Archives of Agriculture Sciences Journal
Print ISSN: 2535-1680
Online ISSN: 2535-1699

ARCHIVES OF AGRICULTURE SCIENCES JOURNAL

Volume 8, Issue 2, 2025, Pages 124–130

Available online at https://aasj.journals.ekb.eg

DOI: https://dx.doi.org/10.21608/aasj.2025.407802.1203

Estimation of rodent losses in some greenhouse crops in Toshka, Egypt

Mostafa M. F., Abdel Samad M. A., Baghdadi S. A. S., Dongol E. M. A.*

Agricultural Zoology and Nematology Department, Faculty of Agriculture, Al-Azhar University, Assiut, Egypt

Abstract

Rodent damages were analyzed in six major vegetable crops grown in greenhouses in Toshka region of Egypt. Infestation levels varied significantly, with eggplant being the most affected (19.71%), followed by pepper (12.76%). In contrast, squash (1.91%), tomato (2.97%), and common bean (3.72%), recorded lower damage rates. While cucumber recorded (7.45%) Peak damage occurred during specific periods for each crop (July-August) and for eggplant, May and June for pepper). The study recommends identifying dominant rodent species and implementing targeted integrated management strategies to reduce losses in the most susceptible crops.

Keywords: Greenhouse crops, vegetable crops, rodents, rats, damage.

*Corresponding author: Dongol E. M. A.,
E-mail address: welhussein3102@gmail.com

1. Introduction

Protected agriculture in greenhouses is a fundamental pillar for enhancing agricultural production and ensuring year-round crop availability, especially in areas with unfavorable climatic conditions for open-field cultivation. The main objective of protected agriculture is to create controlled microclimate that protects the crops from adverse weather conditions, pests, and diseases, while improving environmental factors (Jewett and Jarvis, 2001). This technique helps improve product quality and reduces reliance on chemical pesticides (Jain *et al.*, 2023). Protected agriculture refers to the practice of growing crops in enclosed or semi enclosed environments, such as greenhouses, shade houses, or high tunnels (Lamichhane *et al.*, 2023). This method enables year-round or off-season cultivation, extends the growing season, improves crop quality and productivity, and reduces dependence on external factors. Protected cultivation is widely used in the production of various horticultural crops, including vegetables, fruits, flowers, and herbs (Tüzel and Kacira, 2021). Greenhouse cultivation is particularly suitable for warm season crops (tomatoes, cucumbers, peppers), well as cool season (lettuce, spinach, radishes, broccoli) (Savic and Ilin, 2022). However, protected cultivation faces several challenges, most notable insect pests and rodents, which cause significant economic losses for farmers. The largest taxonomic group of mammals is rodents, with over 2200 species known worldwide (Nowak, 1999). More recently, over 2,500 species have been reported (Burgin *et al.,* 2018). Rodents, such as mice and rats, are common agricultural pests that cause significant damage to various crops, including greenhouse vegetables. Rodents can damage almost all cultivated crops worldwide, including cereals vegetables, cotton, alfalfa, sugar cane, potatoes, tree fruits, and many others (Witmer *et al*., 2012). Rodents' pests are characterized by their rapid reproduction, diverse diets, and nocturnal activity, making their control challenging and complex. Rodents cause direct damage to crops by gnawing leaves, stems, fruits, and roots, leading to plant weakening, and stunted growth, resulting in reduced yield and crop quality (Sarwar, 2015). Previous studies have highlighted the extent of damage caused by rodents to various crops. Several researchers (Asran and Abd El Galil, 2018; Desoky and Baghdadi, 2022; El Deeb *et al*., 1985; Mortada and Zedan, 2007; Singleton *et al.,* 2010) have estimated the damage caused by rodents to cucumber, tomato, pepper, eggplant, beans, and squash which are widely cultivated and highly economically valuable vegetables extensively grown in greenhouses. Given their significant economic importance, any losses to these crops due to rodent infestations directly result in significant financial losses for farmers. Ali *et al*. (2017), in their study on protected crop pests, reported that rodents can cause significant damage to tomatoes and peppers, especially during early growth stages and on fruits, through nibbling and contamination. Abdullah *et*

al. (2019) noted that rodents can pose a problem in greenhouse cultivation of squash and cucumber, affecting fruit quality and reducing their market value. Despite these indicators, there is still an urgent need for more detailed studies to quantitatively and economically estimate the extent of these losses to these crops especially in Egyptian greenhouses. Despite ongoing efforts to control rodents, there is still a lack of detailed studies specifically quantifying the economic losses caused by these pests to these crops, especially under protected cultivation conditions. This study aims to address this critical problem by estimating the quantitative and qualitative losses caused by rodents to cucumber, tomato, pepper, eggplant, bean, and squash plants grown in greenhouses. The results of this research will provide accurate and reliable data, enabling farmers and decision-makers to take necessary measures to develop effective and integrated rodent control strategies, thereby reducing losses and enhancing the benefits of protected agricultural production.

2. Materials and methods

The study evaluated rodent damage to greenhouse grown vegetable crops in the Toshka region of Egypt. These crops included common beans **(***Phaseolus vulgaris),* cucumber **(***Cucumis sativus),* eggplant *(Solanum melongena),* peppers (*Capsicum annuum*), squash (*Cucurbit pepo*) and tomatoes (*Solanum lycopersicum*). Ten raised beds were randomly selected from different greenhouses for each of the six vegetable crops. Thirty consecutive plants were examined in each raised bed (out of ten beds allocated for each crop). Healthy and damaged fruits were identified and recorded. For these 30 plants. Rodent-damage to the fruits was determined based on the standardized description provided by Asran *et al*. (1985), which included characteristic gnawing marks and changes in fruit shape and condition. The percentage of damage was calculated as follows:

$$Damage\ Percentage\ (\%) = \frac{Number\ of\ damaged\ fruits}{Total\ number\ of\ fruits\ (Healthy\ +\ Damaged)} \times 100$$

3. Results and Discussion

Table (1) provides important insights into the extent of rodent damage to six vegetable crops (i.e., beans, cucumber, eggplant, pepper, squash, and tomatoes) grown in Toshka area of Egypt. The data clearly shows significant variation in the severity of rodents, infestation of each crop, suggesting differences in the susceptibility or attractiveness of these pests during specific assessment periods. Infestation rate is a vital indicator of the extent of losses caused by rodents in each crop. Eggplant is the most affected, recording the highest rodent infestation rate of a remarkable 19.71%. This exceptionally high figure indicates that rodents cause significant losses in

eggplant, making it the most susceptible and damage crop among the studied crops. Pepper follows closely, behind, recorded a high infestation rate of 12.76% (Table 1). In contrast, crops such as squash (1.91%), tomatoes (2.97%), and beans (3.72%) show much lower infestation rates. Cucumber, on the other hand, showed an average infestation rate of 7.45%.

Table (1): Evaluation of the damage caused by rodents to the fruits of some vegetable crops grown in greenhouses in Toshka region, Egypt.

Vegetables crops	Loss assessment dates	Number of fruits /30 plants	Number of infested fruits /30 plants	Infestation (%)	Total number of infected fruits	Overall infection percentage
Beans	15th October	2844	132	4.64	336 c	3.72
	1st November	3021	108	3.57		
	15th November	3264	96	2.94		
Cucumber	15th March	1116	78	6.99	273 c	7.45
	1st April	1134	84	7.41		
	15th April	1395	111	7.96		
Eggplant	15th July	1968	360	18.29	1140 a	19.71
	1st August	1806	363	20.15		
	15th August	2016	417	20.68		
Pepper	1st May	2499	285	11.4	960 b	12.76
	15th May	2520	315	12.5		
	1st June	2505	360	14.37		
Squash	1st December	1341	33	2.46	81 d	1.91
	15th December	1392	30	2.16		
	1st January	1632	18	1.1		
Tomatoes	1st January	2457	60	2.44	225 c	2.97
	15th January	2541	75	2.95		
	1st February	2565	90	3.51		

Eggplant recorded the highest number of rodent infested fruits (1140 fruits) out of 5783 fruits examined per 30 plants. While pepper came in second in percentage, it also suffered from a large number of infested fruits (960 fruits). In contrast, Squash recorded the lowest number of infested fruits (81 fruits) (Table 1). The greatest damage to eggplants was recorded between July 15 and August 15, while the greatest damage to pepper occurred between May 1st to June 1st. Based on these data, it is recommended that detailed studies be conducted to identify the rodent species prevalent in the Toshka area and causing this damage. Furthermore, integrated rodent management strategies should be developed and implemented, focusing on the most affected crops and taking into account peak infestation periods. These results are consistent with those of several authors, Asran *et al.* (2018) reported that regarding rodent damage to winter crops, tomatoes were less susceptible to rodent attack than wheat; meanwhile, rat damage to horse beans was less than to both wheat and tomatoes. Summer crops in descending

order of average damage percentages, were maize 0.57% > tomatoes 0.55% > soybeans 0.23%. Wheat was severely attacked by field rodents during the milk and dough stages, with total damage percentage reaching 2.62 % and 2.15 %, while tomatoes reached 2.89% and 2.44% (Mortada and Zedan, 2007). Reports agree that rodent damage increases with crop phenology. The nature of rodent pest species, nearby habitats, storage conditions, and crop growth stages can also influence the form and degree of damage caused by rodent pest (Kasso, 2013). Globally, Feldhamer (2007) reported that 30% of crops were damaged by pest rodents during the pre- and post-harvest stages. In northern Ethiopia (Yonas *et al.*, 2013). Reported losses ranging from 8.9 % to 44% of the annual cereal crop due to pest rodents. Abroad, these losses range from 2 % to 5 % in Australia. Losses of up 40 % have been recorded in Hawai (U.S), 12-20 % in South America, and 20.7 % in Andhra Pradesh (India) from sugarcane plantation (Stenseth *et al.,* 2003). In some areas of South America, Rodriguez (1993) reported crop damage due to pest rodents, ranging from 5 % to 90% of the total yield. In Tanzania, Mulungu *et al*. (2002) also reported 80% loss on maize crops.

References

Abdullah, M., Hassan, S. and Hussain, M. (2019), "Survey of major pests of cucurbit crops in greenhouses and their management", *International Journal of Agricultural Research*, Vol. 14 No. 1, pp. 23–30.

Ali, S., Ahmad, S. and Khan, M. A. (2017), "Integrated pest management strategies for protected cultivation", *Journal of Entomology and Zoology Studies*, Vol. 5 No. 3, pp. 1081–1087.

Asran, A. A. and Abd El Galil, Y. M. A. (2018), "Rat damage to certain vegetable crops and population density of *Arvicanthis niloticus* (Desmart) with its number of active burrows in Qalubia and Fayoum Governorates", *Assiut Journal of Agricultural Sciences*, Vol. 49 No. 3, pp. 41–46.

Asran, A. A., El-Deeb, H. I. and Kuhnert, G. (1985), "Rat damage assessment in vineyards and orchards of apricots and plums", *Journal of Agricultural Science - Mansoura University*, Vol. 10 No. 2, pp. 573–575.

Burgin, C., Colella, J., Kahn, P. and Upham, N. (2018), "How many species of mammals are there?", *Journal of Mammalogy*, Vol. 99, pp. 1–14.

Desoky A. S. S. and Baghdadi, S. A. S. (2022), "Response of certain cultivars of broad bean to the injury with rodents at Assiut Governorate, Egypt", *Journal of Agricultural Research Pesticides and Biofertilizers*, Vol. 3 No. 5, pp. 1–4.

El Deeb, H. I., Asran, A. A., Kuehnert, G. and El-Halfawy, M. A. (1985), "Rodent damage to strawberry,

squash, tomatoes and peas in some Delta Governorates in Egypt", *Journal of Agricultural Science - Mansoura University*, Vol. 10 No. 4, pp. 1515–1516.

Feldhamer, G. A., Drickamer, L. C., Vessey, S. H. and Joseph, F. (2007), *Adaptation, diversity and ecology*, 3rd ed., Johns Hopkins University Press, Baltimore, Maryland, pp. 345–363.

Jain, S., Kore, D. S., Kishorkumar, G. K., Mohapatra, A., Baksh H., Kumar, V., Mohanty, S. and Haokip, S. W. (2023), "A comprehensive review on protected cultivation of horticultural crops: Present status and future prospects", *International Journal of Environment and Climate Change*, Vol. 13 No. 11, pp. 3521–3531.

Jewett, T. J. and Jarvis W, R. (2001), "Management of the greenhouse microclimate in relation to disease control: A review", *Agronomie*, Vol. 21 No. 4, pp. 351– 366.

Kasso, M. (2013), "Pest rodent species composition, level of damage and mechanism of control in Eastern Ethiopia", International Journal of Innovation and Applied Studies, Vol. 4, pp. 502–511.

Lamichhane, P., Adhikari, J. and Poudel, A. (2023), "Protected cultivation of horticultural crops in Nepal: Current practices and future needs", *Archives of Agriculture and Environmental Science*, Vol. 8 No. 2, pp. 268–273.

Mortada, M. M. and Zedan, H. A. (2007), "Damage assessment caused by rodent to certain crops in Dakahlia governorate", *Journal of Plant Protection and Pathology*, Vol. 32 No. 2, pp. 1495–1499.

Mulungu, L. S., Makundi, R. H., Massawe, A. W., Stenseth, N. C., Leirs, H., & Vibe-Petersen, S. (2002), "The rodent density-damage function in maize fields at an early growth stage", In Singleton G. R., Hinds L. A., Krebs C. J. & Spratt D. M. (Eds.), *Rats, Mice and People: Rodent Biology and Management*, Australian Center for International Agricultural Research, Canberra, Australia, pp. 301–303.

Nowak, R. (1999), *Mammals of the World*, John Hopkins University Press, Baltimore, MD, USA.

Rodriguez, J. E. (1993), *Rodent plague: A permanent problem in Latin America and the Caribbean*, FAO, Regional Office for Latin America and the Caribbean, Santiago, Chile.

Sarwar, M. (2015), "Pattern of damage by rodent (Rodentia: Muridae) pests in wheat in conjunction with their comparative densities throughout growth phase of crop", *International Journal of Scientific Research in Environmental Sciences*, Vol. 3 No. 4, pp. 159–166.

Savic, D. and Ilin, Ž. M. (2022), "Advantages of growing vegetable crops in modern greenhouses", In: *Vegetable Crops - Health Benefits and Cultivation*, IntechOpen,

London, United Kingdom.

Singleton, G. R., Belmain, S. R., Brown, P. R. and Hardy, B. (2010), *Rodent outbreaks: ecology and impacts*, International Rice Research Institute, Los Baños, Philippines, pp. 289.

Stenseth, N. C., Leirs, H., Skonhoft, A., Davis, S.A., Pech, R. P. and Andreassen, H. P. (2003), "Mice and Rats: Mice, rats, and people: The dynamics and bioeconomics of agricultural rodent pests", *Frontiers in Ecology and the Environment*, Vol. 1, pp. 367–375.

Tüzel, Y. and Kacira, M. (2021), *Recent developments in protected cultivation*, In VIII South-Eastern Europe Symposium on Vegetables and Potatoes, Ohrid, North Macedonia, Vol. 1320, pp. 1–14.

Witmer, G. and Singleton, G. (2012), "Sustained agriculture: the need to manage rodent damage", In *Rodents: Habitat, Pathology, and Environmental Impact*, Triunveri, A., Scalise, D., Eds., NOVA Science Publishers, Inc., New York, USA.

Yonas, M., Sluydts, V., Kiros, W., Deckers, S., Raes, D. and Makundi, R. (2010), "Farmers' perspectives of rodent damage and management from the highlands of Tigray, Northern Ethiopia", *Crop Protection*, Vol. 29, pp. 532–539.