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RODENT
Newsletter

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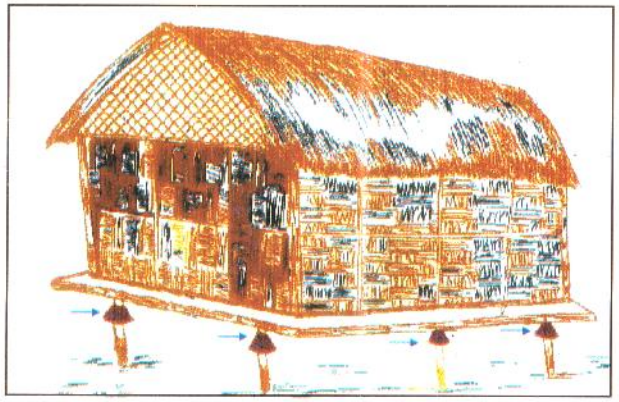
All India Network Project On Rodent Control

Central Arid Zone Research Institute
Jodhpur - 342 003, India

Rodent Damage in Maize crop in Punjab



Lakhmi Bhoral equipped with Rat Guard

Jodhpur Railway Station :
First settlement site of *Bandicota Bengalensis* in arid zone

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CONTENTS

AINP on Rodent Control
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Socio-economic impact of Rodent Control campaigns in Andhra Pradesh

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Till date socio-economic studies on large-scale rodent control campaigns conducted in India are very meagre. Hence an attempt was made to study the impact in Godavari delta districts of Andhra Pradesh. The state organized rodent control campaign in two endemic districts of the State-East and West Godavari districts during Rabi 2003-04 covering an area of 3.5 lakh hectares (in 82 Mandals) with a financial outlay of Rs. 47.69 lakh that reportedly resulted in control success of 76-86% increasing the yield at 310 kg per hectare. The knowledge, attitude and practices (KAP) analysis made by randomly selected 120 farmers from 12 villages in each district indicated that all of them realized the consequences of non-adoption of rodent control at village level (Table 1). They expressed that distribution of poison in earlier campaigns made most of the farmers to go for individual approach; thereby resulted mostly in failure. The farmers were convinced that village level campaign by centralized bait preparation and distribution in packets as per requirement prevented rat damage significantly. Due to this they were willing to actively participate in future such campaigns. One of the significant aspects of the campaign impact was change in farmers' mind set regarding procuring the rodenticides for use in their fields. In addition to this social motivation, there was also reduction of preference to acute rodenticide, zinc phosphide from 35 to 4 per cent and consequently phenomenal increase in preference for single dose anticoagulant, bromadiolone 'C' from 0 to 83 per cent thereby reducing the environmental hazards like accidental and secondary poisoning cases. At the same time this would increase usage of environmentally safer anticoagulant, bromadiolone for a long-term benefit. The tendency of depending on government supply of the rodenticides also exhibited a decline as a consequence of the campaign (Table 2).

With respect to economic impact, almost all the farmers were unanimous that they could feel increase in productivity (Table 1) due to the campaign. Majority of them (50 to 56%) felt that they gained an increased yield in rice of 3 bags per acre with a harvest of about 45 bags

Table 1. Socio-economic impact of rodent control campaign in Andhra Pradesh (as perceived by the farming community)

Sociological impact			
S. No.	**Attribute**	**East Godavari District (%)**	**West Godavari District (%)**
1.	Realized consequences on non adoption of control	100	100
2.	Convinced on village level approach of rodent control	100	100
3.	Convinced that campaign prevents rodent damage	100	100
4.	Realized that neighbors should also adopt rodent control for success	98	100
	Economic impact		
1.	Campaign was cost effective for farmers	100	100
2.	Witnessed more crop yield due to campaign	96	100
3.	Rodent number decreased and damage is less	98	100
4.	Productivity increased by 2 bags per acre	40	43
5.	Productivity increased by 3 bags per acre	56	50

Table 2. Impact on input preference of farming community after rodent control campaign, 2004

S. No.	District	Rodenticide	Response from farmers on rodent control campaign (%)	
			Before	After
1.	East Godavari	Zinc phosphide	35	22
		Anticoagulant	0	66
		Govt. supply	65	12
2.	West Godavari	Zinc phosphide	18	4
		Anticoagulant	0	83
		Govt. supply	82	13

per acre. The farmers' impressions more or less tallied with the department's estimate of economic benefit accrued as a result of rodent control. The farmers further felt that non-coverage of coconut trees for rodent management might be one of major factors responsible for the continuation of rodent problem in rice even after controlling lesser bandicoots. In view of this there is a requirement of simultaneous treatment of rice and coconut crops for rodent control in these districts.

A record of rodent infestation and damage in maize crop

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The problem of rodent damage in agriculture is complex because almost any crop can be the target of rodent attack. For decisions to be made about rodent control in any cropping system, the density of rodents and damage caused by them at different stages must be estimated. During present investigations, rodent infestation and damage was recorded in maize (*Zea mays*) crop grown in an area of about 5 acres at Ladhowal Seed Farm of the University. During the maturity stage of maize crop the surrounding fields after harvest of wheat were being prepared for paddy transplantation by puddling and flooding with water, which caused increased rodent burrowing activity in the maize crop. Trapping of rodents carried out by using single and multiple catch rat traps in two rows of eight traps each with trap to trap and line to line distance of 10-15 meters, revealed 37.50% trapping success with single rat traps and 93.75% trapping success with multiple catch rat traps. The number of female rats trapped was more than that of male with male to female ratio of 3:4. A total of 21 *Bandicota bengalensis* (6 in single and 15 in multi-catch rat trap) were trapped in a single night in 16 traps of each type, thus showing high population density of this species in maize fields in the month of June. During summer months (May-June), coinciding with period of preparation of vacant fields for paddy transplantation, maize fields provided good shelter to rodent population, particularly to *B. bengalensis*.

For recording rodent damage to maize crop at pre-harvest stage, five lines each of about 100-150 meter length were selected at random and in each row total number of cobs present on all the plants and the cobs damaged by rodents were counted to calculate percent cobs damaged by rodents. Results revealed a pre-harvest rodent damage of 4.67± 0.43%(n=5) to the maize crop. Rodents inflicted more damage to the cobs, which were present at the lower portion of the plants by nibbling cob leaves and grains. As a result of rodent activity, some of the damaged cobs were found hanging upside down from the main stem. After harvest, as a usual practice the harvested crop was left in the field for some time in the form of small bundles. At this stage, rodents inflicted more damage to the cobs on the underside of the bundles. For recording rodent damage at post-harvest stage, ten bundles of harvested maize crop were selected at random and total cobs as well as cobs damaged by rodents on all the plants were counted. Results revealed 15.85 % damage to the cobs at post-harvest stage. These cobs damaged both at pre- and post-harvest stages were partially damaged and were used by owners for removing the grains. Thus these damage figures do not reflect the actual grain loss. After the harvest of maize crop, some of the rodent burrow complexes (n = 7) were also excavated to see the kind of material hoarded in them. Excavation revealed the presence of cobs without grains and cob leaves in the burrows (n=3) up to the depth of 12 inches inside the burrow.

During present studies, rodent infestation and damage to maize crop at pre-harvest and harvesting stages was mainly due to the migration of rodents from surrounding fields which were being prepared for paddy transplantation by puddling and flooding with water whereas at post harvest stage, rodent damage was due to the usual practice of keeping the crop bundles in the field after harvest. It is, therefore, suggested to carry out rodent control operation in maize crop grown in rice-wheat ecosystem when there is puddling and flooding going on in the surrounding fields. Also after the harvest, crop should be immediately removed from the fields to avoid post-harvest rodent losses.

Rodent management in indigenous storage structures

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Farmers commonly store their foodgrains, exclusively for household consumption for a longer period in various structures made of locally available materials. Besides pre harvest damage to standing crops,

the rodents inflict serious losses to stored grains during post harvest also. Among the different indigenous storage structures, Lakhimi bhoral, a chung type rice storehouse is an integral part in the residential premises of the farming community in Assam. Its wall and floor is commonly made of mud-plastered bamboo and the column is made of cement concrete or bamboo or timber. Besides Lakhimi bhoral, other storage structures namely 'Duli', 'Mer', ' Borpachi' etc are also frequently used by most of the marginal and small farmers for storing rice grains. These structures are generally made from woven bamboo sometimes plastered with mud or cow dung. These storage units are often raised on a bamboo made platform on bamboo pillars. In such structures, commensal rodents damage considerable amount of stored rice by climbing on the platform/pillar from the ground. In order to check rodent infestation, an attempt was made to make these storage structures rodent proof by fixing ' Rat guards' of G.I. sheet (0.5mm thick& 30cm width) at 60 cm height on the four pillars in farmers houses in three villages viz., Kathkotia, Lakhimikhat and Gual gaon, Dist. Jorhat (Assam).

Table 1. Field efficacy of fixing rat guards in Lakhimi bhoral, an indigenous grain storage structure in North Eastern India

Village	Trap index in stores		Loss (kg/m²/week)	
	with rat guard	without rat guard	with rat guard	without rat guard
Gual gaon	0.00	13.9	0.00	0.09
Kathkotia	0.00	16.7	0.00	0.11
Lakhimikhat	0.00	11.1	0.00	0.07

Data represent the mean of three replications

The effectiveness of fixing rat guard in Lakhimi bhoral was evaluated by trap index and the estimating losses to stored rice grains. For estimating the post harvest loss, a close wave basket of 1 m^2 surface area filled with known quantity of rice grain was kept in both types of Lakhimi bhoral, i.e., with and without rat guard. . The weight of grains kept in the basket was measured at weekly intervals for 3 months for working out loss per unit surface area (kg/sqm/week). The results revealed that rat guards provided total protection from rodent infestation as the trap index and losses to the stored grains in stores fitted with metallic rat guard was

nil in all the tested store houses of the three villages. However in stores without rat guards trap index ranged between 11.1-16.7 rats/100 traps/ 24 hrs with a grain loss ranging from 0.07-0.11-kg/m^2/ week (Table 1).

Burrowing behavior of rodents in rocky habitats in arid zone

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Rodents trapping in rocky habitats near Jodhpur revealed presence of two gerbils viz., desert gerbil, *Meriones hurrianae* and Indian gerbil, *Tatera indica* and one mice species, *Mus platythrix*. Incidence of Indian crested porcupine, *Hystrix indica*, though not trapped was also evident from the presence of its tunnels and quills in the study area. Both the gerbils are extensive burrowers and require enough soil depth to make their burrows, whereas, *Mus platythrix* makes simple burrows even at shallower soil depths. Burrows of *M. platythrix* are characterized by presence of small pebbles collected by the mice around the burrow openings. Burrows of porcupine, *H. indica* were observed under the clumps of *Euphorbia caudicifolia* commonly growing in rocky areas. Size of burrow opening is more than double the size of gerbil burrows. It was also seen to hide in the rocky crevices.

Table. 1. Occurrence of rodent species and their burrows at different soil depths

S.No.	Soil Depth (cm)	No. of burrows/m²	Species
1.	Upto 10	Nil	-
2.	10-40	1.20	*M. platythrix*
3.	50-80	1.40	*M. platythrix & T. indica*
4.	80-120	2.40	*T. indica*
5.	>120	3.01	*T. indica & M. hurrianae*

Rodent burrows present at different soil depth in rocky regions revealed that no burrows were observed where the soil depth was less than 10 cm, however, *Mus platythrix* burrows were found at a soil depth upto 80 cm. Among the gerbils, burrows of *T. indica* was observed in the areas with more than 40 cm, whereas *M. hurrianae* could make its burrows in deeper soils i.e. > 120 cm (Table 1). This diurnal gerbil makes highly

complex burrows in 2-3 tiers with multiple openings to protect itself from predators and harsh climatic conditions of arid region. These observations indicate that in rocky areas soil depth determines the distribution of rodents. Burrow density also registered an increasing trend with increase in soil depth.

Biochemical changes induced by bromadiolone in black rat, *Rattus rattus*

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Effect of bromadiolone, a second-generation anticoagulant rodenticide on biochemical changes in *Rattus rattus* was studied in laboratory. A sub lethal dose of bromadiolone @ 0.12 mg/kg was administered to 10 house rats (5 male and 5 female) and equal numbers of untreated rats were kept for control also. Water was provided *ad libitum*. Rats were autopsied after 24, 48 and 72 h of bromadiolone treatment. Similarly control rats were also autopsied. Blood serum of experimental rats was separated and used for estimation of glucose, protein, cholesterol, urea, alkaline and acid phosphatase in treated and control animals. The effect of bromadiolone on these blood parameters of treated rats are detailed below:

1. Glucose: The serum glucose in male and female control rats was 448 and 440.10 mg/dl respectively, whereas, it was drastically reduced to 172.62 and 124.04 g/dl after 24 hr of bromadiolone treatment and showed steady decline subsequently recording to 164.5 and 118.0 mg/dl after 72 hr of treatment.

2. Protein: It was slightly increased from 4.3 mg/dl to 4.8 (in males) and 4.6 mg/dl (in females) as compared to control animals after 24 hr of treatment.

3. Cholesterol : Bromadiolone treatment in rats resulted more than two fold increase in cholesterol levels in blood of treated male rats (from 85.4 mg/dl (control) to 181.1 to 183.6 mg/dl (in treated rats). This increase was noticed in females also (82.4 in control to 103-109 mg/dl in treated animals).

4. Urea: Administration of bromadiolone (0.12 mg/kg) decreased

the serum urea levels. It was 42.0 and 39.4 mg/dl in untreated male and female rats, respectively, which was reduced to 37.2 and 33.2 mg/dl after 24 hr of anticoagulant treatment in respective sexes. The reduced urea levels with increased duration of treatment of 2-3 days remained at par.

5. Serum phosphatase: Alkaline phosphatase in control rats was higher (185-189 Iu/l) as compared to acid phosphatase (7.8-8.2 Iu/l). In the treated rats the values of alkaline phosphatase registered an increase, whereas, acid phosphatase showed declining trend during subsequent observations.

Since the anticoagulant is stored in the liver for prolonged period, glucose metabolism is highly disturbed in liver and activities of hexokinase and glucokinase also effect the carbohydrate metabolism at some stage which caused alteration in serum glucose in rats. The increase in serum proteins may be due to the increase of enzymes and immuno globin under stress conditions caused by bromadiolone administration. Similarly increase of cholesterol and alkaline phosphatase and decrease in urea, acid phosphatase and phosphoric esterase enzyme secreated by the liver may be due to the toxic action of anticoagulant.

Incidence of *Bandicota bengalensis* in the urban locales of Jodhpur city

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Owing to remarkable adaptability to diverse ecological condition and human interventions *Bandicota bengalensis*, primarily a wild mesic rodent fauna, has established itself as the most predominant rodent pest of Indian agriculture. Though widely distributed in India, arid regions have not been a preferred region for lesser bandicoots. Thus it was not reported from extreme western desert regions except in urban locales of Bikaner city. In Jodhpur, it was first reported in 1999-2000 (Rodent Newsletter 2001 Vol. 25(3-4)), since then regular surveys are continued to record incidence/spread of this unwanted colonizing rodent in Jodhpur town, the gateway of Indian desert.

During 2005 bimonthly surveys and trapping conducted in the city area, railway station, zoo, etc. revealed a very high trap index (22-rodents/100 traps/night) indicating a very heavy infestation of bandi-

coots in the area. The sex ratio in these collection was 1:1.05. Maximum body weight of the bandicoots was recorded in the month of July. The body weight of animals ranged between 205.75 ± 5.87 g (Jan.) and 279.40 ± 11.08 g (July) for males, and from 177.70 ± 8.37 g (Jan.) to 237.00 ± 16.70 g (July) for females. In general males (229.40 ± 11.08g) were comparatively heavier than females (195.08 ± 9.26g) (Table 1).

Table 1. Body weight and other body measurement (Mean + SE) of *Bandicota bengalensis* collected from Jodhpur.

Month		Body weight	Head and body (HB) length (mm)	Hind foot (HF) length (mm)	Tail (T) length (mm)	Ear (E) length (mm)
Jan. 05	Male Female	205.75 + 5.87 177.70 + 7.74	203.00+3.06 183.80+2.05	33.63+0.53 29.70+0.49	151.50+2.87 140.00+3.12	14.50+0.63 12.00+0.65
Mar. 05	Male Female	219.60+7.83 187.0 + 4.89	201.80+4.57 195.50+3.55	35.00+0.71 33.16+0.70	160.80+3.49 155.17+2.18	15.60+0.24 13.67+0.42
May 05	Male Female	239.20+17.16 205.89+11.36	208.70+4.96 202.22+3.37	34.00+1.42 33.89+0.68	163.70+2.79 161.78+3.79	15.10+0.59 14.00+0.55
July 05	Male Female	279.40+18.17 237.00+16.70	218.60+4.57 207.55+6.29	35.20+1.02 34.67+ 0.67	167.20+1.85 158.00+7.60	14.60+0.75 14.34+0.42
Sept. 05	Male Female	209.67+9.37 187.40+15.64	202.50+3.32 190.20+4.40	35.84+0.65 31.60+0.60	169.83+2.40 156.40+2.73	15.17+0.48 13.00+0.63
Nov. 05	Male Female	222.75+22.36 178.50+8.57	206.00+5.26 193.50+5.75	34.75+0.47 32.25+0.49	166.50+3.86 157.50+4.37	14.25+1.25 13.00+1.08
Mean	Male Female	229.40+11.08 195.58+9.26	206.77+2.60 195.45+3.45	34.73+0.33 32.41+0.69	163.26+2.67 154.80+3.10	14.87+0.20 13.33+0.34
Over all		212.49+16.96	201.11+5.67	33.57+1.16	159.03+4.24	14.10+0.77

Mean values of various measurements of Head body (HB), Hind foot (HF), Tail (T) and Ear (E) lengths of *B. bengalensis* captured from Jodhpur city were also recorded. The HB length ranged between 201.80-218.60 mm (males) and 183.80-207.55 mm (females). HF was between 33.63-35.84 mm in males and 29.70-34.67 mm in females. Tail length varied from 151.50-169.83 mm and 140.00-161.78 mm for male and females, respectively. Similarly, length of ear of males was between 14.25-15.60 mm and that of females was 12.00-14.34 mm. Mean of whole year for various measurements of body were HB: 206.77; HF: 34.73; Tail: 163.26; Ear: 14.87 in males and HB: 195.45; HF: 32.41; Tail: 154.80; Ear: 13.33 in females (Table 1).

During last 5-6 year of invasion of *B. bengalensis* in Jodhpur, the species has well established its population on and around Railway station constituting over 90% of rodent composition and has nearly replaced the house rat, *Rattus rattus*, which were around 5.8% in the study area. The bandicoots seem to have entered in the desert city through rail transport only. Considering the Railway Station and nearby area as the first focal habitat in Jodhpur, the bandicoots are establishing in newer areas, especially towards the walled city through open drains, posing a severe threat to the economy and health of desert people.

RODENT MANAGEMENT TECHNOLOGIES RECOMMENDED FOR FARMERS

Punjab

- Rodent control in fields of zero tillage wheat should be carried out by burrow baiting with freshly prepared zinc phosphide (2%) or bromadiolone (0.005%) baits before sowing of the crop in the months of October and November followed by crop period control operation in February.
- In fields of delayed harvesting of sugarcane, rodent control should be carried out with freshly prepared bait of bromadiolone (0.005%) @ 4 kg/ha bait placed at about 100 bait stations covering rodent activity damage sites.
- In fields of rice-wheat rotation, burrow baiting with freshly prepared baits of zinc phosphide (2.0%) @10 g/burrow or of bromadiolone (0.005%) @ 20 g /burrow in months of May, September, November and February along with bund height and width reduction (harbourage reduction) should be carried out.

Kartnataka

- In dry land crops one chemical control using zinc phosphide (2%) in cereal-groundnut oil bait prior to sowing followed by bromadiolone baiting for surviving population. A second similar operation at grain/fruit maturation stage.

Andhra Pradesh (In Rice)

- Summer ploughing and reduction in size and number of field bunds.
- Timely field operations puddling and transplantation and avoid

staggered planting.

- Allow alleyways in transplanted rice 20 cm for every 2 meters crop.
- During the first month of transplanting keep bait stations made of coconut husks. Five bait stations/ha, four in four corners one meter inside the crop and one in the center of the field. Place bait material twice in a week (50 g/bait station)
- Set bamboo traps @ 20/acre up to primordial initiation stage.
- Place bromadiolone bait (15 g/ burrow) inside the burrows.
- At grain formation stage kill burrow dwelling rats by natural smoke employing burrow fumigator.

Rajasthan

In wheat-cumin-mustard cropping system application of zinc phosphide (2%) bait in pearl millet @ 10g/burrow followed by bromadiolone (0.005%) bait in pearl millet @ 20 g/burrow before sowing. If both these treatments are not done before sowing, then two baitings with bromadiolone (0.005%) baits prepared in pearl millet grains @ 20 g/ burrow one at vegetative growth stage and another at flowering stage is recommended.

Himachal Pradesh

1. GI sheet of 45 cm width erected around mango tree trunk at a height of 1 m above ground level gives complete control against squirrels.
2. Integrated rodent pest management in cauliflower seed crop :
   - Fumigation of active burrow.
   - Live trapping for 3 successive days each month.
   - Regular removal of grass, weed, bushes, litter etc.
   - Burrow treatment with 2% zinc phosphide bait at curd formation.
   - Burrow baiting with 0.005% bromadiolone at flowering stage.

Gujarat

- Two applications (first at tillering stage and second at milky stage) of Coumatetralyl 0.0375% wax cake (ICBR 1:22.09) @ 10 g per live burrow are recommended as an alternative to bromadiolone 0.005% wax cake recommended earlier for effective control of rodents in wheat crop.
- Bromadiolone 0.005% wax cake or coumatetralyl 0.0375% wax cake and zinc phosphide 2% poison bait each @ 10 g per live burrow are found equally effective for reducing rodent activity and damage in sugarcane crop.

NOTES AND NEWS

XII Group Meeting of AINP on Rodent Control: The XIIth Group Meeting of All India Network Project on Rodent Control was held at Punjab Agricultural University, Ludhiana from 20-22 July 2005. Dr. T.P. Rajendran, ADG (PP), in his address outlined some important researchable issues on the subject. Dr. R.S. Tripathi, Project Coordinator (Rodent Control) presented the progress report of the Project for the biennium. Progress of research at different cooperating and self funded centers, state agricultural departments, rodenticide manufacturers etc. were deliberated at length. A brain storming session on bamboo flowering vis-à-vis rodent problem in NEH was also held to review the present situation in the NEH in view of bamboo flowering and future plan of action to tackle any possible rodent outbreak. Future programmes of the Project for the next biennium were formulated and the recommendations on rodent management for the farmers were approved. Three technical bulletins viz., "Burrow Fumigator-an eco-friendly device for rodent control", "Rodent Management in Arid Zone", and "Distribution of Rodents in Indian Agriculture" and a CD on 'Social behaviour of gerbils' were released by honourable guests on this occasion.

On-farm training on Rodent Pest Management at SFCL, Suratgarh : National Plant Protection Training Institute, Hyderabad organized a training programme at Central State Farm, Jetsar (Surat Garh, Rajasthan) on 17-18th August, 2005. In all 42 officials of the Central State Farm of Suratgarh, Jetsar and Sardargarh (Rajasthan) and Hisar (Haryana) participated in this programme. The training programme was entirely based on skill development exercises which included, (i) diagnosis of rodent infestation in fields (ii) infestation measurement of rodent pests (iii) crop-rodent seasonal calendar (iv) community planning (v) habitat analysis of rodents (vi) rodent management measures.

In State Training on Rodent Pest Management in Uttaranchal:

National Plant Protection Training Institute (NPPTI), Hyderabad organized two trainings on Rodent Pest Management for the extension functionaries of Uttaranchal State from February 16-18 and October 18-20,

2005. Feedback received from the trainees during the first programme revealed that the state suffers significant rodent problem in rice and wheat crops. Damage assessment surveys in wheat undertaken in all districts indicated tiller damage ranging from 5.9% (Dehradun district) to 17% (Almora district). Thus the second training was held in Kumaon region at Haldwani. Dr AMK Mohan Rao, Rodent Specialist, NPPTI, Hyderabad and Dr R.S. Tripathi, Project Coordinator (Rodent Control), CAZRI, Jodhpur were the resource persons. The training covered many aspects, viz., diagnostics of rodent problem, identification of major rodent pest species, ecology of rodent pests in relation to their management, breeding patterns of rodents, rodenticides, rodent management techniques and planning rodent management at community level.

Special training on Rodent Pest Management in Arunachal Pradesh: In view of severe rodent outbreak and resultant losses to standing kharif crops synchronizing with bamboo flowering during 2005. A special training programs on Rodent Pest Management was organized at Seppa (East Kameng Distt), Sagalee (Papumpare Distt) and Ziro (Lower Subhansiri Dist) on December 19,21 & 23 2005, respectively. Dr R. S. Tripathi, Project Coordinator (Rodent Control) and Drs B. C. Dutta and D. K. Bora, Rodent experts from AAU, Jorhat center of AINP were the resource persons. There were 150 participants, mostly extension functionaries from three districts. Based on the reports and feed back received from the trainees, an action plan for rodent management was also formulated for effective management of rodents during out breaks.

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12th All India Group Meeting on Rodent Control at PAU, Ludhiana

State level training on Rodent Management at Haldwani, Uttaranchal

State level training on Rodent Management at Ziro (Arunachal Pradesh)

Contributions for inclusion in the Newsletter may please be forwarded alongwith 1 - 2 good black and white / colour photographs to :

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