



# Diversity and management of scale insects infesting coconut

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**Outbreak of scale insects and other sucking insect pests is likely to happen in an era of climate change. A careful study on the bionomics and bio-suppression of scale insects would therefore be the need of the hour in general to plantation crops and particularly on coconut.**

Scale insects constitute a diverse group of insects placed under the order Hemiptera. There are about 6,000 species of scale insects in 21 families worldwide. The two most common families of scale insects are Diaspididae comprising the armoured scales and Coccidae containing the soft scales. Scale insects derive their name from the scale or shell-like covering that conceals their body. They are sap feeding insects and can attain the role of serious pests on all types of woody plants and shrubs. Scales are so unusual looking that many people fail to recognize them as insects. Adult females and many immature forms do not move, are hidden under a disc-like or waxy covering, and lack a separate head and other distinguishable body parts. Scales have long piercing and sucking mouthparts for feeding the plant sap. Depending upon the species, scale insects may be found on different

plant parts *viz.*, stems, twigs, leaves or fruits. Severe infestations can cause overall decline and even death of plants. Scale insects have high population density during summer months. Scales are characterized by having a single claw, neotenic adult females, winged but non-feeding adult males, and an unusual form of metamorphosis that normally includes a prepupa and pupa in the adult male (Miller & Kosztarab 1979). The distinguishing features of the two categories of scales *viz.*, armoured and soft scales are furnished below.

## Scale insects of coconut

Scale insects though minor pests, are assuming the status of major pests in India due to high density of planting of palms, scarce rainfall and poor management practices (Vidyasagar and Keshava Bhat, 1991). More than 12 species of scale insects have been reported on

| Armoured scales   | Soft scales  |
|---|--|
| Have a hard shield-like cover composed of shed skins and wax that is not attached to the body of the insect i.e., unattached shell and body wall. | Produces a soft cottony, powdery or waxy substance that cannot be separated from the insect body i.e., attached shell and body wall. |
| Smaller at maturity than soft scales (Less than 1/8 inch in diameter)   | Larger at maturity than armoured scales (Have a diameter of 1/4 inch or less).   |
| No honeydew production  | Often produce abundant honeydew  |
| Never mobile after crawler stage  | Some mobile stages occur after crawler stage   |
| Parenchyma feeders  | Phloem feeders.  |

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coconut in India among which, *Aspidiotus destructor* Signoret, *Lepidosaphes megregori* Banks and *Aonidiella orientalis* (Newstead) are the major species having wider distribution. Important species of both armoured and soft scales reported from South India are described below.

**A) Armoured scales**

In coconut, four species of armoured scales are reported from Kerala/Minicoy. They are

- 1) Coconut scale, *Aspidiotus destructor* Signoret
- 2) Oriental scale, *Aonidiella orientalis* (Newstead)
- 3) Mussel scale, *Lepidosaphes megregori* Banks.
- 4) Needle scale, *Chionaspis* sp.

**1) Coconut scale, *Aspidiotus destructor* Signoret**

This is the most important scale insect infesting coconut in India. It is distributed through out tropical and subtropical regions of the world,

particularly on Islands and is present in all countries where coconuts are grown. It is sometimes called red flies because of abundant male flies during late afternoons in case of severe outbreak.

**Hosts**

The major hosts of coconut scale are typical perennial species including many species of fruit trees such as avocado, breadfruit, mango, guava, banana and papaya. Other major hosts are cocoa, cassava, cardamom, black pepper, cotton, oil palm, rubber, sugarcane and tea. It also attacks a range of ornamental plants including roses.

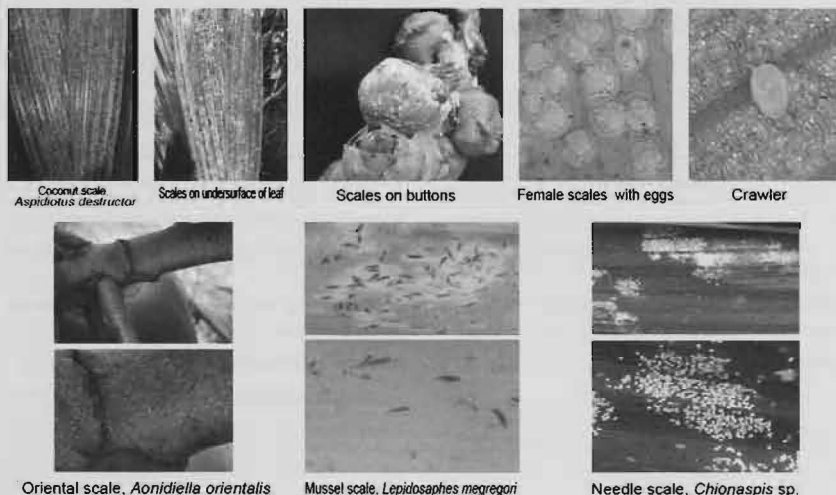
**Damage**

Coconut is the preferred host and this scale is found mainly on the undersurface of leaves, but occasionally they attack frond stalks, flower clusters and young fruits (Mohandas and Remamony, 1993). On the leaves, the crawlers of *A. destructor* settle and develop into scales with yellow spots. Entire leaves may turn yellow to brown and

fall. The bright yellow colour of affected palms is clearly visible from a great distance. In extreme cases, the leaves dry out, entire fronds drop off and crown dies. Heavy infestation results in stunting of new leaves, reduction of crop yield or complete crop failure. Attack on fruits causes shriveling of nuts leading to premature nut fall. Young coconut palms aged 10-15 years are more vulnerable to scale damage.

**Biology**

The life cycle of *A. destructor* lasts for 34 days in female and 29 days in case of male (Jalaluddin and Mohanasundaram, 1989). Eggs are yellow and very small and are laid underneath the scale around the body of the female. After hatching the nymphs crawl out and colonize the plant surfaces. Crawlers of both sexes and adult males are the only mobile stages of the pest. The first instar crawlers leave the maternal scale and begin feeding by inserting feeding tubes on the affected part of the plant surface. The first instar crawlers are about 1 mm in length, yellowish brown, oval and translucent. Second-instar females are sedentary and secrete a translucent wax cover. The females have two nymphal stages. The males have four developmental stages, two feeding nymphal stages, a pre-pupal and a pupal stage. The scale cover of adult female is oval to circular, 1.5 to 2.0 mm across, flat, thin and translucent. Inside the scale the yellow adult female measures 0.6 to 1.1 mm wide. Adult males are more reddish than females, but much smaller and more oval. The male has one pair of wings and is motile.



Armoured Scales



Female scale insects are wingless and winged adult males do not feed. First-instar nymphs are often transported by wind, and any instar can be introduced on plant material. Birds also aid in phoretic dispersal of scales.

Infestation is most severe in areas where the rainfall is scanty and the palms are closely planted; neglected palms grown in dense and semi-wild vegetation are particularly susceptible. In general, palms grown in well managed plantations exposed to the prevailing winds are not severely infested.

## 2) *Aonidiella orientalis* (Newstead)

It is one of the predominant scale insects associated with coconut and widely distributed in Tamil Nadu, Andhra Pradesh, Karnataka and Kerala. It has a wide host range and has already been recorded from the fruits in several crops including papaya and also from arecanut. Female scales are mostly confined to rachillae and nuts. Adult females are orange in colour with a round shield. The male and female crawlers are mobile, females of all other stages and immature males were sessile. Adult males are alate. The alate males emerge just prior to females commencing the third-scale enlargement phase. Females at this time have moulted to the third instar (adult) and are presumably receptive although mating was not seen. It then takes a further 25 days for the females to enlarge the scale, grow and start producing crawlers. Males took  $19.5 \pm 2.7$  days from the crawler stage to adult. Females took  $43.2 \pm 2.4$  days from the crawler stage to

production of the first crawler of the subsequent generation (Elder and Smith, 1995).

## 3) Mussel scale, *Lepidosaphes megregori* Banks

The adult female scales are normally aggregated, typically boat shaped and feed continuously from undersurface of coconut leaflets. The pest infestation leads to yellowish-brown spots on the upper surface of leaflets which under severe infestation coalesce and whole leaf becomes yellow. Mussel scales are mostly confined on coconut leaflets and no other plant parts are normally invaded. Occurrence of this scale in Kerala was first reported by Visalakshy *et al.* (1982).

The scale is brown, thin, translucent and the first-instar crawlers are conspicuous at the anterior end and are mobile. Male scales are elongate and smaller than female. Males are winged and ephemeral. Eggs are laid by the female under the scale cover and the

crawlers that hatch out from the eggs move out and fix themselves on the host plant at suitable places and remain stationary during the remaining part of its life.

## 4) Needle scale, *Chionaspis* sp.

These white scales of 3 mm in length are elongate and oval in shape. They are confined to undersurface as well as upper surface of coconut seedlings in large numbers that are densely congregated. Continuous feeding leads to chlorosis and drying of unsplit leaves of the seedling.

## B) Soft scales

In coconut, three species of soft scales are reported in Kerala and Island conditions of Minicoy. They are

- 1) Wax scale *Ceroplastes floridensis* Comstock
- 2) Brown soft scale, *Coccus hesperidum* Linnaeus
- 3) Stellate scale, *Vinsonia stellifera* Westwood



Wax scale, *Ceroplastes floridensis*



Adult females



Settled crawler



Crawler with appendages



Brown soft scale, *Coccus hesperidum*



Stellate scale, *Vinsonia stellifera*



Adult female



Nymph with rays and anal tufts

Soft Scales



### 1) Wax scale *Ceroplastes floridensis* Comstock

These wax scales are occasionally found on coconut leaflets and are easily recognized by thick wax coverings with characteristic mounds or projections. Female adults are projected, globular possessing waxy covering with two pairs of conspicuous white markings on the body (Howard, 2001). This scale insect was mostly found singly on coconut leaflet on both upper and under surface. No other palm parts are found invaded by the pest. In few scale projections exit holes are also quite visible. It has not assumed pest status anywhere in Minicoy or Kerala. The greyish to pinkish-white waxy covering of the mature female is 1.0–3.5 mm wide and 3.0–4.0 mm long. Crawlers are very small with three pairs of legs with well developed antennae and a posterior caudal filament.

### 2) Brown soft scale, *Coccus hesperidum* Linnaeus

These oval, flattened, reddish-brown soft scales are found on coconut leaflets. Immature scale insects (second instar) resemble adults but are smaller, except for mobile crawler stage which has three pairs of wings, is pinkish, oval in shape and has two prominent hairs (setae) arising from the end of the abdomen. Eggs are produced within the females and hatch out into first-instar crawlers when they are laid. Crawlers are normally dispersed by air currents and find suitable feeding site with a few days and become afterwards. Winged adult males and females emerge in

about a month. These scale insects are closely associated with black ants in Minicoy due to the excretion of honey dews by the insects and continuous removal of sap by feeding. In most cases a sooty mould fungus colonizes the honey dew and causes the surface to turn black.

### 3) Stellate scale, *Vinsonia stellifera* Westwood

Star scale insect adversely affects the vigour of the palm by mass-feeding on leaflets. Adults are characterized by seven or eight rayed star with a convex maroon coloured body. Nymphs are whitish with small body and longer rays possessing a pair of well-developed anal tufts. It is a polyphagous coccid sometimes seen on palms. Usually no more than few individuals are found on palms, but it attracts attention because of its curious star shape.

### Management

Scale insects are bio-suppressed by natural enemies when predators and parasitoid activities are not disrupted by ants or application of broad spectrum insecticides. In case of soft scales, controlling ants may be sufficient to bring about gradual control of scales as natural enemies become more abundant. Coconut scales can be easily reintroduced even after suppression because of its host range.

### Phytosanitary measures

Scale insects are spread by transport of infested plants or plant parts. Surveillance should be strict on the movement of planting material to avoid spread of scale

insects across the transcontinental borders.

### Cultural control

Plants need to be provided with good growing conditions and proper cultural care, especially appropriate irrigation so they are more resistant to scale damage. Healthy plants in well drained soils are seldom seriously infested. Weak and neglected plantations are susceptible to damage by scale insects.

### Mechanical control

Scale insects should be monitored by inspecting plants for crawlers, matures females or ants. Heavily infested twigs and branches are to be pruned off to eliminate scales when infestations are on limited parts of the plant.

### Biological control

Biological pest suppression is the long term solution and has been successfully utilized against certain key pests. In countries where the scale is present, pest population is controlled by introducing natural enemies. However, biological control takes time to establish and become effective and occasionally there are pest outbreaks due to imbalance or loss of natural enemies. The imbalances or loss of natural enemies occur due to natural causes like droughts, cyclones *etc.* In such cases introduction of new stocks of the natural enemy may be necessary.

Scale insects are attacked by a few specific and a large number of non-specific parasitoids and predators. Predators rather than the parasitoids play a significant role in limiting coconut scale population



(Waterhouse and Norris, 1987). Coccids are essential food for a large proportion (36%) of coccinellid species globally, especially in the tropics and subtropics (Hodek and Honek, 2009). The most common are the coccinellid beetles, *Chilocorus nigritus*, *Cryptognatha nodiceps*, *Pseudoscymnus anomalus*, *Pseudoscymnus dwipakalpa*, *Scymnus luteus*, *Rhyzobius* spp. and *Telsimia nitida*. Parasitoids are not well studied but *Aphytis* spp., *Coccobius reticulatus* and *Encarsia* spp. contribute significantly in maintaining of scale insect population in the field. Jalaluddin and Mohanasundaram (1989) reported *Aphelinus chrysomphali* and *Casca parvipennis* as effective parasitoids of *A. destructor* in Tamil Nadu.

In Minicoy, two different species of lady beetles *Chilocorus subindicus* Booth (Coccinellidae : Coleoptera) and *Scymnomorphus* sp. (Coccinellidae : Coleoptera) were found predatory on coconut scale insects as well as spiraling whitefly. The former is a sibling species of *Chilocorus nigritus* whereas the latter is one of the smallest types of lady beetles measuring <1mm. Conservation of these lady beetles is therefore required for the natural suppression of scale insects. In addition to that, a nitidulid predator *Cybocephalus* sp. (Cybocephalidae / Nitidulidae : Coleoptera) identified by its hump-backed appearance is associated with bio-suppression of the pest in Minicoy (Josephraj Kumar *et al.*, 2010). These lady beetles can be introduced in the mainland where

scale insects pose a concern to various crops.

### Chemical control

The use of chemicals is not usually recommended as a pest control method, especially on coconuts. Pesticides can also kill the natural enemies present in the field. However, a number of insecticides could be used on affected plants and young establishing coconut plants. Some of the recommended insecticides include carbaryl, monocrotophos, dimethoate and white oils. Three sprays of 2.5% fish oil rosin soap were found to be effective in reducing the population of *A. destructor* (Jalaluddin and Mohanasundaram, 1989).

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