

A New Papaya Scale Insect in Hawai'i: Oriental Yellow Scale, *Aonidiella orientalis*

Description

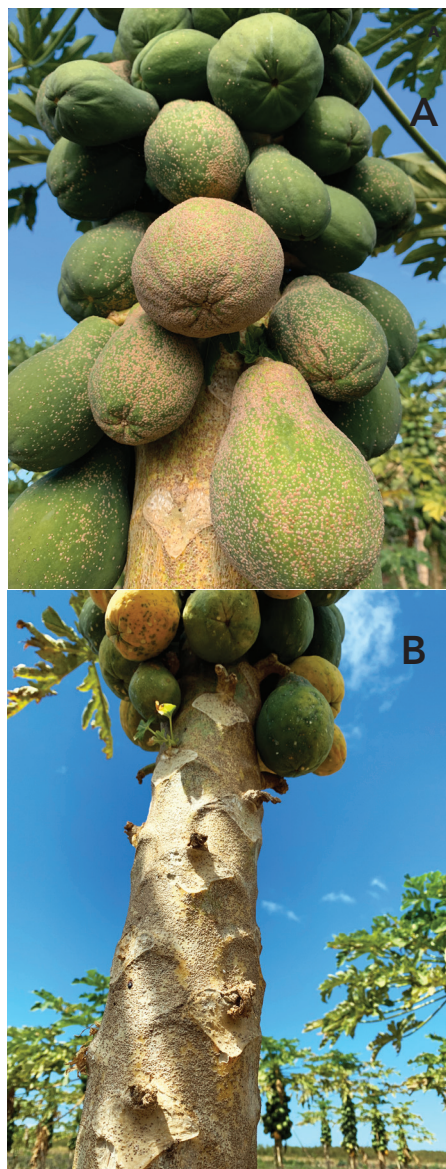
The Oriental Yellow Scale, *Aonidiella orientalis* Newstead (Hemiptera: Diaspididae), is an “armored” scale, which means the adult is covered with a scale that is created by incorporating the cast skins from previous molts with newly secreted wax from the body. The scale shield on the female is circular and flat in shape, almost yellow to dark brown, positioned more or less centrally, while on the male, the shield is elongated-to-oval shape and smaller than on the female (CABI 2021, Figure 1). This new invasive scale insect closely resembles the white peach scale, *Pseudaulacapsis pentagona* (Targioni) of papaya, and sometimes occurs together on the same tree. Unlike yellow scales, white peach scales are snow-white in color with a yellow spot in the center of the scale (Figure 2).

Distribution

Aonidiella orientalis was first described by Newstead in 1894 from an undetermined host plant in India (CABI 2021). Since then, this pest has been distributed worldwide, mostly in tropical and subtropical areas, including West Indies, Middle East, India, East Africa and Southern Africa, Southern Asia, and Northern Australia (~48 countries) (CABI 2021). In the U.S., this scale insect was established only in Florida but now has also spread to Hawai'i (Matsunaga et al. 2019), though it was intercepted in Georgia and California multiple times (CABI 2021). It was first reported on O'ahu in 2009 (Matsunaga et al 2019) and later found on Kaua'i in 2018.

Hosts

Oriental Yellow Scale has been recorded from 163 plant genera across 74 families (CDFA 2016, CABI 2021). Elsewhere in the world, it is an economically damaging pest



in fruit trees (mango, papaya, citrus, avocado), palm trees (coconut, arecanut), and many other crops (acacia, tea, banana) (CABI 2021). In Hawai'i, it was first reported on the fruit of a potted Loulu palm (*Pritchardia* sp.) in a nursery on O'ahu in 2009 (Matsunaga et al. 2019). Later, field populations of *A. orientalis* was confirmed on papaya trees on Kaua'i in November 2018 by the Hawai'i Department of Agriculture. In this event, the scale insects were colonizing primarily on fruits and trunks and occasionally on leaves (Figure 1).

Life Cycle

Eggs of the Oriental Yellow Scale are laid under the scale shield of the female on the host plant. The eggs hatch into larvae (1st instar crawler) in approximately 3-5 days. The crawlers will soon settle on a suitable host, where they insert their mouthparts (stylet) for feeding. The female subsequently becomes immobile, with successive molts adding to the size of the scale. Females undergo two molts before attaining full maturity. The males have additional prepupal and pupal molts before attaining a

Figure 1. Colonizing Oriental Yellow Scale on A) papaya fruits, and B) the trunk.

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Figure 2. A colony of A) Oriental Yellow Scale on a papaya fruit, and B) White Peach Scale on papaya fruit and trunk.



Figure 3. Severe damage of papaya trees by Oriental Yellow Scale causing A) deformed and shrunk papaya fruits, and B) weakened and dislodging papaya trunk.

winged adult stage. Adult males lack mouthparts, do not feed, and are short-lived. Depending on weather conditions, these scales have 3 to 5 generations per year (CABI 2021). However, it is likely they may have more than 5 generations per year in Hawai'i.

Economic Impact

Oriental Yellow Scale is highly polyphagous and is therefore potentially a serious pest of a wide range of crops. It is an important quarantine pest. The greatest economic impact is often in areas where it has recently been invaded. It is usually spread naturally or by human intervention (CDFA 2016, CABI 2021). Oriental Yellow Scale is a serious pest in certain parts of the world, notably on coconut and areca nut in India (Rajagopal and Krishnamoorthy, 1996), coconut in Florida (CABI, 2021), neem in Africa (Lale, 1998), papaya in Australia (Elder et al., 1998), and citrus in Iraq (Ahmad et al., 2022). The damage is caused by the scale insect feeding on plant tissues, resulting in yellowing, reduced vigor, and deformed fruits, as well as cosmetic issues with the presence of scales on the fruit. On papaya, severe feeding damage can significantly reduce the size of the fruit, yielding shrunken fruits and weakening the trunk, which may eventually collapse the tree (Figure 3).

Management

Biological control: A number of biological control agents have been found to suppress White Peach Scale populations in papaya (Branscome 1999, Lale 1998). In Hawai'i, surveys showed a number of coccinellid species (lady beetles) preying on them. Also, minute aphelinid wasps have been reared from White Peach Scale (Wright 2011). Similar natural enemies have also been found to be associated with Oriental Yellow Scale in Hawai'i, including lady beetles preying on scales and parasitoid wasps assessing them to lay eggs or oviposition (Figure 4). The abundance and activity of natural enemies observed on papaya trees suggested these natural enemies play a role in the fluctuating population density of Oriental Yellow Scale on papaya

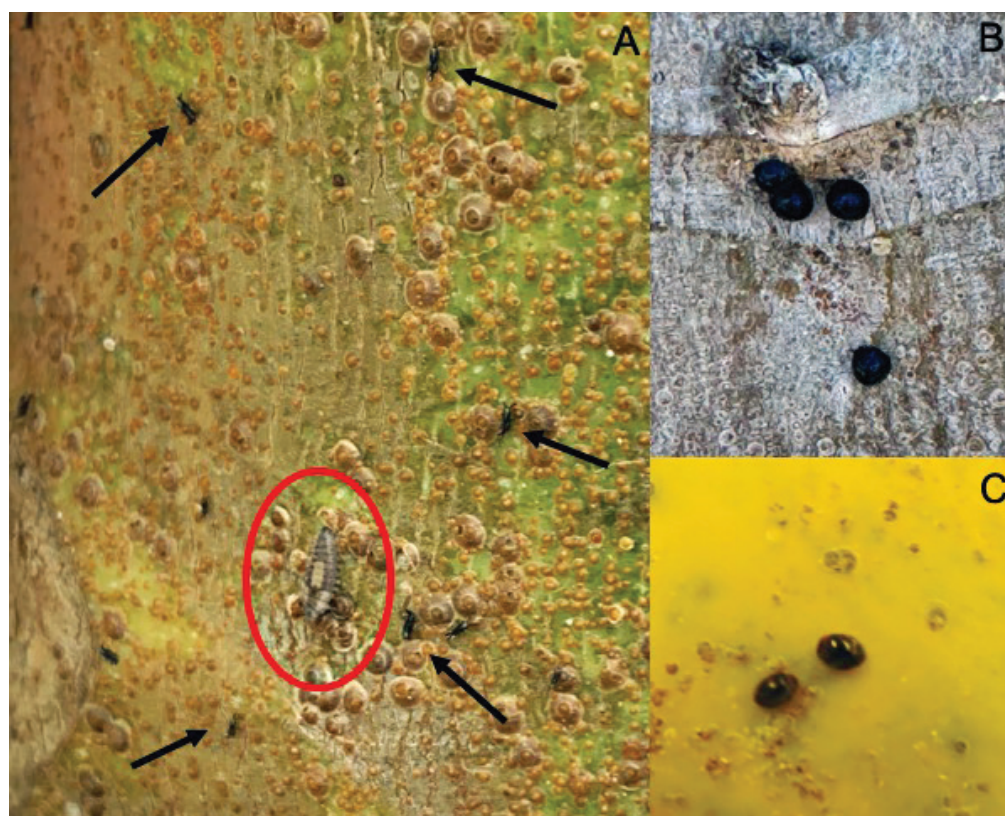


Figure 4. A) Parasitoid wasps (black arrows) assessing host scales for oviposition, and a lady beetle larva (red circle) preying on Oriental Yellow Scale, and lady beetles B) *Chilocorus nigritus* and C) *Stethorus* sp. feeding on scale insects.

farms in Hawai'i (R. Manandhar, personal observation). In Australia, introduced parasitoids, *Comperiella lemniscata* (Encyrtidae) and *Aphytis melinus* (Aphelinidae), established successfully after a release. Along with a naturally occurring *Encarsia citrina* (Aphelinidae), parasitism of Oriental Yellow Scale increased up to 80%, which allowed a significant reduction in pesticide applications to control Oriental Yellow Scale (Elder et al. 2007), illustrating the success of biological controls.

Chemical control: Traditional methods of armored scale control included various insecticidal oils, as well as several other pesticides (Branscome 1999, Baker 2013). Horticultural oils can effectively control scale insects in papaya if applied with good coverage, particularly on fruits and trunks that are more liable to be colonized by Oriental Yellow Scale. Alternatively, insect growth regulators (a.i. buprofezin) are also useful in controlling scale insects of papaya. At higher densities of scale insects, systemic insecticides (e.g. imidacloprid) approved for papaya are more likely to provide effective control of this scale insect. Farmers should practice proper pest and natural enemies scouting to apply insecticides as part of a good integrated pest management (IPM) practice.

Although the established population of the Oriental Yellow Scale was under control in the papaya farm found on Kaua'i, there remains the chance that incipient populations may exist in the nearby area and might spread to other farms.

Thus, it is recommended that papaya farmers should monitor their papaya crop regularly for Oriental Yellow Scale. If they are observed on fruits, it is recommended to remove the infested fruits and solarize them in heavy-duty clear plastic bags to kill the sessile insects. In cases of multiple detections on a farm, preventative sprays of mineral oil at monthly intervals were found to restrict the spread of this insect effectively.

For complete control, curative sprays of systemic insecticide (e.g. imidacloprid) to the colonized trees and buffer trees surrounding that tree, two times within a month were found to control this scale effectively. Consult the local CTAHR Cooperative Extension office if farmers suspect the presence of Oriental Yellow Scale in their farms.

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