6

PESTS

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Arecanut palm, *Areca catechu* L. is attacked by several insect and non–insect pests. They infest all parts of the palm such as roots, stem, leaves, inflorescence and nuts. Since the earliest record of brown bug *Saissetia hemisphaericum* Targ. as a pest of arecanut by Coleman and Rao (1918), about 90 insect and non–insect pests have so far been reported on arecanut palm, including pests on stored arecanut (Appendices 6.1 and 6.2).

Among these, the four pests which cause considerable economic loss to the crop are mites, spindle bug, inflorescence caterpillar and root grubs. They are either seasonal or persistent on the crop. Though not highly host specific, they always infest the crop and assume serious proportions.

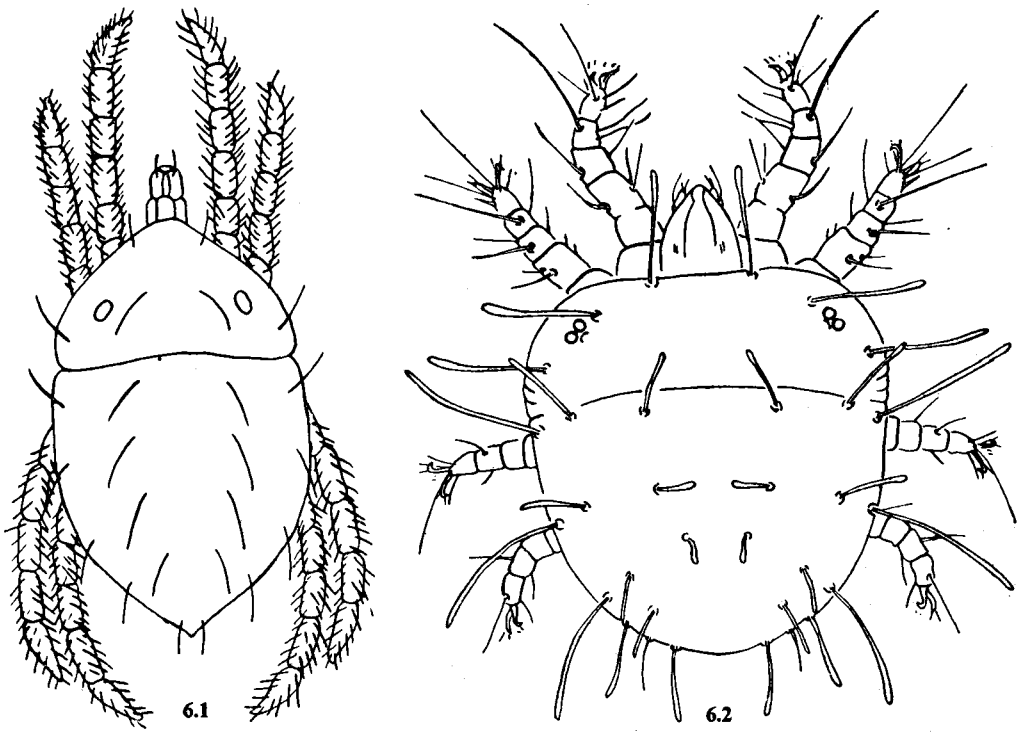
I. Pests causing major crop loss

1. Mites

Two species of leaf feeding mites and one species of perianth mite cause damage to the arecanut palm. The two major species of foliage mites are the cholam mite (*Oligonychus indicus* Hirst), and the palm mite (*Raoiella indica* Hirst).

Oligonychus indicus Hirst (Acarina: Tetranychidae): This is commonly known as white mite. Puttarudriah and Channabasavanna (1956) first reported this spider mite (Fig. 6.1) on arecanut seedlings near Bangalore in Karnataka. Both adults and nymphs colonise under webs on the lower surface of leaves, which is characteristic of the species.

The incubation period varies from 72 to 95 hr. The larval, proto–nymphal and deuto–nymphal periods last 26.6, 30.8, and 44.0 hr respectively. The total duration of the immature stages varies from 6.5 to 9.0 days with an average of 7.5 days. The female mite lays on an average 3–4 eggs per day and the average oviposition period lasts 10.1 days (Anonymous, 1970).



Figs. 6.1—6.2 Arecanut mites. *Fig. 6.1 White mite; Fig. 6.2 Red mite.*

Raoiella indica Hirst *(Acarina: Tenuipalpidae):* The palm mite *R. indica* (Fig. 6.2) commonly known as red mite is active during summer months. Both the adults and nymphs are seen in large numbers on the lower surface of arecanut leaves, though in severe cases of infestation they are seen on the upper surface, leaf stalks and on the spindle. Puttarudriah and Channabasavanna (1956) first recorded *R. indica* on arecanut seedlings at Hebbal, Bangalore.

The life cycle of the female and male mites is completed in 12.9 days and 11.2 days respectively, during April–May (Anonymous, 1977).

R. indica is also observed on coconut, date palms, *Areca macrocalyx* and the ornamental palm, *Livistona chinensis.*

i. *Seasonal abundance of arecanut mites*

The mite population starts building up soon after the monsoon. With the onset of hot weather they become more active and attain virulent form

especially during the summer months in April–May (Patel and Rao, 1958). Poorly irrigated gardens and nurseries particularly those in exposed situations are very much prone to mite infestation. The pest incidence is less under well–irrigated and partially shaded conditions. The mite population declines with the onset of monsoon.

ii. *Symptoms of infestation*

Very often colonies of *O. indicus* and *R. indica* coexist on the same leaf. They suck the sap from the green portion of the plant. Due to their feeding, yellowish speckles develop on the lamina. These speckles later coalesce, become bronze coloured (Fig. 6.3) and the leaves wither away. The growth of the fungi *Meliola* sp. and *Capnodium* sp. on the leaves associated with mite infestation interfere with the normal photosynthesis of the affected leaves (Menon, 1960). In the case of infestation all the leaves in the seedlings are affected causing often death of the seedling. In older palms infestation starts in the lower whorl of leaves and as the population increases it spreads to the inner whorl.

iii. *Control*

Heavily infested and dried leaves are to be cut and burnt to check the spread of mites. Bhat, Patel and Bavappa (1957) suggested spraying with wettable sulphur, Folidol or dusting with lime and sulphur at 2:1 ratio for control of mites. Puttarudriah and Channabasavanna (1957b) suggested soil application of Systox, Solbar and Pestox 3H besides wettable sulphur for the control of areca mites. Patel and Rao (1958) reported that spraying of Folidol E 605, Systox or Ekatin was effective in control of foliage mites. Ponnuswamy (1966) suggested spraying of 0.03% Parathion or Malathion and 2% Parathion dust and sulphur dust for control of *R. indica* on arecanut.

O. indicus and *R. indica* can be controlled by spraying with dicofol (Kelthane 1.86 ml/litre of water), carbophenothion (Trithion 1.26 ml/litre of water) or chlorobenzilate (Akar 338 one ml/litre of water) (Anonymous, 1967). Maximum ovicidal effect on *O. indicus* was shown by Kelthane (1.86 ml/litre of water) (Anonymous, 1969a, 1969b). Kantha, Ray and Lal (1963) reported ovicidal action of Kelthane resulting in 23% reduction in hatching of eggs at 0.1% concentration.

Puttarudriah and Channabasavanna (1956) reported many coleopterous predators chiefly coccinellids of the palm mites. They include *Aspectes indicus* Arrow (Dermestidae), *Cybocephalus semipictis* Champ–var (Nitidulidae), *Stethorus*

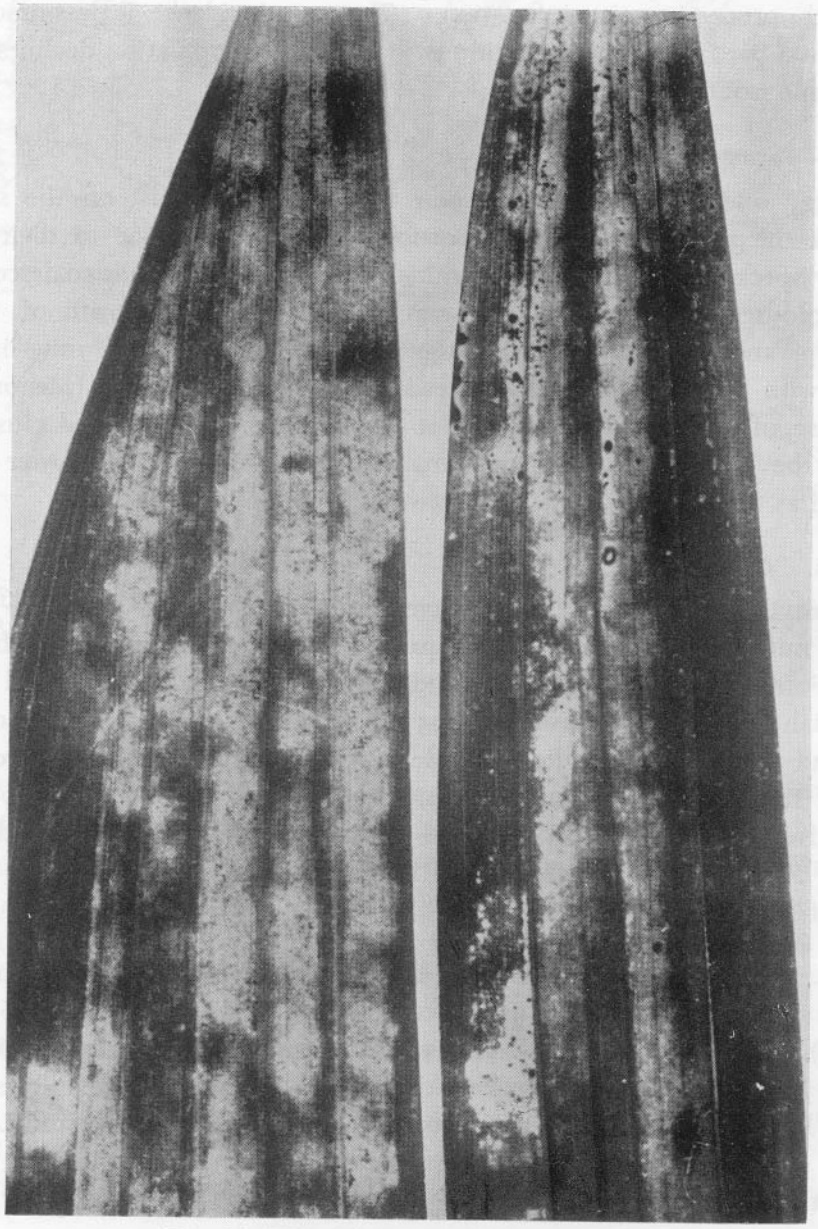


Fig. 6.3 Mite infestation on areca leaflets

parcepunctatus Kapur, *S. tetranychi* Kapur, *Juaravia soror,* (Wse.) and *Spilocaria bisselata* Muls. (Coccinellidae). These predators particularly the species of *Stethorus* keep the mite population in check during summer months. *Stethorus keralicus* Kapur (Coccinellidae) as a predator on *R. indica* was recorded by Kapur (1961). This ladybird beetle is one of the major predators of the mite and takes 12–14 days to complete its life cycle (Daniel, 1976).

Daniel (1979) recorded a number of indigenous predators and among them two species of *Stethorus* and a staphylinid beetle are the major predators of *O. indicus.* The coccinellid *S. keralicus* and the phytoseiid *Amblyseius channabasavanni* Gupta and Daniel are the key predators of the palm mite *R. indica.* Details of other members of the predator complex of *R. indica, O. indicus* and *Tetranychus fijiensis* Hirst are furnished in Table 6.1.

Table 6.1. *Natural enemy complex of arecanut phytophagous mites*

Coleoptera	:	Coccinellidae	– *Stethorus keralicus* Kapur on *Raoiella indica* H. *Stethorus* spp. on *Oligonychus indicus* H. and *Tetranychus fijiensis* H.
	:	Staphylinidae	– A single species on *O. indicus* and *T. fijiensis.*
Thysanoptera	:	Thripidae	– A single species on *O. indicus.*
Neuroptera	:	Chrysopidae	– *Chrysopa* sp. on *R. indica* and *O. indicus.*
Hemiptera	:	Anthocoridae	– A single species on *R. indica.*
Diptera	:	Cecidomyiidae	– A species related to the genus *Arthrocnodax* on *R. indica* A species related to the genus *Feltiella* on *R. indica* A species on *O. indicus* and *T. fijiensis.*
Acari	:	Phytoseiidae	– *Amblyseius channabasavanni* on *R. indica and T. fijiensis.* *Typhlodromus* sp. on *O. indicus.*
	:	Araneida	– A single species on *R. indica.*

The females of predacious mite *A. channabasavanni* require an average of 98 hr and males an average of 93.3 hr to complete the developmental period on the eggs of *R. indica.* A total of 15–38 host eggs are consumed during this period by female and 14–19 eggs by males (Daniel, 1981).

Attempts to introduce the predacious mite *Phytoseiulus persimilis* A–H for the control of *O. indicus* and *R. indica* were not successful as the predator could not acclimatise itself to the local conditions at Vittal in Dakshina Kannada district of Karnataka (Daniel and Seshadri, 1976).

2. Spindle bug *Carvalhoia arecae* Miller and China (Heteroptera: Miridae)

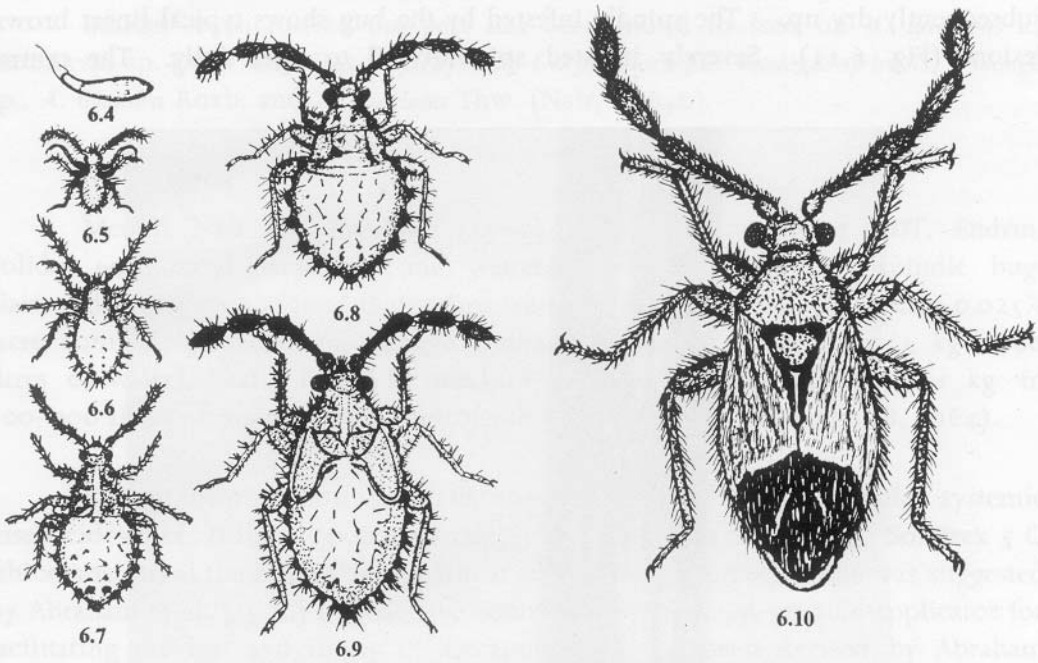
This capsid (=Mirid) bug was first reported as a pest of arecanut palm from Dakshina Kannada, Karnataka by Khandige (1955). Miller and China (1957) described it as *Carvalhoia arecae* based on the specimens collected from Dakshina Kannada. Detailed biology of the pest was studied by Nair and Das (1962). The bugs are seen in colonies within the top most leaf axil of the arecanut palm. More than 80 per cent damage to the spindle has been observed in certain gardens in South Kerala and parts of Dakshina Kannada in the case of severe infestation (Nair, 1964a; Abraham, 1976).

Twenty four to thirty three days are required for the bug to complete life cycle (Nair and Das, 1962). The egg is oval measuring 1.36 mm × 0.34 mm (Fig. 6.4). The anterior end is distinctly demarcated into a short neck bearing at its tip an oval convex operculum. The chorion is smooth and leathery and the operculum is thick and rigid. Two bristle like chorionic processes arise from the operculum. One of them is very long and the other is short and slightly curved. Freshly laid egg is milky white. Gradually the egg turns to pink and then red on further development. It hatches out in 9 days. The eggs are thrust singly into the tissues of tender unopened leaves. The site of egg laying becomes dark in colour. Rarely two or three eggs are laid together.

There are five nymphal instars which extend for 15–24 days (Figs. 6.5—6.9). The newly hatched nymph is 1.07 mm long. The head is triangular with a pair of four jointed antennae. The rostrum is three segmented and reaches up to hind coxae. The thoracic segments are equal in size. The legs are long, six segmented and each bears a two segmented tarsus. The abdomen is oval with nine visible segments. The antennae, legs and rostrum are deep violet brown; thorax and border of abdomen light violet brown, remaining part of abdomen greenish yellow and the head light yellow with scarlet red eyes. The wing rudiments appear towards the end of this instar. The fifth instar nymph is 4.43 mm long and 2.15 mm broad. Wing pads are well developed reaching upto the third abdominal segment in the fifth instar nymph.

The adult bugs are 6.0 mm long and 2.8 mm broad (Fig. 6.10) and red and black in colour. The females are slightly bigger than the males. The abdomen of the female bug is broader and stouter. Sexes can be easily distinguished by the black colour of the abdominal tip on the ventral side.

In the male, this colour is confined to the lateral border of the sixth, seventh and whole of the eighth abdominal segments. In females the black colouration extends medially upto the fourth abdominal segment.



Figs. 6.4—6.10 Life cycle of spindle bug. *Fig. 6.4 Egg; Figs. 6.5—6.9 Nymphs; Fig. 6.10 Adult.*

i. *Seasonal abundance*

According to Nair (1964a), the peak incidence of the pest in Kerala is from June to October with maximum population in August and September. But a high population density in December–January and July has also been reported (Anonymous, 1972). According to Koya et al. (1979) the pest population is high during the monsoon and post–monsoon periods and low during summer months.

ii. *Nature of feeding and symptoms of infestation*

Both the nymphs and adults suck the sap from the tender spindle and leaves. While feeding the stylet is thrust into the tissues by bending the rostrum slightly and feeding is completed in about 20 minutes. Immediately after the feeding a longitudinal, narrow discoloured zone is formed on the sides of the feeding point. According to Nair and Das (1962) it appears that the bug injects probably saliva

with some digestive enzymes into the tissues, which liquefies the cell contents before feeding. The liquefied cell content is sucked by the bug.

The infested portions develop necrotic patches which turn brown and subsequently dry up. The spindle infested by the bug shows typical linear brown lesions (Fig. 6.11). Severely infested spindles fail to open fully. The central

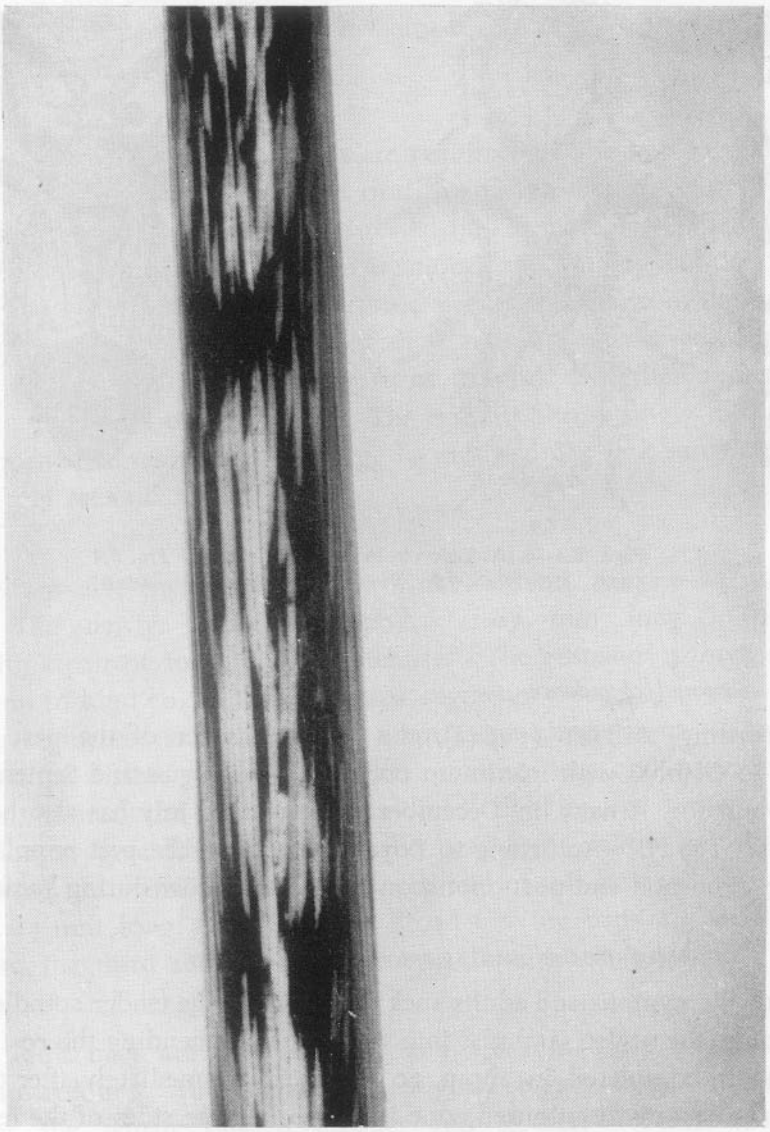


Fig. 6.11 Lesions on the spindle caused by the bug

portions of the necrotic patches after turning brown often drop off forming numerous holes on the leaves. Due to severe infestation the leaves are shredded and the palms become stunted.

Besides *Areca catechu* the pest has been found to feed on *A. lutescens* L., *Loxococcus* sp. (Nair and Das, 1962) and *Chrysalidocarpus madagascariensis, Pinanga* sp., *A. triandra* Roxb. and *A. concinna* Thw. (Nair, 1964b).

iii. *Control*

Menon, Nair and Abraham (1962) suggested spraying of DDT, Endrin, Folidol 605 (ethyl parathion) and wettable BHC to control the spindle bug. Nair and Das (1962) found that palms treated with BHC 0.2% and Endrin 0.025% were completely free from damage. Spraying fish oil resin soap (1 kg in 80 litres of water), Ekatin (1 ml in one litre of water) or Endrin (Endrex) (1 kg in 700–900 litres of water) could control the pest effectively (Anonymous, 1964).

Filling the innermost leaf axils around the spindle with granular systemic insecticides like Thimet 10 G (phorate) or Sevin 4 G (carbaryl) or Solvirex 5 G (thiodemeton) at the rate of 10 g/palm at an interval of three months was suggested by Abraham et al. (1976) for effective control of the pest. A granule applicator for facilitating the leaf axil filling of arecanut palm has been devised by Abraham (1975). Koya et al. (1979) in a field trial with granular insecticides at Palode (South Kerala) found that all the insecticides were effective in giving significant control of the pest, and the palms treated with quinalphos (Ekalux) granules showed lower population of the bug and minimum leaf damage (Table 6.2 and 6.3).

Table 6.2. *Population count of spindle bug on palms under different treatments*

Treatments	Mean number of spindle bug/palm
Lindane 6G	8.4
Carbaryl+Lindane 4:4G	8.3
Carbaryl 4G	10.6
Mephosfolan 5G	12.0
Thiodemeton 5G	11.5
Quinalphos 5G	6.9
Control (untreated)	18.6
SE/Mean = 1.28	CD = 3.95

Table 6.3. *Percentage leaf attack by spindle bug under different treatments*

Treatments	Percentage leaf attack				
	Pre-treatment	Post-treatment (intervals of 6 months)			
		1	2	3	4
Lindane 6G	81.4	31.9	47.2	30.6	24.7
Carbaryl+Lindane 4:4G	75.5	28.2	48.8	24.6	21.2
Carbaryl 4G	80.2	38.8	47.9	31.1	25.6
Mephosfolan 5G	96.4	40.5	44.9	32.4	27.4
Thiodemeton 5G	75.0	33.8	39.4	21.7	23.6
Quinalphos 5G	78.1	34.5	39.6	19.6	13.3
Control (untreated)	66.0	58.2	78.3	43.1	50.2

3. Inflorescence caterpillar *Tirathaba mundella* Walker (Lepidoptera: Pyralidae)

This lepidopteran caterpillar causes damage to areca inflorescence in pockets of Dakshina Kannada district in Karnataka and Trichur district in Kerala (Anonymous, 1962; Nair and Rawther, 1969).

i. *Biology and nature of damage*

The female moth deposits egg into the spadix through punctures made on the spathe by slugs or snails (Fig. 6.12). The eggs are also deposited on the under surface of the spathe. The egg period lasts for 5 days. The full grown larvae is greyish brown with a reddish brown head and measures 23–25 mm in length. The larval period lasts for about 26 days covering five instars. Pupation is in silken cocoons with a wet mass of frass inside the spathe. Pupal period lasts 9–11 days (Figs. 6.13—6.16) (Nair and Rawther, 1969).

The caterpillars that emerge out bore into the interior of the spathe. They move towards the tip of the inflorescence and commence feeding on the tender rachillae and male flowers (Fig. 6.17). In severe cases, the caterpillars may bore into the tender buttons as well. They are very sensitive to light and web together the terminal portions of the inflorescences with silken threads and throw out large wet masses of frass. As a result of the webbing, the inflorescence fails to exert the natural pressure on the spathe and eventually the opening of the spathe is delayed (Nair and Rawther, 1969).

ii. *Control*

Spadices showing external indication of damage by slugs or traces of frass and oozing out of brownish sap or fluid may be force–opened and if all the female flowers have been damaged, the inflorescence should be removed and burnt. If the

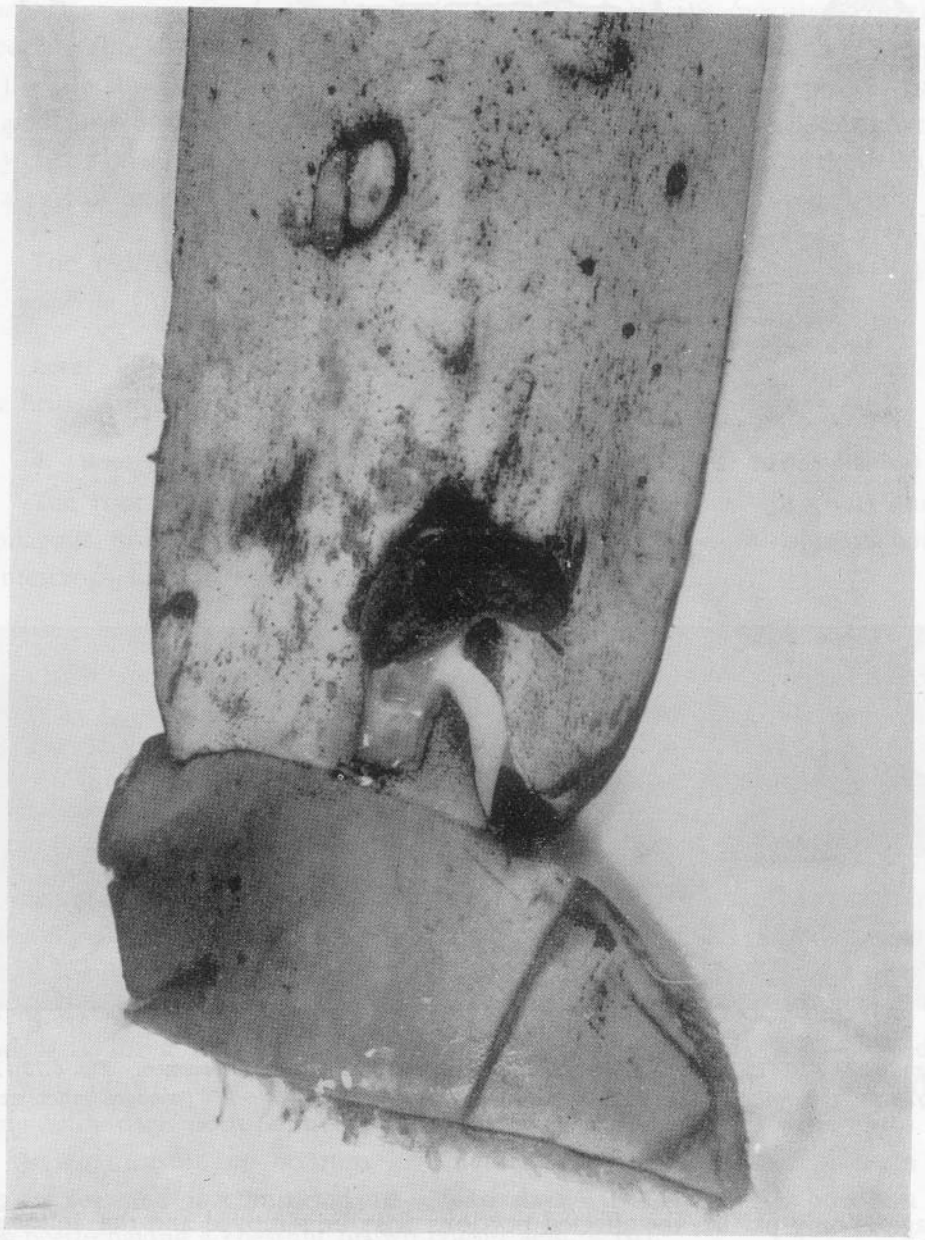


Fig. 6.12 Slug damage on spathe

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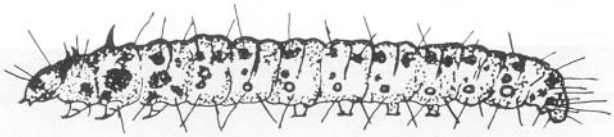

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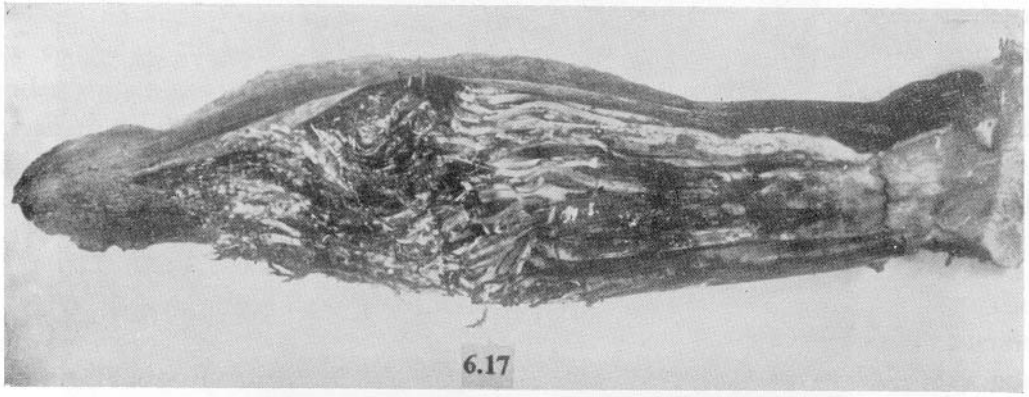

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Figs. 6.13—6.16 Life cycle of *T. mundella* and the damaged inflorescence. *Fig. 6.13 Egg; Fig. 6.14 Caterpillar; Fig. 6.15 Pupa; Fig. 6.16 Adult; Fig. 6.17 Damaged inflorescence.*

damage is only partial, the affected portions may be removed and the inflorescence sprayed with 0.125% Endrex 20 EC (Anonymous, 1962) or 0.125% Malathion (Anonymous, 1971a). Since it is the injury by slugs that predisposes the unopened inflorescences to the infestation of inflorescence caterpillar, control measures are to be taken against the slugs.

The slug causing damage to the arecanut inflorescence has been identified as *Mariaella dussumieri* Gray. There was a highly significant positive correlation between the slug damage and the caterpillar incidence on areca spathes (Anonymous, 1981). The slugs could be controlled by either hand picking or poison baiting with a mixture of bran, molasses or jaggery, lead arsenate and water (Anonymous, 1962). The poison bait containing a mixture of bran and cement in the ratio 13:2 with a part of metaldehyde has also been suggested (Anonymous, 1971b).

The red ant *Monomorium gracillimum* Sm. feeds on the young caterpillars of *T. mundella* (Anonymous, 1962).

Lever (1937) noted the occurrence of *T. rufivena* Walk. on areca palm in the British Solomon Islands.

4. Root grub *Leucopholis burmeisteri* Brenske (Coleoptera: Melolonthidae)

The root grubs or white grubs are voracious feeders on roots and are polyphagous in nature. Besides the arecanut palm, they feed on roots of coconut and intercrops such as banana, yams and other tuber crops.

The root grubs affecting arecanut are *Leucopholis lepidophora* Blanch (Puttarudriah and Channabasavanna, 1956), *Lepidiota* sp. (Rao, Naidu and Bavappa 1961) and *Leucopholis burmeisteri* Brenske (Anonymous, 1967). *L. burmeisteri* is the most common species infesting arecanut in Dakshina Kannada district.

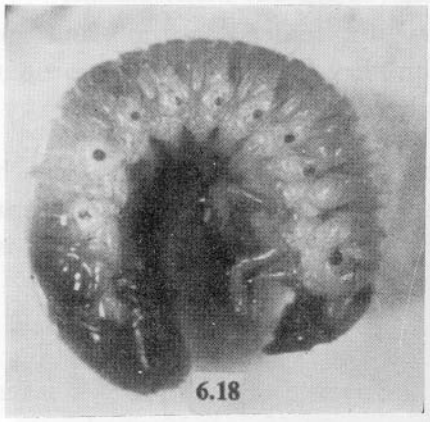
i. *Biology*

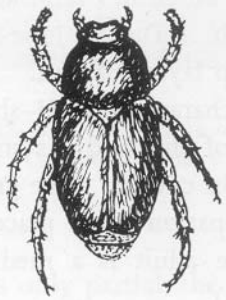
L. burmeisteri has an annual life cycle. Emergence of adult beetles takes place during the premonsoon showers in May–June. The female beetles lay eggs in the loose soil around the root zones. The eggs are smooth, round and creamy white. Incubation period lasts for more than a month. During June–July large number of early instar grubs can be seen on the top layers of soil. The larval period lasts for a few months. The larvae have a characteristic U-shaped soft body with brown head (Fig. 6.18). The hind part of the body is smooth and shining with dark body contents seen through the thin cuticle. The grubs when fully grown measure 50–60 mm in length. The pupation takes place in deep layers of soil and is completed in 35–40 days. The adult is a medium sized chafer beetle having a chestnut brown colour (Fig. 6.19).

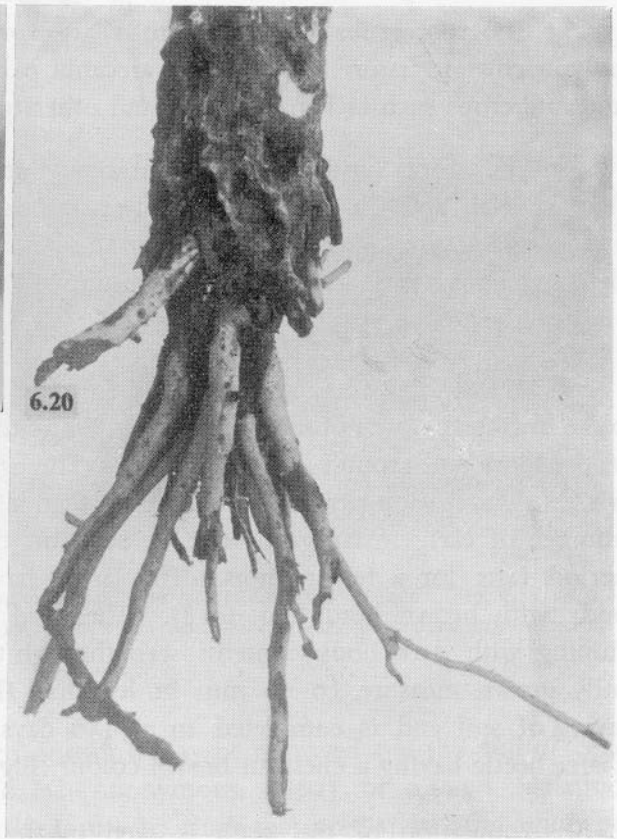
Population of the grub is seen in the moist soil from May–June till February–March. As many as 40–50 grubs could be dug out from the base of severely infested palms (Rao et al., 1961). The presence of the grubs in the deep

layers of the soil is highly related to the water table of the garden. In infested gardens with higher water table the grubs will be seen in top layers of soil. The incidence of the pest is more in ill-drained and low-lying clayey soils.

The root grubs feed on the roots, particularly tender ones. The roots are damaged near the bole either by eating the tender roots from the tip or cutting them across at various points (Fig. 6.20). In rare cases of severe infestation the grubs feed on the entire bole region. When all the roots are destroyed the palm will lose its grip on the soil and it will be toppled down. In the *Maidan* areas of Karnataka, the white grubs were reported to be serious on nursery seedlings and young palms (Rao et al., 1961).







Figs. 6.18—6.19 Grub and adult of *L. burmeisteri*.
Fig. 6.20 Damaged bole and roots.

The visual symptoms of infestation in the nursery are the drooping and complete drying of the leaves within two to three days. The affected seedlings can be pulled out easily as they have an entirely damaged root system. Mortality is quicker in younger palms. Older palms will continue to survive for a longer period. Due to feeding of roots the leaves turn to a sickly pale yellow. Tapering of the stem, reduced yield, nut fall and production of less number of bunches are the other symptoms of white grub infestation.

ii. *Control*

Soil insecticides control white grubs effectively. Chlordane and Heptachlor were earlier recommended for the control of white grubs on arecanut (Anonymous, 1961; Rao et al., 1961). In an insecticidal trial, Intox-'8' liquid (Chlordane) applied at the rate of 50 ml in 100 litres of water around the root zone was quite effective in controlling arecanut white grubs. (Rao et al., 1961). Application of Heptachlor 20 EC at 6.3 ml per 100 litre water, BHC 5% dust at 63.08 kg per ha and Chlordane 5% dust at 31-54 kg per ha (Rao, 1963), Thimet 10 G (phorate) at the rate of 8g per palm applied at the base (Anonymous, 1972) Rogor 5 G (dimethoate) granules at the rate of 30 kg per ha (Kumar, 1974) gave good control of white grubs.

Results of field trials using systemic granules, soil amendments and contact insecticides showed that Rogor 5 G (dimethoate) at 30 kg per ha (Table 6.4), *Pongamia* oil cake at 2000 kg per ha (Table 6.5), Chlordane 5% dust at 90 and 120 kg per ha, BHC5% dust at 120 kg per ha and Ekalux (quinalphos) 1.5% dust at 90 and 120 kg per ha (Table 6.6) applied twice in an year in May and November for three years were effective in giving significant control of the grubs (Kumar and Daniel, 1981).

Table 6.4. *Mean grub counts per plot treated with different insecticides*

Insecticide and dosage (kg/ha)	Mean grub count during different years			
	1972-'73	1973-'74	1974-'75	Mean
Phorate (Thimet 10G @ 15 kg)	4.18	3.95	2.54	3.55
Thiodemeton (Solvirex 5G @ 30 kg)	4.56	4.19	2.98	3.91
Thiodemeton (Disyston 5G @ 30 kg)	4.61	3.78	2.36	3.58
Dimethoate (Rogor 5G @ 30 kg)	3.23	3.26	2.10	2.86
Carbofuran (Furadan 3G @ 45 kg)	4.69	4.14	2.75	3.86
Chlordane (dust 10% @ 30 kg)	4.94	3.69	2.44	3.71
Control (no treatment)	8.39	6.16	5.09	6.55

Table 6.5. *Mean grub counts per plot treated with different oil cakes*

Oil cakes and dosage (kg/ha)	Mean grub count during different years			
	1973–'74	1974–'75	1975–'76	Mean
Neem cake 1000 kg	4.19	4.03	3.67	3.99
Neem cake 2000 kg	4.66	3.66	3.64	3.99
Pongamia cake 1000 kg	3.87	3.87	3.85	3.86
Pongamia cake 2000 kg	3.69	2.03	2.91	3.14
Control (no treatment)	4.36	4.82	4.55	4.57
C.D. P = 0.05	0.72	0.76	0.84	0.34

Table 6.6. *Mean grub counts per plot treated with different insecticide dusts*

Insecticide and dosage (kg/ha)	Mean grub count during different years			
	1973–'74	1974–'75	1975–'76	Mean
BHC 5% 60 kg	5.67	5.32	2.69	4.56
90 kg	4.54	4.99	2.46	3.99
120 kg	4.31	3.98	1.98	3.43
Chlordane 5% 60 kg	4.84	4.93	2.36	4.04
90 kg	4.19	3.88	1.74	3.27
120 kg	4.11	3.10	1.41	2.87
Heptachlor 60 kg	5.31	5.47	2.93	4.57
90 kg	4.53	4.64	2.44	3.87
120 kg	4.43	3.66	2.30	3.85
Aldrin 5% 60 kg	5.52	4.72	2 44	4.22
90 kg	5.09	4.55	2.61	4.08
120 kg	5.06	3.87	2.20	3.74
Quinalphos 1.5% 60 kg	5.14	5.06	2.64	4.28
90 kg	4.79	4.35	2.06	3.73
120 kg	3.22	4.08	2.14	3.14
Control (no treatment)	7.74	6.30	4.24	6.09
C.D. P = 0.05	0.67	0.61	0.84	0.39

The nematode cum bacterium culture DD–136 *Neoaplectana carpocapsae* Weiser and *Achromobacter nematophilus* (Poinar and Thomas) has been tested for the biological control of this pest. A suspension of 60–100 nemas killed the early instar grubs in five days. Soil treatment with 600–800 nemas killed the grubs in 23 days (Anonymous, 1974).

II. Minor pests

1. Nursery pests

Daniel and Kumar (1976) in their review on the pests of arecanut reported six species of insects associated with arecanut in nurseries. Seedlings in the primary nursery as well as secondary nursery and also the transplanted seedlings in the main field are subject to damage by many insects other than the major pests of the crop. Description of some of the more important pests of seedlings are furnished here.

i. *Bagworms (Lepidoptera: Psychidae)*

Pillai and Kurian (1959 b) reported *Manatha albipes* Moore on arecanut. Other two species *viz., Cryptothelia* sp. and *Thyridopteryx* sp. have also been reported from Kerala (Nair and Menon, 1963). These are found in large numbers feeding on the lower side of leaves. The attacked leaves show numerous small holes. Bagworms can be controlled by spraying 0.2% BHC.

ii. *Termites* Odontotermes obesus *Ramb (Isoptera: Termitidae)*

Termites infest seednuts and seedlings in nursery during dry weather (Pillai and Kurian, 1959 b; Rao et al., 1961; Nair 1975). Rarely they infest the bark of older palms. Normally termites infest seedlings through the collar region. The wilting of central shoot followed by the death of the seedling is the symptom of termite infestation.

Incorporation of soil insecticides like BHC, Aldrin or Chlordane to the nursery soils before sowing of nuts and removal of decaying organic debris from the soil are some of the preventive measures. Covering the nuts with a layer of river sand is also recommended for avoiding termite infestation (Pillai and Kurian, 1959b).

iii. *Grasshoppers (Orthoptera: Acridiidae)*

Two species of grasshoppers *viz., Aularches miliaris* Linn. and *Melanoplus* sp. have been reported to cause leaf damage to arecanut seedlings (Nair and Menon, 1963; Nair 1975). They eat away portions of the lamina causing holes of different sizes. *A. miliaris* was first reported in arecanut by Jones (1954). An epidemic outbreak of *A. miliaris* in June 1975 in Malappuram district, Kerala was reported on teak, coconut, arecanut, coffee, *Erythrina* etc. (Pillai, Dubey and Singh, 1976).

iv. *Nymphalid caterpillar* Elymnias caudata Butl. *(Lepidoptera: Nymphalidae)*

The caterpillars while feeding the leaves clip off the lamina and reduce the leaf area considerably. The pest incidence is more during the period from September to December. The spherical and white coloured eggs are laid on the lower leaf surface. Incubation period lasts for 5–7 days. The caterpillars are pale yellowish in the early instars and when fully grown they are green in colour. Full grown caterpillar measures about 35 mm. The larval period takes about 21–25 days. Pupa is green in colour with yellow and red markings on the body and is about 25 mm long. Pupal period lasts 8–9 days. The adult butterfly is brown with patches of white, yellow and violet colouration (Nair, 1964b). The larvae are parasitized by *Brachymeria* sp (Nair, 1975).

v. *Coccids*

Rao and Bavappa (1961) reported the mealy bug *Dysmicoccus brevipes* Ckll. (Homoptera: Pseudococcidae) and the scale insect *Aonidiella orientalis* Newst. on arecanut seedlings. These insects infest the lamina and collar regions of the seedlings, causing yellowish patches. Treatment with contact insecticides like Malathion or Parathion for their control has been suggested (Rao and Bavappa, 1961).

In addition to the above two species of coccids, Nair (1975) reported the hard scale *Aspidiotus destructor* Sign., *A. ficus* Ash., *Chionaspis dilatata* Gr., *Phenacaspis cockerelli* Cooley, *Pinnaspis buzi* Bouche, *P. dracoenae* Cooley, *Lepidosaphes* sp., *Parlatoria mytilaspiformis* Gr. and *Quadraspidiotus* sp. on arecanut seedlings.

2. Stem feeders

i. *Stem weevil* Diocalandra stigmaticollis *Gyll. (Coleoptera: Curculionidae)*

This weevil was reported from certain areas of Kerala and Mettupalayam in Tamil Nadu (Pillai and Kurian, 1959b; Anonymous, 1963; Naidu and Kumar, 1963). It infests tender portions of the stem covered by the leaf sheath. When the leaves drop off, the damage can be noticed on or above the nodes. The feeding of grubs produces characteristic dents on the stem. The damage can be seen on the successive internodes. As the development of leaves is adversely affected, quite often the leaves fail to develop further and the stem gets weakened and breaks off easily.

The adult weevil is cylindrical and brown in colour with a prominent curved snout. The weevils gain entry through the tender leaf sheaths and lay eggs on the stem surface. The grubs are initially dull white with a brownish head and later turn to creamy white. Fully grown grubs are 8–9 mm long and 2 mm

wide. The pupa is creamy white earlier and later on turns yellow. Pupal period lasts about 12–14 days. Sun scorched or mechanically injured stem is more prone to infestation. Murthy and Hanumanthappa (1965) recommended spraying or dusting with contact insecticides like DDT or BHC for the control of this weevil. Murthy et al., (1965) recorded *D. frumentii* on the stem of arecanut from Mysore. Nair (1975) reported *D. stigmaticollis* on areca inflorescence in some parts of Kerala.

ii. *Shot-hole borer* Xyleborus perforans *Woll. (Coleoptera: Scolytidae)*

Seshadri (1968) recorded this polyphagous pest on arecanut and coconut from different parts of Dakshina Kannada. After entering through the basal portion of the stem, the pest bores upwards gradually. A large number of circular holes extruding frass can be seen on the stem. If damage is severe the leaves turn yellow and the palm dries up. Maximum damage is seen during October–November. Painting of infested stem with contact insecticides like BHC or Dieldrin check the incidence of the beetle. *X. habercorni* was reported on arecanut by Murthy et al., (1965) from Mysore.

iii. *Redpalm weevil* Rhynchophorus ferrugineus *F. (Coleoptera: Curculionidae)*

The grubs of this weevil tunnel through the soft and exposed portions of the stem and crown. The incidence is more in neglected young palms. Pillai and Kurian (1959b) suggested injection of 1 per cent Pyrocone-E for the control of the pest.

3. Leaf feeders

i. *Grapevine thrips* Rhipiphorothrips cruentatus *Hood (Thysanoptera: Thripidae)*

It is widely distributed in India on a variety of host plants including grapevine, pomegranate, crotons, rose, cashew, etc. Its incidence on arecanut is scattered and negligible. Puttarudriah and Channabasavanna (1956) reported the pest on arecanut in Tharikere and Bangalore, Karnataka and Pillai and Kurian (1959a) recorded it in Ochira in Quilon district, Kerala.

The dark brown adults and pinkish nymphs of the thrips occur in groups on the lower surface of arecanut leaves and suck the sap. Feeding marks are seen as silvery blotches. Attacked portions of leaves turn brownish yellow and dry away(Fig. 6.21). Areca palms of all ages are infested by thrips and often the pest may assume serious proportions during summer in certain localised tracts.

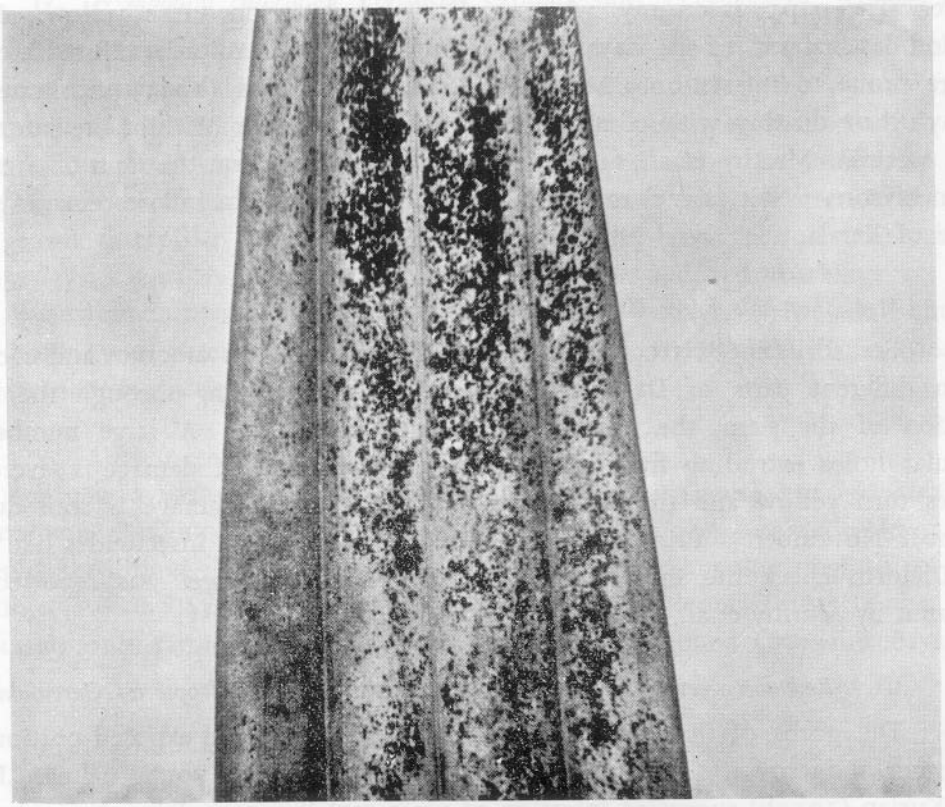


Fig. 6.21 Thrips damage on areca leaflet

Biology of the pest on arecanut was studied by Pillai and Kurian (1959a). The egg period varies from 3 to 8 days. The duration of the immature stages ranges from 11 to 24 days. Total duration of life cycle ranges from 14 to 33 days. The pest could be successfully controlled by spraying Malathion. This pest is attacked by an endoparasite *Thripoctenus maculatus* Waterston (Hymenoptera: Eulophidae).

ii. *Scale insects and mealy bugs*

Many species of scale insects and mealy bugs infest the areca leaves. They colonise on the lower leaf surface and in severe cases even the upper lamina will also be affected. The feeding results in the production of yellow patches on the leaves, which under severe infestation cover the entire leaf area. Nair (1975) gave a list of coccids affecting leaves of arecanut palm. The soft scales *Coccus hesperidum* Linn., *C. acutissimum* Gr. and *Saissetia* sp. also infest leaves.

iii. *Rhinoceros beetle* Oryctes rhinoceros L. *(Coleoptera: Scarabaeidae)*

This black beetle occasionally infests arecanut palms besides its normal host, coconut palm. Nambiar (1949) and Valsala (1958) found this beetle damaging the fronds of arecanut palms in West Bengal. In some cases, the adult beetles bore into the stem upto 60–90 cm below the crown exposing inner fibrous tissues (Kumar, Sannamarappa and Khan 1967).

Other foliage feeders include the spider mite *Tetranychus fijiensis* Hirst (Daniel, 1977), the caseworm larvae (Venugopal and Venugopal, 1961) and hairy caterpillar *Euproctis semisignata* Walk (Nair, 1975).

4. Inflorescence, bunch and tender nut feeders

i. *Mealy bugs*

The mealy bug *Icerya aegyptiaca* Dougl. was noted by Puttarudriah and Channabasavanna (1957a) on arecanut from Karwar in Karnataka. Heavy infestation of bunches was sometimes common in isolated tracts. The stalks and basal parts of fruits in various stages of development were completely covered by the mealy bug population (Fig. 6.22). Infestation during the tender nut stage causes immature nut fall. Natural enemies like the adults and grubs of the coccinellid *Rodolia* sp. and the pteromalid parasite *Pachycrepoides coorgensis* keep the pest under check. Nair (1975) also reported the occurrence of *Pseudococcus citriculus* (Green) and *Rostrococcus iceryoides* (Green) in addition to *I. aegyptiaca* infesting arecanut inflorescence as well as leaves.

ii. *Perianth mite* Dolichotetranychus sp. *(Acarina: Tenuipalpidae)*

Perianth mite infestation results in severe tender nut fall in affected palms. Its infestation has been noticed very extensively in areas around Trichur in Central Kerala. The mite is slender, orange coloured and is seen colonised inside the perianth of tender nuts. As a result of its feeding activity, the nuts shrivel and later on fall off resulting up to 10% crop loss. The period of infestation was during November–May. Sadanandan and Antony (1973) suggested spraying of bunches with dimethoate and formothion at 1 ml and 2 ml per palm respectively.

iii. *Scale insects*

Nair and Menon (1963) and Nair (1975) reported three species of scale insects on arecanut inflorescence *viz., Gossyparia* sp., *Pinnaspis aspidistrae* Sign. and *P. strachani* Cooley. They are rarely seen on leaves too. Adults and nymphs of *Gossyparia* sp. suck the sap from inflorescence. They may sometimes prevent pollination by covering the female flowers. *Pinnaspis aspidistrae* Sign. and

Fig. 6.22 Mealybug *I. aegyptiaca* infested fruit and basal portion of inflorescence

P. strachani Cooley feed on the tender floral parts and cause premature flower and button shedding. Severe infestation results in complete drying of inflorescence.

iv. *Nut borer*

Appanna (1959) mentioned about a lepidopterous borer of tender nuts of areca palm near Koppa, Chickamagalur district, Karnataka. The caterpillar is

dark slate in colour and the attacked nuts show lots of webbed brownish excreta and smaller circular holes on the surface.

v. *Red ants* Oecophylla smaragdina *F. and* Monomorium gracillimum *Sm. (Hymenoptera : Formicidae)*

These ants feed on the honey dew secreted by the coccids and aphids on the inflorescence. They check the proper development of the spathe or the developed spathe do not open completely. With the silken strands, the rachillae are netted together for their harbouring along with coccids. Ultimately the female flowers fall off and the inflorescence dries up. Nair and Menon (1963) reported them to be very serious on arecanut. Sometimes pollination is prevented causing severe button shedding.

5. Vertebrate pests

i. *Squirrels*

Squirrels feed on 3–5 months old tender nuts. The damage is more on arecanut in the *Maidan* tracts of Karnataka causing sometimes as much as 10–15 per cent loss. (Naidu, 1962). Nambiar (1949) reported nearly 20% crop loss in Assam during certain years.

The control measures adopted by the farmers include shooting and setting up bait traps. Spraying of the bunches with 5% solution of zinc phosphide for the control of squirrels has also been recommended (Naidu, 1962).

ii. *Rats*

Rats usually feed on the tender nuts and rarely half mature nuts below the perianth region (Fig. 6.23). Baiting with zinc phosphide and fumigation of burrows are commonly practised for the control of rats. According to Pillai and Kurian (1959b) rats can be successfully controlled by zinc phosphide or anticoagulant rodenticides. The poison is mixed with cereal powder and kept in shallow containers in the crown or base of palm. Trapping, erection of physical barriers and application of chemical repellents etc. are other common remedial measures. Avoiding shelter places in the gardens by clearing bushes would be advantageous in reducing the incidence.

iii. *Other mammalian pests*

The frugivorous bats (fruit eating) or flying fox occasionally cause loss by removing ripe nuts (Pillai and Kurian, 1959b; Daniel and Kumar, 1976). It is rather difficult to control this pest. Breaking their roosts by burning of

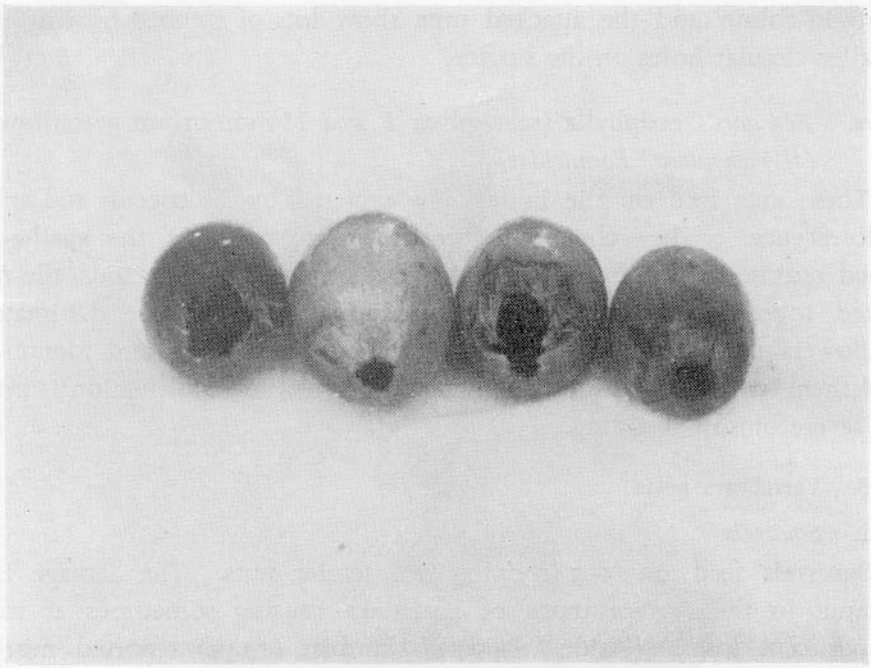


Fig. 6.23 Rat damaged tender arecanuts

sulphur in braziers under the roosting trees may give some temporary relief (Pillai and Kurian, 1959b). Nambiar (1949) reported damage by monkeys in *Malnad* areas of Dakshina Kannada and Uttara Kannada districts of Karnataka and Midnapur district of West Bengal.

Woodpecker is another commonly seen avian pest damaging the arecanut stem in Kerala and Dakshina Kannada (Nair and Menon, 1963). The bird usually pecks the stem tissues weakened by sun-scorching and this hastens the deterioration of the tissues.

III. Storage pests

The husked arecanut known as *chali* is stored in godowns, sometimes even upto one year in gunny bags before marketing. Insect damage becomes a problem under storage conditions. The insects feed on the inner central core and due to their feeding, lot of holes appear on the surface of the nut (Fig. 6.24). Ayyar (1940) was the first to report insect infestation in stored arecanut caused by *Araecerus fasciculatus* D. Later, Nair and Oommen (1969) published the results of a survey

of storage pests of arecanut in Kerala. They listed 14 insects and mites and outlined the biology of the more important storage pests. Daniel and Kumar (1979) recorded 21 species of insect and mites infesting stored arecanuts, in a survey of godowns in Mangalore.

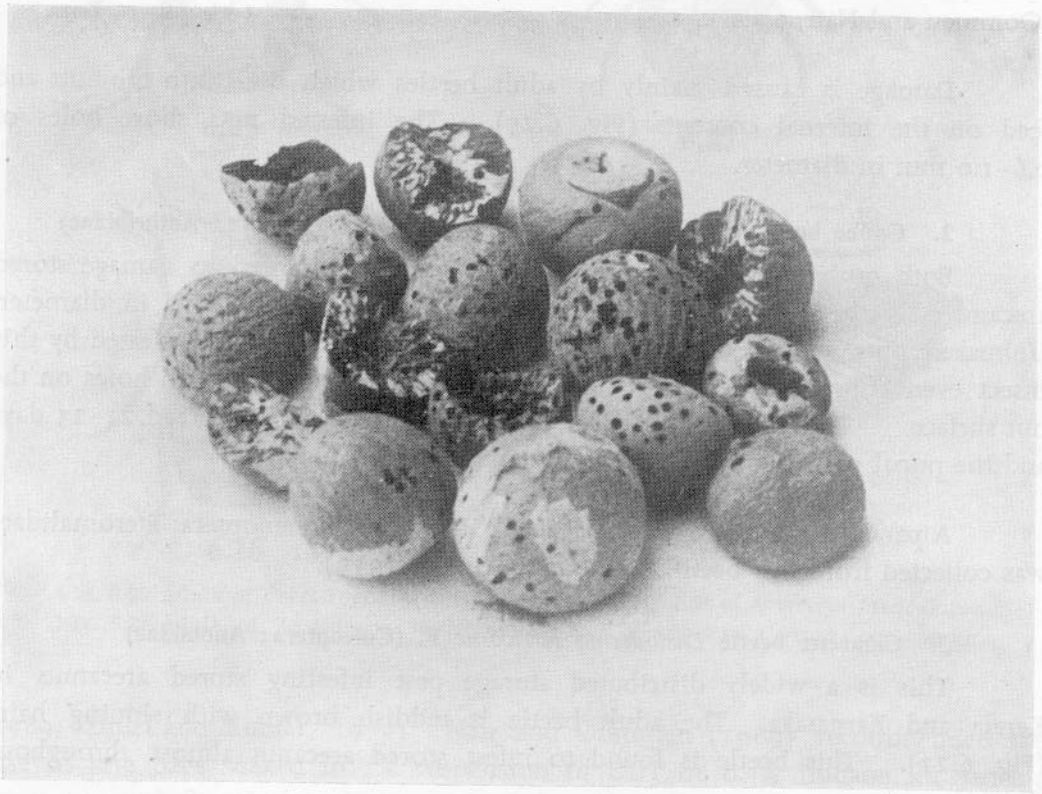


Fig. 6.24 Insect damage on stored arecanut

Tender arecanut chips show maximum resistance to infestation by insects (Nair and Oommen, 1969).

Daniel and Kumar (1979) found that insect damage was maximum during the rainy months when the atmospheric humidity was high and minimum during winter and summer months. The moisture content of the stored arecanuts varied from 8.0% to 28.3% on oven dry weight basis. Details on the life history and nature of damage of the important pests are given here.

1. Arecanut beetle *Coccotrypes carpophagus* Horn (Coleoptera: Scolytidae)

This is the most important storage pest of arecanut. Beeson (1941) furnished a list of host materials of this insect. The damage was maximum during November. Nuts affected by this beetle are not seen to develop secondary infestation by other insects. Damage upto even 100% has been reported in a few cases (Daniel and Kumar, 1979). Its life cycle is complete in 22–29 days (Oommen and Nair, 1968).

Damage is caused mainly by adult beetles which bore into the nuts and feed on the internal contents (Fig. 6.25). The infested nuts show holes of 0.6–1.0 mm in diameter.

2. Coffee bean weevil *Araecerus fasciculatus* D. (Coleoptera: Anthribidae)

Both grubs and adults (Fig. 6.26) have been reported to damage stored arecanut (Ayyar, 1940). Infested nuts show holes 1.5–2.5 mm in diameter. Unhusked nuts with intact perianth were not seen to have been infested by this insect even after one year of storage. Eggs are laid singly in small holes on the nut surface. The incubation period lasts for 5–6 days, larval period 21–23 days and the pupal period 7 days (Nair and Oommen, 1969).

A parasite, *Anisopteromalus calandrae* (Howard) (Hymenoptera: Pteromalidae) was collected from this beetle (Daniel and Kumar, 1979).

3. Cigarette beetle *Lasioderma serricorne* F. (Coleoptera: Anobiidae)

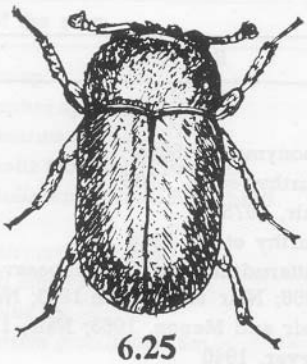
This is a widely distributed storage pest infesting stored arecanuts in Kerala and Karnataka. The adult beetle is reddish brown with shining hairs (Fig. 6.27). This beetle is found to infest stored arecanut almost throughout the year.

The adults and grubs damage the nuts by making tunnels within the nuts and reducing them to a powder (Nair and Oommen, 1969). It was observed that the life cycle of this insect was completed in 39–69 days.

A predatory bug was collected feeding on the grubs of this beetle. The parasite *A. calandrae* also was found on arecanuts infested by this pest.

4. Rice moth *Corcyra cephalonica* (Stainton) (Lepidoptera: Galleriidae)

The caterpillars of this moth construct galleries of silk and frass over stored nuts, remain within and feed on them (Fig. 6.28) (Nair and Oommen,



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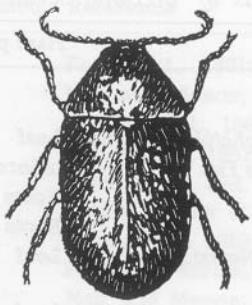

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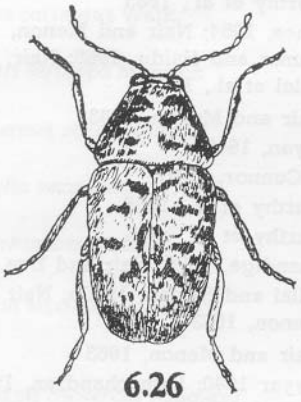

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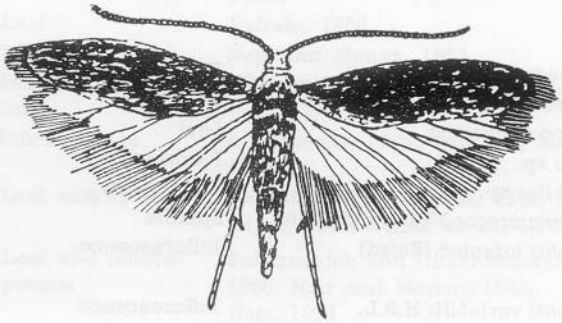

6.28

Fig. 6.25 Adult of *Coccotrypes carpophagus*. Fig. 6.26 Adult of *Araecerus fasciculatus*.
Fig. 6.27 Adult of *Lasioderma serricorne*. Fig. 6.28 Adult of *Corcyra cephalonica*.

1969; Daniel and Kumar, 1979). Nair and Oommen (1969) recommended the use of jute bags soaked in 1% suspension of DDT or 0.1% lindane for storing arecanuts and found that they remained free from insect infestation for up to six months. Phostoxin tablets used at the rate of 800 g per 1000 cm^3 are also effective in controlling stored arecanut pests.

Appendix 6.1. *Pests of arecanut seedlings and palms.*

Name of the pest	Plant parts infested	Reference
INSECTS		
Acanthopsyche plagiophelphs Hampson	Leaf	Anonymous, 1969a
Acicnemis praembulans Fst.	Inflorescence	Murthy, et al., 1965
Anomala varians Ol.	Roots and leaf	Nair, 1975
Anomelochela sp.	Roots	Murthy et al., 1965
Aonidiella orientalis (Newst.)	Leaf	Puttarudriah and Channabasavanna, 1956; Nair and Menon 1963; Nair, 1975
Aspidiotus destructor Sign.	Leaf	Nair and Menon, 1963; Nair, 1975
Aspidiotus ficus Ash	Leaf	Ayyar, 1940
Aulacophora sp.	Inflorescence	Murthy et al , 1965
Aularches miliaris Linn.	Leaf	Jones, 1954; Nair and Menon, 1963, Kumar and Naidu, 1965; Nair, 1975; Pillai et al., 1976
Batrachedra sp.	Floral parts	Nair and Menon, 1963
Brontispa mariana	Leaf	Bryan, 1949
Brontispa longissima	Leaf	O'Connor, 1940
Bruchus sp.	Floral parts	Murthy et al., 1965
Carpophilus sp.	Floral parts	Murthy et al., 1965
Carvalhoia arecae Miller and China	Spindle	Khandige, 1955; Nair and Das, 1962
Cerataphis lataniae (Boisd)	Inflorescence	Pillai and Kurian, 1959b; Nair and Menon, 1963
Cerataphis variabilis H.R.L.	Inflorescence	Nair and Menon, 1963
Chionaspis dilatata Gr.	Leaf	Ayyar 1940; Ramachandran, 1951; Nair, 1975
Coccus acutissimum Gr.	Leaf	Nair and Menon, 1963; Nair, 1975
Coccus hesperidum Linn.	Leaf	Puttarudriah and Channabasavanna, 1956; Nair and Menon 1963; Nair, 1975
Contheyla rotunda H.	Leaf	Sathiamma and Bhat, 1972
Cryptothelia sp.	Foliage	Nair and Menon, 1963
Diocalandra frumenti F.	Stem and inflorescence	Murthy et al., 1965; Nair and Menon, 1963
Diocalandra stigmaticollis Gyll.	Stem and inflorescence	Murthy et al., 1965; Pillai and Kurian 1959b; Nair and Menon, 1963; Nair, 1975
Dioryctus sp.	Inflorescence	Murthy et al., 1965
Dysmicoccus brevipes (Ckll.)	Collar of seedlings	Rao and Bavappa, 1961; Nair, 1975
Elymnias caudata Butl.	Seedlings	Nair, 1964b; Nair, 1975
Euproctis semisignata Walk.	Leaf and inflorescence	Nair, 1975
Gossyparia sp.	Inflorescence	Nair and Menon, 1963; Nair, 1975
Hemerocampa sp.	Leaf	Nair and Menon, 1963; Nair, 1975
Icerya aegyptiaca (Doug).	Leaf and inflorescence	Puttarudriah and Channabasavanna, 1957b, Nair and Menon, 1963; Nair, 1975

Name of the pest	Plant parts infested	Reference
Lepidiota sp.	Roots	Rao et al., 1961; Murthy et al., 1965
Lepidosaphes sp.	Leaf	Nair and Menon, 1963; Nair, 1975
Leucohimatum sp.	Inflorescence	Murthy et al., 1965
Leucopholis burmeisteri Brenske	Roots	Anonymous, 1967
Leucopholis lepidophora Blanchard	Roots	Puttarudriah and Channabasavanna, 1957b; Murthy et al, 1965
Mehasena corbetti Tams.	Leaves	Anonymous, 1929
Manatha albipes Moore	Foliage	Pillai and Kurian, 1959b; Nair, 1975
Melanoplus sp.	Foliage	Nair and Menon, 1963; Nair, 1975
Monomorium gracillimum Sm.	Foliage and inflorescence	Anonymous, 1962; Nair and Menon, 1963
Morismus carinatus Walk.	Young palms	Kumar and Naidu, 1965; Anonymous, 1969a
Nephantis serinopa Meyrick	Leaf	Valsala, 1958
Nygmia	Inflorescence	Nair and Menon, 1963
Odontotermes obesus (Ramb)	Seednuts and seedlings	Pillai and Kurian, 1959b; Nair, 1975
Oecophylla smaragdina F.	Inflorescence	Anonymous, 1962; Nair and Menon, 1963
Oryctes rhinoceros Linn.	Leaf and spindle	Nambiar, 1949; Valsala, 1958; Murthy et al., 1965; Kumar et al., 1967
Parlatoria mytilaspiformis Gr.	Leaf and inflorescence	Puttarudriah and Channabasavanna, 1956; Nair and Menon, 1963; Nair, 1975
Phenacaspis cockerelli (Cooley)	Leaf	Nair, 1975
Phenacaspis dilatata Green	Leaf	Nair and Menon, 1963
Phyllophaga fissa	Roots	Anonymous, 1971a
Pinnaspis aspidistrae Sign.	Leaf and inflorescence	Ayyar, 1940; Pillai and Kurian, 1959b; Nair and Menon, 1963; Nair, 1975
Pinnaspis buzi (Bouche)	Leaf	Nair, 1975
Pinnaspis dracoenae Cooley	Leaf	Nair, 1975
Pinnaspis strachani Cooley	Leaf and inflorescence	Nair and Menon, 1963; Nair, 1975
Porthesia sp.	Leaf	Nair and Menon, 1963
Promecotheca cumingi Baly	Leaf	Lever, 1951
Proutista moesta Westw	Leaf	Nair and Menon, 1963
Pseudococcus citriculus (Green)	Leaf and inflorescence	Nair, 1975
Pyroderces sp	Floral parts	Nair and Menon, 1963; Nair, 1975
Ouadraspidiotus sp.	Leaf	Nair, 1975
Rostrococcus iceryoides (Green)	Leaf and inflorescence	Nair, 1975
Rhipiphorothrips cruentatus Hood	Leaf	Puttarudriah and Channabasavanna, 1956; Pillai and Kurian, 1959; Nair, 1975
Rhynchophorus ferrugineus Fab.	Stem	Pillai and Kurian 1959b; Murthy et al., 1965

Name of the pest	Plant parts infested	Reference
Rhynchophorus sp.	Inflorescence	Murthy et al., 1965
Saissetia hemisphaericum	Leaf	Coleman and Rao, 1918
Saissetia sp.	Leaf	Nair and Menon, 1965; Nair, 1975
Spatulifimbria gresia Hering	Leaf	Anonymous, 1969a
Thrips hawaiiensis Morgan	Flower	Nayar et al., 1976
Thyridopteryx sp.	Foliage	Nair and Menon, 1963; Nair 1975
Tirathaba mundella Walk.	Inflorescence	Anonymous, 1962; Nair and Menon 1963; Nair and Rawther, 1969
Tirathaba rufivena Walk.	Inflorescence	Lever, 1937
Wallacea palmarum Gestro	Young leaves	Anonymous, 1929
Xyleborus habercorni Egg.	Stem	Murthy et al., 1965
Xyleborus perforans Woll.	Stem	Seshadri, 1968
Xylotrupes gideon Linn.	Fronds	Anonymous, 1970
MITES		
Dolichotetranychus sp.	Tendernuts	Sadanandan and Antony, 1973
Lasioseius sp.	Inflorescence	Nair and Rao, 1964
Neocypholaelaps stridulans Evans	Inflorescence	Nair and Rao, 1964
Oligonychus biharensis Hirst	Leaf	Puttarudriah and Channabasavanna, 1956
Oligonychus indicus Hirst	Leaf	Puttarudriah and Channabasavanna, 1956
Raoiella indica Hirst	Leaf	Puttarudriah and Channabasavanna, 1956
Tetranychus fijiensis Hirst	Leaf	Daniel, 1977
Amblyseius ovalis Evans	Leaf	Prasad, 1974
VERTEBRATE PESTS		
Squirrels	Tendernuts	Ramachandran, 1951; Pillai and Kurian, 1959b; Naidu, 1962
Rats	Tendernuts	Coleman and Rao, 1918; Pillai and Kurian, 1959b; Nair and Menon, 1963
Bats	Fruits	Pillai and Kurian 1959b; Daniel and Kumar, 1976
Monkeys	Fruits	Nambiar, 1949; Pillai and Kurian, 1959b; Daniel and Kumar, 1976
Woodpecker	Stem	Nair and Menon, 1963

Appendix 6.2. *Pests of stored arecanut*

Name of the pest	Family	Reference
Araecerus fasciculatus DeG.	Anthribidae	Ayyar, 1940
Coccotrypes carpophagus H.	Scolytidae	Oommen and Nair, 1968
Lasioderma serricorne F.	Anobiidae	Nair and Oommen, 1969
Corcyra cephalonica (Stainton)	Galleriidae	,,
Setomorpha rutella Zell.	Tineidae	,,

Name of the pest	Family	Reference
Ephestia cautella (Walk)	Phycitidae	Nair and Oommen, 1969
Tribolium castaneum Hest.	Tenebrionidae	,,
Alphitobius piceus 01.	,,	,,
Microcrypticus scriptipennae F.	,,	,,
Cryptolestes pusillus Schonh	Cucujidae	,,
Tyrophague putrescentiae Schrank	Acaridae	,,
Carpophilus mutilatus Er.	Nitidulidae	,,
Ahasverus advena Waltl.	Cucujidae	,,
Attagenus gloriosae F.	Dermestidae	,,
Carpophilus pilosellus Mots.	Nitidulidae	Daniel and Kumar, 1979
Thaneroclerus buquet (Lefebvre)	Cleridae	,,
Sitophilus oryzae. L.	Curculionidae	,,
Proceus sp. (?) depressus Woll.	,,	,,
Psocid sp. (undetermined)	Psocidae	,,
Pseudoscorpion	Pseudoscorpionidae	,,
A mite (undetermined)	Cheyletedae	,,

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