FUDMA Journal of Sciences (FJS)
ISSN online: 2616-1370
ISSN print: 2645 - 2944
Vol. 8 No. 6, December, 2024, pp 17 - 23
DOI: https://doi.org/10.33003/fjs-2024-0806-2654

EVALUATION OF DEPREDATION ACTIVITIES OF RODENT PEST ON MAIZE CULTIVATED IN SASA-AJIBODE FARM, IBADAN, SOUTHWEST, NIGERIA

***Hafiz Ayinde Badmus, Oluwaseun Sunday Olubode and Sharon Ojo**

Department of Crop Protection and Environmental Biology, University of Ibadan, Nigeria

*Corresponding authors' email: badmus.hafiz@gmail.com

ABSTRACT

Maize is a staple crop that is cultivated across different agro-ecologies in Nigeria. Maize adaptability and high yield potential, as well as its utility as a food, feed, and forage crop, clearly shows its significance. However, pests like rodent species remain an age-long challenge to its production by causing economic losses and low income for farmers. The study was carried out in Sasa – Ajibode farm. Systematic method of sampling was employed to observe and gather data in the study site. Quantitative data were collected by counting the number of damaged vegetative parts of the maize plant while qualitative data were collected by scoring observable damage signs on the maize. The result of the study revealed no observable signs of damage during the pre-flowering and post-flowering stages of maize cultivation in the study site during the dry and wet season in 2021. However, depredation activities of Ground squirrel (*Xerus erythropus*) by seed removal were observed during the sowing stage in the wet season. It can be concluded that rodent pest infestation is not the main threat to maize cultivation in the study site. However, environmentally-safe rodent management strategies should be adopted in the study area.

Keywords: Depredation activities, Rodent species, Maize cultivation, Season, Rodent damage

INTRODUCTION

Depredation caused by pests on field crops is a major challenge faced by both subsistence and commercial type of farmers. Vertebrate pests such as birds and rodents cause significant damage to field crops and fruit trees, thereby affecting crop quality, yield, and market value. It could also cause pre-harvest and post-harvest losses (Desoky, 2014). Various crops like maize, rice, wheat, sugar cane, sugar beet, groundnut, coconut, cocoa, cardamom, oil palm and commodities are mostly damaged by vertebrate pests most especially rodents through their feeding and causing indirect damage like spoilage (Desoky, 2014).

Zea mays (Maize), one of the cereals mostly affected by rodents' activities in Nigeria, is a staple crop massively consumed by Nigerians. It is cultivated in the rainforest and the derived Savannah zones of Nigeria and unarguably the most popular type of crop commonly cultivated in the country (Iken and Amusa, 2004). Most Nigerians consume maize or any of its derivatives once in a day (Olaniyan, 2015) and likewise it is used in production of animal feed (Girei *et al.*, 2018).

An average production volume of 11.136 million metric tonnes of maize was recorded from 2015 to 2019 of which 12.7 million metric tonnes was recorded in 2019 alone and 12 millon metric tonnes was forecast in 2020 (United Nation Food and Agricultural Organisation, 2020). Due to intensive maize farming in the country, agroecosystems where one or two crop plants make up the plant species, such areas are vulnerable to rodent attack (Olakojo, 2001).

Rodents, the single largest groups of mammals, of the order Rodentia, under the family Muridae in the Murinae sub-family, are ubiquitous vertebrates as they are present everywhere and native to most habitats or subsequently have been introduced by human activity (Tobin and Fall, 2004). Rodents are known to have wide species diversity, as they comprise more species than any other mammalian orders (Mihalca and Sandor, 2013). They are adaptable to various lifestyles such as terrestrial: Natal multimmamate mouse (*Mastomys natalensis* W. Smith), arboreal: tree squirrel (*Funisciurus lemniscatus* Le Conte), fossorial: African giant rat (*Cricetomys gambianus* Waterhouse) and semi - aquatic (*Ondatra zibethicus* also known as muskrat) (Witmer and Shiels, 2018). Most species are small, nocturnal, and secretive, have keen senses of touch, taste, and smell (Witmer and Shiels, 2018). A single pair of continuously growing, razor-sharp, open-rooted incisors in each of the upper and lower jaws characterize them and is a distinguishing feature (Witmer and Shiels, 2018). The incisor, which does not stop growing throughout their lifespan, requires constant gnawing to keep it sharp and at an appropriate length which results in extensive damage to seeds, fruits, field crops, structures, wires and insulation (Witmer and Shiels, 2018).

Rodents play several roles in the ecosystem as they have ecological, scientific, social and economic values and they are important in seed and spore dispersal, pollination, energy and nutrient recycling, modification of plant succession and species composition and food source for many predators (Witmer and Shiels, 2018). Additionally, some species of rodents provide food and fur for human use. If the rodent species are totally removed from the surface of the earth, a huge disruption would occur in the overall balance of the ecosystem (Mihalca and Sandor, 2013).

Although rodents can be beneficial to the ecosystem, some species are identified as the most important mammalian pests that cause damage to plants at all stages of growth and development (Govinda, 2018). They have caused serious impacts to native flora and fauna, agriculture, property, and other resources (Capizzi *et al.*, 2014).

Rodent damage is a major hindrance to agriculture (Singleton *et al.*, 1999). Its effects on agriculture are also complicated because rodents attack almost all crops at all stages (Singleton *et al.*, 1999). The resultant effect of this damage is serious losses and widespread of the rodent as well as food shortages (Fayenuwo *et al.*, 2000; Amusa *et al.*, 2005). Damage ranges from negligible destruction to total crop loss have been experienced in major maize producing belts of Africa. In Nigeria, damage to maize varieties by rodent pests constituted a major problem to production reducing quantity and quality of maize (Fayenuwo *et al.*, 2007). Besides the damage they cause, they are also instrumental in transmitting deadly

zoonotic diseases to humans and their livestock (Govinda, 2018).

Although rodents have been implicated as the most destructive species on earth, and are among the most important global pests, their impacts on farmlands have been greatly belittled and control neglected most especially in developing countries (Adebisi *et al*., 2018; Stenseth *et al*., 2003). Most farmers ignore the impact of rodents thereby considering their damage as unavoidable (Stenseth *et al*., 2003). Nevertheless, as important as rodent species are to the ecosystem at large, they remain an age-long challenge to humans (Adebisi *et al.*, 2018).

The productivity of maize is usually being hampered by rodent pest species as they inflict damage on maize from the period of sowing to harvesting and even beyond, thereby leading to economic losses. Unfortunately, the qualitative and quantitative assessments of rodent damage have been a major concern among farmers as there is little or no information for them to know the period that is economically safe to embark on control measures.

Farmers over time have resorted to chemical control measures (the use of rodenticides), which has led to drastic effects of which rodent species develop resistance and the ecosystem at risk. Farmers need adequate information on the assessment of rodent damage on the farm in order to embark on appropriate control measures.

Therefore, the study is aimed at evaluating the depredation activities of rodent pest species in maize cultivation at Sasa-Ajibode farm in Ibadan.

MATERIALS AND METHODS

Description of the Study area

The study area for this research was Sasa farm near Moniya, Ibadan. Sasa is located in Akinyele local government area of Ibadan. A reconnaissance survey was carried out in the study area by having one-on-one interview with the farmers of Sasa-Ajibode farm and gathering the information about the area. Although, it was gathered that crop farming was the major occupation by the farmers in the study area, its practice cannot be considered as commercial farming, hence damage to their fields by any pest leads to reduction in their income. The study area is a farm and the agricultural activities involve small-scale farming where maize, cassava (*Manihot esculenta* Crantz), cucumber (*Cucumis sativus* L.) and groundnut (*Arachis hypogea* L.) crops are planted mainly for subsistence and commercial purposes.

The study site was bordered by maize and cassava cultivations. To the right of the study site were bushes (in form of abandoned farmland that have been overgrown with weeds) at a distance of 13.5 m to the edge of the study site. In addition, notable in the agro-ecosystem is a river, which is at a distance of 17 m to the edge of the maize cultivation (study site). Remarkably, all of these characteristics -the availability of water, bush that serves as shelter and source of food- contribute to the successful habitation and existence of rodent pest species (Cane rat - *Thryonomys swinderianus*, African giant rat - *Cricetomys gambianus*, Nile harsh-furred rat - *Arvicanthis niloticus*) in the Sasa-Ajibode farm.

Study site

The study site is a maize farm with measurements of 55m long and 23m wide. It has a latitude of N7˚ 28' 39.916" and longitude of E 3˚ 54' 7.193" with altitude 145 m above the sea level.

The study site was chosen due to prior information obtained on farmers' response to risk of uncertain rodent attack by scheduling prophylactic treatment in which the timing and amount of chemicals are quite independent of the actual pest numbers. Apparently, farmers in the study area administer control measures before any pest attack including rodent pest attack. Observation of the study site was necessary to identify the rodent causing damage in the agro-ecosystem especially on maize fields.

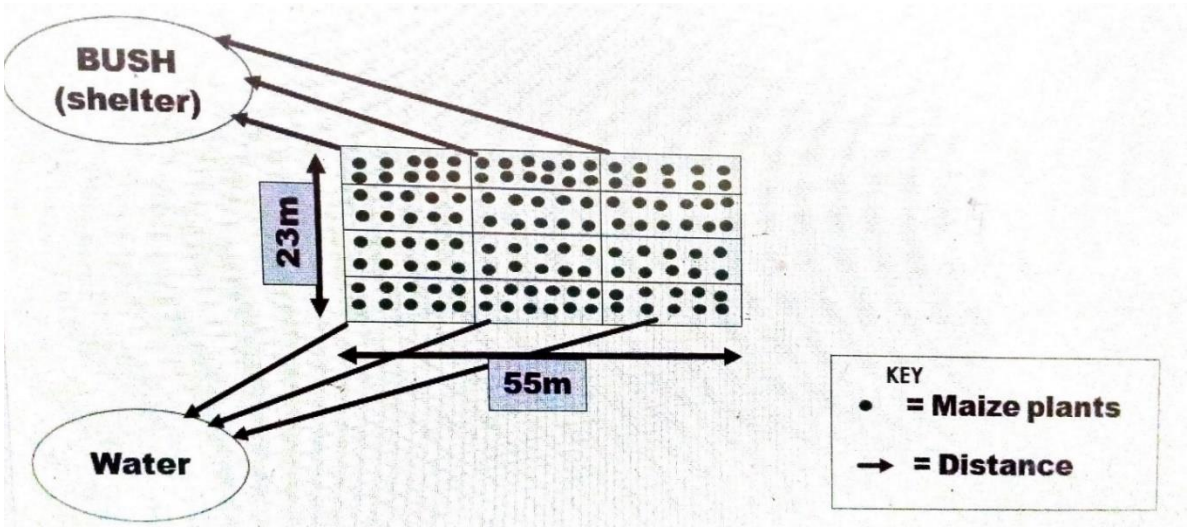

Figure 1: Experimental farm layout

Sampling methods

A complete enumeration of all the plants in the study site was carried out at random to observe the sporadic depredation activities of rodent pests in the study site. Additionally, the systematic method of sampling was employed to observe and gather data on the study site. This method was used to properly gather and analyze the depredation activities done by rodent pests. The study site was divided into three portions and each portion was further divided into four portions of which data was recorded on every "tenth" plant where the first plant of each portion was the starting point (Figure 1).

Data collection

The data collected were in two forms: quantitative and qualitative

Quantitative data collection

At planting stage

At planting stage, rodent pest species cause damage on the field by removing the seeds sown. The count of the number of seeds removed in the maize plot on the study site was recorded.
Date of planting: April, 2021 for wet season and November, 2021 for dry season.
Data collection commenced 2 weeks after planting.
Total seed planted per block = 3 seeds x 8 rows x 40 per row = 960 seeds
Damage (%) at the sowing stage of the maize was then estimated using the formula:

$$\%\ damage\ at\ sowing = \frac{\text{total seeds removed}}{\text{Total seeds sown}}\ x\ 100$$

At maturity stage
Data was also gathered in the study site based on the noticeable damages done to leaves, stem and cobs of the maize plant, which includes; number of stems cut observed on the field and at what height of stem cut, in order to differentiate between cane rat and African grass rat as they damage at different heights of the stem. Also, damage done to cobs was observed and the number of plants affected recorded.
The formula used in the estimation of the damage (%) done to the vegetative parts of the maize is:

$$\%\ damage\ at\ maturity = \frac{\text{Total crop damaged}}{\text{Total damaged} + \text{undamaged}}\ x\ 100$$

In addition, the count of burrows (abandoned and active) were noted as this would help in narrowing down the damage observed to fossorial animals.

Qualitative data collection
This encompasses gathering of data by scoring observable damages on the maize plants at pre-flowering and post-flowering stages, which includes its vegetative parts.
Scoring was done based on the observable damage signs done to the leaves, stems and cobs in the study site. Scores were awarded based on the extent of damage observed ranging from numbers 0 to 3. Each of these scores represents the extent of damage inflicted by rodent pest observed on the maize at both pre- and post-flowering stages in the study site as follows:
(0) – No visible damage signs observed on the maize plant parts (leaves, stems and cobs) observed.
(1) – Low damage observed on the sampled plants (0-5% of the maize plots was affected)
(2) – Moderate damage observed on the sampled plants (6-10% of the maize plots was affected)
Qualitative assessment of damage by rodents on stem was carried out by inspecting for maize stem cuts on the plots while that of maize cob was carried out by checking opened and gnawed cob on the maize stand.
(3) – High damage observed on the sampled (11-15% of the maize plots was affected)
Collection and Identification of rodent fecal droppings
Faecal droppings around the damaged crops and burrows present on the study site were collected and taken to Ecology Research laboratory of the Department of Crop Protection and Environmental Biology, University of Ibadan, Nigeria, for identification and to determine the rodent pest species responsible for the damage on the maize field.

Data analysis
Quantitative data taken were analysed using descriptive statistics and percentage damage was computed.
Regression analysis was done using Palaeontological Statistics (PAST) software Version 3.0 to show the relationship between the distance of the water source from the field and the number of seeds removed. In addition, the relationship between the distance of the bush from the field and the number of seeds removed was analysed using PAST.

RESULTS AND DISCUSSION
The results showed no qualitative damage due to rodent pest species was observed to have been inflicted on the leaves and stems of the maize in the experimental field during both the wet and dry season of the sampling period (Table 1).
Assessment of seed removal at sowing stage during the wet and dry season
The results revealed seed removal by rodent pest species during the wet season in the study site (Table 1). There were characteristic patterns of seed removal exhibited by the rodent pest species (Plate 1). There were no seed removal observed and recorded during the dry season in the study site (Table 1). Percentage seed removal at 2 weeks after planting (WAP) in all the blocks was higher than that recorded at 4 WAP. No seed removal was recorded in all the blocks at 6 WAP (Table 1). The results showed that at sowing stage during the wet season, the percentage damage recorded was 25.10 % while during the dry season, percentage damage due to seed removal by rodent pest species was 0.00% (Table 2).

Table 1: Seed removal by rodents (Wet and Dry seasons) from maize field in Sasa-Ajibode farm, during 2021 growing season

	Seed removal (%) during the wet season			Seed removal (%) during the dry season		
	2WAP	4WAP	6WAP	2WAP	4WAP	6WAP
1st block	8.90	1.90	0.00	0.00	0.00	0.00
2nd block	7.20	1.30	0.00	0.00	0.00	0.00
3rd block	5.40	0.50	0.00	0.00	0.00	0.00

WAP: Weeks After Planting

Table 2: Percentage damage at sowing stage due to seed removal by rodent pests

Season	Total seed planted	Total seeds removed	% damage at sowing stage
Wet season	960	241	25.10
Dry season	960	0	0.00

Pre flowering and post flowering stage
There were no damages observed and recorded during the pre-flowering and post-flowering stages of maize in the study site during 2021 growing season (Table 3).

Table 3: Percentage crop damage at maturity stage by rodents

Season	Total crop damaged	Total crops (damaged + undamaged)	% crop damage
Wet season	No damage by rodents	No damage by rodents	No damage by rodents
Dry season	No damage by rodents	No damage by rodents	No damage by rodents

Relationship between the seed removal by the rodents and the distance of the maize plots from water source and shelter

Figure 1 shows the relationship between number of seed removed in the maize plots and the distance of the maize plots to the bush (shelter). This revealed that the closer the maize plots (study site) to shelter (abandoned farmland), the more the number of seeds removed from the maize plots.

Similar results were observed in Figure 2 which shows the relationship between the number of seeds removed in the maize plots and the distance of the maize plots (study site) to the water source (river). This revealed that the closer the maize plots (study site) to availability of water (river), the more the number of seeds removed from the maize plots.

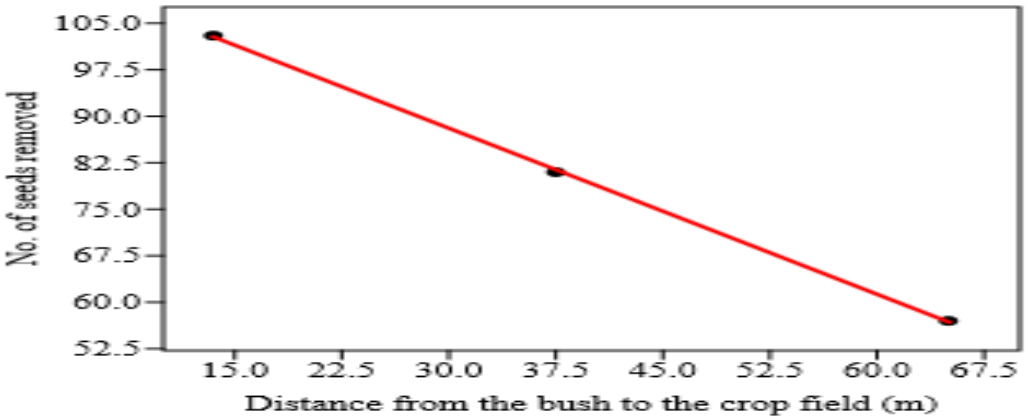

Figure 1: Relationship between the number of seeds removed and the distance of the field to the fallow bush.

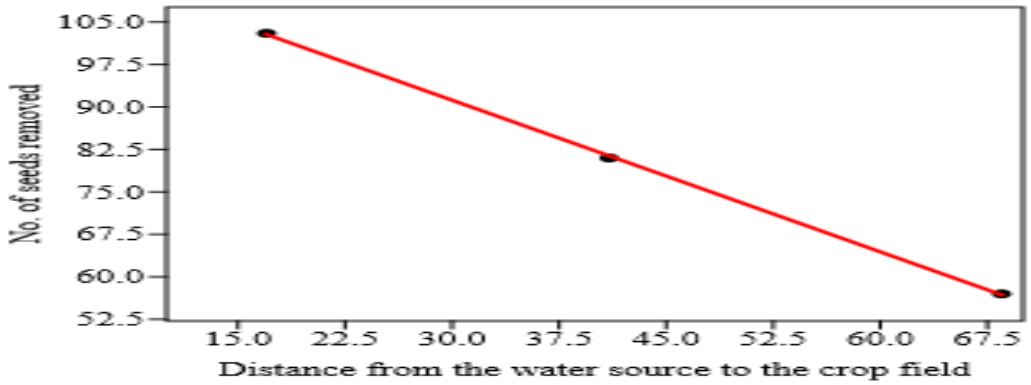

Figure 2: Relationship between the number of seeds removed and the distance of the field to water source

Plate 1: Pattern of seed removal during the wet season on study site

Plate 2: *Cricetomys gambianus* burrow on study site

However, the above burrow (Plate 2) is not active on the study site at the time the study was carried out, as there was no damage due to rodent species. The burrow pattern is characteristic of *C. gambianus* due to its round shape at the entry point and the size. In addition, *C. gambianus* is a notable burrowing species that makes this kind of deep burrow in the soil as shown.

Discussion

The present study revealed no seed removal during the dry season. This could be due to the fact that the cultivated land was dry and difficult for rodent species to burrow into the soil to remove the sown seeds. In contrast, there was removal of seed during the wet season as revealed in this study. In the study area, the portion of the study site nearest to the source of water (the river in the area) and shelter (bushes around the site) experienced higher seed removal than other portion of the site as revealed in the present study. The proximity of the maize cultivation to shelter (abandoned farmland) and availability of water (river) influenced the survival and reproduction of rodents and hence their damage. Notably the presence of these features predisposes the study site to depredation activities of rodents. The type of seed removal pattern observed and recorded in the study area is suggestive of red-legged ground squirrel (*Xerus erythropus*), which has been found to constitute a serious pest to maize seed at the planting stage and which eventually leads to economic losses. Similar report was given by Talluto and Benkman (2013) that red-legged ground squirrels (*Xerus erythropus*) forage on the ground and are mostly granivorous. They are skillful at removing the sown seeds of groundnuts and maize by ensuring that no seed is omitted during the course of its seed removing activities.

Factors that make rodent species to thrive include food, water, and shelter. These factors were available in the study area. However, damage was not observed on all parts of the plant. No damage to cobs due to rodents was recorded during the dry and wet seasons. This could be attributed to the effects of other environmental factors such as flooding (inundation) which usually occur in the area thereby making the environment unfavorable for them to thrive. It was earlier reported by Witmer (2007) that rodent species migrated from areas usually disturbed by flooding to a less disturbed area where they could survive and reproduce. A number of seed removal was recorded in all the portions of the crop field in the wet season while there was no seed removal in the dry season. Although Aplin *et al.* (2003) reported that rodents often enter fields to dig up and consume the newly sown seeds, or to feed on the early shoots after germination but at any period of the seasons, the pattern of seed removal observed was indicative of Ground Squirrel (*Xerus erythropus*) as it was consistent through-out the maize cultivation field. A similar finding was reported that Squirrels are significant seed predators in forest ecosystems whereby they consume large quantities of seeds, often approaching entire seed crops usually in a highly efficient manner (Talluto and Benkman, 2013). In a report by Badmus (2021) in Ido local government, Oyo state, of all the three stages (seedling, maturity and harvesting) in which maize plants become susceptible to rodent damage, seedling was identified as the most susceptible stage by the farmers (85%), while harvesting stage was not viewed by any of the farmers as being susceptible to rodent damage.

The digging out and damage of newly emerged seedlings caused serious missing stands on the field that cannot be ignored by the farmer. This forced the farmer to supply the missing stands, resulting in unequal plant growth, different cob maturation times, and harvesting periods. The maize cultivation closer to water and the abandoned farmland, which might have served as shelter for the rodent, suffered severe damages of seed removal from the results obtained (Figure 1 and 2) and the observation during the data collection process. As revealed from the present study, no maize stem cut characteristic of rodent activities was recorded throughout the period of the study. This could be as a result of the rodents preference for other crops such as Cassava in neighboring farms in the study area. It was observed that the surrounding of the maize farms are phyto-sanitarily clean of weeds, which could have served as a hide out for rodents as infrequent weeding especially at the edge of the field would favor rodent

occurrence on the crop fields. Weeding is an essential cultural practice during the planting period. Rodents are highly secretive in habit and a regularly weeded cultivated field would prevent the rodents from visiting the field to depredate the crops since they have nowhere to hide in the course of their damage activities.

CONCLUSION

The study revealed that rodent pest infestation is not a main threat to maize productivity in the study site. The study also revealed that although some damage were recorded during the wet season, which can be linked to availability of food and water, the damage observed did not reach an economic threshold level. Therefore, there is no need for use of chemical rodenticides before and during pre-flowering and post-flowering stages of maize cultivation especially in the study area, which has become conventional among farmers. However, farmers in Sasa-Ajibode farm should adopt environmentally safe rodent deterrent strategies during sowing period to prevent attack by *Xerus erythropus* and should subsequently ensure that whatever damage observed on the field is carefully studied and proper environmentally-safe control is administered.

Most importantly, the practice of farmers using chemicals without identifying the rodent causing damage or the damage reaching economic threshold level should henceforth be discontinued, as the practice is detrimental to humans and the environment.

Farmers should not administer control until qualitative and quantitative assessment are carried out, and the pest causing damage is identified. It is important that the farm area be weeded regularly as they serve as hideout for rodents. Neighboring bushes including abandoned farmlands should be taken care of as they serve as shelter for rodents.

REFERENCES

Adebisi L.O., Jimoh O., Jonathan A., Osasona K.K., and Omafaiye M.O. (2018). Economic analysis of rodenticide use among maize-cassava farmers in Kwara State, Nigeria. 4(2). 185-191.

Amusa N. A., Iken J.E., and Fayenuwo, J.O. (2005). The incidence of Field Diseases and Vertebrate Pests on Popcorn (*Zea mays* everta) Varieties cultivated in forest Agro-ecologies in Nigeria. *World J. of Agric. Sci*. 1(2). 173 – 177.

Aplin, K.P., Brown P., Jacob J., Krebs C.J., and Singleton G.R. (2003). Field methods for rodent studies in Asia and the Indo-Pacific. ACIAR Monograph No. 100. BPA Print Group, Melbourne. 223pp.

Badmus H. A. (2021). Rodent damage and management approach by cereal crops farmers in Ido Local Government Area, Oyo State. *Journal of Entomology and Zoology Studies*. 9(4). 118-126

Capizzi, D., Bertolino, S., and Mortelliti, A. (2014). Rating the rat: Global patterns and research priorities in impacts and management of rodent pests. *Mammal Review*. 44. 148–162.

Desoky, A. S. S. (2014). Damage caused by birds and rodent in field crops and their control. *J. Glob. Innov. Agric. Soc. Sci*. 2(4):169-170.

Fayenuwo J. O., Akande M., Olakojo S.A., Amusa N.A., and Akinlosotu T.A. (2000). Comparative study of vertebrate pests damage on Open- Pollinated and Hybrid maize plant. In-House-Research Review of IAR&T, Moor Plantation, Ibadan. 65-70.

Fayenuwo, J., Olakojo, S., Akande, M., Amusa, N., and Olujimi, O. (2007). Comparative evaluation of vertebrate pest damage on some newly developed quality protein maize (QPM) varieties in south-western Nigeria. *African Journal of Agricultural Research*. 2 (11): 592-595

Girei, A. A., Saingbe, N. D., Ohen, S. B. and Umar, K. O. (2018). Economics of small-scale maize production in Toto Local Government Area, Nasarawa State, Nigeria. 90-92. https://dx.doi.org/10.4314/agrosh.v18i1.8

Govinda, R.G. (2018). Rodents. In: Omkar (eds) Pests and Their Management. Springer, Singapore. https://doi.org/10.1007/978-981-10-8687-8_26

Iken, J.E. and Amusa, N.A. (2004). Maize research and production in Nigeria. *African Journal of Biotechnology*. 3(6): 302-303.

Mihalca A.D. and Sándor A.D. 2013. The role of rodents in the ecology of *Ixodes ricinus* and associated pathogens in Central and Eastern Europe. *Front. Cell. Infect. Microbiol*. 3. 56. https://doi.org/10.3389/fcimb.2013.00056

Olakojo, S.A. (2001). Comparative assessment of vertebrate pest damage on some maize varieties in Southwestern Nigeria. *Trop. Agric. Res. and Extension*. 4(2). 112-114.

Olaniyan, A. B. (2015). Maize: Panacea for hunger in Nigeria. *African Journal of Plant Science*. 9(3). 155-174. https://doi.org/10.5897/AJPS2014.1203

Singleton G. R., Hinds L. A., Leirs H., and Zhang Z. (1999). Ecologically Based Management of Rodent pests – re-evaluating our approach to an old problem. In: Singleton, G.R., Hinds, L.A., Leirs, H. and Zhang Z., eds, Ecologically-based Management of Rodent Pests. ACIAR. Monograph No.59. Canberra Australian Centre for International Agricultural Research; 17 – 29.

Stenseth, N.C., Leirs, H., Skonhoft A., Davis S.A., Pech R.P., Andreassen H.P, Singleton G.R., Lima M., Machangu R.M., Makundi R.H, Zhang Z., Brown P.R, Shi D., and Wan X. (2003). Mice, rats, and people: dynamics and bio-economics of agricultural rodent pests. *Frontiers in Ecology and the Environment.* 1(7). 367–375.

Talluto, M. V. and Benkman, C. W. (2013). Landscape-scale eco-evolutionary dynamics: selection by seed predators and fire determine a major reproductive strategy. *Ecology*. 94. 1307–1316. URL: https://doi.org/10.1890/12-2058.1.

Tobin, M. E., and Fall. M.W. (2004). Pest control: rodents, in Agricultural Sciences. from Encyclopedia of Life Support Systems (EOLSS), Developed under the Auspices of the UNESCO, Eolss Publishers. Oxford, UK. [http://www.eolss.net].Maryland: Johns Hopkins University Press. 2. 142.

UNFAO. (2020). GIEWS - Global Information and Early Warning System: Country briefs, Nigeria. http://www.fao.org/giews/countrybrief/country.jsp?code=NGA

Witmer, G. (2007). The ecology of vertebrate pests and integrated pest management (IPM). Perspectives in Ecological Theory and Integrated Pest Management. https://doi.org/10.1017/CBO9780511752353.013

Witmer, G.W. and Shiels, A.B. (2018). Ecology, impacts, and management of invasive rodents in the United States. 193-219.