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Record of Vertebrate pests in date palm (*Phoenix dactylifera* L.) in an arid ecosystem

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Date palm, *Phoenix dactylifera* L. (Arecaceae, or Palmae), is an important species cultivated chiefly in arid areas of the world. In arid regions of Rajasthan, cultivation of date palm was started in 2007-08 when Govt. of Rajasthan initiated cultivation of tissue culture raised saplings of date palm procured from UAE on a trial basis in 135 ha in its farmland in Jaisalmer and Bikaner District and later its cultivation was promoted in other arid districts of the state. However, the production and productivity of dates in the arid region are low compared to the world average, mainly because of several biotic, abiotic stresses and the non-availability of quality planting material. Among the biotic stress, vertebrate pests, viz., birds, rodents, bats, etc., cause incredible damage to date palm fruits in the field and storage. Besides causing fruit damage, the rodents also nibble the roots, tender shoots, and newly emerged inflorescences in fields.

A block of date palm was raised with variety ADP 1 in the CR farm of the Institute seven years back. Observations recorded during fruiting seasons revealed the damage to mature and immature fruits of date palm and damage to inflorescences due to vertebrate pests, mainly by rodents and birds. A study was therefore conducted to record the rodent pests and bird species associated with date palms during flowering and fruiting season. Direct observation on the activity of these pests was recorded for an hour each during morning and evening, five days a week, and trapping was also done for three nights in a month by laying snap traps in a grid pattern to record rodent pest species. Four rodents and 18 species of birds were found associated with date palms during the study period. The nature of damage by these vertebrates involved direct feeding of mature and immature fruits by plucking/nibbling and dropping of the dates. An overall 9.0 percent damage to dates by these pests was recorded. Besides, damage to inflorescences was also recorded. The major vertebrate species involved in the damage was Northern palm squirrel, *Funambulus pennantii* (a diurnal, arboreal rodent) and the Rose-ringed parakeet, *Psittacula krameri* (a frugivorous bird). The burrowing species of rodents observed to construct the

burrows near the root zone of the date palm were responsible for damage to roots and dates hanging near the ground. Different vertebrate species of economic importance recorded on date palm are listed below (Table 1)

Table 1. Vertebrates associated with Date Palm in arid regions

Vertebrate group	Order	Family	Species	Common name
Rodents	Rodentia	Sciuridae	*Funambulus pennantii*	Northern palm squirrel.
	Rodentia	Muridae	*Tatera indica*	Indian gerbil
	Rodentia	Muridae	*Rattus rattus*	House rat
	Rodentia	Muridae	*Golunda ellioti*	Indian Bush rat
Birds	Psittaciformes	Psittaculidae	*Psittacula krameri*	Rose-ringed parakeet
	Cuculiformes	Cuculidae	*Eudynamys scolopacea*	Koel
	Cuculiformes	Cuculidae	*Centropus sinensis*	Greater coucal, crow pheasant
	Coraciformes	Coraciidae	*Coracias bengalensis*	Indian roller
	Passeriformes	Sturnidae	*Acridotheres tristis*	Common myna
	Passeriformes	Sturnidae	*Acridotheres ginginianus*	Bank myna
	Passeriformes	Sturnidae	*Sturnus pagodarum*	Brahminy myna, Brahminy starling
	Passeriformes	Corvidae	*Corvus splendens*	House crow
	Passeriformes	Pycnonotidae	*Pycnonotus leucogenys*	White eared bulbul
	Passeriformes	Pycnonotidae	*Pycnonotus cafer*	Red vented bulbul
	Passeriformes	Muscicapidae	*Orthotomus sutorius*	Tailor bird
	Passeriformes	Muscicapidae	*Saxicoloides fulicata*	Indian robin
	Passeriformes	Nectariniidae	*Nectarinia asiatca*	Purple sunbird
	Passeriformes	Ploceidae	*Passer domesticus*	House sparrow
	Galliformes	Phasianidae	*Pavo cristatus*	Common pea fowl
	Galliformes	Phasianidae	*Coturnix coturnix*	Common grey quail
	Columbiformes	Columbidae	*Streptopelia decaocto*	Indian ring dove/ Eurasian collared dove
	Columbiformes	Columbidae	*Columba livia*	Blue rock pigeon

Rediscovery of Kerala rat, *Rattus ranjiniae* an endemic species

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Kerala rat, *Rattus ranjiniae*, an endemic rodent, was first reported from Kerala (India) in 1966 (Agrawal and Ghosal, 1969). The species was recaptured after over 50 years by us, and it has a close resemblance to other *Rattus* sp. (*R. norvegicus*, *R. rattus*). Hence, morphological and morphometric parameters of the three *Rattus* sp. were compared.

Routine field surveys to understand rodent diversity was carried out in the rice fields in Thrissur, Kerala. Coconut pieces laced with peanut butter were used as bait in Sherman traps. Collected rodents were photographed, and morphological features measured. Head body length (HB), length of ear (E), hindfoot (HF), tail length (Tl), and body weight (BW) were recorded. The specimens collected were sent to the Zoological Survey of India for further characterization and identification. Tail samples were preserved for molecular characterization of the specimens collected.

Of the collected rodents, one specimen identified as *R. ranjiniae* appeared to have similarities with the house and Norway rats. The specimen had dark grayish brown (bistre) dorsum and a dirty white ventral side (Plate 1). It was a large-sized field rat (mean body weight 326 g), with tail length equal to or slightly shorter than head and body length. The fur on the dorsum was relatively longer with an admixture of soft spines, especially along the mid-dorsal line. The whiskers were brown at the base and white towards the distal end. Hindfoot was long with prominent claws. The tail was uniformly dark.

Morphometric details showed that the captured specimen was more or less similar to *R. norvegicus*. The length of the body (HB) was 215 mm, length of tail (Tl), 230 mm, length of the ear (E) 20 mm, and length of the hindfoot (HF) 43 mm (Table 1). These morphometric measures were very close to the body measurements of *R. norvegicus* registering length as HB-226 mm, Tl-224 mm, E-22 mm, and HF- 40 mm. However, the length of the tail and the color of the ventrum had some similarities with the house rat, *R. rattus*. The body weight has also been compared, and it showed that *R. ranjiniae* had body weight (326 g) which was close to *R. norvegicus* (386 g) and bulkier than *R. rattus* (102 g).

Upon running the taxonomic keys and morphometric measurements, the specimen collected from the rice fields of Thrissur District of Kerala in 2016 was confirmed as *R. ranjiniae*. The collection happened for the first time since similar specimens were collected from Thrissur, Alapuzha, and Thiruvananthapuram Districts by Agrawal and Ghosal in 1969.

Table 1. Morphometric measurements of *Rattus ranjiniae* in comparison with other *Rattus* sp.

Common name	Scientific Name	Length of head and body (HB) (mm)	Length of the tail (Tl) (mm)	Length of the ear (E) (mm)	Length of hindfoot (Hf) (mm)	Weight (BW) (g)
Kerala rat	*Rattus ranjiniae* Agrawal & Ghosal	215 ± 3.974	230 ± 5.103	20 ± 2.356	43 ± 0.653	326 ± 5.103
Norway rat	*Rattus norvegicus* (Berkenhout)	226 ± 3.974	224 ± 4.573	22 ± 1.729	40 ± 1.132	386 ±6.232
House rat	*Rattus rattus* (Linnaeus)	145 ± 4.526	200 ± 5.103	21 ± 1.729	34 ± 0.653	102 ±3.395

Values are mean of three observations

Population Structure, Damage and Management Strategies for Nilgai in Jodhpur District

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Nilgai is one of the largest antelope occurring in the Indian subcontinent. It is a member of the family Bovidae and is one of the most discussed animals after cow in the agrarian society of India. However, the conflict between farmers and nilgai due to damage to the crops in the agricultural lands is increasing in recent years.

The villages in Rajasthan have the typical setting, with a centrally placed grazing area called 'Orans'. The primary vegetation in the 'Orans'

includes *Prosopis juliflora*, *Capparis*, *Zyzyphus*, and some other desert herbs predominantly. Nilgai usually takes daytime refuge in these areas and raid the crops during dusk and night. The present study was carried out in villages of Osian Tehsil, district Jodhpur, Rajasthan, from Oct 2020 to March 2021 by applying scan sampling methods during morning and evening hours. The direct sighting from a close distance without disturbing the heard of nilgai was made to observe the activities of nilgai in the area. The total numbers of nilgai were recorded along with the age, sex, and habitat during the course of the study period. All Nilgai groups encountered were classified as (a) adult male, (b) adult female, (c) sub-adult male, (d) sub-adult female, and (f) calves.

A total five numbers of herds were found, comprising a total of 83 individuals. The maximum numbers of individuals were recorded in herd 1 (21), while the minimum was found in herd group 03 (7). The heard wise composition of the group is given in Table 1.

Table 1. Population structure of nilgai (*Boselaphus tragocamelus*) in Aau oran area, Jodhpur

Number of Herds	Group composition						Total
	AM*	AF*	SAM*	SAF*	Calves	Unidentified	
1	2	8	1	4	6	0	21
2	0	6	2	5	4	0	17
3	4	0	2	0	0	1	7
4	3	7	1	3	4	1	19
5	0	9	2	3	5	0	19
Grand Total	9	30	8	15	19	2	83

*Am- Adult male, AF- Adult Female, SAM-Sub Adult Male, and SAF- Sub Adult Female

During the study period, an opinion survey was also carried out to estimate approximate crop damage and methods used by villagers to manage the crop damage in 4 villages of the tehsil. The information was collected on the occurrence and abundance of nilgai and their habitat and crop depredation patterns in the affected areas. The nilgai population was confined in and around the orans. A total of 80 farmers were interviewed, and as per the opinion survey, the damage to different crops by nilgai was mainly due to direct feeding and trampling. The estimates of damage to wheat (*Triticum aestivum*), gram (*Cicer arietinum*), and mustard (*Brassica campestris*) were in the range of 10-30 percent.

The management strategies adopted by villagers includes watch and ward during the critical period of crops, and different kind of fencing, such as barbed wire fencing, boundary wall, chain-link fences, live fencing, electric fencing, etc. More than 50 percent of framers in the area are using chain-link fencing, followed by barbed fencing (25%), electric fencing (23%), and only 2% are using live fencing. Evaluation of the efficacy of various kinds of fencing on the basis of damage to crops by nilgai revealed that the least damage was found in the field protected with the electric fence compared to other fencing and unprotected field. Less than 5% damage was noticed in electric fence fields followed by chain fencing 15-20% and barbed wire fence 25-30% compared to un-protected fields (50-60%).

Male antifertility effects of papaya seed powder against *Bandicota bengalensis*

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The importance of plants as a source of antifertility drugs has been emphasized by many researchers. Papaya (*Carica papaya* L.) seed extracts have shown great promise in the quest for a safer, cheaper, and alternative method of regulating fertility in male rats, rabbits, and monkeys. The *C. papaya* seeds contain active ingredients such as caricacin, an enzyme carpasemine, a plant growth inhibitor, and oleanolic glycoside, which cause sterility in male rats. The present study investigated the potential of papaya seed powder as a natural reproduction inhibitor for adult male *Bandicota bengalensis*, the most destructive rodent pest causing heavy losses to field crops throughout Southeast Asia. Exposure of different groups of male *B. bengalensis* to cereal-based bait containing 2, 3, and 5% concentrations of papaya seed powder for 15 and 30 days durations in bi-choice laboratory feeding tests resulted in the ingestion of a total 7.14-18.15 and 13.74-41.25 g/kg bwt of the active ingredient, respectively. The breeding performance of treated rats was 33.33 and 16.67% after treatment with 5% papaya seed powder for 15 and 30 days. Autopsy of rats immediately after treatment withdrawal revealed a significant decrease in weight of testis, cauda epididymis, seminal vesicles, and prostate gland. Sperm motility, sperm viability, and sperm count were found reduced,

and sperm abnormality increased significantly in the cauda epididymal fluid of treated rats compared to untreated rats. The total proteins, 17β-HSD, 3β-HSD, and testosterone levels were also decreased in treated rats compared to untreated rats. All the changes observed in treated rats showed partial or no recovery after 30 days of treatment withdrawal. The study suggests the potential of papaya seed powder in regulating the fertility of male *B. bengalensis* as part of an integrated rodent pest management program.

The potential of a synthetic predatory cue in the management of *Rattus rattus* population under store conditions

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Rodents cause huge losses to food grains at all the stages such as production, harvesting, transportation, storage, and marketing. The house rat, *Rattus rattus* is one of the major commensal and agricultural rodent pests worldwide. To date, the control of rodents relies extensively on the use of rodenticides which also affects non-targets. Biological control has the advantage of dealing with rodent problems without such side effects.

Evidence suggests that prey can detect cues of different predators and respond accordingly. Predator-based signals have been used experimentally to reduce damage to crops caused by wildlife. This aversion could be due to the sulfurous odours present in the urine of carnivores as a result of meat digestion. Prey may identify these odours and use them to assess the presence of predator. Predatory odours elicit a fear-of-predation response in prey animals which, in turn, leave the treatment area. Aversion to predatory smells appears to be innate in some rodents. Synthetic predatory odours function similar to natural predatory odours and have considerable potential as area repellents for controlling problem mammals in commensal and agricultural situations. The present study was conducted to evaluate the potential of 2,4,5-trimethylethiazol (TMTZ), a synthetic predatory cue based on odours from fox feces, in eliciting an aversive response in *R. rattus* and reducing the damage caused.

Different groups of mature and healthy *R. rattus* of both sexes were exposed to 0.5, 1 and 2% concentrations of 2,4,5-trimethylthiazole (TMTZ), applied through cotton swab on a daily basis and once in a week or fortnight basis under laboratory and simulated store conditions. Results revealed low food consumption from the treatment side compared to the untreated side at all the three concentrations of TMTZ applied once a week for all six days. Maximum aversion was observed at 2% concentration. No significant difference in percent repellency among all the 6 days with all the three concentrations of TMTZ applied daily for a week revealed no habituation to the predatory odour in the rats.

Under simulated store conditions, 1% TMTZ applied once through cotton swab prevented damage to bags containing grains up to 14 days. Spilled wheat grains collected from the untreated side when viewed under UV fluorescence in UV chamber showed fluorescence, thus indicating that in addition to consumption of food grains, rats also spoil the grains by contamination. The present study reveals the potential of 1 and 2% TMTZ in managing *R. rattus* population under indoor store conditions.

Potential of Barn Owl, *Tyto alba* as biocontrol agent of rodent pests in Punjab, India

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The use of rodenticides is an effective remedy against the overwhelming rodent population; however, due to the development of rodenticide resistance and environmental health hazards, there is a need to develop some environment-friendly and sustainable methods. In recent years, biological control using natural predators has been suggested for pest management. This method can be used as part of an integrated management approach for rodent pest species.

Barn Owl (*Tyto alba*) (Order: *Strigiformes*, Family: *Tytonidae*) is a cavity-nesting bird that has adapted well to trees, redundant buildings, and other shelters in rodent-rich environments. It is nocturnal and feeds almost exclusively on small animals, especially rats, mice, shrews, and occasionally

bats, birds, reptiles, amphibians, and insects. Its high mobility permits a quick response to spatially scattered rodent populations. Owls generally swallow their prey whole or in large pieces, and the indigestible parts (hair, bones, exoskeleton, etc.) are regurgitated in the form of a pellet. The pH of Barn Owl's stomach is less acidic than that of many other predatory birds, and hence most of the bones of ingested prey are left undigested. Such pellets prove useful for dietary analysis because they preserve the bones of prey items that can be easily exposed through a simple dissection process. The Barn Owl regularly drops at least one pellet daily from a roosting perch after hunting. The pellets are compact and slow to disintegrate. Diet composition studies of owls can provide the foundation for additional investigations, besides documenting the existence of certain prey species within the owl's range, its capability to take such prey, and the relative abundance of prey species in the owl's diet. In particular, these studies may be used in the process of evaluating the use of owls as biological control agents.

The use of Barn Owls to control rodents has been implemented in many regions of the world. In India, research on Barn Owls has mainly been conducted in southern parts about their prey composition, feeding behaviour, and utilization of man-made nest boxes. There is no information about their occurrence and diet composition from northern India. For the first time, a study was conducted in Punjab (North India), recording the diet composition of Barn Owl, *T. alb*a as determined through regurgitated pellet analysis to evaluate its potential as a bio-control agent of rodent pests.

Analysis of 390 regurgitated pellets of Barn Owl collected from six different locations in districts Ludhiana, Jalandhar, and Fatehgarh Sahib of Punjab revealed mean weight, length, breadth and thickness of pellets to be 4.7 g, 3.9 cm, 2.7 cm, and 2.0 cm, respectively. Remains of total 843 prey individuals including 372 rats (44.1%), 370 mice (43.9%), 96 shrews (11.4%), 2 bats (0.2%), 1 bird (0.1%) and 2 frogs (0.2%) were found in these pellets. The Diet of Barn Owl consisted only of vertebrates, 99.6% of which were small mammals, and 88% were rodents alone. Based on skeletal remains, the average number of rats and mice consumed per pellet of Barn Owl were found to be 1.1 and 2.3, respectively, with a maximum capacity of consuming four rats and nine mice per night. Rodent species consumed by Barn Owl were the lesser bandicoot rat, *Bandicota bengalensis*; Indian gerbil, *Tatera indica*; the

soft furred field rat, *Millardia meltada*; Indian bush rat, *Golunda ellioti* and field mouse, *Mus booduga*. Total active rodent burrows were highest in the radius of 1001-2000m from the nesting or roosting sites of Barn Owl, with the highest number of burrows of B. bengalensis at three locations selected. The study suggests the effective potential of Barn Owls as one of the components in integrated rodent pest management. However, the Barn Owl population is scanty in Punjab; therefore, steps should be taken not only to protect and conserve Barn Owls but also to increase their population by installing artificial nest boxes and perches to attract them to the crop fields and open storage godowns.

Efficacy of rodent management modules in groundnut (*Arachis hypogaea* L.)

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India is one of the largest producers of oilseeds in the world and significantly contributes to the country's agricultural economy. Among the oilseed's groundnut is called as the 'King' of oilseeds. Groundnut production is ruined by a series of diseases, insect and vertebrate pests. Among the vertebrate pests' rodents are very critical as these pests inflict severe losses from the day of sowing to the harvesting of the crop. Rodents damage the sown and sprouted seeds, damage the vegetative parts during burrowing, cause damage through cutting and feeding, and hoarding the pods. For the management of rodents, the application of rodenticides is often considered an effective method; however, the efficacy of rodenticide application may not provide sustainable results due to neophobia, shyness, resistance, improper bait placement, and timing and crop stage. In the present study, various modules were formulated and evaluated. The study was conducted for two years (2018-2020) in Tagachaguppe of Magadi taluka Ramanagara district in Karnataka. The experiments were laid by randomized block design with three replications. Each block measured about 1.5 acres, and the efficacy of treatments was assessed by recording live burrow counts and total yield. The recorded data were subjected to a one-way analysis of variance (ANOVA) for significance. The results indicated significantly highest (82%) reduction of live burrow

counts in T11 (zinc phosphide 2% baiting at germination stage and burrow fumigation with Aluminium phosphide at peg formation stage), which was on par with T9 (54 Snap traps/ha at germination stage and zinc phosphide 2% baiting at peg formation stage) with 80% reduction. The yield data also followed similar trends recording the highest yield of 1381.00 kg/ha in T11 followed by T9 with 1363.65 kg/ha. Control success on the base of LBC and yield gained with other treatments are given in Table 1. The C: B ratio was highest (1:38.82) in T7 with Zinc phosphide 2% baiting at peg formation stage with a yield of 1281.09 kg/ha followed by (1:32.67) in T8 with aluminum phosphide fumigation in burrows at peg formation stage (yielding 1306.11kg/ha). The above results convey that baiting at critical stages of the crop and combinational rodenticide application effectively managed the rodent population and enhanced the yield of the groundnut crop (Table 1).

Table.1. Evaluation of different modules in groundnut field for rodent management (2018-2020)

Treatments	Live burrow count/ha			Yield (kg/ha)	Cost: Benefit ratio
	14 days after the treatment (Peg formation stage)	Harvesting stage	Reduction in population %		
T1: Setting 54 Snap traps per ha at germination stage	33.33 ± 3.77	56.67 ± 3.64	31	1076.36	1: 4.37
T2: Zinc phosphide (2%) baiting at germination stage	28.33 ± 2.64	53.33 ± 3.64	35	1111.81	1:20.60
T3: Bromadiolone (0.005%) CB at germination stage	33.33 ± 2.64	58.33 ± 5.58	29	1024.00	1:10.19
T4: Aluminium phosphide application at germination stage	20.00 ± 2.00	43.33 ± 5.77	47	1190.01	1:22.82
T5: Setting 54 Snap traps per ha at peg formation stage	10.00 ± 2.00	28.33 ± 2.64	65	1252.27	1:9.23
T6: Bromadiolone CB (0.005%) at peg formation stage	18.33 ± 7.64	33.33 ± 2.89	59	1229.63	1:30.59

Treatments	Live burrow count/ha			Yield (kg/ha)	Cost: Benefit ratio
	14 days after the treatment (Peg formation stage)	Harvesting stage	Reduction in population %		
T7: Zinc phosphide (2%) baiting at peg formation stage	13.33 ± 2.89	25.00 ± 2.00	69	1281.09	1:38.82
T8: Aluminium phosphide application in burrows at peg formation stage	6.67 ± 2.89	18.33 ± 2.64	78	1306.11	1:32.67
T9: T1+T7	8.33 ± 2.89	16.67 ± 2.89	80	1363.65	1:10.17
T10: T3 + T7	8.33 ± 2.89	18.33 ± 2.89	78	1321.71	1:5.17
T11: T2 + T8	6.67 ± 2.89	15.00 ± 2.00	82	1381.00	1:21.88
T12: T2 + T6	11.67 ± 2.89	18.33 ± 2.89	78	1335.19	1:21.40
T13: Control	61.67 ± 3.77	81.67 ± 5.77	-	920.80	-
F test	*	*		*	
SEM ±	0.93	2.19		6.04	
CD (0.05)	1.69	4.10		7.62	
CV %	9.56	7.89		18.56	

Note; * significant at Pd0.05.

Efficacy of rodenticides in the management of rodents in coffee plantations

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India is the only country in the world where coffee is grown under a well-defined two-tier shade canopy of evergreen leguminous trees under monsoon rainfall conditions. Karnataka alone shares 71 percent coffee production of the country. Various potential pests, viz. insects, vertebrates, diseases, and nematodes, hinder coffee production. Rodents alone account for 5-19 percent of damage among vertebrate pests. The predominance of

Funambulus palmarum, *Rattus rattus*, *Bandicota bengalensis* and *Mus booduga* in the plantation were recorded (Table 1). Rodents damage the inflorescence, ripened and unripe berries, and make cuts in the growing tip of the shoot region. The grasses in the plantation facilitate the growth of the rodent population by providing favourable habitat. In the present investigation, seven coffee plantations were selected, out of which five were treated with commercially available rodenticides Zinc phosphide (2%) bait, Bromadiolone (0.005%) loose bait & cake formulation) and new rodenticides (Difenacoum (0.005%) cake, and Flocoumafen (0.005%) cake formulation whereas, in the 6th plantation, snap traps @ 54 per ha were employed with sanitation measures, and the seventh plantation was treated as control where no treatments were taken up. The study was conducted for two years (2017-2019). Rodent density (LBC/ha) and Trap index (TI) were recorded prior to and 15 days after the treatment. The results indicated that the percent reduction in TI and LBC/ha was highest (81.90, 66.47%, respectively) in treatment where the placement of snap trap @ 54 per ha with sanitation measures were followed. In case of rodenticides application all the treatments performed well with the per cent reduction in TI and LBC/ha with Zinc phosphide (2%) baiting (respectively), Bromadiolone (0.005%) loose baiting, Bromadiolone (0.005%) cake was 74.16 & 52.87%; 69.70, 54.65%; 70.29, 46.59%, respectively. Whereas the new anticoagulant rodenticides viz., Difenacoum (0.005%) cake and Flocoumafen (0.005%) cake yielded in reduction of Trap index to the extent of 73.27 and 75.22 % and rodent diversity to the extent of 52.47 and 56.69%, respectively. Thus the efficacy of both the new anticoagulants was at par with Bromadiolone (0.005%) in this study. The above result also conveys that trapping of migrated rodents along with habitat manipulation through sanitation appeared to be the most effective; however, rodenticidal baiting with new anticoagulants was also equally effective in comparison to both the commercially available rodenticides like zinc phosphide (an acute rodenticide) and Bromadiolone (anticoagulant) in managing rodent pest in the coffee plantation.

Table 1: Field efficacy of rodenticides in coffee plantation for management of rodents in coffee plantations.

Treatment	Pre-treatment		Post treatment (15 DAA)		Reduction in RD over Pre-treatment (%)	Reduction in TI over Pre-treatment (%)
	RD (LBC/ha)	TI	RD (LBC/ha)	TI		
Zinc phosphide (2%) baiting	19.14	39.50	9.02	10.20	52.87	74.16
Bromadiolone (0.005%) loose baiting	16.56	38.12	7.51	11.55	54.65	69.70
Difenacoum (0.005%) cake formulation	20.45	40.23	9.72	10.75	52.47	73.27
Bromadiolone (0.005%) cake formulation	21.68	38.17	11.58	11.34	46.59	70.29
Flocoumafen (0.005%) cake formulation	17.85	34.08	7.73	8.44	56.69	75.22
Snap trap @ 54 / ha with Sanitation	18.25	37.33	6.12	6.75	66.47	81.90
Untreated control	19.55	39.33	21.23*	41.46*	08.59*	5.43*

Species composition: *Funambulus palmarum*, *Rattus rattus*, *Bandicota bengalensis* and *Mus booduga*.

(*Increased over the pre-treatment)

- RD= Rodent density, LBC/ha = Live burrow counts / ha.
- TI = Trap Index = (((Number of rodents caught/Number of Traps Placed) x 12 / (Number of days traps are set)) X 7).
- TI = 1(0-10) LOW, 2(11-25) Moderate, 3(26>) High.

Rattus ranjiiniae

Rattus norvegicus

Rattus rattus

Contributions for inclusion in the Newsletter may please be forwarded alongwith 1 - 2 good coloured photographs to :

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