



Estimation of damage caused by rodents on orange and mandarin orchards at Sohag governorate, Egypt

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Abstract

This study was aimed to determine the damage caused by rodents in three different districts (Shandaweel, Tahta and Gerga) at Sohag governorate, Egypt during November 2018 until February 2019. Many hundred feddans was cultivated with orange and mandarin orchards in these districts. Rodent damage assayed in orange and mandarin trees in different districts at Sohag governorate, (The Shandaweel Research Station, Tahta, and Gerga). where it spreads the white-bellied rat, *Rattus rattus frugivorous* (Linnaeus), the grey-bellied rat, *Rattus rattus alexandrinus* (Linnaeus), the Nile grass rat, *Arvicanthis niloticus* (Desmarest), and house mouse, *Mus musculus* are commonly found in and around the citrus farms (orange and mandarin) at Sohag governorate. Results showed the damage percentages were in (orange and mandarin) (25.5 and 19.7%), for (19.5 and 12.00%) and 15.70 and 9.3 %) in Shandaweel Research Station, Tahta and Gerga farms. Where the average rate of infestation in the fruits of orange and mandarin trees in the three different districts (Shandaweel Research Station, Tahta and Gerga farms) reached a rate of (20.2%) and (13.6 %) respectively. Also showed the damage in of fruit and branches on orange and mandarin trees caused by rodents in the same places mentioned above that the damage percentage on orange and mandarin were high in the Shandaweel Research Station, the percentage was (29.05 and 21.07%) for orange and mandarin fruits. While the percentage of damage in orange and mandarin branches reached (21.16 and 39.44%), respectively. Followed by the infestation rate is the Tahta districts where the percentage was lower. The percentages were (21.89 and 14.80 %) for orange and mandarin fruits. While the percentages of damage in orange and mandarin branches reached (14.97 and 30.26%), respectively. As for Gerga districts, it was the least in terms of the rate of infestation, where the percentage was lower. The percentages were (16.98 and 10.52 %) for orange and mandarin fruits, respectively. While the percentages of damage in orange and mandarin branches reached (11.50 and 22.29%), respectively during the period of the study at Sohag governorate. This study was aimed to determine the damage caused by rodents in three different districts (Shandaweel, Tahta and Gerga) at Sohag governorate, Egypt during November 2018 until February 2019.

Keywords: rodent species, infestation, citrus farms, orange, mandarin, fruit, branches.

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1. Introduction

The white-bellied rat, *R. r. frugivorous* (Linnaeus), the grey-bellied rat, *R. r. alexandrinus* (Linnaeus), and the Nile grass rat, *A. niloticus*, and house mouse *M. musculus* are the most common invasive rodent species of crops and Citrus farms in Egypt (Abd El Galil, 2019; Ahmed, 2017; Desoky, 2016; Desoky and Baghdadi, 2019; Metwally *et al.*, 2011). These rodents are the most destructive pests which cause damage directly to on fruits and branches by their burrowing nature, burrows, and nests gnawing branches habits and their indirect impact include fruits and branches through their urine, feces, and hair. Rodents are considered one of the most important pests in Egypt. This is a great reason for economic losses for farmers (destruction of crops, stored products, poultry, and animal farm) (Abdel Gawad and Farghal, 1982). Rats were affected by some crops and the density of *A. niloticus* in Fayoum governorate (Asran *et al.*, 1991). It has been recognized at a global scale that rodents cause problem and cause great economic loss to farmers (damage the growing crops, citrus orchards stored products, poultry and animals farm); and to food manufactures by damaging the structure and fabric of buildings. Besides, they gnaw through almost any object in their ways to obtain food and shelter (Abdel-Gawad and Maher, 1982). Both just planted, young, and grown-up plants of orange, lemon, tangerine, Clementine are discriminately attacked (Santini, 1986). Also, citrus orchards of south ern Italy. In this case, the damage results in the removal of the

bark of the root system and the crown area of the plant often are causing its death (Ciampolini *et al.*, 1985). And from rodent damage, loss Bark-stripping of tankan orange, citrus tankan, by the roof rat, *R. rattus* at Japan. Roof rats, *R. rattus*, damage the bark of tankan orange, citrus tankan Hayata, over a wide area of Amami Oshima Island, in the Nansei Islands in southern Japan (Yabe, 1999). Also, rodent causes economic damages in coconut up to 28% in peninsular India and up to 45% in Andaman and Nicobar Islands and Lakshadweep. In the case of oil palm, it causes damages up to 57% in Andaman and Nicobar Islands (Mariadoss *et al.*, 2020).

2. Materials and methods

2.1 Study area

This study has conducted from the beginning of November 2018 until the end of February 2019 on citrus Trees (orange and mandarin farms) in three distracts (Shandaweel Research Station, Tahta and Gerga at Sohag governorate, Egypt.

2.2 Data collection

This work was carried out in Three distracts Shandaweel Research Station, Tahta, and Gerga) at Sohag governorate, Egypt. It covers 150 feddans cultivated with orange, lime, fig, grape, mango, and mandarin. Two Feddans were cultivated with orange and mandarin and were selected for estimating the damage

caused by rodents in every districts. One hundred trees (50 orange and 50 mandarins) were chosen at randomly at the three districts above. Estimation of the damage was carried out according to the following criteria:

- The number of infested trees in each type of fruit.
- The location of the infestation on the trees.
- Effect of damage on the crop weight of orange and mandarin.

This was done by estimating the number and weight of fruits collected from 20 infested trees and compared with twelve sound ones as described by Farghal *et al.* (1986). infested trees were randomly selected from the fifty predetermined trees in both oranges and tangerines at the stage of fruit growth completion beginning from November until the end of February. The weeds under these trees are removed and the fallen fruits are counted under each tree on which the manifestations of infection are present from rodents after excluding the fruits that have the manifestations of infection by birds or bats every week and is recorded in the field record and that work is repeated until the end of the fruit collection in February, so that the quantity produced by the tree during that season is weighed and the infected fruits are converted from a number to a kilogram until The percentage of losses can be calculated from the following equation.

$$\text{Infestation (\%)} = \frac{\text{The weight of the infested fruits}}{\text{Total weight of fruits (healthy + infested)}} \times 100$$

2.3 Statistical analysis

All obtained data were subjected to statistical analysis of variance and treatment means were compared for significant differences using the Duncan's Multiple Range Test (significant differences at $p=0.05$) according to the MSTAT- C Statistical software (Russell, 1986). The computer program was used to perform all the analyses of variance in agreement with the procedure outlined by Duncan (1955).

3. Results and Discussion

3.1 Estimation damage caused by common rodent species on orange and Mandarin farms

This study was carried out from November 2018 to February 2019 for four a month on three districts (Shandaweel Research Station, Tahta and Gerga at Sohag governorate, Egypt during 2018-2019.

3.1.1 Rodent damage assessment to orange and mandarin trees

Data in Table (1) showed the damage on orange and mandarin trees caused by the white billed rat, *R. r. frugivorus*, the gray-belly rat, *R. r. alexandrinus*, Nile grass rat, *A. niloticus* and house mouse, *M. musculus* in three different districts at

Sohag governorate (the Shandaweel Research Station, Tahta and Gerga). Results showed that the average damage percentage caused by rodents on orange and mandarin were very high in the Shandaweel Research Station, the percentage was (25.5 %) in orange fruits and (19.7%) in mandarin fruits followed

by the infestation rate is the Tahta distracts, where the percentage was lower, reaching (19.5 %) in orange fruits and (12.0 %) in mandarin fruits. As for Gerga distracts it was the least in terms of the rate of infestation, as the rate of infestation in orange fruits reached (15.7 % and 9.3%) in mandarin fruits.

Table (1): Percent damage of fruits by rodents on orange and mandarin trees in three different distracts at Sohag governorate, Egypt during November 2018 until February 2019.

Distracts	Orange						Mandarin					
	Infested trees				Sound trees (control)		Infested trees				Sound trees (control)	
	Fruit		Infested	Infestation (%)	Number of fruits/tree (yield)	yield/tree (kg)	Fruit		Infested	Infestation (%)	Number of fruits/tree (yield)	yield/tree (kg)
Shandaweel	893.0a	148.8a					227.5a	25.5a				
Tahta	885.5a	147.6a	173.0b	19.5b	938.5a	156.4a	1126.6a	125.2a	135.3b	12.0b	1154.3a	128.3a
Gerga	775.0b	129.2b	121.8c	15.7c	870.0b	145.0b	916.0c	101.8b	84.8c	9.3c	1044.8b	116.1b
Mean	851.2	141.9	174.1	20.2A	921.2	153.5	1003.5	111.5	136.7	13.6B	1106.0	122.9

In the Gerga distracts, the damage percentage was low compared with the damage percentage in two distracts of Shandaweel Research Station and Tahta. From the previous results, the highest damage percentage was in Shandaweel Research Station. The lowest damage percentage was on the farm of Center Gerga distract in orange and mandarin trees. Where the average rate of infestation in the fruits of orange and mandarin trees in the three different distracts (Shandaweel Research Station farm, Tahta and Gerga) reached a rate of (20.2%), (13.6 %), respectively. Rodent damage orange trees and mandarin may be due to neglect of the farmer, non-clean around the trees, not pruning trees, and not demolition of rat burrows. These results agree with Ahmed (2007), and

Kandil and Ahmed (2017) those reported that the damage in crops was due to the density of rats.

3.1.2 Rodent damage assessment of fruit and branches on orange and mandarin trees

Data in Table (2) showed the damage of fruit and branches on orange and mandarin trees caused by the white billed rat, *R. r. frugivorus*, the gray-belly rat, *R. r. alexandrinus*, Nile grass rat, *A. niloticus* and house mouse, *M. musculus* in different distracts at Sohag governorate, (the Shandaweel Research Station, Tahta, and Gerga). Results showed that damage percentage caused by rodents on orange and mandarin were very high in the Shandaweel Research

Station, the percentage was (29.05 %) in orange fruits and (21.07%) in mandarin fruits, While the percentage of damages in orange and mandarin branches reached (21.16%) and (39.44%), respectively. Followed by the infestation rate is the Tahta distracts, where the percentage was lower, the percentage was (21.89 %) in orange fruits and (14.80 %) in mandarin fruits, while the percentage of damages in orange and mandarin branches reached (14.97 %) and (30.26 %), respectively. As for Gerga, distract it was the least in terms of the rate of infestation, where the percentage was lower, the percentage was (16.98 %) in orange fruits and (10.52 %) in mandarin fruits, While the percentage of damages in orange and mandarin branches reached (11.50 %) and (22.29 %), respectively. In Gerga distract, the damage percentage was low compared with the damage percentage in

two distracts of Shandaweel Research Station and Tahta. From the previous results, the highest damage percentage was in Shandaweel Research Station. The lowest damage percentage was on the farm of Gerga, distract in orange and mandarin trees. Where the average rate of Infestation in the fruits of orange and mandarin trees in the three different distracts (Shandaweel Research Station farm, Tahta, and Gerga farms) reached a rate of (22.64%), (15.46 %), respectively. While the average percentage of damage to orange and mandarin branches was (15.88 %) and (30.66 %) respectively. The infestation of orange and mandarin was much evident in the area near the bank of the Nile and decreased gradually towards the middle of the orchard these results are in agreement with Farghal *et al.* (1986), Abdel-Gawad *et al.*, (1982) and Mariadoss *et al.* (2020).

Table (2): Comparison between rodent's infestation of fruit and branches on orange and mandarin in three distracts, at Sohag governorate, Egypt during November 2018 until February 2019.

Distracts	Orange									Mandarin								
	Infested trees						Sound trees (control)			Infested trees						Sound trees (control)		
	Branches			Fruit			No. of fruits/tree (yield)	yield/tree (kg)	Branches			Fruit			No. of fruits/tree (yield)	yield/tree (kg)		
	Total number examined	Infested	Infestation (%)	No. of fruits/tree (yield)	yield/tree (kg)	Infested			Infestation (%)	Total number examined	Infested	Infestation (%)	No. of fruits/tree (yield)	yield/tree (kg)			Infested	Infestation (%)
Shandaweel	15.75a	3.33a	21.16a	733.7b	122.3b	213.0a	29.05a	954.5a	159.1a	15.00b	6.0a	39.44a	865c	96.0c	182a	21.07a	1119.0b	124.3a
Tahta	15.58a	2.30b	14.97b	759.0a	126.6a	166.0b	21.89b	939.0b	156.4a	16.25a	4.9b	30.26b	958a	106.4a	142b	14.80b	1154.0a	128.3a
Gerga	16.67a	1.90c	11.50c	710.0c	118.3c	121.0c	16.98c	870.0c	145.0b	13.83c	3.1c	22.29c	891b	99.0b	94c	10.52c	1045.0c	116.1b
Mean	16.00	2.51	15.88B	734.2	122.4	166.7	22.64A	921.2	153.5	15.03	4.67	30.66A	904.7	100.5	139.3	15.46B	1106.0	122.9

Rodent damage orange trees and mandarin may be due to neglect of the farmer, non-clean around the trees, not pruning trees, and not demolition of rat burrows. These results also agree with Ahmed (2007), and Kandil and Ahmed (2017) those reported that the damage in

crops was due to the density of rats. Also, rodents attack the branches, perhaps due to the mice's need for sodium and calcium, as well as their association with the mineral content of tree branches. These results are consistent with Hansson (1991). Where it

showed experiments with wooden sticks impregnated with various mineral salts, available to small rodents in peak winter, demonstrated a pronounced interest in sodium and calcium that contrasted with avoidance of phosphorus. Similarly, the mineral content of tree seedlings was associated with the attack rates. In conclusion, the battle to control rodent species will continue as long as these pests compete with mankind for food. This study revealed the differences in species composition of rodents depending on locality, habitat type, and preferred food. These rodents can cause damage by consumed fruits and branches and the removal of the bark of the root system and the crown area of the plant. Therefore, there is an acute need for determining the pest method for controlling and can be used effectively in an Integrated Pest Management Approach (IPMA) for the regulation of the rodent's population density in citrus farms.

References

- Abdel-Galil, Y. M. A. (2019), "Survey and population density of some rodent species in Sahel Silem district at Assiut Governorate", *Egyptian Academic Journal of Biological Sciences*, Vol. 11 No. 1, pp. 101–107.
- Abdel-Gawad, K. H. and Farghal, A. I. (1982), "Levels of Egypt rodent sensitivity to warfarin", *Assiut Journal of Agricultural Sciences*, Vol. 13 No. 2, pp. 145–152.
- Abdel-Gawad, K. H. and Maher, A. A. (1982), "The active burrows as a parameter for the detection of population density of rodents during control campaigns", *Assiut Journal of Agricultural Sciences*, Vol. 13 No. 2, pp. 115–120.
- Abdel-Gawad, K. H., Salit, A. M. and Maher, A. A. (1982), "Damage caused by rodents in sugar-cane plantations", *Assiut Journal of Agricultural Sciences*, Vol. 13 No. 2, pp. 63–70.
- Ahmed, H. A. A. (2017), "Evaluation of rodenticide bromadiolone and chlorophacinone in controlling rodent infestation at Al-Wadi Al-Gadeed governorate in Egypt", *Egyptian Academic Journal of Biological Sciences*, Vol. 9 No. 1, pp. 41–48.
- Ahmed, H. A. A. (2007), *Ecological and toxicological studies on some domestic rodent species prevailed in buildings*, M.Sc. Thesis, Faculty of Agriculture, Al-Azhar University, Egypt.
- Asran, A. A., El-Deeb, H. I. and El-Halafawy, (1991), "Rat damage to certain crops and population density of *Arvicanthis niloticus* in Fayoum Governorate", *Egyptian Journal of Agricultural Research*, Vol. 9 No. 1, pp. 273–279.
- Ciampolini, M., Suss, L., Zerbi, N. and Penna, E. (1985), "I topi campagnoli

- causing grave danni agli argument Calabresi", *L'Informatore agrario*, Vol. 11, pp. 93–99.
- Duncan, B. D. (1955), "Multiple ranges and multiple F tests", *Biometrics*, Vol. 11, pp. 1–42.
- Desoky, A. S. S. (2016), "Rodenticide use in rodent control in Upper Egypt: An overview", *Global Journal of Life Sciences and Biological Research*, Vol. 2 No. 2, pp. 25–27.
- Desoky, A. S. S. and Baghdadi, S. A. S. (2019), "Comparison between distribution of rodent species in old and Newly Reclaimed Lands at Sohag region, Egypt", *International Journal of Research in Agriculture and Forestry*, Vol. 6 No. 8, 2019, pp. 1–3.
- Farghal, A. I., Abdel- Gawad, K. H., Salman, A. G. A. and Ali, M. K. (1986), "The damage caused by rodents to mango, mandarin and orange orchards", *Assiut Journal of Agricultural Sciences*, Vol. 17 No. 1, pp. 63–70.
- Hansson, L. (1991), "Bark consumption by voles in relation to mineral contents", *Journal of Chemical Ecology*, Vol. 17, pp. 735–743.
- Kandil, R. A. and Ahmed, H. A. A. (2017), "Rat damage assessment and evaluation of some methods of control for *Rattus rattus* on date palm and orange trees in New Reclaimed Land", *Egypt. Acad. J. Biolog. Sci. (B. Zoology)*, Vol. 9, No. 2, pp. 39–44.
- Mariadoss, A., Alice, J. and Chakraborty, A. (2020), "Rodent damages and approaches for their management", *Innovative Farming*, Vol. 5 No. 2, pp. 54–59.
- Metwally, A. M., Abdel-Gawad, K. h. H., Abdel-Samad, M. A., Nafady, A. A. and Saudi, A. S. (2011), "Evaluation of different control methods against rodent species in some field crops and date palm trees in Assiut Governorate", *Journal of Plant Protection and Pathology*, Vol. 2, No. 10, pp. 845–853.
- Russell, D. F. (1986), *MSTAT Director*, Crop and Soil Sciences Department, Michigan State University, USA.
- Santini, L. (1986), "Agriculture and forest rodent problems and control in Italy", *Proceedings of the Vertebrate Pest Conference*, Vol. 12 No. 11, pp. 93–99.
- Yabe, T. (1999), "Bark- stripping of tankan orange, citrus tankan, by the roof rat, *Rattus rattus*", In: *Rodent Biology and Management (Zhang Z. B., Hinds L., Singleton G. and Wang Z. W. Ed.)*, ACIAR Technical Report 45, Canberra, Australia, pp. 67–68.