Propagation and Cultivation of Cycads

Hannes Robbertse
Department of Plant Production & Soil Science, University of Pretoria, Pretoria 0001, South Africa

Steve Trollip
Bark Enterprises, Growing Medium Producers, PO Box 3622, Brits

Guidelines for collection and storage of cycad pollen, the pollination techniques, seed harvesting viability assessment, seed germination, and the growing on of cycad (*Encephalartos*) seedlings are discussed in this paper. The male cone axis elongates and cone scales become separated. Female cones elongates slightly and some skill is required to decide when they are receptive for pollination. Artificial pollination can be done with dry pollen, or a slurry. Pollination is repeated at 3- to 4-day intervals. Cones should not be harvested prematurely for seed gathering. Seed are placed in water to test for viability. Cycad seed germinates 3 to 8 months after sowing. A cable-heated sand bed with intermittent spray mist is the ideal system for germination. Seedlings are transplanted after germination and a well drained potting mix is required. Plants are transplanted to bigger containers as they grow bigger.

INTRODUCTION

In large natural stands of cycads, sufficient evidence is available to believe that specific insect vectors are responsible for the transport of pollen from the male cones to female cones. In reduced natural populations, the reduced number of cones also reduces the chances of synchronous coning and successful pollination. The same applies to garden plantings where, if pollination does occur, the identity of the male may be unknown and hence hybrids of doubtful parentage can be produced. In order to produce reputable seed from garden plantings of cycads, it is, therefore, necessary to adopt artificial pollination procedures. This paper suggests guidelines for collection and storage of cycad pollen, the pollination techniques, seed harvesting and viability assessment, and seed germination.

PROPAGATION

Collection and Storage of Pollen. Male plants of the genus *Encephalartos* produce from one to eight (sometimes more) cylindrical cones per cycle. Just prior to the time of pollen release, the cone axis elongates and the individual cone scales become separated. In the "wooly" species, like *E. friderici-guiliemi, E. ghellinckii,* and *E. lanatus*, the cone often also bends sideways and downwards towards the time of pollen shedding. In many cases the temperature of the male cones rises quite steeply, this being especially noticeable towards the evening. The rise in temperature may also coincide with a strong odor as in the case of *E. villosus*. Pollen is released from the hundreds of small pollen sacs on the undersurface of each cone scale. Left undisturbed, the cone would normally continue to shed pollen over a period of a week or so.

Pollination Techniques. In natural populations, the female cones of most species

are ready for pollination when the male cones shed their pollen, usually in autumn. In garden plantings, this is not necessarily true and some skill is required to decide when to carry out the pollination of the female cones. A slight extension in the cone axis of the full-sized female cones often results in crack-like openings between the upper rows of cone scales. This is certainly a good indication of the female's receptivity, and under natural conditions, would provide access for the pollinating beetles.

Various techniques for the artificial pollination of cycads have been proposed. Essentially the pollen must be transferred to the interior of the upper part of the female cone, so that it can travel down amongst the spirally-arranged cone scales and come into contact with each of the ovules, two of which are borne on each scale with the micropyle (opening for pollen entrances) pointing towards the axis. Some authorities use the pollen in a dry condition and place it amongst the topmost cone scales, using a bicycle pump or air syringe to force the pollen into the cone. Others prefer to make a slurry of about 1 teaspoonful pollen to a cupful of water and to squirt this into the topmost section of the female cone. It is sometimes necessary to remove one of the uppermost scales from the female cone to gain a 'port of entry' to the cone. This should be done with a clean sharp knife so that the scale removed can be re-inserted as a 'plug' at the end of the process. Because of the difficulty in predicting exactly when the female is ready, it is advisable to repeat the pollination procedure, say at 3- to 4-day intervals a few times.

Seed harvesting and viability assessment. The period for seed maturation on the cone varies from species to species. In most cases it takes 6 to 10 months from the time of pollination to seed harvesting, but in some plants, like *E. arenarius* and *E. transvenosus*, it requires well over 1 year for this part of the life cycle to run its course. Cones should not be picked prematurely for seed gathering. When the seeds are ready, the first few cone scales loosen from the cone axis and fall away to expose those below. The sequence works its way down over a period of a week or so. Each cone scale is shed with its two seeds which are clearly recognized by the red, orange, or yellow colour of the fleshy external part of the seed coat (sarcotesta). As the scales and seeds fall from the cone, the seeds can be gathered for viability assessment and cleaning. In some species the cone does not disintegrate as described above but the whole structure dries out progressively. In these cases, a loosening and softness of the cone scale is a good indication of the time to harvest seeds.

A preliminary screening test to determine whether the seeds are fertile, is to place them, still with the outer seed coat intact, in water. Those that float are buoyant because of air cavities resulting from insect attack or the lack of an embryo. A more reliable test is to select a few sample seeds randomly from the harvest and slice them longitudinally and cleanly into two halves. A very small embryo and its coiled suspensor will be present only in fertile seeds while infertile seeds will have a small cavity where the embryo would normally be found.

The seeds are best cleaned by soaking them in water for 1 to 2 days so that the outer fleshy layer becomes soft and can be separated easily from the hard inner kernel. The cleaned seeds should again be subjected to a float test and a sample number dissected to establish their viability. Seed prepared in this manner should be dried and then stored in a cool well ventilated area until being planted. A sprinkling of an insecticide powder will inhibit insect activity.

Seed germination. It is unusual for cycad seeds to germinate immediately after harvesting. A 3- to 8-months maturation period is typically required during which time the embryo continues to develop before being ready to germinate. Moisture and warmth are the key ingredients for germination. A cable-heated sand bed with intermittent spray mist irrigation is the ideal system, but good results can be achieved with seeds in vermiculite, perlite, sphagnum moss, a well drained potting mixture in seed trays, plant pots, or even between two sheets of moist undercarpet felt. Seeds should be laid horizontally and buried to about one-half their depth in the medium.

Evidence of germination is provided when a root-like, elongating cotyledon base, breaks through the star-shaped crown at the end of the seed and turns downwards into the medium. Soon afterwards the root emerges from the cotyledon base. Many growers remove seeds from their germination beds at this stage and plant them in small nursery bags (containers), or alternatively they plant several seedlings in one communal pot. The medium of choice is a well drained potting soil. Moisture, warmth, and hygiene are more important than soil nutrients at this stage since the plantlet draws most of its nutrition from the seed by means of the terminal ends of the cotyledons which remain in the kernel. After a few weeks, the first leaf breaks through from between the two cotyledons where they join the succulent taproot. A reasonably high light intensity is needed to prevent undue legginess of the leaves. All being well, the seedling will continue to grow to produce more and bigger leaves each season. From time to time it is necessary to move the plants into bigger containers as the root system develops. As this development occurs, the plants should be hardened off to adapt to greater light intensities and to be able to withstand wider variation in ambient temperatures, humidities and soil moisture conditions.