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Toxicity and Acceptability of Difethialone Baits Against *Tatera indica* Hardwickei

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Abstract: Indian gerbil, *Tatera indica* is a predominant vertebrate pest of different production systems of arid ecosystem. It inflicts incalculable losses to crops, grasslands, afforestation sites etc. besides being a carrier of plague *bacillus*. Three concentrations of difethialone, viz., 0.00125, 0.0025 and 0.005% were evaluated for three exposure (one, two, three days) under choice and no-choice condition. In no-choice test single day exposure yielded hundred per cent mortality of the test rodents at 0.0025 and 0.005% conc. in 7.90 and 7.10 days, respectively, whereas, increase in feeding period (2 and 3 days) reduced the mean days to death to 4.30 and 5.60 days, respectively. The lowest conc. (0.00125%) yielded 100% mortality after 2 to 3 days exposure with mean days to death 10.1 and 10.0 days, respectively. In choice test the consumption of plain and poison bait was at par for all the three-test concentrations and exposure periods. At the lower test concentration (0.00125%), the mortality after 1, 2 and 3 days feeding on poison bait was 50, 70 and 90%, 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 Indian gerbils.

Key words: Anticoagulant, poison habit, difethiolone, *Tetera indica*, bail shyness.

The Indian gerbil, *Tatera indica* Hardwickei is a predominant rodent pest of different production systems of arid region viz., field crops, grasslands and afforestation sites and is also a carrier of plague *bacillus* (Prakash, 1991). A conventional acute rodenticide, zinc phosphide, has been in use since long for the control of the gerbils. Besides being highly toxic to non-target species zinc phosphide induces bait shyness and poison aversion due to its sublethal consumption by target pests, thereby limiting its usefulness on a sustainable basis (Prakash, 1988). Therefore search for improved and safer alternative rodenticides is considered to be of paramount importance. Among anticoagulants, the first generation rodenticides, viz., warfarin, fumarin, chlorphacinone, etc., could not become popular due to their multidose requirement for being effective against target rodents. Second generation anticoagulants like bromadiolone, brodifacoum and flocoumafen have been evaluated extensively against *T. indica* (Jain, 1980; Jain and Tripathi, 1988; Jain *et al.*, 1992), but information on the acceptability and toxicity of difethialone baits towards *T. indica* is lacking. The present study attempts to establish the bioefficacy of difethialone against *T. indica*.

Materials and Methods

Indian gerbils were captured from crop fields and grasslands near Jodhpur (Lat.

26°18′N, Long. 73°01′E) and Bikaner (Lat. 28°01′N, Long. 73°18′E) and were caged for two weeks for acclimatization in laboratory. During this period they were provided with whole grains of pearl millet (*Pennisetum glaucum*). Tap water was available to the stocked and experimental rodents *ad libitum*. Ten adult rodents were taken for each set of experiment and only healthy animals were selected for the study. The injured, sick animals and pregnant females were discarded as per the guidelines of European Plant Protection Organisation (Mathys, 1975). Pearl millet is the main staple food and is highly preferred by *T. indica* in baits (Rana *et al.*, 1992). Therefore pearl millet was selected as base for preparing difethialone bait of varying concentrations (0.00125, 0.0025, 0.005%) for the present investigation. The test rodenticide in varying concentration and feeding periods was exposed to experimental gerbils under two conditions.

In no-choice feeding trials, experimental rodents were offered only the poisoned food for different durations (one, two and three days). Three concentrations of difethialone, viz., 0.00125, 0.0025, 0.005% were evaluated. The poison baits were prepared by mixing desired quantity of difethialone master mix (0.125%) in whole pearl millet grains to achieve the desired test concentration (Table 1). In the choice feeding trials an alternative unpoisoned bait was also offered to test animals in a separate container along with poison bait. The position of containers of unpoisoned plain bait and poison bait was altered every day to overcome place preference, if any. The choice test was conducted for all the feeding periods of no-choice test with all the three concentrations of the anticoagulant rodenticide (Table 2). Thus there were three sets concentration-wise and three sets feeding period-wise for both the feeding trials. Prior to exposure to different concentrations of difethialone under both the trials mean daily consumption of plain bait was recorded for 3 days. On the 4th day the test poison was given for varying periods as per the experimental requirements. Consumption of bait was measured daily for 30 days. The dead animals were autopsied for confirmation of anticoagulant poisoning. The symptoms included bleeding through nose, mouth, ear, anus and lesion in liver and kidney and internal haemorrhage.

Data on per cent mortality, mean days to death and ingestion of poison (mg kg^{-1}) was also worked out. In choice test, the data on consumption of plain and poison bait were subjected to student 't' test for comparing the acceptability and palatability of poison bait.

Results and Discussion

Since consumption of poison bait and mortality patterns under no choice and choice tests were significantly different between males and females of the Indian gerbils, the data for both the sexes were pooled and analyzed for drawing various inferences.

Toxicity

Difethialone proved its potency as a rodenticide against *T. indica*. Under no choice, single dose efficacy of the chemical was reflected by 100% mortality of test animals at 0.0025 and 0.005% conc. within 4 to 11 and 4 to 10 days, respectively.

Table 1. Consumption of difethialone treated baits and mortality patterns in Indian gerbils T. indica under no-choice test

Conc. (%)	Feeding period (days)	Body weight (g) (Mean±SE)	Poison consumption g/100 g body wt. (Mean±SE)	Anticoagulant consumed (mg kg^{-1}) (Mean±SE)	Mortality (%)	Days to death	
						Mean±SE	Range
0.00125	One	122.25±10.30	5.52±0.39	0.69±0.05	80	8.88±0.82	7-13
	Two	104.60±11.40	8.12±0.50	1.02±0.02	100	10.10±1.57	4-20
	Three	115.90±4.56	9.98±0.39	1.25±0.05	100	10.00±1.04	3-15
0.00250	One	112.30±6.79	4.50±0.53	1.04±0.16	100	7.90±0.77	4-11
	Two	115.90±6.29	7.83±0.27	1.96±0.06	100	5.60±0.30	3-9
	Three	121.50±3.75	9.52±0.29	2.38±0.07	100	4.90±0.43	3-7
0.00500	One	127.90±4.05	7.29±0.24	3.65±0.11	100	7.50± 0.58	4-10
	Two	105.80±2.54	7.91±0.21	3.96±0.10	100	7.50±0.58	4-8
	Three	105.80±2.54	12.09±0.69	4.90±0.19	100	4.30±0.50	2-7

The lowest test concentration (0.00125%) yielded 100% kill after increasing the exposure period for 2 to 3 days. The mean days of death were 10.1 and 10.0 after 2 and 3 days feeding, respectively. Increased dosages (0.0025 and 0.005%) and feeding periods (2 to 3 days) reduced the mean days to death (4.30 to 5.60 days) with 100% mortality of test gerbils (Table 1).

Acceptability

In choice tests, the consumption of plain and poison baits by *T. indica* did not record any significant difference in all the experiments involving different concentrations and exposure periods (Table 2). This evidently reflects that difethialone bait is fairly acceptable to the test gerbils. The consumption of plain bait, at post-treatment stages too recorded a decreasing trend, which was possibly due to the effect of toxicosis induced by the anticoagulant leading to the death of experimental animals on later days.

Mortality pattern

Mortality of test animals was relatively lower in choice test as compared to no choice. It may be because of the reduced ingestion of poison due to availability of alternate plain food. In choice test, the death of test animal was initiated between 3 to 5 days and lasted up to 14 days after treatment. However, maximum mortality was noticed between 6 to 10 days in all the experimental sets. The median test dosage (0.0025%) recorded mean death periods of 7.4, 6.25 and 5.1 days for 1, 2 and 3 days of exposure, respectively. Overall comparison of the data for single day feeding on poison baits revealed 100% kill of the gerbils at 0.0025 and 0.005% concentration in no-choice and 80%

Table 2. Acceptability of difethialone treated baits and mortality pattern among Indian gerbils, T. Indica in choice tests

Conc. (%)	Feed period (days)	Mean daily bait intake (g/100 g body wt.) Mean±SE		Mortality (%)	Days to death	
		Poison	Plain		Mean±SE	Range
0.00125	One	3.7±0.69	1.27±0.31	50	9.00±1.89	3-13
	Two	5.48±0.50	4.50±1.02	70	6.86±2.11	5-11
	Three	7.20±0.76	4.43±0.92	90	9.00±1.18	4-14
0.00250	One	3.06±0.27	4.60±0.62	80	7.40±1.34	6-11
	Two	4.30±0.70	5.43±0.72	80	6.25±0.53	5-8
	Three	7.91±1.69	7.11±1.33	100	5.10±0.89	3-12
0.00500	One	3.56±0.51	5.78±0.88	80	6.88±0.66	5-11
	Two	6.43±1.18	11.44±1.20	90	5.44±0.90	3-12
	Three	9.95±0.66	15.14±1.51	100	7.00±1.02	3-14

mortality in choice tests (Table 3) proving the single dose efficacy of difethialone.

The results are in conformity with the earlier studies on *T. indica* where Sridhra *et al.* (2000) recorded 100% mortality of *T. indica* by difethialone (0.0025%) at an exposure periods of 24 and 48 hours under choice and no-choice conditions. The authors used rice and roasted groundnut oil as the base for preparing the poison bait.

Bioefficacy trials with difethialone conducted on other field rodents species viz., *Rattus rattus*, *Mus booduga*, *Bandicota bengalensis* and *Meriones hurrianae* are in agreement with present findings on *T. indica* (Kumar *et al.*, 1996; Sheikher and Sood, 2000; Chaudhary *et al.*, 2001).

The finding remains consistent when the toxicity of other anticoagulants was compared against this species. Among first generation anticoagulant rodenticides effective kill of *T. indica* was achieved only after feeding coumatetralyl (0.0375%), chlorophacinone (0.0075%), warfarin (0.025%) and fumarin (0.025%) for more than a week (Mathur and Prakash, 1981). The second-generation anticoagulants have proved relatively more effective in achieving complete kill of Indian gerbils. Jain (1980) and Jain *et al.* (1992) reported that bromadiolone and flocoumafen (0.005%) gave 100% mortality of gerbils after 1 and 2 days feeding in choice and no-choice conditions, whereas, difethialone in the present study yielded similar results at relatively lower concentration of 0.0025%.

Thus the present findings prove that difethialone is a fairly palatable and a potent rodenticide for the control of Indian gerbils. Among different test concentrations no significant difference in the mortality of test rodents was noticed. Therefore, it could be inferred that difethialone bait prepared in pearl millet at 0.0025% concentration is quite effective against the Indian gerbils.

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Table 3. Single dose efficacy of difethialone against T. indica in no choice and choice trials

Trials	Concentration of poison (%)	Mean poison bait consumed (g)	Mean poison ingested (mg kg^{-1} body wt.)	Mortality (%)	Days to death
No-choice	0.00125	5.52±0.39	0.69±0.05	80	7-13
	0.00250	4.50±0.53	1.40±0.16	100	4-11
	0.00500	7.29±0.24	3.65±0.11	100	4-10
Choice	0.001250	3.75±0.69	0.47±0.09	50	3-13
	0.002500	3.06±0.27	0.77±0.06	80	6-11
	0.005000	3.56±0.51	1.78±0.25	80	5-11

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