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THE CYCAD AULACASPSIS SCALE, *AULACASPIS YASUMATSUI*: MANAGEMENT APPROACHES AND PESTICIDE TRIAL UPDATES

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Abstract. **A recently arrived plant-killing scale insect, *Aulacaspis yasumatsui* Takagi, the cycad aulacaspsis scale (CAS), has eliminated many queen and king sagos (cycads) from south Florida landscapes in recent years. Results, with one application of foliar applied insecticides, were evaluated. Applications were made on October 1, 2002 to evaluate potential efficacy in managing this destructive pest. Seven days after treatment, the softer (less toxic) pesticides; Organocide™, horticultural mineral oil, and Safer® Soap, did not provide acceptable control with 21%, 47% and 5% mortality, respectively, of the second instar nymphal population on the underside of the leaflets. The best results with foliar treatments, 85% mortality, were with dimethoate (Cygon 2E). In another test, even greater mortality, 95%, of the adult female stage was achieved with a dimethoate (Cygon 2E) root drench (2 oz/gal per plant). The egg-devouring larvae of the imported predator beetle, *Cybocephalus binotatus*, appear to have become more widespread and a factor in reducing above ground populations of CAS.**

The cycad aulacaspis scale (CAS) is an armored scale (Diaspididae) from Thailand (Figs. 1 and 2). It invaded the Miami, Fla. area about 1994 and has spread throughout the state. It is especially destructive because: it has multiple generations; has a moderately high reproductive rate; feeds on foliage and underground tissues (Howard et al., 1999); and under petiole bases; and because predator and parasite insects that regulate

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Fig. 1. Cycad aulacaspis scales have encrusted the petioles and fronds of this king sago. The CAS feeding activity has distorted the newly emerging fronds.

the scale in its native range are slowly establishing in Florida. This scale insect has eliminated many queen and king sagos (cycads) from south Florida landscapes.

Queen sago, *Cycas rumphii* Miquel and king sago, *Cycas revoluta* Thunberg are used as focal plants in Florida landscapes. These plants were previously low maintenance, uniquely tropical, and used extensively, typically in entrance areas and other prominent locations. In the last few years, because of CAS, the use of these plants is being questioned and the demand has been reduced. Some nursery managers are faced with large inventories that are not selling. Management attempts for CAS infestations have focused on repeated foliar applications of insecticides, monthly or more often. Infested cycads suffer die-back of the lower fronds, which are typically pruned, thus creating a different plant form (bare trunk) that, to many people, is unappealing. Many infested plants have died within a 2 to 3 year time span due to rapid CAS resurgence from the hidden populations on the trunk or roots or untreated nearby plants. Thus, what was once a low-maintenance focal plant has become a high maintenance eyesore in the landscape. Plants are invariably removed in frustration with the CAS onslaught. Pesticide strategies are needed to slow the spread of this pest and protect infested plants until effective predators and parasites become more widely dispersed. Some foliar pesticide approaches are proposed by Hodges et al. (2003). More data are needed on the efficacy of a single application approach with soft pesticides. From credibility, financial and logistical perspectives, landscape managers and maintenance companies prefer products that are effective with a single application, as opposed to frequently repeated applications.

Finally, a root-absorbed systemic insecticide is needed to attempt management of the populations on the underground plant parts and under the petiole stubs on the trunk. A commonly used soft, root-absorbed, systemic insecticide, imidacloprid (Merit®, Bayer Corp.) has been reported as ineffective (Hodges et al., 2003).

Materials and Methods

Foliar Applications. An 8 ft, severely infested, queen sago in a Naples landscape was used for this foliar spray test. On 1 Oct. 2002, three fronds were sprayed as a treatment block using 25 oz. hand-misters (spritzer bottles). The pesticides, Organocide™, Ortho horticultural mineral oil, dimethoate (Cygon® 2E, Southern Agriculture Insecticides, Inc.) and Safer® Soap were applied at label rates (Table 1). Both sides of the fronds were sprayed until thoroughly wet. Three untreated fronds served as a buffer between treated blocks. Using a microscope, five leaflets (a leaflet was used as replicate)

Fig. 2. The female test (wax covering) of the cycad aulacaspis scale is circular and the male has an elongate, narrow test. Some crawlers and a few second instar nymphs are present on these distorted king sago leaflets.

were examined from each treatment block; 20 individuals of each stage (n = 100), adult females and second instar female nymphs, were examined. Mortality of the populations on the upper leaf surface and lower (bottom) surface of the leaflets was calculated. Treatment results were evaluated at 7 d after treatment (DAT) on 8 Oct. 2002. No rainfall occurred during the test. Statistical analyses were conducted using ANOVA and Duncan's New MRT, P = 0.05.

Root Drench. On 3 Nov. 2002, three king sagos (8 to 12 inch trunk diameter and 12 to 28 inches tall, as measured from the ground to the bud) in a Naples landscape were treated with a Cygon 2E drench. Each plant was treated with a solution of 1 gal of water mixed with 2 oz of Cygon 2E. The solution was applied, with a watering can, directly on the soil within a 3-inch band around the entire trunk circumference. Three king sagos served as untreated checks. Plants were in irrigated beds. All plants had been previously pruned because of CAS damage, so that only the last 2 year's foliage remained, rather than a full "head". Adult female mortality was evaluated at 31 DAT. Twenty female scales/leaflet, on each of four leaflets (n = 80), per plant were examined using a microscope. In both tests the wax cover (test) was removed with an insect pin so that the insect's condition could be evaluated. The data were statistically compared using a t-test with P = 0.05.

Results and Discussion

Foliar Applications. Treatment mortality of individuals on the upper leaf surface was greater than mortality of individuals on the lower leaf surface (Table 1). However, scale populations are initially greater on the lower leaf surface during the early phase of an infestation, until they overflow onto the upper leaf surface. Higher mortality on the upper leaf surface of queen cycad leaflets may occur because there is a "gutter" along each side of the mid-vein that holds the spray liquids longer, rather than the quick run-off that would occur on the lower surface. Mortality on the lower surface of leaflets is more critical as that is where the scales initially settle and are more abundant. The second instar nymphal stage is considered more vulnerable than the adult to an insecticide spray application because it has a thinner wax cover. This is evident in these results, as the second instar nymphs suffered greater mortality than the adults in all treatments (Table 1).

In this test, the indication of a chemical's potential to manage this pest will be based on results with the second instar, on the lower side of the leaflets. The softer pesticides; Organocide, horticultural mineral oil, and Safer Soap, at the recommended label rates, did not do well on this pest with 21%, 47% and 5% mortality, respectively (Table 1). Mortality

Table 1. Efficacy of foliar applied pesticides on CAS adult female and second instar nymphal stages on a queen cycad, 7 DAT (days after treatment) in Naples, Fla. Means (± standard deviations), within columns, followed by the same letter, are not significantly different (P = 0.05, Duncan's New MRT). Mortality was assessed on the upper leaf surface and the lower surface (bottom) of the leaflets. Each mean was derived by taking five leaflets per treatment and 20 individuals per leaflet (n = 100).

Product applied Oct. 1, 2002	Product (gal) per 100 gal water	7 DAT % mortality ± S.D. adult females		7 DAT % mortality ± S.D. 2nd instar nymphs	
		Upper	Lower	Upper	Lower
Organocide™[z]	1.56	46 ± 19 b	8 ± 8 b	79 ± 33 ab	21 ± 11 cd
Ortho Hort. Mineral Oil	2.0	84 ± 20 a	19 ± 21 ab	100 ± 0 a	47 ± 20 b
Safer® Insecticidal Soap (concentrate)	2.0	12 ± 9 c	1 ± 2 b	Not counted	5 ± 4 d
Cygon 2E (dimethoate)[y]	0.52	71 ± 29 ab	35 ± 24 a	88 ± 8 a	85 ± 14 a
Check		1 ± 2.2 c	5 ± 4 b	54 ± 21 b	23 ± 16 c

[z]Sesame (5%) and fish oil (92%), from Organic Lab, Stuart, FL.
[y]Cygon 2E label, 2002, excludes use on ornamentals in residential landscapes. The existing label does not list cycad plants. The 2003 Dimethoate 400 label allows root drench treatments.

with the horticultural mineral oil was significantly greater than the fish oil product. Cygon 2E provided the best control, 85% mortality, and was significantly better than all other treatments as a foliar application.

Root Drench. Mortality of the difficult-to-control adult females at 31 DAT, with a Cygon 2E drench (2 oz/gal per plant), was 95%; whereas natural mortality on the check plants averaged 16%. The treatment mortality was significantly greater (t-test 0.05) than the natural mortality. Cygon 2E is not labeled for use on cycads. The EPA published a voluntary cancellation notice of dimethoate products for residential use in the Federal Register (Vol. 67, No. 7) on January 10, 2002 (U.S. Environ. Protect. Agency, 2002). However, Dimethoate 400 (Clean Crop®) has a label that permits root drench in residential landscapes on a wide array of species until their new label is released. This product is only available in 2.5 gal containers. To avoid phytotoxicity, do not apply the root drench rate of Cygon 2E as a foliar application to newly expanding fronds, as necrosis of these tender tissues occurred on a king sago that was not in these tests.

These trials are an initial evaluation. Management of CAS needs more extensive investigation. Long-term management data, insecticide impact on the hidden populations; and for the homeowner, the effects of multiple applications of the soft pesticides bear continued evaluation. New systemic insecticides that are moving into the horticultural arena are being evaluated for CAS management in several University of Florida locations.

Biological Control. Two natural enemies that attack this scale in Thailand were introduced into south Florida beginning in 1997-98 (Howard and Weissling, 1999). They are a predaceous beetle, *Cybocephalus binotatus* Grouvelle [Coleoptera: Nitidulidae] and a parasitic wasp, *Coccobius fulvus* (Compere and Annecke) [Hymenoptera: Aphelinidae]. Intermittent CAS suppression due to these beneficials has been reported (Hodges et al., 2003). In Collier County, the beneficials have been slow in catching up. In October 2002, during the foliar treatment trial, of 2000 scales examined, about 0.6% had been parasitized. However, later during the second test in the same neighborhood in December, activity of the larvae of the predator beetle, *Cybocephalus binotatus,* was especially evident. The beetle larvae are found underneath the scale coverings feeding on eggs. Their feeding behavior helps clean the encrusted scale layers off of the plant surface. In spring of 2003, CAS has not flared up as quickly as in previous years and this may be due to the apparent increase in activity of the beetle larvae.

Plant Resistance. Nursery managers and landscape architects should consider alternative plants that would fill a geometric niche similar to queen and king sagos, although nothing quite matches up. Some alternatives include: *Phoenix roebelenii* O'Brien*; Crinum* spp.; *Agave* spp.; *Yucca* spp.; but the grandest and most appealing match is *Dioon spinulosum* Dyer or other similar *Dioon* spp.

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