

Control of Cycad Aulacaspis Scale on *Cycas reveluta* and *C. taitungensis* using Imicide trunk microinjection

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ABSTRACT:

Cycads are an ancient and unique group of plants that reach tree size in warm climates. The recently introduced cycad aulacaspis scale insect has killed many mature cycad trees and threatens cycad collections in Florida, California, Hawaii, south Texas and other sites where cycads are grown. Trunk injection with the Imicide formulation of imidacloprid was demonstrated to provide at least 60 days control.

Cycads

Cycads are a small group of plants with many unique features, an ancient origin and a very long history (Hill, 1988.). Cycads are known to have lived in the Permian era, over 200 million years ago even before the dinosaurs roamed the earth. Although once abundant across the globe, the cycads are now greatly reduced in both numbers and distribution and there are now only about 250 species of cycads in 11 genera. All cycads are tropical or subtropical and each genus has a restricted geographical range (Whitelock, 2002).

The cycads have been classified as “gymnosperms” in the past, although recent studies have shown that this is not a natural group, some members being closer to the flowering plants than to other “gymnosperms”. The “gymnosperms” are all ancient seed plants, many now extinct, but with four major groups living today. These are the cycads (Cycadophyta), the Welwitschia group (Gnetophyta), the conifers (Pinophyta) and Ginkgo, the Maiden Hair Tree (Ginkgophyta). They are now regarded as quite separate and distinct classes of equivalent status to the flowering plants (Angiosperms or Magnoliophyta). Although the four groups of “gymnosperms” are very different from one another in appearance they all produce naked ovules in contrast to flowering plants in which the ovules are enclosed in an ovary.

Cycad plants resemble palms or tree-ferns in overall appearance, and some species are given the common name of sago palms. . *Cycas* is the sole genus of the family Cycadaceae. The name cycas is from kykas, Greek for palm, referring to the palmlike growth habit. Cycads, however, differ greatly from palms in almost all aspects of anatomical structure and reproductive behavior. For example, cycads are technically woody plants, unlike other woody plants, cycads possess a pachycaul stem. This is a thick, soft stem or trunk made up of mostly

storage tissue with very little true xylem. Within the trunk, leaf traces or veins leading to leaves arise at a point opposite the attachment of the leaf, and circle the trunk within the storage tissue. These are known as with girdling leaf traces, and occur in some ferns but no other seed plants.

Cycad aulacapsis scale

Cycad aulacapsis scale, also named the Asian cycad scale, *Aulacapsis yasumatsui*, was first discovered in Thailand in 1972 (Takagi, 1977). It was recently imported into Florida where it has been reported to cause mortality on a large number of cycads (Howard, et al 1999, DOACS, 2000). The scales of mature *A. yasumatsui* females are white, 1.2 to 1.6 mm long and highly variable in form. They tend to be pear-shaped but are often irregularly shaped, conforming to leaf veins, adjacent scales, and other objects. The scale of the male is 0.5 to 0.6 mm long, white, and elongate. The bionomics of the Asian aulacapsis scale insect was studied by Howard, et al (1999). Females go through three instars, and the average time from egg hatch to adult is 28 days. Females can lay more than 100 eggs which hatch in eight to 12 days at 25 degrees C. Most females do not live longer than 75 days. Asian cycad scale is unusual in that it also infests the roots of its host plant at depths of up to 60 cm in the soil. Only a few other species of armored scale insects infest roots and those roots are generally located near the soil surface.

Control of cycad aulacapsis scale via spray applications has not been effective but use of trunk-injected systemic insecticide treatments may be able to achieve control. Trunk injection of Imicide, a 10% formulation of imidacloprid in Mauget (J.J.Mauget Company, Arcadia, CA) capsules has proven effective in controlling many sucking insects, including soft-bodied scales. The objective of this study was to determine if trunk injection with Imicide in microinjection capsules could provide effective control of infestations of the cycad aulacapsis scale in cycad trees.

METHODOLOGY

The study was conducted at the Cycad Gardens at 4524 Toland Way in Los Angeles, CA. Nine mature Cycads, *Cycas revoluta* and *C. taitungensis*, were used in the experiment. All nine cycads were heavily infested with the Asian cycad scale. Leaf samples were taken prior to any treatment applications and insect counts were performed on each leaf sample in the laboratory. Three *C. revoluta* and two *C. taitungensis* were injected with 3ml Mauget (J.J.Mauget Company, Arcadia, CA) Imicide capsules containing 10% Imidacloprid on July 13, 2003. Mauget's standard procedure for applying Imicide, $DBH / 2$ was used to determine the number of capsules used. Imicide capsules were injected $3/8$ " into active xylem. Two *C. revoluta* and two *C. taitungensis* cycads were untreated and served as controls. On August 12, 2003, 30 days after microinjection and on September 12, 2003, 60 days after microinjection, leaf samples were taken from

the nine cycads in the study and population counts of the Asian cycad scale were performed in the laboratory.

RESULTS

A comparison of the insect counts at 30 days of both the Imicide-treated and untreated trees on Table 1 indicates a large decrease in the average number of scale insects per tree. However, the decrease in average number of scales in the Imicide-treated cycads of 72% was substantially greater than the 40% reduction found in the untreated control cycads. However, at 60 days, the control population of cycad aulacaspis scale has greatly increased, while the Imicide-treated cycads remain at a low population level. These results would indicate that Imicide injection treatment was directly related with a 32% reduction in scale population in the test samples after 30 days and continued to suppress scale population for 60 days.

DISCUSSION

The reduction in cycad aulacaspis scale population in both treated and untreated trees could be explained by excessive heat and dry weather during the 30-day trial period or due to normal scale population fluctuation. Since this insect has only recently been introduced into California its life cycle and population dynamics are not well understood. The further reduction in scale population associated with Imicide injection would indicate efficacy of this systemic insecticide within 30 days. The dramatic increase in the Asian scale population from 30 to 60 days in the control population is an indicator of the serious threat that this insect poses to the health of cycads. On the other hand, the stability of the scale population in the Imicide-treated cycads can only be explained by the efficacy of the trunk injection treatment of that systemic insecticide. Due to the known stability of Imicide in tree tissues, it might be expected that control of this scale insect may continue in treated cycads for up to one year and possibly longer.

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Table 1 Effect of Imicide injection on population of Asian cycad scale on cycad leaves.

Time (days) after treatment sample	Ave. # of Asian cycad scales/leaf	
	Imicide	Control
0 (pretreatment counts)	87*	70
30	24	42
60	54	284

* Leaf counts based on a 10 leaf sample