Seed quality and germination

To grow plants from seed, some knowledge of the quality and germination requirements of your seed is required. Not all fruits will produce seed. Not all seed produced will be viable or germinable. Seed is a highly variable resource and lack of seed production in flowering plants can be caused by a number of factors. These include pollination failure, resource deficiency, predation and genetic defects causing developmental failure. Environmental stress and age structure of the population can also contribute to a low seed production.

Cost effective and simple methods to identify seed quality and germinability are required for any seed related venture. The techniques outlined below incorporate some general principles for assessing seed quality and germinability. They are not definitive. It is important to remember that there is great variability in seed production between plants, sites and years of collection. Your results for one seed batch are unlikely to be the same for another seed batch. Each collection must be assessed on an individual basis. You may discover other methods for assessing quality and germinability of your seed that are not listed, but that work well for your species. If some techniques work well, share your knowledge and we will all be the better for it.

Seed quality testing

There are a number of quick tests that can be conducted on seed to determine whether or not the seed is potentially viable. Insect damaged seed and shrivelled seed is unlikely to germinate. Fruits with no seed within will also not germinate. Don’t waste your time on trying to germinate, store or direct seed material that is no good. Spend some time on assessing seed quality using one or several of the methods below.

REMEMBER:

Always assess your seed in some way. If at a later date the success of your planting effort was dismal, it may have been due to lack of germinable seed within the seed batch used. Avoid disappointment and do quality assessments and/or germination tests.
Seed sectioning (cut test)

The cut test is a very simple method to determine whether your seed is full (contains an endosperm, the food necessary for growth and development) or empty. Simply take a representative sample of your seed, either by weight or by a count, and cut each seed carefully to see if there is anything inside. Generally, a good healthy seed will be firm and white inside, not shrivelled or overly dry. Empty fruits will be very obvious and may even have evidence of insect damage or an aborted seed. Often green seed is a sign of immaturity and these seeds may not germinate because of incomplete development. It is usually fairly easy to determine whether the seed of species with canopy-stored seed (e.g. Banksia, Hakea and Dryandra) is healthy. Once the seed is extracted, check to see if the seedcoat is dark brown or black and the inside of the seed is firm and white. The hard seed of genera in the pea families can also be assessed visually if not too small. Any insect damaged and shrivelled seed should be discarded. In some cases you will not be able to tell a good filled seed from an empty one as many species produce ‘dummy’ seed—a fully formed hard seedcoat with nothing within. This has been known to occur in the genus Adenanthos.

Cut tests on Allocasuarina can be very useful to identify full from empty seeds. It is also possible to use this technique of assessing seed quality on the seed of Adenanthos, Petrophile and many other species that produce single-seeded fruits. In Verticordia, Darwinia and Chamelaucium the small seed is a nut enclosed within the old flower receptacle. Not all receptacles contain a fully formed seed. Seed set in Verticordia may be anything from zero to 68 per cent, with much variation between plants, collection sites and years of collection. Five grams of material may represent many thousands of flowers but the number of seeds held within that weight may be in the order of 100 or less. A cut test on these species will determine how much seed has set per unit weight. Ideally do your cut test on several replicates of 50 or 100 fruits to ensure that you are getting an average over the whole collection.

Visual inspection

Very simply, look at your seed closely. If your seed is large use the naked eye. Use a magnifying glass or microscope if the seed is very small. Do some seeds appear shrivelled? Do some seeds have holes in them or frass (the debris or excrement of insects or insect larvae, which can look like sawdust) around them? These signs may indicate insect damage. Are the seeds broken or damaged in any way? Too vigorous cleaning of the seed may have caused some damage to the outside coat and also the inside of the seed itself. The seed that is healthiest and most likely to germinate will be undamaged and plump. After a while you will get a feel for the look of the seed and you should be able to discard any seed that does not look full, undamaged and plump. Often green seed is a sign of immaturity and these seeds may not germinate because of incomplete development. It is usually fairly easy to determine whether the seed of species with canopy-stored seed (e.g. Banksia, Hakea and Dryandra) is healthy. Once the seed is extracted, check to see if the seedcoat is dark brown or black and the inside of the seed is firm and white. The hard seed of genera in the pea families can also be assessed visually if not too small. Any insect damaged and shrivelled seed should be discarded. In some cases you will not be able to tell a good filled seed from an empty one as many species produce ‘dummy’ seed—a fully formed hard seedcoat with nothing within. This has been known to occur in the genus Adenanthos.
Canopy-borne seed

Canopy stored seed held in woody fruits such as occurs in Banksia, Hakea, Lambertia and Dryandra tend to germinate readily without any pre-treatment once seed is extracted from the woody fruits. Light, moisture and a moderate temperature will suffice. Germination may take up to one month.

Hard-seeded species

Seed of pea species such as Acacia, Daviesia, Gastrolobium and Chorizema generally require cracking of the hard seed coat before germination will commence. The hard seed coat prevents the seed from taking up water. This cracking of the seed coat can be achieved by mechanical scarification (rub the seed gently over sandpaper or an emery board) or by pouring near boiling water onto the seed and allowing the seed to soak in the cooling water for two or more hours. It is also possible to crack the seed coat by nicking a small portion of the coat with a scalpel to reveal the seed beneath. The seed itself must not be damaged or it will die. This technique requires more skill and should be conducted with the aid of a dissecting microscope. Germination of seed of many hard-seeded species is relatively quick and may commence one week after treatment.
Small-seeded Myrtaceous species

These include seed from the genera Eucalyptus, Melaleuca, Callistemon and Kunzea to name a few. The capsules of these plants contain not only seed but also chaff (sterile and aborted ovules). Chaff does not germinate, and it is often very difficult to distinguish between seed and chaff in some species. In other species such as Eucalyptus calophylla (marri) the seed and chaff are readily distinguishable. If you have access to a microscope the task of identifying seed will be easier. Otherwise it is necessary to weigh the collection of seed and chaff, take out a representative sample and place both seed and chaff onto a medium for germination. Most of these small seeded myrtaceous species contain no dormancy mechanisms to prevent their germination and only require light, moisture and a suitable temperature. In the case of these small-seeded species, the weighed replicate test (number of germinable seed per unit weight) may be the most accurate assessment of your seed batch.

Difficult species

In our experience there are a range of native species from the south-west of Western Australia that are in this category. They come from a range of families and include Eremophila, Verticordia, Darwinia, Chamelaucium, Conospermum and Andersonia. Many require the seed or fruit coat to be removed before germination can proceed. In the natural environment this will occur over time, after passage through an animal gut or through insect or micro-organism activity. This means that germination will be hard to replicate without some specialised equipment or a great deal of time waiting (from one to two years in some cases). For difficult species we have no easy recommendations. Many of these seed types respond to soaking in a smoke water solution for up to 24 hours before sowing. If access to a microscope is available, then carefully removing the seedcoat structures without damaging the seed, soaking the seed in smoked water and placing the seed in a container for germination should give some success. Seeds of these species often respond to applications of naturally occurring plant growth hormones such as gibberellic acid as the compound GA3. This hormone can be purchased in powder form from chemical companies, such as Sigma, and is made up with a phosphate buffer to the desired strength (the stock solution). 1000ppm is recommended. A small amount of this mixture is then added to the medium, or else the seed can be soaked in a diluted stock solution for several hours before sowing. Around 25mg to 50mg of stock solution is added to a litre of water to stimulate germination.

For more information on seed quality assessment and germination the following references will be helpful:


Seed Notes

These Seed Notes aim to provide information on seed identification, collection, biology and germination for a wide range of seed types for Western Australian native species.

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