House Rat | BAITS

SUSCEPTIBILITY OF HOUSE RAT, *Rattus rattus* LINNEAOUS AGAINST DIFETHIALONE TREATED BAITS IN LABORATORY

VIPIN CHAUDHARY AND R. S. TRIPATHI

AICRP on Rodent Control, Central Arid Zone Research Institute, Jodhpur-342 003, Rajasthan, INDIA.

ABSTRACT

The house rat *Rattus rattus* is one of the most important vertebrate pests constituting about 70-75 per cent of the rodents in houses and godowns. It inflicts heavy losses to stored food grains, storage structures, gunny bags, cloths and utensils besides contaminating the food. Difethialone, a second-generation anticoagulant rodenticide was extensively evaluated in laboratory for its management.

Three concentrations of difethialone, *viz.*, 0.00125, 0.0025 and 0.005 per cent were evaluated for three exposure (one, two, three days) periods under choice and no-choice condition. In no-choice test single day exposure yielded cent per cent mortality of the test rodents at 0.0025 and 0.005% conc. within 3-10 and 2-9 days, respectively, whereas, increase in feeding period (2 and 3 days) reduced the mean days to death (4.40-5.40 days).

In choice test the consumption of plain and poison bait was at par for all the three-test concentration and exposure periods. At the lower test concentration (0.00125%), the mortality after 1, 2 and 3 days feeding on poison bait was 50, 80 and 90 per cent, however, at 0.0025 and 0.005% concentration, 80% of the test animals succumbed to the anticoagulant in a single day exposure. Thus, the present findings proved that difethialone is a fairly palatable and a potent rodenticide for the control of house rat.

KEY WORDS: R. rattus, Difethialone, Choice and No-choice Tests, Anticoagulants, Rodenticides.

INTRODUCTION

THE HOUSE RAT *Rattus rattus* Linneaous is widely distributed in India and is one of the most important vertebrate pests and constitutes about 70-75 per cent of the rodents in houses and godowns. In recent years it has been reported from crop fields and fruit orchards in arid regions too (Tripathi *et al.*, 2002).

This rodent inflicts heavy losses to stored food grains, storage structures, gunny bags, cloths and utensils besides contaminating the food. Therefore, control of such a dreadful pest is warranted to optimize the food production and protect the human health.

In India control of these tiny vertebrate pests has been largely dependent on the use of acute rodenticides, *viz.*, zinc phosphide. However its use in indoor habitats is not advisable due to high toxicity to non-targets. The development of bait shyness and poison aversion in rodents towards acute rodenticides further limits its applicability.

Among second-generation anticoagulants only bromadiolone is registered by CIB for public use. Therefore, search for more improved alternative rodenticides *vis-a-vis* screening their bio-efficacy is considered to be of paramount importance. Most of the second-generation rodenticides discovered so far have been studied against this species (Jain, 1980; Mathur and Prakash, 1981a&b; Chopra and Parshad, 1985 and Jain *et al.*, 1992) but little information is available pertaining to the acceptability and toxicity of difethialone against *R. rattus* in an arid ecosystem.

Table 1

Consumption of difethialone treated baits and mortality pattern in house rats *R. rattus* under no-choice test

S. No.	Conc. (per cent)	Feeding period	Mean body weight Mean ± SE	Poison consumption g/100 g body weight Mean ± SE	Anticoagulant consumed (mg/kg) Mean ± SE	Mortality	Days to death	
							Mean ± SE	Range
1.	0.00125	One	90.25 ± 8.57	7.09 ± 0.29	0.89 ± 0.14	8/10	5.38 ± 0.62	3-9
2.		Two	106.67 ± 4.63	10.44 ± 0.24	1.31 ± 0.03	9/10	8.12 ± 1.58	3-16
3.		Three	102.70 ± 3.54	12.40 ± 0.46	1.58 ± 0.05	10/10	8.50 ± 1.87	3-20
1.	0.0025	One	126.70 ± 5.38	5.94 ± 0.44	1.49 ± 0.14	10/10	5.94 ± 1.97	3-10
2.		Two	110.40 ± 3.34	7.60 ± 0.22	1.90 ± 0.05	10/10	4.60 ± 0.45	3-8
3.		Three	110.20 ± 3.34	8.40 ± 0.57	2.10 ± 0.06	10/10	5.30 ± 0.52	2-7
1.	0.005	One	111.00 ± 3.88	7.64 ± 0.37	3.82 ± 0.18	10/10	5.20 ± 0.51	2-9
2.		Two	114.70 ± 4.80	8.31 ± 0.38	4.15 ± 0.20	10/10	5.40 ± 0.56	3-8
3.		Three	107.90 ± 4.51	9.32 ± 0.58	4.66 ± 0.19	10/10	4.40 ± 0.50	2-7

The present study describes the bio-efficacy of difethialone against *R. rattus* at different concentrations and feeding periods.

MATERIAL AND METHODS

(i) The test animals: The rats were captured from houses and godowns in Jodhpur (Lat. $26^0$18'N Long. $73^0$01'E). They were individually caged and acclimatised for two weeks on whole grains of bajra (*Pennisetum typhoides*). Tap water was available to the stocked and experimental rodents *ad libitum*. Ten healthy adult rodents were selected for each set of experiments as per the guidelines of European Plant Protection Organisation (Mathys, 1975).

(ii) The test rodenticide, dosages and exposure periods: In the no-choice test experimental rodents were offered poisoned food only for different study (one, two and three days) periods. Three concentrations of difethialone *viz.*, 0.00125, 0.0025, 0.005 per cent were evaluated for their toxicity to house rats after varying exposure periods.

In the choice test an alternative un-poisoned bait (same food in which poison was provided) was also offered to test animals in a separate container along with poison bait. The position of containers of plain and poison bait was altered every day to overcome place preference, if any. The trial was conducted for the three feeding periods (1, 2 and 3 days) and three dosages (0.00125, 0.0025 and 0.005 per cent).

Prior to exposure to different concentration of difethialone under both test conditions daily consumption of plain bait was recorded for three days. On 4th day the test animals were exposed to different concentration for varying periods as per test requirement. Consumption of bait was measured daily and was replenished with freshly prepared bait. Data on bait consumption during exposure of poison bait, plain bait (pre and post treatment), per cent mortality and days to death were recorded and were subjected to various statistical treatments for deriving inferences.

RESULTS AND DISCUSSION

Since no significant difference in consumption of poison bait and mortality pattern was noticed between the sexes, the data for both sexes were pooled and analysed. Under no-choice test, single day exposure of difethialone at 0.0025 and 0.005 per cent provided 100 per cent mortality of the test rats, however, similar results could be achieved after three days exposure of difethialone at 0.00125 per cent. As expected two and three day exposure of test animals at 0.0025 and 0.005 per cent of anticoagulant rodenticide yielded 100 per cent mortality in relatively reduced period of time as compared to respective concentrations after one day exposure.

Under one-day feeding trial the consumption of poison bait ranged between 5.94-7.64g/100g body weights, which recorded an upward trend when exposure period was increased to 2 and 3 days respectively. Maximum intake of 12.40g/100g

Table 2

Acceptability of difethialone treated baits and mortality among house rat, *R. rattus* in choice tests

S. No.	Conc. (per cent)	Feeding period	Mean daily bait intake (g/100 g body weight) Mean ± SE		Significance of student 't' between	Mortality	Days to death	
			Poison (1)	Plain (2)	1 & 2		Mean ± SE	Range
1.	0.00125	One	5.39 ± 0.29	3.08 ± 0.76	> 0.01 (Ns)	5/10	7.80 ± 0.85	5-10
2.		Two	5.21 ± 0.37	6.87 ± 0.60	> 0.01 (Ns)	8/10	8.25 ± 1.23	4-14
3.		Three	7.78 ± 1.01	9.38 ± 0.54	> 0.01 (Ns)	9/10	6.78 ± 1.20	3-14
1.	0.0025	One	3.60 ± 0.34	3.38 ± 0.62	> 0.01 (Ns)	7/10	4.71 ± 0.48	3-10
2.		Two	8.52 ± 0.40	6.67 ± 0.69	> 0.01 (Ns)	9/10	6.23 ± 0.57	4-10
3.		Three	9.26 ± 1.32	6.38 ± 0.66	> 0.01 (Ns)	10/10	4.90 ± 0.66	3-9
1.	0.005	One	7.92 ± 0.77	5.66 ± 0.81	> 0.01 (Ns)	8/10	7.38 ± 0.73	5-12
2.		Two	10.76 ± 1.19	13.12 ± 1.74	> 0.01 (Ns)	9/10	5.78 ± 1.15	3-12
3.		Three	10.82 ± 1.13	13.58 ± 1.33	> 0.01 (Ns)	10/10	6.80 ± 0.89	3-7

was recorded at the lowest test concentration after three days feeding, whereas, it was least 8.40 and 9.32g/100g body weight at 0.0025 and 0.005 per cent concentration, respectively for similar exposure period (Table 1). Mean daily intake of plain bait during post-treatment period decreased sharply for all the individuals. This reduction in mean plain bait consumption might be due to initial sufferings out of toxicosis.

In no-choice condition the death of experimental rats was initiated on 2nd day (with three-day exposure of 0.0025 per cent) and lasted up to 20 days (with 3 day exposure of 0.00125 per cent). At lowest test concentration maximum death period of 3-20 days (Av. 8.5 days) was noticed after 3 day exposure for cent per cent kill, whereas, it was 2-7 days (Av. 5.3) and 2-7 days (Av. 4.4) for 0.0025 and 0.005 per cent concentration, respectively for similar exposure periods (Table 1).

In choice test cent per cent kill of house rats was achieved with 0.0025 and 0.005 per cent concentration only that too after three days of exposure. The lowest test concentration (0.00125 per cent) yielded 90 per cent mortality after three days feeding. As expected, the mortality of test rodents showed increasing trend with increase in exposure periods for all the respective test dosages. However, 2 days exposure with 0.0025 and 0.005 per cent conc. yielded 90 per cent kill of test rodents (Table 2).

Days to death with all the three exposure periods were between 3-14, 3-10 and 3-12 days for 0.00125, 0.0025 and 0.005 per cent concentration respectively. There was no significant difference in mortality and days to death at 0.0025 and 0.005 per cent concentration after three days of exposure. Period for cent per cent mortality, was recorded to be 3-9 days (Av. 4.90) and 3-7 days (Av. 6.80) with 3 days exposure at 0.0025 and 0.005 per cent concentration respectively in choice test which, was almost similar to those observed in no choice test.

The consumption of plain and treated bait varied from 3.08-13.58 and 3.60-10.82 g respectively for various treatments. At 0.0025 per cent the respective data for 1, 2 and 3 days exposure were 3.38 & 3.60, 6.67 & 8.52, and 6.38 & 9.26g/100g body weights (Table 2). This showed that consumption pattern of plain and poison bait were significantly at par for all the respective test concentrations and exposure periods. This evidently indicated that the anticoagulant is fairly well acceptable and palatable to house rats in pearl millet baits.

It was quite apparent that difethialone is one of the most toxic anticoagulant rodenticides against *R. rattus* because single day exposure was sufficient to provide cent per cent kill of test rodents at 0.0025 and 0.005% concentration in no-choice tests. The results corroborate with the findings of Lechevin and Poche (1988), Arora *et al.* (1992), wherein the authors reported over 80% mortality of *R. norvegicus*, *R. rattus* and *Mus musculus*.

The findings suggest that difethialone is a superior rodenticide as compared to other anticoagulant rodenticide against *R. rattus*. Jain (1980) reported cent per cent mortality of *R. rattus*

Table 3

Single dose efficacy of difethialone against *R. rattus* in no choice and choice trials

Trials	Conc. of Poison (per cent)	Average poison bait consumed (g)	Average poison ingested (mg/kg)	Mortality	Average days to death
No-choice	0.00125	7.09±0.29	0.89±0.14	08/10	3-9
	0.0025	5.94±0.44	1.49±0.14	10/10	3-10
	0.005	7.64±0.37	3.82±0.18	10/10	2-9
Choice	0.00125	5.39±0.29	0.70±0.30	05/10	3-14
	0.0025	3.60±0.34	0.90±0.10	07/10	3-9
	0.005	7.92±0.77	3.96±0.39	08/10	2-12

with bromadiolone at (0.005%) whereas, three to four days feeding of (0.0025 and 0.005%) brodifacoum was required to achieve complete kill of *R. rattus* (Mathur and Prakash, 1981a). Jain *et al.*, (1992) reported that flocoumafen bait yielded 80% mortality of *R. rattus* at 0.0025% conc. in choice and no-choice tests and at least 2 days exposure is needed for cent per cent kill. However, at 0.005% one-day exposure yielded 100% mortality of house rats in 3-17 days. Among first generation anticoagulants complete kill of *R. rattus* was achieved only after feeding of chlorophacinone (0.0075%), coumatetralyl (0.0375%) and warfarin and fumarin (0.025%) for 7 days (Prakash & Mathur, 1979 and Mathur and Prakash, 1981b, 1984).

Thus, the present findings proved that pearl millet based difethialone bait is highly effective, fairly acceptable and palatable to house rats at single day exposure (Table 3). Moreover, there was no significant difference in the mortality with two concentrations, *viz.*, 0.0025 and 0.005 per cent, therefore, it is concluded that freshly prepared loose bait of difethialone at 0.0025 per cent could be an ideal bait formulation for containing these rodents. Owning to its lower concentration (0.0025 per cent) showed an edge over other existing second-generation anticoagulant rodenticides *viz.*, bromadiolone, brodifacoum, flocoumafen which are required at 0.005 per cent in bait for similar effect.

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BIBLIOGRAPHY

Arora, K.K., Lal, J., Kumar, V., Ram, B. and Lal, S. 1992. Evaluation of Difethialone (LM-2219) a new anticoagulant rodenticide against house rat *Rattus rattus*. *Rodent Newsletter* 16(4): 10-11.

Chopra, G. and Parshad, V.R. 1985. Efficacy of four anticoagulants (Brodifacoum, Bromadiolone, Coumatetralyl, Warfarin) in controlling the house rat, *Rattus rattus*. *Indian Journal of Agricultural Science* 55(2): 155-158.

Jain, A.P. 1980. Efficacy of supercad (Bromadiolone) against five rodent pests. *Rodent Newsletter* 4: 18.

Jain, A.P., Mathur, M. and Tripathi, R.S. 1992. Bio-efficacy of flocoumafen against major desert rodent pests. *Indian Journal of Plant Protection* 20: 81-85.

Lechevin, J.C. and Poche, R.M. 1988. Activity of LM 2219 (difethialone) a new anticoagulant rodenticide in commensal rodents. *Proc. 13th Vert. Pest Conf.*, Montery, Calif. (Ed. Crabb, A.C. and Marsh, R.E.). pp. 59-63.

Mathur, R.P. and Prakash, I. 1981a. Evaluation of brodifacoum against *Tatera indica, Meriones hurrianae* and *Rattus rattus*. *Journal of Hygine, Cambridge* 87(2): 179-184.

Mathur, R.P. and Prakash, I. 1981b. Comparative efficacy of three anticoagulant rodenticides on desert rodents. *Protection Ecology* 3: 327-331.

Mathur, R.P. and Prakash, I. 1984. Acceptability and toxicity of six anticoagulant rodenticides against Indian rodents. *Proc. Conf. Organ. Practice Vertebrate Pest Control* (Ed. Dubock, A.C.), El-Vetham Hall, Hampshire, England. ICI-PPD. pp. 381-393.

Mathys, G. 1975. Guidelines for the development and biological evaluation of rodenticides. *EPPO Bulletin* 5(1): 50.

Prakash, I. and Mathur, R.P. 1979. Efficacy of chlorophacinone for the control of Indian desert rodents. *Pesticides*, 13(6): 44-46.

Tripathi, R.S., Chaudhary, V. and Rana, B.D. 2002. Infestation pattern of rodent pests in arid production system. *Proc. Regional Workshop on Pest Disease Scenario in arid agri-silvi-horti-pastoral system*. CAZRI, Jodhpur, pp. 17 (Abstract).