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Efficacy of a cellulose-based product in controlling house mouse (*Mus musculus*) in agricultural storage facilities

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Abstract

Possibilities of using new and naturally-occurring chemical compounds for controlling rodent pests are tested as part of a widespread effort to make possible foodstuffs production that would meet high ecological standards. One of such compounds is cellulose, a naturally-occurring substance with a mode of action different from other rodenticide active ingredients. Ingestion of cellulose-based baits leads to immediate dehydration, reduction in bood volume and pressure, tissue decay and circulation arrest.

Biological efficacy of an ecologically-friendly rodenticide produced from powdered maize cobs (40-45 % cellulose) in controlling house mouse (*Mus musculus*) was tested. The experiment was carried out on 1,600 m^2 of storage area. Products based on bromadiolone and brodifacoum, containing 0.005 % active ingredients, were used as standards. The experiments complied with the standard OEPP/EPPO method. Baits in the amounts of 15-20 g were applied at 1-2 m intervals on sites where rodent activity had been observed. Consumed bait was recorded and replenished as necessary on a daily basis over a period of 10 days. Mice numbers were estimated based on the highest and lowest daily amounts of consumed bait divided by normal daily feeding requirement. Monitoring of mouse presence continued over the next 20 days. The efficacy of products tested was calculated using Abbott's formula.

Our results showed a 91.66 % efficacy of the cellulose-based product. Bromadiolone efficacy was found to be 86.20 % and brodifacoum 97.05 %.

Key words: cellulose; brodifacoum; bromadiolon; *Mus musculus*; storage facilities; efficacy.

Introduction

Integrated pest management (IPM) is a new approach to plant protection, which is expected to replace the outdated methods of control of harmful organisms. The fundamental idea of IPM is to put to maximum use nature's own regulatory mechanisms in order to prevent damage, which serves the best interest of manufacturers, society at large and the environment (Kogan, 1998). IPM is the most effecient, cost-effective and natural way of controlling pest organisms. Several measures are currently used that have been designed to prevent or alleviate potential damage caused by rodents in stored agricultural products over long periods of time (Spragins, 2006). At the end of the 20th century, Haines (2000) found stored products IPM still insufficiently developed. A form of support to IPM development in stored agricultural products is the use of natural compounds to control rodent pests. One of such compounds is cellulose, whose mode of action differs from the modes of other rodenticide

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active ingredients. After bait ingestion, the product quickly brings about dehydration in mice, causing decrease in blood volume and blood pressure, tissue decay and circulation arrest, and the ultimate result is death (Anonymous, 2005).

Mus musculus is widespread in nearly all parts of the globe, except in north-eastern and eastern parts of Asia and northern Canada. The mouse, together with Norway rat (*Rattus norvegicus*) and black rat (*R. rattus*), is a most important rodent pest in stored products (Hrgovic et al., 1991; Đukic et al., 2005). Daily feeding requirements of the house mouse are equivalent to 15 % of its weight (3-4 g), or up to 1.4 kg annually (Gwinner et al., 1996). In agricultural storage facilities, house mouse causes serious damage not only through product consumption and pollution, but by damaging various products of plant, animal and synthetic origin as well (Ruzic, 1983; Korunic, 1990; Gwinner et al., 1996). According to Hrgovicu et al. (1991), house mouse pollutes up to nine times more food than it consumes.

House mouse control in agricultural storage facilities is undertaken only after its presence has been registered (Korunic, 1990; Spragins, 2006). Products used to control house mouse need to meet palatability requirements, i.e. to be able to stimulate mice to choose baits rather than other food available in abundance (Shafi et al, 1992; Spragins, 2006).

This study aimed to determine the effectivenss of one ecologically-friendly rodenticide in controlling house mice.

Material and methods

The experiment was carried out in the Institute of Animal Husbandry in Belgrade where agricultural products (sunflower, maize, wheat and feeding meal) are stored in sacks lifted up on palletes, rather kept as bulk goods. Total surface area treated with the test products was 1,600 m^2.

Biological efficacy of the product Natromouse, manufactured by PINUS TKI d.d., Raèa, Slovenia, was tested. Natromouse is a natural product composed of powdered maize cobs (40-45 % cellulose). A bromadiolone-based product (Brodisan-PEF, manufactured by EKO-SAN, Beolgrade) and a brodifacoum-based product (Rattack – paraffinized pellete, manufactured by DUOHEM, Belgrade), containing 0.005 % a.i., were used as standards.

The experiment was carried out in compliance with the PP 1/114(2) standard (OEPP/EPPO, 1999). Baits in the amount of 15-25 g were laid into active holes at sites where mouse activity and damage had previously been observed (Figure 1), as well as near electical wiring, and on mice routes (underneath palletes holding the sacks with feeding meal) at 2-4 m distance.

Figure 1. Damage caused by house mouse feeding in the storage facility investigated.

Over a ten-day period of monitoring, consumed baits were recorded daily and portions replanished as needed. Mice numbers were assessed based on the highest and lowest daily amounts of bait consumed, divided by its daily requirement. The presence of house mouse was monitored over the next 20 days.

The efficacy of products tested was calculated using Abbott's formula (Abbott, 1925).

Results

Table 1 shows the test products, assessed abundance of house mouse at the beginning and end of experiment, and biological efficacy calculated according to Abbott's formula (Abbott, 1925).

Figure 2 shows daily product palatability of house mice.

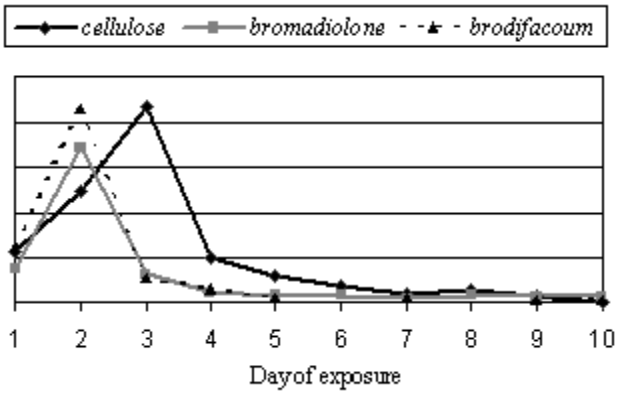

Figure 2. Palatability of test products.

Discussion

Palatability of the bromadiolone- and brodifacoum-based products reached maximum on the second day of experiment and the cellulose-based product on the third day. After reaching maximum, product palatability dramatically decreased. On the seventh day of experiment, palatability of the three products showed no significant difference.

Our results showed that the cellulose-based product had 91.66 % efficacy in controlling house mouse (*Mus musculus*) in agricultural storage facilities. The bromadiolone-based product had 86.20 % efficacy and brodifacoum-based product 97.05 %.

No other data are generally available on the efficacy of products based on cellulose in controlling rodent pests. According to a report by Brooks and Rowe (1987), published by the World Health Organization, the efficacy of bromadiolone-based products (0.005 % a.i.) applied in the field to control house mouse (*Mus musculus*) ranged from 70 % to 100 %. Brodifacoum-based products (0.005 % a.m.) were shown to have efficacy ranging from 98.4 % to 100 %.

Bromadiolone- and brodifacoum-based products used to control house mouse on poultry farms have been found to demonstrate 80.8-97 % efficacy (Parshad et al., 1987).

Rowe et al. (1978) reported a brodifacoum efficacy against house mice on farms as ranging between 92.7 % and 100 % (mean 98.8 %). Bromadiolone efficacy against the same farm pest ranged from 92.7 % to 100 % (mean 92.4 %) in another trial (Rowe et al., 1981).

Compared to brodifacoum and bromadiolone efficacy, cellulose as a natural active ingredient was found to have satisfactory efficacy in controlling house mouse in agricultural storage facilities.

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Table 1. Efficacy of products tested in controlling house mouse (*Mus musculus*) in agricultural storage facilities.

Product	A.i. concentration	Estimated abundance		Efficacy (%)
		Beginning	End	
Natromouse	45.00 % (*Cellulose*)	36	3	91.66
Brodisan-PEF	0.005 % (*Bromadiolone*)	29	4	86.20
Rattack-peleta parafinizirana	0.005 % (*Brodifacoum*)	34	1	97.06

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