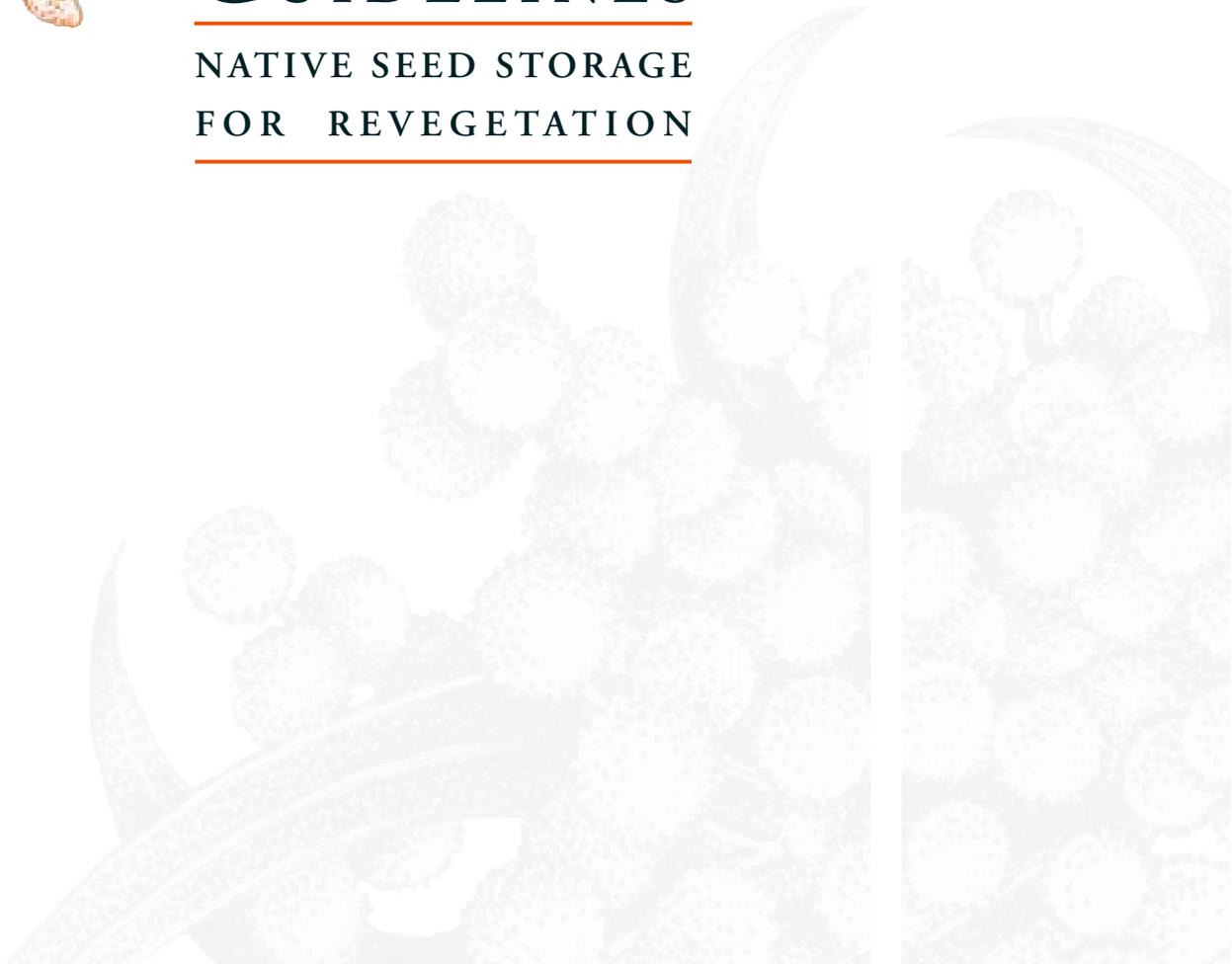




GUIDELINES

NATIVE SEED STORAGE
FOR REVEGETATION



Low-cost storage

Many people store native plant seed quite effectively without spending a lot of money. Low-cost storage can be very effective in the short term if basic rules are understood and followed. However, not all seed can be stored at low cost for all purposes.

In general, we store seed to maintain it in a viable condition from the time of collection until the time of sowing. Storage time varies according to the purpose for which you store it. In revegetation work, for example, seed is generally collected with the aim of sowing it as soon as possible in the next growing season. A storage period of 2 or 3 years for most of your seed might be appropriate, with a maximum storage time of 5 years. In comparison, the conservation of a species through storage of seed may involve periods in excess of 10 or 20 years over which viability must be maintained. Remember that the longer you need to store seed, the more expensive it becomes.

Think of seed storage as a learning process. There has been very little research on storing Australian indigenous plant seed and most guidelines are based on research conducted for agricultural industries. Sharing your experiences and understanding with others will help to overcome this lack of knowledge. After looking at storage systems all over Australia, we developed this guideline with our recommendations for good, low-cost storage for the short term (up to 5 years). It covers room temperature, air-conditioned and refrigerated storage useful for periods up to 5 years, depending on the species stored. This typically covers seed storage for revegetation purposes.

There are other FloraBank guidelines for improving storage practices. The Australian Network for Plant Conservation has excellent *Germplasm Conservation Guidelines for Australia* (long-term storage).

So what do we recommend?

Firstly, you should think about the following.

1. The basic requirements for good storage are to ensure that seed is:
 - collected from fruit that is fully mature
 - well dried and cleaned
 - stored in airtight containers
 - stored at constant temperature, and
 - at all stages the subject of thorough record-keeping.
2. It is more important to **dry seed well** and store it in an **airtight container** than to store it at low temperature. Start off with room temperature storage and introduce air-conditioning or refrigeration later if you need to. Don't just assume that you need refrigerators or a walk-in cold storage to store seed. Many commercial seed merchants don't have such facilities, or use a small domestic fridge. You can move to more sophisticated storage options, such as low-temperature and low-humidity storage, if the need arises.
3. It is much cheaper to only use refrigeration for the seed that won't keep at room temperature or in air-conditioning. Many Australian plants, particularly those with hard-coated seeds (acacias), store easily at room temperature for years. Many rainforest species with soft or fleshy seeds (acmena, syzygium) may last only a matter of weeks, or up to a year, and many must be stored in a fridge.
4. You need to learn **which species can be stored viably at room temperature** and which species require refrigeration. Start by developing your understanding of the broad groupings of Australian plants – at genus level – and how their seed is rated in terms of its **natural viability** and its **expected storage life**.

5. Draw up a list of species you will collect and group them into those that you think will store at room temperature and those that you know will not.
6. Plan a low-cost storage.
 - Plan as dry a storage area as you can.
 - Plan as cool a storage area as you can. But be careful, many cool buildings are also damp.
 - Plan a storage area that you can easily work in as you will spend a lot of time in it. Is it easy to keep clean, easy to keep dry, easy to keep cool? Choose a well-lit storage area and use opaque containers to keep your seed in the dark.
 - Plan a storage time limit for seed suitable for your work.
 - Storage space is expensive because it involves building ownership and maintenance or rental of space. It is therefore important to understand your needs and not to over-cater for them. It may be cheaper for you to rent space that you don't have to maintain. The cheapest option is to obtain free or sponsored storage space. A seedbank needs areas for receiving and drying seed, seed cleaning, storage, packaging and dispatch, germination testing, office and record-keeping, and a pleasant place to sit and talk to your clients. Here we are concerned only with storage, which is one of the smallest users and lesser considerations in the space requirements for most community seedbanks.

Room temperature storage

Airtight plastic bags

FloraBank recommends drying all seed and sealing it in airtight resealable press seal plastic bags as the best low-cost option. Always properly close the press seal. These bags are cheap and available in bulk (in standard sizes) even from supermarkets. Test the bags by blowing them up like a balloon and sealing, like an inflatable

pillow. Press down on the inflated bag with your hands to see if you can squeeze the air out. If you can easily do this – pick another supplier. These bags do allow moisture in through the plastic over time, so select heavy duty bags rather than thin 'sandwich' bags. Place one bag inside another for a better seal, added strength or storage of larger seedlots.

Storage containers

The filled plastic bags should be stored in strong containers for protection and to maximise storage space. If possible, use standard sized containers that are airtight or have a well-fitting lid and are not transparent. All manner of new plastic storage containers or recycled containers (coffee tins, honey containers) may be used.

Square stackable containers with lock-down lids are available from large supermarkets, camping stores and plastic manufacturers in a variety of sizes. Thirty-litre containers suit floor-level bulk storage but when storing seed on shelves use smaller sized containers (approximately 15 litres) that are reasonably full with 6 to 8 kilograms of seed. If you are prepared to pay more, you can purchase containers (usually barrels) with a rubber seal. If you can only find clear plastic containers, simply paint them with water-based paint to keep the seed in the dark.

If using recycled containers, avoid using a big mixture of shapes and sizes. Go for the cheapest option with the least hassles. But remember that a standard system of closed containers does not cost a lot (20 containers at \$15 each = \$300) and has many advantages.

To reduce moisture uptake by seed, fill the containers to reduce the amount of airspace. Always close lids firmly.

Storage space requirements

Calculate the room temperature storage space you need or have available in cubic metres of wall or free-standing shelving space below chest height. (It isn't safe practice to place loads above chest height.)

The use of shelving and storage containers will help to maximise the use of vertical space. As a guide, 10 square stackable 30-litre containers and 20 15-litre containers should store 20 and 15 kilograms (respectively) of eucalypt, acacia, callistemon, casuarina or similar seed. This is a total storage capacity of 400 kilograms and even at half this rate (200 kg) amounts to more storage room than most community seedbanks need: particularly where direct seeding is not involved. The 30 storage bins fit easily on three shelves (50 cm wide x 50 cm spacing) against one wall in a standard room 3 metres long. Make the shelves yourself from recycled timber to save money.

Insects and pests

Include regular basic insect and pest control measures in your seed cleaning and storage. Using airtight containers prevents seed damage. Set rat and mice, cockroach and other baits regularly. Many people achieve successful control using Driacide (amorphous silica), diatomaceous earth or magnesite (magnesium sulfate) powders. These are irritants dusted through seed to provide good protection from insects. Swimming pool filter grade diatomaceous earth should not be used as it is unsuitable. Wear a mask and place a small amount in each bag and shake to disperse the powder well.

Where control of pests is problematic, or your results with irritant powders are unsatisfactory, you could use paradichlorobenzene (toilet bowl deodoriser) rather than naphthalene to kill insect pests in seed. As with all chemicals, you should check the warnings and information available on this chemical before using it – carefully. This is the active ingredient in toilet cakes, which are available from many sources and are used by most councils throughout Australia. They are very cheap and available in bulk.

Apply a single application at the rate of 1 gram per kilogram inside the press seal plastic bag when putting seed into storage, or immediately following cleaning if there are any signs of insects (Angophora seed).

Within days, the compound evaporates and is invisible in the bag. A further application should not be necessary.

Monitoring

Monitor the humidity in your storage area (or fridge) with a simple electronic humidity meter. These are typically battery-operated and measure temperature (0° to 60°C), humidity (10 to 95% relative humidity) and the maximum and minimum for each. It is important to monitor the extremes in temperature and humidity. These meters are available from scientific instrument suppliers for \$250 to \$350.

Air-conditioned storage

In many parts of Australia it may be difficult for you to keep temperature and humidity constant in the storage environment – for example, if you live where there are hot, humid summers, cold, very wet winters, or extremely hot summer days with cool nights. Think seriously about using an air-conditioner to maintain *constant* temperature or storing your seed in air-conditioned premises. Air-conditioners dehumidify (dry the air) at different rates. Get one that achieves the best relative humidity compared to outside air. Typically, dehumidifiers achieve relative humidity of 25% or better, but these are very costly. An air-conditioner may at best only achieve a relative humidity of 50%, but this is a lot better than humid tropical summer or temperate wet winter air.

Try air-conditioning your storage space only for maximum efficiency. Set the temperature to a comfortable level that does not overwork the capacity of the air-conditioner. If you are buying a new unit, select a capacity that gives you the lowest *constant* temperature for your budget.

Moving seed into air-conditioning after drying in the open air should further lower seed moisture content, but it may take a week or so. Do this before sealing the seed into containers.

Refrigerated storage

Many fridges (especially older ones) operate at a high relative humidity in the storage cabinet. Modern fridges are self-defrosting and have an internal drainage system leading to an evaporation tray below the fridge. However, they still create relatively high humidity storage conditions. You should make sure that condensation is well drained from the fridge and the door seal is intact.

When removing seed from a cold storage, always allow seed to come to room temperature before breaking the seal. Condensation will result on cold seed if you expose it to room temperature and humidity, increasing the likelihood of spoilage.

Containers

Using resealable press seal plastic bags keeps your seed dry and allows you to store it in a fridge. However, press seal plastic bags do allow some moisture to move into the seed through the plastic over time (even in a year). Always properly close the press seal and buy heavy duty bags for use in a fridge. Because of the high humidity, you must store seed in airtight containers in a fridge. There are a great variety of small sealing containers for use in fridges, for example, clip-lock rubber-sealed food containers, vacola jars and screw cap bottles. FloraBank recommends using a standard sized square stackable plastic container rather than glass and round containers – to maximise space and for easy handling. Avoid using recycled ice cream containers, trays, or similar.

How big a fridge?

Calculate the refrigerated storage space you need or have available in litres (1 litre equals 10 cm x 10 cm x 10 cm). Fridges come in all shapes and sizes, new and second-hand, most labelled with the litres of storage space. As a rule of thumb, you should be able to store about a kilogram of seed in every 2 litres of space for eucalypt, acacia, callistemon, casuarina or similar

seed. So a standard 400-litre fridge should store up to 200 kilograms of seed! Buy or borrow a second-hand fridge.

Again, it may be cheaper to look for free or rented space in a walk-in refrigeration unit at a nearby vegetable or fruit handler, or cold storage facility. If your seed is stored in stackable plastic containers, you can accurately describe your space requirements and your seed is easily handled and stored. Many walk-in fridges are 'dry' fridges or humidity-controlled, which is an added advantage.

How do you know it's working?

How do you know you've got it right? Well, if the seed you collect and store has an acceptable viability when you distribute it for use, then you have got it right! You must test the viability of seed in storage to know if your practices are OK. Be aware that many Australian species have naturally low viability in seed. In addition, perhaps one-third require some form of pre-treatment for their seed to germinate. Perhaps the same numbers again are extremely difficult to germinate at all.

Cut tests

FloraBank strongly recommends that you at least do a simple **cut test** on all seed collected – before it is even cleaned. Use a sharp blade (scalpel, knife or sharp secateurs) to cut right through 20 or more seeds from the seedlot (a unique batch of seed of a species from a location). Visually inspect the seeds, if necessary using a small hand lens. Is the seed firm and creamy-white in colour? Do the embryos look similar or are some deformed? How many empty seed coats are there? Some seedlots you will find are *all* chaff and non-viable seed material! Reject seedlots that fail this test unless you can remove the inferior material by cleaning.

To inspect very fine seed (eucalypts, melaleucas), first soak a sample of the seed in water for 2 to 4 days. Remove the seed from the water and squeeze using a pair of tweezers. Again, look for creamy-white embryos.

Germination testing

FloraBank also strongly recommends that you do a germination test on all seed as it goes into storage. If you do the same test as seed comes out of storage, you can determine if viability has declined. We show you some cheap methods for doing germination testing in another guideline.

In practice, germination testing may not be immediately possible because you lack the equipment. There are people who do germination testing of seed on a fee-for-service basis. If you have the finances to commission limited viability testing or germination testing, this could be your answer.

Close your eyes and hope?

If you turn over seed quickly and use the very best practices possible on your budget, then you may take the view, as some seedbanks do, that you are doing all you can to guarantee viability. Some seedbanks do not do germination testing and rely on in-field germination rates and the feedback of seed users as their sole means of assessing viability.

Reduced germination success of more than about 20% (or perhaps germination below 50% of seed) is considered unacceptable for direct seeding and nursery propagation and the seed rejected. (These are the figures often cited by commercial and community-based seedbanks.)

There are two big problems with this approach and FloraBank doesn't recommend it as a replacement for viability testing.

Firstly, where seed is rejected, a seedbank manager only has the user's word on its quality unless the seedbank itself does germination testing. (So why not do it to start with?) There is also the strong possibility that the user is not using the correct germination procedure for that species and that this, rather than any lack of viability in the seed, may be the real cause of poor germination.

Secondly, if the seed does have poor viability, a seedbank manager will not know if the seed had poor viability when it was collected or if storage practice is to blame. Indeed, for unfamiliar species, a seedbank manager may not pick up that the species might have naturally low viability. If you get more than one complaint, are the clients right, do you throw the seed out?

Some precautions

FloraBank recommends that you fit smoke alarms and a fire extinguisher in the storage area of a seedbank, which should be a no smoking area.

Make sure your insurance policy covers you for the loss of seed to flood and fire at the commercial replacement rate.

If a fridge fails, it is not the end of the world. Rent space in a commercial unit immediately until you get your fridge fixed.



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Your Comment

The FloraBank guidelines are a consolidation of existing information and draw on the practices observed at seedbanks across Australia as well as the expertise and technical understanding of the Australian Tree Seed Centre at CSIRO Forestry and Forest Products, Greening Australia's Seedbanks and the Australian National Botanic Gardens Seedbank. The guideline present, as far as is known by the authors, best practices. However, they are drafts because we recognise that other people may have better approaches, and that best practices change with time. Also, our climate and vegetation is diverse and not all practices are equally applicable across Australia. If you would like to comment on any of the guidelines, or have practices or knowledge you would like to share with others, please contact the FloraBank Coordinator.

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