

Pests of Oil Palm

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1. INTRODUCTION

Oil palm (*Elaeis guineensis* Jacq.), like many other crops, is infested by a wide range of pests. In equatorial Africa, which is the native home of oil palm, except for the incidence of hispid beetle *Coelaenomenodera minuta*, no other major pests are noticed. However, in all the other countries, where oil palm is an introduced crop, pest problem have been frequent and severe. In India also, oil palm is infested by a wide range of fauna which includes insects, birds, rodents and large mammals (Dhileepan, 1987). In view of the potential of oil palm attaining popularity as a major oil yielding crop in India, it is essential to identify the prevalent and potential pests of the crop, and to develop suitable strategies for their management.

2. INSECT PESTS

In an introduced crop like oil palm, insect pest problem can arise because of :

- a) entry of pest species along with the imported germplasm,
- b) known insect pests of related native crops switching over to the introduced oil palm, and
- c) insects infesting forest species of plants getting adapted to oil palm.

In India, since the importation of germplasm is in the form of seeds/sprouts, possibilities for accidental introduction of the pest species from other countries are very much limited. But many of the pest species of related palm species such as coconut and areca palm have got adapted to oil palm. In India, majority of the oil palm plantations have been raised in and around forest areas, as a result, many insect pests of forest plants also got adapted to the oil palm. Survey of oil palm plantations and nurseries in India during 1985-1991 indicated that about 59 species of insects infest oil palm (Dhileepan, 1988, 1991a, 1992b). Eight out of 20 species of insects infesting oil palm nursery are known pests of areca palm. Among the 49 species of insects infesting field palm, 14 species are known pests of coconut palm and 19 species are known pests of areca palm. Insect pests of oil palm in India are similar to those reported from Malaysia and other South-East Asian countries.

2.1 Insect Pests of Nursery

In the oil palm nursery, insect pests of economic importance are not many, and those which infest cause only non-lethal damage leading to reduced vegetative growth and loss of vigour of the seedlings. The spindle bug *Carvalhoia arecae* and the tussock caterpillar *Dasychira mendosa* are the major pests of oil palm nursery (Table 1).

2.1.1 Spindle Bug

The spindle bug *Carvalhoia arecae* Miller & China (*Miriidae*: Heteroptera) primarily a serious pest of areca palm has in recent years, attained the pest status in oil palm also (Dhileepan, 1991b, 1992b). However, the intensity of infestation by *C. arecae* in oil palm is comparatively lesser than in areca palms. The nymphs and adult bugs suck the sap from the spindle and the unfolding leaves resulting in linear necrotic lesions. Infestation by *C. arecae* in the oil palm nursery was noticed only in Kerala, where the intensity of infestation ranged from 11.8 to 31.8 per cent. At Palode, spindle bug infestation

Table 1 : Important Insect pests of oil palm in India

Insect pests	Nature of damage	Category
Coleoptera		
<i>Oryctes rhinoceros</i>	Adults bore into fronds and spindle	+++
<i>Rhynchophorus ferrugineus</i>	Grubs feed on soft tissues of stem and meristem and kill the palm	+++
Heteroptera		
<i>Carvalhoia arecae</i>	Adults and nymphs infest spear leaves in the nursery	+++
Homoptera		
<i>Pinnaspis aspidistrae</i>	Encrust ripe and unripe fruit bunches	++
<i>Hemiberlesia lataniae</i>	Encrust ripe and unripe fruit bunches	+
<i>Chrysomphalus aonidum</i>	Encrust fruit bunches and leaves	++
<i>Dysmicoccus brevipes</i>	Encrust inflorescences and fruit bunches	++
<i>Palmicultor</i> sp.	Encrust spear leaves and unfolding leaves	++
Lepidoptera		
<i>Dasychira mendosa</i>	Larvae cause defoliation in nursery	+++
<i>Manatha albipes</i>	Larvae cause defoliation in adult palms	+
<i>Metisa</i> sp.	Defoliation due to frequent out-breaks	++
<i>Eumeta</i> sp.	Defoliation due to frequent out-breaks	+
<i>Thosea andamanica</i>	Defoliation due to frequent out-breaks	++
<i>Dama jasea</i>	Larvae cause occasional defoliation	+
Isoptera		
<i>Odontotermes</i> sp.	Form galleries on roots, inflorescences, spear leaves and fruit bunches	++

+++ = Major pests; ++ = Minor pests; + = Potential pests.

was noticed throughout the year, and the incidence was the highest during June. In the nursery, the spindle bug infestation was higher when the seedlings were maintained under areca garden than under oil palm plantation.

2.1.2 Tussock Caterpillar

The tussock caterpillar *Dasychira mendosa* Hb. (Lymantriidae: Lepidoptera), a polyphagous insect, is a known pest of areca palm, cacao and other crops. They also infest oil palm, especially in the nurseries at Palode (Kerala) and Shimoga (Karnataka) (Fig. 1). The larvae feed on the young and mature leaves, causing considerable defoliation. The per cent of seedlings defoliated ranged from 3 to 11 at Palode and around 20 per cent at Shimoga. In Kerala, though infestation by *D. mendosa* was noticed throughout the year, the highest incidence was recorded during June-July coinciding with the onset of rains.

2.1.3 Other Insects Infesting Nursery

Pseudococcids (*Dysmicoccus brevipes* and *Palmicultor* sp.) and margarodids (*Icerya aegyptiaca*) infesting the spear leaves of oil palm seedlings in Karnataka are the minor pests (Dhileepan, 1992b). Aphids *Mysteroneura setariae* and *Schizaphis rotundiventris* colonising on the under-surface of older leaves and Pseudococcid *Pseudococcus citriculus* encrusting spear leaves are the potential pests. Occasionally *Spodoptera litura* also cause defoliation in Kerala and Andhra Pradesh. Cockchafer beetles (*Apogonia* sp. and *Adoretus* sp.) and grasshoppers make short feeding holes in the older leaves of the seedlings. Other insects infesting oil palm nursery include *Gangara thyraxis*, *Paratettix* sp., *Proutista moesta*, *Ricania speculum* and *Odontotermes* sp.

2.2 Insect Pests of Field Palms

In the field palms, the rhinoceros beetle *Oryctes rhinoceros* (L.) and the red palm weevil *Rhynchophorus ferrugineus* Oliver are the major pests, while limacodids and psychids causing frequent defoliation and coccoids infesting fruit bunches are the minor pests. Termites and pseudococcids are classified as potential pests (Table 1).

2.2.1 Rhinoceros Beetle

The rhinoceros beetle *Oryctes rhinoceros* (L.) is primarily a serious pest of coconut palm and in recent years has attained the pest status in oil palm also (Dhileepan, 1988, 1992b). Infestation by *O. rhinoceros* was noticed in the oil palm plantations in Kerala, Karnataka, Andhra Pradesh, Maharashtra and Gujarat states as well as in the Little Andaman Island (Table 2 and Figs. 2 & 3). The damage is by the adult beetle which bores through into the spear leaves, resulting snapping off the fronds at the feeding sites. However, unlike in coconut, damage to inflorescence was not noticed in oil palm. In the oil palm plantation, failed female inflorescences, dead palm trunks, persistent leaf

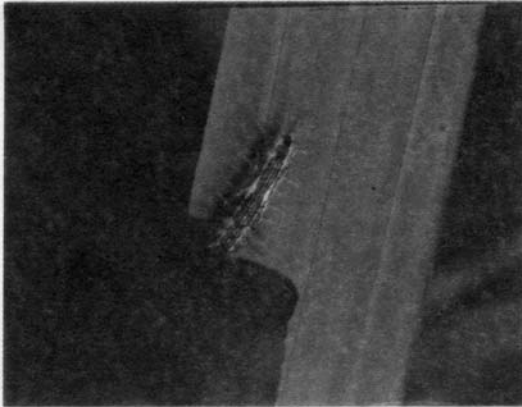


Fig. 1 : *Lymantriidae* (larva) feeding on oilpalm leaf.



Fig. 2 : *Oryctes rhinoceros* beetle damage in young oilpalm.

Fig. 3 : *Oryctes rhinoceros* damage in adult palm.

axils filled with organic waste and empty bunch heaps, which are available in plenty, act as ideal breeding sites for the pest. However, intensity of infestation by *O. rhinoceros* in oil palm is relatively less than that in coconut palm.

Table 2 : Intensity of infestation by the rhinoceros beetle in the oil palm plantations in India

State	Area (ha)	Infestation (per cent)
Kerala	3680	1.5 - 13.5
Andhra Pradesh	1050	0.3 - 15.0
Karnataka	1020	3.6 - 63.6
Gujarat	2000	15.0 - 20.0
Little Andamans	1593	< 0.01

2.2.2 Red Palm Weevil

Infestation by the red palm weevil *Rhynchophorus ferrugineus* Oliver was noticed in majority of the oil palm plantations in Kerala, usually resulting in death of the palms. However, intensity of infestation by *R. ferrugineus* in oil palm was less frequent when compared with that in coconut palm. Damage is due to the feeding activity of the grubs, usually 12-87 per palm, which bore through and feed on the softer tissues of stem and meristem. Palms infested by *R. ferrugineus* show gradual wilting and drying of outer whorl of fronds. In some cases, rotting of spear was also noticed. Except for the stray incidence at Manvi (Karnataka) and Eluru (Andhra Pradesh), infestation by *R. ferrugineus* has not been reported from other oil palm growing areas of this country.

2.2.3 Scales and Mealybugs

Around 20 species of coccoids (pseudococcids, diaspidids, coccids and margarodids) are reported from India (Dhileepan, 1991b, 1992b). Among them, diaspidids *Hemiberlesia lataniae* (Signoret), *Chrysomphalus aonidum* Linn. and *Pinnaspis aspidistrae* (Signoret), and pseudococcid *Dysmicoccus brevipes* (Cockerell) infesting oil palm fruit bunches are of economic importance (Table 1). At Chithara and Kulathupuzha plantations in Kerala, 3.1 to 10.7 per cent of unripe bunches and 39.5 to 100 per cent of the ripe bunches surveyed during 1987-91 showed the coccoid infestation (Dhileepan, 1992b). However, the actual economic loss due to this pest, particularly the quality of oil is yet to be assessed. *Dysmicoccus brevipes* also infested the pre-anthesising male and female inflorescences, affecting normal anthesis at Chithara and Kulathupuzha plantations. The pseudococcid *Palmicultor* sp. infested the spear cluster and unfolding leaves of the newly field planted oil palm in Shimoga (Karnataka) resulting in yellowing of unfolding leaves and stunted growth of the palm. Among the other diaspidids, *Ischnaspis longirostris* (Signoret) and *C. aonidum* infesting mature leaves are classified as potential pests. Coccids like *Coccus hesperidum* Linn., *C. acutissimus* (Green), *Eucalymnatus tessellatus* (Signoret), *Ceroplastes actiniformis* Green, *C. rusci* Linn., margarodids like *Icerya formicarum* Newstead, *I. aegyptiaca* (Douglas), *I. menoni* Rao and *I. seychellarum* (Westwood) and pseudococcid *Pseudococcus citriculus* Green, infest oil palm leaves throughout the year, but in fewer numbers, thus having no economic significance.

2.2.4 Nettle Caterpillars and Caseworms

Among the nine species of caseworms (Psychidae) and three species of nettle caterpillars (Limacodids) infesting oil palm (Dhileepan, 1991b, 1992b), the psychid *Manatha albipes* Moore causing occasional defoliation in Yeroor plantation (Kerala) is of economic importance (Table 1). Other psychids like *Manatha scolopepla* Hampson, *Metisa plana* Walker, *Kophena minor* Heylaerts, *Kotochalia doubledayi* Westwood and *Acanthopsyche cana* Hampson also occasionally infest oil palm. The spread of psychids within the plantation is either through across the fronds or by wind to adjacent palms. In Little Andaman Island, psychids *Metisa* sp. and *Eumeta* sp., and limacodid *Thosea andamanica* Holloway attained pest status causing severe defoliation due to frequent outbreaks. Other limacodids like *Darna jasea* (Swinhoe) and *Thosea aperiens* Walker are also commonly noticed in many of the oil palm plantations in the mainland, but without causing any major problem. In oil palm, infestation by psychids and limacodids are restricted mostly to outer whorl of fronds and occasionally in the middle whorl of fronds and never in the spear cluster and younger fronds.

2.2.5 Termites

In Andhra Pradesh, termite *Odontotermes* sp. infest the spear leaves, male inflorescences and fruit bunches of the field planted young oil palm. Termite galleries were noticed in 22.7 per cent of the field planted palms in Andhra Pradesh, and was restricted to the oil palm plantations with red soil and without adequate irrigation. In Karnataka, two species of termites, *Pericapritermes* sp. and *Hypotermes* sp., feed on the roots of the seedlings maintained in polybags, resulting in stunted growth of the seedlings.

2.2.6 Other Sap Feeding Insects

In the field planted young oil palms at Palode, infestation by *Carvalhoia arecae* was noticed only when under-planted in areca garden; while *C. arecae* attack was not noticed when planted in cleared forests or under-planted in coconut garden. Occasional infestation by the spindle bug was also noticed in the young field planted oil palms at Charmadi (Karnataka). In Little Andaman Island, the aphid *Astegopteryx raphidis* (Van der Goot) encrusted the oil palm and coconut leaves resulting in yellowing of leaves. Among the other sap feeding insects, Derbid, *Proutista moesta* (Westwood) noticed in majority of the oil palm plantations is of significance as they are putative to be vectors of MLOs (mycoplasma-like organism) causing root (wilt) disease of coconut and yellow leaf disease (YLD) of areca palms in Kerala.

2.3 Pest Incidence in Relation to Intercrops

The major problem of raising intercrops with oil palm is that they are susceptible to infestation by a wide range of insect pests. Hence, there should be no risk of an intercrop pest attacking the oil palm and developing into problem. Among the seven

species of forest plants, viz., eucalyptus, Australian black wood, Ailanthus, Albizzia, Subabul, Casuarina and cacao grown as intercrops with oil palm in an oil palm based agroforestry system, only cacao shared a common pest complex with oil palm. Insect pests of other intercrops like Albizzia, Ailanthus and Casuarina are highly host-specific. No pest incidence was noticed in eucalyptus and Australian black wood (Dhileepan, 1991a). In Andhra Pradesh and Karnataka states, the pest incidence in oil palm varied depending upon the local crops as well as upon the intercrops. In Karnataka, pseudococcid (*Palmicultor* sp.) infestation was more prevalent when oil palm was grown near sapota (*Acros sapota*) trees. Similarly, oil palm nurseries located near sugarcane fields had a very high incidence of aphid infestation. In Andhra Pradesh, defoliation by *Spodoptera litura* was noticed when oil palm was grown near tobacco fields or when tobacco was interplanted with oil palm. In both Karnataka and Andhra Pradesh, infestation by *O. rhinoceros* in oil palm was more severe, when under-planted in coconut gardens, than as pure crop. However, raising other intercrops like sorghum, maize, mulberry, lilly, onion, chilly, banana, groundnut, etc., with oil palm as practised in Andhra Pradesh did not pose any pest problem to oil palm.

2.4 Strategies for Insect Pest Management

Oil palm being a perennial crop, grown in extensive areas, provides congenial ecological niche for the sustenance of the pest species. Due to consistently favourable ecological niche, it is expected that the pest population would increase continuously resulting in 'chronic' infestation. But in nature, the pest incidence in oil palm is irregular and spasmodic, resulting in either frequent or occasional outbreaks. Such natural regulation of pest species is mainly due to biotic factors like predators, parasitoids and entomopathogens and, to a certain extent due to environmental factors acting directly or indirectly. Any disturbance in the equilibrium between the pest and its natural enemies results in pest outbreaks. In Malaysia, outbreaks of psychids is a clear example of disturbance in natural equilibrium due to indiscriminate pesticide application. Recent outbreaks of limacodids and psychid in Little Andaman Island is also believed to be due to indiscriminate use of pesticides. In view of the various complexities involved, the following factors are to be taken into consideration while formulating any pest management strategy :

- a) In India, all the insect pests of oil palm are native ones and as such there is no dearth of indigenous natural enemies for majority of them. It is necessary to survey and catalogue various natural enemies of the prevalent and potential insect pests.
- b) A thorough knowledge of the bionomics, population dynamics and alternative hosts of the pest species is essential.
- c) Application of pesticides to be restricted, if possible avoided unless it is essential. Indiscriminate use of pesticides against the non-serious insects would upset the natural balance.

- d) Oil palm is an entomophilous crop, and hence the exotic pollinating weevil *Elaeidobius kamerunicus* Faust was introduced and established into the oil palm plantations in India (Dhileepan, 1992a; Dhileepan and Nampoothiri, 1989). Application of pesticides will adversely affect the pollinators, thereby the normal fruitset as well.

In nature, *O. rhinoceros* is suppressed by entomopathogens like *Baculovirus oryctes* (virus) and *Metarhizium anisopliae* (fungus). Re-release of baculovirus in the oil palm plantations at Palode minimised the pest infestation by 50 per cent in the first three years, after which the infestation level remained low. When the infestation level is very high, especially in very young plantations, hand picking of adult beetles and placing 3-4 naphthalene balls in the axils of the youngest spear leaves at weekly intervals are recommended. Field sanitation and elimination of breeding sites like dead palm trunks, empty bunch heaps, etc, within the plantation are essential for the management of both rhinoceros beetle and red palm weevil.

The spindle bug *C. arecae* is naturally controlled by an entomopathogen *Aspergillus candidus* Link during the rainy season, which is the peak period of pest infestation (Dhileepan *et al.*, 1990). When the intensity of spindle bug infestation in the oil palm nursery is very high, placing 1-2 phorate sachets (0.2 g ai) in the axils of the new leaves is advised.

Various diaspid infesting oil palm leaves at Palode are naturally suppressed by the coccinellid predator *Chilocorus nigrita* F. Similarly, in Little Andamans, *Chilocorus coelosimilis* naturally controlled the diaspid *Aspidiotus destructor* infesting oil palm and coconut leaves. In view of the absence of any parasitoids or predators for diaspid like *Chrysomphalus aonidum* and *Hemiberlesia lataniae* infesting oil palm fruit bunches at Chithara and Kulathupuzha plantations, possibilities for introducing *C. nigrita* into these plantations appear promising.

3. AVIAN PESTS

3.1 Birds

Several species of birds cause extensive damage to oil palm fruits and are emerging as pests of oil palm in India (Table 3). In Kerala, the Indian myna *Acridotheres tristis* Linn., the jungle crow *Corvus macrorhynchus* Wagner and the house crow *C. splendens* Viellot cause heavy fruit damage. Other birds like crow pheasant *Centropus sinensis* Stresmann, the pariah kite *Milvus migrans* Skys, the white headed babbler *Turdoides* sp. and the large pied wagtail *Motacilla mederaspatensis* (Gmel) also occasionally feed on oil palm fruits (Dhileepan, 1989). In Little Andamans, the Alexandrine parakeet *Psittacula eupatria* (Linn.) cause severe damage to ripe fruit bunches. All these birds feed on the fleshy mesocarp of ripe fruits resulting in heavy fruit loss, thereby reducing the oil yield. Damage to oil palm fruit bunches by birds was noticed throughout the year, and no seasonal variation in damage intensity was evident. Infestation by birds was

Table 3 : Avian pests of oil palm in India

Pest species	Common name	Category	Location
<i>Acridotheres tristis</i> Linn.	Indian myna	+++	P,C,Y,K,T
<i>Corvus macrorhynchus</i> Wagner	Forest crow	+++	P,C,Y,K,T
<i>Corvus splendens</i> Vieillot	House crow	+++	P,C,Y,K,T
<i>Psittacula eupatria</i> (Linn.)	Alexandrine parakeet	++	LA
<i>Turdoides</i> sp.	White headed babbler	++	P,K
<i>Milvus migrans</i> Skys.	Pariah kite	+	P,C,Y
<i>Centropus sinensis</i> Stresmann	Crow pheasant	+	P,C,Y
<i>Motacilla maderaspatensis</i> (Gmel.)	Large pied wagtail	+	P

(P = Palode; C = Chithara; Y = Yeroor; K = Kulathupuzha; T = Thodupuzha; LA = Little Andaman).
+++ = Major pest; ++ = Minor pest; + = Potential pest.

more in ripe bunches (76%) than in unripe bunches (5.6%). Among the ripe bunches, *Dura* bunches are more susceptible (84%) than the *Tenera* (63%) bunches. However, damage to *Pisifera* bunches was uncommon presumably due to the low oil content of the fruits.

3.2 Nature of Damage

Feeding damage by birds in individual oil palm fruits can be identified and differentiated from that of rodent damage by their specific feeding marks. Rodents feed on the pericarp with their incisors and the characteristic gnawing marks will be present on fruits. Sometimes, they also cut open the seeds and feed on the kernel. Feeding marks by birds are unique that they feed exclusively on mesocarp and fibres of the mesocarp are left attached to the seeds. Damage by birds was either partial or complete. In partially damaged fruits, 40-50 per cent of the total weight of the individual fruits were eaten away by birds. In bunches with total fruit damage, nearly 68-73 per cent of the fruit weight was lost, when the entire mesocarp was eaten away leaving the seeds attached to the bunch. However, in many ripe bunches, the whole fruits were removed, resulting in 100 per cent loss of fruit weight. During initial stage of ripening (130-150 days old), partial fruit damage was more common ($r = 0.65$), while the complete fruit damage increased as the ripening of fruits progressed ($r = 0.73$). Fruit loss was very high in fully ripe (160-180 days old) bunches.

3.3 Economic Loss

Damage by birds was evident in 76 per cent of the harvested ripe bunches, and the number of fruits damaged in each bunch ranged from 1 to 850. Percentage of fruits damaged per bunch was higher in palms in border area (24.8%) than in the interior of the plantation (11.4%). In each damaged bunch, along with the number and weight of the partially and completely damaged fruits, average weight of the undamaged fruits was also assessed and the fruit loss per bunch was estimated using the following regression :

$$Y = -3.13 + 1.23x_1 + 0.78x_2 + 0.99x_3 + 1.00x_4 ; (r = 0.99)$$

where x_1 = age of palm; x_2 = location of palm; x_3 = partial fruit loss and x_4 = complete fruit loss.

The average weight of fruits lost per bunch due to bird damage was 2.3 kg/bunch in the border palms and 1.3 kg/bunch in the palms located in the interior of the plantation. In each harvested bunch, an average of 1.8 kg (14%) of mesocarp was lost due to birds damage. The average weight of fruits lost/ha/year was estimated as 2.8 tonnes, which is equivalent to 420 kg of palm oil which costs Rs. 4200 (Dhileepan, 1989). In many bunches, since seeds are also removed, considerable quantity of kernel is also lost.

3.4 Protection Against Bird Damage

Shooting of birds is the common method usually practised in the oil palm plantations. Shooting of birds twice a week (12-16 birds/week) and scaring them off by hanging the dead birds in the border palms, though less expensive (Rs. 432/ha/year), reduced the birds damage only by 10 per cent. Moreover, this method proved ineffective when practised for a long period. Application of insecticides (monocrotophos) to the oil palm fruit bunches in the initial stage of bird damage as trap-bunches (baits) is also less expensive, but reduced the bird damage only by 15 per cent. But this method is hazardous from human point of view. Moreover, such trap-bunches are unselective and could pose severe environmental problem. Protecting the bunches with wirenet (75 cm \times 60 cm) after 150 days of fruitset, though expensive (Rs. 1680/ha/year), is more effective resulting in 72 per cent reduction in bird damage. To prevent any damage by birds through the holes of the wirenet, a gap of 3-5 cm should be provided between the bunch and the wirenet. Wirenets discarded after two years of use (due to rusting) can also be used for covering the roots of the oil palm seedlings while planting, as a method to protect the seedlings from burrowing rodents. However, this method of protecting the bunches with wirenet is labour intensive and expensive (Rs. 2/bunch) and may not be feasible for larger plantations and older palms (Dhileepan, 1990).

3.5 Newer Methods for Avian Pest Management

Oil palm being a crop grown in larger holdings, feasibility of using conventional bird scaring devices like shooting, baiting, distress calls, reflective tapes, trap-nets, etc., is limited and less efficient. Hence, it is imperative to use newer bird scaring devices like 'solar scare crow', propane gas operated 'picoton missiles', 'vicllar Ipe II', etc., for effective protection of fruit bunches from bird damage. Radio-telemetry can also be successfully employed for larger areas to locate the roosting sites of various avian pests and destroy their nests (Dhileepan, 1990).

4. MAMMALIAN PESTS

Rodents, wild boar, porcupines, wild elephants, dogs, squirrels, bear, monkeys and cattle are the common mammals causing problem to oil palm cultivation (Table 4).

Table 4 : Mammalian pests of oil palm in India

Pest species	Common name	Family	Category	Location
<i>Rattus rattus</i>	Black rat	Muridae	+++	P,C,Y,K,T,Cn
<i>Rattus rattus wroughtoni</i>	Black rat	Muridae	+++	Ks.
<i>Rattus rattus andamanensis</i>	Andaman rat	Muridae	+++	LA
<i>Mus booduga booduga</i>	Field mouse	Muridae	++	P, Ks
<i>Bandicota indica</i>	Bandicot rat	Muridae	++	P,C
<i>Funambulus</i> sp.	Squirrel	Scivridae	+	P,A
<i>Hystrix indica</i>	Porcupine	Hystricidae	++	Ch, K,S
<i>Sus scrofa</i>	Wild boar	Suidae	+++	P,C,K
<i>Sus scrofa andamanensis</i>	Andaman wild pig	Suidae	+	LA
<i>Melursus ureinus</i> Meyr.	Indian bear	Uresidae	+	Bk
<i>Macaca radiata</i>	Macaque	Cercopithecidae	+	P,K
<i>Elephas maximus</i>	Wild elephant	Proboscidae	+	K,C

(P = Palode; C = Chithara; Y = Yeroor; K = Kulathupuzha; T = Thodupuzha; Ks = Kasaragod; Cn = Cannanore; Ch = Charmadi; Bk = Bukasagara; S = Sawantwadi; A = Andhra Pradesh; LA = Little Andaman).
+++ = Major pest; ++ = Minor pest; + = Potential pest.

Damage by these pests can be either in the nurseries and field planted young palms or in grown up palms.

4.1 Rodents

Rodents (*Rattus rattus*, *Mus booduga* and *Bandicota indica*) are the common pests causing serious damage to the field planted young seedlings (Table 5, Fig. 4). These rodents gnaw the bole region of the seedlings and kill the palms. Damage by burrowing rodents is normally noticed only in the young plantations of up to 2-3 years

Table 5 : Rodent damage to oil palm in India

State	Location	Year of planting	Number of palms	Rodent damage	
				Year	Per cent
Kerala	Palode	1984	300	1985	8.0
	Chithara	1988	4000	1988	30.0
	Cannanore	1987	1200	1989	3.4
	Kasaragod*	Nursery	425	1988	45.4
Maharashtra	Igatpuri	1988	225	1988	66.7
West Bengal	Mohitanagar*	1988	155	1989	1.3
Little Andaman	Hut Bay*	Nursery	1,60,000	1981	40.0
	Hut Bay*	1981	60,000	1982	29.5-47.3

*Bhat *et al.*, 1990.

*Dr. China Chenchia, personal communication.

*Subbiah, K.S., 1983.

old (Table 5). Field planted young palms in the border area are more susceptible to rodent damage than those in the interior of the plantation. Rodent damage was more frequent in Kerala and Little Andamans, where the oil palm plantations are surrounded by forests. In Andhra Pradesh and Karnataka states, where oil palm is raised in agroecosystems, rodent damage was not severe. Bhat *et al.* (1990) recorded *Rattus rattus wroughtoni* as a pest of oil palm seedlings at Kasaragod. Subbiah (1983) reported rodents as serious pests of oil palm plantations in Little Andamans. Incidence of rodent damage to the field planted young oil palm was also reported from Palode (30%), Igatpuri (66.7%), Cannanore (3.4%), Mohitnagar (1.3%) and Andhra Pradesh (Table 5). Rodents also cause considerable damage to unripe and ripe fruit bunches, but only in older plantations like Thodupuzha, Yeroor and Little Andamans. In Little Andamans, around 40-50 per cent of the unripe fruit bunches were damaged by rodents.

Damage by rodents to the newly planted oil palm seedlings can be prevented by covering the roots of the seedlings with wirenet (75 cm X 60 cm) while planting. Such protection in the border area alone, as a trial at CPCRI, Palode at an area of 3 ha protected all the seedlings from rodent damage, suggesting that this is a very efficient method. Since the weeds provide abundant nesting materials and protection, regular weeding of the plantation also minimised the rodent damage. Placing of 4-5 laterite blocks (50 cm long; 15 cm thick; 23 cm wide) around the collar of the field planted seedlings, as practised at Cannanore plantation, is very effective in preventing rodent damage (Fig. 5). This method is more efficient than covering the roots with wirenet, as the laterite blocks can be reused for any number of times and is cheaper also. For minimising the rodent damage to oil palm fruit bunches use of anticoagulant baits and traps are advised.

Squirrels (*Funambulus* sp.) occasionally feed on the mesocarp of oil palm fruits at Palode. At Vijayarai, squirrels eat away the emerging plumules (4.5%) of the sprouts planted in the polybags. Covering the polybags with nylon nets protected the sprouts from squirrel damage.

4.2 Large Mammals

Among the large mammals, the wild boar (*Sus scrofa* Linn.) and the porcupine (*Hystrix indica*) are the major pests. Other mammals like Indian bear (*Melursus ureines* Meyr.), monkeys (*Macaca radiata*) and wild elephants (*Elephas maximus*) cause damage only occasionally and are of minor importance only (Table 4).

Wild boars are nocturnal, causing damage to the field planted young seedlings and fruit bunches, in the oil palm plantations located in an around forest areas. At Palode during 1988, 54.6 per cent of the ripe fruit bunches and 6.5 per cent of the unripe bunches in the young plantation were eaten away by wild boar. Damage to the fruit bunches was evident only in the young plantation (3-5 years old), where the bunches are nearer to the ground level. Bunches which are 40-90 cm above ground level were more prone to infestation than those at 100 cm or above the ground level. Wild boars also uprooted the newly field planted seedlings and chew away the meristem.



Fig. 4 : Rodent damage in young oilpalm.



Fig. 5 : Placing laterite block against burrowing rodents.



Fig. 6 : Protection against porcupine damage.

Porcupines also cause serious damage by uprooting the seedlings at Charmadi (Karnataka), Kulathupuzha (Kerala) and Sawantwadi (Maharashtra). At Sawantwadi, around 2.7 per cent of the field planted one-year old seedlings were killed by porcupine damage. Construction of walls using laterite/granite blocks and mud, at a radius of 90 cm from the palm base and to a height of 75 cm as practised at Charmadi is an efficient method to prevent the porcupine damage. Use of baits containing zinc phosphide is worth trying. However, the spiral wire guards, which are very effective against large mammals are not effective against porcupines (Fig. 6).

Damage by other mammals is occasional and localised without any serious economic loss. Monkeys occasionally removed the ripe fruits at Chithara, Kulathupuzha and Palode plantations. Cattle as pests, causing defoliation was noticed at Chithara, Yeroor and in some of the demonstration plots in Karnataka. However, cattle grazing was noticed for the initial 2-3 years only. Uprooting of seedlings and removal of spear leaves by Indian bear was reported from Bukasagara (Karnataka). Occasionally, dogs also chew the ripe fruits fallen from bunches.

4.3 Management of Mammalian Pests

Approach for the management of mammalian pests of oil palm, especially that of large mammals, involving physical barriers appears to be more efficient. Live traps and deadfalls as well as other indigenous rodent traps are also efficient in minimising the burrowing rodent population, especially in smaller areas. Manipulation of predators for the management of mammalian pests is gaining importance. In the oil palm plantations of India, except for the rat snake (*Ptyas mucosus*), no specific natural enemies have been recorded for the mammalian pests. The barn owl (*Tylo alba*) and the monitor lizard (*Varanus* sp.) can also be exploited for managing the rodent pests of oil palm. In Little Andamans, where rodents are the most serious pests of oil palm, efforts are being made to introduce the barn owl (*Tylo alba*) from the main land (Tamil Nadu) area.

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1. INTRODUCTION

Cocoa (*Theobroma cacao* Linn.) is cultivated in India on a large scale for the last 20-25 years. It is grown mainly in Kerala, Karnataka and Tamil Nadu, mostly as a component of mixed crop with arecanut or coconut. In few instances, it is grown in forest clearings with few forest trees retained as shade trees. In the last 25 years of cultivation in India, the cocoa plant is infested by most of the polyphagous forest pests of this part of the country, but none of them have evolved to a status which warranted regular chemical control. Probably this 20-25 years period is not enough for these weevils to acclimatise to this crop. Another reason is the time lapse in area under the crop. For within a short period, one group of pests have become a major threat to this crop economically, they are the rodents. The reason for this sudden acclimatization of rodents to cocoa pods may be the reduction in number of their traditional fruit crops.

Of course, few of the insects could cause severe damage during the initial years of the plant and few sucking insects could cause direct loss of the crop by sucking on young and maturing cocoa pods. In this chapter is presented the available information on the insect and other pests of cocoa in India. The insects are grouped according to the damage they cause to the crop.

2. INSECT PESTS

2.1 Sucking insects

2.1.1 Mealy Bugs

This cosmopolitan group of insects with exceptional powers of dispersal are first appearing cocoa from the initial years of introduction to India.

2.1.1.1 Cocoa mealy bug, *Pseudococcus blattinus* (Cox.) (*Pseudococcidae*). It is regarded as a serious pest from India in the seventies. It ranks as the most important pest causing damage to cocoa and is present in all cocoa tracts of the country. This occurs everywhere in the crop and is present throughout the year (CPOBI, 1977). This infests the lower parts of the plant, such as the growing tips of the shoots, the terminal buds, the stem sections, the young cherries and the mature pods. Mealy bug feeding on the