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## Rodent Management in Horticultural Crops

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### Abstract :-

Rodents have been acknowledged as one of the important agricultural pests, causing significant losses to field crops as well as horticultural crops. More than twelve rodent species are important from economic point of view, out of which only few namely: Indian gerbil (*Tatera indica*), squirrels (*Funambulus spp.*), porcupine (*Hystrix indica*), short-tailed mole rat (*Nesokia indica*), soft-furred field rat (*Millardia melitana*), mice (*Mus spp.*) and lesser-banded rat (*Bandicota bengalensis*) have been reported to damage horticultural crops. These species can be effectively managed by adopting integrated pest management strategies incorporating cultural, physical, mechanical as well as need based application of certain rodenticides.

### Key Word :-

Rodents, management, Field rats, Indian gerbil.

### Introduction :-

Since Vedic times, the Indian people realized the role played by the rodents as agricultural pests and the carriers of diseases. They are also termed as 'gnawing animals' and are one of the major pests of field crops, store grains, grasses, fodder crops, agro-forestation, orchards and vegetable crops. Rodents occupied an esteemed place in Hindu mythology as the carriers of Lord Ganesha and this religious belief has helped the man to accept rodents as a part of their life for centuries. Now the common people and the farmers in particular have started realizing the

rodents as pests because of the heavy losses done by them in fields, storage and houses. They also cause heavy damage by cutting electric wires, making burrows and to in earthen dams, by hoarding food in their burrows and to poultry industry.

Of the 1750 known rodent species from the world, 128 species occur in India (Parshad and Ahmad, 1996). Rodents are prolific breeders and often represent a significant amount of the animal biomass in forests, orchards and other natural ecosystems. As such, they play an important role in the food web, both as consumers of plants and fungi, and as a food resource for many of the larger predators (Aplin et al., 2003). They are also important environmental engineers, helping to spread pollen and seed, aerating the soil through their digging and burrowing activities, and in extreme cases (e.g. beavers), changing the whole nature of the landscape. These ecological benefits were sometimes called 'ecosystem services'. Rodents inflict serious damage to all types and all stages of crops, from sowing to storage.

In India reports on analysis of the information available on the damage and economic losses caused by rodents clearly shows that chronic damage ranging from 2% -15% persist throughout the country and severe damage sometimes even up to 100% loss of the field crop, was not rare (Parshad, 1999). Indeed, the conservation of non-pest species of rodents should always be of concern in any control programme. Studies on the ecological consequences of extensive deratization by chemical methods have conclusively shown that any rodenticides can have only a short-term effect, even when this agent was highly toxic and its effect is strong (Leirs et al. 1997). The affected population suffers a critical decline but rapidly restores its initial size due to self-regulatory population mechanisms (Krebs, 1999). Rodent conservation poses special challenges, especially where the separate imperative of small mammal conservation and pest rodent management meet and potentially collide in an agricultural landscape (Aplin and Singleton, 2002). Rodent management action can have potentially deleterious impacts on small mammals and other wildlife, especially where non-selective methods such as poisons were applied. However, without pest management, the crop production will be at risk. It is therefore evident that reducing harvest losses caused by rodents should be an integral part of the global goal of alleviating world hunger as well as meeting future food demands.

### **Research on Vertebrate Pest Management :-**

The Government of India has taken step to tackle the rodent problems and a National Plan for Rodent Pest Management has been launched which has 3 major components: (i) Training, (ii) Actual control operations and (iii) Preparation of community to undertake control operations. For this, AICRP project was launched on Rodent Control during 1977-78 at 3 centers, viz. CAZRI, Jodhpur; PAU, Ludhiana and UAS, Bengaluru with CAZRI, Jodhpur as the Coordinating Unit. During 1982 three more centres at CPCRI, Kasaragod; JNKVV, Jabalpur and ICAR Research Complex NEH, Barapani were added. The project was further strengthened and 2 centers at ANGRAU (ARS), Maruteru and IISR, Lucknow during 1985 and another two at GAU, Junagadh and YSPUH&F, Solan during 1987 were added. During IX Plan the project was rechristened as All India Network project (AINP) on Rodent Control; however, some centres were closed and one new center at AAU, Jorhat was started. During XI Plan CIARI, Port Blair and CAU (CH&F) Pasighat and during XII Plan KAU, Thrissur and OUA&T, Bhubneshwar were started (AINP on Vertebrate Pest Management, 2014a). During XII Plan ICAR merged the exiting vertebrate AINPs, viz. Rodents Control and Agricultural Ornithology with the new initiative on Higher Vertebrates (viz., Nilgai, wild boar and monkeys) so as to carry out R&D activities on management of these pests across the country under the umbrella of AINP on Vertebrate Pest Management (AINP-VPM) (AINP on Vertebrate Pest Management, 2014b).

Major International Centers have been operating in this field (e.g. Central Arid Zone Research Institute, India; Rodent control centre, Tanzania, Africa; Institute of Zoology, Chinese Academy of Sciences, Beijing, China) (Stenseth et al., 2001).

### **Damage :-**

Rodents alone cause over 15% losses to our food basket at pre-harvest (standing crops) as well as post-harvest stages (during processing, storage, transport, etc.). They also contaminate food/fodder/feed and are responsible for several communicable diseases. Orchards and vegetable fields are also seriously damaged by rodent pests. They eat or spoil the fruits or gnaw at vegetable stems. Squirrels are major pest of grapes, guava and other fruits while porcupines damages particularly tuber crops (Prakash, 1976). Rodents also damage coconut trees and coconut palms are severely destroyed by rats.

### **General habits of rodents :-**

- (a) Rodents are highly adaptable and can cope up with newer environments, new foods and adjust to new associates with a striking swiftness.
- (b) Primarily nocturnal, herbivorous and live in burrows.
- (c) Their learning ability is very sharp and they can discriminate harmful and harmless sounds and food.
- (d) Nocturnal rodents usually make simple and elongated burrows while diurnal rodents make complex and circular burrows.
- (e) During breeding season they enlarge their burrows and make breeding and hoarding pouches.



**Fig. 01 : Oening of rodent burrow in field**

- (f) Burrows (Fig. 1) give them some protection from predators and help them in thermoregulation. They make one or more emergency exit for escape.
- (g) Know their territory well and know where to find food and water and restrict their movement in 'home range'. Rats travel along a definite route, leaving well defined trails or runways.
- (h) Whatsoever food items they consume, much more than that they damage by gnawing.
- (i) They can survive without food and water for many days.

- (j) Spoil food items with their faecal materials; however, they are choosy and won't take moldy food.
- (k) Show the characters of bait preference and bait shyness.
- (l) They spread disease like plague and typhus fever, rat-bite fever, salmonellosis, etc.
- (m) Heavy losses are caused by them to electric wires, water pipes, railway property, earthen dams, poultry industry, house hold objects, etc.
- (n) Have high reproductive potential and multiply very fast.

### **Predominant rodent species in India :-**

Rodents are distributed from extreme desert conditions to green forests, deep coal mines to mountains, jungles to houses. The main features of predominant Indian rodent species are detailed below :-

1. **Squirrel :-** Two species of squirrels, *Funambulus pennanti* and *F. palmarum* are economically important. The former species occurs in north and northeastern India, whereas, the later one inhabits southern region. They are arboreal, found near villages, living commensally with man, but wild populations also occur, especially in rocky habitats. In wild state as well as in other habitats, it inhabits holes of the trunks of trees, but near villages and cities it mainly lives in crevices in the walls of buildings. The breeding female builds a brood nest. Litter size varies from 1 to 5.
2. **Porcupine :-** The Indian crested porcupine, *Hystrix indica* is predominant in rocky habitats and is destructive to the tuber crops and trees. It is nocturnal and live in tunnels. Its body is covered with quills with alternate deep brownish black and white bands. The porcupine breeds throughout the year with a litter size of 1 to 3.
3. **Indian Gerbil :-** The Indian gerbil, *Tatera indica* is distributed throughout India. This gerbil is highly adaptable and hence is able to spread in the desert as well as high regions of Assam. It is nocturnal and inhabits simple burrows. It has large body with tail longer than body and tail with a tassel of hairs at tip. It breeds throughout the year, litter size 1-9.
4. **House rat :-** The house rat, *Rattus rattus* is most common predominant species and is a serious pest of coconut. It breeds throughout the year with a litter size of 1 to 10 and gestation period of 25 days. Its tail are longer than body, commensal with man, nocturnal, fossorial and causes serious damage in house and fields.
5. **Soft-furred field rat :-** *Millardia meltada* is mostly found in irrigated crop fields, in bunds, in hedges and grasslands. It lives in the burrows vacated by the bandicoot rats or in crevices in irrigated crop fields formed by the drying of moist clay. It breeds throughout the year, and litter size varies from 2 to 10.
6. **Brown or Norway rat :-** The brown rat, *Rattus norvegicus* is universal in the cities and farm lands of the temperate countries but it is restricted only to major sea ports in the Indian subcontinent. Recently it is spreading in other parts of India through navigable routes.
7. **House mouse:-** The house mouse (*Mus musculus*) is most common species throughout the world. It is a commensal, small sized rodent occurring in the houses, shops, flourmills, backyards, gardens, cattle sheds, godowns, warehouses and poultry farms. It breeds throughout the year with litter size varying from 4 to 8.

8. **Field mouse :-** The common Indian field mouse (*Mus booduga*) is found active in field crops. It inhabits mainly by making shallow burrows up to a depth of 40 to 50 cm with one or two openings.
9. **Short-tailed mole rat :-** The short tailed mole rat, *Nesokia indica* is mainly found in northern part of India particularly in Punjab, Haryana, Rajasthan, Delhi and Uttar Pradesh. It inhabits cultivated crop fields and canal bunds. Its tail is very shorter than its body length.
10. **Lesser-bandicoot rat :-** The lesser bandicoot rat, *Bandicota bengalensis* is distributed throughout the India. It is nocturnal and fossorial rat which makes complex burrows. Its tail is shorter than body. Litter size 5- 8 and breeds throughout the year. It is the most common rat in urban areas and also a carrier of diseases. It is a serious pest of stored food grains.
11. **Large-bandicoot rat :-** The larger bandicoot rat, *Bandicota indica* is also found throughout India. It lives near human habitation and but it is most common in the orchards, gardens and other horticultural crops. It is nocturnal in habit and the litter size varies between 10 to 12.

Rodents, mainly gerbils, squirrels, porcupine, short tailed mole rat, soft-furred field rat and *Mus* spp. are major threat to vegetable crops, horticultural plants and nurseries (Prakash, 1976). These rodents feed on bark, stem and roots of the trees. They cut the root which affects the plant growth and as a result, plants die.

### **Management :-**

The rodent management operation should be undertaken on area-wide basis with the close cooperation of the people of the area. The most common signs of rodents' activities are: droppings, rub marks, runways, tracks, gnawings, live or dead rats, nests, and rodent odours. Control programmes must be aimed at controlling the entire population, not individual rodents. Programmes must include a survey to: (1) identify the species causing the problem, (2) determine the approximate size of the population, and (3) identify the characteristics of the infected area. More than one method is employed in an integrated manner for their successful management operation. When the operation is over, it is necessary that a follow up programme continues. Management strategies for rodents also include the following points (Desoky, 2018):

- Field must always be cleaned of weeds.
- Differences in species composition of rodents depend on locality, habitat type and preferred food.
- Close rodent active burrows in the outer border of the field.
- Observe the field continuously, especially in the final stage of maturity of crop and after irrigation.
- The management of rodents depends upon the locality, neighbouring and available food.

### **1. Inspection and identification :-**

Have a careful look and try to determine exactly where the infestation is coming from (typical signs are the smudge marks left by a rodent's oily hair, its droppings and any damage to goods or structures).



## 2. Cultural :-

**Sanitation :-** Removing the rodents' food sources is a key factor in successful rodent control. Try to reduce the number of extraneous water sources where rodents are able to drink water. Weeds in the fields and orchards, ill-cared garbage in storage and poor sanitation help in building up dense populations of rodents. Sanitation reduces their carrying capacity and infestation.

**Deep ploughing :-** Deep ploughing of orchards during non fruiting season helps in destruction of rodent burrows which exposes the newly born to the predators and adults migrate to other areas.

## 3. Mechanical :-

**Trapping :-** Trapping can be a very useful tool for the management of rats. If you have a rat problem in your field/ orchard it is important to be realistic about the number of traps that will be required to manage the issue. One or two traps will not curb a population and sufficient number of traps should be used (Quinn, 2018). There are many types of traps in use today which can capture rodents live or dead. Some commonly used traps are Sherman traps, and snap traps, urang or arrow trap, wonder trap, wooden trap, bow, pit fall traps (for dead trapping). Trapping method is more advisable for small areas with populations consisting of mostly adult rodents. It can also be used as follow up action after chemical control operation.

**Electric fencing :-** Fencing having electric charge is set around fields having valuable research materials.

## 4. Biological control :-

Methods for the biocontrol of rodents include sterility control, reproductive inhibitors, predators and parasites, and diseases.

**Predation :-** Cats, kites owls, snakes, etc. are important predators of rodents. These predators are useful in maintaining the natural ecological balance but do not prove to be an effective tool for rodent management as the predators has many limitations.

**5. Chemical control :-** The rodenticides form the major component of rodent management strategies. They are mixed with attractive food, so that the rat swallows it and dies. There are acute (single doses with quick action) and chronic (multiple dose with slow action) types. The acute poisons give a quick knock down, but rats associate their memory of poisoning and develop bait or poison shyness. The chronic poisons (anticoagulants) are safe, slow and are common in use all over the world.

**(i) Acute rodenticides :** Zinc phosphide ( $Zn_3P_2$ ) and barium carbonate ( $BaCO_3$ ) are used in India and preferred for field application.

The poison bait of zinc phosphide can be prepared by mixing following:

Zinc phosphide - 1 Part

Bait (grains or wheat / gram flour) – 40 parts

Mustard oil – 1 part

Sugar – 1 Part

For better results pre - baiting with untreated bait material is important. The control operations should be undertaken in a large area with careful planning. A follow-up programme should be continued.

Schedule of rodent management in fields as given by Prakash and Mathur (1987):

Day 0 – \*Survey to locate live burrows

\*Formation of squads

\* Distribution of works

Day 1 – Start pre-baiting

Day 2 – Pre-baiting

Day 5 – Poison baiting

Day 7 – Close burrows openings

Day 8 – Fumigation of burrows

Day 9 and 10 – sanitation

**Fumigation:** These chemicals kill rodents by entering body in gaseous form through respiration. In India, aluminium phosphide \*(R) tablets are commonly used for killing rat population in fields/ orchards. It releases phosphine gas on exposure to soil moisture (Pest Control Operations with Aluminium Phosphide may be undertaken only by Govt./ Govt. undertakings / Govt. Organizations / pest control operators under the strict supervision of Govt. Experts or experts whose expertise is approved by the Plant Protection Advisor to Govt. of India).

\*(R) For restricted use only

**(ii) Chronic rodenticides:** These are anticoagulants of blood and used in multiple doses, e.g. Coumatetralyl and Bromadiolone.

#### **Precautions :-**

- 1) Control operations should be undertaken by trained persons.
- 2) Keep rodenticides away from children and domestic animals.
- 3) Do not fumigate in rainy seasons and in residential premises.
- 4) Do not eat and drink anything while using rodenticides.
- 5) Wear protective clothing during operations.
- 6) Not breathing in dust during operations (wear dust mask).
- 7) Thoroughly wash the skin, clothing and equipment after operations.
- 8) Sanitation is very important after control operations.

#### **Public awareness :-**

Rodent management can only be successfully done with close cooperation of public and their awareness. Before undertaking any operation people should be educated by short pamphlet, training, lectures, electronic media, newspaper, etc. Besides this, good administrative set up is also necessary for success of the operation.

#### **Conclusion :-**

Rodent populations can be kept under threshold levels through effective management strategies. All the management tools, i.e. deep ploughing, trapping, proper application of baits and finally need based application of chemicals should be employed in a unified programme with community approaches for getting better results.

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