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Short Communication

Pattern of Rodent Damage in the Fields of Groundnut (*Arachis hypogaea*) Plants in Mianwali, Punjab, Pakistan

Umana Niazi, Muhammad Mushtaq*, Mehwish Kanwal and Momina Raheem

Departments of Zoology, Wildlife and Fisheries, PMAS Arid Agriculture University, Rawalpindi, Pakistan

ABSTRACT

Groundnut (*Arachis hypogaea* L.) is an important cash crop; being cultivated in more than 100 countries of the world (Pround and Phiri, 2010). It's the 4th most important source of edible oil and 3rd important source of vegetable protein. In Pakistan, it was grown on area of about 86974 ha with a total production of 100790 tons during 2018-19; almost 89% groundnut area lies in the Punjab province. Average per hectare yield of groundnut, in Pakistan, is near 1200 kg, which is quite low as compared to its potential, which is some 3000 kg. The low productivity of groundnut is attributed to a number of factors, like, rainfall uncertainties, low yielding varieties, diseases, insect and rodent pests etc. (Okello *et al*., 2010; Parshad, 1999).

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MM conceived the idea and supervised the study. UN, MK and MR conducted the field experiments, MM and UN wrote the article, proof read and analysed the data.

Key words
Groundnut, Rodents, Edge, Center, Stages of crop

Rodents are among the highly successful and diversified mammalian group (~ 42% of all the mammalian species), comprising of some 2700 species (Aplin *et al*., 2003). Some species of the rodents are serious pests of stored products, agricultural crops and cause severe economic losses resulting in malnutrition and even famine. The economic losses due to rats on world-wide basis have been reported around 33 million tons annually of bread grain and rice in storage and it has been estimated that 130 million people could be fed each year with the food spoiled by world's rat population (FAO, 1999). Parshad *et al*. (1987) reported that rodent caused a yield loss of 3.86% due to cutting and/ or hoarding activities in Indian Punjab. Brooks *et al*. (1988) reported that rodents are responsible for 43 kg/ ha loss of groundnut yield in Punjab, Pakistan. Similarly, Zang el al. (1998) reported that the rat like hamster (*Cricetulus trition*) was responsible to groundnut damage from 14.8 to 19.6% in an enclosure study in China. Among the important rodent pest species, *Bandicota bengalensis, Nesokia indica* and *Hystrix indica* (Indian crested porcupine) are considered as serious pests of the agricultural crops in Pakistan (Khan, 2013). Keeping in view the importance of field rodent depredations, the specific objective of this research study was to quantify the damage caused by the rodents in Mianwali district of Punjab, Pakistan.

Materials and methods

The present study was conducted between April and December 2021 in a groundnut cropland of Chak 14 ML (32º 14' 0" N 71º 26' 50"E), district Mianwali, Punjab, Pakistan, where climate is extremely hot during June and July. Average rain fall is 250 ml and mean temperature is about 32°C with extreme temperature of 52°C in summers. It is an agricultural land where wheat, canola and groundnut and chick pea are the prominent crops during the summer season. Rodents are considered as serious pests for all the crops. Within groundnut crop wild plants and grass like *Tribulus terrestris* (bakhra boti), Beliric, *Terminalia bellirica* (beherra) were recorded, which are also source of food for rodents.

For estimation of the damage caused by the rodents to the groundnut crop, four plots of 200 m^2 were selected, maintaining at least 200 m distance apart from each other. In each plot, a baseline along the long axis of the field was established. Four transect lines, perpendicular to the base of the line were selected, running in from the edge of the crop field and were spaced at least 20 m apart from

* Corresponding author: mushtaq@uaar.edu.pk
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each other. Transect 1 and 4 were kept away from roads, human settlements and/ or water sources, as these may have produced atypical level of damage. To accommodate the variation of damage due to rodent species, the damage was estimated at three levels, i.e., edge of the plot, 25% inside the field and center of the field/ plot, following the modified methodology of Aplin *et al*. (2003). At each point (edge, 25% inside and center), a quadrat of 1 x 1 m was thoroughly investigated. In each quadrat, total number of plants were counted and a record of fully and partially damaged (major and minor) plants was maintained. Damage to the groundnut crop was observed at three stages of the crop, i.e., early stage (about 40 days), flowering stage (40 to 60 days after planting) and then at ripening stage (120-150 days) of the groundnut crop when peanuts are fully matured in pods. At each stage of the crop, a total of 48 quadrats (16 at each location of plot, i.e., edge, 25% inside and center of plot) were sampled. Total number of plants in different quadrats and pattern of damage has been presented in Table I. The percentage of damage caused was calculated by the following formula. Damage % = damaged plants/ total number of plants x 100. The damage caused by the rodent species was sorted out by following Brooks *et al*. (1988).

To compare the damage at different stages of the crop (early, maturity and flowering) and different locations in the plot (edge, 25% inside and center), student t test was employed at 5% significance level (Steel and Torrie, 1980).

Results and discussion

Results of the damage assessment by inflicted by the field rodents to the groundnut crop indicated that the maximum damage was recorded at the maturity stage, followed by the flowering stage, while early stage was the least effective by the rodent depredations. At maturity stage (Fig. 1C), more than 8% plants were completely damaged by the rodents; maximum damage (11.81%) was recorded in the centre of the plot, followed by 25% inside (7.96%) and the edge (4.86%). In addition, more than 15% plants of the crop were having major damage by the rodent species in the area. Again, maximum effected plants were recorded in the center of the plot (20.9%), followed by the 25% inside (17.41%) and at the edge (7.02%). Similarly, sufficient number of the plants (35%) of the crop showed minor damage. As regards the damage pattern at the flowering stage (Fig. 1B), some 11% plants were completely damaged; maximum damage (11.64%) was recorded at the edge of the plot, followed by 25% inside (11.55%) and the center was the least effected (9.03%). Similarly, some 17% plants of the crop had major damage by the rodent species. As regards the damage pattern, maximum affected plants were recorded in the center of the plot (18.69%), followed by the 25% inside (16.50%) and at the edge area was the least effected (15.71%). Similarly, some 25% of the sampled plants of the crop also had minor damage. Results on the damage caused by the rodent species to the groundnut crop at the early stage (Fig. 1A) revealed that 3.43% plants were fully damaged, while some 4.21% and 5.39% plants of the crop had major and minor damage, respectively. Similarly, a uniform pattern of damage was recorded at three sides, i.e., at the edge of the plot, 25% inside and the center.

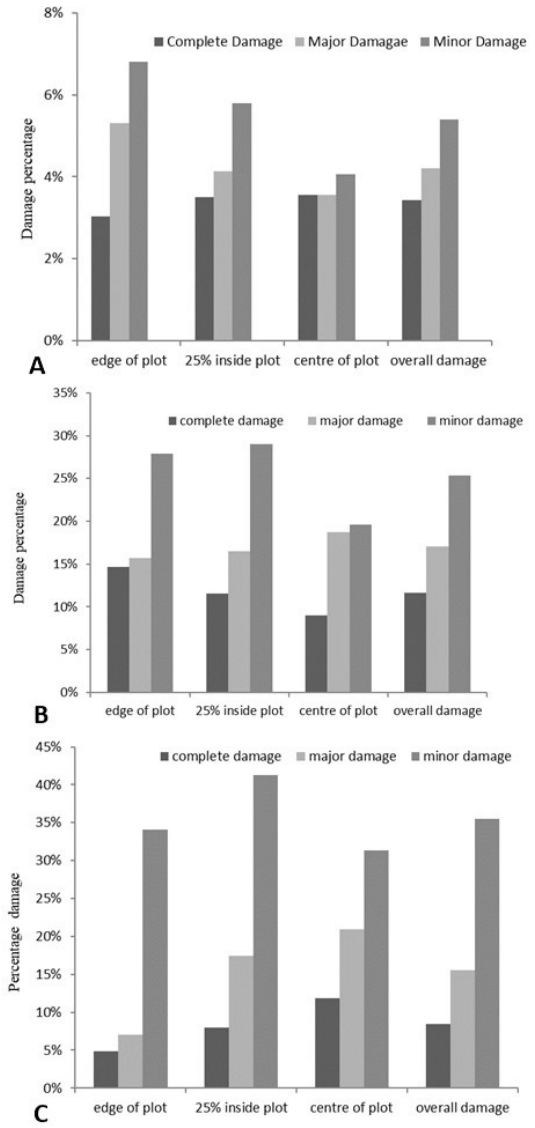

Fig. 1. Damage (%) done by the field rodents to the groundnut crop at sowing stage (A), flowering stage (B) and maturity stage (C) in district Mianwali, Punjab, Pakistan.

Table I. No. of plants and damage pattern to different stages of groundnut crop by field rodents in district Mianwali, Punjab, Pakistan.

Crop stage	Sampling location	No. of quadrats	Total no of plants	Complete damage	Major damage	Minor damage	No damage
Early	Edge	16	264	8	14	21	221
	25% inside	16	362	14	15	21	312
	Center	16	394	14	14	16	353
Flowering	Edge	16	280	41	44	56	148
	25% inside	16	303	35	48	88	130
	Center	16	321	29	60	62	168
Maturity	Edge	16	175	9	13	63	101
	25% inside	16	201	16	21	83	67
	Center	16	220	26	46	69	79

As regards the comparison of damage caused by the rodent species at the three stages of groundnut crop, i.e., early, flowering and maturity stages, student t test revealed that a significantly higher damage ($P < 0.05$) was observed at the flowing stage over early stage, as well as the damage at maturity stage was also significantly higher to the sowing stage; a non-significant difference ($P > 0.05$) was recorded between the flowering and maturity stages. Similarly, there was also a non-significant difference ($P > .05$) among the three locations of the field, i.e., the edge, 25% inside the field and center of the field.

According to estimates the world population is expected to reach 8.5 billion in 2030, 9.7 billion in 2050 and 10.9 billion in 2100 (World Population Prospects, 2019); accordingly, the need for increasing the food sources for feeding the increasing population is need of the time. Agricultural production has become tripled between 1960 and 2015, owing in part to productivity-enhancing Green Revolution technologies and a significant expansion in the use of land, water and other natural resources for agricultural purposes (FAO, 2017). The agriculture sector has always been negatively affected by a number of factors; pest species whose feeding and / or other damage activities may lead to a serious loss of agricultural output (Sexton *et al*., 2007). Among pest species, rodents can cause a significant financial damage to farming communities which are associated with their general feeding styles, high reproductive rate and ubiquitous nature (Lourens *et al*., 2017).

The damage to the crops by the rodent pests occurs differently at different stages of the crop; generally, it is higher at the maturity stage (Aplin *et al*., 2003). Results of the present study support; yet a non-significant difference in the damage pattern at the flowering and maturity stages indicate that either population of the rodent species is greater in the area or other vegetation is not preferred and / or limited. Rodent preferences (especially the *Bendicota bengalensis*) for the groundnut during the summer season has also been documented (Baig *et al*., 2021). Similarly, Indian crested porcupine (*Hystrix indica*) is also widely distributed rodent species in the study area and has been reported by the farmers as a serious pest of the groundnut crop. A number of studies indicated that there are differences in the damage pattern at different parts of a particular plot/ area (Aplin *et al*., 2003). However, the results of the present study don't support this assumption, as non-significant differences were recorded among all the three parts of the sampled plot, i.e., the edge, 25% inside the plot and in the center of the plot. So, in the current scenario, the damage can be considered as the random type damage pattern.

Present results indicated that the damage caused by the rodent species to the groundnut crop in an agricultural landscape of the Punjab, Pakistan is a serious issue, as the farmers of the area are facing significant losses. It has also been reported from a number of developing countries, indicating that rodent infestation poses a serious threat for lowering of income and in causing food shortage by causing sufficient damage to food and cash crops (Stenseth *et al*., 2001; Khan, 2013). In such circumstances, the heavy losses caused by the rodent species to the rural farming communities are really alarming, which needs to be addressed to prevent such damage with the correct application of tools and technologies of rodent control.

Statement of conflict of interest

The authors have declared no conflict of interest.

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