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Bio-efficacy of difethialone, a second-generation anticoagulant rodenticide, for the control of poison shy rodents

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ABSTRACT

An experiment was conducted during 2002 to evaluate bio-efficacy of difethialone, a second-generation anticoagulant rodenticide, for the control of poison shy rodents. It was found quite effective in the management of poison shy rodents (*Tatera indica* and *Rattus rattus*). A 100% mortality of poison shy *T. indica* and *R. rattus* was recored in reduced time, ie 4.1–4.80 and 3.6–4.4 days, respectively, compared with the control set where 100% mortality of these rodents was achieved in 7.9 and 5.94 days, respectively. Moreover, in both the test species higher intake of zinc phosphide recorded reduced mean days to death after difethialone baiting. The difethialone (0.0025%) baiting can be successfully integrated as a follow-up measure after zinc phosphide treatment for managing the poison shy population of *T. indica* and *R. rattus*.

Keywords: Rodent control, Poison shyness, Residual population, *Tatera indica*, *Rattus rattus*, Anticoagulants, Difethialone, Acute poison

Zinc phosphide has been in use since long as a potent and economical rodenticide for the control of pest rodents in India. Being an acute poison, the death of target animals occurs within few hours of poison intake. However, single exposure of its sublethal dose induces poison shyness among almost all the pest rodents studied in India (Prakash and Jain 1971, Prakash *et al.* 1975, Bhardwaj and Khan 1979, Jain and Tripathi 2000). The persistence of the shyness in rodents is of very high mangnitude. Prakash *et al.* (1975) reported that this behaviour might last for 115 and 75 days in *Tatera indica* and *Rattus rattus* respectively. Such a situation is commonly encountered in fields where zince phosphide baiting is resorted for quick knockdown of rodent pests. The surviving rodents do not accept the zinc phosphide baits on subsequent exposures. Control of these residual populations exhibiting shyness behaviour becomes difficult unless poison as well as bait is changed (Prakash 1988). National Programme on Rodent Pest Management launched by the Government of India had advocated use of aluminium phosphide fumigation as a follow-up action for the control of poison shy residual population of rodents. This fumigant does not hold any promise in arid zone, where moisture is a scarce commodity. Bhardwaj and Prakash (1984) reported that anticoagulants could be exploited successfully for managing the poison shy house rats. Since no such information is available on difethialone, a new second-generation anticoagulant rodenticides, the experiment was conducted to evaluate its efficacy in managing the poison shy rodents, viz *T. indica* and *R. rattus*, the 2 predominant rodent pests in crop fields and commensal sites in, respectively arid areas.

MATERIALS AND METHODS

The indian gerbils, *T. indica* were trapped from crop fields and grasslands near Jodhpur (26°18'N, 73°01'E) and the house rats, *R. rattus* were trapped from residential areas and grain markets of Jodhpur city. Before trapping, it was ensured that the captured rodents had no previous experience of rodenticidal treatments. The trapped animals were acclimatized in laboratory cages individually for 15 days and were fed pearl millet [*Pennisetum glaucum* (L.) R. Br. emend. Stuntz] grain. Tap-water was available to them *ad libitum*. Before initiating the trials, the experimental rodents were provided with measured quantity of food and their daily consumption was recorded for 3 days.

Two sets with 6 rodents each (for both the species separately) were laid to establish the induction of poison-shyness behaviour in *T. indica* and *R. rattus*. For this, the test rodents were exposed to sublethal doses of zinc phosphide (0.01 and 0.05%) in pearl millet flour baits for 24 hr. The phenomenon of shyness was confirmed in both the test species following standard procedures explained by Prakash *et al.* (1975). Simultaneously, another experiment with 10 laboratory-acclimatized animals of both the species were exposed to

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difethialone bait (0.0025%) for 24 hr to confirm the single-dose toxicity of the anticoagulant (Table 1).

For evaluating the bioefficacy of difethialone against poison shy rodents, 2 separate sets of 10 no. acclimatized rodents of both the species were exposed to 2 sublethal doses of zinc phosphide for 1 day. This induced the shyness behaviour in the test rodents. These shy rodents were later exposed to freshly prepared difethialone (0.0025%) in pearl millet baits for 1 day. Data on consumption of poison bait and mortality patterns were noted. For comparison, absolute consumption data of each individual were converted into relative values (g/100 g body weight). Similarly, ingestion of active ingredient of zinc phosphide and difethialone expressed as mg/kg was also worked out (Table 2).

RESULTS AND DISCUSSION

Single-day exposure of zinc phosphide at 0.01 and 0.05% in baits did not result in mortality of any of the test animals (Table 1). The gerbils recorded an ingestion of 4.22 and 19.83 mg/kg ai of zinc phosphide at 0.1 and 0.05% concentrations respectively. Similarly, the house rats too did not succumb to this poison even after consuming 4.98 and 19.77 mg/kg of its active ingredient. These surviving rodents rejected zinc phosphide baits (2.0%) on subsequent days. It confirmed the induction of shyness behaviour in both the species. On the other hand, 1 day exposure of difethialone (0.0025%) baits resulted in 100% mortality of both the test species within 4–11 days (*T. indica*) and 3–10 days (*R. rattus*) (Table 1). These findings are in conformity with those of Bhardwaj and Prakash (1984) where the consumption of zinc phosphide up to 59 mg/kg dosage did not kill *R. rattus* and the rats exhibited poison shyness .

For evaluating the efficacy of difethialone fresh sets of poison shy *T. indica* and *R. rattus* were used. As expected, both the test species survived in spite of ingestion of zinc phosphide to the extent of 4.16 and 18.65 mg/kg (*T. indica*) and 4.90 and 23.11 mg/kg (*R. rattus*), indicating the induction of poison shyness behaviour. All the poison-shy test rodents

Table 1 Intake of sublethal dosages of zinc phosphide and difethialone (0.0025%) and mortality of *Tatera indica* and *Rattus rattus* after 1-day exposure

Rodenticide (%)	Mean body weight (mean ± SE)	Poison intake (g/100 g body weight) (mean ± SE)	Poison consumed (mg/kg) (mean ± SE)	Mortality	Days to death	
					Mean ± SE	Range
Tatera indica						
Zinc phosphide (0.01)	100.67 ± 0.64	4.22 ± 0.23	4.22 ± 0.23	0/6		
Zinc phosphide (0.05)	101.17 ± 2.93	3.96 ± 0.28	19.83 ± 1.42	0/6		
Difethialone (0.0025)	112.3 ± 6.79	4.50 ± 0.53	1.04 ± 0.16	10/10	7.90 ± 0.27	4–11
Rattus rattus						
Zinc phosphide (0.01)	111.0 ± 3.78	4.98 ± 0.19	4.98 ± 0.19	0/6		
Zinc phosphide (0.05)	106.0 ± 2.87	3.86 ± 0.49	19.77 ± 2.08	0/6		
Difethialone (0.0025)	126.7 ± 5.28	5.94 ± 0.44	1.49 ± 0.14	10/10	5.94 ± 1.97	3–10

Table 2 Effectiveness of difethialone (0.0025%) treated baits against zinc phosphide induced poison shy rodents

Exposure of sublethal dosages of zinc phosphide					Control of these survived poison shy rodents by difethialone (0.0025%)				
Mean body weight (Mean ± SE)	Concentration (%)	Poison intake g/100 g body weight (mean ± SE)	Poison consumed (mg/kg) (mean ± SE)	Mortality	Poison intake g/100 g body weight (mean ± SE)	Poison consumed (mg/kg) (mean ± SE)	Mortality	Days to death	
								Mean ± SE	Range
Tatera indica									
112.60 ± 3.75	0.01	4.16 ± 0.13	4.16 ± 0.13	0/10	4.26 ± 0.18	1.05 ± 0.16	10/10	4.80 ± 0.44	3–8
106.30 ± 2.65	0.05	3.73 ± 0.13	18.65 ± 0.63	0/10	4.30 ± 0.16	1.09 ± 0.18	10/10	4.10 ± 0.35	3–6
Rattus rattus									
108 ± 2.89	0.01	4.90 ± 0.18	4.90 ± 0.18	0/10	4.04 ± 0.21	1.01 ± 0.09	10/10	4.40 ± 0.58	2–7
120.80 ± 3.82	0.05	4.62 ± 0.57	23.11 ± 0.81	0/10	3.84 ± 0.70	0.96 ± 0.25	10/10	3.60 ± 0.43	2–6

succumbed to single-day baiting with difethialone (0.0025%). Anticoagulant poisoning of non-shy rodents resulted in 100% mortality of *T. indica* and *R. rattus* in 7.9 and 5.94 days respectively (Table 1), whereas the poison-shy rodents recorded reduced duration of death, ie 4.1–4.80 and 3.6–4.40 days for *T. indica* and *R. rattus*, respectively (Table 2).

Indian gerbils having higher intake of zinc phosphide (18.65 mg/kg) recorded reduced mean days to death (4.10 days) after difethialone baiting than those with lesser intake of acute rodenticide (4.80 days). Similar trends were observed in case of house rats also (Table 2). It was possibly due to the presence of some phosphine in liver and blood of the target animals making them sick, resulting in accelerated rate of prothrombin inhibition after ingestion of difethialone bait. Consequently the time to death might have got reduced. Curry *et al.* (1959) detected the presence of phosphine in the liver of dead rodents. This was further revealed from the present finding also because the rodents consuming more active ingredient of zinc phosphide died earlier after administration of difethialone. Bhardwaj and Prakash (1984) reported similar results with *R. rattus* when they exposed poison shy rats to brodifacoum (0.025%), coumatetralyl (0.025%) and warfarin (0.075%) and found 100% mortality of house rats within 5–6, 6–8 and 13–14 days, respectively.

On the basis of present findings it may be inferred that difethialone (0.0025%) baiting can be successfully integrated as a follow-up measure after zinc phosphide treatment for managing the poison shy population of *T. indica* and *R. rattus*.

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