RODENT NEWSLETTER

Vol. 15 1991

ALL INDIA COORDINATED RESEARCH PROJECT
ON RODENT CONTROL

Central Arid Zone Research Institute, Jodhpur

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CENTRAL ARID ZONE RESEARCH INSTITUTE
JODHPUR-342 003

CONTENTS

The mouse in Hindu mythology

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Our ancient scriptures are replete with stories on interrelations between the gods and the animal kingdom. Almost all important birds and animals have found a place in our mythology. Perhaps the most interesting, and astonishing account of these interrelationships concern the tiny mouse which has been regarded as the *vahana* or carrier of the elephant headed Lord Ganesh, the *premier* among all the gods in the Hindu pantheon. There are different versions of the story of the mouse-Ganesh relationship. One of these goes as follows : There used to be a prominent *Gandharva* (a celestial musician/dancer) named Kaunch in the court of Lord Indra, the king of the gods. Once, while hurrying to the court. Kaunch accidentally touched the body of the sage *Vamdev*. This misdemeanor enraged the sage immensely and he cursed the *Gandharva* to be transfromed into a mouse. Kaunch was naturally upset at this prospect and he entreated the sage to revoke his curse. The anger of the sage had somewhat subsided by then and he relented to the extent that the cursed *Gandharva* in his mouse form would have the honour to be the carrier of none but Lord Ganesh himself. We are not sure if this was any consolation to the *Gandharva*. but, the story goes that he assumed a huge mouse form and fell from the heavens into the *ashram* (hermitage) of the sage Parashar. Its violently marauding nature soon created panic among the inmates of the *ashram* and, ultimately, the sage himself decided to abandon his favoured abode of peace. It was then that the sage's son-Gajamukha-literally elephant-faced, and in all probability an incarnation of Lord Ganesh- took upon himself the task of taming the formidable mouse to act as his carrier. Parashar apparently stayed on in his *ashram* and the mouse became subservient to the will of his son.

There is yet another story which narrates a fight between Lord Ganesh and the demon-Gajmukhasur. One of Lord Ganesh's tusks broke in the course of the fight. He used the broken tusk and gave the demon a thorough beating with it. Conceding defeat, the demon tried to flee the battle field in the guise of a mouse. But the all knowing Ganesh captured the mouse and made it serve him as his carrier.

According to Hindu philosophy, *Brahman*, or the ultimate reality, lies hidden in the core of our hearts. It reveals itself only to the eager seekers of eternal bliss. It is the same with the mouse (or, for that matter, most rodents) which mostly remains hidden in its burrow and can be seen after a good deal of effort. The nature of the mouse has, therefore, been considered in our scriptures as similar to that of *Brahman* itself.

Of the several interpretations of the lowly mouse being accepted as the carrier of Lord Ganesh, one that would seem to have some semblance of rationality in the modern context, is the importance that our ancient seers used to place on the bounties of Mother Earth. Food, from harvested food grains, was considered the most vital element for achieving godhead through nourishment of the human body having a yearning soul. Since the mouse typifies the evil forces that tend to destroy food grains, it must have occurred to our ancient seers that the mouse must at all times be kept under control, and hence its depiction as a subdued carrier of Lord Ganesh-the epitome of wisdom.

In this way, since time immemorial, the mouse has remained a part of the spiritual as well as the material facet of the Indian way of life.

Rodent damage in Strawberry

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During a survey conducted in April, 1991, of rodent damage in the mandate crops of C. S. I. R. Complex, Palampur, severe damage was observed in the strawberry crop. The area under strawberry covers 0.43 acres. The extent of damage caused by rodents was recorded to be upto 19.87% in fruits on the basis of examining 468 fruits from 100 randomly selected plants. The number of fruits per plant ranged from 1-9 and the number of damaged fruits per plant ranged from 1-3. The damage was severe on fully ripened and semi ripened fruits.

Efficacy of Difethialone against *Meriones hurrianae* (Jerdon) under no-choice condition

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Laboratory trials were conducted using a newly developed anticoagulant rodenticide, difethialone ($C_{31}H_{23}BrO_2$ S) against *Meriones hurrianae* (Jerdon.) The rodents were caged individually and fed on millet and water ad libitum during acclimatization. Ready to use poison bait containing 0.025% active ingredient in the form of oose bait was offered in no-choice test. The constituents of the bait involved vegetable oil 25 g, garlic chutney - 50 g and broken wheat - 925 g. Findings reveal 100 percent mortality in both the sexes when the bait was exposed for 3 days and the acceptance of the bait was good.

It was observed that the days to death varied from 3 to 5 days in case of males and 7 to 9 days in case of females. The result thus indicates that the males are more susceptible than females (Table 1). Hence difethialone could be a useful rodenticide to kill Indian desert gerbil, a predominant pest in the field.

Table 1. Efficacy of Difethialone (0.025%) against *Meriones hurrianae* (Jerdon) (No-choice feeding test)

Sex	Average body weight (gm)	Exposure period (days)	Mean poison bait intake (gm/kg. b. wt)	Mean active in-radient intake (mg/kg. b. wt.)	Mortality (%)	Days to death Mean	Range
Male	81.66 ± 1.66	3	270.95 ± 24.94	67.75 ± 6.23	100	4.15	3-5
Female	88.33 ± 1.76	3	197.77 ± 21.72	51.74 ± 7.72	100	8.16	7-9

Rodents a serious pest of Groundnut in Gujarat

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Gujarat state experienced a severe rodent outbreak during 1988-90. The groundnut crop was badly affected by rodents in these years. During *kharif* season of 1988-89, 4.45, 6.90 and 7.33 percent rodent damage was recorded at the time of pod development, pod maturity and harvest stage of the crop, respectively. The rodent population was subsequently increased during *rabi*, 1988-89 and summer, 1989 which caused 2.90 to 85.42 per cent damage in summer groundnut. The rodent damage varied from 4.00 to 51.86 percent at the time of germination of the crop in *kharif* 1989-90, whereas it was 7.04 to 14.05 percent in remaining crop growth stages of groundnut in South Saurashtra. The rodent infestation in groundnut also resulted in 9.93 percent crop damage in North Saurashtra and 11.66 per cent damage in Bhal and coastal area of the state during *kharif* 1989-90.

Amongst three major rodent species associated with groundnut crop in Gujarat State, *bandicota Gengalensis kok* was found preoominant one and was followed by *Millardia meltada meltada* and *Tatera indica* during *kharif*, 1988-89 and summer, 1989 in South Saurashtra zone except Junagadh, Mendarda Dhoraji and Upleta taluka of this agroclimatic zone where the predominant species, *B. bengalensis kok* was followed by *T. indica indica* and *M. meltada meltada* during summer 1989. Similarly, the predominant species, *B. bengalensis kok* was followed by *T. indica indica* and *M. meltada meltada* during summer 1989. Similaly, the predominant species, *B. bengalensis kok* was followed by *T. indica indica* and *M. meltada meltada* in South Saurashtra and North Saurashtra zone during *kharif* 1989-90. Conversely, *T. indica indica* was found predominant species in Bhal and coastal areas and it was followed by *B. bengalensis kok* and *M. meltada meltada* during *kharif*, 1989-90.

Because of heavy damage due to rodents, in *rabi* crops of 1989-90, farmers avoided to sow the summer groundnut during 1990 in most of the summer groundnut growing areas of Saurashtra region. On the other hand the rodent damage was comparatively low (2.0 to 5.0 percent) in groundnut fields, where it was sown in summer, 1990. This might have happened

due to drastic reduction in rodent population as a consequence of heavy parasitization of rodents by sucking lice, *Polyplax spinulosus*, during the season.

Amongst the different combinations of two rodenticides (zinc phosphide 2% poison bait and bromadiolone 0.005% wax cake) and bromadiolone 0.005% wax cake + bromadiolone 0.005% wax cake i.e. two applications of bromadiolone 0.005% wax cake each at flowering stage and pod maturity stage was found comparatively better in respect of reduction in rodent activity as well as crop damage at flowering and pod maturity stages and also recorded highest pod yield (2139 and 1220 kg/ha) as well as maximum net incremental cost benefit ratio of 1:39.17 and 1:55.91 during *kharif* 1989-90 and 1990-91, respectively.

Study of plain and poison bait consumption pattern in the Indian desert gerbil *Meriones hurrianae* (Jerdon)

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Plain feed was prepared from wheat flour, sugar (2%) and arachis oil (2%) and was given to acclimatised gerbils for three days in no choice test followed by bromadiolone (0.005%) and brodifacoum baits and that of warfarin (0.025%) from 4th to 10th day.

The intake of poison bait on 4th day showed insignificant deviation from plain food intake on the first three days. The decrease in plain food intake was significant ($P > 0.001$) from 8th day onwards in both bromadiolone and brodifacoum poisoned gerbils (Table 1).

The poison bait of warfarin (Rodafarin 'C') was provided from 4th to 10th day. Mean daily intake of poison bait was smooth for first three days viz. from 4th to 6th day. The intake of poisoned bait was found to be insignificant up to 8th day. From 12th day onwards, the depletion of plain food intake was found to be highly significant ($P < 0.001$). Average days to death was minimum in brodifacoum (6.76 days). The study reveals that to avoid over killing of rats by contiuous surplus baiting with single dose anticoagulants, it would be advisable to use the technique of pulse baiting which requires less bait materials.

Table 1 Intake of plain and poison bait by Indian desert gerbil *Meriones hurrianae* (Jerdon) on g/100g body weight

Rodenticides	Bromadiolone (0.005%)	Brodifacoum (0.005%)	Warfarin (0.025%)
Number and Sex	8 (4M+4F)	8 (3M+5F)	8 (4M+4F)
Mean Body Weight (g)	70.33	68.65	72.30
1 st Day	11.22	10.81	9.04
2 nd Day	10.30	10.62	9.32
3 rd Day	8.22	10.68	8.87
4 th Day	9.05*	10.04*	8.90*
5 th Day	8.78	9.61	8.78*
6 th Day	6.20	7.30	7.50*
7 th Day	7.00	4.08	6.34*
8 th to 10th Day	5.35	3.48	8.64*
11th Day	2.36	1.15	4.37*
12th Day	0.85	—	3.80
13th Day	—	—	1.08
14th Day	—	—	0.25
Per cent Mortality	100%	100%	100%
Mean period to death (days)	7.86	6.76	9.34

*Poison feeding

Evaluation of rodenticides and their acceptability in the control of rats in wheat fields

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The field trials were carried out in two locations during 1988-89 at the University Research farm at Jabalpur in wheat crop (Variety 'C' 306) under partially irrigated system. The rodenticides namely, flocoumafen (0.005% wax blocks), bromadiolone (0.005% wax blocks) and zinc phosphide (2% solid bait) were tested at the grain filling stage of the crop. Both the anticoagulants (flocoumafen and bromadiolone) were applied each at the rate of 15g/burrow, while zinc phosphide was used at the rate of 8g/burrow. The wax blocks of both the anticoagulants were hanged with the help of cotton thread, tied to wooden stick at the entrance of each live burrows. This method is convenient in recording the field acceptability of rodenticides by the rats in the form of wax blocks. The efficacy of rodenticides was judged on basis of live burrow reduction after 2 (zinc phosphide), 7 and 10 days (flocoumafen and bromadiolone) after treatment. In another trial the wax blocks of flocoumafen and bromadiolone were kept *in situ* for 3 days for observing the daily acceptability in presence of ample grain in the field. The acceptability of wax blocks to rats at live burrow was categorised as fully eaten, partially eaten and uneaten. The removal of wax blocks by the rats was considered as fully eaten. Only one application of the rodenticide was made after recording the rat infestation. The major rodent species attacking wheat crop, are *Bandicota bengalensis* and *Rattus rattus*.

The post treatment data recorded 2 days after application of zinc phosphide indicated 61.50% reduction of live burrows. The observations taken 7 days after application of flocoumafen and bromadiolone resulted into 65.1 and 50.2% burrow reduction respectively, and 72.7 and 53.8% reduction after 10 days of application (Table 1). Thus, it is apparent that flocoumafen proved better in reducing the activity of rodents.

The acceptability of flocoumafen was comparatively more as all the blocks were eaten within two days in comparison to bromadiolone (Table 2). Even on the first day of application, more number (14.5) of wax blocks of flocoumafen were fully eaten as compared to bromadiolone (9.5). On the basis of cumulative acceptability after 3 days in terms of fully eaten, the preference of rats to flocoumafen (20.5) was more in comparison to bromadiolone (14.0).

Table 1. Comparative efficacy of rodenticides for rat control in wheat crop*

Treatment	Pretreatment live burrows (no.)	Reduction in live burrows (%) days after application 2	7	10
Flocoumafen (0.005%)	22.5	—	65.1	72.7
Bromadiolone (0.005%)	22.5	—	50.2	53.8
Zinc phosphide (2%)	27.5	61.5	—	—

*Mean of 2 locations

Table 2. Field acceptability of rodenticides to rats in wheat fields*

Days after treatment	Extent of feeding	Mean acceptability of wax block (no.) Flocoumafen	Bromadiolone
1	E	14.5	9.5
	PE	2.0	1.0
	UE	6.0	12.5
2	E	19.5	14.0
	PE	1.0	1.0
	UE	2.0	7.5
3	E	20.5	14.0
	PE	1.5	2.0
	UE	0.5	1.5

*Mean of 2 locations

E = ully eaten, PE = Partially eaten, UE = Uneaten

Breeding aspects of the soft-furred field rat, *Rattus meltada* in and around Bangalore, Karnataka

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The studies were initiated to identify the months of peak and least reproductive activity in *Rattus meltada* so that the time of control operation can be focussed accurately. The metads were collected during 1985-88 every month.

Seasonal reproductive activity was exhibited by both the sexes. In the males the activity started in July and continued upto March. During this period majority of the males had distinct scrotal sacs. Spermatogenesis was evident in seminiceous tubules and epididymal smears showed active motile sperms. The sex accessories were hypertrophied with heightened secretory activity. Some metads without distinct scrotal sacs also exhibited active breeding conditions. The fecund males caught after March had reduced body weights, indistinct scrotal sacs and regressed condition of testes and sex accessories. The paired testicular weight ranged from 1.3 gm

to 1.8 gm being maximum during September, October and November and least during April, May and June.

The females collected during the period July to March also exhibited peak reproductive activity during September (62%), October (68%) and November (83%) and least during March when only 2% of the captured females were found pregnant. The corpora lutea formed after ovulation were distinct and their number always corresponded to the visible number of embryos in the uterine horns. The litter size ranged from 2 during March to 9 during November. After March the ovary weight decreased and the uterus was regressed and thin.

It is concluded that the period March to June is most suitable for initiating control in agricultural fields against *R. meltada*, when they are in a non-breeding state.

Opinion survey on rodent control

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In the beginning of the work of social engineering activity on rodent control an opinion survey on status of rodent problem was conducted at Pondikhurd, Bela (1987-1989) and Koodan, Dursara (1990 continued) villages of Sehora Tahsil under maintenance and survey areas, respectively, of Jabalpur district, Madhya Pradesh.

Views expressed by the farmers of these villages indicated that rodents in general, and rats in particular, caused incalculable losses to different crops and household goods in many ways. They were of the opinion that the yield loss due to rats in wheat crop is to the tune of 26.66-250 kg/ha, and in paddy 80-200 kg/ha. every year. In the houses 10% food grains are destroyed. The status of rodent problems in both the areas was from medium to high. About 0 percent of the farmers were very much keen to adopt the rodent control technology in houses as well as in crop fields.

Bench mark survey revealed that only some of the farmers are using rodenticides for controlling the rats but they could not get desirable

success. Farmers reported that they were using zinc phosphide (black powder) provided by the rural banks and which is also locally available in the market. Most of them were preparing the baits in a dry form in which they were mixing the rodenticide and wheat flour in equal proportion, which results in very high concentration of the rodenticide in the bait, making if highly unpalatable to the rodents. A very low degree of confidence was observed in rodent control success due to the improper bait preparation technique, hence it is needed to educate them on this aspect.

No one used any mechanical means (sticks, cage trapping etc) for controlling the rodents. Some tribal people are using a Tendu stick which looks like a snake and act as a behavioural control agent. The majority of people interviewed knew about the predators of rodents like owl, cat, snake & *newla* (mongoose) etc. But the snake population remains low in the fields because generally the farmers kill the snakes as cases of snakebite are frequent. Regarding the cats, the farmers do not like them in residential premises because they damage the daily household goods. No body believed in worshipping the rats as lord Ganesha's Vahan.

Rodent scourge in forest nurseries and plantations

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Forest nurseries are sites where seedlings are grown and maintained for afforestation programme. Often in nurseries rodents cause considerable damage to young seedlings. Seedlings of tree species like *Shisham* (*Dalbergia sissoo*), Teak (*Tectona grandis*), *Bakain* (*Melia azadirachta*), *Bans* (*Dendrocalamus strictus*), and Mango (*Mangifera indica*), have been reportedly destroyed by a rodent species *Nesokia indica* (*Gray*) at Satyanarayana Forest Nursery, Dehra Dun (U. P.)

Damage in forest nurseries : This brief account highlights certain unpublished data on rat damage in various forest nurseries of Uttar Pradesh, Madhya Pradesh and Haryana. The damaging species could not be trapped as these observations were made occasionally during surveys for insects. Nevertheless, rat damage was ascertained by the presence of burrows in nurseries and typical markings of incisors on eaten roots

In most cases the tap roots were eaten upto the collar region. Rat damage associated with various forest tree species in forest nurseries is given in Table 1.

Table 1. Rat damage associated with different forest tree species in forest nurseries

Tree species	Date of observation	Percent damage	Location
Acacia nilotica	Feb. 1984	15.0	Forest nursery Neemkhera, Jabalpur, (M.P.)
	Feb. 1985	10.0	Karanjia (Shadol) Forest nursery (M. P.).
	August 1988	8.0	Roadside nursery, Sohna (Haryana).
Acacia tortilis	July 1988	7.0	Jhumpa (Haryana), Forest nursery.
Albizzia lebbek	March 1985	8 0	Forest nursery, Neemkhera, Jabalpur, (M.P.)
	April 1990	4.0	Satyayarayan forest nursery, Dehra Dun (U. P.)
Dalbergia sissoo	June 1988	11.0	Sohna (Haryana) road side nursery.
	April 1989	9.0	Cheekan (Pinjore) Forest nursery (Haryana)
Dendrocalamus strictus	Feb. 1985	12.0	Bhai-Bahan forest nursery Moti Nala Range (M. P.)
	Feb. 1985	20.0	Karanjia forest nursery. Dindori Range, Mandla Forest Division, (M. P.)
	March 1985	9.0	Forest nursery, Neemkhera Jabalpur (M. P.)
Tamarindus indica	Jan. 1984	100.0	Barah forest nursery Jabalpur, (M.P.)
Tectona grandis	Feb. 1985	6.0	Mandia Forest nursery (M.P.)
	Feb. 1985	4.0	Chilpi forest nursery, (M.P.)
	May 1985	7.0	Forest nursery, Neemkhera, Jabalpur, (M.P.)

Damage in forest plantations : Species of *Dalbergia sissoo*, *Acacia nilotica*, and *A. tortilis* are vulnerable to rat damage in arid and semi-arid-plantation areas of Haryana. In Jhumpa, two year old plants of *A. nilotica* and *A. tortilis* were found dead due to rats feeding on roots. In the same way, newly transplanted seedlings of *D. sissoo* were killed by rats in Pinjore. Near Rohtak in the Ismalia plantation, five plants

of three year old *A. nilotica* were found dead due to rodent activity. The height and girth of these plants were between 2 to 3 metres and 10 to 14 cm, respectively.

The above observations indicate that forest nurseries and plantations are favourable sites for rats. Although rat damage is of common occurrence in forest nurseries and plantations, adequate control practices are seldom adopted by forestry personnel. This is partially due to less exposure of concerned specialists to such areas. Studies on occurrence, population dynamics, and control of rats in forest nurseries and plantations may be a fruitful research topic for rodentologists.

Food intake by *Rattus rattus* in an ultrasound environment

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Rodents can perceive sounds with frequencies above the hearing capacity of human beings. Recoginising this auditory faculty of rodents, a number of ultrasonic devices have been fabricated, either to drive out the rodents or to discourage them from invading the residential premises/ godowns etc. A number of them were tested but they have not shown desired effect. A French ultrasonic device was tested against *Rattus rattus* in laboratory under caged conditions.

Freshly captured house rats were weighed, sexed and acclimatised on pearl millet grain and tap water for 10 days in laboratory. Two categories of experimental rats weighing 51-100 g and 101-150 g with an uniform sex ratio were selected for study. For exposing the ultra sound waves, the device was placed in the centre of a big room and two group of eight rodents each and a third set of 6 rodents (individually caged) were kept at 1, 2 and 3 m away from the ultra sound source respectively in a circular fashion. A separate set for control with no such sound source was also maintained in another room. Daily food intake was recorded for all the sets for 8 days.

Study was based on feed intake by experimental rats under ultrasound enviroment, because this is an important parameter reflecting any sort of stress/ disturbance/ uneasiness for the rats.

Data presented in Table 1 indicate that the ultrasound waves ot no significant effect on the test rats because their feed intake under ta sound environment (4.25-6.85) was at par with that of control rats (3-5.85 g) on g/100g body weight basis. Further probe into the data vivy reflect that there was no adverse effect on feeding by either sexes or e groups. It was interesting to note that rodents kept closest to the ultra-und source (1 m) registered higher food intake than those kept at n away from the source. Thus, results clearly prove that the ultrasod waves have no desirable influence on the house rats under cad conditions.

Table 1. Food consumption of *Rattus rattus* under ultrasound environment

Type of treatment	Food consumption (g) mean ± s	
	under ultrasound environment	Control
a. Distance between ultrasound source and the rat cages :		
i. 1 m	6.11±0.15	3.51±0.5
ii. 2 m	6.24±0.26	4.53±0.
iii. 3 m	5.69±0.43	4.84±0.
b. **Body weight classes**		
i. 51-100 g	6.85±0.41	5.85±0.
ii. 101-150 g	4.25±0.92	3.84±0.
c. **Sexes**		
i. males	5.14±0.22	4.43±0.
ii. females	6.42±0.24	5.27±0.

Notes and News

A Group Meeting of project workers of the All India Coordinated Research Project on Rodent Control was organised by the I.C.A.R. at the Central Arid Zone Research Institute, Jodhpur, on November 13 & 14, 1991.

A National Sympcsium on Rodent Pest Management—a scenario for the 21st Century - was held at CAZRI, Jodhpur on November 15 & 16, 1991. The Symposium was sponsored by the Arid Zone Research Association of India, Jodhpur. Dr. Ishwar Prakash, Professor of Eminence, chaired the inaugural session and Dr. R.L. Rajak, Plant Protection Adviser to the Govt. of India delivered the valedictory address. A new book titled "Rodents in Indian Agriculture" and edited by Drs. Ishwar Prakash and P.K. Ghosh was released by the Plant Protection Adviser on the occasion.

On completion of his glorious career in rodent research at CAZRI, Jodhpur, Dr. Ishwar Prakash retires from active service on December 31, 1991. Dr. Prakash, who has been selected as a Senior Scientist of the Indian National Science Academy, will henceforth sit in the Zoological Survey of India, Paota B Road, Jodhpur.