Biochemical Changes During Seed Germination of Selected Members of Palmae (Arecaceae)

Synopsis

Submitted by

Radha P.G.

Division of Plant Physiology and Biochemistry
Department of Botany
University of Calicut
Kerala

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Considerable ambiguity exists regarding the nature of dormancy, desiccation and chilling sensitivity, storage behaviour, germination pattern and mobilization of reserve materials in palm seeds. The literature available in these aspects is scant and often contradictory. The present investigation aims to throw more light into the behaviour of selected palm seeds under storage and during germination. Seeds of five common palm species of Northern Kerala, such as Borassus flabellifer L., Corypha umbraculifera L., Caryota urens L., Licuala peltata Roxb. and Livistona rotundifolia Mart. were selected for the present study. Different aspects such as germination pattern, storage behaviour, effect of pulp/husk on seed germination, time taken for initiation of germination, nature of reserves and their mobilization during seedling growth etc. are included in the investigation.

Ripened fruits/seeds of the palms were collected and both entire fruits and dehusked/depulped seeds were stored under different storage conditions viz. in open trays at room temperature, in polythene bags at room temperature and in polythene bags at 4°C. Determination of seed moisture content and germination percentage were carried out. The biochemical aspects of storage reserves and mobilization pattern were also subjected to detailed study.

In order to assay the biochemical processes associated with mobilization, samples were drawn from seeds and component structures of seedlings, such as endosperm, haustorium, cotyledonary sheath and plumular sheath at regular intervals associated with specific stages of germination. Different parameters considered for the study include determination of dry
weight, estimation of seed reserves such as galactomannan/mannan, starch, total sugars, reducing sugars, proteins and lipids. Amylase activity was assayed in starch rich organs of the seedlings, such as haustorium and cotyledonary sheath. HPLC analysis of galactomannan/mannan and electrophoretic studies of protein profile also were carried out.

The following observations were made in the present investigation.

Storage studies reveal that the palm seeds are short lived and belong to two different categories such as recalcitrant and intermediate. True seed dormancy is apparently seen in all the five palm species. Dormancy studies have shown that all the seeds show morphophysiological dormancy. Of the three different storage conditions employed, seeds stored in polyethylene bags at room temperature retained viability for the longest period than those in the other two storage conditions.

All the five palm species selected show remotive type of germination, where the cotyledon after emerging out of the seed, elongates forming a cotyledonary sheath that carries the embryonic axis. During germination, the proximal part of the cotyledon is modified as a cotyledonary sheath where as the distal part is differentiated as a haustorium that grows into and eventually fills the cavity of the endosperm. During later stages of seedling growth the embryonic axis located at the tip of the cotyledonary sheath is differentiated into radicle and plumule. The plumule consists of a sheath enclosing a leafy shoot within.

The major storage reserve is found to be mannann/galactomannan, located in the cell walls of the endosperm. Other reserves like starch, lipids and proteins are seen only in low quantities in the endosperm. The dry weight of the endosperm declines only insignificantly due to the water resistant nature of mannann/galactomannan.
The products of endosperm degradation are translocated to the haustorium where it is utilized for the synthesis of starch. Galactomannan degradation in the endosperm and starch formation in the haustorium occurs simultaneously. The total starch content in the endosperm is very low. The soluble as well as reducing sugar content of the endosperm show a marked decrease in the final stages of germination.

The haustorium shows very high amylase activity. The amount of soluble as well as reducing sugar content in the haustorium also increases due to degradation of starch. The protein content in the haustorium is found to increase in the initial stages of germination, which decreased in the final stages.

The cotyledonary sheath serves as a passage for the translocation of reserves from the haustorium to the plumular sheath. It contains only negligible amount of starch, but is rich in protein. The sugar content of the cotyledonary sheath shows an initial increase followed by a decline. The plumular sheath also is rich in starch, which is a secondary storage site of starch. All the results obtained in the present study are discussed in detail with relevant literature.