Notes on Some Factors Affecting the Germination of Palm Seeds

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INTRODUCTION

The palms (*Palmae*) are a relatively large family (over 200 genera) of monocotyledons which are distinguished, despite their diverse appearances, by their woody habit—an uncommon feature in monocots. They are not, in general, readily propagated by vegetative methods and are, therefore, principally produced from seed.

Despite extensive and diverse uses which are made of palms—as specimens in the landscape, as container subjects, as indoor plants, and as economic crops—the propagation of palms from seed has received scant technical observation. It is, therefore, often a hit and miss affair, often producing erratic responses. There has been little in the way of controlled observation, trial or experiment to determine the limitations of the parameters within which the process occurs, for this group of plants.

The seeds of individual palm species vary dramatically in size from the coco-de-mer (*Lodoicea maldivica*) of the Seychelles, which has the largest seeds of the plant kingdom to relatively small seeds of a few millimetres across. They vary in shape from ellipsoidal, through ovoid, to round, or indeed sometimes they are irregular.

COLLECTION AND STORAGE OF SEED

The first significant factor for reliable commercial propagation is to start with fresh, recently harvested seed. The viability of palm seed tends to decline rapidly after collection and extraction, especially if any significant degree of drying is involved. Palm seeds should, therefore, be stored under water-conserving conditions to maintain viability for as long as possible.

Palm seed contains an embryo which does not reach maturity, in general, until just before the fruit is shed. The embryo is typically small and somewhat conical in shape and is embedded towards the base and on the periphery of an extensive, homogenous and tightly packed endosperm which is turgid when fresh.

If the seed is allowed to dry (the seedcoats and pericarps are generally not impermeable) the endosperm, with its embedded embryo, begins to shrivel away from the seedcoat until contact is lost and it thus becomes separated and isolated within the seed. So direct contact with any potential water source is lost and the inward transfer of water becomes impeded and uncertain thus reducing the seed's ability to rehydrate. The potential for germination then becomes erratic. It may be possible to rehydrate the seed by soaking but any success will be determined by the permeability of the seedcoat, the level of internal shrinkage and the extent to which any points of contact remain. The extent to which this condition has developed may well prove to be one of the reasons for the very long periods and erratic time scales, reported in the literature for the germination of some samples of stored seeds.

Most commercial growers in Florida, Hawaii, and Australia soak palm seeds as a matter of course, for periods of from 1 to 6 days, to ensure an acceptable turgidity before beginning the germination procedures. Aerating the water at this stage may reduce the danger of "drowning" the seed.

Palm seed usually develops within some form of fleshy fruit. The dispersal strategy, under natural conditions, would involve the separation of this from the seed as a result of paring or by digestion on passage through the gut of a bird or animal. In propagation practice this flesh is removed in order to eliminate the potential for rotting agents to establish and for the removal of any chemical inhibitors to germination which may be present. The fruits should not, as a general rule, be picked until they are mature and ready to fall. At this stage they are macerated, placed in warm water and allowed to marginally ferment so that the flesh can be rubbed free and decanted off. The separated seeds can now be washed to clean them off completely. They are then surface dried and if required dressed with fungicide for storage or processing.

There has been considerable discussion in many reports about the feasibility of collecting the fruit while it is still green and/or the necessity for removing the flesh from the seeds. The more conclusive and generalised evidence suggests that mature fruits should be used and that they should have the flesh removed.

TEMPERATURE FOR GERMINATION

Palm seeds, in general, require relatively high temperatures for a full and successful germination, usually in the region of 33 to 37C, a range directly associated with their tropical and subtropical distribution. Because of the high energy inputs required to maintain such temperatures in a conventional propagation system, often for relatively long germination periods, energy efficiency is even more important than it is for temperate woody plants. This may include concentrating the seeds in a limited volume and incubating them *en masse* until the actual emergence phase begins, then sowing the seeds only when the radical is about to emerge.

The limited research literature which exists reports extremely wide variations in germination times, even when looking at distinct seed samples of the same species and from what are often painstakingly measured responses. There are three possible reasons: either they cannot all have used fresh seed, as indicated above; or that they have been derived using a single temperature regime; or, possibly, there is an inherent discontinuity in response. Certainly the age of the seed and the previous history of handling and storage conditions will influence the situation but the single critical environmental feature which has not generally been investigated and determined is the optimum temperature range required to achieve success for the particular subject. If a trial was not using the best germination temperature, then its assessment of time scale becomes of relatively less value.

In a series of elegant and simply based (although practically complex) observations Carpenter (1988), working in Florida and using four native palm species, has demonstrated that germination only occurs rapidly and productively within a distinct and limited temperature range and that even if the temperature is only marginally above or below this range the process of germination may not only be dramatically slower but the number of seeds responding declines considerably. Within the optimum temperature range the highest number of seedlings emerge in the shortest time span and with the greatest degree of synchronisation. That a particular temperature range is critical to each individual species and that one temperature range is not necessarily universally applicable is demonstrated by the responses he determined:

Sabal etonia	24 to 36C
Coccothrinax argentata	33 to 36C
Thrinax morrisii	33 to 39C
Acoelorraphe wrightii	33 to 39C

This series of results also indicated that the greater the temperature deviation was from the optimum, the longer was the time needed before 50% of seeds had germinated; the more erratic was the emergence and the number of seeds which germinated normally was fewer. If seeds which were exposed to less than ideal temperatures were then transferred to temperatures optimum for germination they quickly responded and germinated normally.

Many reports in the literature provide or cite extensive data on the times for germination and percentage emergence for considerable numbers of species. These responses, however, have virtually always been gathered from observations based on a single temperature regime and it cannot be expected that they represent the optimum response pattern for all the species enumerated. Using the wrong temperature probably accounts in most instances for the variations in response of individual species.

THE EFFECT OF SEED TREATMENTS

The literature provides many examples of the use of artificial treatments being carried out to improve and/or hasten germination.

The most obvious is the use of scarification but simple physical abrasion to reduce the thickness of the pericarp—especially on seeds which are not effectively impermeable to moisture—does not improve the rate of water uptake and is more likely to encourage rotting. It is only likely to provide significant benefit in seriously dehydrated samples. However, in those species which develop an impervious micropylar cap, the careful removal of this structure can be shown to aid imbibition and promote a more rapid germination and greater synchronisation of emergence.

A number of attempts have been made to enhance germination by various treatments using gibberellic acid and although such treatments, in many cases, can be shown to hasten germination response the seedlings usually develop atypically, with elongated stems and these do not easily recover normality. However, many of these observations on the use of growth-promoting substances lose some of their validity if the results have been achieved without considering the need for a critical temperature regime.

THE INFLUENCE OF LIGHT IN THE GERMINATION OF PALM SEED

In general it would appear that light is not a significant feature in controlling germination and that palm seeds are not light sensitive.

However, there is some observational evidence to suggest that the presence of light may inhibit radical emergence in open habitat species—such as *Washingtonia*—where survival depends on establishment beneath the protection of the canopy.

CONCLUSION

It is thus evident that knowledge concerning the pretreatment of, and the environmental influences during, the germination of palm seeds is fragmented and significantly incomplete. Any propagator seeking to determine treatments for a sample of seeds of any one particular species may well be stymied by the lack of sources of information—the problem which has given rise to these notes!

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ADDENDUM

Palms exhibit such a wide variety of germination strategies (not a surprising state of affairs in such a large and diverse group of plants) and so little information is available about particular species (and that which is available is spread across a wide spectrum of sources). A fuller list of available literature is provided below.

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