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Low Cost and Environmental Friendly Indoor Storage Methods of Guarding Food against Rodents in a Store

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Abstract:

Rodents are serious pests in agriculture both in field and food stores putting food security and nutrition under big threat. This calls for effective control measures before they can cause economic damage. In this study, three indoor storage methods were evaluated in regard to their effectiveness in guarding food against rodents in a store; hanging baskets, metallic drum and cupboard storage methods. Hanging baskets was investigated by keeping 200 grams of maize seeds in form ofsmall buckets hangedwith a banana fiber string tied at the roof. While the use of metallic drums was investigated using sauce pan which were covered on top with another pan supported with a heavy load as metallic container,200 grams of maize seeds were on plastic plates kept in three chamberedwooden cupboard. In additional to the three methods, control treatment was in place for comparison purpose. Each method was replicated three times for the purpose of reliability. Daily monitoring was done to check for damaged seeds, contamination and weight losses. The software "R" was used to perform one-way ANOVA to find the significant differences in losses, rate of damage and contamination at 0.05 significant level.There are significant differences in loss, contamination and damages of maize seed among the different indoor storage methods ($p < 0.05$). Highest losses incurred in cupboard and control methods of 156 grams and 144 grams respectively. While there were no lossesregistered for seeds stored in metallic containers and hanging baskets. Hanging baskets and metallic containers (drums) were confirmed as most effective indoor storage methods in guarding food against rodents.

Key Words: *Rodents, Food Storage, Indoor Methods, Rodent Control.*

Introduction:

Rodents are small to mediumsized animals in mammal group characterized by a pair of incisor teeth (Waggoner,2000).This category of animals comprises of 1500 species, but in Uganda rats and mice are the most important pests (Delany,1974). Rodents are threat to food security, nutrition and health (Steven et al,2015) hence they are threat to human life. In fact, they destroy crops both in field and produce in the store (Fiedler, 1994).

Rodents are capable of causing over 17% of postharvest losses of grains (Steven et al,2015) if control measures are not put in place. In additional, rodents are carrier of 60 diseases which are transmittable to man and livestock (Davis et al, 2005).These justify for timely application of control measures before rodents cause threat to food security and health of individuals.

Poisoning is the most common method of controlling rodents in the majority of households (Hegdal et al, 1984) but there is associated risk of contamination of food and other environmental issues such as poisoning non-targets like children and pets (Hegdal et al, 1984).Some species of rat such as *R. norvegicus* are suspicious and have tendency of avoiding any object that is strange to it hence an inner ability to escape poison and traps (Vadell, 2014).

The aim of this study was to evaluate the effectiveness of three indoor storage methods i.e. metallic drum, wooden cupboard and hanging baskets using the models explained in materials and methods. Hanging baskets method termed as "Ebiteko" in rutoro language (figure 1). This method although has limited documentation was used by Batooro in Western Uganda since ancient times.

Some households keep their food items such as eggs, sugar, rice and beverages in wooden cupboard (Karla and Willenberg, 2002) thus it is relevant to evaluate that method as well.Metallic drums (figure 2)were described as a storage method for grains by Odogola and Henrikson, 1991 so these two methods were used for comparison purposes with hanging baskets.

Figure 1.Hanging basket method "Ebiteko" in Rutooro language.

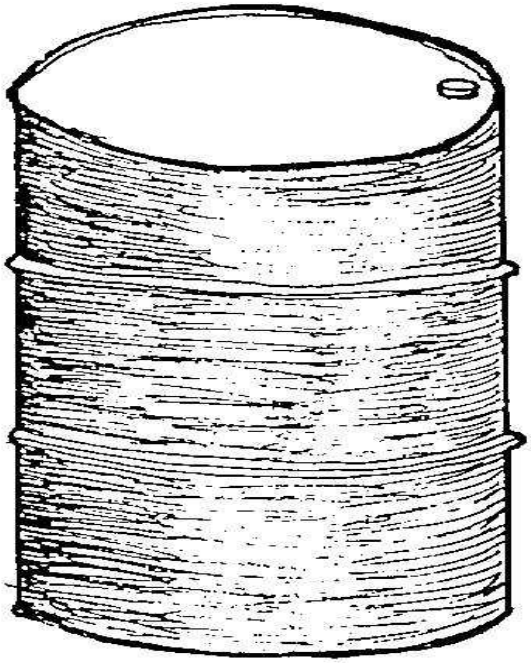

Figure 2.Metallic drum for storing grains adopted from Odogola and Henrikson, 1991.

MATERIALS AND METHODS:

Description of the experiment:

The experiment was conducted in a single room, one of the agriculture stores at Mountains of the Moon University,Saaka campus. Maize seeds were kept in two (2) models were used to represent the two indoor storage methods whereby hanging small buckets and sauce pan covered on top by another sauce pan supported with a heavy stone to represent hanging baskets and metallic drums respectively (figure 3). Hanging baskets were designed in such a way,length of string from horizontal pole of roof to bucket (70 centimeter).The space from the floor and walls was 3 meters and 50 centimeters respectively.
Each model was replicated three times so as to produce reliable results and each replicate contained a net weight 200 grams of maize seeds. The 200 grams of maize on uncovered plastic plates were kept in three closed chambers of woodencupboard termed as cupboard storage. Control treatment where 200 grams on plastic plates left un-protected and exposed were also set up.

Figure 3: Part of experiment set up without cupboard storage.Hanging buckets representing hanging baskets storage, modified saucepans (Metallic container) to illustrate metallic drum storage and exposed seeds as control set up.

Data collection and analysis:

Damaged seeds in each storage method were sorted and counted on daily basis for the period of 8 days to determine rate of damage. Weighing of seeds was done at beginning and end of the experiment to ascertain the baseline and final weight of maize seeds.Counting of the rodent fecal pellets was done to determine contamination of food in storage methods.

The data was entered into asoftware "R" which was used to perform one way ANOVA to find the significant differences in losses, rate of damage and contamination at 0.05 significant level.

RESULTS

Damage rate:

The highest damage rate was observed in maize seeds stored in cupboard with 41.5 seeds damaged per day followed by control storage with 40.6 seeds being damaged per day. The hanging buckets and metallic containers had lowest damage with 0 seed per day (figure 4) registered. There were significant differences in damage rate among the storage methods (one way ANOVA, $p < 0.05$) as indicated by different letters. In day one, 34 and 38 maize seeds were damaged in cupboard and control then seed damage had raised to 325 and 332 seeds by day eight.

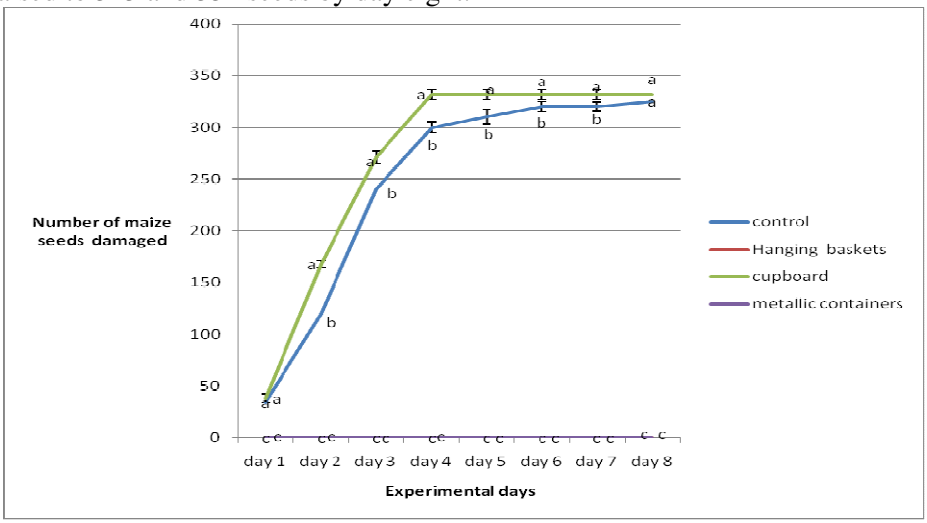

Figure 4: Damage rate of maize seeds in indoor storage methods in study , Error bars standing for standard deviation

Amount of losses:

The highest amount of losses was incurred in the cupboard and control methods of 156 grams and 144 grams respectively. The lowest amount of losses incurred in hanging buckets and metallic containers with 0 gram lost (figure 5). There were significant differences in amount of losses among storage methods (one way ANOVA, $p < 0.05$) indicated by different letters in figure 5.

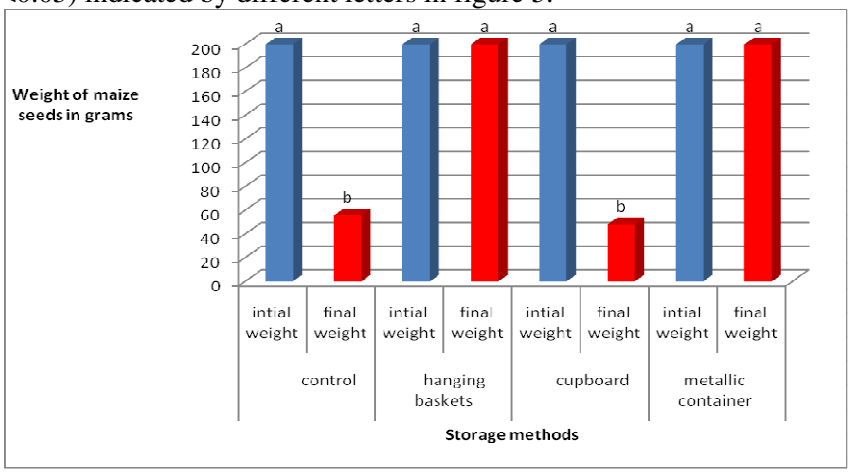

Figure 5: Losses in maize seeds incurred in storage methods illustrated differences final weight and initial weight.

Contamination:

The most contaminated were maize seeds stored in cupboard with 57 fecal pellets and the least contaminated were maize seeds in hanging buckets and metallic containers with 0 fecal pellet (figure 6). There were significant differences in number of fecal pellets in maize seeds among storage method(one way ANOVA, $p < 0.05$) indicated by different letters in figure 6.

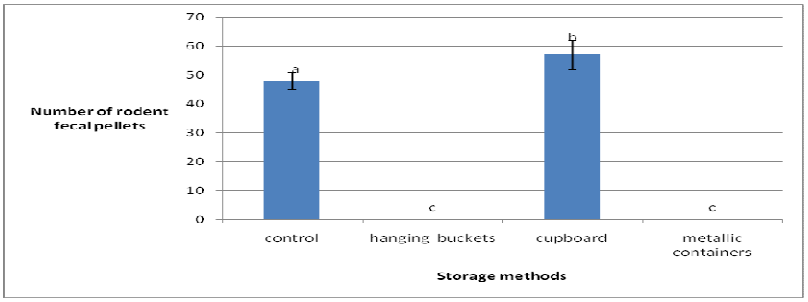

Figure 6: Mean amount of rodent fecal pellets in maize seeds stored in different methods and error bar stand for standard deviation

Discussion:

Maize seeds in hanging bucket and metallic containers were neither damaged nor contaminatedwith fecal pellets of rodents during the experimental period. This implies that rodents were not able to gain access into these containers. In spite of dismantling the cupboard and control sets from the experimental set up, still no damage and contamination occurred in hanging and metal containers from day 8 to 10. For case of metallic containers with tight fitting lids, these are rodent proof (Baker et al,1994)so this is why rodents could not access the maize seeds.

Rodents are able to chew wood, wall board and aluminum (Indiana State Department of Health, 2017) and they capitalize on small openings of 1.3 and 0.6 centimeters for rats and mice (Baker et al, 1994) to access into the cupboard. This justifies why maizeseeds stored in cupboard werehighly damaged than those in other storage methods i.e. metallic containers and hanging baskets. Control seeds were less damaged than those in cupboard because they were exposedto open areas and yet rodents are more active in hidden spots and dark places (Corrigan, 2001 and Baumgardener et al, 1980).

Baskets hanged tied with banana fiber from the roof proved more effective than cupboard because of its design. Length of string from horizontal pole of roof to bucket (70 centimeters) was too longfor rodents coil their tails around pole and stretch to maize seeds in buckets. According to Baker et al,1994, mice normally jump 46 centimeters from ground to elevated point therefore the distance from floor to the bucket is a factor to consider. In this study it was 3 meters above floor and 50 centimeter away from the wall. Rats descending vertically along the string are not yet established in the literature, may be another reason for the effectiveness of hanging buckets. However, hanging bucket method may be challenged by some circumstances such as;some rat species such roof rat*(Rattusrattus*) have ability to climb thin branches of tree with diameter 0.5 centimeter with aid of its strong tail (Division of Agriculture and Natural Resources, 2017). Baker et al, 1994 explains that rats can fall down 15 meters without serious injury, maybe they can fall from roof and land into an open hanging bucket.

Conclusion and Recommendation:

Hanging baskets and metallic containers were most effective indoor storage methods in guarding rodents against rodents since no damage and fecal pellets was observed in maize seeds stored by these methods. This would imply the hanging baskets (Ebiteko method) and metallic drum are very effective methods against rodents. Wooden Cupboards are susceptible to rodents since maize seeds stored in cupboard were the most damaged and contaminated with fecal pellets.

There is need to re-experiment the principle of hanging basket method in rat laboratory where rats are too many to thrive for survival because in the store rodents were few with evidence of the small number of fecal pellets in control and cupboard maize seeds less than 60 pellets in 8 days. This would confirm the effectiveness of hanging principle against rodents in food store.

References:

Baker, R. O., Bodman, G. R., & Timm, R. M. (1994). Rodent-proof construction and exclusion methods.

Baumgardener, D. J, Ward, S.E, & Dewsbury, D.A. (1980).*Animal learning & behavior* 8:322 doi 10: 3758/BF03199612.244 download

Belmain, S. R., Htwe, N. M., Kamal, N. Q., & Singleton, G. R. (2015).Estimating rodent losses to stored rice as a means to assess efficacy of rodent management. *Wildlife Research*, *42*(2), 132-142.

Corrigan, R. M. (2001). *Rodent control: a practical guide for pest management professionals*. GIE Media.

Davis, S., &Calvet, E. (2005). Fluctuating rodent populations and risk to humans from rodent-borne zoonoses. *Vector-Borne & Zoonotic Diseases*, *5*(4), 305-314.

Delany, M.J (1974). *The rodents of Uganda.Trustees of British museum (Natural History*), London.

Division of Agriculture and Natural Resources, University of California.*Getting rid of rats* –Marin Master Gardeners (www.marinmg.ucanr.edu/marin_Master_gard).

Fiedler, L. A. (1994). *Rodent pest management in eastern Africa* (Vol. 123). Food & Agriculture Org..

Hegdal, P. L., Colvin, B. A., &Blaskiewicz, R. W. (1984, August). Field evaluation of secondary hazards to barn owl (Tytoalba) and screech owl (Otusasio) associated with brodifacoum baits used for rodent control. In *Proceedings of a Conference on the Organization and Practice of Vertebrate Pest Control (ed. AC Dubock)* (pp. 647-662).

Indiana State Department of Health, 2017.*Rats and Mice* (http://www.in.gov/isdh/23256.htm)

Odogola, W.R and R.Henrikson,1991.*Postharvest management and storage of maize.*Technical systems for Agriculture.UNDP/OPS regional on agricultural operations technology for small holders in East and southern Africa, pp 162.

Vadell, M. V., Villafañe, I. G., & Cavia, R. (2014). Are life-history strategies of Norway rats (Rattusnorvegicus) and house mice (Musmusculus) dependent on environmental characteristics?. *Wildlife Research*, *41*(2), 172-184.

Waggoner, B. (2000).Introduction to the Rodentia. *University of California Museum of Paleontology*

Willenberg B and Karla H 2002. *Storing Food in the Cupboard, Extension department*, Missouri University http://extension.missouri.edu/p/MP557
