A simple and efficient method of germinating cycad seeds©

B. Schutzman[a]

Environmental Horticulture Department, University of Florida, Gainesville, Florida 32611-0670, USA.

INTRODUCTION

Cycads, an endangered group of plants from the world's tropics and subtropics, have been a mysterious and intriguing plant group to botanists since they were first documented more than 200 years ago. The number of described species continues to grow as subtropical and tropical regions are thoroughly explored; the latest count published in the World List of Cycads (*q.v.*) is 343. Interest in these plants has grown tremendously over the last 20 years, especially since accurate information has become readily available on the internet. The World List of Cycads, the Cycad Pages, the Cycad Society's Web site, and a number of other groups readily share information and photographs.

Many species of cycads are endangered, and both plants and seeds can be both difficult and expensive to obtain. The seeds of several species can be difficult to germinate and keep alive. The purpose of this paper is to explain and recommend the "baggie method" of germination, a technique that already is well-known in palms. It is not a new method for cycads by any means, but too many people are still unfamiliar with its ease and benefits. The method increases germination percentage and survivability of scarce and expensive seed. The information is especially useful to both the nursery industry and hobbyists; it will ultimately reduce the pressure exerted by poaching on indigenous cycad populations by making plants of the species easier to obtain. Indirectly, greater availability and ease of germination will reduce cost per plant, making cycad species readily available to those who wish to grow them.

Status of wild cycads

Unfortunately, at the same time as we continue to document new cycad species, habitat destruction and poaching continue to exact a heavy toll on wild cycad populations. Many species may become extinct in the wild. This is not new knowledge, with notable figures such as the late Cynthia Giddy, working as tireless advocates for the protection of cycad habitats in the 1960s. The IUCN Red List of Threatened Species can be accessed at: htpp: www.iucnredlist.org, and detailed information on each threatened to endangered species can be found. Unfortunately, lack of knowledge about cycads has led to some imprudent regulations prohibiting seed collection from the wild. Very few seed produced by cycads in the wild result in mature, fertile offspring. Making allowances for collection of some seed from wild populations would dramatically increase the number of living plants of a given species, and reduce pressure on wild populations. Ironically, the prohibition of wild seed collection has increased the amount of poaching and resulted in some species becoming more endangered, since it is almost impossible to protect every endangered cycad population in the wild from poaching. In fact, the IUCN Red List documents four *Encephalartos* species that are now extinct in the wild due to poaching.

Seed germination

While cultivating cycad species out of habitat is of limited use in preventing extinction, it can be of great utility in making many species available to those who might otherwise traffic in illegal collected plants. There are enough privately and publicly held cultivated specimens of many species to make seed available. The cost of seed is still high compared to many other groups of plants, but this cost is considerably less than the price of a germinated seedling or a plant poached from the wild. The value of providing someone with a plant that

[a]E-mail: bart@ufl.edu

is legally obtained is inestimable. The relative availability of seed alone is an invitation to the horticulturally curious to attempt germinating their own seeds, with the great benefit of making the cost per plant reasonable for most collectors. The Cycad Society has a seed bank available to its members that routinely offers seed of fairly rare species at reasonable prices, and many members have developed formidable plant collections just by obtaining and growing Cycad Society seed bank offerings over the years.

The major problems in growing most cycads from seed (though there are exceptions to this generalization) are: (1) the seeds of most cycads have a fleshy sarcotesta (outer seed coat) with germination inhibitors that must be removed; (2) when the ripe female cones of many cycads disintegrate, dropping their seeds, embryos are often underdeveloped, requiring time, sometimes several months, for the embryos to reach maturity and germination to become possible; and (3) hard sclerotestas (inner, stony seed coat) of many cycad seeds resist penetration by moisture, thus slowing germination. The end result of these factors is that cycad seeds under normal greenhouse or shade house conditions, when they survive, germinate slowly and over a long period of time — a perplexing scenario to many nurserymen.

Three papers (Dehgan and Johnson, 1983; Dehgan and Schutzman, 1983, 1989) explain the relative impenetrability of a cycad seed coat and immaturity of the seed of some species at cone dehiscence. The drawbacks to the proposed method are twofold: the potentially dangerous and/or expensive chemicals to improve germination, notably concentrated sulfuric acid and gibberellin, and the fact that only three species, *Cycas revoluta* Thunb., *Zamia integrifolia* L., and *Zamia furfuracea* L.f., were tested, and optimal times and concentrations would have to be determined for other species. A skilled nurseryman, taking proper safety precautions, could use the acid and gibberellin method satisfactorily, but it is not feasible for a hobbyist or collector that may only want to grow small quantities of each species, seed of which can cost upwards of $5 each. In fact, anecdotal evidence suggests even nurserymen were not as successful with the chemical methods and laboratory exactitude that were used in the published papers. Anyone wishing to germinate species other than *Z. integrifolia* and *C. revoluta* would have to determine chemical concentrations and exposure times to produce optimal germination rates.

Having heard anecdotal evidence of great success growing cycad seeds with a simple method requiring only readily available materials and simple procedures, I investigated the "baggie method" and found it successful and gratifying. Two cycad species were available to test for a report to this conference. Many hobbyists have been discouraged by low germination rates when attempting to grow costly cycads from seed. Low percentage germination, first and foremost, can be related to seed viability, but attempting to germinate cycad seed in greenhouses or shade houses under mist can result in high attrition of the percentage of seed that are viable due to insects, microorganisms, and seed pilfering by rodents. Because the method considered here allows seed to be kept in protected locations until planting, a higher success rate can be achieved. The method is equally attractive because of the amount of space, money, and expertise necessary to establish a mist system and attempt chemical seed treatments. Success could be instrumental in rekindling the desire of many people to germinate cycads.

MATERIALS AND METHODS

Seed of two cycads became available in time for this trial, *C. bifida* (Dyer) K.D. Hill, and *Cycas revoluta* Thunb. (king sago) × *C. taitungensis* (emperor sago). *Cycas bifida* (fork-leaved cycad), from China and Vietnam (Figures 1 and 2) is little known in cultivation and quite rare, but a friend and I successfully pollinated a female plant and produced seed (Figures 3-6). A few seeds were sacrificed to look for embryos, and they were visible but very small, suggesting that a maturation period was most likely necessary. I also performed the pollination of a *C. revoluta* plant with *C. taitungensis* pollen in late spring of 2014. Both parents of the hybrid are known to have immature embryos in seeds at the time female cones either dehisce or the abscission layer between seeds and the megasporophylls are fully developed and seeds may easily detach.

Figure 1. Generalized distribution of *Cycas bifida* in China and Vietnam [Image credit to Wikipedia Foundation©].

Figure 2. Mature female plant of *Cycas bifida.*

Figure 3. Unpollinated female cone of *Cycas bifida* (forefront).

Figure 4. Female *Cycas bifida* cone a few weeks after pollination.

Figure 5. Mature female cone of *Cycas bifida* prior to dehiscence.

Figure 6. Cleaned *Cycas bifida* seeds.

The sarcotestas of all seeds were removed, and cleaned seeds mixed with slightly moistened sphagnum peat moss, and then put into freezer bags (Figure 7) and sealed. In the case of *C. bifida*, seed coat removal was easy because the sarcotestas scrape off with very little effort. The *C. revoluta* × *C. taitungensis* seed required repeated soaking and whisking in wet coarse sand with a cordless drill fitted with a wire wheel, and washing. This process was repeated over the course of approximately two weeks to completely remove the sarcotestas. As mentioned earlier, removal of sarcotestas was done to completely eliminate: (1) any germination inhibitors that might be present as well as (2) fleshy seed coat material that could decompose, potentially infecting and killing viable seeds. The amount of water required to moisten the sphagnum peat moss was approximately equal to the weight of the unmoistened sphagnum peat moss. Some 259 *C. bifida* seeds were put into freezer bags on 20 November 2014, and kept at room temperature on a desk in my office.

Figure 7. Cleaned *Cycas bifida* seeds in freezer bag.

RESULTS AND DISCUSSION

The first sign of germination in the bags was noticed in mid-February (Figure 8). Germinated seeds were taken from the bags (Figure 9) and planted nine times during the 4 month period from 28 February to 27 June 2015 (Figure 10). Each time, any ungerminated seeds were placed back into the baggies, and planting was done again each time emerging roots were seen at the extremities of the baggies. After the June 27th planting, the few remaining seeds were judged inviable and discarded. Cumulative germination of this seed batch was approximately 95%, and no decomposing seeds were seen during plantings. No attrition due to insects, microorganisms or rodents was experienced. It is also worth mentioning that the baggies were not routinely opened throughout the length of any of these experiments, and this seems not to have stopped germination.

Figure 8. Germinating seeds of *Cycas bifida* in freezer bag.

Figure 9. Germinating seeds of *Cycas bifida* ready for planting.

Figure 10. *Cycas bifida* germinating seeds planted in tree pots.

Because this species is known to possess a strong taproot, germinating seeds were planted in well-drained mix (2-1-1 Fafard 2P-fine pine bark-sand) in deep tree pots (Figure 10). Germination was rapid (Figure 11) and seedling growth appeared brisk (Figure 12).

Figure 11. *Cycas bifida* seedling producing its first leaf.

Figure 12. *Cycas bifida* seedlings several months after planting.

The other *Cycas* experiment was begun much later and has not yet been concluded. For the purposes of this paper, germinating seeds were deliberately left in the freezer bags to see if they would be damaged by remaining unplanted (Figure 13). The seedling roots of *C. revoluta* × *C. taitungensis* were tangled, requiring patience and time to separate without damage (Figure 13). However, the unplanted, germinating seeds were in good health at the submission of this manuscript.

Figure 13. *Cycas revoluta* × *C. taitungensis* seeds germinating and becoming tangled in baggie.

CONCLUSIONS

The success of the "baggie method" in germinating cycad indicates that it is worth trying on any available cycad seed. It seems to be a worthwhile way to optimize the percentage of viable seed brought from cone abscission to successful establishment in individual containers, and should be considered by nurserymen and hobbyists alike.

Literature cited

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