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RODENT AND OTHER VERTEBRATE PEST MANAGEMENT IN COCONUT AND COCOA



CENTRAL PLANTATION CROPS RESEARCH INSTITUTE
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INTRODUCTION

Among the non-insect pests, rodents are the major threat to plantation crops all over the world. Rodents belong to the class 'Mammalia' and can easily be distinguished from other mammals by the presence of a pair of chisel like evergrowing incisors or cutting teeth. These animals are the most successful living mammals both in terms of their numbers as well as species diversity. Their remarkable success can be attributed mainly to their ability to thrive in a wide range of climatic conditions, omnivorous feeding habits and potentiality to breed prolifically. They adapt well to the changing habitats, tolerate sub-lethal doses of poisons and learn quickly to avoid unsafe objects. The incisors of these animals are so sharp and sturdy that they can easily cut through any hard object, including the shells of nuts and seeds, aluminium pipes and domestic utensils. According to the Food and Agricultural Organization of the United Nations, crop loss upto 10% has been assessed due to rodent infestations in the under-developed countries. In perennial crops such as coconut and cocoa where the damage is cumulative, the problem is much more serious.

In India about ten species of rodents are found to co-exist in coconut and cocoa cropping systems (Table 1). Of these only seven species are considered to be the pests of these crops (Fig. 1). Among them, the black rat, *Rattus rattus* and the striped squirrels, *Funambulus* spp. are the most important ones.

A. RODENTS

1. Black rat

The black rat, *Rattus rattus* Linn. is medium sized (80-120g) and the most common rodent found throughout the country. Two sub-species of this rat, *R. r. wroughtoni* and *R. r. rufescens* are known to cause damage to coconut and cocoa in the mainland.

1.1 Biology

R. r. wroughtoni is nocturnal and arboreal. It is distributed in Kerala, Tamil Nadu, Karnataka, Andhra Pradesh and Maharashtra. In coconut plantations these rats live mainly on the crowns of palms by constructing nests either in the interspaces of nuts or inside stipules in the spindle of the palm. They move from one palm to the other through the fronds and seldom come to the ground for foraging. Coconut being a perennial crop provides abundant food and supplies water to these animals round the year. These rats breed all through the year with peaks during early summer (February and March) and late monsoon (July and August) periods (Fig. 2). The intensity of breeding is the lowest during summer months (April-June).

R. r. rufescens is a major rodent pest of stored grains and other food stuffs all over India. It sometimes migrates to the coconut and cocoa plantations from the nearby buildings.

1.2 Damage

A typical rat damage to tender coconut consists of a small hole of about 5 cm

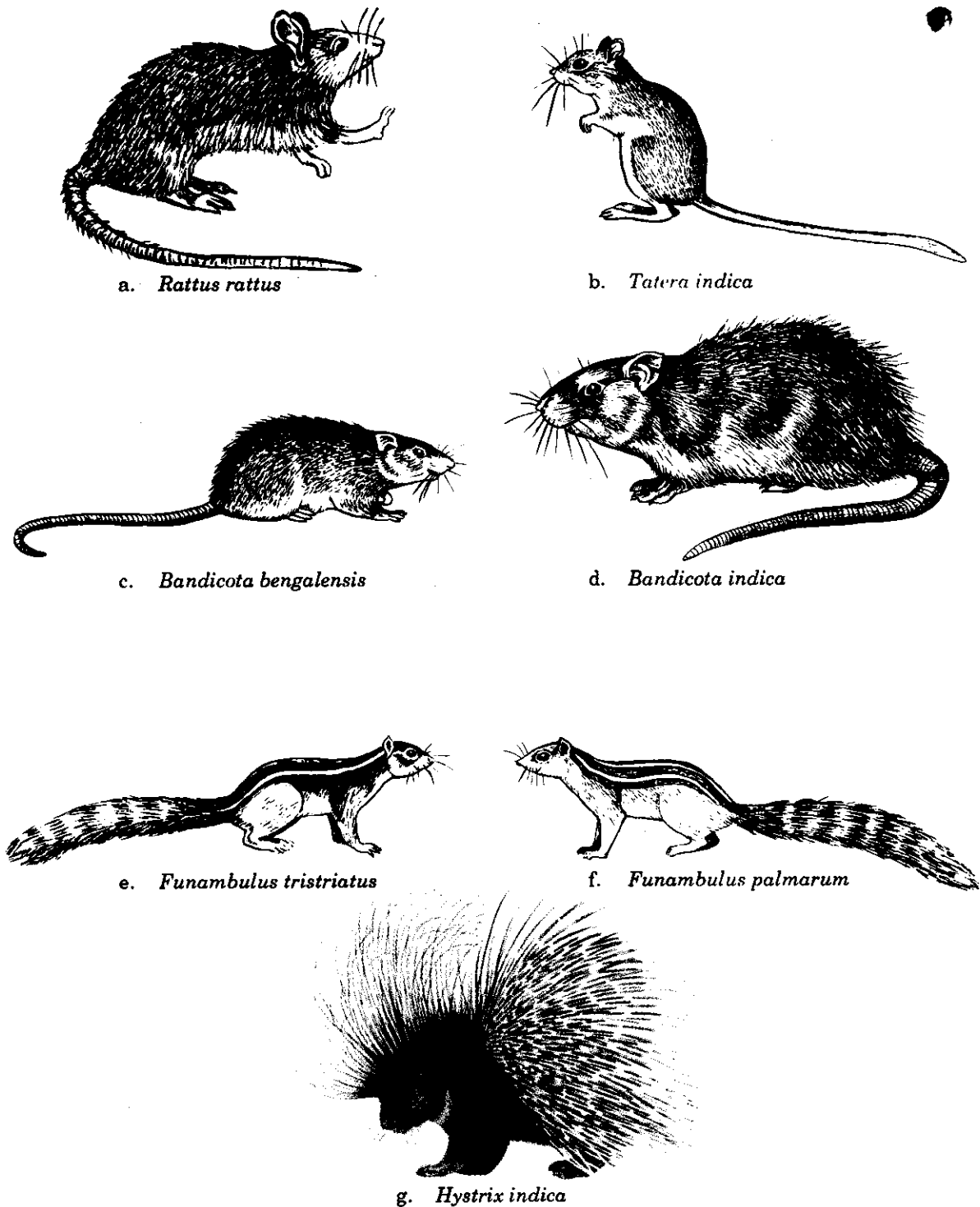


Fig. 1 Common rodent pests of coconut and cocoa (Diagrams not to the scale)

Table 1 : Common rodents infesting coconut and cocoa cropping systems in India and its islands

Common name	Species	Habits	Crop damaged
Mainland			
Black rat	<i>Rattus rattus</i>	Arboreal	Coconut, arecanut, oil palm, cocoa, cardamom
	<i>R.r. wroughtoni</i>		
	<i>R.r. rufescens</i>	Arboreal & commensal	Coconut, cocoa, cashew
Indian gerbil	<i>Tatera indica</i>	Fossorial	Coconut, cardamom
Lesser bandicoot	<i>Bandicota bengalensis</i>	Fossorial	Coconut, cashew, rubber, cardamom
Larger bandicoot	<i>Bandicota indica</i>	Fossorial	Coconut, cashew, rubber, cardamom
Western ghats squirrel	<i>Funambulus tristriatus</i>	Arboreal	Cocoa, coconut
South Indian palm squirrel	<i>Funambulus palmarum</i>	Arboreal	Cocoa, cardamom
Grey squirrel	<i>Sciurus</i> sp.	Arboreal	Coconut
Indian crested porcupine	<i>Hystrix indica</i>	Fossorial	Coconut, cashew, rubber
Andaman islands			
Andaman rat	<i>R.r. andamanensis</i>	Arboreal	Coconut, oil palm, cashew
	<i>R.r. holechu</i>	Arboreal	
	<i>R. pulliventer</i>	Arboreal	
Pulliventers rat			Coconut, oil palm, cashew
Lakshadweep islands			
Black rat	<i>R. rattus</i>	Arboreal	Coconut

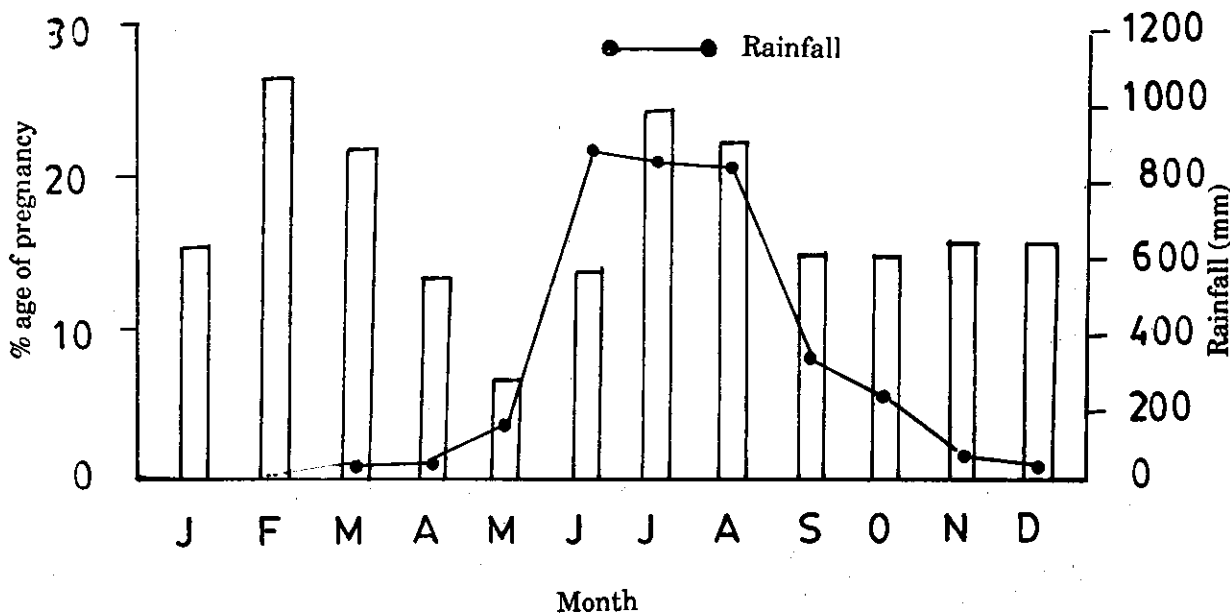


Fig. 2 Breeding season in *R. r. wroughtoni*



Fig. 3 Rat damaged tender coconuts still remaining on the bunch

diameter near the stalk region. The rat after gnawing the husk consumes the inner contents including the soft shell of the nut and such damaged nuts usually remain on the bunch for a further period of 2 to 6 days (Fig. 3). The fallen nuts are seen around the basin of the palm (Fig. 4). Three to six month old tender nuts are mostly preferred by these animals.

The extent of rat damage to tender coconut varies from 8.7% in certain parts of Andhra Pradesh to 50% in Lakshadweep islands (Table 2) where close planting is practised. The intensity of damage is more during summer and early monsoon (April-June) and less during post monsoon (August-October) (Fig. 5). Further, the damage increases when certain intercrops such as cocoa and cassava are cultivated along with coconut. Apart from tender nuts, these rats also damage leaf stalks, unopened spathe, female flowers and mature nuts in the field as well as nuts stored in the godown.

Table 2 : Intensity of rat damage to coconut in India*

State	Crop loss
Kerala	24% 21-28%
Karnataka	16.8 nuts/palm
Andhra Pradesh	8.7% 15%
Gujarat	9.3%
Andaman islands	32%
Lakshadweep islands	50%

* Based on the reference given in 'Rodents in Indian Agriculture'. Ed. Ishwar Prakash & P.K. Ghosh. 1992. Scientific Publ. Jodhpur 692 pp.

In cocoa, the black rats damage both mature as well as immature pods. The damage is mostly confined to the stalk end of the pod (Fig. 6). While feeding on the mature pods only the mucilage is consumed and the beans are discarded but in immature pods the beans are also damaged/eaten.



Fig. 4 Rat damaged tender coconuts fallen around the basin of a palm

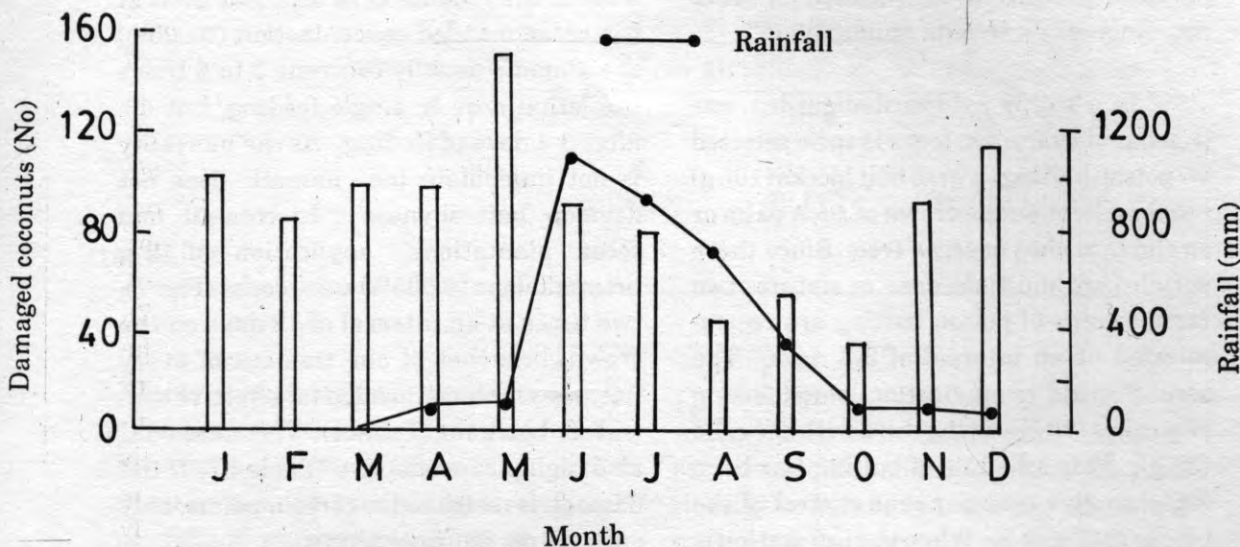


Fig. 5 Extent of rat damage to tender coconuts in different months

1.3 Control

In coconut plantations the black rats generally live on the crowns of coconut palm by constructing nests. Hence, removal of dried leaves, spathes and matrix regularly from the crowns expose the nesting places of these rats to predators. A habitat alteration discourages rats from population build up on the crown.

An effective chemical method of control for the suppression of this important pest is the use of multiple dose anticoagulants such as warfarin and fumarin. These poisons, being slow in action, do not induce any sort of bait shyness in rodents. The poison baits are prepared by mixing broken rice, jaggery, paraffin wax and poison (warfarin or fumarin having 5% a.i.) in the ratio of 12:1:6:1. First, the rice, jaggery and poison are mixed in a tray of convenient

size. In another vessel the paraffin wax is melted. The molten wax is then poured over the bait mixture in the tray, mixed



Fig. 6 Rat damaged cocoa pod

properly and spread evenly. Once the smooth surface is formed the slightly hardened mixture is cut into blocks of 4x4x2 cm. Each block weighs around 35 g.

In a highly rat-infested garden, one tree out of every five trees is to be selected for poison baiting. Three bait blocks (105 g) are then kept on the crown of such palm or on the branches of cocoa tree. Since these poisons are multiple dose in nature, two more rounds of poison baiting are recommended at an interval of 2-3 days. The second round of application is done using two cakes (70 g) and the third with one cake (35 g). This schedule of baiting has been found to give cent per cent control of the black rat (Table 3). When the infestation is restricted to certain palms, only such palms need be treated with poison baits.

The more effective and economic way of controlling this pest is by the use of single dose anticoagulant rodenticide

bromadiolone (0.005%) in wax cake formulation. The lethal dose of this poison to most of the rodents is so less that even at the recommended concentration (0.005%) the animals usually consume 3 to 6 times the lethal dose in single feeding, but die after 3-4 days of feeding. As the mortality is not immediate the animal does not develop 'bait shyness'. In coconut and cocoa plantations application of 10 g bromadiolone (0.005%) wax blocks (Fig. 7), two times at an interval of 12 days on the crowns/branches of one tree out of every five trees is recommended for effective control of black rat (Table 4). This method is also highly cost effective (Table 5). If the damage is restricted to certain palms, only such palms require baiting.

2. Western Ghats squirrel

The Western Ghats squirrel, *Funambulus tristriatus* Waterhouse is the common striped squirrel found in the West Coast and the evergreen forests of the Western Ghats and prevalent in almost all

Table 3 : Effect of warfarin and fumarin baiting on rat damage in coconut

No. of baitings	Treatment	No. of damaged nuts*		% age of reduction
		Pre-treatment	Post-treatment	
One application	Warfarin	63.5	29.5	53.5
	Fumarin	48.0	23.0	52.1
	Control	21.0	18.0	14.3
Two applications	Warfarin	23.5	7.0	70.2
	Fumarin	22.5	7.0	68.9
	Control	18.0	20.0	-11.1
Three applications	Warfarin	21.5	Nil	100.0
	Fumarin	27.5	Nil	100.0
	Control	20.0	24.0	-20.0

* Mean value of two 0.4 ha plots

The total cost of the bait material/ha for three applications is Rs. 100/- (1993)

Table 4 : Percentage of reduction in rat infested coconut palms and damaged tender nuts after bromadiolone baiting

Plot	Number of rat infested palms and tender nuts					
	Pre-treatment		After 1st baiting		After 2nd baiting	
	Palms	Nuts	Palms	Nuts	Palms	Nuts
Treated	45	103	8 (82.2%)	21 (79.6%)	0 (100.0%)	0 (100.0%)
Untreated	16	47	23	78	22	60

Percentage of reduction is shown in parentheses

habitats of this region including villages and towns, cultivated lands, orchards, plantations and forest lands. This is the largest species of the striped squirrels found in India and weighs around 125 g.

2.1 Biology

It is diurnal and arboreal living mostly on tree tops. It constructs globular nests on the bushy canopy of trees and even on the rafters of tiled or thatched buildings.

This squirrel exhibits bimodal feeding as well as activity patterns with one peak each during the morning and evening periods. During the hot mid-day period the squirrels invariably rest, stretching out on the cooler branches of trees. It breeds round the year, but more during summer (December-May) and less during monsoon (June-September) periods (Fig. 8).

Table 5 : Cost of the poison bait (0.005% bromadiolone) for treating 1 ha coconut garden against black rat

Poison bait required for 1st baiting	:	$30^* \times 10g=300g$
Poison bait required for 2nd baiting	:	$6^{**} \times 10g=60g$
Total requirement of poison bait for both the operations	:	360g
Cost of the poison bait @ Rs. 90/kg	:	Rs. 35/-

- * 30 bait points (palms) are sufficient for one ha
 ** After 1st baiting only 18-20% palms showed symptoms of rat infestation

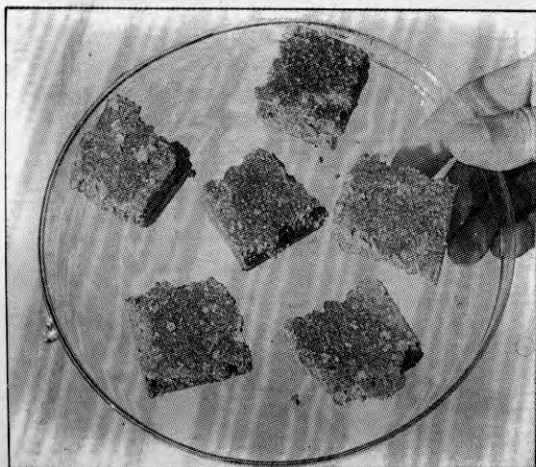


Fig. 7 Bromadiolone wax blocks

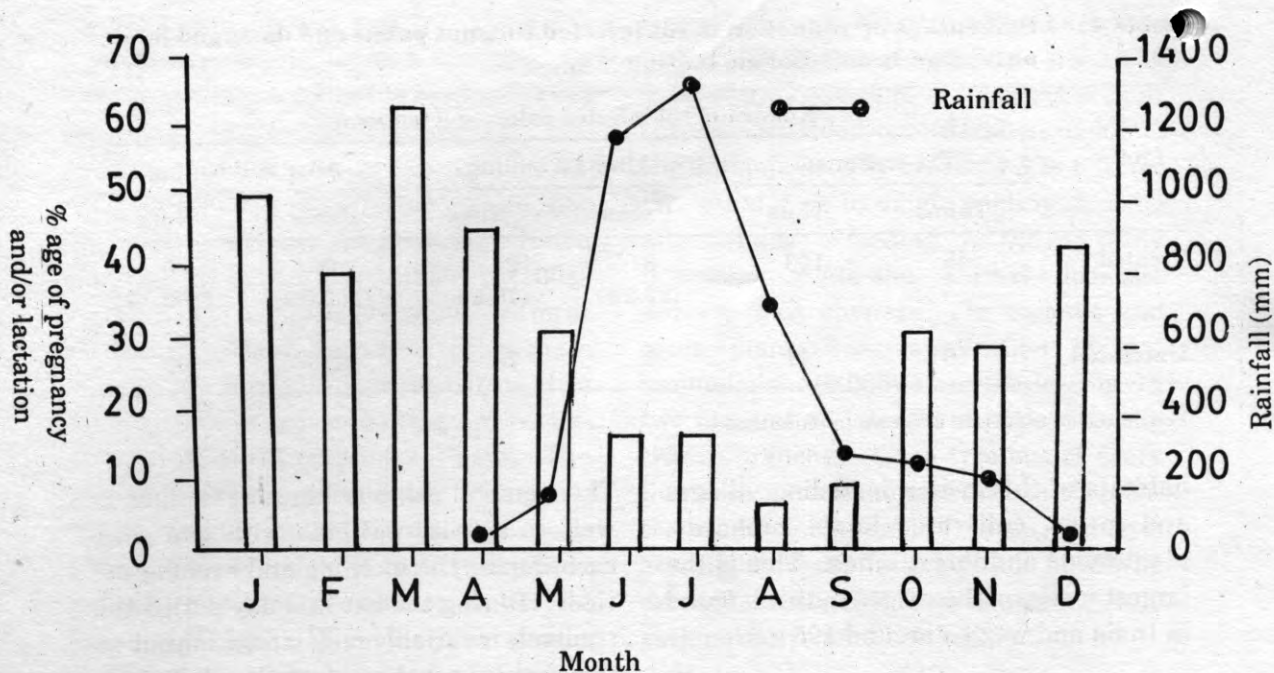


Fig. 8 Breeding season in *F. tristriatus*

2.2 Damage

The Western Ghats squirrel is the major pest of cocoa. It gnaws a hole in the centre of the pod (Fig. 9) and extracts the

beans to consume the mucilage. The naked beans are discarded.

The extent of rodent (both rats and squirrels) damage to cocoa varies from 18 to 47.6% in Dakshina Kannada district of Karnataka, 8 to 51.3% in different districts of Kerala and 18.5 to 50% in Kanyakumari district of Tamil Nadu (Table 6).



Fig. 9 Squirrel damaged cocoa pods

Table 6 : Intensity of rodent damage to cocoa in South India

State	District	% age of damage
Karnataka	Dakshina Kannada	18.0 to 47.6
Kerala	Cannanore	30.5
	Kozhikode	10.5
	Palghat	17.6
	Trichur	15.5
	Ernakulam	51.3
	Kottayam	33.3
	Quilon	14.7
	Trivandrum	8.0
Tamil Nadu	Kanyakumari	18.5 to 50

2.3 Control

In cocoa plantations timely harvest of mature pods will reduce squirrel damage to a certain extent. Studies have shown that poison baiting against squirrels is not a success. However, for the effective control of squirrels, trapping using wiremesh/wooden/metallic single catch 'live' traps is recommended (Fig. 10). From the data it is

observed that trapping is much superior to chemical control methods (Table 7). Ripe coconut kernel is the ideal bait to use in the trap. While setting the traps care should be taken to set them on the 'runways' of these animals. After setting the traps should be inspected daily and proper care taken to remove the trapped animals and re-set the traps. The presence of the bait

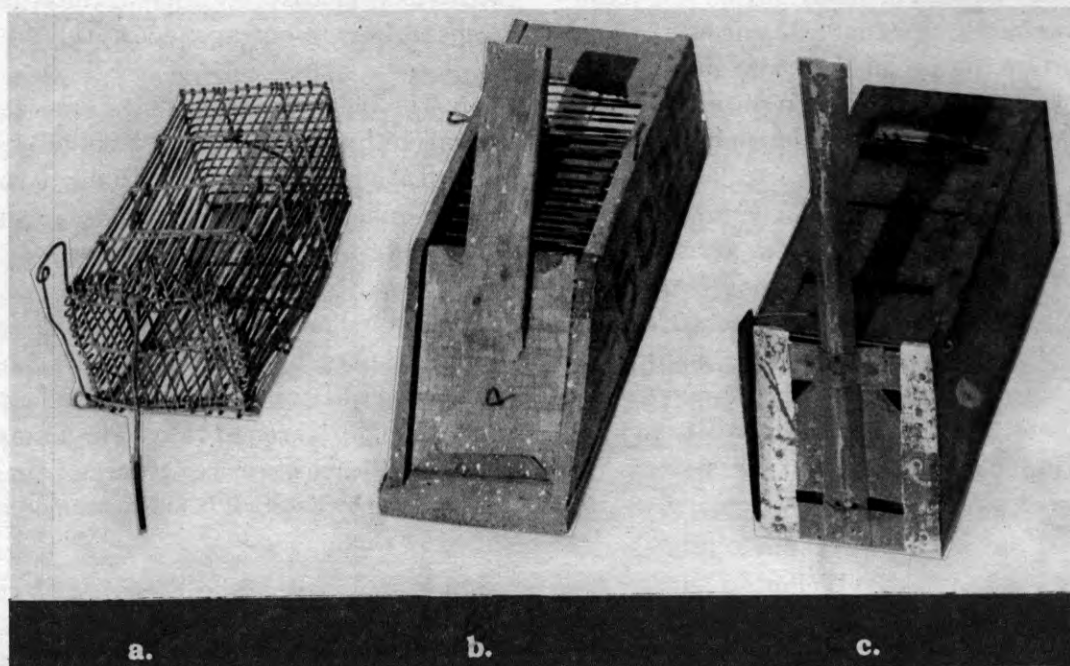


Fig. 10 Single catch 'live' traps. a. wiremesh; b. wooden; c. metallic

Table 7 : Relative efficacy of different methods of control against squirrels and rats in cocoa

Animal	Method of control	No. of cocoa pods damaged		% age of control
		Pre-control	Post-control	
Squirrel	Warfarin wax blocks	29	20	31.0
	Warfarin loose baits	55	33	40.0
	Zinc phosphide	17	14	17.6
	Trapping	27	0	100.0
Rat	Warfarin wax blocks	26	1	96.2
	Warfarin loose baits	36	1	97.2
	Zinc phosphide	36	0	100.0
	Trapping	11	0	100.0

inside and the functioning of the trap should be confirmed frequently. The success of trapping is more if carried out during the lean period of the crop (September-December) and when the alternate foods such as paddy, cashew and jack fruits are not available. Timely harvest of the pods will also help in increasing the efficiency of trapping. As the home ranges of squirrels cover an area of about 1.67 ha it is recommended to carry out trapping on a community basis by all the cocoa farmers in a locality. This will minimise the risk of immigration and population build up.

3. Other rodents

Other rodents which attack coconut are the lesser bandicoot (*Bandicota bengalensis*), larger bandicoot (*B. indica*), Indian gerbil (*Tatera indica*) and the Indian crested porcupine (*Hystrix indica*). All these animals are burrowing rodents. They dig extensive burrow systems and live inside.

The bandicoots are robust animals with rounded ears, and short and blunt muzzle. The tail is always shorter than the head and body. These animals have the habit of erecting their bristle-like hairs and grunting when excited. The lesser bandicoot (about 300 g) is much shorter than the larger bandicoot (around 1000 g). The former usually conceals its burrow entrance with a heap of loose soil whereas the latter keeps its burrow entrance open.

The Indian gerbil is a medium sized rodent (150 g). Unlike rats and bandicoots, the tail of a gerbil has a tuft of hairs at the tip. It inhabits semi-arid plains, grasslands and borders of cultivated areas.

The Indian crested porcupine is easily recognised by the covering of long spines or quills over the body. It is a large rodent weighing around 15 kg. The animal lives inside caves, crevices of rocks or in a burrow dug by itself. It is most common in



Fig. 11 Mature coconuts damaged by bandicoots



Fig. 12 A fresh burrow of *B. bengalensis* cleared to show the path leading to the bole portion of the coconut seedling

● forest areas, hilly slopes and riversides damaging plantations, forestry and tuber crops.

In coconut gardens the fallen nuts are damaged by bandicoots (Fig. 11) and porcupines. Both bandicoots and porcupines along with the Indian gerbil also damage coconut seedlings in the nursery. These burrowing rodents dig burrows underneath the coconut seedlings and eat the cabbage portion. The burrows of lesser bandicoots are generally concealed with loose soil and the burrow entrance is visible only after removal of this soil (Fig. 12), whereas the burrow entrances of the larger bandicoots and Indian gerbils are kept open. In certain parts of North Eastern region of India the squirrel of the genus *Sciurus* is reported to cause damage to tender coconut. However, the information on the extent of damage caused by all these rodents is scanty.

Both bandicoots and gerbils are effectively controlled by poison baiting using zinc phosphide. Poison baits can be prepared by mixing 95 parts of raw rice, 3 parts of coconut oil and 2 parts of zinc phosphide. Tubers of cassava can also be used as the bait. Since zinc phosphide is an acute poison rodents quickly develop bait shyness towards this poison bait. In order to overcome the problem of bait shyness plain baits (bait without poison) should be kept in each 'active' burrow for 2-3 days before putting poison baits.

The damage caused by porcupines could be minimized by covering the basal portion of the seedlings with wire mesh. Traps such as death fall trap or stockade

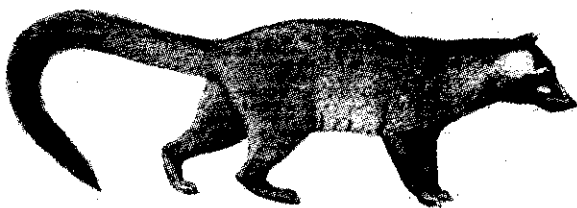


Fig.13 The palm civet, *Paradoxurus hermaphroditus*

trap are suggested to trap these rodents. Poison baiting with carbofuran granules in cassava tubers can also be tried to control porcupine menace.

B. OTHER VERTEBRATE PESTS

1. Palm civet

The palm civet, *Paradoxurus hermaphroditus* (Fig. 13) belonging to the order Carnivora, is very fond of fruits and has been recorded as a pest of cocoa. The animal is about the size of a small dog weighing 3.0 to 3.5 kg with a slightly pointed snout and a long hairy tail. The coat is black with white undercoat which is more prominent on the belly and sides of the body. The back is often with faint longitudinal stripes and shoulders and thighs with spots.

The palm civet is nocturnal in habit and is an active climber. It lives mostly on big trees and palms, lying curled up during day time. In towns, they usually hide in the



Fig. 14 Cocoa pods damaged by palm civet



drainage channels or on the false roofing of buildings. Unlike rodents, the palm civets are observed to bite and break open the cocoa pods. The pieces of broken chunks are 2-3 cm in diameter. There is no distinct pattern in the damage. In some pods the terminal half is removed (Fig. 14a), whereas in some others only one side is broken (Fig. 14b). In civet-damaged pods two distinctly placed (about 1.0 cm apart) markings caused by the canine teeth (biting teeth) are very prominent on the husk. Civets, unlike rodents, are observed to gulp the beans without mastication. Hence, such beans come out through the faecal matter undigested. The damage reaches upto 12.8% in certain areas.

The problem of civets in cocoa gardens can be effectively controlled by poison baiting with carbofuran granules using ripe banana as bait. A longitudinal slit

is made on the banana and about 0.5 g of carbofuran granules are placed in it and closed properly. Two such poison bananas each are to be tied to the branches of five to six cocoa trees per hectare.

2. Wild boars

The Indian wild boar (*Sus scrofa*) is one of the most troublesome animals to coconut gardens adjoining forest areas. They often attack seedlings as well as mature shed nuts. They are known to dig up the soil and break open the germinating nuts and consume the haustorium. In the case of fallen nuts, the husk is torn off and the shell is broken to consume the kernel. Erection of sub-lethal electric fence around the plantation or use of crackers have been found to give good protection against this pest in certain areas.

3. Monkeys

The bonnet macaque (*Macaca radiata*) is known to damage tender coconuts as well as cocoa pods in several parts of coastal Karnataka and Kerala. They come in groups and damage crops. In coconut plantations they pluck tender nuts, tear off the husk, drink tender nut water and eat the kernel whereas in the case of cocoa, they break open the pods and eat the beans. The control is mainly by shooting or trapping.

4. Woodpecker

The golden backed woodpecker (*Dinopium* sp.) is seen damaging tender coconuts as well as ripe cocoa pods. In coconut, it pecks on the husk of tender coconut near the stalk. In certain palms the damage is more perceptible, may be due to the tastier husk. Such damaged tender coconuts eventually fall and cause loss to the farmer. Damage is found to be more during summer months. However, the extent of loss is negligible in a plantation to warrant any control measure.

In cocoa these birds are observed to make small holes of 1-2 cm diameter on the

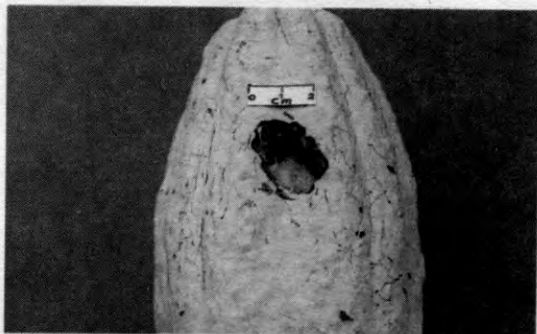


Fig. 15 Cocoa pod damaged by woodpecker

husk of ripe pods (Fig. 15). Unlike rodents, these birds generally don't extract the beans but lick the mucilage inside with their sharp, flexible tongue. The damage is generally noticed during summer and the intensity at times reaches upto 16.0%.

It can be concluded that for the control of rodent pests in coconut and cocoa cropping systems several effective and economic control methods are available. By adopting these recommended control methods crop losses caused by rodent and other vertebrate pests can be greatly reduced.