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Fluorescent non-toxic bait as a new method for black rat (*Rattus rattus*) monitoring

Aulický, R.#[1], Fraňková, M.[1,2], Rödl, P.[3], Eliášová, B.[2], Frynta, D.*[2], Stejskal, V.[1]
[1] Crop Research Institute, Drnovská 507, Prague 6, Czech Republic.
[2] Departments of Zoology, Faculty of Science, Charles University, Viničná 7, Prague 2, Czech Republic.
Email: frynta@centrum.cz
3 National Institute of Public Health, Šrobárova 48, Prague 10, Czech Republic

* Corresponding author
# Presenting author

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Abstract

The detection of synathropic rodents may be difficult since they are animals with nocturnal activity. Methods of their detection and monitoring rely mostly on indirect signs of their activity such as the presence of faeces, urine, consumed foods and damaged materials. Our experimental hypothesis was that the production of fluorescent faeces - following consumption of fluorescent bait - may be used for rodent monitoring. For this purpose we studied the production of fluorescent faeces, temporal dynamics and detectability in wild black rat (*Rattus rattus*). Wild black rats were individually housed in experimental cages with the wire-mesh grid floor and faeces were collected in short-time intervals. The peak of fluorescent activity in faeces was detected 10-20 hours after bait ingestion. We found that there is only relatively short delay between bait consumption and defecation and fluorescent faeces are easily detectable at distance using an ultraviolet hand lamp. Thus, this method can contribute to effective monitoring of rodent pests.

Keywords: *Rattus rattus*, Fluorescent bait, Monitoring, Rodent control

1. Introduction

Black rat (*Rattus rattus*) belongs to the three most important rodent species which cause serious damages in agricultural and urban environment in Europe (Meyer et al., 1993). Rats are rodents with a nocturnal activity and most of the day is spent in hidden shelters or nests. They are good climbers, prefer dry areas above ground and are well know for their behavioural response to novel objects (neophobia) (Battersby et al., 2008), which complicates an effective control (Leung & Clark, 2005). Their presence is not easily detected by direct observation but rather according to the signs of their activity - faeces, urine, consumed foods or damaged material. Research is traditionally focused on trapping and poisoning (Shafi et al., 1992; Prakash et al., 2003, Selvaraj and Archunan, 2006). Nevertheless the precise knowledge of rodent spatial activity is also an important prerequisite for their effective control. Indirect monitoring of rodent movements was traditionally realised by administration of the marking substances into the bait and its subsequent detection in rodent bodies and tissues (Savarie et al., 1992).

In the present study, we focused on a new method of monitoring rodent pests by non-toxic fluorescent bait. This bait enables detection of rodent movements via fluorescent faecal pellets without contact with the target animals. In laboratory test, we offered the bait to wild black rats and monitored temporal dynamics of production of fluorescent faeces.

2. Materials and methods

Fluorescent bait- pellets were formulated by ICB Pharma Poland using encapsulation in a thermoset melamine (formaldehyde) sulphonamide resin complex. Orange fluorescence agent was composed from 2 fluorescent pigments: 2.0 % -orange and 0.4 % yellow (CIBA Specialty Chemicals).

The experimental animals included wild black rat, *Rattus rattus*. Rats were kept solitary in cages with a wire mesh bottom. Standard food (ssniff, Germany) was removed from the feeders the day before experiment (20:00 h). The following day (at 16:00 h) 20 g of fluorescent pellets were offered to each rat. At 18:00 h fluorescent pellets were removed and replaced by standard pellets. All remaining fluorescent pellets and their fragments were collected and weighed; this enabled to estimate the amount (weight) of consumed fluorescent pellets.

All faecal pellets were collected every two hours for 38 hours after administration of the fluorescent pellets. The collected faecal pellets were counted, inspected under the ultraviolet illumination (ICB Pharma, a 21 LED flashlight which emit UV-A light, 390 nm) and classified into the following three groups: (i) highly fluorescent, (ii) poorly fluorescent, and (iii) exhibiting no sign of fluorescence. Finally, all collected pellets were dried and weighed.

3. Results

Rats produced on the average 109 faecal pellets per 38 h; ranging from 76 to 155. The dry weight of the produced faeces ranged from 3.4 to 9.0 g (mean = 5.2 g). The experimental subjects consumed 1.1 – 13.2 g of the pellets (mean = 6.5 g). The first fluorescent faeces were recorded 2-4 h after the introduction of fluorescent pellets into the cages. Total weight of detectable fluorescent faeces (WDFF) produced during the experiment increased with weight of consumed fluorescent pellets (WCFP) following equation: WDFF = WCFP * 0.110 - 0.221.

Figure 1 shows that the production peak of highly detectable fluorescent faeces was 6-16 hours after bait introduction. The last detectable faeces were recorded 28-30 h after bait introduction in most of the experimental animals. However, one individual produced fluorescent faecal pellets even 34 and 38 hours after bait introduction.

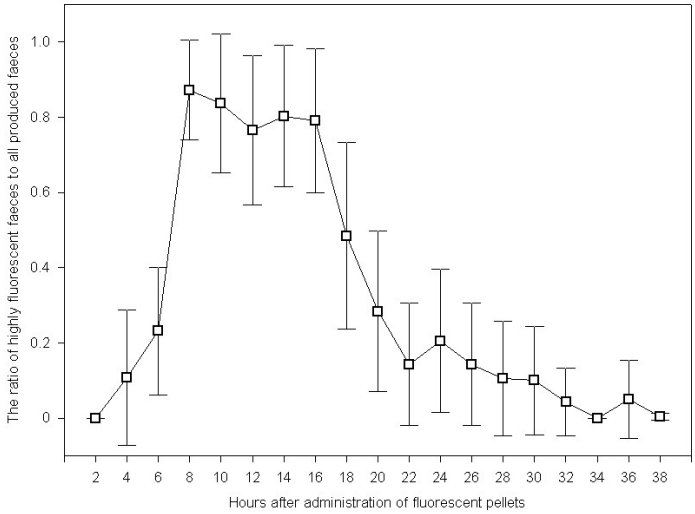

Figure 1 Proportion of the number of highly fluorescent faeces to all produced faeces by black rat after the consumption of fluorescent pellets. Data are given as means and 95% confidence intervals.

4. Discussion

We confirmed that fluorescent pigment is easily detectable with the UV flashlight in black rat faeces after consumption of fluorescent bait. The fluorescent faeces were highly visible from a distance of several meters even when relatively poor flashlight ultraviolet illumination was used. The low overall production of faecal pellets by black rats may be considered as a limiting factor for rat monitoring under field condition, since some proportion of faecal pellets is usually deposited in inaccessible sites (shelters etc.). However, the high visibility of even a single faecal pellet in UV light may help to overcome this limitation.

The production peak of detectable fluorescent faeces was 6-16 hours after administration of fluorescent pellets into the rat cages. This delay corresponds with those reported for Norway rat (Bungay et al. 1981). The rate of bait conversion into highly fluorescent faeces was 11%. It means that nine times more bait should be administered and consumed to produce a unit weight of detectable faeces. Hence, high palatability and an appropriate placement of the bait are requested for effective monitoring (Clappperton, 2006). Fluorescent bait was offered to rats in non-choice experiment and some individuals, although food

motivated, did not accept the food immediately. It confirms behavioural neophobia in black rats which should be taken into account in the application of the method. This phenomenon is going to be studied in our future research.

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