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# RODENT
## Newsletter

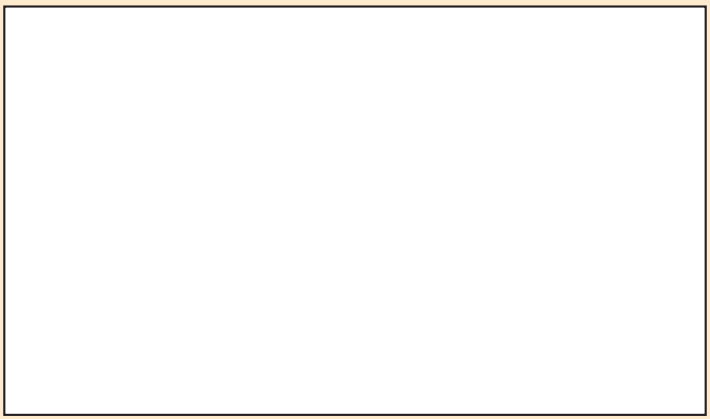
Vol. : 42 (1-4) 2018

**All India Network Project on Vertebrate Pest Management**

**ICAR-Central Arid Zone Research Institute**

**Jodhpur - 342 003, India**

## HEADING



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AINP on Vertebrate Pest Management
ICAR-Central Arid Zone Research Institute
Jodhpur - 342 003, India

# Altitudinal distribution of rodents on Ladakh range in Jammu and Kashmir

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Surveys on rodent diversity was undertaken along a transect in Ladakh Range, J&K, at altitudes ranging from 3350 to 5300 m, with a major focus on crop fields, grasslands, horticultural plantations and villages/ towns. A total of 132 individual rodents belonging to five species under three families were recorded from surveyed habitats. The species identified were: Little Indian field mice, *Mus booduga* (Gray), Turkish rat, *Rattus turkestanicus (Satunin) (=Rattus pyctoris* (Hodgson)), Blyth's voles, *Pitymys leucurus* (Blyth) (=*Phaiomys leucurus* Blyth), Himalayan marmot, *Marmota himalayana* (Hodgson) and *Rattus* spp.

The Himalayan marmots were observed at an altitude ranging from 3200 to 5000 m in grassland and barren lands. Marmots are heavily bodied rodents weighing around 6-8 kg. They make highly extensive burrow system, spread in an area of 15-20 m with 4-5 openings. A single burrow system is usually occupied by a single marmot, however the young ones remain with the mother and share the same burrows. Their activities were also noticed along the roadsides. The Blyth's voles, another species recorded from higher altitudes were mainly confined to grasslands at an altitude ranging from 4000-5000 m. The voles weighing 25-35g dig shallow burrow systems (up to 8 cm deep), spread in 8-10 m length with several intermediate openings. A single burrow system was generally occupied by a pair of vole. The Little Indian field mice were collected from the crop fields, field stores, poly houses, Godowns & shops and urban fallow. It was the most abundant species collected at an altitude of 3350 -3750 m). The mice, weighed 20-30 g with tail slightly shorter than head body. The burrow systems of mice were very simple and shallow with 15-20 cm depth and 60-75 cm long with maximum two openings. Each burrow system was occupied by 2-5 animals. The fourth species i.e., the Turkish rat was collected from godowns and shops, kitchen gardens and horticulture plantation in Leh city at an altitude ranging from 3300-3650 m. It weigh 150-200g with tail as long as head body. Besides, a single specimen of *Rattus* sp was also collected from crop field at an altitude of 3600 m.

# Giant Malabar squirrel, *Ratufa indica maxima*– an emerging problem in cocoa and coconut plantations in Kerala

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Giant Malabar squirrel, *Ratufa indica maxima* belongs to the sub family Ratufinae under family Sciuridae of order Rodentia (Fig. 1). Earlier, squirrels had been classified in two subfamilies: *Sciurinae* and *Pteromyinae* that included tree, arboreal and flying squirrels. However, with recent findings based on molecular evidences, squirrels are being now classified into five sub-families: *Ratufinae*, *Sciurillinae*, *Sciurinae*, *Xerinae*, and *Callosciurinae*. Giant Malabar squirrel (*Ratufa indica*), a large bodied squirrel is diurnal animal and feeds mainly on seeds, fruits, leaves and occasionally on small vertebrates and insects. Although arboreal squirrels are known to damage fruits in orchards, feed on crops and cause injuries to trees by debarking. Apart from being an indicator species for structurally diverse forests, arboreal squirrels play an important role in seed-dispersal helping in biodiversity conservation thus, providing valuable ecosystem services. Based on their pelage color *Rattufa indica* has five recognized sub-species, viz., (i) *R. i. dealbata* (Blanford, 1897) (believed to be extinct); (ii) R. *i. bengalensis* (Blanford, 1897), (iii) *R. i. centralis* (Ryley, 1913) (iv) *R. i. maxima* (Schreber, 1784) and (v) *R .i. indica* (Prater, 1980).

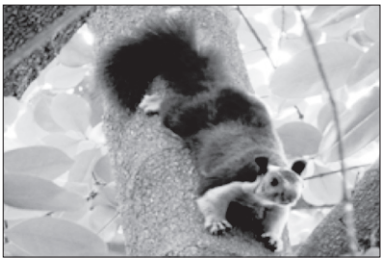

**Fig.1. The Giant Malabar Squirrel *Rattufa indica* maxima**

The present work had been carried out to know the human- squirrel conflict in the coconut, cocoa and other commercial plantations of Kerala. Direct observation of activity pattern, feeding preference and social interaction were made in the fields between dawn and dusk (6 AM to 5 PM) with the help of 10x35 binoculars. We recorded giant squirrel presence based on direct evidences (sightings and calls), and indirect evidences (nests). Since calls are heard from a maximum distance of 100 m the squirrels are assumed to be within the range of the observer. Distance sampling had been used for population estimation. Squirrels are generally found singly but are occasionally seen in pairs. Majority of the travel occurred during the morning and evening hours. During morning hours the squirrel travels away from the drey (nests)

and in evening the travel is towards the drey The location of dreys are mostly at the forked branch where crowns of neighbouring trees interlink so as to allow easy access for jumping and moving away from the drey. Average encounter rate of giant Malabar squirrel is 0.18 in the observation area.

In the survey, the damage to coconut, cocoa, banana and cashew plantations by R. *i. maxima* was also noticed (Fig. 2). Table 1 depicts the extent of damage by giant Malabar squirrels to cocoa at different stages.

**Fig. 2. Giant Malabar squirrel damage on cocoa pods and Coconut**

**Table 1. Giant Malabar squirrel damage to cocoa**

| Month | Stage of the crop | Damage (%) |
|---|---|---|
| June 2018 | Flowering | 1.26 |
| July 2018 | Flowering | 1.03 |
| August 2018 | Flowering/Fruiting | 2.84 |
| September 2018 | Fruiting | 3.10 |
| October 2018 | Fruiting | 7.99 |

# Rodent Pest Scenario and impact of rainfall on incidence and multiplication of *Bandicota bengalensis* in irrigated rice ecosystem of Godavari Delta of Andhra Pradesh.

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Rodents are one of the major biological production constraints in rice and Godavari delta of Andhra Pradesh is endemic to rodent problem. Several

factors like continuous availability of food and water, crop coverage all through the year, loamy black alluvial soils, intermittent coconut plantations etc. are the major reasons for persistent rodent problem in the region. The major rodent species present in the region is lesser bandicoot rat, *Bandicota bengalensis*, an aggressive dominant wet rodent species with high fecundity. Abnormal breeding of lesser bandicoot under 'r' strategies, especially during years of natural calamities; inundation of crop fields due to flash floods and heavy rains is well established. About 10-15% pre harvest damage to rice is quite common in Godavari delta of Andhra Pradesh and damage crosses even 38-45%, if shoot removal is after PI / 40 DAT. Rodent damage is often aggravated in *kharif* crop succeeding to summer pulse. In the past, the region has witnessed minor and major rodent out breaks generally at 4 and 10 year cycles, respectively. Due to shortage of irrigation waters and low market prices in 2009-10 the State Department of Agriculture had declared crop holiday in certain mandals of Godavari districts. The deltaic region had witnessed a major rodent outbreak in this year due to the population explosion of *B. bengalensis* following the cyclonic rains and the population immigration into the crop fields from the surrounding vacant fields aroused due to crop holiday.

Lesser bandicoot, *B. bengalensis* (upto 90%) followed by *M. booduga* (~ 10%) are the predominant pest rodent species associated with rice crop in this region. *B. bengalensis* remains fecund throughout the year with higher reproductive activity during the reproductive phase of the crop *i.e.*, March (*rabi* season) and Oct-Nov (*kharif* season). Previous data reveals that the super pregnancy/ super foetation was intermittent and the super pregnant females possessed almost double the number of embryos as that of normal pregnant females. The mean population growth estimates over the years indicated that, in general *B. bengalensis* could breed 2.7 and 2.45 times/season with seasonal productivity of 31 and 27 young ones/female during *kharif* and *rabi*, respectively.

Results presented in Table 1 revealed that the incidence of lesser bandicoot was very low (0-25 LBC/ha) from the year 2015 onwards till 2018. Correspondingly, the tiller damage was also low during these years. Highest tiller damage of 7.6% was noticed during the kharif 2015-16 and it was further reduced during the subsequent seasons. The number of females was also low during the year 2016 and 2017. Rainfall played a pivotal role on the incidence of *B. bengalensis* in rice ecosystem. The actual rainfall received was below the normal, which was more during 2016-17 and 2017-18 both in *kharif* and *rabi* seasons. The other weather parameters like temperature and relative humidity did not show any significant effect on the incidence and multiplication of the lesser bandicoots.

In general incidence of *B. bengalensis* was higher during the *kharif* season season (June- December) compared to the *rabi* season (December-March) as shown in Table 1. During the year 2018-19, being good rainfall year and rains received early in the season has resulted in slight increase in population of lesser bandicoots.

**Table 1. Rodent incidence and rainfall in Godavari districts**

| Year | LBC/ha | Mean tiller damage | Sex ratio (M:F) | Rainfall (mm) | | |
|---|---|---|---|---|---|---|
| | | | | Normal | Actual | Excess/ deficit (%) |
| 2015-16 | | | | | | |
| *Kharif* | 20.2 | 7.6 | 1:1.05 | 957.6 | 810.5 | -15.36 |
| *Rabi* | 7.6 | 0.75 | | 80.7 | 106.0 | -23.8 |
| 2016-17 | | | | | | |
| *Kharif* | 14.7 | 3.46 | 1:0.82 | 957.6 | 826.6 | -13.68 |
| *Rabi* | 9.6 | 2.17 | | 105.7 | 17.18 | -83.82 |
| 2017-18 | | | | | | |
| *Kharif* | 8.93 | 3.21 | 1:0.80 | 961.9 | 832.0 | -13.5 |
| *Rabi* | 15.44 | 2.46 | | 108.3 | 12.3 | -88.6 |
| 2018-19 | | | | | | |
| *Kharif* | 18.78 | 6.8 | 1:1.02 | 960.5 | 1060.8 | +10.44 |

Annual productivity was 31.93 during 2015-16 which was drastically reduced to 8.28 and 2.60 during rainfall deficit years of 2016-17 and 2017-18 respectively, however in 2018-19, being a good rainfall year recorded increased productivity (16.47) during *kharif* (Table 2).

Rainfall has showed positive correlation with all the parameters like rodent incidence (LBC), tiller damage and its growth parameters. Reproductive rate, litter size and seasonal productivity also showed positive correlation with rainfall and which are found highly significant (Table 3).

**Table 2. Population growth parameters of *B. bengalensis* in irrigated rice ecosystem**

| Population growth parameter | Mean Values | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2015-16 | | 2016-17 | | 2017-18 | | 2018 |
| | *Kharif* | *Rabi* | *Kharif* | *Rabi* | *Kharif* | *Rabi* | *Kharif* |
| Reproductive rate F* | 2.12 | 1.76 | 1.31 | 1.83 | 2.62 | 2.58 | 2.64 |
| Average litter /female | 7.92 | 8.60 | 2.55 | 2.70 | 0.49 | 0.51 | 6.24 |
| Productivity /season F x Avg. litter/ female | 16.8 | 15.13 | 3.34 | 4.94 | 1.28 | 1.32 | 16.47 |
| Annual Productivity | 31.93 | | 8.28 | | 2.60 | | 16.47 |

**Table 3. Correlation between rainfall and B. bengalensis incidence and its multiplication**

| Parameter | LBC/ha | Mean tiller damage | Reproductive rate F* | Average litter / female | Productivity /season |
|---|---|---|---|---|---|
| Rainfall (r) | 0.524 | 0.758 | 0.176 | 0.142 | 0.279 |
| | Significant | Significant | Significant | Significant | Significant |

From the above evidences it clearly indicated that, among the various weather parameters rainfall has played crucial role on incidence and multiplication of pest rodent species in the region in rice ecosystem. Based the results it may be concluded that the lesser bandicoots invariably requires good amount of rainfall for their incidence and multiplication.

# Predatory potential of Indian Eagle owl, *Bubo bengalensis*

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The Indian Eagle Owl or Bengal Eagle Owl, *Bubo bengalensis* is a large horned owl species found in South Asia. It builds terrestrial nests on hill slopes, earth cuttings and rocky outcrops and under bushes, where the surrounding areas consisted of agriculture, scrub or grassland, water body, hills and rural habitats which serve as its hunting grounds.

In the present study 3389 regurgitated pellets of Indian Eagle owls were collected from six roosting/nesting sites of rocky hillocks located in Tiruchirappalli District, Tamil Nadu, during January to December 2016 to understand prey composition and predatory potential of the owl species. The pellets were initially exposed to 70°C temperature in oven for 24 hrs to kill the associated arthropod parasites. The pellets were kept individually in 8% Sodium hydroxide solution in a separate container to segregate the osteous and chitinous remains. The osteous and chitinous remains were air dried and preserved for prey species identification. The observed osteous remains were mostly of skulls, mandibles, vertebrae, pectoral and pelvic girdles, limb bones, etc. The mandibles of lower jaws or dentaries were used as the keys for the identification of prey species as they occurred in most of the pellets. In the analyzed pellets, one set of mandibles (left and right) was counted as one prey species.

There were 6505 individual prey items representing seven species of small mammals, birds, bats, amphibians, insects, *Calotes sp* etc. The small mammals in the diet of Indian Eagle Owl were represented by six rodent species *viz.*, Mus sp. (26%); Millardia meltada (12.48%); *Bandicota bengalensis* (11.86%), *Tatera indica* (0.72%); *Rattus rattus* (0.83%); *Bandicota indica* (0.35%); unidentified rodent species (12%), and an insectivore, *Suncus murinus* (5.56%). Thus the prey composition in the diet of owl constituted a total of 64.24 % of rodents, 5.56% insectivores and 18.78 % of insects (that too large sized insects such as Rhinoceros beetles). Of the remaining 16.98 %, the prey composition included *Calotes sp*. (3.42%), amphibians (2.62 %), birds (2.5%), other reptiles (1.27%), *bat*s (0.4%) and other unknown species (1.21%) (Table 1). The observed mean prey items/pellet was 1.91 indicating that the Indian Eagle Owls consumed more than one prey/day.

**Table 1. Prey composition of Indian Eagle owl, *Bubo bengalensis***

| **Prey Species** | **Total Number of Prey items from six Roost/Nest Sites** | **Prey Composition (%)** |
|---|---|---|
| *Bandicota bengalensis* | 0772 | 11.86 |
| *Millardia meltada* | 0812 | 12.48 |
| *Mus sp.* | 1697 | 26.00 |
| *Tatera indica* | 0047 | 0.72 |
| *Rattus rattus* | 0054 | 0.83 |
| *Bandicota indica* | 0023 | 0.35 |
| *Suncus murinus* | 0362 | 5.56 |
| Unidentified rodents | 0773 | 12.00 |
| Insects | 1222 | 18.78 |
| Birds | 0162 | 2.50 |
| Bats | 0025 | 0.40 |
| Amphibians | 0171 | 2.62 |
| *Calotes Sp.* | 0223 | 3.42 |
| Reptiles | 0083 | 1.27 |
| Other unknown species | 0079 | 1.21 |
| **Total** | 6505 | 100.0 |

Analysis of data indicated that small mammals like rodents and insectivores formed the major portion of the diet of Indian eagle owl followed by insects. The owls might have used the crop fields and coconut grooves present in the study area as their hunting grounds and hence rodent pests and rhinoceros beetles dominated in the diet. Therefore it may be concluded that the Indian Eagle owl is an efficient predator of rodent and insect pests under agricultural ecosystems, and may be used as a bio-control agent against both vertebrate and invertebrate pests.

# Comparative Efficacy of K-othrine and Neem Oil to Control the Field rodents

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Rodent pests cause economic losses at every stage of crop production and storage besides being carrier of many zoonotic diseases. Rodent pest management technology now days mainly depend on use of broad spectrum acute and chronic rodenticides.

A lot of stress is being laid on exploring the possibility of using bio-pesticides for rodent pest management rather than toxic chemicals, as they are effective, economic, eco-friendly and nonlethal to control the pests . There is a long history to experiment the plant products as repellant or antifeedant to protect the crop from pests and diseases. Present investigation is an attempt to evaluate the efficacy of neem oil (a botanical) and K-othrine, a synthetic pyrethroid based natural pyrethrin against rodent pests under field conditions.

The field trials were conducted in wheat crop in the village Nyla, 30 Km from Jaipur. The burrows in the area were counted and plugged with with soil and marked. The opened or live burrows were treated with bait. The bait was prepared with Neem oil 10% using broken bajra grains mixed with 1% vegetable oil and evaluated in four plots. The second trial was conducted with K-othrine bait prepared in the same way in another sets of four plots. The baits were applied at the rate of 10g/burrow. After treatment the burrows were plugged again and on the next day the live burrows were counted for evaluating control success. The observations were recorded on $2^{nd}$, $4^{th}$, $6^{th}$ and $8^{th}$ week for number of burrows re-opened after each operation. The efficacy of modules was assessed in terms of percent reduction in live burrows before and after imposition of treatments at seedling, tillering and harvesting stage. The major rodent species inhabiting the study area were *Meriones hurranaae, Tatera indica* and *Rattus rattus*.

The results of the investigation revealed fairly good acceptability of the bait which remained effective for ten days after each application. It seems to be area repellent and also antifeedant. The results indicated that the treatment with 10% of Neem oil after $2^{nd}$ and $4^{th}$ and $6^{th}$ $8^{th}$ week of treatment, achieved a control success of 52.15% at seedling stage; 60.4% at tillering stage and 67.5% at harvesting stage. Likewise treatment with K-othrine, yielded 59.1, 66.1 and 78.2% control success at respective plant growth stages.

There results therefore revealed that use of such non-lethal compounds may be utilized for managing the pest rodents. However, further investigation are suggested for validation their effectiveness against field rodents.

# Trap Barrier System is an effective technique for protecting the rice nurseries against lesser bandicoot, *Bandicota bengalensis* in rodent endemic areas.

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Rodent pests are one of the major biological constraints in rice cultivation. Lesser bandicoot rat, *Bandicota bengalensis* is the predominant pest rodent species in rice ecosystem in the State of Andhra Pradesh and severely infests rice crop throughout its crop growth periods. Rodent problem is endemic to Godavari delta of Andhra Pradesh and rodents often causes 5-10 % yield loss at pre-harvest stage which may be as high as 80-100% during the outbreak years. Continuous availability good food and water, crop coverage all through the year, loamy black alluvial soils, intermittent coconut plantations etc. are supposed to be the major cause of persistent rodent problem in the region. Abnormal breeding of lesser bandicoot under 'r' strategies, especially during years of flash floods and heavy rains is well established in the region. Early or timely sown rice nurseries often suffers rodent attack by nibbling the seeds and its sprouts and damage to growing seedlings, thus necessitates repeated sowings by the farmers. Therefore, famers in this area generally prefer to delay or postpone the sowing of rice nurseries to escape/ avoid the rodent attack. As a result, transplanting of main crop gets delayed and crop harvestings often coincides with late cyclonic rains and crop loss.

Trap barrier system (TBS) is an ecologically based rodent management method comprises of a physical barrier combined with live-multiple-capture cages to manage pest rodents in rice fields. TBS works on the principle that attracts rodents to the enclosed trap crop which is sown 2-3 weeks earlier. The experiments were carried out to find out the efficacy of TBS in protecting the rice nurseries against lesser bandicoots and its halo protection on the following transplanted crop/ main crop at Research farms of AP Rice Research Institute and farmers' fields during *Kharif* in 2017 and 2018. TBS was constructed on the day of seed sowing and allowed till the pulling of the nursery. TBS of 20 x 5 m plastic fence was laid with 8 multi catch traps inserted intermittently at its base at equidistance. The fence was erected to a height of 2 feet above the ground and approximately 0.5 feet buried underground and fixed upright to the ground with bamboo sticks. Multiple capture traps were placed through the barrier with earth moats across leading to traps. The traps

were emptied early in each morning and the polythene barrier was checked daily for holes made by rats and repaired, if found any. The captured rodents were identified species wise and their sex and body weights were recorded throughout the nursery growth period. The individuals of *B. bengalensis*, the most common rodent species caught by TBS, were categorized into adults (body weight >150g in males and > 80g in females) and left over population was considered as juveniles. The live burrows were counted around the TBS in 10, 50 and 100 meter radius to ascertain halo protection offered by the TBS. Other two treatments i.e. farmer practice (burrow digging and trapping) and control (nil protection) were also compared to find the relative efficacy of TBS.

The trap catches revealed relatively lower rodent population (7-12 bandicoots) during kharif 2017 than that in 2018 (10-21 bandicoots trapped). The predatory snakes and mongoose also trapped in the TBS might be due to accidental entry in traps while chasing the rodent prey. Analysis of sex wise catches revealed higher catches for males (52) than the females (22). It can be viewed in supporting to the known fact that the females were attracted to the crop more during PI and flowering stages, mostly to acquire/ingest plant sap containing its breeding precursors/ stimulating substances, which needs further detailed investigation. Among the trapped individuals, adults comprised more (16-34) compared to juveniles (7-10) during both the years (Table 1).

**Table.1. Number of lesser bandicoot rats trapped in TBS erected around rice nurseries**

| Season and Year and location | No. of animals trapped | | Sex of *B. b.* trapped | | Stage of the animals trapped | |
|---|---|---|---|---|---|---|
| | *B. b.** | Others** | Male | Female | Juveniles | Adults |
| ***Kharif* 2017** | | | | | | |
| APRRI Research Farm | 08 | 02 | 04 | 04 | 02 | 06 |
| Farmers field (Vill. L.Koderu) | 12 | 01 | 07 | 05 | 02 | 10 |
| Farmers field (vill. B.Moguturu) | 07 | - | 04 | 03 | 03 | 04 |
| ***Kharif* 2018** | | | | | | |
| Research Station | 16 | 01 | 14 | 02 | 03 | 11 |
| Farmers field (vill. K. Chikkala) | 10 | - | 06 | 04 | 04 | 06 |
| Farmers' field (vill. Eletipadu) | 21 | 01 | 17 | 04 | 04 | 17 |

**B.b.: Bandicota bengalensis;* ** others – snake/ mongoose etc*

Data on efficacy of TBS as presented in Table 2 showed that rodent damage at Nursery stage was nil in TBS erected plots which reveals that TBS has offered cent per cent protection against field rodents in the rice nurseries. However in other fields rodents inflicted 3.8 and 8.6% damage (in farmer's practices) and 8.4 and 16.8% damage (in control) during 2017 and 2018 respectively. Further, Live Burrow Counts (LBC) were recorded from the surrounding fields at different radius intervals to ascertain its halo protection. In non-TBS fields the LBC were found more or less uniformly distributed (18.6 - 26.4 /ha), however in TBS fields the LBC was lower (6.4 - 12.4/ha). The LBC were in general higher near the TBS, with in the circumference of 10m, than the areas farther from TBS indicating that the rats were attracted to the lure crop present in the TBS and made burrows in the vicinity of the barrier (Table 2). In addition to nursery protection, TBS has also showed halo protection by way of driving and trapping the native and immigrant populations from the surrounding fields, thus reducing the population load in the following transplanted crop.

**Table 2. Efficacy of TBS against rodents in rice nurseries**

| Treatment | Nursery damage (%) | | Live burrows (LBC/ha) in main field in a radius (m) (mean of 2017& 2018) | | |
|---|---|---|---|---|---|
| | 2017 | 2018 | 10 m | 50 m | 100 m |
| TBS | 0.0 | 0.0 | 12.4 | 6.4 | 10.8 |
| Farmer practice | 3.8 | 8.6 | 22.6 | 21.4 | 18.6 |
| Control | 08.4 | 16.8 | 23.8 | 26.4 | 21.4 |

From the above studies it was established that, TBS is one of the best effective rodent management technology against lesser bandicoots in irrigated rice ecosystem, especially in rodent endemic areas. This technology may be promoted by the government agencies by subsidizing the input costs as it was an eco-friendly technique for rodent pest management.

# Surveillance of rodents in Medicinal Garden

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The main objective of this study was to determine relative abundance of rodents in farms and poly houses of medicinal garden of the University. The abundance of rodents was determined in medicinal gardens with 10 plant species following two methods, viz., live burrow counts (LBC) and trapping. The rodent species recorded were *Mus booduga*, *Bandicota bengalensis*, *Tatera indica*, *Funambulus palmarum* and *Rattus rattus*. Overall live burrow counts

ranged from 7/ha in *Ruta graveolens* (Rue) to 22/ ha in *Piper nigrum* (pepper) plots. The trap index in the study area was highest (28.65) in the plots of Piper nigrum and lowest (5.26) in *Plectranthus amboinicus* (Mexican mint) plots. The results on the Trap Index shown in the Table 1 indicates that *Piper nigrum* plots harbored high rodent population, however others showed moderate pest abundance except *Plectranthus amboinicus* which had low population intensity

**Table 1: Surveillance of rodents in Medicinal garden.**

| Name of the Plant | LBC/ ha | Trap index (TI) | Ranking of Trap index* | Rodent Species recorded |
|---|---|---|---|---|
| *Ocimum sanctum* (Tulasi) | 12 | 19.68 | Moderate (2) | *Mb>Bb>Ti>Fp* |
| *Bacoppa monnieri* (Water hyssop) | 18 | 22.69 | Moderate (2) | |
| *Mentha spicata* (Mint) | 08 | 13.56 | Moderate (2) | |
| *Plectranthus amboinicus* (Mexican mint) | 09 | 5.26 | Low (1) | |
| *Ruta graveolens* (Rue) | 07 | 12.65 | Moderate (2) | |
| *Piper nigrum* (Pepper) | 22 | 28.65 | High (3) | *Fp, Rr* |
| *Curcuma longa* (Turmeric) | 17 | 21.36 | Moderate (2) | *Mb>Bb>Ti>Fp* |
| *Aloe barbadensis* (Aloe) | 09 | 11.25 | Moderate (2) | |
| *Crithmum maritimum* (Sea fennel) | 13 | 19.85 | Moderate (2) | |
| *Centella asiatica* (Brahmi) | 14 | 17.98 | Moderate (2) | |

*Bb- Bandicota bengalensis Mb- Mus booduga Mme- Millardia meltada Ti- Tatera indica Fp- Funambulus palmarum, Rr- Rattus rattus.*

***Trap index Ranking**: Low: 0-10; Moderate 11-25 and high: >26**.**

# Efficacy of rodenticidal treatments in the management of rodents in Coffee plantations in Karnataka

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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 per cent of coffee

production of the country. The coffee production suffers greatly due to infestation of various potential pests, viz. insects, diseases, nematodes and vertebrates. Among the vertebrates, rodents alone accounts 5-19 per cent damage. Rodents damage the inflorescence, ripened and unripen berries and make cuts in the growing tip of the shoot region. The grasses in the plantation facilitates rodent populations by providing them conducive habitat. In the present study seven coffee plantations were selected, out of which five were treated with commercially available rodenticides like zinc phosphide (2%) bait, bromadiolone (0.005%) loose bait and bromadiolone (0.005%) wax cake, difenacoum wax cake (0.005%), and flocoumafen wax cake (0.005%) whereas, in the 6th plantation, only snap trap @ 54/ ha was employed with sanitation measures and seventh plantation was treated as control where no treatments were taken up.

The study was conducted for two years (2015-2016). The major rodent species recorded frcoffee plantations were *Funambulus palmarum*, *Rattus rattus*, *Bandicota bengalensis* and *Mus booduga*. Rodent density measured as Live burrow counts /ha (LBC/ha) and trap index (TI) were recorded prior and 15 days after the treatment. Rodent control success was worked out on the basis of both these parameters i.e., rodent density (LBC/ha) and Trap Index (TI).

Data presented in Table 1 reveals that rodent control success in terms of reduction in LBC/ha and TI was highest (66.47 and 81.90%, respectively) in the treatment where snap trap were placed @ 54 per ha with sanitation measures. In case of rodenticidal baiting treatments rodent control success was at par with all the treatments. Treatment with acute rodenticide (zinc phosphide 2% baiting) yielded an overall success (mean of both the methods) of 63.52%. In case of treatments with anticoagulant rodenticide, bromadiolone (0.005%) loose bait as well as wax cake formulation, the mean success was 62.18 and 58.44% respectively. The two new anticoagulants, viz., difencoum (0.005%) and flocoumafen (0.005%) wax cake formulations produced 52.47 and 56.69% success in terms of reduction in rodent density expressed as LBC/ha. Likewise, both these rodenticides yielded 73.27 and 75.22% control success in terms of reduction in trap index. However overall mean success was 62.87 and 65.96% with these respective anticoagulants. Both these rodenticides are yet to be registered with Central Insecticide Board. In the untreated control plantations the rodent density as well as trap index has increased by 8.59 and 5.43% due to immigration from other areas.

The results therefore indicate that use of snap traps along with habitat manipulation (regular sanitation in the plantation areas) and rodenticidal baitings with either zinc phosphide (2%) or bromadiolone (0.005%) may be employed for managing rodents in coffee plantations.

**Table1. Management of pest rodents in coffee plantations in Karnataka**

| Treatments | Pre treatment | | Post treatment (15 DAT) | | Rodent control success (Based on LBC/ha) | Rodent control success (Based on TI) | Overall control success (Mean of both methods) |
|---|---|---|---|---|---|---|---|
| | Rodent density (LBC/ha) | Trap index (TI) | Rodent density (LBC/ha) | Trap index (TI) | | | |
| Zinc phosphide (2%) | 19.14 | 39.50 | 9.02 | 10.20 | 52.87 | 74.16 | 63.52 |
| Bromadiolone (0.005%) Loose bait | 16.56 | 38.12 | 7.51 | 11.55 | 54.65 | 69.70 | 62.18 |
| Bromadiolone (0.005%) Wax cake | 21.68 | 38.17 | 11.58 | 11.34 | 46.59 | 70.29 | 58.44 |
| Difenacoum (0.005%) Wax cake | 20.45 | 40.23 | 9.72 | 10.75 | 52.47 | 73.27 | 62.87 |
| Flocoumafen (0.005%) Wax cake | 17.85 | 34.08 | 7.73 | 8.44 | 56.69 | 75.22 | 65.96 |
| Snap trap @ 54 / ha + Sanitation | 18.25 | 37.33 | 6.12 | 6.75 | 66.47 | 81.90 | 74.18 |
| Untreated control | 19.55 | 39.33 | 21.23* | 41.46* | (-) 08.59 | (-)5.43 | (-) 7.01 |

# Incidence of Nilgai in agricultural fields in arid regions

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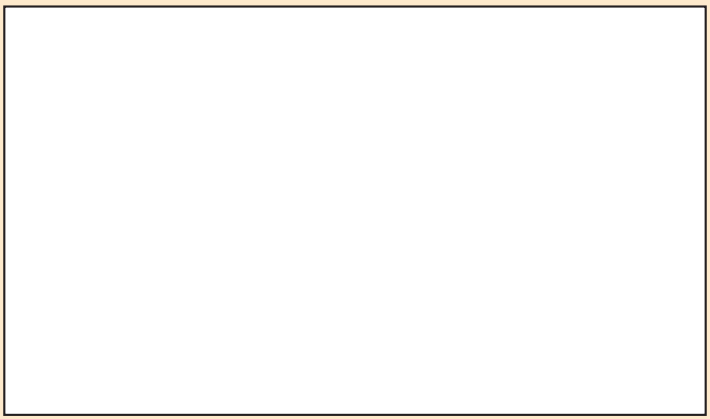
Crop raiding by locally overabundant population of nilgai (*Boselaphus tragocamelus*) is very common in Rajasthan. They cause immense damage to standing crops, trees & herbs through grazing, browsing and trampling activities. To acquire relevant information on the aspects of ecology and behavior of nilgai and the management practices adopted by the farmers for management of nilgai intensive surveys were conducted in the districts of Jodhpur, Pali, Jalore and Jaipur. The herd size of Nilgai raiding the crop fields ranged from 2-7. Damage to crops was mostly observed during evening and night hours. In addition to agricultural crops the animal mostly

prefers *Oran* vegetation on regular basis in arid regions. In Narmada canal command area raiding of sown crops results into trampling of 2-4 per cent sown area of wheat, mustard, cumin etc at vegetative growth stage. Mustard and castor suffers nilgai raiding at flowering and fruiting stage, respectively resulting into a plant damage of 20.0% (mustard) and 14.9% (castor).

An opinion survey of 100 farmers was also conducted. One third of the respondents opined that nilgai problem is more serious in agricultural crops; 16.67 % to *oran* vegetation and 50 % farmers reported that both *oran* vegetation and agricultural crops suffer the nilgai damage. Nilgai remains active most of the time in these areas. The activity period of nilgai is mostly during dusk and night as opined by 63.34% farmers, however 23.33% farmers said that some activity is also seen in morning hours. Majority of the farmers (83.3%) said that crop raiding incidence are irregular, as same herd rarely turned to the same field for some days. Likewise two third of the respondents (66.67%) opined that these animals raid the fields in groups of 1-10. Males quite often are seen solitary (16.67 percent response). Fencing of the area with watch and ward and driving the animal away by producing sound, as a method of nilgai management was revealed by 60% farmers.

The strategies adopted by the farmers to reduce crop damage include use of fear provoking stimuli, repellents (insecticide granules, animal excreta etc), trenching around crop fields and fencing (bio fencing, barbed wire, stone slab fencing), use of scare crows, deployment of professionals etc.

## HEADING



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