Domestic Cat (*Felis silvestris catus*) Urine Odour as a Potential Rodent Management Strategy

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Abstract: The aim of this study was to investigate the effects of cat urine *odour extract on rodent pest species to reduce crop losses. Cat urine from the captured cats was drawn using cat catcher. Urinary catheter was inserted into the urethra up to the urinary bladder and a syringe attached to the urinary catheter was used to draw urine which was stored in universal bottles at a temperature below -20°C. The stored cat urine was directly bound to the maize starch by slowly mixing the urine with the starch until dough was formed which was then granulated. The granules were dried at room temperature and packed in a tight closed jar. Mastomys natalensis of 25 – 40 g were used in this study. Wild captured individuals were acclimatized in a room for 7 days prior to experiment by providing them with food and water. The effect of cat urine odours on rodent pest species was studied in a single box. Camera traps were set at the top of each room in order to monitor rodents' activities. Our Findings suggests that cat urine odour has a potential to repel rodent pest species whereas female cat urine was more effective than male cat urine. However, more investigations are needed to evaluate its effectiveness under field conditions.*

Keywords: rodents, rodenticides, crop losses, odours, repellants, cat urine, granules

INTRODUCTION

Rodent pest species are important agricultural pests causing severe crop losses. They have the potential to breed quickly and infest crops leading to serious economic damage (Mulungu, 2003). In Tanzania, damage to crops is largely attributed to *Mastomys natalensis* and the Nile rat, *Arvicanthis* sp, *Gerbilliscus* sp, *Lemniscomys* sp, and *Aethomys* sp. (Mulungu et al., 2006). The damage to maize crop can exceed 80% (Mulungu et al., 2003a) and 5 – 12% in rice crop, depending on season and location (Mulungu et al., 2014). The economic impact of rodent damage is high especially in small scale farms (Mdangi et al., 2013). The types of

damage most often caused by rodents to crops in fields are: (i) destruction of seeds after sowing, and (ii) damage to stems of the mature crop (Mulungu et al. 2003b). Severe rodent damage to crops contributes to food shortage in rural communities of Tanzania, resulting in immediate financial loss.

The eruptive nature of rodent pest species raises serious concerns to farmers. Farmers control rodent pests using natural enemies, cultural techniques and killing by rodenticides. The most common method of reducing the size of rodent populations generally relies on lethal control methods, including the use of poisons (rodenticides) (Myllymäki, 1987; Mulungu et al., 2010). These methods, however, provide only a short-term solution. All too often removal of a rodent simply provides a space into which others from the surrounding areas may be drawn and the colony soon recovers and the problems posed by the rodents persist. Buildings rendered free of commensal rodent, for example, can be re-infested within a relatively short time (Kilonzo, 2006; Mulungu et al., 2010). The development of resistance to the most commonly used rodenticides has led to the introduction of more toxic variants. These variants currently pose a risk to non-target species and therefore, their use is strictly regulated. Thus the options for controlling rodent populations steadily decrease while conflict still remains.

The drawbacks of this method of rodent management suggest the need for an alternative approach. Humane, effective and environmentally acceptable approaches to rodent population control therefore, need to be developed, techniques that in the longer-term, will limit the growth and development of problem populations to levels where the problems posed are not economically significant. Such techniques could either be used in isolation or be used to improve the efficacy and efficiency of current control techniques and thereby reduce the risks posed to non-target wildlife. Chemical repellents signals could produce an immediate avoidance response in rodent pests by restricting the growth of rodent populations in an area.

Potentiality for synthetic predator odors as repellents for different preys has been reported on the efficacy of various raw predator odors and extracts as feeding repellents for deer (Abbott et al., 1990; Swihart et al., 1991), elk (Andelt etal., 1992), and sheep (*Ovis aries*) (Arnould and Signoret, 1993). In addition, several studies support the hypothesis that predator odors also function as kairomones (interspecific chemical signals) for prey species that perceive the odors as "danger" signals and warn them that a predator is nearby. Perception of predator odors is thought to elicit a "fear-of-predation" response in prey animals which, in turn, causes the animal to seek out alternative, less threatening habitat (Abbott et al., 1990). Responses of rodents to predator's odor have been variable, including changes in habitat use, shifting of activity time and delaying maturation. Anti-predator behaviour therefore, can affect the fitness of individuals and the dynamics of population.

Therefore, if feasible using the cat urine odour will be an added tool to protect farmers' crops in fields and increase the economy. Little is known about whether predator-specific risk assessment and response could work as a rodent pest management strategies. This study aimed to investigating the effects of cat urine odour extract on rodent pest species activities to reduce crop loss.

MATERIALS AND METHODS

Trapping of cats

Urine from domestic cats (*Felis silvestris catus*) was used as a source of predator chemical cues. These cats normally hunt rodents and have rodents as part of their diet. Baited cages were set in evening and checked in the morning. Captured cats were brought at Sokoine

University of Agriculture, Faculty of Veterinary in cages and kept in kennels where they were given adequate food and water. The cats in the kennels were caught using cat catcher and anesthetized by intramuscular injection of Xylazine and Ketamine hydrochloride. Urinary catheter was inserted into the urethra up to the urinary bladder. A syringe attached to the urinary catheter was used to withdraw urine into universal bottles. Therefore, freshly cat urine samples were frozen and stored in -20°C and transferred to Muhimbili University of Health and Allied Sciences, Institute of Traditional Medicine for cat urine extract production.

Cat urine extract

Stored cat urine was directly bound to the maize starch by slowly mixing the urine with starch until dough was formed. Granulation machine was used to form granules from the dough and were dried at room temperature and packed in a tight closed jar.

Rodent trapping

Wild rodent species of *Mastomys natalensis* 25 – 40 g was captured from field. This species was used as a model because is a major rodent pest species in sub Saharan African countries including Tanzania (Massawe et al., 2011; Mulungu et al., 2013). One Sherman LFA live trap (8×9×23 cm; H.B. Sherman Traps Inc., Tallahassee, FL) was placed at a distance of 10 m apart, for three consecutive nights. The traps were baited with peanut butter, mixed with maize bran/maize flour and were placed in the afternoon and inspected in the morning of the following day. The captured individuals were acclimatized in a room for 7 days prior to experiment by providing them food, which was maize grains and water.

Rodent activity study

The effects of cat urine odours upon *M. natalensis* were studied in a single box, which had two inner participations rooms similar to Y-maze set up. Rodents were released at the middle room and able to choose where to go either in room with or without cat urine. The camera traps were hanged at the top of each room with and without cat urine extract in order to monitor rodents' activities and visitations. Ten animals (5 females and 5 males) were released in the box's room. Maize grains, water and cat urine extract were available in the first room while the second room only maize grains and water were present. Both cat urine extract from females and males cats were tested to rodents' behavioural response separately. This built a comprehensive picture of the impact of cat urine odours on the physiology and behavioral of individual animals.

Data analysis

To determine whether *M. natalensis* in a room with or without cat urine extracts bias or equal, we counted the number of visits to each room and compared the two using percentages and graphs.

Results

Results show that the number of visits to rooms with or without cat urine extract and cat sexes were different. Results indicate that only 333 (6.8%) frequency visit activities were recorded in a room with female cat urine extract while 4564 (93.2%) were recorded in a room with no female cat urine extract. For male cat urine extract, 8283 (33.9%) frequency visits were recorded in a room with cat urine extract while 16150 (66.1%) frequent visit was recorded in a room with no cat urine extract.

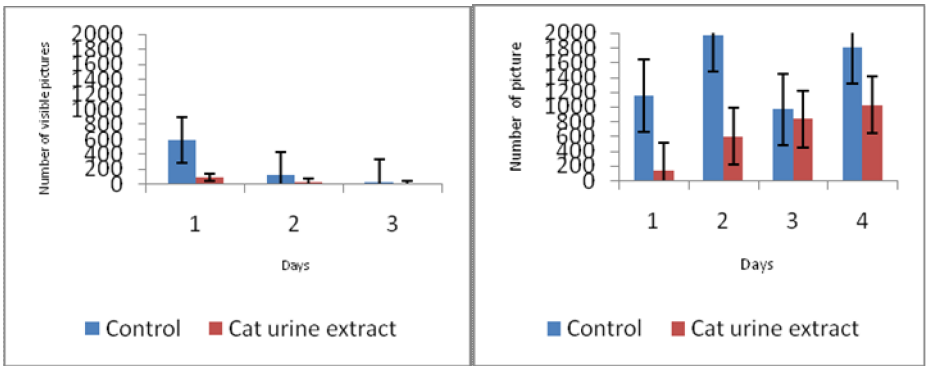

Fig. 1: Effectiveness of cat urine extract of (a) female cat urine extract, and (b) male cat urine extract

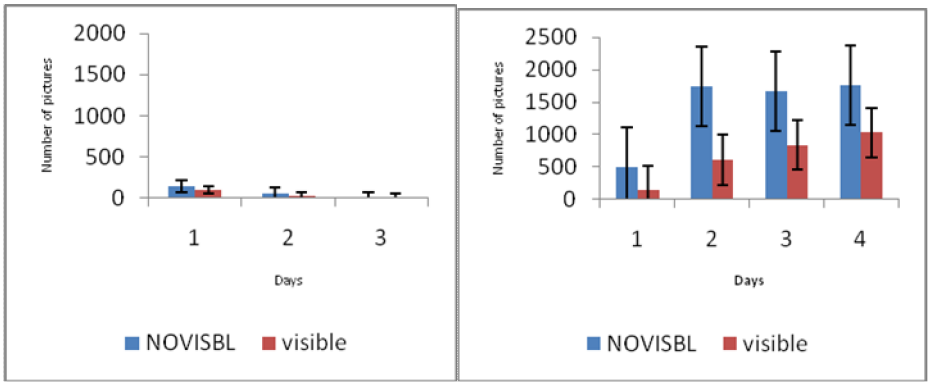

Fig. 2: Effectiveness of cat urine extract over the type of picture against (a) female cat urine extract, and (b) male cat urine extract.

Therefore, female cat urine extract was more effective in repelling rodents than male cat urine extract indicated by few pictures recorded in a room with female cat urine extract compared to more pictures observed in room with male cat urine extract (Fig. 1). Similarly, male cat urine extract produced higher number of both visible (pictures with complete individual rodent body) and invisible (pictures with incomplete individual rodent body) pictures as compared to female cat urine extract (Fig.2).

DISCUSSION

Our results indicate that cat urine is able to effectively repel *M. natalensis* which is a major crop pest in sub Saharan Africa. *M. natalensis* were able to detect the odour of their predator cats. Prey species show specific adaptations that allow recognition, avoidance and defense against predators. For many mammalian species this includes sensitivity towards predator-derived odors. The typical sources of such odors include predator skin and fur, urine, feces and anal gland secretions (Abbott et al., 1990; Arnould and Signoret, 1993). In the current study therefore, *M. natalensis* has shown to ovoid cat urine extract with evidence that the room with food and cat urine extract had significantly less activities than the room without cat urine extract. This indicates that *M. natalensis* were repelled by cat urine extract consequently their activities declined. Avoidance of predator odors has been observed in many mammalian prey species (Abbott et al., 1990; Swihart et al., 1991; Andelt etal., 1992, Arnould and Signoret, 1993).

It has been reported that predator odors have distinctive behavioral effects which include (i) inhibition of activity, (ii) suppression of non-defensive behaviors such as foraging, feeding and grooming, and (iii) shifts to habitats or secure locations where such odors are not present. This has also been shown in the current study where non-visible pictures were less in the room with cat urine extract. It seems that animals were looking space to escape in a room that is a reason where invisible pictures were observed. Most of animals were freezing in a corner of room without cat urine extract (Own observation), which is often used to measure fear (Fendt and Fanselow, 1999; Wiltgen and Fanselow, 2003; Sullivan et al., 2004), indicating avoidance behavior. Furthermore, flat back approaches (Own observation), a form of risk assessment (Blanchard et al., 1990), were observed only in the room with cat urine extract although this was not measured in the current study.

Similar observation has been reported for both raw and synthetic materials of urine from wolf, coyote, fox, bobcat, lynx, and wolverine, feces from lynx and bobcat, and weasel anal gland secretions were the most effective materials for suppressing snow shore hare feeding (Sullivan and Crump 1986). Generally, several predator odors as repellents have shown potentiality as feeding repellents for prey (Sullivan, 1985). Interesting, cat urine extract from female has been observed in the current study to be more effective to repel *M. natalensis*. This therefore needs to conduct further studies to determine the different in two urines. Female lions, for example, do the hunting for their prides being the main role of the males is to protect the pride and defend against foreign male lions who will often try to overthrow him in order to gain access to the females and resources. Therefore, it is likely that *M. natalensis* perceive more quickly the female cat urine odour due the effectiveness in hunting.

CONCLUSION

Our Findings suggests that cat urine odour has a potential to repel rodent pest species. Using rodent repellent in handling rodent problem might be considered scientifically sound, more humane and convenient as compared to using rodenticides and rodent traps. Nevertheless, results from the current study is inconclusive and therefore more investigations are needed to evaluate its effectiveness under field condition, application methods, states of the synthesis product (either in liquid, gel or powder), and under high population.

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