Unaspis yanonensis

Scientific Name
Unaspis yanonensis (Kuwana)

Synonyms:
Chionaspis yanonensis (Kuwana)
Prontaspis yanonensis Kuwana

Common Names
Arrowhead scale, Oriental citrus scale, yanone scale

Type of Pest
Scale insect

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

Reason for Inclusion
CAPS Target: AHP Prioritized Pest List for FY2012

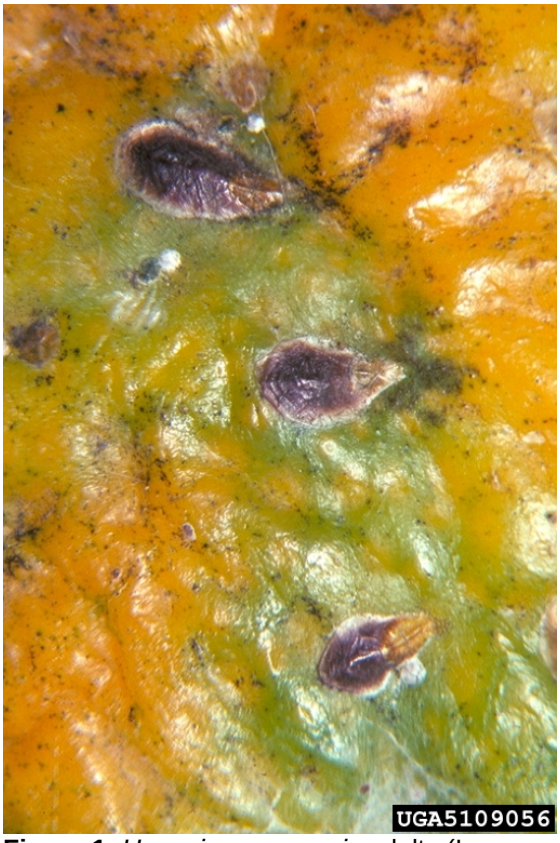

Figure 1. *Unaspis yanonensis* adults (Image courtesy of United States National Collection of Scale Insects Photographs Archive, USDA Agricultural Research Service, Bugwood.org).

Pest Description
Eggs:
"The egg is oval in shape, measuring about 0.18 mm [0.01 in], in length and 0.09 mm [0.003 in], in width. The color is orange yellow with the surface entirely smooth" (Kuwana, 1923).

Larvae:
"The active, or first larval stage of the insect is a flat oval-shaped creature, pale yellow in color, with the posterior end yellowish brown. The total length of the body is about 0.23 mm and the greatest width 0.14 mm [approximately 0.001 in]" (Kuwana, 1923).

"The antennae are five segmented, the last being the longest and distinctly annulate; segments one to four bear one hair, while the distal segment bears several. A pair of relatively large glandular pores with very strongly curved cylindrical ducts; on the dorsal surface near the front. The mouth parts are well formed, with the rostal loop long. Eyes prominent and purple in color, placed at the sides behind the antennae. The three pairs of legs are similar and well developed; the femur longer and highly convex at the outer margin; the tibia short, less than half the length of the tarsus; the claw very large and slightly curved; the digitules prominent. The margin bears about thirty hairs. There are

three pairs of small lobes at the posterior end; the median pair longest, the second and third smaller and similar; near the base of these lobes on the inner side is a spine which extends slightly beyond the tip of the lobe. There are two other similar spines beyond the lobes and two very long hairs at the caudal end between the median lobes. The general shape of the male and female are alike, but the former is slightly deeper in color" (Kuwana, 1923).

Prepupae (only male): "The general color of the body of the pro-pupa is orange yellow with the abdominal end yellowish brown, while the eyes are very dark purple brown. The dorsal eyes are just posterior to the antennal sheaths, while the ventral eyes are larger, closer togethe[r], and a little more caudad than the dorsal ones. The sheaths of the antennae, legs and wings are visible. However, they are all more rudimentary and more closely appressed to the body than the next stage" (Kuwana, 1923).

Pupae (only male): "The color of the body is the same as that of the propupa. The ventral eyes are larger and almost touch each other. They are situated a short distance from the anterior margin while the dorsal pair is wider apart and somewhat closer to the anterior margin, The sheaths of the antennae, wings, and legs are evident and ordinarily lie close to the body along the ventral margin. The style is not prominent. The length of the body exclusive of the style is about .80 mm [0.03 in], the style .15mm [0.006 in], and the greatest width .30 mm [0.01 in]" (Kuwana, 1923).

Adults:
Adult female:
"The scale of the female is of a dirty blackish-brown color with a gray margin; the exuviae are pale yellow, and elongate in form. There is a central ridge from which the sides of the scale slope away like the roof of a house. The ventral scale is white, and does not meet in the middle. Length 2.84 to 3.56 mm [0.11 to 0.14 in], width at the broadest point 1.40 to 1.92 mm [0.06 to 0.08 in]" (Kuwana, 1923).

"The body of the female is elongate in form, distinctly segmented; the anterior margin with the end rounded; constrictions at the sutures distinct, especially so on the two segments preceding the penultimate one. The antennae are represented by minute tubercles bearing one short hair. The mouth parts are well formed, rostral loop very long. Two pairs spiracles prominent. There are more than twelve spine-like plates or gland spines at the side of the penultimate segment. Length about 2.5 mm [0.10 in], width 1.0 mm [0.04 in]" (Kuwana, 1923).

"Scale of the female broadly elongate, flat, with a distinct median ridge, blackish brown with lighter margin, exuvia pale yellow. Length 2.5-3 mm [0.10-0.11 in], greatest width 1.5-2 mm [0.06-0.08 in]. Scale of the male of the type common to the genus" (Rao, 1949).

“Adult female with the prosoma strongly sclerotized, occupying about two-thirds of the length of the body, rather cuneiform and with its posterior angles projecting and acute. Remainder of the body slightly sclerotized throughout at maturity, the two prepygidial abdominal segments quite strongly lobed laterally. Median pygidial lobes quite small, forming a slight notch in the apex of the pygidium, their mesal margins slightly longer than the lateral margin and irregularly serrate. Second and third lobes about equal to each other, their lobules of about the same size. Dorsum of the pygidium with great numbers of macroducts, the total being as great as 150. Anterior spiracles with a cluster of about 15 associated pores. Perivulvar pores lacking” (Rao, 1949).

Adult male:
“The scale of the male is long, white, distinctly carinatod. Exuviae pale brownish yellow. Length about 1.25 to 1.56 mm [0.05 to 0.06 in], width 0.48 to 0.75 mm [0.02 to 0.03 in]” (Kuwana, 1923).

The male’s “wing expanse [is] 1.76 mm [0.07 in], length of the body exclusive of the style .45 mm [0.02 in], style .36 mm [0.01 in]. General color orange yellow, eyes deep dark brownish purple, antennae and legs pale yellow. Head rounded, somewhat pointed at the apex. The antennae composed of ten segments, the first two being much shorter and thicker than the others. The total length of a typical antenna is about 0.54 mm [0.02 in]. All the segments except the first two bear rather long fine hairs.” (Kuwana, 1923).

“The thoracic band is of a light brown color. The wings extend beyond the tip of the style when resting on the body. The halteres are club-shaped, with the slender hook arising from the tip of the club. The legs are slender and hairy, similar; femur is only a little longer than tibia, but the former much broader; tarsus shorter than the tibia and with a curved claw; digitules as usual. The measurements of the different parts of the hind leg are: coxa 0.04 mm [0.002 in], trochanter and femur 0.15 mm [0.006 in], tibia 0.11 mm [0.004 in], tarsus 0.07 mm [0.003 in], claw 0.02 mm [0.001 in]” (Kuwana, 1923).

“Abdominal segments well defined, narrowing slightly towards the posterior end, which is furnished with a sharp style. All segments bear very fine hairs” (Kuwana, 1923).

Biology and Ecology:
Females lay eggs under the scale, behind the body. Incubation is short and lasts approximately one hour. After hatching, the larvae disperse. They can be found actively crawling on host twigs and leaves, but this is short lived and larvae settle within a few hours (Kuwana, 1923).

After settling, the female larvae withdraw the legs under the body and begin feeding on the plant juices of the host plant. The larvae then secrete a thin, grayish waxy material that eventually covers the posterior half of the body before

molting. After molting, the shed skin is incorporated into the dorsal covering and the waxy material is extended posteriorly. The larvae molt a second time into the adult stage and once again the cast skin is incorporated into the scale covering (Kuwana, 1923).

Male larvae have a similar developmental process until the first molt in which the male produces a cocoon; it molts again to form the prepupa and then once more to form the pupa. The adult male soon emerges and immediately begins searching for females. Only males can fly. The adult stage of males is short and death occurs shortly after mating (Kuwana, 1923).

Kuwana (1923) states that the period of oviposition and the amount of eggs laid can differ greatly for individual females according to the season. The fertilized female is the overwintering stage (EPPO, 1989).

In Japan, this species usually has three generations per year (Kuwana, 1923). In southern France, there are two generations per year (EPPO, 1989). In Japan, eggs first appear around May of each year (Kuwana, 1923).

Symptoms/Signs

Attacked plants show inhibited growth, yellow blotches and necrosis of leaves, leaf fall, shortened or dead branches, and small deformed fruits. Large masses of male white scales may be seen on twigs with darker curved female scales. In cases of severe attacks, tree mortality has been observed (CABI, 2004).

Figure 2. Infestation of *U. yanonensis* on an orange leaf; showing the white males and the darker curved female scales (image courtesy of F. Bertaus, GRISP, Antibes, Bugwood.org).

U. yanonensis lives on fruit, foliage, or young twigs of host plants; they cannot attack large branches or the trunk (Ohkubo, 1980). It is characteristic for scales to only infest fruit in the 2nd and 3rd generations (Ohkubo, 1980).

The two types of damage caused by *U. yanonensis* is reduction of the commercial value of fruit through damage to the fruit surface and loss of yield caused by foliage and twig infestations (Ohkubo, 1980). Foliage and twig infestations may result in poor host growth and withered leaves (Ohkubo, 1980).

Heavily infested host plants can be easily recognized by the large amounts of white males covering twigs, leaves, and fruit (USDA, 1985).

Pest Importance

This species is an important citrus pest in Asia, especially in Japan since its discovery in 1907 (Ohkubo, 1980; Blackburn and Miller, 1984). Smith and Peña (2002) state that *U. yanonensis* is an important pest in southern China and Taiwan.

Unaspis yanonensis feeds almost exclusively on *Citrus* spp. In Japan, it is found on all types of citrus except on the Japanese hybrids known as Natsudaidi and on *Citrus junos* (Ohkubo, 1980). It affects fruits, leaves, stems—the whole plant—and can cause serious damage to orchards due to leaf drop and rapid dieback. According to Ohkubo (1980), only 2nd and 3rd generations are found on fruit.

Fruits, leaves, and small branches are attacked, whereas large branches and trunks are not. Only the second and third generations are found on fruits (Ohkubo, 1980). Attacked fruits lose their commercial value because of the feeding punctures of the pest. Relatively low numbers of scales can cause damage. Leaves and branches begin to die back at a density of 1.1 females per leaf (Ohkubo, 1980), while, in the spring, a density of 8 females per leaf is likely to lead to complete dieback of the tree within the year (Ohgushi and Nishino, 1968). The cause of the dieback is not yet understood, but it has been suggested that the scale may inject toxic saliva into the tissues.

Even at low densities, *U. yanonensis* can reduce the cosmetic value of fruit resulting in economic damage (Adachi and Korenaga, 1991).

Known Hosts

This species' host range is mostly restricted to citrus.

Major hosts

Citrus spp., *C. aurantium* (bitter orange), *Citrus clementina* (clementine), *Citrus deliciosa* (Mediterranean mandarin), *Citrus depressa* (shekwasha mandarin), *Citrus grandis, Citrus limon* (lemon), *Citrus sinensis* (navel orange), *Citrus tachibana* (kinokuni mandarin), *Citrus unshiu* (satsuma), *Fortunella japonica* (round kumquat), *Poncirus trifoliata* (trifoliate-orange) (USDA-APHIS, 1985; Davis et al., 2005; CABI, 2010).

Other hosts

Ananas spp., *Artocarpus heterophyllus, Camellia* spp., *Citrus asahikan, Citrus aurantifolia* (lime), *Citrus bergamia* (bergamot orange), *Citrus canaliculata, Citrus glaberrima, Citrus hassaku, Citrus ichangensis, Citrus iwaikan* (grapefruit), *Citrus iyo, Citrus junos, Citrus keraji, Citrus madurensis, Citrus maxima* (pummelo), *Citrus medica* (citron), *Citrus medioglobosa, Citrus natsudaidai, Citrus nobilis* (satsuma mandarin), *Citrus paradisi* (grapefruit), *Citrus reticulata* (mandarin), *Citrus sulcata, Citrus tamurana, Citrus tankan, Citrus tengu, Citrus wilsonii, Citrus yamabuki, Citrus yatsushiro*, *Cocos nucifera, Damnacanthus* spp., *Dimocarpus*

spp., *Fortunella* spp., *Fortunella margarita*, *Hibiscus* spp., *Musa* spp., *Poncirus* spp., *Psidium guajava* (USDA-APHIS, 1985; USDA-APHIS, 2002; Bugwood, 2010).

Pathogens Vectored

This pest is not currently known to vector any pathogens or other associated organisms.

Known Distribution

This pest is present in: Armenia, Australia*, China, Fiji, France, India*, Indonesia*, Italy, Japan, Korea, Malaysia*, Myanmar*, Pakistan*, Philippines*, Taiwan**, Thailand*, Tibet, Vietnam* (EPPO, 1989; Davis et al., 2005; EPPO, 2007).

*Davis et al. (2005) states that these records are dubious.
**Davis et al. (2005) states that this pest has been eradicated.

Potential Distribution within the United States

This predominately Asian species prefers the warm temperate Mediterranean and tropical climates; citrus is its host species. There is potential for *U. yanonensis* to become established in particular areas of the United States where citrus production and warm temperatures co-exist.

Pathway

This species has a low dispersal rate as the females are sedentary for most of their lives and have limited movement after first hatching. It may be possible for this pest to spread through international trade through movement of citrus plants for planting or through citrus fruit (EPPO, 1989).

This species has been intercepted at United States ports of entry multiple times from 1985 to the present (AQAS, 2011; queried 3-31-2011). This pest has been intercepted over 6,000 times, mostly from Japan (over 5,000 interceptions) (AQAS, 2011). Over 5,000 of the interceptions were in baggage on fruit brought into the country for consumption (AQAS, 2011).

Survey

CAPS-Approved Method*:

Visual Inspection. This pest has no known chemical attractants, and light traps have not been proven effective at assessing population sizes (Davis et al., 2005).

Literature-Based Methods:

Visual inspection:

In Japan, plants damaged by this scale typically have leaves, withered green twigs, and whole branches that are dead. Feeding by this scale seems to cause inordinate amounts of damage; very lightly infested leaves will wilt and die.

Heavily infested trees are conspicuous and easily recognized by large masses of white male scale covers on the twigs, leaves, and fruit. The small size, dark color, and sessile nature of the female scales make them difficult to detect unless present in large numbers. On citrus fruit, the female scales can be confused with the common *Lepidosaphes* spp. or easily overlooked as dirt particles.

Individual leaves, stems, and fruit should be examined for various stages of the scale insect. If scale insects are present, the insects should be removed and placed into vials containing 75-90% ethanol (ETOH), or an equivalent such as isopropyl alcohol.

Survey site and selection:
U. yanonensis is found on leaves and twigs of host plants (Itioka and Inoue, 1989). This species is most likely to be found in areas where host material is present, like nurseries, groves, and some residential areas. An appropriate sample unit would be branches with leaves (Davis et al., 2005).

Time of year to survey:
Adults may be found year round as fertilized females are the overwintering stage. In China, larval populations from the first generation peak in late April, in early to mid July for the second generation, in early September to early October for the third generation, and in December if a fourth generation occurs (Song et al., 1990). In France, emergence peaks are observed in April and July (Davis et al., 2005).

Identification

CAPS-Approved Method*:
Morphological. Adult females can be distinguished at the genus and species level based on morphological characters observed on cleared slide-mounted specimens. Species level identification cannot be performed on nymphs or adult males.

A key to the species of *Unaspis* along with a description and illustration of *U. citri, U. euonymi,* and *U. yanonensis* can be found in Rao (1949). A description of the adult female can be found in USDA (1985).

*For the most up-to-date methods for survey and identification, see Appendix M in the most recent CAPS Survey Guidelines.

Easily Confused Pests

This species can be confused with other armored scales of citrus including *Lepidosaphes* spp., *Unaspis citri*, and *Unaspis euonymi*.

Unaspis yanonensis is similar to the citrus snow scale, *U. citri*, but can be distinguished from it by microscopic examination of the adult females. *U. citri* is present in Florida and Louisiana. *U. citri* has been reported to be found in California and Georgia , but these are likely misidentifications of *U. euonymi* (Miller, personal communication). Adult female *U. citri* have relatively few pygidial dorsal ducts (60-75), do not have marked divisions between the thoracic segments, and have median lobes that are more or less parallel with rounded apices (Evans, personal communication). Adult female *U. yanonensis* have numerous pygidial dorsal ducts (as many as 150) and median lobes that are diverging with angular and dentate apices (USDA, 1985; 2004; Evans, personal communication).

To differentiate *Unaspis yanonensis* from *U. euonymi,* adult female characters must be examined in slide-mounted specimens. *U. euonymi* has numerous perivulvar pores and paired glandular spines between the pygidial lobes and relatively few dorsal pygidial ducts, whereas *U. yanonensis* lacks perivulvar pores (and *U. citri)* has 1 glandular spine between pygidial lobes and numerous dorsal pygidial ducts (Evans, personal communication; Miller, personal communication).

A key to distinguish certain diaspidid scales (*Lepidosaphes* spp., *Unaspis citri*, and *U. yanonensis*) on citrus in the EPPO region can be found in EPPO (2004).

Commonly Encountered Non-targets

Unaspis citri is present in Florida and Louisiana and shares many of the same host plants as *U. yanonensis*. *Unaspis euonymi* occurs throughout the United States and is most often found on *Euonymus* spp., although it is known to occur on other hosts (Personal communication, Evans). Other scale insects may be encountered when surveying for *U. yanonensis.* Most of these can be easily distinguished from *U. yanonensis*.

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