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THE USE OF A ZINC PHOSPHIDE/MOLASSES GEL,
AND A BRODIFACOUM/MOLASSES GEL DELIVERY SYSTEM
FOR THE CONTROL OF RATTUS NORVEGICUS AND MUS MUSCULUS
BY

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Rodent pests that consume sublethal doses of acute rodenticides frequently develop bait shyness. Since most rodents groom foreign substances contaminating their fur, an alternative approach to the control may be to incorporate a rodenticide with a gel contaminant. Contaminated rodents would then ingest the toxicant during grooming. Grooming behavior, thus, might be used to deliver toxicants for crop protection (Reidinger and Mason, 1986).

The behavior and the physiological basis of grooming have been investigated by various authors (Colbern et al., 1978; Dunn et al., 1979; Geyer and Kornet, 1982; Cohen and Price, 1979; Mason et al., 1985; Reidinger and Mason, 1986; and Reidinger et al., 1982). Reidinger and Mason (1983) referred to the physiological basis of grooming in rodents. They indicated that grooming an aversive tastant from the fur was associated with increased blood levels of corticosteroids which are believed to stimulate grooming in rodents. Thus grooming results in the reception of the aversive tastant, and perception of the aversive tastant results in more grooming and so on.

Grooming was used as the means of delivering poisonous tracking dusts or powders (Howard and Marsh, 1974; and Partt et al., 1977), and was also used for delivering rodenticides in the form of grease/poison, and used motor oil/poison formulations (Fiedler, 1979, 1980, and 1983; and Poché et al., 1979). However, the techniques are still developmental. The present study aims to develop and quantify a technique for contaminating the fur of rats and mice with a gel/toxicant formulation consisting of zinc phosphide or brodifacoum mixed with molasses gel in different lethal concentrations. It is supposed, however, that these rodenticides could be consumed either by direct ingestion, by grooming

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the fur which is contaminated with the poison or both. Zinc phosphide is an acute poison, and brodifacoum is an anticoagulant which has a single-feeding action at low concentrations. In contrast to acute rodenticides, symptoms of brodifacoum poisoning are delayed and no bait shyness is observed (Kaukeinen, 1982).

MATERIALS AND METHODS

This study was conducted in two stages; laboratory bioassay cage tests, and simulated grain storage tests. Laboratory tests were completed first on Wistar rats and Swiss Webster mice. Simulated grain storage tests were then conducted on wild rats and mice. Molasses gel, which is a mixture of molasses, wheat flour, glycerin, and margarine, was selected as a gel contaminant. It had proved to be an inexpensive material, and readily accepted by both albino rats and mice and wild house mice (Soliman, 1988). Two rodenticides were chosen; Zinc phosphide as an acute poison, and the anticoagulant brodifacoum.

Cage Tests :

Studies were conducted on individually caged albino rats and mice (ten males and ten females in each step) to determine the appropriate concentration of both rodenticides in molasses gel which would result in the highest mortality rate. Rat cages were 33 cm x 17.5 cm x 17.5 cm, and mouse cages were 24cm x 17.5 cm x 17.5 cm. Animals were maintained on Purina Laboratory Chow #5001 and water ad libitum.

The average amounts of plain molasses gel removed by individual rats and mice per day were determined first (Soliman, 1988). The concentration of the rodenticide in molasses gel was based on the mean daily amounts of gel removed by individual rodents and on the average body weights by sex. Two concentrations of each rodenticide were tested; an exploratory concentration which equaled four times the LD₅₀ expressed as mg/test individual and a check concentration. The mortality rate obtained after applying the exploratory concentration determined the concentration of each chemical (whether higher than or lower than the exploratory concentration) in check tests.

The gel/toxicant was applied to the outer surfaces of the plastic tubes of the cage dispensing devices (Soliman, 1988), and each device was weighed to the nearest 0.1 g, and hung in a test cage. The dispensing devices were removed 24 h later and weighed to determine the amount of formulation removed. Rats and mice were observed for 14 days after gel/poison application, and mortalities were recorded. At the end of the 14 day period survivors were euthanized using carbon dioxide. All individuals were weighed after mortality or euthanization.

Simulated Grain Storage Studies:

The results obtained from the cage tests were evaluated under simulated grain storage conditions using wild rodents. When possible, 3 males and 10 females of wild Norway rats, and 5 males and 15 females of wild house mice, were established in separate rooms. Each room was approximately 5 m x 4m, with a tight door, and it was illuminated only during animal care and data collections.

Individual rats and mice were weighed to the nearest 0.1 g just before release into the rooms. Sixteen large cardboard boxes (60 cm x 30 cm x 30 cm) each with a 5 cm hole at one of the lower corners, and furnished with bedding for harborage and nesting were set in the rat room. Boxes were set along the walls of the room with the holes directed to the center of the room. Thirty small cardboard boxes (9 cm x 9 cm x 9 cm) were similarly prepared and put in the mice room. Each room was provided with a heater and a thermometer. Two large wheat bags (22.5 kg) were put on a wooden pallet, about 10 cm off the floor at the center of each room. A bottle filled with drinking water was put in each room.

Wild rodents were acclimated for two weeks in each room. During this period, the stability of the population was observed and dead individuals were replaced by others of the same sex. After this two-week period, plain molasses gel, applied to the inside of plastic tubes and soft drink cans to rats and mice, respectively, was provided for three nights. The average amounts removed by individual rodents were calculated. Molasses gel/toxicant formulations were then applied to ten plastic tubes and ten cans, and each was then weighed to the nearest 0.1 g. The tubes and cans were evenly distributed in the rat and mouse rooms, respectively, around the wall and the wooden pallet in the center of each room. The tubes and cans were set for 3-7 nights, after which they were removed, weighed, and the amount of the gel/toxicant removed was determined. Rats and mice were maintained on wheat grains and water and were observed for two weeks and mortalities were recorded. At the end of the two-week period survivors were euthanized with carbon dioxide and the rooms were cleaned and disinfected.

RESULTS

1. Cage Tests:

In all cage tests plain molasses gel was first provided to individual caged animals for one day. The next day the toxicant/molasses gel was provided to these caged animals.

1. Zinc phosphide/molasses gel application:

a. Exploratory tests:

In this test calculations were made to give both rats and mice an amount of zinc phosphide equivalent to 4 times LD_{50} expressed as mg zinc phosphide/individual (Table 1). Rodents were supposed to take the gel/toxicant formulation containing this amount either by contact, by direct consumption or both. In this test it was assumed that the mean actual amount of molasses gel consumed by individual animals per day equals 50% of the mean amount estimated.

The mortality rate among albino rats was 100% in both sexes. The mean amounts of zinc phosphide ingested were 5.6 LD_{50} and 4.5 LD_{50} by male and female rats, respectively. The mortality rate among mice was much lower. It was 30% and 40% for males and females, respectively. The mean amounts of zinc phosphide ingested were 5.8 LD_{50} and 4.7 LD_{50} for males and females, respectively. It is worthy to mention here that observations indicated that all the weight loss of the gel/toxicant provided to rats and mice was supposedly due to ingestion by test animals (Table 2).

b. Check tests:

In exploratory tests the mortality rate among rats was 100% in both sexes, so the concentration of zinc phosphide in molasses gel was decreased in check tests. In this test it was estimated that each rat would ingest an amount equivalent to 3 LD_{50} of zinc phosphide expressed as mg zinc phosphide/individual (Table 3). In case of mice the mortality rate in exploratory tests was 30% and 40% among males and females, respectively. The concentration of zinc phosphide in molasses gel was therefore increased for mice in check tests to be 5 LD_{50} expressed as mg zinc phosphide/individual (Table 3). The assumed amounts of the gel consumed by individual rats and mice per day was 75% of the total amount estimated per day, not 50% as assumed before in exploratory tests. In other words, rats and mice were assumed to consume more amounts of molasses gel than assumed in exploratory tests (this assumption is based on observations made during exploratory tests). The increased amount of zinc phosphide provided to mice in this test was, therefore, mixed with an increased amount of molasses gel. This resulted in the decrease of the concentration of zinc phosphide from 9.3 and 7.3 mg zinc phosphide/g molasses gel in exploratory tests to 8.3 and 5.9 mg/g in check tests in case of male and female mice, respectively (Tables 1 and 3). For this reason this test was conducted again on caged wild mice. In this latter test it was estimated that wild mice would ingest 10 LD_{50} expressed as mg/individual (Table 3).

In check tests the mortality rate among rats decreased to 90% and 70% for males and females, respectively, after decreasing the concentration of zinc phosphide in molasses gel from 44 mg/g and 35 mg/g in exploratory tests to 22 and 17.5 mg/g in check tests in case of males and females, respectively. All mortalities were recorded after less than 24 h of applying the toxicant/gel formulation except for one female which died after 3 days. The mean amounts of zinc phosphide ingested were 2.8 LD₅₀ for both sexes. For albino mice there was not much difference in the rate of mortality, which was 30% for both sexes. The mean amounts of zinc phosphide ingested were 5.6 LD₅₀ and 4.4 LD₅₀ by males and females, respectively. For caged wild mice it was estimated that mice would ingest 10 LD₅₀ expressed as mg/individual (Table 3), the mortality was much higher (80% among both sexes). However, the mean amounts of zinc phosphide actually ingested were 3.7 LD₅₀ and 4.7 LD₅₀ by males and females, respectively (Table 4).

2. Molasses gel/brodifacoum application:

a. Exploratory tests:

In these exploratory tests it was estimated that both individual albino rats and mice would consume brodifacoum/molasses gel formulation in amounts containing 4 LD₅₀ of brodifacoum expressed as mg/individual (Table 1).

The mortality rate among albino rats was 100% for both sexes. The mean amounts of brodifacoum ingested by individual animals were 5.5 LD₅₀ and 5.8 LD₅₀ by males and females, respectively. The mortality rate among albino mice were 90% and 100% for males and females, respectively. The mean amounts of brodifacoum ingested by individual mice were 7.1 LD₅₀ and 8.2 LD₅₀ by males and females, respectively (Table 2).

b. Check tests:

In the previous test the mortality rate was 100% among rats. In the check test the concentration of brodifacoum in molasses gel was decreased. Calculations were made on the basis that individual rats would ingest 3 LD₅₀ of brodifacoum expressed as mg/individual. For mice the concentration of brodifacoum was increased so that mice would ingest 5 LD₅₀ of the anticoagulant (Table 3).

The mortality rate among albino rats was 80% and 90% for males and females, respectively. Individual animals ingested mean amounts of brodifacoum equivalent to 3.2 LD₅₀ and 3.5 LD₅₀ by males and females, respectively (Table 4). The mortality rate among mice was 90% and 100% for males and females, respectively. The mean amounts of brodifacoum ingested by individual males and females were 6.8 LD₅₀ and 6.2 LD₅₀, respectively (Table 4). The decrease of the concentration of

brodifacoum from 0.085 to 0.070 mg/g for rats resulted in a decreased rate of mortality, while the increase of the concentration of brodifacoum from 0.030 to 0.040 mg/g in case of male mice did not increase the mortality rate.

II. Simulated Grain Storage Studies:

Simulated field studies were conducted on wild rats and mice under conditions similar to those of grain stores. The concentration of the poison in the molasses gel was chosen on the basis of the results obtained from cage tests.

1. Zinc phosphide/molasses gel application:

In this test the concentration of zinc phosphide in the gel was calculated on the basis that each individual rat would ingest an amount of the poison equivalent to 4 times LD_{50} and each individual mouse would ingest an amount equivalent to 8 times LD_{50} (Table 5).

The mortality rates were 46% and 90% among rats and mice, respectively (Table 6). Rats did not readily remove the toxicant/gel from the tubes.

2. Brodifacoum/molasses gel application:

The concentration of brodifacoum in the gel was similarly determined on the basis of the results of the cage tests. Calculations were made on the basis that individual rats would ingest an amount of the poison equivalent to 4 LD_{50} and individual mice would ingest an amount equivalent to 5 LD_{50} (Table 5).

The results were encouraging in case of mice, since the mortality rate among them was 100%. In case of rats mortality rate was only 30%. Rats did not show signs of active removal of the toxicant/gel formulation.

DISCUSSION

In this study, two rodenticides were used, zinc phosphide as an acute poison, and the anticoagulant brodifacoum. In spite of the evidence of a somewhat increased tolerance in some commensal rodents, brodifacoum still should be considered a highly effective rodenticide against almost all important rodent pests (Lund, 1984). When used in baits, it either produces 100% mortality among Norway rats and house mice (Meehan, 1984) or greatly reduces their number (Dubock and Kaukeinen, 1978). Both zinc phosphide and brodifacoum

Table 1. Calculations for an exploratory concentration of zinc phosphide and brodifacoum in molasses gel applied to albino rats and mice. The mean is followed by \pm S.D. and the range in (parentheses).

	Zinc phosphide				Brodifacoum			
	Albino rats		Albino mice		Albino rats		Albino mice	
	Males	Females	Males	Females	Males	Females	Males	Females
- LD ₅₀ (mg/kg)	40.5	40.5	40.0	40.0	0.26	0.40	0.40	0.40
- Mean body weight (g)	217.2 \pm 12.5 (196.9 - 233.6)	173.4 \pm 7.1 (167.5 - 190.5)	26.4 \pm 1.5 (24.5 - 28.8)	26.2 \pm 1.7 (24.0 - 29.2)	171.4 \pm 15.6 (129.6 - 188.0)	161.0 \pm 6.8 (149.0 - 166.2)	24.3 \pm 2.6 (20.7 - 29.0)	21.9 \pm 1.4
- LD ₅₀ (mg/individual)	8.80	7.00	1.05	1.04	0.044	0.041	0.009	0.008
- 4 LD ₅₀ (mg/individual)	35.20	28.00	4.20	4.16	0.178	0.167	0.038	0.035
- Daily consumption of molasses gel (g/individual)	1.6	1.6	0.90	1.15	2.5	2.4	1.6	1.3
- 50% daily consumption (g/individual)	0.8	0.8	0.45	0.57	-	-	-	-
- 80% daily consumption (g/individual)	-	-	-	-	2.0	1.9	1.3	1.0
- Concentration of zinc phosphide in molasses gel (mg/g)	44	35	9.3	7.3	-	-	-	-
- Concentration of brodifacoum in molasses gel (mg/g)	-	-	-	-	0.089*	0.088*	0.029**	0.035**

* The actual concentration used in case of both sexes is 0.085 mg/g.
 ** The actual concentration used in case of both sexes is 0.030 mg/g.

Table 2. Results of zinc phosphide/ and brodifacoum/molasses gel application to albino rats and mice in exploratory tests. The mean is followed by \pm S.D. and the range in (parentheses).

	Zinc phosphide				Brodifacoum			
	Albino rats		Albino mice		Albino rats		Albino mice	
	Males	Females	Males	Females	Males	Females	Males	Females
- Number of individuals	10	10	10	10	10	10	10	10
- Average toxicant/gel consumption (g/individual)	1.1 \pm 0.42 (0.78 - 1.73)	0.9 \pm 0.34 (0.34 - 1.17)	0.66 \pm 0.23 (0.30 - 0.96)	0.66 \pm 0.24 (0.33 - 1.19)	2.8 \pm 1.02 (1.0 - 4.3)	2.8 \pm 0.83 (1.4 - 3.9)	2.3 \pm 0.21 (2.0 - 2.4)	2.4 \pm 0.29 (2.0 - 2.8)
- Mean amount of brodifacoum ingested (X LD ₅₀)	5.6 \pm 2.0 (2.4 - 8.2)	4.5 \pm 1.7 (1.7 - 7.0)	5.8 \pm 2.0 (2.6 - 7.7)	4.7 \pm 1.8 (2.4 - 9.0)	5.5 \pm 2.1 (2.0 - 8.5)	5.8 \pm 1.6 (3.1 - 7.9)	7.1 \pm 1.3 (5.3 - 9.8)	8.2 \pm 1.1 (7.5 - 10.3)
- Percentage mortality	100	100	30	40	100	100	90	100
- Longevity after application	< 17h	< 17h	< 24h	< 24h	4 - 7 days	4 - 9 days	4 - 12 days	5 - 9 days

Table 3. Calculations for an affirmative concentration of zinc phosphide and brodifacoum in molasses gel applied to albino rats and mice and to wild mice. The mean is followed by \pm S.D. and the range in (parentheses).

	Zinc phosphide						Brodifacoum			
	Albino rats		Albino mice		Wild mice		Albino rats		Albino mice	
	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
- LD ₅₀ (mg/kg)	40.5	40.5	40.0	40.0	40.0	40.0	0.26 (0.20-0.37)	0.40	0.40	0.40
- Mean body weight (g)	217.2 \pm 12.5 (196.9 - 233.6)	173.4 \pm 7.1 (167.5 - 190.5)	280 \pm 2.13 (27.5 - 31.2)	25.6 \pm 2.2 (23.1 - 28.4)	18.3 \pm 2.1 (14.4 - 21.2)	17.1 \pm 2.6 (13.0 - 20.8)	141.7 \pm 8.8 (127.0 - 155.4)	139.0 \pm 11.4 (123.6 - 151.6)	21.9 \pm 0.9 (21.0 - 22.8)	20.2 \pm 1.2 (17.8 - 22.0)
- LD ₅₀ (mg/individual)	8.80	7.00	1.12	1.02	0.73	0.68	0.037	0.036	0.009	0.008
- 3 LD ₅₀ (mg/individual)	26.4	21.0	-	-	-	-	0.111	0.108	-	-
- 5 LD ₅₀ (mg/individual)	-	-	5.6	5.1	-	-	-	-	0.045	0.040
- 10 LD ₅₀ (mg/individual)	-	-	-	-	7.3	6.8	-	-	-	-
- Daily consumption of molasses gel (g/individual)	1.6	1.6	0.9	1.1	1.3	1.3	2.0	2.1	1.3	1.7
- 75% daily consumption (g/individual)	1.2	1.2	0.67	0.86	0.97	0.97	-	-	-	-
- 80% daily consumption (g/individual)	-	-	-	-	-	-	1.6	1.7	1.0	1.3
- concentration of zinc phosphide in molasses gel (mg/g)	22.0	17.5	8.35	5.93	7.54	7.05	-	-	-	-
- concentration of brodifacoum in molasses gel (mg/g)	-	-	-	-	-	-	0.069**	0.063**	0.045	0.030

* The mean body weight is the same as that in exploratory tests.
 ** The actual concentration in case of both sexes is 0.070 mg/g.

Table 4. Results of zinc phosphide/ and brodifacoum/molasses gel application to albino rats and mice and to wild mice in affirmative tests. The mean is followed by \pm S.D. and the range in (parentheses).

	Zinc phosphide						Brodifacoum			
	Albino rats		Albino mice		wild mice		Albino rats		Albino mice	
	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
- Number of individuals	10	10	10	10	10	10	10	10	10	10
- Average toxicant/gel consumption (g)	1.3 \pm 0.4 (0.7 - 1.5)	1.2 \pm 0.7 (0.4 - 2.3)	0.8 \pm 0.2 (0.5 - 1.0)	0.8 \pm 0.2 (0.6 - 1.0)	0.4 \pm 0.2 (0.1 - 0.6)	0.5 \pm 0.2 (0.3 - 0.8)	1.7 \pm 0.84 (0.7 - 3.1)	1.7 \pm 0.59 (0.9 - 2.8)	1.5 \pm 0.25 (1.2 - 1.9)	1.6 \pm 0.31 (1.2 - 2.2)
- Mean amount ingested (X LD ₅₀)	2.8 \pm 0.8 (1.6 - 4.1)	2.7 \pm 1.6 (1.1 - 5.0)	5.5 \pm 1.1 (3.8 - 7.7)	4.4 \pm 1.3 (2.8 - 6.4)	3.7 \pm 1.7 (0.8 - 6.5)	4.7 \pm 1.4 (2.8 - 7.9)	3.2 \pm 1.5 (0.5 - 5.4)	3.5 \pm 1.3 (1.6 - 5.7)	6.8 \pm 1.2 (5.5 - 9.0)	6.2 \pm 1.1 (4.6 - 8.0)
- Percentage mortality	90	70	30	30	80	80	80	90	90	100
- Longevity after application	1 day	1 - 3 days	1 day	2 days	1 - 3 days	1 - 3 days	4-10 days	4-13 days	4 - 8 days	4-13 days

Table 5. Calculations for zinc phosphide and brodifacoum in molasses gel applied to wild rats and mice in simulated field studies.

	Zinc phosphide		brodifacoum	
	Wild rats (males and females)	Wild mice (males and females)	Wild rats (males and females)	Wild mice (males and females)
- LD ₅₀ (mg/kg)	40.5	40	0.26(0.20 - 0.37)	0.40
- Mean body weight (g)	257.6	17.5	229.3	19.1
- LD ₅₀ (mg/individual)	10.43	0.69	0.078	0.007
- 4 LD ₅₀ (mg/individual)	41.72	-	0.312	-
- 8 LD ₅₀ (mg/individual)	-	5.52	-	-
- 5 LD ₅₀ (mg/individual)	-	-	-	0.035
- Daily consumption of molasses gel (g/individual)	6.0	1.6	5.9	1.2
- 80% daily consumption (g/individual)	4.8	1.3	4.7	1.0
- concentration of zinc phosphide in molasses gel (mg/g)	8.76	4.21	-	-
- concentration of brodifacoum in molasses gel (mg/g)	-	-	0.066	0.035

Table 6. Results of zinc phosphide, and brodifacoum/molasses gel application to wild rats and mice in simulated field studies.

Species	Strain	No.		Toxicant	Concentration (mg tox/g gel)	Mean tox/gel consumption (g/indiv.)	Mortality		Percentage mortality	Longevity after application (days)
		M	F				M	F		
R. norvegicus	Wild	1	12	Zn ₃ P ₂	8.78	1.5	1	5	46	one day
M. musculus	Wild	4	16	Zn ₃ P ₂	4.21	0.6	3	15	90	1-3
R. norvegicus	Wild	3	10	Brod.	0.068	1.8	1	3	30.7	3-7
M. musculus	Wild	6	14	Brod.	0.035	2.5	6	14	100	3-6

were given to cage animals for only one night. Plain molasses gel was first provided for one night as a prebait to make animals more readily remove the toxicant/gel formulations. Prebaiting is used with ordinary baits to reduce zinc phosphide shyness in field as well as commensal rodents (Bhardwaj and Prakash, 1982).

Tables 2 and 4 give figures for the mean amounts of the gel/toxicant removed by individual rats and mice, the mean amounts of the poisons ingested by individual cage animals in terms of LD₅₀/individual, as well as the percentage mortality among test animals. It is calculated from tables 1 – 4 that 100% mortality among male and female albino rats was produced when individual animals ingested 49.3 mg and 31.5 mg zinc phosphide, respectively. For albino mice 30% and 40% mortalities were produced among males and females when individual mice ingested 6.0 mg and 4.9 mg zinc phosphide, respectively. Ingestion of 2.7 mg and 3.2 mg by male and female wild house mice, respectively, produced 80% mortality among them. It is noticed that wild mice, compared to albino mice, are more sensitive to zinc phosphide, since lesser amounts of the poison produce higher mortality rates among them. It is also noticed that rats and mice removed lesser amounts of zinc phosphide/gel formulation than of plain molasses gel indicating that zinc phosphide reduces the acceptability of molasses gel by albino rats and mice and by wild mice when mixed in the given concentrations (Tables 1 – 4).

Regarding the mean amounts of brodifacoum ingested by individual cage animals it is calculated from tables 1 – 4 that 100% mortality was produced among both sexes of albino rats when individual animals ingested 0.24 mg brodifacoum. Ingestion of 0.06 mg brodifacoum by individual albino mice produced 90% and 100% mortalities among males and females, respectively. According to Chmela and Rupes (1980), lower amounts of brodifacoum produced 100% mortality when given in oat baits to caged Norway rats (0.13 mg/individual) and house mice (0.051 – 0.142 mg/individual).

In simulated grain storage tests, plastic tubes and aluminum soft drink cans were used as dispensing devices (gel stations) for the poison/gel formulations. The use of such simple devices in field situations reduces the hazards of rodenticide use. These gel stations keep the poison away from the reach of people and non – target vertebrate animals.

In simulated storage studies, the ingestion of zinc phosphide in 13.1 mg by individual rats and 2.5 mg by individual mice produced 46% and 90% mortalities among them, respectively (Tables 5 and 6). In case of brodifacoum, ingestion of 0.11 mg by individual rats and 0.08 mg by individual mice produced 30.7% and 100% mortalities among them,

respectively (Table 6). In case of house mice, the results of simulated field tests could be compared with those of cage tests. The low mortality rate among Norway rats is attributed to a low removal of the toxicant/gel formulation from the plastic tubes. More laboratory studies should be done to improve the technique for rats.

SUMMARY

One method under development for the control of rodent pests is to contaminate their fur with a suitable substance containing the rodenticide. Since most rodents groom foreign substances contaminating their fur, they would then ingest the poison during grooming. Two rodenticides were used here; zinc phosphide as an acute poison, and the anticoagulant brodifacoum. Both rodenticides were mixed with molasses gel at different concentrations. The toxicant/gel was provided to rats and mice in two stages; cage tests and simulated grain storage tests. The mortality rate was high among cage animals. In simulated field tests the mortality rate was only high among wild mice. Results with wild rats were not encouraging.

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