CYCAD SEED PRODUCTION AND GERMINATION

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1. Introduction

[...] It is believed that wind and/or specific insect vectors are responsible for the transport of pollen from cones of male cycads to those of females. In reduced natural populations, the number of cones in any area is much less and hence the chances of synchronous coning and successful pollination are substantially reduced. 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 leaflet suggest guideline for collection and storage of cycad pollen, the pollination techniques, seed harvesting and viability assessment, and seed germination.

2. Collection and storage of pollen

Male plants of the genus Encephalartos produce from one to eight (sometimes more) cylindrical cones. Just prior to the time of pollen release, usually in the autumn months, the cone axis elongates quite markedly and the individual cone scales become clearly separated. In the “woolly” species like E.friderici-guilielmi, E.ghellinckii and E.lanatus, the cone often also bends sideways and downwards toward the time of pollen shedding. In many cases the temperature of the male cones rises quite steeply, this being especially noticeable towards early evening. Pollen is released from the hundreds of small pollen-sacs on the undersurface of each cone scale. Shedding of the pollen starts slowly at first and is underway when a gentle tap of the cone produces a fine cloud of pollen dust. Left undisturbed, the cone would normally continue to produce pollen of the period of a week or so, after which the cone slowly shrivels and eventually falls off the plant. In order to collect pollen, it is necessary to cut the male cone cleanly from the plant at the base of the cone stalk. This should be done just at the start of pollen release but not prematurely.

The cone should be wrapped in clean, dry paper (brown paper and newspaper) and left in a well-ventilated area. Occasional shaking of the cone helps with the pollen release. Every 2 days or so, the pollen should be transferred to a perfectly dry container and sealed and stored until use. Pharmacists' vials or plastic film containers, with "snap-on" lids, ar ideal for this purpose. Individual vials, properly labelled with the date and the identity of the male plant, are best secured in a plastic bag or other moisture-proof device such as a "Tupperware" container and are then kept in a deep-freeze or ice-compartment of a fridge. Pollen collected and stored in this way appears to maintain its viability for several years.

3. Pollination techniques

In natural populations, the female cones are ready for pollination at the same time as the male cones shed their pollen, usually in autumn. In garden plantings, this is not necessary true and some skill is required to decide when to carry out pollination of the female. A slight extension in the cone axis of the fully-sized female cones often results in crack-like openings between the upper row of cone scales; this is certainly a indication of the female's receptivity. This phenomenon is not always obvious and it sometimes helps to feel if the topmost cone scales are less tightly held than normal.

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 is can travel down amongst the spirally-arranged cone scales and come into contact with each of the ovules, two of which are set below each scale. Some authorities use the pollen in a dry condition and place it amongst the topmost one 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 then 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. Pollination, by whatever method, should not only be done once. Because of the difficulty in predicting exactly when the female is ready, it is advisable to repeat the procedure, say at 3-4 intervals for a fortnight or longer. [** Cycad Trust comment: 50 ml.]

4. Seed harvesting and viability assessment

The period for seed maturation on the cone varies from species to species. In most cases it takes about six to ten months from the time of pollination to that for seed harvesting, but in some plants, like E.arenatius and E.transvenosus, it requires well over one 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 recognised by the red, orange or yellow colour of the fleshy seed coat. As the scales and seeds fall from the cone, they 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 scales is a good indication of the time to harvest seeds.

Cautionary notice: As cycad seeds contain harmful toxins, it is essential that gloves are worn whenever fresh seeds are handled, especially during the seed-cleaning operation described below. This precaution is not necessary after the outer flesh has been removed, but at all times the seeds should be kept out of reach of children and pets.

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 attach or the lack of an embryo. Those that sink are more likely to be fertile. This test, however, is an indication only. A more reliable test is to select a few sample seeds randomly from the harvest and slice them longitudinally and cleanly into two halves. An embryo and its coiled suspensor will be present only in fertile seeds. [Fig 1] while infertile seeds will have a small cavity where the embryo would normally be found. The seeds are best cleaned by soaking then in water for 1-2 days so that the outer fleshy layer becomes soft and can be easily separated from the hard inner kernel [N.b. See Cautionary notice].

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 dried and then stored in a cool well-ventilated area until being planted. A sprinkling of an insecticide power will inhibit insect activity.

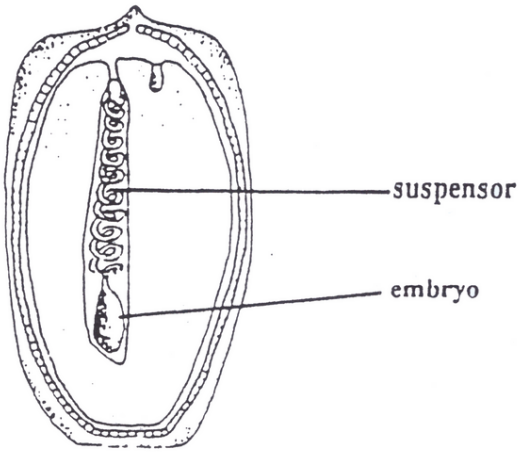

Figure 1: Longitudinal dissection of a fertile seed shows the presence of an embryo and the coiled suspensor - an umbilical cord by which it is attached to the parent tissue.

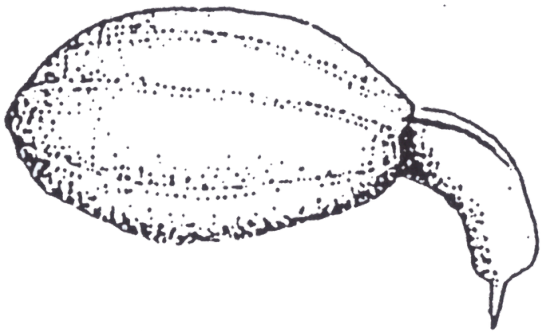

Figure 2 (right): The first sign of germination is when the root sheath breaks through the seed kernel and turns vertically downwards.

5. Seed germination

It is unusual for cycad seeds to germinate immediately after harvesting; a 3-6 month maturation period is typically required – during which the embryo continues to develop before being ready to germinate. Storage as outlined above allows this process to occur naturally. It is also important to note that seeds cannot be kept indefinitely – prolonged storage leads to desiccation and eventual loss of viability. It is thus suggested that seeds are planted during the first spring season to follow after harvesting.

Whilst there are several different techniques for germination seeds, experience has shown that moisture and warmth are the key ingredients. 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 or a well-draining potting mixture in seed trays or plant pots. Excess heat and cold should be avoided and the seeds should never be allowed to dry out completely. Seeds should be laid horizontally and buried to about one-half their depth in the medium.

Evidence of germination is provided when a rootlike structure, botanically known as the colcorhiza(rootsheath), breaks through the star-shaped crown at the end of the seed and turns downwards into the medium. [Fig 2]; soon afterwards the primary root emerges from this structure. Many growers remove seeds from their germination beds at this stage and plant them in small nursery bags, 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 time since the germinating plantlet draws most of its nutrition from the seed kernel – to which it remains attached for some time. After sa few weeks, the first leaf breaks through from between the two cotyledons which remain inside the seed kernel [Fig 3]. A reasonably high light intensity is needed to prevent undue “legginess”to this leaf growth. All being well, the seedling will continue to grow, producing 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 so too the plantlets 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.

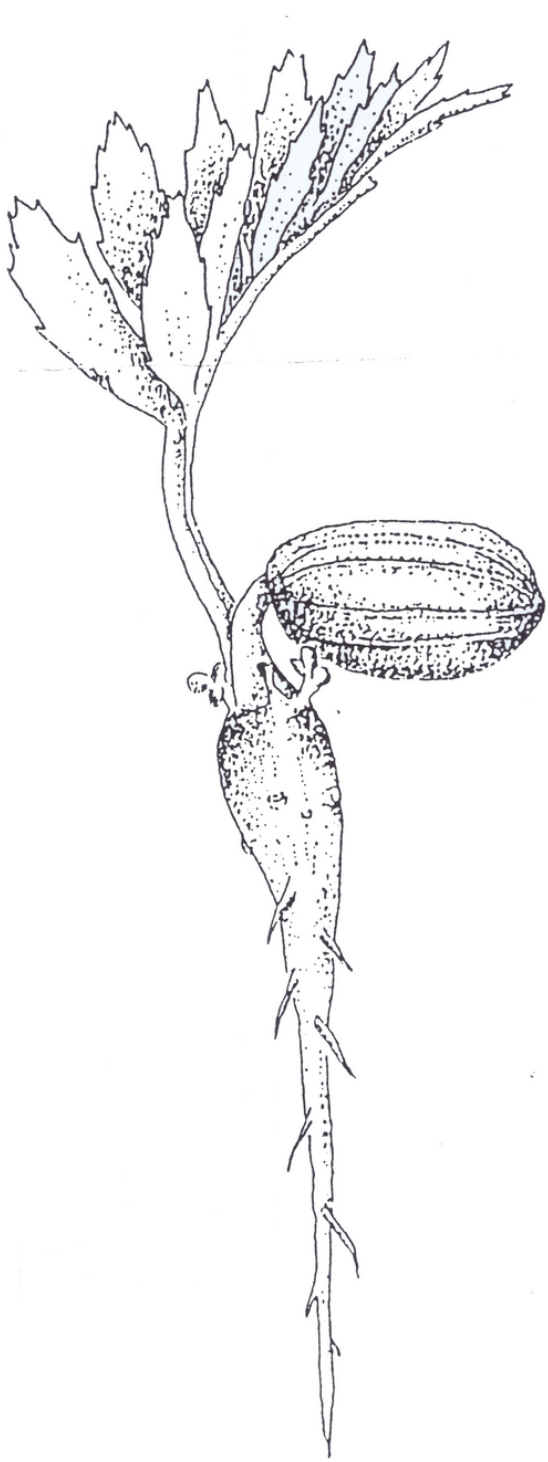

Figure 3 (above): A few months after germination, the first leaf arises and the primary root is well developed.

[...]

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