ISSN 0972-2939

RODENT
Newsletter

Vol. : 25(3-4) 2001

भाकृअनुप
ICAR

ALL INDIA COORDINATED RESEARCH PROJECT ON RODENT CONTROL

Central Arid Zone Research Institute
Jodhpur - 342 003, India

RODENT Newsletter

Vol. : 25(3-4)

2001

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AICRP on Rodent Control
Central Arid Zone Research Institute
Jodhpur - 342003, India

Observations on changing behaviour in house rat, *Rattus rattus*

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Rodents comprise 44% of total mammal species (4629) of the world and what makes them most diverse and successful group is their quick adaptability and prolific breeding rate. On the ladder of evolution, when Man started practising agriculture, many species of rodents *(Rattus rattus, R. norvegicus, Mus musculus)* became commensal. However, considering the role played by these species in destroying properties, disseminating diseases, polluting environment and inflicting damages to food grains, man started putting pressure on these species. The methods commonly applied to control their population are using rodenticides, attractants and repellents, fumigants and rodent proofing. This pressure from humans, made these species to revert back to their original habitat. Such cases of behavioural atavism have been observed by many scientists. Recent studies revealed that *R. rattus* is one of the most pre dominant species in the crop fields, at Mount Abu district Sirohi. Similar situation had been reported regarding house mouse, *Mus musculus* which is the most common rodent in the sugarcane fields of Punjab. By moving out to crop fields and forests, these commensal species provided space for sylvan species to become associated with man. *Bandicota bengalensis* has been reported from flour mills in Kurukshetra. Similarly, breeding of *Cremnomys cutchicus* has also been observed in a house. During our survey of Udaipur region we have also collected this species from the hutment in the vicinity of crop fields.

During my recent visit to village Faridpur (Dist. Karnal, Haryana), I happened to visit a crop field. There were two rooms - one meant for the machinery of tubewell and the second for storing thrashed wheat straw. This thrashed wheat straw was used as cattle feed during lean period. The room was 16x18 feet and the thrashed straw attained a maximum height of 3 feet. On opening the iron door of the room I was surprised by the presence of house rats everywhere. On that particular moment I counted 10 house rats and was astonished to find burrows in the thrashed hay stacks. I counted 16 burrows in the hay and also found a wooden door of almirah gnawed by these rodents. On opening the door I came across two more house rats huddled up in a black polythene lying in the almirah. The nest in the polythene was made by accumulating wheat straw. Even though the waif dogs were common in the area, this room provided a safe abode for this rodent species.

Even though *R. rattus* is more adapted to live in the residential premises and godowns, it is now moving out. The reason of this behavioural atavism from commensal to sylvan habitats needs further investigations. Is it because of Man's pressure on this species or is it declining number of predators that is causing this species to give up commensal nature?

Occurrence of the lesser bandicoot rat, *Bandicota bengalensis* in Jodhpur town

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Since 1970, the authors have been surveying intensively various localities of Jodhpur city viz., residential premises, industrial areas, grain *mandis* (foodgrain markets), fruit markets, poultry feed shops, hotels, railway station, adjoining farm-houses and poultry farms for monitoring the rodent population. The house rat, *Rattus rattus rufescens* and the house mouse, *Mus musculus* have been regularly collected from these areas. Ecological survey conducted during October 2001 in residential premises, 12 Indian mole rats, *Bandicota bengalensis* and 4 house rats, *Rattus rattus* were trapped in a single night trapping from the hotels and Sulabh Complex, situated 500 m away from the Jodhpur Railway Station. Similarly, nine bandicoots were also observed moving on railway tracks. Sex ratio for *B. bengalensis* and *R. rattus* were recorded 66.6% and 25.0% respectively. The catch index was at higher magnitude i.e. 64.0 rodents/100 traps/24 hours. Some morphological details of the bandicoots are detailed in following table.

Table: Body measurements (mm) of *B. bengalensis*

Body parts	Males (N = 8)	Females (N = 4)
Head -Body length	193.25 ± 12.15	208.75 ± 7.56
Hind foot	31.75 ± 4.35	34.00 ± 3.15
Tail	142.33 ± 6.22	166.25± 8.20
Ear	12.37 ± 0.80	13.00
Body weight (g)	209.75 ± 11.50	238.50 ± 9.40
Mammae (Nos.)	–	3–3 (= 12)
		4+4 (= 16)

The Indian mole rats, *B. bengalensis* collected from Jodhpur city are significantly heavier (209.75 ± 11.50 g male; 238.50 ± 9.40 g female) than those collected from crop fields at Bisalpur ,Pali district(body weight of males = 175.50 ± 7.75 g; females=182.44 ± 10.81g) however, no significant difference was found with those of Bikaner population. Interestingly the fur of urban population is blackish whereas, it is brownish in the bandicoots collected from crop field at Bisalpur.

Since last one decade the process of urbanization and industrialization has increased manifold all around Jodhpur. In recent years, there has been improved and very good rail connectivity in Jodhpur with Mumbai, Kolkata, Chennai, Bangalore etc. through broad gauge rail lines resulting in enhanced transportation of goods and traffic from these cities. These areas are reservoir of this destructive "colonizing rodent", which is being transported to Jodhpur without ticket. Transport of goods by the trucks may also help in spreading this species.

Breeding performance of *Bandicota bengalensis* under laboratory conditions

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Lesser bandicoot rat, *Bandicota bengalensis* is considered to be one of the serious pests because of its voracious feeding habits and high rate of reproduction and population growth resulting in failure of efforts to manage their population. In agricultural ecosystem *B. bengalensis* breeds throughout the year with seasonal peaks. This study reports the breeding behaviour of this species under laboratory conditions.

Bandicoots were trapped from the fields of Ludhiana. On the day of collection, they were weighed and randomly paired in the breeding cage of 30 x 30 x 24 inches size with two nesting sites inside the cage. Grass straw kept inside the chamber was used for nesting purpose. Rats were provided with food and water *ad lib*. Feed mixture contained 88% cracked wheat, 5% sugar, 5% milk powder and 2% oil. They were also provided green food consisting of maize and, stems and leaves of sprouted *moong*. Observations on the breeding behaviour were made on 14 pairs for two breeding cycles. After pairing rats were seen fighting. In two cages, where male was smaller in size and weight was killed by the female, but when re-paired with male of larger size, they survived in both cases. The male female ratio of pairing was kept 1:1 in all cases. For comparison of litter size, sex ratio and growth of young ones of those breeding under laboratory and field conditions, pregnant females collected from the fields were used. After trapping, these females were brought to the laboratory and observed till they delivered young ones.

Extensive variations have been recorded with regard to the time taken to establish pregnancy and deliver young ones of the first litter in the breeding cages. Most of them (65%) delivered after 47 to 96 days of pairing, however, 35% of the females delivered young ones within 24-26 days after pairing when the females were acclimatized to laboratory conditions or used for obtaining second litter in the laboratory, time taken to establish pregnancy and to deliver young ones appeared normal as for other rodent species.

Comparison of the breeding data on rats conceived in field and laboratory conditions has shown that pregnant females from field have larger litter size (7-14 youngones) as compared to laboratory bred females (2-7 young ones). Weight of youngones appears to be greatly dependent upon litter size. In rats, where litter size was larger the body weights of youngones were relatively less. Weight of youngones delivered by pregnant females collected from the fields was less as compared to those conceived & delivered under laboratory conditions. The influx of males in sex ratio was observed in both laboratory bred females and pregnant females collected from field.

There is high rate of cannibalism, females ate youngones after delivery. Mostly females which brought from the fields and delivered within 1-2 days ate their youngones. This may be due to change in their habitat, insecurity to their youngones and stress. Also in the laboratory, females if disturbed before delivery, eat their youngones, otherwise rate of cannibalism is very low in laboratory bred females but they conceived after taking a longer time for acclimatization. Cannibalism ability was found high in case of pregnant females collected from the field.

Histopathological changes induced by Difethialone (LM-2219), a new anticoagulant in testis of *Rattus rattus*

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Histo-pathological studies in the testes of black rats with 0.0025 per cent concentration of difethialone for 24, 48 and 72 hours feeding were conducted. The following alterations were observed :

After 24 hours : Degenerative changes were observed in the seminiferous tubules with degenerating cells in the lumen depicting a eosinophilic mass of cell debris towards the inner lumen. Sertolic cells and leydig cells were normal in appearance. No congestion or haemorrhage in the interstitial cells was observed. Tubules revealed hyperchromatic spermatogonia.

After 48 hours : Blood vessels were dilated and congested. Degenerative changes in interstitium tissue were observed. Few tubules showed thickening of basement membrane with accumulation of cell debris in lumina. Outer tubular spaces revealed mild endema. The saminiferous tubules also revealed degenerative sperms with few primary spermatocytes and cell debcries.

After 72 hours : Marked congestion and dilation of blood vessels in the interstitium were observed along with edema. Seminiferous tubules also revealed degenerating spermatozoa. Haemorrhage in the interstitium and thickening of basement membrane was more pronounced. Difethialone also caused testicular atrophy, reduction of tubular size, enlarged interstitium and distinct edema.

The above investigations have given strong evidence that the difethialone (LM-2219) is a potent anticoagulant rodenticide as it also alters most of the histo-pathological responses in house rats.

Comparison of two methods for estimation of efficacy of rodenticides in wheat fields

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Efficacy of 2% zinc phosphide bait, 0.0375% coumetetralyl (Racumin) and 0.005% bromadiolone was determined against rodents in the wheat fields at village Jodhan located in Pakhowal block of district Ludhiana. Baits were prepared by mixing them in a mixture of wheat flour, powdered sugar and groundnut oil (WSO-Mix, 96:2:2). Zinc phosphide (2%) bait was prepared by mixing 25 g of 80% zinc phosphide concentrate in 975 g of WSO-Mix, Racumin bait (0.0375%) by mixing its 50 g of 0.75% concentrate in 950 g of WSO-Mix and bromadiolone bait (0.005%) by mixing its 25 g of 0.25% concentrate in 975 g of WSO-Mix. The experimental fields were infested mainly with *Bandicota bengalensis*, *Mus musculus* and *Tatera indica*, as determined by pretreatment burrow survey. Four fields each of approximately 4 acres area in triplicate were allocated to each treatment of 3 rodenticide baits along with untreated control fields as reference. Before the treatment of zinc phosphide pre-baiting was done for two days with pre-bait material (WSO-Mix). Poison baiting was done @ 1 kg/ha of rodenticide that is 100 baiting points per hectare with 10 g of poison bait at each bait point. To determine the effect of each rodenticide treatment success, pre (Pr) and post treatment (Po) plain bait consumption (g/ acre) was recorded in all the treated and untreated fields. Cracked wheat used as plain bait was kept on pieces at 40 baiting points per acre and about 10 g bait at each point for 2 days before and after poison treatment. Data on the post treatment bait consumption was taken 15 days after the poison baiting. The per cent rodent control success with different rodenticide treatments was calculated as reduction in rodent activity within the same fields by using the formula :

$$\frac{Pr-Po}{Pr} \times 100$$

and with respect to corresponding changes in the reference fields by using the formula :

$$\frac{(1-T_2 x r_1)}{T_1 x r_2} \times 100$$

Where, T_1 and T_2 represent pre- and post- treatment bait consumption respectively in treated fields and r_1 and r_2 represent pre- and post-treatment bait consumption respectively in reference field. Pre-harvest damage was estimated in the treated and reference fields by counting cut tillers in 10 randomly selected plots of one square meter in each field by Line-transect method. Damage in the form of percent cut tillers was calculated from each field as :

$$\frac{Ct}{T} \times 100$$

where, Ct represents number of cut tillers per m^2 and T represents total number of tillers per m^2. For yield estimation, 10 plants were harvested from each field and yield loss was calculated as follows :

$$\text{Yield loss (g per m}^2) = Ct \times y$$

where, y represents yield (g per tiller). Single baiting of the rodenticides as calculated on the basis of pre- and post treatment census within the same field (Table) resulted in 63.12, 64.50 and 58.67 per cent rodent control success with zinc phosphide, Racumin and bromadiolone treatments, respectively. In comparison corresponding values of per cent rodent control success as calculated taking into account the changes in the reference field were 68.09, 69.10 and 63.81 per cent. However, the differences were statistically non-significant. Earlier workers had used either of the two methods for the estimation of rodent control success. The present study revealed that any of the above methods may be applied in determining the efficacy of rodenticidal treatments (Table).

Table. Efficacy of rodenticide baiting in wheat fields

Rodenticides	Rodent Control Success		Cut tillers (%)	Yield loss (g/m^2)
	$\frac{Pr-Po}{Pr} \times 100$	$\frac{(1-T_2 x r_1)}{T_1 x r_2} \times 100$		
Zinc phosphide (2%)	63.12±4.76*	68.09±3.65*	0.41±0.57	1.84 ±2.49
Racumin (0.0375%)	64.50±9.82*	69.10±8.20*	0.99±1.37	3.56±4.58
Bromadilone (0.005%)	58.67±5.79*	63.81±6.01*	0.00	0.00
Reference (No rodencide)	14.78±5.96		5.96±9.70	23.35±3.06

* Values with same rank do not differ significantly at 5 .00 per cent

Damage to wheat in terms of cut tillers was 0.41, 0.99 and 0.00 per cent after treatment with zinc phosphide, Racumin and bromadioljone respectively, which were significantly less than 5.96 in the reference field (Table).

Bromadiolone treated fields had no damage but reduction in rodent activity was 58.67 per cent indicating the post-treatment avoidance to the crop or emigration of the population to adjacent fodder fields or change in feeding activity in the neighbouring barseem fields. Reference field revealed the yield loss of 23.35 g m^{-2} which is very high as compared to 1.84, 3.56 and 0.00 g m^{-2} with respect to zinc phosphide, Racumin and bromadiolone treated fields, respectively.

NOTES AND NEWS

Expert Committee on Rodent Control reconstituted

Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India has reconstituted the Expert Committee on Rodent Control. The Committee consists of following members :

Plant Protection Advisor Govt. of India, Dte. of Pl. Prot. Quarantine & Storage, NH IV, Faridabad.	: Chairman	Project Coordinator, AICRP on Rodent control, CAZRI, Jodhpur.	: Member
Asstt. Director General (PP) Indian Council of Agricultural Research Krishi Bhavan New Delhi	: Member	Director, Indian Grain Storage Management & Research Institute (IGMRI), Hapur	: Member
Deputy Commissioner (S&R) Ministry of Consumer Affairs & Public Distribution, Krishi Bhavan, New Delhi	: Member	Director of Agriculture of the State of Andhra Pradesh, Mizoram, Gujarat, Tamil Nadu and Uttar Pradesh.	: Member
Representative from the Ministry of Health & Family Welfare (NICD) New Delhi	: Member	Rodent Specialist, NPPTI, Hyderabad.	: Convener

The functions of the Committee are as under--

(i) To advise the Central and the State Governments on various aspects of Rodent Pest Management.

(ii) To identify the areas requiring further investigations as also organizations of take up such work for improving the available know-how of rodent control technology.

(iii) To review periodically the progress made on Rodent Pest Management, its dissemination and implementation at field level, and

(iv) To discuss any other relevant issues the Committee may come across on the various aspects of rodents and their control from time to time.

Contributions for inclusion in the Newsletter may please be forwarded along with 1-2 good black & white photographs to :

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Published by the Project Coordinator, AICRP on Rodent Control, CAZRI, Jodhpur and Printed by Indian Tourism Publications, Graphic, opp Nehru Park, Jodhpur Phone - 641778