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Effect of intercropping sesame (*Sesamum indicum* L.) with maize (*Zea mays* L.) on damage and economic losses caused by rodent species in some genotype of maize, Egypt

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Abstract

This study intends to determine the impact of intercropping sesame as a secondary crop with maize as a main crop on lowering the amount of rodent infestation in maize, which is a significant crop in the study area in Qena governorate, Egypt. Due to its importance as a fodder crop for feeding livestock and poultry, maize is regarded as one of the most crucial strategic crops in both the Arab Republic of Egypt and the rest of the globe. Many nations, including Egypt, have a big imbalance between their output and consumption, forcing them to import a lot of goods to make up for the lack of production. Highest rodent infestation was recorded in Balady, it was 19.50% and 16.17% followed by genotype single cross Hay tak 2066, it was 15.17% and 12.33%, while the lowest one was genotype single cross Hay tak 2055, it was 13.50 and 10.33% in maize without and with sesame respectively. The percentage of economic losses caused by rodents show that the highest value of loss was recorded in genotype single cross Hay tak 2066 was about 3.00 and 2.47 ardeb/feddan (Feddan = 4200 m² = 0.420 hectares = 1.037 acres, Ardeb = 5.44 imperial or 5.619 U.S. bushels) worth about 3600 and 2964 EGP, representing about 15.17 and 12.33% of the total production as a result of rodents' attack in the case of cultivation alone.

Keywords: intercropping, rodents, maize, sesame, damage, genotype.

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1. Introduction

The third-most cereal crop in the world and a source of nutrients for both people and animals is maize (*Zea mays* L.). Rodent behavior might differ from location to location. Many researchers throughout the world have identified maize crop fields as a favorable habitat for rodent pests (Ahmed, 2006; Baghdadi, 2012; Desoky, 2018 and Elrawy, 2021). Pests are said to cause less damage in fields containing a variety of crops than in farms with just one crop, or monocultures. This theory is founded in part on the presumption that in a more diversified environment, a particular pest will find fewer appropriate hosts to feed or lay eggs on. Nevertheless, literature evaluations show that insects with a wide host range. Diversifying crops may not, however, diminish insects with a wide range of hosts, according to research evaluations (Smith *et al.*, 2001). The capacity of intercropping to lessen insect and disease damage is a significant benefit. In general, there are three categories into which solutions for decreasing insect infestation and damage in intercropping can be divided: As an example, the second species, which is more frequently utilized by proprietary pests, slows down a pest's ability to assault its host. Second: trap crop refers to a second species that is drawn to a pest or pathogen that often harms the primary species and is more commonly used for pests and pathogenic agents. Thirdly, intercropping reduces parasitized and prey populations because predators and parasites are drawn to it more than mono cropping (Mousavi and Eskandari, 2011).

2. Materials and methods

The present investigation was carried out during Season Summer (2022). Afield experiment was conducted in old areas (one sowing date) at two location was at Dahasa village, Farshut district, Qena governorate, Egypt, one of them using seven treatments without sesame (six maize genotypes and Balady variety) and the other using seven treatments with sesame (six maize genotypes and Balady variety) for the evaluation of damage caused by rodent species of maize cultivars. The genotypes studied were four white seeds maize [(*i.e.*, (Single cross: S. C. 4 and S. C. 6) and (three ways cross: T.W. C. 310 and T. W. C. 11)] and three yellow seeds maize (*i.e.*, Single Cross: S. C. 2055, S. C. 2066 and Balady). Monitoring of rodent species damage in the field, based on the frequency encounter of damage maize corn cob until the harvest time. Direct count method was used in order to determine the rodent damage. Samples of thirty plants were taken randomly from the field of each replicate and damage crops were measured. Half feddan each treatment of maize during Season Summer (2022) was chosen to this experiment. Samples from each experiment were 30 plants representing five randomized replicates. The degree of damage due to rodent species in the ears was estimated according to Hamelink (1981) by using the following equations:

$$\text{Damage (\%)} = \frac{0.0 \times S1 + 0.25 \times S2 + 0.50 \times S3 + 0.75 \times S4 + 1.0 \times S5}{N} \times 100$$

Where: S1= number of undamaged corn cob, S2= number of 1/4 damaged corn cob, S3= number of 1/2 damaged corn cob, S4= number of 3/4 damaged corn cob, S5= number of complete damaged corn cob, N= total number of investigated corn cob.

Data were analyzed according to standard procedures for analysis of variance (Duncan's 1955; Steel and Torrie, 1980).

3. Results and discussion

3.1 Assessment of damage caused by rodents in maize crop

Results presented in Tables (1 and 2) indicate the infestation of damage caused by rodent species in maize without and with sesame. The percentage of rodent damage show that the highest rodent infestation was recorded in Balady, it was 19.50% and 16.17% followed by genotype single cross Hay tak 2066, it was 15.17% and 12.33% followed by genotype single cross Hay tak 2055, it was 13.50 and 10.33% in maize without and with sesame respectively. While the moderate rat infestation was recorded in the genotype three-way cross Watania 11, it was 11.00% and 8.50% followed by genotype three-way cross Watania 310, it was 9.67% and 7.17% in maize without and with sesame respectively. While the least rat infestation was recorded in the genotype single cross Watania 6, it was 4.50% and 3.33% followed by genotype single cross Watania 4, it was 6.00% and 4.67% in maize without and with sesame respectively. Elrawy *et al*. (2021a) revealed those genotypes percentages of rodent losses for maize as summer crop. Damage appraisal was fluctuated from genotype to another.

Table (1): Average percentage of damage caused by rodents in some genotypes of maize without sesame.

Genotypes	1	2	3	4	5	Mean
Balady	22.50	15.83	20.00	18.33	20.83	19.50 a
Hay tak 2055	14.17	10.83	15.00	11.67	15.83	13.50 bc
Hay tak 2066	15.83	13.33	16.67	15.00	15.00	15.17 b
Watania 11	12.50	10.83	14.17	7.50	10.00	11.00 cd
Watania 310	10.83	9.17	9.17	9.17	10.00	9.67 d
Watania 4	7.50	2.50	9.17	5.83	5.00	6.00 e
Watania 6	5.00	2.50	5.83	4.17	5.00	4.50 e

Means in each column followed by the same letters are not significantly different by (P=0.05) according to Duncan's multiple range test.

Table (2): Average percentage of damage caused by rodents in some genotypes of maize with sesame.

Genotypes	1	2	3	4	5	Mean
Balady	20.00	13.33	15.83	15.83	15.83	16.17 a
Hay tak 2055	10.83	10.00	9.17	10.00	11.67	10.33 bc
Hay tak 2066	12.50	13.33	10.83	10.83	14.17	12.33 b
Watania 11	12.50	7.50	10.83	5.83	5.83	8.50 cd
Watania 310	6.67	6.67	10.00	5.00	7.50	7.17 de
Watania 4	7.50	2.50	5.83	2.50	5.00	4.67 ef
Watania 6	4.17	2.50	0.83	4.17	5.00	3.33 f

Means in each column followed by the same letters are not significantly different by (P=0.05) according to Duncan's multiple range test.

Generally, from data in Tables (1 and 2) revealed that the maize without sesame gave high damage caused by rodents compared to the maize with sesame by an estimated difference 16.84%. This may be due to sesame to high content of methionine, leucine and aspartic acid watch it a rodent repellent effect. Embarak (1997) evaluated the damage caused by rats in three different types of field crops (maize, wheat, and barley) in farmed areas. The rodent damage concentrated at five meters alongside the boundaries of damaged wheat and barley. For maize, wheat, and barley, the damage percentages were, in descending order, 11.67, 4.5, and 3.5%.

3.2 Economic losses caused by rodents in some genotypes of maize

Data presented in Tables (3 and 4) showed that, the value of loss (quantitative) in genotypes of maize without and with sesame. The percentage of economic losses caused by rodents show that the highest value of loss was recorded in genotype single cross Hay tak 2066 was about 3.00 and 2.47 ardeb/feddan worth about 3600 and 2964 EGP, representing about 15.17 and 12.33% of the total production as a result of rodents attack in the case of cultivation alone, followed by genotype single cross Hay tak 2055 was about 2.57 and 1.96 ardeb/feddan worth about 3084 and 2352 EGP, representing about 13.50 and 10.33% of the total production as a result of rodents attack in the case of cultivation alone, followed by Balady was about 2.34 and 1.94 ardeb/feddan worth about 2808 and 2328 EGP, representing about 19.50 and 16.17% of the total production as a result of rodents attack in the case of cultivation alone in maize without and with sesame, respectively.

Table (3): Average percentage of economic losses caused by rodents in some genotypes of maize without sesame.

Genotypes	Average of fadden yield/ardeb	Losses (%)	Losses/ardeb	Average of ardeb price/EGP	Losses/EGP
Balady	12	19.50	2.34	1200	2808
Hay tak 2055	19	13.50	2.57	1200	3084
Hay tak 2066	20	15.17	3	1200	3600
Watania 11	19	11.00	2.10	1100	2310
Watania 310	19	9.67	1.84	1100	2024
Watania 4	20	6.00	1.20	1100	1320
Watania 6	23	4.50	1.04	1100	1144
Mean	18.86	11.33	2.01	1142.86	2297.14

Table (4): Average percentage of economic losses caused by rodents in some genotypes of maize with sesame.

Genotypes	Average of fadden yield/ardeb	Losses (%)	Losses/ardeb	Average of ardeb price/EGP	Losses/EGP
Balady	12	16.17	1.94	1200	2328
Hay tak 2055	19	10.33	1.96	1200	2352
Hay tak 2066	20	12.33	2.47	1200	2964
Watania 11	19	8.50	1.60	1100	1760
Watania 310	19	7.17	1.40	1100	1540
Watania 4	20	4.67	0.90	1100	990
Watania 6	23	3.33	0.80	1100	880
Mean	18.86	8.93	1.58	1142.86	1807.35

While the moderate value of loss was recorded in the genotype three way cross Watania 11 was about 2.10 and 1.60 ardeb/feddan worth about 2310 and 1760 EGP, representing about 11.00 and 8.50% of the total production as a result of rodents attack in the case of cultivation alone, followed by genotype three way cross Watania 310 was about 1.84 and 1.40 ardeb/feddan worth about 2024 and 1540 EGP, representing about 9.67 and 7.17% of the total production as a result of rodents attack in the case of cultivation alone in maize without and with sesame respectively. While the least value of loss was recorded in the genotype single cross Watania 6 was about 1.04 and 0.80 ardeb/feddan worth about 1144 and 880 EGP, representing about 4.50 and 3.33% of the total production as a result of rodents attack in the case of cultivation alone, followed by genotype single cross Watania 4 was about 1.20 and 0.90 ardeb/feddan worth about 1320 and 990 EGP, representing about 6.00 and 4.67% of the total production as a result of rodents attack in the case of cultivation alone in maize without and with sesame respectively. The study showed significant differences between cultivars of maize. At El-Behria governorate, Metwally *et al*. (2009) found the losses to maize crop by large jird M. shawi isis (Thomas) were about 2 ardab/feddan, and decreased to 0.9 ardab/feddan, during 2001 and 2002 agriculture seasons, respectively. These results are in agreement with data obtained by Elrawy *et al*. (2021b).

4. Conclusion

In general, the recorded data showed that genotype single cross Hay tak 2055 had the lowest genotype single cross Balady infestation rates 13.50 and 10.33% and the greatest genotype single cross Balady infestation rates 19.50% and 16.17% in maize without and with sesame, respectively. The percentage of economic losses brought on by rodents reveals that the genotype single cross of Hay Tak 2066 with the highest loss was recorded at about 3.00 and 2.47 ardeb/feddan worth about 3600 and 2964 EGP, or about 15.17 and 12.33% of the total production as a result of rodent attack in the case of cultivation alone. Our recommendation is: Using agricultural techniques to control rats is one of the most effective, healthy means of doing so. The need of emphasising the use of non-chemical management techniques to lessen environmental pollution. Analyzing the economic viability of various control techniques to determine the viability of the control technique in use.

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