inverted over glass Petri dishes (15cm) lined with filter paper at the bottom. The filter paper provided with rough surface for oviposition. Eggs laid were collected from the filter paper with a brush. These were then placed in glass petri dishes, and the newly hatched adults were picked out for the following tests.

Source of graminaceous crops:

In a choice or non-choice infestation test, fifteen crops belonging to the Gramineae family were examined to determine which kinds were most favored by the Angoumois grain moth, *S. cerealella* (Oliv.). The varieties were Sorghum (Local- 1; Local- 2); Barly (Giza-132; Giza-123); Rice (Giza-181; Sakha-101); Maize (SC-10; SC-131); Bread Wheat (Giza-171; Sids-12; Gimeza-11; Sakha-95; Shandweel-1); Durum Wheat (Misr-1, Bani sweaf-5). These varieties were purchase from Field Crops Research Institute, Agriculture Research Center, Giza, Egypt. All lines used were previously sanitized by keeping them inside a deep freezer (-20 ^{0}C) for three weeks; subsequently, to get rid of any remaining grain or insect fractions, the tested lines were washed and sieved. After sterilizing the grains for eight hours at 65±5 °C to remove any insects or mites that might have invaded them covertly, they were incubated for two weeks at 29±1 °C and 75±10% RH to reach moisture content equilibrium.

Preference invasion test:

To study the preference of different gramineous species to *S.cerealella*. Twenty grams of each variety were weighted using an electrical automatic balance accurate to 0.0001 g. and each sample was kept in plastic container (8×16 cm). These Container (4 replication X 15 varieties =60Containers) were placed in a glass box (150 x 70 x 30 cm). Impulse of about 500 couple adult, *S. cerealella* were released in the box. All samples were kept under laboratory conditions during for a one generation (temperature 28±1°C and 75±10 % relative humidity). Sample were checked at the end of generation and reweighed determine the percentage of infestation and the weight loss by using the following formula given by (GWinner *et al*., 1996):

$$\text{Weight loss (\%)} = (wu \times Nd) - (Wd \times Nu)/Wu \times (Nd + Nu) \times 100$$

Whereas, wu=weight of undamaged grains

Nu = number of undamaged grains

Wd = weight of damaged grains

Nd = number of damaged grains

$$\text{Grain damage (\%)} = \frac{\text{No.of insect damaged grains}}{\text{Total number of grains in the sample}} \times 100$$

Force invasion test:

Adults of *S. cerealella* were collected from a mass rearing under laboratory Conditions of temperature 28±1°C and 75±10 % RH. In each container 4 sample of varieties = 60 container. Adults of *S. cerealella* were placed on 20g grains and each sample was kept in plastic Container (10 cm height and 5 cm diameter) and allowed to lay eggs for 7 days and then removed. The plastic containers were covered with muslin held in place with rubber band and kept at 28±1°C and 75±10 % RH until the new adults started to emerge. The experiment was continued under laboratory conditions until the emergence of adult, *S. cerealella* stopped. The experiment was continued under laboratory conditions until the emergence of adult, *S. cerealella* stopped. The final weight was recorded after removal of all adults from the damaged materials and weight were recorded as mentioned above.

Statistical interpretation:

Data obtained underwent analysis using an ANOVA test, and significant means were differentiated through Duncan's range test utilizing the SPSS 14.0 computer program.

RESULTS AND DISCUSSION

Free Choice invasion test:

Data presented in table (1) shows the adult emergence, percentage of damage cereals, and percent decrease in the weight of each graminaceous crop resulting from *S. cerealella* after one generation. In general, all graminaceous crops had some degree of invasion by the *S. cerealella* in the basis for the percentage of damaged grains, The statistical interpretation showed the highly meaningful between graminaceous crops. The graminaceous crops namely Sorghum (Local- 2); Sorghum (Local- 1); Maize (SC-10); and Barley (Giza-123); were the greatest damaged graminaceous, whereas, the graminaceous crops Bread wheat (Giza -171); Bread wheat (Sakha -95); Bread wheat (Shandweel- 1); and Durum wheat (Masr- 1), were the least damage and two graminaceous. Moreover, the remaining graminaceous were intermediate. On the other side the statistical analysis showed highly significant between graminaceous crops concerning weight loss, The largest percentage decrease in weight was observed in Barley Giza-123 (18.13±2.53) followed by Barley Giza-132 (16.88±3.52) followed by Sorghum Local- 2(14.43±4.09). Whereas the graminaceous crops namely, Maize (SC-10); Rice (Sakha- 101); Maize (SC-131); Sorghum (Local- 1); Rice (Giza -181) and Bread wheat (Giza-11) were the least weight loss. Moreover, remaining graminaceous were observed intermediate. The mean number of *S. cerealella* moths emerged in different emerged graminaceous varied significantly. The adult emerged in Sorghum (Local- 2) and Sorghum (Local- 1) were significantly higher than rest of the graminaceous crop. Adult emerged from Barley (Giza-123) and Barley (Giza-132) were though significantly less than Sorghum (Local- 2) and Sorghum (Local- 1), but it was significantly higher than rest the graminaceous crops. The adult emerged from Rice (Sakha- 101); Maize (SC-131) and Maize (SC-10) were intermediate. Maize (SC-10). Meanwhile the least adults emerged were recorded in Bread wheat (Giza-11); Bread wheat (suds- 12); Durum wheat (Beni suef -5); Rice (Giza -181); Bread wheat (Sakha -95); Bread wheat (Giza -171); Bread wheat (Shandweel- 1); and Durum wheat (Masr- 1).

Table (1). Response of different graminaceous crops to *S. cerealella* infestation (free choice test) after one generation.

Grain varieties	Adult emergence (number)	Grain weight loss%	Infestation %
Barley (Giza-123)	27.00^{c}±2.45	18.13^{a}±2.53	31.00^{d}±3.83
Barley (Giza-132)	24.00^{c}±3.37	16.88^{ab}±3.52	13.00^{ef}±3.83
Bread wheat (Giza-11)	7.75^{e}±0.96	4.73^{de}±0.49	10.00^{fg}±2.31
Bread wheat (Giza -171)	1.75^{f}±1.50	0.50^{f}±0.00	4.00^{hi}±0.00
Bread wheat (Sakha -95)	2.00^{f}±0.82	1.50^{ef}±0.82	5.00^{ghi}±2.00
Bread wheat (Shandweel- 1)	1.25^{f}±0.50	0.65^{f}±0.30	5.00^{ghi}±2.00
Bread wheat (suds- 12)	5.00^{ef}±2.16	2.75^{ef}±2.96	18.00 ^{e}±2.31
Durum wheat (Beni suef -5)	2.75 ^{f}±1.50	2.38^{ef}±0.48	8.00^{fghi}±3.27
Durum wheat (Masr- 1)	1.00^{f}±0.00	0.50^{f}±0.00	3.00 ^{i}±2.00
Maize (SC-10)	17.25^{d}±2.22	11.11^{c}±2.03	40.00 ^{c}±3.27
Maize (SC-131)	19.00^{d}±1.15	8.25^{c}±0.87	17.00^{e}±2.00
Rice (Giza -181)	2.50^{f}±0.58	4.80^{de}±1.38	9.00^{fgh}±3.83
Rice (Sakha- 101)	19.25^{d}±4.92	10.25^{c}±0.65	13.00^{ef}±2.00
Sorghum (Local- 1)	33.50^{b}±4.20	7.86^{cd}±4.69	58.00^{b}±2.31
Sorghum (Local- 2)	38.25^{a}±6.24	14.43^{b}±4.09	65.00^{a}±10.00

Means at each column followed by the same letter are not significant at 5% probability.

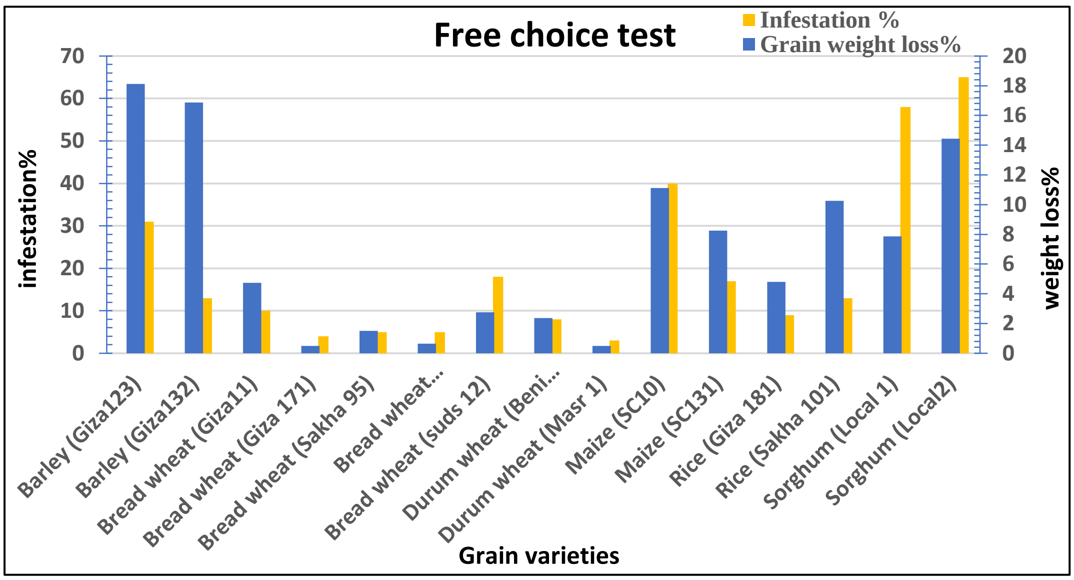

Figure (1). Sensitivity of certain grain varieties to the invasion with *S. cerealella* free choice test after one generation.

Non-choice test:

Data shown in Table (2) represented the percentage of invasion, grains weight loss and adult emergence of fifteen graminaceous caused by *S. cerealella* after one generation. The two graminaceous crops, Sorghum (Local 1); and Sorghum (Local2) Showed the highest percentages of infestation (57.00±2.00%and 48.00±5.66%). The graminaceous groups namely Bread wheat (suds 12); Bread wheat (Giza 171); Durum wheat (Beni suef -5); Rice (Giza 181); Rice (Sakha 101); Bread wheat (Giza11); Bread wheat (Sakha 95); Bread wheat (Sakha 95); and Bread wheat (Shandweel 1); were the least infestation, whereas remaining graminaceous crops were in between. Conversely, the greatest percentage weight loss was observed in Sorghum (Local 1) (13.55±3.31) followed by Sorghum

(Local2) (11.63±4.09), followed by Barley (Giza132)(11.36±1.13) whereas, the graminaceous Bread wheat (Giza11); Bread wheat (Shandweel 1); Bread wheat (Sakha 95); Durum wheat (Beni suef -5); Bread wheat (Giza 171); Rice (Sakha 101); Durum wheat (Masr 1)and Maize (SC10)were the least weight loss. Moreover, remaining graminaceous were intermediate. Statistical analysis of the mean number of *S. cerealella* adult emerged from different graminaceous crops showed highly significant variation between graminaceous crops. In Sorghum (Local 1); Barley (Giza132) and Sorghum (Local2) adults emerged were higher than rest of graminaceous Crops (41.00±3.46), (32.75±0.96) and (24.00±1.83) respectively. The adult emerged in Bread wheat (Giza11); Bread wheat (Giza 171); Bread wheat (Sakha 95); Bread wheat (Shandweel 1); Durum wheat (Beni suef -5); Maize (SC10); and Rice (Giza 181) were the least. The adult emerges in rest graminaceous crops were intermediate. From previous results we could concluded that, Statistical analysis showed that in free choice test the graminaceous crops Sorghum (Local- 2); Sorghum (Local- 1); Maize (SC-10); Barley (Giza-123); where the highest percentage, weight loss observed in Barley Giza-123, Barley Giza-132 and Sorghum Local- 2. In non-choice test the graminaceous crops, Sorghum (Local 1); and Sorghum (Local 2) were observed the highest infestation by *S. cerealella* and also the highest percentage weight loss. The variations in the susceptibility of graminaceous crops have been linked to physical characteristics like grain hardness, pericarp surface texture, and nutritional components such as amyloses, lipid, and protein content (Dobie, 1977; Tepping *et al*., 1988) or non-nutritional factors, particularly Phenolic compounds (Serratos *et al*., 1987), have also been identified as influential. Grain hardiness has been highlighted as the primary resistance factor (Bamaiyi *et al*., 2007). From the previous results we can concluded that the number of emerged adults increasing caused in an increasing seeds Injury and seeds weight decrease. It can be inferred that resistant genotypes, Thus, it can be employed as a sustainable method to lessen the harm caused by insects kept in conventional storage settings. In breeding programs to diversify the base of resistance to this pest, the resistant genotypes found in this study can also be employed as a source of resistance. And this data could be valuable for farmers when deciding on long-term storage of a specific cultivar, thereby avoiding those cultivars most severely impacted by the moth.

Table (2). Sensitivity of certain cereal grains varieties to the invasion with *S. cerealella* non choice test after one generation

Grain varieties	**Adult emergence (number)**	**Grain weight loss%**	**Infestation %**
Barley (Giza123)	12.00^{d}±2.16	5.63^{b}±1.25	12.00^{d}±3.27
Barley (Giza132)	32.75^{b}±0.96	11.36^{a}±1.13	15.00^{cd}±3.83
Bread wheat (Giza11)	0.50^{f}±0.58	0.25^{c}±0.29	2.00^{f}±2.31
Bread wheat (Giza 171)	2.75^{ef}±0.96	0.88^{c}±0.25	5.00^{ef}±2.00
Bread wheat (Sakha 95)	0.50^{f}±0.58	0.50^{c}±0.00	2.00^{f}±2.31
Bread wheat (Shandweel 1)	0.75^{f}±0.96	0.26^{c}±0.30	2.00^{f}±2.31
Bread wheat (suds 12)	2.75^{ef}±0.96	2.13^{c}±2.29	7.00^{e}±3.83
Durum wheat (Beni suef -5)	1.25^{ef}±0.50	0.64^{c}±0.24	5.00 ^{ef}±2.00
Durum wheat (Masr 1)	3.25^{e}±1.50	1.26^{c}±0.63	5.00^{ef}±2.00
Maize (SC10)	1.25 ^{ef}±0.50	1.63 ^{c}±0.25	4.00^{ef}±0.00
Maize (SC131)	11.25^{d}±1.50	6.49^{b}±2.05	19.00^{c}±3.83
Rice (Giza 181)	1.75^{ef}±0.96	1.25^{c}±0.87	5.00^{ef}±2.00
Rice (Sakha 101)	2.00^{ef}±0.82	1.88^{c}±0.63	4.00^{ef}±0.00
Sorghum (Local 1)	41.00^{a}±3.46	13.55^{a}±3.31	57.00^{a}±2.00
Sorghum (Local2)	24.00^{c}±1.83	11.63^{a}±4.09	48.00^{b}±5.66

Means at each column followed by the s ame letter are not significant at 5% probability

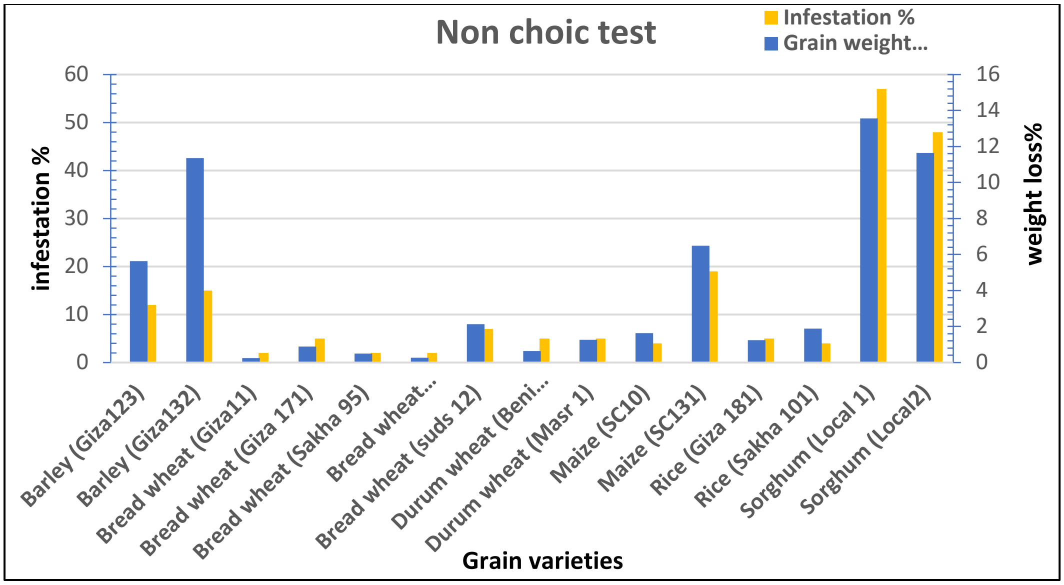

Figure (2). Sensitivity of certain grain varieties to the invasion with *S. cerealella* non choice test after one generation.

Similar to the present findings with those of Williams Mills (1980) and Shazali (1987). Additionally, it was determined that the nutritional and chemical compositions exert a greatest significant influence on promoting oviposition and the developmental rate of insects across various cereal varieties, in addition to the physical attributes of the grains. Gupta *et al*. (2000) documented that toughness of the grains was identified as a potential contributing factor to the resistance of certain grain varieties against insects of stored product. Salama and Youssef (2004) found that Giza-2 genotype was the least cultivar invaded by insects considering the total number of adults which emerged of stored insects. The four cultivars were significant and accordingly arranged as Giza 2, Single Cross 10, Sweet Grain Sorghum and the more susceptible one was three was Cross-321. El-syrafi *et al.* (2005) investigated the food preference of *S.oryza* and *T.grnarium* towards various Wheat and Maize varieties through choice and non-choice tests. The study revealed that both *S.oryzea* and *T. granarium* exhibited a preference for certain Wheat and Maize varieties. Specifically, the findings indicated that Sakha 8 and Sakha 93 were susceptible Wheat varieties, with Wheat varieties generally being more preferred by both insects in non-choice or free choice scenarios. Furthermore, the Wheat variety Sakha 8, followed by Sakha 93, and the Maize variety Tri-H322 were identified as the most preferred options for both insects, while Gize168 and Okrani were the least preferred in this regard. A study conducted by Ashamo and Khanna (2006) demonstrated the varietal resistance in sorghum to the Angoumois grain moth, *S. cerealella* . They indicated that IHT 405 was the least sensitive (most resistant) variety (period of development (33.3days), emergence of adult (2.3), Susceptibility Index (SI) of (2.7) and weight loss of (1.2%) while AVHT 303 was most sensitive (emergence of adult (15.7), Susceptibility Index (SI)of (9.3) and loss of weight (6.1%). Small-sized seeds tend to be less susceptible than larger-sized seeds. Longevity, larva to adult developmental period of (34.0 days) was observed on IHT 405. The female adult lived longer (9.0 days) than males (8.0 days). Additionally, research by Ashamo (2009) investigated the sensitivity of some sorghum varieties against *S. cerealella* . AVHT 303, CSV 15, AVHT 310, AVHT 313, AVHT 328, AVHT 644, AVHT 646, IHT 405, IHT 419, and IHT 424 were among the sorghum varieties that were tested. First trial: 100 eggs (0–24 hours old) of *S. cerealella* were used to infest twenty grammes of each sorghum variety while second experiment, glass vials containing adults aged 0 to 24 coupled. He demonstrated that CSV 15, with the shortest developmental time (26.7 days) and the highest percent survival of egg to adult (47.4%), had the highest susceptibility to *S. cerealella* infestation, while IHT 405, an initial variety (experimental), had the longest developmental time (29.7 days) and the lowest percent survival of egg to adult (20.6%). Male newly emerging adults weighed 1.55 g (AVHT 313) to 2.09 g (AVHT 310), whereas female newly emerged adults ranged in weight from 2.79 g (IHT 405, 419) to 3.93 g (IHT 424). Females normally outlived males, but virgin females lived longer than their partnered counterparts. Significant differences were found in the number of eggs laid. IHT 405 had the lowest fecundity (96 eggs/female) and the maximum (130 eggs/female) in AVHT 303. In AVHT 644, hatchability varied from 88.0% to 97.2%. In a study conducted by Ahmed and Raza (2010) studied Physical characteristics of eight maize varieties (EV-6089, EV-1098, Golden, 34N43, Sahiwal-2002, Sultan, China-1, EV-20), against *S. cerealella*. *S. cerealella* was cultured on a susceptible maize variety for two generations and was then transferred on the grains of the test varieties. They showed that the maximum number of moths was emerged in Sultan (9.33) and China-1 (9.33). Fecundity was highest on variety EV-6089 (50.00). Maximum number of eggs hatched in Sultan (87.83%). Highest moth weight was observed in variety EV-6089 (7.82 mg). Maximum development time was shared by China 1 and 32N43 (32.67 and 32.33 days, respectively). Maximum grain damage and weigh loss was in EV-1098 (93.46% and 42.19%, respectively). Average grain weight percentage was maximum (32.33 mg) in China-1. EV-6089 and EV-1098 had significantly high hardness index. The varieties had positive as well as negative correlation between hardness index and average grain weight (1000 grains) and life history parameters. Rizwana *et al.* (2011) examined the infection of eight rice genotypes under storage conditions against the Angoumois grain moth, *S. cerealella*. The means of moth emergence, weight loss (%), damage (%), and developmental period were used to calculate the results. It was discovered that no variety exhibited perfect resistance to pest invasion. Basmati-370 was shown to be the most resistant rice type, whereas Basmati-Pak and G-7 were the most susceptible. The following was the order of insect resistance: IRRI-6 ≥ G-6 ≥ Basmati-2000 ≥ PK-Basmati-385 ≥ Super Kernel Basmati. The number of moths that emerged had a positive and statistically significant connection with the percentage of weight loss (r=0.780) and damage (r=0.882). Bushra *et al*. (2013) assessed the susceptibility of five distinct barley cultivars Jau-83, Sanober-96, Soorab-96, ICBA, and Sterling to *S. cerealella* feed attack. The percentage of damage (%) and weight loss (%) in grains were calculated after 30, 60, and 90 days of infestation. The variety Soorab-96, which becomes sensitive, had the highest damage percentage (99.38%), whereas Sanober-96, which becomes resistant, had the lowest damage percentage (90.62%). The type that lost the most weight was Soorab-96 (49.71%), which became vulnerable, while Sanober-96 (45.32%), which becomes resistant, had the lowest percentage. Damage was positively correlated with weight loss and negatively correlated with seed germination. Variety Sterling (3%) exhibited the maximum germination in germination studies and turned resistant, while ICBA (0%), which turned sensitive, displayed the lowest germination. Variety Sanober96 produced the highest percentage of germination (2%), whereas ICBA produced the lowest percentage (0%), in the sand germination test. Analyzing the proportion of losses of the different cultivars revealed that none of them showed complete resistance or sensitivity. Soujanya *et al*. (2013) examined the resistance of eleven different genotypes of maize grains to the non-choice rice weevil, *Sitophilus oryzae* (L.), and the Angoumois grain moth, *S. cerealella*. Studies were conducted on parameters like susceptibility index, weight loss, adult emergence, and seed damage. According to their findings, *S. oryzae* had low adult emergence, seed damage, and weight loss in Shaktiman1 (41, 12% and 0.29%) and RHM 2 (40, 17.0% and 0.73 %), respectively. PEEHM 5 (228.0) had the highest data, followed by Shaktiman 2 (85.0). The genotypes for *S. cerealella* that demonstrated the highest adult emergence were VH 9 (63.0) and PEEHM 5 (58.5). Consequently, weight loss and seed damage were higher in PEEHM 5 (63.15, 14.27) and VH 9 (48.27, 10.13) and lower in VH 4 (4.28, 2.74) and VH 5 (6.70, 2.86). It was discovered that VH 4 and VH 5 were somewhat susceptible to *S. cerealella*, while Shaktiman 1 was moderately susceptible to *S. oryzae*. None of the genotypes, however, was discovered to be the least vulnerable to *S. cerealella* and *S. oryzae*. For both pests, there were strong and positive associations between adult emergence, seed damage, weight loss, and susceptibility index. Aleksandra *et al*. (2018) observed how populations of the Angoumois grain moth, *S. cerealella*, responded to whole grains (corn, wheat, barley, sorghum, millet, tall fescue, and Kentucky bluegrass) and mechanically damaged grains (corn in fractions with/without embryo, polished rice) in a non-choice laboratory experiment (temperature 27±1ºC; relative humidity 60–80%). The entrance and exit hole positions on various grains were observed in order to ascertain the behavior of the pests. Following adult emergence, food consumption was calculated by calculating the mass losses of infected grains. Grain characteristics, both qualitative and quantitative, were linked with mass losses. With the exception of Kentucky bluegrass, all grain substrates saw successful development. Grain morphology determined the larval penetration strategies and exit hole location. Individual growth often occurred in a single grain, although in polished rice, there was evidence of grain-to-grain transfer. Corn grains had the most recorded loss of contaminated grain (55.48 mg), while tall fescue grains had the lowest (2.40 mg). Mass losses were found to have positive connections with the contents of protein, fat, and sugar; cellulose and ash concentrations showed negative associations. Salman *et al.*(2024) evaluated relative sensibility of fifteen cultivars of gramineous crops Sorghum (Giza-15, Dorado); Barley (Giza-132, Giza-123); Rice (Giza-181, Sakha-101); Maize (SC-10, SC-131); Wheat (Giza-171, Gimeza-11, Sakha-95, Miser-1, Sids-12, Shandweel-1 and Bani sweaf-5) against *Sitophilus granarius* L., two test (free choice and Non-choice) were conducted in the research lab at 28±1 °C and 65±5% R.H. they demonstrated that highly significant differences between various graminiaceous grains in their susceptibility against *S. granarius* L. infestation. In free choice, the lines were categorized into three categories i.e., Giza-15, Dorado, Giza-171, and Gemiza-11 were found to be greatest susceptible; Giza-123, Giza-181, Sakha-101; SC-131and Miser-1 were found to be less susceptible and shandweel-1 was no injury. Weight loss was categorized into three categories i.e., Giza-15 (71.31±3.01) followed by Dorado (61.55±6.47) were highly weight loss, Giza-181, Sakha-101, SC-131, Misr-1, Bani sweaf-5 found to be less weight loss, Shandweel-1 was no infestation. The result indicated that the adult who emerged in Giza-123, Giza-181, SC-10, SC-131, Bani sweaf-5 were found to be less, Sakha-101, Sids-12, Shandweel-1 were no adult emerged. In the non-choice test, the two varieties, Giza-15, Gimeza-11 Showed the highest percentage of infestation (44.0±3.27) and (48.0±3.27%), followed by Dorado (35.0±2.0%). The varieties Giza-123, Giza-181, SC131, Misr-1, Bani sweaf-5 were the least; Sakha-101, Sids-12, Shandweel-1 observed no infestation. The highest percentage weight losses were in Giza-15 (28.71±3.08) followed by Dorado (22.46±4.53), Giza-123, SC-10, SC131, Miser-1 and Bani sweaf-5 were the least loss. Sakha-101, Sids-12 and Shandweel-1 were no weight loss. No adult emerged observed in Shandweel-1. The least adult emerged recorded in Giza-181, Sakha-101, SC-131, Misr-1 and Bani sweaf-5. These details are importance for host plant resistance breeding programs for the plant breeders.

CONCLUSION

The comparative sensitivity of various graminaceous crops and wheat varieties against *S.cerealella* in the present studies has great future prospects of safe storage. This information of course, to all concerned agencies is a valuable contribution towards stored grain research and wheat food self-sufficiency programs in Egypt, which will further strengthen our economy by insect losses through evolving insect resistance varieties. It is concluded from the above discussion that considering emergence, percent damage and percent weight loss as parameter factors of sensitivity response in the fifteen varieties, and life table parameters of *S.cerealella* on most susceptible and least susceptible gramplasm. Sorghum varieties; maize (SC-10); and Barley (Giza-123) were found to be the greatest sensitive, while, Bread wheat (Giza-171; Sakha-95; SHANDWEEL-1) and Durum wheat

(Masr-1), were found to be less sensitive. Now a day's *Trichogramma* spp, (eggparasite) are encouraged as biocontrol agent for controlling of many serious lepidopterous pests i.e., *Helicoverpa* sp., and borers etc. these parasites are reared in laboratories on *S.cerealella* eggs. Therefore, it is suggested that Sorghum varieties the most sensitivity variety and best for mass production of *S.cerealella* can be recommended for *Trichogramma* rearing, further research need to be done to screen and evaluate more varieties against *S.cerealella* and also find the genes of resistance in graminaceous against *S.cerealella*. It is also suggested that breeders should concentrate efforts on evolving varieties yhat have potential yield and more insect resistance level.

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