Aspidiotus rigidus

Scientific Name
Aspidiotus rigidus Reyne 1947

Synonyms:
Aspidiotus destructor rigidus Reyne, 1947

Taxonomic note: Reyne (1947) first described this species as a subspecies of *A. destructor*. It was initially misidentified as *Aspidiotus destructor* in the Philippines.

Common Name(s)
False coconut scale, coconut scale insect

Type of Pest
Scale insect

Taxonomic Position
Class: Insecta, **Order:** Hemiptera, **Family:** Diaspididae

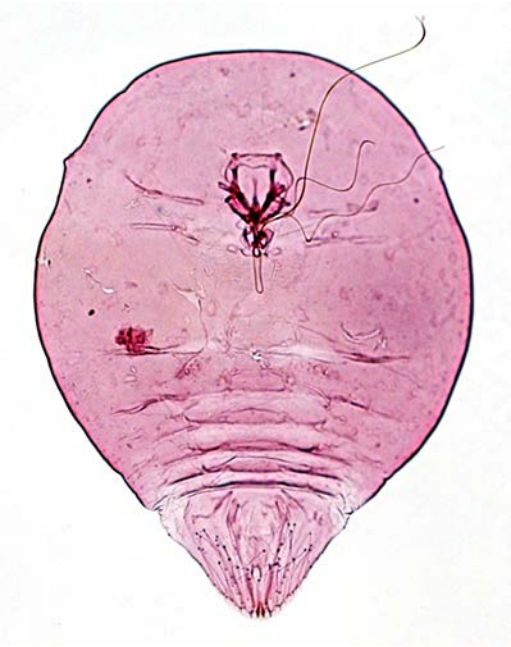


Figure 1. *Aspidiotus rigidus* (Photographs by Gillian W. Watson, California Department of Food and Agriculture).

Reason for Inclusion
CAPS Target: Tropical Pest List – 2015

Pest Description
Eggs: Eggs mainly develop in the females. The white eggs are laid in a crescent shape around the female (Kalshoven et al., 1981).

Larvae: Their length is 0.22 to 0.23 mm; width is 0.14 to 0.15 mm; and height is 0.05 mm. The first larval stage has legs and antennae; these are lost in the first molt. The cast skin is incorporated into the scale of the second larval stage. Females molt twice, while males molt at least three times (Reyne, 1948).

Adults: “Scale cover broadly oval to circular, 1.5–3mm across, fairly flat, very thin and transparent, with subcentral yellow exuviae; scale colour varying from pale yellow to (occasionally) chestnut brown. In mature specimens, white egg skins accumulate under one half of the scale cover, in a crescent shape and the large female is stiff when pushed with a blunt needle” (Watson et al., 2014).

“Males are pale and bright yellow with a red thoracic band” (Kalshoven et al., 1981). Males are also winged (Watson et al., 2014).

A description and illustration of the adult female can be found in Reyne (1948).

Biology and Ecology

The eggs mainly develop within the female. The female then lays the eggs in groups of around 12 around her in a crescent shape. Soon after being laid, the larvae hatch and disperse to prevent crowding. Dispersal can occur by wind or by dropping from the palm. The larvae usually affix themselves to a leaf within 12 hours unless crowding is an issue (Kalshoven et al., 1981). After fixation occurs, the legs and antennae are withdrawn and the larvae begin forming a cocoon from minute white threads. The cocoon turns into the transparent scale after fluid impregnation (Reyne, 1948). Females typically produce about 25 to 50 larvae each that survive to the settling stage when conditions are favorable (Kalshoven et al., 1981).

It takes about 16 to 18 days for the scale to molt to the second stage larva (Reyne, 1948). It takes approximately 45 to 55 days for females to develop. The ratio of males to females increases when conditions become unfavorable. Although males are present, reproduction is thought to be mainly through parthenogenesis. During heavy attacks, there can be 20 to 30 scales per cm^2 which can amount to 40 to 60 million scales per coconut tree (Kalshoven et al., 1981). The Philippines has approximately 8 generations per year (Watson et al., 2014).

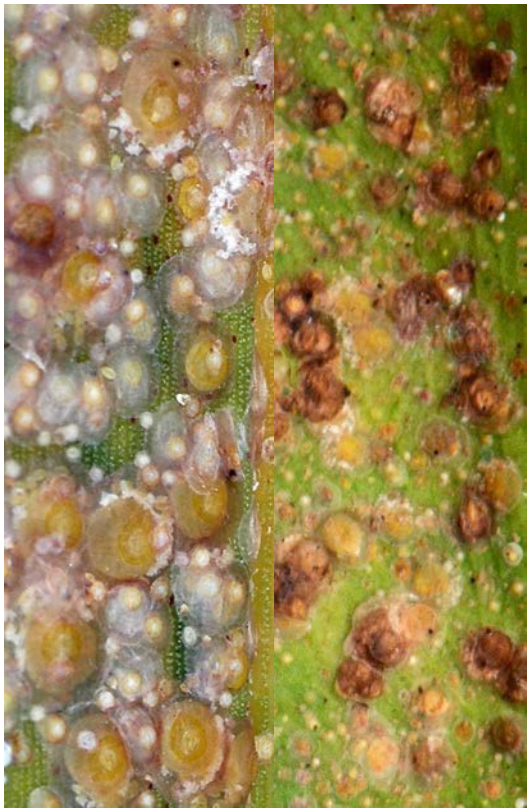
This species prefers humid conditions (Kalshoven et al., 1981). The scales are usually found on the lower parts of the coconut leaflets or pinnae when the population is low (Reyne, 1948). During outbreak conditions, *A. rigidus* can multiply at a rate of 5 to 10 times per generation (Watson et al., 2014).

Figure 2. Damage to coconut palms caused by *Aspidiotus rigidus* in the Philippines (Photographs by Gerry Carner, Clemson University).

This species is similar to the cosmopolitan and polyphagous *A. destructor* with some key differences. Adult females of *A. rigidus* have an extremely tough and rigid cuticle, unlike *A. destructor*. The life cycle is also about 1.5 times longer than that of *A. destructor*. The egg pattern also differs with *A. rigidus* with eggs being laid in a crescent shape under half of the scale cover (Watson et al., 2014).

Damage

This species feeds on the lower leaf surfaces, blocking the stomata and destroying the cholorphyll. This causes the leaves to yellow and dry (Watson et al., 2014). The yellow spot forms soon after the larva attaches itself to the leaf. Although the scales attach themselves on the underside of the leaf, the yellow spot is most conspicuous on the upper surface of the leaf. The yellow spots coalesce into larger yellow patches if population levels are high (Reyne, 1948). Small infestations can cause the leaf-tips to yellow. Heavy infestations can cause leaves to die prematurely and turn grey and reddish. Young leaves become stunted and wilt. The tree crown may also collapse. The tree will eventually die with heavy infestations (Kalshoven et al., 1981).



Figures 3 & 4. *Aspidiotus rigidus* on coconut (left) and mangosteen (right) (Photographs by Gerry Carner, Clemson University).

The leaves can have up to four layers of scales; the new generation of scales feed through the old dead scale layers (Kalshoven et al., 1981).

When populations are high, the coconut crop (dried kernel content and number of nuts) decreases. Coconut water becomes tasteless or slightly sour during attacks while the palm cabbage loses flavor, likely due to loss in sugar content. Moderate attacks can lead to copra losses of 25 to 50% (Reyne, 1948).

Pest Importance

This species was recorded causing severe damage on coconut plantations in Sangihe Islands, Indonesia in 1925 through 1927. This infestation not only affected coconut palms but sago palms as well (Kalshoven et al., 1981). More recently, the spread of this insect within parts of the Philippines has reached epidemic proportions. It is considered a major threat to the local coconut industry (Almarinez et al., 2014). To help mitigate losses, some farmers in affected areas cut down dying trees to sell for lumber. Recovery from this is hard as it takes at least 5 years after planting for coconut trees to begin bearing fruit (Watson et al., 2014). As of June 2014, this pest has affected 2.1 million trees in the Philippines. Approximately 65% of the infected trees have died, while fruit yields have reportedly dropped an average of about 60% (FAO, 2014).

Infestations of this scale lead to fruits forming less nutmeal, sour tasting water in the nuts, and when infestations are severe, death of the tree in six months or less (Watson et al., 2014).

Outbreaks of this species appear to occur when the scale is introduced into new areas that have favorable environmental conditions. Favorable conditions include densely

planted coconut palms, a humid climate, and strong winds to facilitate dispersal (Watson et al., 2014).

Damage caused by this species has led to work being completed on natural enemies and other control methods. Several natural enemies have been introduced into areas where this species has caused extensive damage to help lessen the impact (Kalshoven et al., 1981). A native *Comperiella* sp. has been found to parasitize from 65 to 92% of *A. rigidus*; and coconut trees showed significant recovery where the *Comperiella* sp. is found (Almarinez and Amalin, 2015).

The destruction of coconut trees caused by *Aspidiotus rigidus* in the Philippines has also led to the implementation of an Integrated Pest Management program which includes leaf pruning, trunk injections, insecticide sprays, biocontrol agents, and fertilization to hasten recovery of infested trees (Philippine Coconut Authority, 2014).

Known Hosts

This species is found primarily on palms. It can sometimes be found on banana and mangosteen (G. Evans, 2014, personal communication). In heavy infestations, the scales can be found on surrounding plants that may or may not be true hosts (Kalshoven et al., 1981).

In outbreak areas in the Philippines, *A. rigidus* attacked both short and tall coconut cultivars equally severely with none showing resistance (Watson et al., 2014).

Major hosts

Cocos nucifera (coconut), *Garcinia mangostana* (mangosteen), and *Musa* spp. (banana) (Reyne, 1947; 1948)

Minor hosts

Chrysalidocarpus lutescens, *Cyrtostachys* sp., *Metroxylon* sp. (sago palm), and *Nypa fruticans* (nipah palm) (Reyne, 1948).

Pathogens or Associated Organisms Vectored

This species is not known to be associated with pathogens or other organisms.

Known Distribution

Asia: Indonesia (including Western and Central Java, parts of South and North Sulawesi, Sangihe, and Bali) and the Philippines; **Oceania:** Republic of Palau[1] (Kalshoven et al., 1981).

[1]According to Watson et al. (2014) this population is likely *A. destructor* and not *A. rigidus*.

Pathway

The current outbreak in the Philippines was likely due to the accidental importation of infested plants to areas with favorable environmental conditions (Watson et al., 2014).

Aspidiotus sp. have been intercepted at U.S. ports of entry 184 times. Of these interceptions, 23 originated on material from Indonesia or the Philippines. Most were found on host material, including coconuts, bananas, and mangosteen (AQAS, 2014, queried April 28, 2015).

Potential Distribution within the United States

This species is found in Indonesia and the Philippines. The plant hardiness zones found in these two countries (10-13) correspond with the more tropical areas of the United States and its territories, including American Samoa, Florida, Hawaii, Puerto Rico, and the U.S. Virgin Islands. Many of these areas have appropriate host material as well.

Survey

Approved Method for Pest Surveillance*:

The approved method for this species is visual inspection.

Heavy infestations of this species can destroy host chlorophyll, turning the leaves yellow; “feeding punctures increase water loss from the leaves; the fruits form less nutmeat and the coconut-water becomes sour as a result of a lack of sugar content; new leaflets are stunted and weak, and tend to bend over strongly or break off; nut production falls and then stops; and, finally, the tree dries out and dies in 6 months or less” (reviewed in Watson et al., 2014).

*For the most up-to-date methods for survey and identification, see Approved Methods on the CAPS Resource and Collaboration Site, at https://caps.ceris.purdue.edu/approved-methods.

Survey Site Selection:

This species is primarily found on palms but can sometimes be found on bananas and mangosteen as well (G. Evans, 2014, personal communication). This species feeds on and can be found on the leaves of host plants.

Time of year to survey:

This species is likely to be found year round in tropical conditions; however, this species favors humid conditions. Both heavy rain and dry conditions can limit population numbers (Kalshoven et al., 1981).

Key Diagnostics/Identification

Approved Method for Pest Surveillance*:

Morphological. The adult female is the identifiable life stage. Identification requires the specimen to be slide mounted; however, its biological characteristics can provide supporting evidence of the identification of this species versus *A. destructor*. Therefore, the surveyor should note scale cover color and position of eggs under the adult female. Photographs should be taken of the scale in the field and sent to the identifier.

For a key to scale families, including Diaspididae, see Miller et al. (2014). For a key to differentiate between *A. rigidus* and *A. destructor*, see Watson et al. (2014).

Molecular characterization of this species is currently being carried out at the University of the Philippines at Los Banos (Watson et al., 2014).

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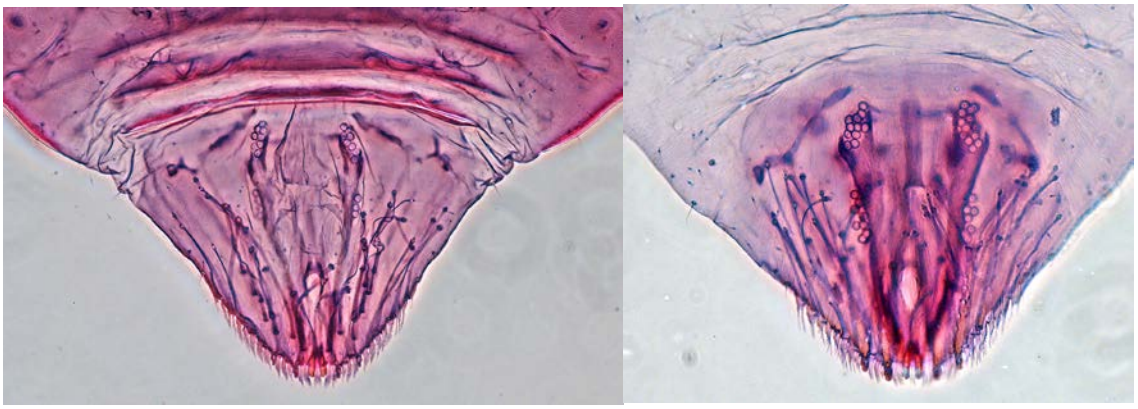

Figures 5 & 6. Pygidium of *Aspidiotus rigidus* (left) and *Aspidiotus destructor* (right) (Photographs by Gillian W. Watson, California Department of Food and Agriculture).

Easily Confused Species

This species is very similar to *Aspidiotus destructor*, a common and cosmopolitan pest (G. Evans, 2014, personal communication). A key to differentiate the two species is found in Watson et al. (2014). Reyne (1947) also lists 4 characteristics that could be used to distinguish *A. rigidus* from *A. destructor*.

Aspidiotus rigidus is primarily found on palms (sometimes on bananas and mangosteen); whereas, *A. destructor* is a widespread, very polyphagous species (G. Evans, 2014, personal communication).

Aspidiotus rigidus is also similar to *A. cryptomeriae*, a species found in northern Asia that feeds on Pinopsida (Watson et al., 2014).

There are 83 *Aspidiotus* species known worldwide. Gill (1997) keyed *A. destructor* versus *A. nerii* in California; Williams and Watson (1988) provided a key to 8 Pacific species but did not include *A. rigidus* (G. Evans, 2014, personal communication).

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Reviewers

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