

## TOXICITY AND FIELD EFFICACY OF BROMADIOLONE AGAINST *RATTUS RATTUS WROUGHTONI* HINTON\*

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### ABSTRACT

The toxicity and field efficacy of bromadiolone, a single dose second generation anti-coagulant rodenticide, was tested against the black rat *Rattus rattus wroughtoni* Hinton. The LD<sub>50</sub> value with 95% confidence limits of this poison to *R. r. wroughtoni* was found to be 0.51 (0.40-0.60) mg/kg body weight. One and two days exposure of rats to bromadiolone baits (0.005%) resulted in 93% and 100% mortality, respectively. The days to death varied from 3 to 20. The rats did not show any aversion to the poison baits. In coconut fields, application of 10g bromadiolone baits, two times, at an interval of 12 days, on the crown of the infested coconut palms completely reduced the rat damage.

### INTRODUCTION

The black rat, *Rattus rattus wroughtoni* Hinton is a predominant rodent pest in coconut and cacao gardens of Kerala (Advani, 1982; Bhat and Sujatha, 1986a). Among the anti-coagulant rodenticides presently available in India for rodent control operations, bromadiolone, a single dose second generation anti-coagulant rodenticide, is reported to be highly toxic and very effective against several rodent pests in India (Jain, 1980; Subaiah and Mathur, 1984) and abroad (Marsh, Howard and Jackson, 1980). In this report, the results on the toxicity of bromadiolone to *R. r. wroughtoni* and the efficacy of this poison in reducing the infestations of this rat on coconut palms are discussed.

### MATERIALS AND METHODS

#### The animal

Live specimens of *R.r.wroughtoni* were trapped from coconut fields near Kasaragod (12°30' N; 75°E) Kerala, where they had no

prior experience of feeding on any poison baits. The animals were brought to the laboratory and caged individually (45x30x25 cm). After acclimatising the rats for the caged conditions for a period of three weeks they were used in the experiment. Only healthy and non-pregnant rats were selected for the study.

#### Acute oral toxicity

Acute oral toxicity tests were conducted using 100% technical grade bromadiolone powder. The poison was dissolved in polyethylene glycol 300 and administered to each animal by oral intubation. Four different doses ranging from 0.25mg/kg to 1.25mg/kg were tried on 12 animals each. Another set of 12 animals was kept as control by administering 0.5 ml of polyethylene glycol without poison. The animals were kept on the laboratory diet and mortality recorded upto 21 days (Anonymous, 1970). The data were subjected to probit analysis (Finney, 1971).

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### Feeding trials

Feeding experiments were carried out with both 'no-choice' and 'choice' tests. The bromadiolone baits (0.005% a.i) were prepared in cake form by mixing bromadiolone with broken rice and paraffin wax (Subaiah and Mishra, 1980). In 'no-choice' tests, only the bromadiolone cakes were provided for one and two days to individually caged animals. In the 'choice' tests both the poisoned and unpoisoned cakes were provided in separate containers for three consecutive days. The position of the containers was changed daily in order to avoid 'position effect' on feeding. In both the experiments water was provided *ad libitum*. The consumption of each cake was recorded daily. After the completion of the experiments, the test animals were maintained on plain food for 21 days and mortality recorded. The symptoms of death were also noted carefully.

### Field efficacy

The field efficacy of bromadiolone against the *R. r. wroughtoni* was evaluated on 45 rat infested coconut palms. Pre-control assessment of damage was done by counting the rat-damaged shed nuts for seven days. On the eighth day one bromadiolone cake (10g)

was kept on the crown of each palm. Post-control assessment of damage was done for another seven days after 12 days of poison baiting. One more baiting was carried out in those palms which still showed rat damage. Another coconut garden (1.5 ha) having rat damage was kept untreated for recording the natural variations in damage.

## RESULTS

### Acute oral toxicity

Table I gives the data on the mortality of *R. r. wroughtoni* different doses of bromadiolone. The LD<sub>50</sub> value with 95% confidence limit was 0.51 (0.40-0.60) mg/kg. Mean days to death varied from 4 to 20 (mean 8.08 days).

### Feeding trials

In no-choice feeding tests (Table II) one day feeding on bromadiolone baits killed 83.3% of the test animals. The quantity of poison intake before death varied from 2.00 to 10.00 mg/kg (mean 6.03 mg/kg). One rat survived a dose of 7.6 mg/kg. Cent per cent mortality in *R. r. wroughtoni* was achieved by two days feeding on bromadiolone baits.

Table I. Toxicity of bromadiolone against *R. r. wroughtoni* (N = 12 in each treatment)

Dose (mg/kg)	Mortality (%)	Days to death	
		mean	range
0.25	0	—	—
0.50	50.0	7.33	4-12
0.75	66.7	8.62	5-17
1.00	91.7	8.45	4-20
1.25	100.0	7.75	4-13
Untreated	0	—	—

In choice-feeding tests (Table III) rats did not show any significant aversion towards bromadiolone mixed baits. Out of the 30 animals used in these experiments, 12 (40%) animals showed a preference for the poisoned baits, 13 (43.3%) animals showed a preference for the plain baits and five (16.7%) animals consumed both the poisoned and plain baits equally. Even when the baits were exposed for three days the preference between the poisoned and plain baits did not deviate from 1:1.

The pooled data on the mortality of test animals are graphically represented in Fig.1. Maximum death was noticed on the fifth day. Out of 116 animals exposed to bromadiolone only four (3.4%) animals took more than 11 days for death.

#### Field efficacy

Among the 45 rat-infested coconut palms baited with bromadiolone cakes, 37 (82.22%) palms did not show any symptom of rat infestation afterwards (Table IV). Even

Table II. No-choice feeding of bromadiolone cakes (0.005%) to *R. r. wroughtoni* ( $N = 30$  in each treatment)

Exposure days	Poison consumed		Mortality (%)	Days to death	
	mean	(mg/kg) range		mean	range
One	6.03	2.0-10.0	93.3	5.28	3-13
Two	11.63	3.4-19.1	100.0	5.80	3-10

Table III. Choice feeding with plain and bromadiolone cakes to *R. r. wroughtoni* ( $N = 10$  in each treatment)

Exposure days	Mean daily bait consumption (g/animal)		Preference (%)			Mortality (%)	Days to death	
	Plain	poison	plain	poison	neither		mean	range
One	3.30	2.30	40.0	40.0	20.0	60.0	7.33	6-11
Two	2.75	3.74	50.0	40.0	10.0	70.0	5.14	5-14
Three	3.85	2.05	40.0	40.0	20.0	100.0	4.12	3-5

Table IV. Percentage of reduction in rat infested coconut palms and damaged tender nuts after bromadiolone baiting

Plot	No. of rat infested palms/tender nuts					
	Pre-control		After 1st baiting		After 2nd baiting	
	Palms	nuts	palms	nuts	palms	nuts
Treated	45	103	8 (82.2)	21 (79.6)	0 (100.0)	0 (100.0)
Untreated	16	47	23	78	22	60

Percentage reduction is shown in parenthesis.

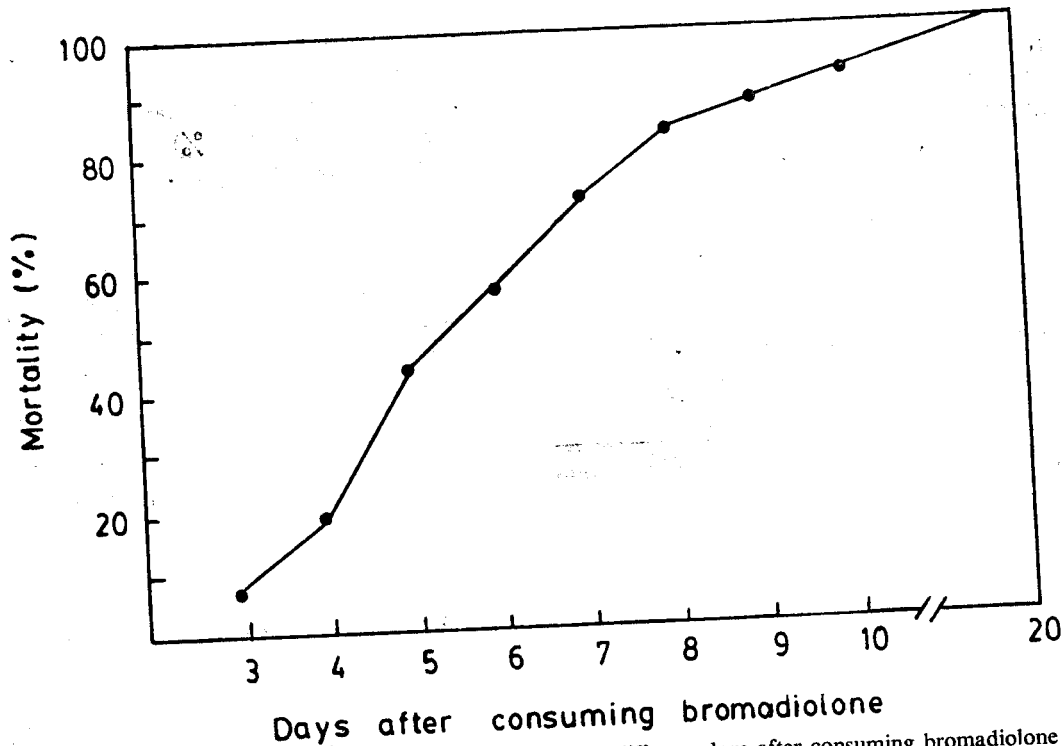


Fig. 1 Cumulative mortality(%) in *R. r. wroughtoni* in different days after consuming bromadiolone baits (N=116).

the adjoining palms were free from rat damage. The total number of damaged nuts was reduced from 103 during pre-control to 21 (79.61% success) during post-control. Such reduction in the damage was not noticed in the untreated plot.

#### DISCUSSION

The results of the present study indicated that bromadiolone is a potent anti-coagulant rodenticide against *R. r. wroughtoni* with a single dose oral LD<sub>50</sub> of 0.51 mg/kg. Compared to the conventional acute rodenticide zinc phosphide, bromadiolone is about seven to eight times more toxic (LD<sub>50</sub> of zinc phosphide to *R. rattus* was 40.1 mg/kg; Prakash and Mathur, 1987). Unlike zinc phosphide the rats did not develop any bait shyness towards bromadiolone mixed baits. Even on the third day of exposure to broma-

diolone baits, *R. r. wroughtoni* did not develop any aversion towards that poison. With zinc phosphide, *R. rattus* developed bait shyness after one exposure itself (Prakash, Rana and Jain, 1975).

The present study also revealed that bromadiolone is much more toxic than the other anticoagulant rodenticides marketed in India, viz, warfarin and fumarin. The lethal feeding periods with warfarin and fumarin for *R. r. wroughtoni* varied from 10 to 12 days (Bhat and Sujatha, 1986b) whereas with bromadiolone the lethal feeding period was only two days.

The results on the no-choice feeding showed that there was considerable variation in the susceptibility of *R. r. wroughtoni* to bromadiolone. One animal survived a dose

of 7.60 mg/kg compared to the lowest lethal dose of 2.00 mg/kg. It could be possible that this animal was inherently more tolerant than the others. Resistance to the conventional anti-coagulant rodenticide such as warfarin was already reported in several countries (Drummond and Rennison, 1973). Hence, prolonged use of bromadiolone might give rise to resistant strain in the years to come.

Mathur and Bhadauria (1985) reported that the success of control operation with bromadiolone baits against the lesser bandicoot, *Bandicota bengalensis* was manifested only 12 days after the poison treatment in sugarcane fields. In a similar experiment with brodifacoum (another single dose slow poison) on rice field rat, *R. argentiventer* Buckle, Rowe and Husin (1982) allowed 10 days' gap between poison treatment and post-treatment assessment of damage. In the present study, more than 76% of *R.r.wroughtoni* died within 12 days of consuming the lethal dose of bromadiolone (Fig 1). Hence, a time gap of 12 days was fixed for the post-control assessment of damage.

The field study with bromadiolone revealed that application of 10 g baits, twice, with a gap of 12 days, on the crown of the infested coconut palms completely reduced the rat damage. In order to achieve similar results in coconut plantations with other anticoagulant rodenticides such as warfarin and fumarin more than 200g of the baits are to be applied in three split doses (Bhat and Sujatha, 1988). Thus application of bromadiolone not only reduced the expenditure on the bait material, but also on the labour.

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