UNIVERSITY OF COPENHAGEN

Københavns Universitet

Storing tree seed

Schmidt, Lars Holger; Prasetyonohadi, Djoko

Published in:
Development Briefs. Technical

Publication date:
2021

Citation for published version (APA):
Schmidt, L. H., & Prasetyonohadi, D. (2021). Storing tree seed. *Development Briefs. Technical*, (21).

Download date: 13. Nov. 2026

DEVELOPMENT BRIEFS
TECHNICAL
No. 21 - August 2021

Storing tree seed

Introduction

Seed is a propagation material. Hence, the purpose of seed is to germinate and grow into plants. However, short-term storage is inevitable and in many cases, it is practical to be able to store seeds for a shorter or longer period of time, for example:

1. Where seed maturity and sowing time do not coincide
2. Where seed is traded, hence need transport from producer to consumer
3. Where seed cannot easily be collected easily (for example remote seed sources, expensive collection procedures or species with long intervals between good seed years)

Most seeds have a certain quiescent period between maturation and dispersal, where seeds are enclosed in a fruit awaiting to be dispersed into a potential growth site. During that period, seeds are usually germinable but are restrained from initiating germination because of inert mechanisms or the outside environment. Most seed undergo a certain maturation drying, but for one seed category, the recalcitrant seed, maturation drying is only slight, - seeds maintain high moisture content. Other category, orthodox seed, reduces moisture content drastically, and the low moisture content prevents them from germination before dispersal. In addition to drying, various types of dormancy mechanisms (chemical inhibitors, thick fruit or seed coat, or delayed development of embryos) prevent pre-dispersal germination. Pre-dispersal germination does happen in viviparous seed (precocious germination) for example in some mangrove species but is not common. During seed storage, seeds are exposed to conditions that would normally prevent them from germination. Where this is not possible, germination speed should be slowed down, and seeds are moved to their proper germination destination (seedbeds, pots or directly into the field) as fast as possible.

Physiological storage categories

Most seed belong to one of the two categories, orthodox or desiccation sensitive (recalcitrant) seed. Species with limited desiccation tolerance but reasonable storability are sometimes called intermediate seed. Orthodox seeds are those seed that naturally undergo maturation drying, and the seeds can be dried to low (5-6%) moisture content. Under these conditions, seeds are metabolically inactive. That means that seeds do not consume their nutrient resources and can keep for long time, often several years, without losing viability. Opposite are the desiccation sensitive seeds which do not undergo drastic maturation drying but maintain moisture content of typically 25-45% depending on species and conditions. Under these condition seeds are metabolically active (they respire) and thus consume their nutrient resources and produce waste products. Desiccation sensitive seed cannot be dried artificially to low moisture content as that of orthodox seed without losing viability. The seeds must be maintained under conditions of high moisture content and active metabolism, which will eventually lead them to either death or germination.

	Storage conditions	
Seed storage categories	Low moisture	Low temperature
Tropical recalcitrant	-	-
Temperate recalcitrant	-	+
Orthodox	+	+

Table.1. General tolerance to storage with low moisture content at low temperature for various categories of seed

UNIVERSITY OF COPENHAGEN

Viability, - individual seeds and seed lots

Seed viability is normally measured on seed lot level, i.e. how many percentages of seeds are alive at a given period of time. Loss of viability is continuous process of deterioration working within individual seeds. A viability of say 50% means that half of the seeds have deteriorated to a level where they can no longer germinate, while the other half are still able to. Viability normally refers to optimal germination conditions i.e. under field conditions germination may be lower. Loss of viability may be caused by 1) inert deteriorating factors such as exhaustion of storage reserves and accumulation of toxic metabolites during active metabolism or breaking down of cell structures or constituents, or 2) external factors such as fungi, bacteria or insect infestation. Often several factors work simultaneously, one deteriorating factor leading to the next. The challenge of seed storage is to reduce the activity of internal and external deteriorating factors.

Storage of orthodox seed.

Orthodox seeds are desiccation tolerant. Storage moisture content[1] (mc) for orthodox seeds is approximately 6-7%. This moisture level can be achieved by sun drying. For long term storage mc at 4-5% may be desirable; this usually requires a method of hot air drying or the like. At low moisture content seeds are not respiring and there is very little activity of mites, bacteria, insects and fungi. There are, however, some seed insects, that can be active at very low mc. Further, most seed attaching organisms start from the outside, so air humidity is crucial. For example, fungi may form mold on otherwise dry seed if air humidity is high. At the same time seed may re-absorb moisture from humid air. Therefore, after drying, orthodox seeds should be stored in closed, airtight containers. Small bags of silica gels are sometimes put with dry seed to help absorb excess moisture. At low moisture content, seeds can also be cooled down to low temperature. This will prolong viability. Dry orthodox seeds cooled down to 5°C have been stored for several decades in cold-rooms with almost no loss of viability.

Storage of desiccation sensitive seed

Desiccation sensitive seed is sensitive to excess storage, but some do tolerate some degree of drying and storage. Lowest safe moisture content is the lowest moisture content at which seeds can survive. It differs from one species to another; some extremely desiccation sensitive seed are damaged if dried to less than 35% mc, - others can be dried to 20% and some intermediate seed to less than 15%.

However, even though germination may be delayed, all these seeds have limited storability. Species that easily suffer from desiccation damage should be stored fully hydrated. If they are enclosed in fruits, extraction should generally be avoided since the inhibitory substances of fruits will often delay germination.

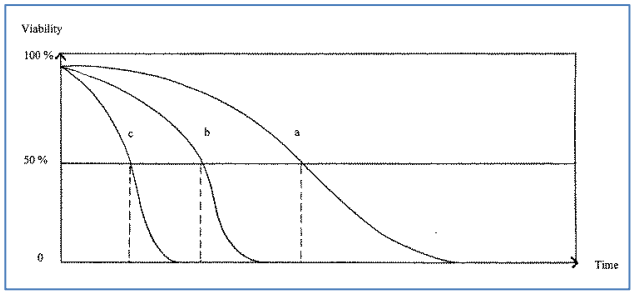

Fig.1. Model of different rate of loss of viability of a seed lot stored under three different conditions. The left curve represents the poorest storage conditions with rapid loss of viability and the right curve the best storage conditions with significantly longer storability.

Fig.2. Airtight containers for storage of dry orthodox seeds. Airtightness prevents the seed from re-absorbing humidity from the air.

Some desiccation sensitive species have delayed seed maturity; - after-maturation in fruits will enable them to achieve germinability while extracted seeds will most often not. Most tropical desiccation sensitive seeds are sensitive to low temperature. Sensitivity varies with species but temperatures below 22-25°C

[1] Moisture content is measured as the loss of water during drying in a drying oven at 103°C for 20 hours. The loss of weight during the drying process is considered loss of water only. The moisture content is thus calculated as weight before drying minus weight after drying in percentage of the weight before drying (moisture content, fresh weight basis)

can be damaging to some species. It is usually safe to store desiccation sensitive seeds in air-conditioned Desiccation sensitive seeds are always metabolically active and need oxygen for respiration and release water during the rooms but the temperature should never be below 22°C. The general rule is that the lower the moisture content, the lower the temperature tolerance. Seeds tolerant to drying to 20% mc can usually tolerate lower temperature than seeds with lowest safe moisture content of 30°C. There are, however, exceptions, where seeds can tolerate low temperatures but not drying (temperate and some

Fig. 3. Desiccation sensitive seed of African *Allanblackia* species stored with disintegrating fruit during after-maturation. Seeds germinate in this species after 3-4 months

highland recalcitrant seed) and other where seed are very temperature sensitive even a low moisture content (some intermediate species). process. The seeds must therefore be stored in open or permeable containers during short term storage.

Since storage of desiccation sensitive seed is at temperatures and humidity levels where insects, mites, bacteria and fungi are active, seeds are prone to attack even during short term storage. Therefore, it is generally advisable to reduce storage of desiccation sensitive seed to the absolute minimum and provide germination conditions as fast as possible. Even if germination is slow or seeds need after-ripening, viability is usually best maintained in a fully hydrated condition, letting the seeds germinate whenever they are prepared for it.

Since most desiccation sensitive seeds are large (and all large seeds are desiccation sensitive), they are usually stored in large open containers or on shelves or floors in store rooms. Water is sprayed on them whenever needed to keep them moist. When germination starts, they are brought to the planting place.

Pest management during seed storage

Insects can be a nuisance in seed lots especially if seeds are infested before harvest. Beetles will often continue to feed on seed, even orthodox dry seed. Some species may even complete their life cycle and re-infest dry seed in storage. Insects are generally sensitive to cold, so cold storage may kill or inactivate the pests depending on species and temperature. If cold storage is not possible, it may be necessary to kill pest by a powdered insecticide. Insecticides do not harm the seeds, but some can be harmful to the environment in general if they are slow decomposing (DDT as an extreme example). Insecticides can also be very toxic to humans. Treated seeds should therefore be handled with care, using gloves during handling, avoid inhaling (use dust mask inside), wash hands and containers after use, and dispose washing water and other waste carefully away from any consumables.

Fig. 4. Seed infested by seed beetle (visible as dark shadows on the seed coat). Right: Adult seed beetle

Selected Readings

Mulawarman, Roshetko, J.M., Sasongko, M.S. and Irianto, D. 2003. Trree Seed Management. Seed Sources, Seed Collection and Seed Handling. A Field Manual for Field Workers and Farmers. TFRI Extension Series No. 152, Winrock International & ICRAF

Schmidt, L. 2000. Seed Storage. Chapter 5 in Handling of tropical and subtropical forest tree seed. Danida Forest Seed Centre. Denmark

Schmidt, L. 2000. Seed Storage. Chapter 4 in Tropical Tree Seed. Springer. Heidelberg and Berlin

Author: Lars Schmidt, Djoko Prasetyonohadi

This DB was prepared as a Fact Sheet for Harapan Rain Forest Project, Indonesia in 2014. It was edited as Development Brief by S. Moestrup and JPB Lillesø in 2016.