King sago (*Cycas revoluta*) production in Taiwan, with comments on cycad aulacaspis scale and the endemic *C. taitungensis*

Eddy Hsieh[1] & Jody Haynes[2]

Fig. 1) Cycad Aulacaspis Scale (CAS) is found on Cycas revoluta *in a public park at CKS Memorial Hall in Taipei, Taiwan.*

Cycad aulacaspis scale (CAS) was first introduced into northern Taiwan in 2000 through an unknown channel. The pest quickly became established in urban areas (Fig. 1), and within the first year it was responsible for killing 110,000 nursery cycads (primarily seedlings and adults of king sago, *Cycas revoluta*) in Taoyuan County alone (#1 on the map [Fig. 2]; Chao & Lai, 2005). In September 2003, the predatory beetle, *Cybocephalus nipponicus*, was imported from Thailand to a quarantine facility at the National Pingtung University. By 2004, CAS had invaded the Taitung Cycad Nature Reserve in southeastern Taiwan (#2 on the map [Fig. 2]), which is home to one of the largest populations of the Taiwanese endemic *C. taitungensis*. The predatory beetle was field released in the cycad reserve in October 2005, and then at Pingtung and Taichung (#3 on map [Fig. 2]) in November 2005 (Chao & Lai, 2005). Seven years after it was first discovered in the country, the sago market in Taiwan is thriving and CAS has become a fairly routine problem. The following is an itemized summary of one Taiwanese company's sago production methods, with some further comments on the effect of CAS on the industry.

Item 1: Photographic overview of how sago exporters prepare their product from field to market.

Export companies purchase sagos from growers, and once the plants leave the field, the exporter takes full responsibility of their quality and ultimate fate. Although most plants growing in sago fields are healthy (Fig. 3), harvesters cannot help but wound the plants during harvest (Fig. 4); thus, the exporters hold the key to decide the sagos' destiny. The following steps are implemented by the Bally Brother Trading Company, Ltd., export company immediately after the plants are harvested from the growers' fields:

1. All roots and leaves are removed (Fig. 5a).
2. Bare caudices ("bulbs") are pressure-washed until no soil remains (Fig. 5b).
3. Cleaned bulbs are dipped in an insecticide/fungicide cocktail.
4. Bulbs are dried with fans under shadecloth (Fig. 5c).
5. Finished bulbs are packed into shipping boxes and inspected (Fig. 5d-f).
6. Upon arrival in the importing country, bulbs are immediately potted and placed under shadecloth, where they quickly produce new roots and leaves. (Fig. 5g-k).

The best harvest time is from December to early March, which is just prior to the normal flushing period of May to July. A 20-foot refrigerated container can accommodate a maximum weight of 17.5 tons (15,875 kg) of bulbs and is held at a constant 15ºC with 75% ventilation; a 40-foot container can take up to 23 tons (20,865 kg) of bulbs. Shipping times vary from 15 days to Central America and East Asia to around 28 days to Europe, South Africa, Australia, and New Zealand. The exporting company provides the following documentation with each shipment:

- CITES export permit
- Phytosanitary certificate, issued by the Bureau of Animal and Plant Inspection and Quarantine Council of Agriculture, Taiwan (an additional declaration can be issued if the importing country requires it)
- Certificate of Origin
- Commercial invoice
- Packing list
- Label (indicates plant name, shipper, consignee, import permit number, etc).

Fig. 2. Map of Taiwan, showing key points discussed in the article.

Fig. 3) Sagos growing in a field in Taiwan.

Fig. 4) Harvesters digging sago "bulbs."

Item 2: Overview of team members and the jobs that each is charged with.

As with any successful company, Bally Brother Trading employs several key personnel that perform critical functions. Yang Senior (Fig. 6a), the

[1] Director, Bally Brother Trading Co., Ltd., Taipei, Taiwan.
[2] Leader, IUCN/SSC Cycad Specialist Group – Invasive Pests Subgroup, Miami, FL.

general manager, ensures that all procedures are followed step by step. Cleaning supervisor Yang Junior (Fig. 6b) oversees the pressure washing of the bulbs, while Mr. Hsieh (Fig. 6c) oversees the insecticide/fungicide dipping process. The insect/fungus controller, Mr. Lee (Fig. 6d), develops the cocktail mix used to dip the bulbs; he is also in charge of quality control. Old Yang (Fig. 6e) is responsible for trimming tender roots, and Eddy Hsieh (Fig. 6f) directs all of the sectional operations.

Item 3. How many sago exporters are there in Taiwan?

According to Taiwan customs public access records covering the years 2001-2006, a total of 15 sago export companies were registered.

Item 4. How much "product" (= sago bulbs, by weight) does Taiwan exported annually?

The following data represent reported export weights of sago bulbs leaving Taiwan (note that customs records are calculated by weight rather than number of bulbs):

- 2001 - 1.44 mil. kg (= 1,587 tons)
- 2002 - 1.51 mil. kg (= 1,665 tons)
- 2003 - 2.66 mil. kg (= 2,932 tons)
- 2004 - 2.71 mil. kg (= 2,987 tons)
- 2005 - 2.38 mil. kg (= 2,263 tons)
- 2006 - 1.31 mil. kg (= 1,444 tons; Jan.-Nov.)

Item 5. Where are the sagos exported?

The following is a list of countries that receive exported sago bulbs from Taiwan:

Belgium	Indonesia	Saudi Arabia
Belize	Italy	Singapore
Canada	Japan	South Africa
China	Jordan	Spain
Costa Rica	Korea	Syria
Denmark	Kuwait	Turkey
France	Lebanon	United Arab Emirates
Greece	Malaysia	USA
Guatemala	Netherlands	Vietnam
Hong Kong	New Zealand	
India	Pakistan	

Item 6. Of these countries, which has the strictest quarantine regulations, and how many exporters are dealing with them?

The New Zealand Ministry of Agriculture and Forestry (NZ MAF) requires that all imported live plants be isolated in quarantine for three months. Only two companies in Taiwan supply to NZ, and 95% of those plants come from Bally Brother Trading.

Item 7. How serious a problem is CAS for sago production in Taiwan?

The export companies all understand that to have a successful business in live plant exportation, there must be very good pest control measures in place. CAS is now a constant problem, but it can be easily controlled with chemical pesticides. Other than CAS, there is also a butterfly known as *Chilades pandava peripatria*, whose primary larval food source is young, tender *Cycas* leaves. These, too, are currently controlled with chemical pesticides.

The main problem with CAS is that buyers are becoming increasingly wary of purchasing sagos from countries where this pest has become established. New Zealand is one such country, but importation of sagos there plummeted when MAF closed the door for importing from Asia in 2003. Even so, Bally Brother Trading has managed to implement control measures that are approved by New Zealand MAF, and their major market remains there. Company records show that over 90,000 bulbs have been exported to New Zealand. With New Zealand's population at 3.8 million, this means that one in every 43 people there own a sago from Bally Brother Trading!

Fig.5. Sago bulb "finishing" process in Taiwan: a) bulbs with roots and leaves removed; b) bulbs being pressure washed; c) bulbs being air-dried under shadecloth; d) finished bulbs; e) finished bulbs in shipping boxes; f) finished bulbs being inspected; g) bulbs arriving at destination; h) bulbs being potted; i) newly potted bulbs in shadehouse; j) sago bulbs flushing first leaves; k) full heads of leaves

Item 8. Do all export companies use the same procedures to finish the bulbs and prepare them for export?

Bulb finishing procedures are closely guarded trade secrets. Therefore, the first author has not had a chance to visit any competitors' operations.

Item 9. Knowing that finishing procedures may be commercial trade secrets, if they were proven to be good preventative measures to reduce the spread of CAS, would Bally Brother Trading consider sharing its procedures with its competitors?

If this would help to prevent the spread of CAS or other pests, Bally Brother Trading would be happy to associate with its competitors. However, based on previous experience, competing companies would be skeptical of any assistance or suggestions from their competitors.

Item 10. What is the outlook on the future of the sago export industry in Taiwan?

Bally Brother Trading's sago market price has been fixed for years, but the cost of field management and quality control get increasingly higher. Bally Brother Trading adheres to a business principle that provides a "triple win:" growers receive good earnings from growing and selling their sagos, exporters have a fair profit, and, because management protocols and care of the harvested plants continuously improve, the buyers are assured a healthy, pest-free product. The company believes its principle will not only allow it to survive in this business, but also to greatly reduce the rate of potential pest transmittal through its worldwide exports. On the other hand, if the company lowers its price to compete with its competitors, this would result in squeezing the farmers' price and would necessitate an abbreviation of the necessary steps of finishing the bulbs that might lead the business to go under.

Item 11. In an effort to raise awareness, does Bally Brother Trading inform its customers about CAS?

Even though it could cause increasing difficulty for the export sale of sagos, Bally Brother Trading Company understands the importance of sending the CAS pest alert to its sellers to make them aware of the risk of this serious pest. Fig. 7 is an example of a communication between the first author and an actual sago seed customer (edited for proper English).

Literature Cited

Chao, J.-T. & P.-Y. Lai. 2005. Taiwan CAS invasion timeline. *CAS Information Page*, IUCN/SSC Cycad Specialist Group website:

http://www.iucn.org/themes/ssc/sgs/csg/pages/CAS.htm

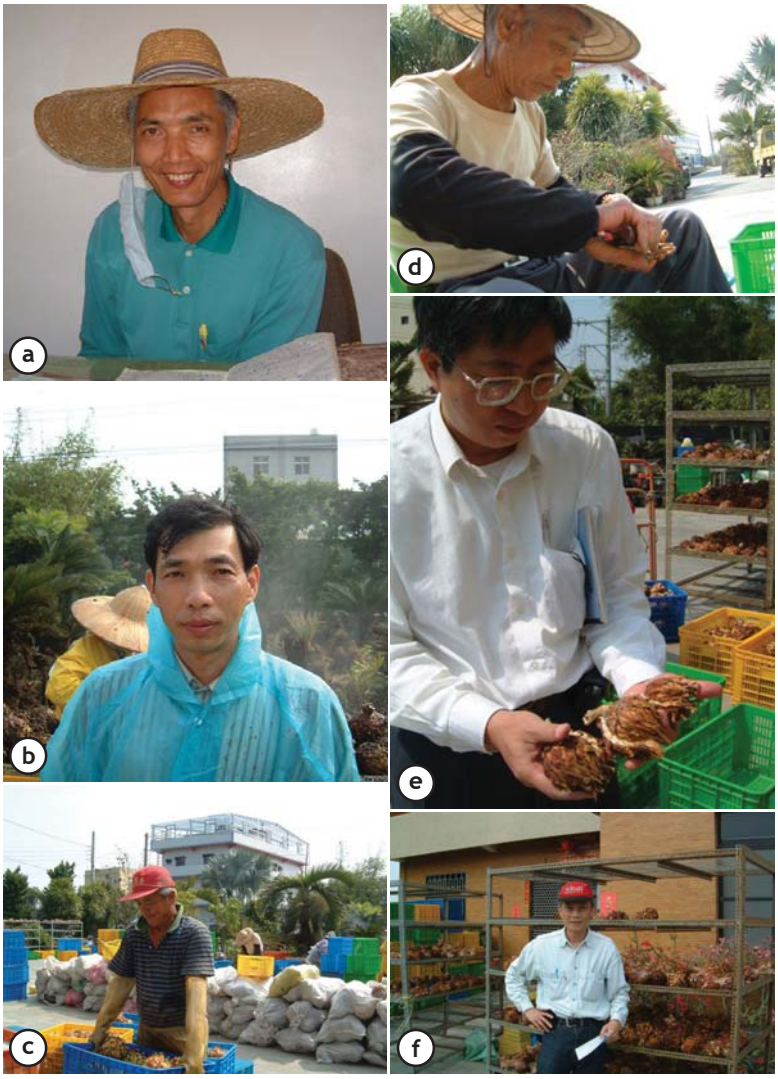

Fig. 6) Employees of Bally Brother Trading Co.: a) Yang Senior; b) Yang Junior; c) Mr. Hsieh; d) Mr. Lee; e) Old Yang; f) Eddy Hsieh.

—— Original Message ——
From: Eddy Hsieh (Xue)
To: [address deleted]
Sent: Sunday, March 18, 2007 1:31 PM
Subject: Re: Cycas revoluta SEEDS

Dear [Customer],

Our staff here are all excited about the opportunity to establish a new relationship with you. We are very much looking forward to linking with each other and moving toward a mutually beneficial business relationship. However, before our business venture gets underway, we would like to make sure you are aware of a pest named Cycad Aulacaspis Scale (CAS), which has became a major problem for a lot of nurseries worldwide. Our seeds are all thoroughly washed to remove the insects and are then "float-tested," and only those that sink will be chosen and packed.

The point is that you need to know that once the seeds sprout you must make sure there is no CAS problem in your area or you will face potential CAS infestation **no matter how healthy the seedlings are that you are growing**. For your more information about CAS please refer to the following website: http://www.iucn.org/themes/ssc/sgs/csg/pages/CAS.htm.

Your attention to CAS is our concern as well as your business.

Kind Regards,

Eddy Hsieh
Taiwan

Fig. 7) Sample letter from Bally Brothers Trading Co. to their customers advising about the CAS issue.