Proceedings of the Ninth International Conference on Urban Pests
Matthew P. Davies, Carolin Pfeiffer, and William H Robinson (editors) 2017
Printed by Pureprint Group, Crowson House, Uckfield, East Sussex TN22 1PH UK

CONTROLLING HOUSE MICE IN THE FOOD INDUSTRY

JOHN SIMMONS AND CHRIS SWINDELLS
Acheta Consulting Ltd, Front Street, Churchill, Winscombe,
North Somerset, UK, BS25 5N

Abstract In recent years we have lost many rodenticide products, and seen increased regulatory restrictions on the way in which remaining products may be used. In the food industry, client-imposed restrictions further limit usage options. House mice (*Mus domesticus*) remain a major challenge to control, even without such developments, and our experience suggests that around 10-20% of all food manufacturing plants in the UK experience resident mouse infestation. Using an electronic monitoring system, we have demonstrated that some of the rodent baits and traps used in 'conventional' monitoring programmes may be an extremely unreliable indicator of activity, with a high degree of behavioural resistance sometimes evident. This has long been known about, or at least suspected, but has rarely been quantified. The implications of this from the viewpoint of controlling mice are profound. Electronic monitoring systems are a useful tool for studying rodent behaviour in the field.

Key words Behavioural resistance, Baits, traps, electronic monitoring,

INTRODUCTION

Humphries et al. (1992), working in central Birmingham, the second largest city in the UK, demonstrated that house mice in this urban area avoided conventional cereal-based rodent baits, a phenomenon they termed 'behavioural resistance'. Further work (Humphries et al., 2000) indicated both a genetic component to the aversion, and recognition that these urban mice exhibited both a degree of neophobia to new foods, and to the receptacles that food is presented in.

Driven largely by food safety concerns relating to the potential contamination issues presented both by rodenticides, and the poisoned rodent, the use of rodenticides to monitor and control mice has declined dramatically in the global food industry in recent years. Most food safety related standards include some degree of prohibition on rodenticide use. Trapping based systems, for both monitoring and control, have seen a resurgence, and numerous electronic monitoring systems are now appearing, which claim to detect rodents through either the presence of the animal alone, through consumption of food within a feeding station, or through activation of a trapping device.

We are not aware of any statistics concerning the proportion of food manufacturing and storage facilities that experience house mouse infestation. A review of rodent activity within our customer base of 180 food manufacturing facilities, over a 12-month period, (Figure 1), indicated that about three-quarters had experienced either no, or very sporadic, mouse activity. A further 5% had experienced recurring activity, but for reasons we believed to be associated with regular re-importation, for example within incoming goods or packaging, or in empty returned food containment trays and baskets. However, we considered that just over one-fifth of the 180 sites had experienced mouse infestation for an extended period, often the full 12-months, indicative of infestation that was resident within the fabric of the

building. Communication with two UK-based pest control companies produced comparable figures of 8 and 20%, so we consider that it is reasonable to speculate that between 10 and 20% of food manufacturing facilities in the UK have a resident population of house mice. Our extensive experience of working in mainland Europe leads us to further speculate that the situation there is no different. Such levels of infestation obviously have extremely significant food safety implications.

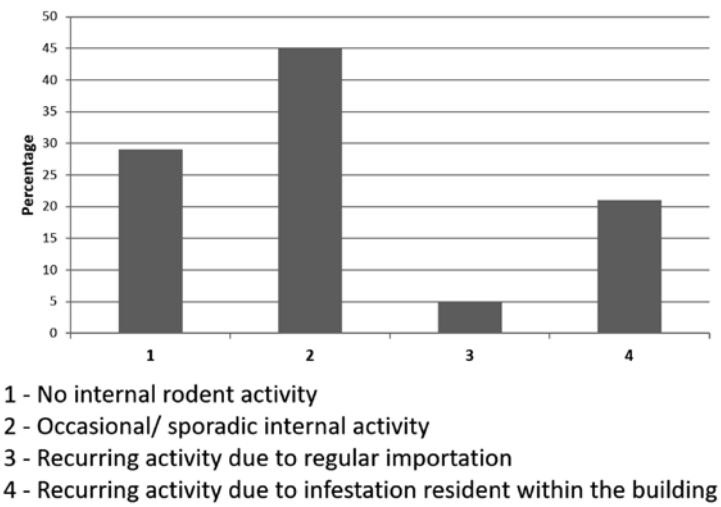

Figure 1. Proportion of UK food manufacturing facilities with house mouse infestation (data generated from Acheta's client database)

The aim of this study was to investigate whether an electronic rodent monitoring system could offer an alternative to the conventional monitoring approaches based on baits and traps. In-so-doing, could such systems better help detect rodent behavior that might indicate some degree of behavioural resistance?

MATERIALS AND METHODS

GreenTrapOnline (GTO) is a wireless electronic system designed specifically for monitoring rodents. A typical GTO set-up (Figure 2) consists of a central control box, routers to boost the signal around the building, and individual detectors, which detect rodent presence using a passive infrared (PIR) sensor. An email alert is triggered by the combination of body heat and movement as the rodent passes beneath the sensor. The system can be combined with conventional bait and trapping stations but, and most importantly for our purposes, the detectors can also be used as standalone monitors, triggered by rodent presence alone.

Figure 2. The main components of the GTO system; control box, router and sensor.

The site chosen for the trial was a large (c. 1,000,000 ft^2) supermarket distribution centre, which had experienced an extensive and very long-standing (believed to be 10 years or more) infestation of house mice. 25 monitoring locations were selected. Evidence for rodent activity at these locations ranged from none, through to widespread evidence for long-established infestation; the latter being typified by numerous droppings and/or heavy smearing. At each location, we placed four separate monitoring devices, detailed below, and shown in Figure 3:

1. A GTO detector, secured to a length of upturned plastic guttering. Under the guttering was placed a non-toxic bait (Rentokil's Non-Tox Indicator Paste), and a band of fluorescent tracking dust (Killgerm Yellow Fluorescent Tracking Dust).

2. A plastic bait station (Killgerm AF Advance Mouse Box), containing the non-toxic paste bait.

3. A cardboard bait station (Killgerm No. 4 Cardboard Bait Box), containing the non-toxic paste bait.

4. A plastic trapping station (Killgerm AF Snappa), containing a break-back trap (Snap-E Mouse Trap), and baited with a commercial rodent attractant (Provoke Mouse Attractant, Bell Laboratories).

Figure 3. The four monitoring devices used within the trial.

Figure 4. Footprints in UV tracking dust where mice have emerged from the plastic guttering.

The paste bait chosen was one that we knew to be highly palatable to house mice in situations where widespread alternative food was available. Provoke was chosen because it is an attractant that is widely used by pest control operatives. The plastic bait and trapping stations are similarly widely used, and a cardboard bait station was included because it is often stated that mice will enter cardboard bait stations in preference to plastic ones, though the use of cardboard bait stations is problematic in the food industry because of the lack of tamper-resistance.

The detectors were left in place for two weeks, with all detections during that period recorded on the GTO central server, accessed via a dedicated portal. All 100 monitors (4 monitors at each of 25 locations) were re-visited at regular intervals (every 3-4 days) through the trial to check on their condition, and to check for evidence of mouse activity.

RESULTS AND DISCUSSION

Efficacy And Reliability of GTO As A Monitor of Mouse Activity

Activations were recorded by 9 of the 25 GTO sensors. The number of activations during the trial, at these 9 locations, varied from 1 to 105. At every one of the 9 locations where mouse activity was recorded there was actual physical evidence for mouse presence found, manifested by footprints through the tracking dust (Figure 4). At none of the 16 GTO locations where there was no activity detected was evidence for mouse activity found. It can therefore be concluded that GTO is a reliable means for detecting the presence of rodents, recording neither false positives nor false negatives.

Efficacy and Reliability Of Baits and Traps As A Monitor Of Mouse Activity

One full-take and one part-take was noted on the non-toxic paste baits placed under the guttering housing the GTO sensors. It can therefore reasonably be assumed that mice had encountered this bait at 9 locations, but had chosen to ignore it at 7 of these.

Similarly, there were no takes of bait in any of the plastic bait stations, and evidence (UV dust footprints) that mice had entered only one of these stations (Figure 5). The situation was only marginally better with cardboard bait stations, mice having entered one of these, partially consuming the bait in the process. The trapping boxes caught nothing, and the only box where there was any evidence for mice having entered was in one station where the trap had been accidentally activated (Figure 6).

Supporting the evidence for mice avoiding baits and traps, and the boxes holding them, was evidence which showed clearly that mice were deliberately avoiding the boxes (Figure 7).

Figure 5. Footprints passing through one of the plastic bait stations.

Figure 6. Mouse movement over the treadle of accidentally activated trap.

Implications From A Mouse Control Viewpoint

Rodenticide baits and trapping devices (typically break-back traps or glue-boards) are the principal means for monitoring for mouse presence on a global basis. Evidence that they are deliberately avoiding such devices has significant implications in terms of under-estimating populations, particularly if inspection for other supporting evidence is insufficiently rigorous. Similarly, such devices are the mainstay of control programmes in those premises where mice are present, so the public health and food safety implications are profound if mice can no longer be controlled using such products.

Electronic Monitoring As A Tool For Rodent Behavioural Studies

Studying the behaviour of rodents in the field is challenging. Tracking dusts and plates will detect presence, and give some indication of the degree of activity. Cameras activated by heat and motion will also highlight presence, but placing sufficient numbers to build a picture of movement and activity throughout a building is probably impractical with current technology. The development of rodent-specific electronic monitoring systems offers an important tool for studying rodent movement in the field.

Sensors relying simply on rodent movement and body heat to trigger an alert offer a reliable means for monitoring both presence and activity patterns. The ability to install these at many locations within a building allows an accurate picture of spatial distribution and movement to be constructed. Furthermore, activity patterns can be determined, with clear peaks of activity being evident when the detector activations in this trial are broken down by time of day (Figure 8).

Figure 7. Mouse footprints showing clear avoidance of bait and trap stations.

SCOPE FOR FURTHER STUDY

Electronic monitoring provides a useful tool for both monitoring rodents on a commercial basis, and for academic studies into rodent behavior. However, the results from those electronic monitoring systems which rely on, for example, food consumption or trap activation, should be considered with caution, due to potential behavioural resistance concerns such as were clearly evident in this trial. It is hypothesized that control practices over many years at the site concerned may have selected for mice that are naturally reluctant to enter bait and trapping stations. Whether there is a genetic component to such behaviour is not known, but this can certainly be suspected. It is believed that this is a wider problem than is currently recognized amongst the pest management industry. The apparent behavioural resistance observed in this study merits further investigation.

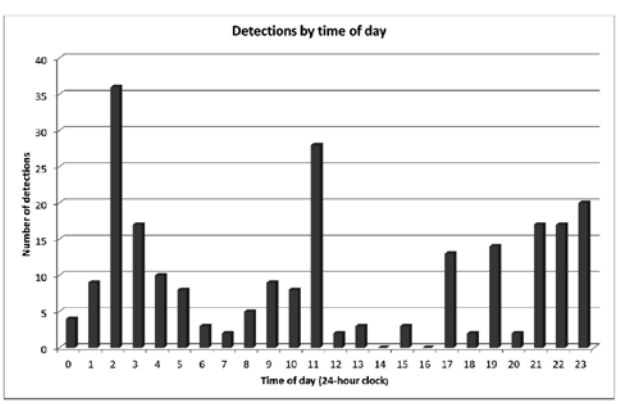

Figure 8. Detector activations by time of day; data generated during week 2 of the trial.

REFERENCES CITED

Humphries, R.E., AP. Meehan, and R.M. Sibly. 1992. Characteristics and history of behavioural resistance in inner-city house mice in the UK. Proc. Vertebrate Pest Conf., University of California, USA, March 1992, 161-164.

Humphries, R.E., R.M. Sibly, and A.P. Meehan. 2000. Cereal aversion in behaviourally-resistant house mice in Birmingham, UK. Appl. Anim. Behav. Sci., 66, 323-333. (erratum vol 69, 175-176)