TRIP REPORT

Forest Health Protection

Region 5

Quick Action and Cooperative Efforts Help Save the Cycads on Guam

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Figure 1. *Cycas revoluta* infested with cycad aulacaspis scale at the Hyatt hotel, Tumon, Guam. April 2007.

BACKGROUND: The cycad aulacaspis scale (CAS), *Aulacaspis yasumatsui,* was first detected on Guam in the Tumon hotel district in late 2003. Native cycads (*Cycas micronesica*), and nonnative ornamentals (*C. revoluta*; Figure 1) were infested. By February 2006, the scale had spread throughout the island leaving only three uninfested areas in the south. *C. micronesica* is the most abundant native tree on Guam and there was great concern that it would disappear from Guam's forests.

CAS is native to Thailand and southern China. Its current distribution in the U.S. and its territories includes Alabama, California, Florida, Georgia, Guam, Hawaii, Louisiana, Puerto Rico, South Carolina, Texas and the U.S. Virgin Islands. Identified pathways for CAS spread include trade between botanical gardens and private collectors, and through movement of plants in the commercial nursery industry. It is likely that CAS hitchhiked to Guam on cycads imported from Hawaii for landscaping.

PLANT INJURY: CAS initially attacks the undersides of cycad leaflets and then quickly spreads to the upper surfaces, the stem, and all other external parts including the roots and cones (Figure 2). Infestation by a large number of scales can result in plant death within one year (Figure 3). It is estimated that 30-80% of the native cycads on Guam have been killed by CAS since its introduction in 2003.

Figure 2. *C. micronesica* male cone and fronds infested with CAS.

Figure 3. Dead and dying *C. micronesica*, Guam's native cycad.

Figure 4. Adult *Rhyzobius lophanthae* feeding on CAS. (photo by Ross Miller, University of Guam).

CONTROL EFFORTS: Efforts to save cycads with insecticides have had limited success. Based on work in the U.S., some contact insecticides, oils, and insect growth regulators, are effective for killing scales; however, the re-infestation rate is rapid and frequent applications are needed.

Biological control agents have been introduced against exotic scale pests worldwide and have resulted in long-term control in many instances. Three insects were previously evaluated as biocontrol agents for CAS; the most effective appears to be the ladybird beetle, *Rhyzobius lophanthae* (Figure 4). This coccinellid beetle, often called the "scale destroyer," was introduced to Hawaii in the 19th century to control scale insects of agricultural importance. More recently in Hawaii, it has provided some control of CAS, which offered some hope for control on Guam.

A cooperative integrated pest management approach to combat the scale was initiated on Guam in 2004. Permission to import *R. lophanthae* from Hawaii was granted by APHIS in August 2004 and adult coccinellid beetles were released at Ritidian Point in northern Guam in November 2004.

During 2006, Forest Health Protection (FHP) provided over $120,000 of funding to the Guam Department of Agriculture, Forestry and Soil Resources Division, the U.S. Fish and Wildlife Service and the University of Guam to combat CAS. Funds were used to treat cycads with foliar insecticides, systemic insecticides (stem injections) and to support a vigorous collection, transport and release program for biological control agents.

Insecticides targeting CAS were applied via foliar sprays and stem injections to ornamental and native forest cycads in several locations on Guam. Although foliar applications were effective, the need for frequent applications was cost prohibitive. Poor access to native cycad populations also limited the utility of foliar spray applications.

Stem injections on native cycads were completed using the Mauget system loaded with Imicide (active ingredient: 10% imidacloprid; Figure 5). No evaluations of insecticide residues have been completed, so the extent of insecticide movement through the plants is unclear. In addition, the efficacy of the injection treatments against CAS is still underdetermined because the overall effects of beetle predation and injected insecticides were similar in terms of scale presence on leaves.

Figure 5. Stem injected *Cycas micronesica* near Mt. Lamlam, Guam.

Following the initial release of the predatory beetles in November 2004, augmentative releases of beetles have been completed at additional sites throughout Guam. Although initially they did not have an observable effect on CAS populations, beetles are now established nearly island-wide and appear to have controlled the scale by reducing populations to levels that are not threatening to cycad health. In fact, live scales are hard to find. Currently, when new CAS infestations are found and beetles are not present, a few beetles are transported from a different site and released in the CAS infested area. Beetle releases are also planned on Rota to combat a CAS infestation detected during April 2007.

Upon introduction to Guam, the scale found a huge host supply, favorable temperatures for reproduction, wind and weather patterns that facilitated easy and rapid spread, and no known natural enemies. This initial explosion of scale populations and its rapid range expansion resulted in widespread and significant levels of cycad mortality. The multi-agency and University of Guam effort to save the remaining live cycads from CAS through an integrated pest management approach appears to be a resounding success. Plant health of residual native live cycads has improved this year and there is a marked increase over the past three years, in male cone and female pseudo-cone production in many locations.

Other Insect Pests on Cycads

The cycad blue butterfly, *Chilades pandava*, another non-native insect, was first detected on Guam in July 2005. Severe defoliation of native cycads by the caterpillars was observed as early as November of the same year. The native range of this species is Sri Lanka to Thailand and eastern Indonesia. Prior to its detection on Guam, the butterfly had been reported on Saipan, Rota and Mauritius. With the biological control efforts successfully reducing scale populations, the consensus among entomologists is that the cycad blue butterfly now presents the greatest insect threat to cycads on Guam.

Figure 6. Feeding injury on new foliage caused by the cycad blue butterfly larvae.

Cycad blue butterfly caterpillars feed on new foliage of cycads. Complete defoliation of the new foliage occurs when larval populations are high (Figure 6). Natural control agents have not been observed. Stem injections using the Mauget system loaded with Abacide 2 (active ingredient: 2% abamectin) were implemented to combat the butterfly larvae (imidacloprid is believed ineffective against Lepidoptera). There is no evidence to date that the Abacide 2 injections have reduced the amount of feeding injury on cycads or that the insecticides translocated effectively. Butterfly populations are currently low, preventing a meaningful comparison of feeding injury between treated and untreated plants. Entomologists on Guam expect the butterfly populations to increase with the rainy season, and they expressed great concern about the recovery of the native cycads if high levels of cycad blue butterfly feeding injury and defoliation occur. Additional insecticide treatments may be warranted if caterpillar feeding is significant; however, efficacy of previous treatments should be determined.

Figure 8. Adult *Dihammus marianarum* cerambycid beetle.

Figure 7. Frass and mucilage secretions on the stem surface of a native cycad.

A variety of other insects, typically minor pests, are present on Guam's cycads. Many of these may be more noticeable now as they exploit weakened cycads recovering from CAS infestation. We observed tunneling in the stem of a cycad by *Dihammus marianarum*, a cerambycid (Figure 8) endemic to the Mariana Islands. Frass and mucilage secretions on the outside of the cycad stem (Figure 7) are an easily observed sign of infestation by this cerambycid. Development of monitoring tools (traps and lures) may be of interest so that cycad recovery can be observed relative to stem borer presence and abundance.

CONCLUSIONS: Additional funding from FHP should not be necessary for cycad aulacaspis scale suppression treatments on Guam. This assumes that the coccinellid beetles continue to maintain scale populations at a low level. If cycad blue butterfly populations increase greatly (as anticipated) during the next rainy season, additional insecticide treatments may be desirable to reduce feeding injury caused by the caterpillars. Funds allocated from FHP during FY07 and previous years can be used if treatments are deemed necessary. In addition, I recommend that some of the residual funds be used to continue monitoring cycad health and recovery from the CAS infestation. Evaluating insecticide residues in some of the stem injected plants would help to determine if the insecticides moved to the target tissues and in what concentrations. This information will help FHP assess the efficacy of this treatment and its duration, both of which are necessary to evaluate if it is warranted to expend our funds in the future on such treatments in this system.

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