Florabank Guidelines

Module 15

Buying and Selling Seeds

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Key points

Options for purchasing: buying seeds that the seller has in stock, or order seeds to be collected from specific sites and species or at particular times.

Plan your seed requirements (species and quantities) well in advance.

Decide the location from which you would like your seeds to be sourced. If seeds from that location are not in stock, they may take time to be sourced.

Ask for information on seed quality.

Decide whether or not to pre-treat the seeds before use, which treatments to use, and who will implement them.

Keep comprehensive records.

Check that the seed collector has the appropriate licences and permissions.

Don’t simply purchase the cheapest seed lot, calculate the value for money.

Seeds should be sold with quality information, so the purchaser can make informed decisions about purchasing, knows what they’ve bought and can adjust their seeding rates accordingly.

Introduction

This second edition of the Florabank Guidelines provides comprehensive information on different aspects of the seed supply chain. In this module, we've summarised some top tips for those purchasing native seed for restoration. When planning to buy seed, read through these tips, and refer back to the preceding modules for further information.

Top tips for seed purchasers

There is an amazing diversity of Australian native seeds. For the novice seed buyer, it may be daunting working out where to start. Besides having to calculate how much seed you will need, there are also several pitfalls to be aware of that may catch people by surprise.

As seed (or plants grown from seed) can be one of the biggest costs in any restoration project, it is imperative to make informed seed purchasing decisions. If seeds are sold with quality information, the purchaser can make informed decisions about their purchase, knows what they've bought and can adjust their seeding rates accordingly.

Seek advice from experienced practitioners and trusted seed suppliers before making a purchase.

Where to buy seed

There are many commercial seed sellers throughout Australia, including private businesses, community organisations and government agencies. These range from individuals collecting and selling a small range of species (cottage industries), to larger retail business, to large wholesale seed buyers and resellers with a large diversity of species.

There are two main options for purchasing seeds:

1. buying seeds that the seller has in stock, or
2. ordering seeds to be collected from specific species, from specific sites, or at particular times.

For the first option, you will be limited by what species the seller has in stock and where and when the seed was collected. Under this arrangement seed is usually purchased by weight.

Under the second option, the buyer has greater control of the seed they receive. This option is best for buyers with regular annual purchases, such as mining companies, or where seeds are to

be used in restoration of threatened ecological communities or species. If a licence is required for seed collection for your project you will have to use this option. Seed can be purchased by weight or under a contractual arrangement.

It is best to use a local seed supplier who has a good understanding of the distribution and identification of the species you are wanting to buy. In regional and remote areas there may be only a few seed collectors covering a large area. In urban and more closely-settled areas there may be many seed sellers to choose from. Always ask for reviews or references from other seed buyers in your area.

Planning

Any project that involves seed, needs to have a comprehensive plan to assist with decision making, budgeting, resource allocation and timing of activities. Seed management needs to be considered at the beginning of the project, as it will take time to source the seed required.

Ensure there is a solid project plan, that includes a section dedicated to seed management.

- The plan should define the species selection and target number of established plants, allowing calculation of the seed quantities required.
- Document the composition, structure and function of your reference site, and your long-term goals and short-term objectives. (see Module 1 – Introduction)
- Objectives should be specific, measurable, achievable, realistic and timely (SMART). They should be written in terms of specific measurements (e.g. minimum number of species, minimum plant density) (see also Gann et al. (2019) for information on setting objectives). Keep species numbers realistic - a balance between sufficient diversity without unrealistic expectations (see Module 1 – Introduction).
- Talk to potential seed suppliers about what they have available, which species are easy or difficult to collect, peak seed collection times for target species, reliability of seed crops each year, and preferred ordering processes.
- Objectives need to be scale dependent. That means, you do not need to return all of the species that occur in the whole ecological community to one small area. Determine the average number of species that occur in an area that is comparable in size and species composition as your project area. This will help to inform your objectives.
- Seek advice and/or planning assistance if you don't know how to calculate how much seed you need. Seed quantities are dependent on a variety of factors and adequate provisions are required to ensure your project goals are realised. Under or over calculating requirements can be costly.
- Seek expert advice on which species are likely to be available and which are suitable for restoration within your project budget.
- If possible, ask an expert to review your plan.
- If the restoration project is being implemented over a number of years, try an adaptive management approach, whereby seeding/planting rates are monitored and improved from year to year.

Define and quantify your restoration targets before ordering the seed.

- Determine how many species you need in total, and how many plants per unit area you need. Then, you can estimate the number of seeds required based on the target density.
- It can be very challenging to estimate the weight of seeds required, as this needs to take into account the individual seed weight, the quality of each seed lot, as well as other factors such as site conditions and restoration techniques (e.g. direct seeding will use a lot more seed than growing seedlings in a nursery). However, it is still useful to estimate the number of seeds required, and possibly place a seed order based on number, rather than weight, as weight is dependent on the quality of the individual seed lot.
- Estimating the number of seeds required to meet targets also needs to take into account losses at each growth stage, i.e. predation, erosion, germination, emergence, survival (e.g. see Commander et al. (2020), which is usually determined by past experience, and is affected by restoration practices, seasonal weather and other factors (see Module 14 – Direct Seeding)). Seek advice from an experienced practitioner.
- If sending seeds to a nursery for seedling production, the nursery may know how many seeds they require for the desired number of plants (e.g. if they sow a certain number of seeds per pot and then thin out). Seedling survival post-planting must also be considered.
- Despite these challenges, knowing your objectives, and keeping good records, will help inform future seed orders.

Where possible, plan well in advance to ensure that seeds of sufficient species and in sufficient quantities can be obtained.

- Order your seeds well in advance. You may need to order 12 months in advance, or more.
- The greater the lead time the less the likelihood that you will need to compromise your plans (i.e. species, quantity, provenance, cost) due to availability. Placing forward orders at least one season in advance is recommended for larger projects, or smaller projects with limited local availability.
- It helps to know at what time of the year the species you require can be collected, so you don't inadvertently order the seed a month after seeding has finished. Be aware that some species may not seed every year. Some locations may not produce much seed in some years due to fire or drought. Some species are able to be collected all year round, such as when seed is held in the canopy (serotinous). Others may only be available in sufficient quantities in 'masting' years.
- A multi-year collection campaign is more likely to fulfill more of your order than a single event.
- Seasonal scarcity may lead to price increases. Conversely, some species may have high production years which may reduce prices.
- The collector may need to apply for permissions and licences (if they don't already have them) before collecting, so incorporate this into the timeline too.
- Be aware that if you purchase general stock from a seed supplier that has previously been collected, the species and provenances you require may not be available.

Know which species you want, and don't instantly accept species substitutions if they are offered.

- Different species in the same genus may not have the same traits, fulfil the same function, or even occur in the same area. If, for example, you ask for *Eucalyptus erythrocorys*, a small eucalypt, don't accept *Eucalyptus diversicolor*, a giant tree! Question them on the reasons for the proposed substitution and do your own research. Then choose the most appropriate alternative from what is available, according to the aims of the project.
- It may be unwise to introduce species which were not there originally, unless part of a well-planned species introduction, with all the relevant permits in place. See the Translocation Guidelines (Commander et al. 2018) for more information on preventing unintended consequences of species introductions.
- Be aware that if species are offered in extra quantities to substitute for other species which are unavailable, they have the potential to result in an imbalance in the ecosystem.
- However, trusted and knowledgeable suppliers will be able to provide useful advice on substitutions if they are familiar with the ecosystem.

Understand that seed cannot be collected from all species and others may only be available in limited quantities, or seed could be short-lived once collected so may not be available for purchase from seed suppliers

- Some species may be difficult to collect from if they take a long time to reach reproductive maturity, aren't common or abundant, have a short collection or viability window, or clonally propagate and don't set much seed. These species may be better propagated from cuttings, or, if a few seeds can be collected, consider growing tubestock rather than including in a seed mix for direct seeding. If there is a soil seed bank, stimulating recruitment in situ may be another option (see Module 13 – Nursery propagation).
- There may be restrictions placed on wild harvest due to licencing conditions.
- There may be restrictions placed on collection of threatened species.

Source location

Consideration of the source location of the seed needs to integrated into the project decision making process and documented in the project plan. The location of a seed collection is known as its provenance. Seeds can be collected from a geographic location close to the restoration site (local provenance) or from a more distant geographic location (non-local provenance). The choice of a provenance strategy depends on many factors as well as practical constraints. For more information see Module 5 – Seed Sourcing.

Know where you want your seed collected from.

- Does it have to be from a specific location, such as within the land you are responsible for?
- Does it need to be collected within a certain radius of your location, i.e. not more than 15 km away?
- Does it need to be collected in a specific catchment, so the environment (soils and climate) is similar? See also Module 5 – Seed Sourcing.
- Be aware that seed sourced from specific locations may be more expensive than normal. This could be due to localised scarcity, differences in growth form or plant height, access difficulty, etc.
- Suppliers should keep records of the source location. Ask them to provide this detail and make your own choice as to which seed lot is most appropriate for your project.

Quantity, quality and cost

Seed quality traits include seed lot purity, seed fill, seed health (diseases and malformations and insect infestation) and viability. It is important to understand the variation that is possible in the quality of seed. Seed lots can include other material such as leaves, stalks or chaff. Some of your seed may be non-viable or damaged by insects. You should be prepared to pay more for higher quality seed, or seed about which you have more information. The critical information you should ask your seed supplier for is:

- Seed purity – how much of what you are buying is actually seed? This allows you to make direct comparisons between different seed lots.
- How old is the seed and how has it been stored? This will give an indication of its quality and likely germinability.
- How many plants was the seed collected from? This gives an indication of genetic diversity, which will directly affect the viability and resilience of the new vegetation established with the seed.

You may also need to know:

- Seed viability – how many of the seeds are viable and have the potential to germinate. Expect to pay extra for tests to determine viability. See Module 10 – Seed Quality Testing.
- Seed germination – how many seeds germinate and the conditions under which the germination test was done. Expect to pay extra for germination tests, and these can take four weeks or more. See Module 11 – Seed Germination and Dormancy.
- Where the seed was collected – this helps you determine suitability of the seed for your project and any licencing requirements.

Calculate how many seeds you need.

- Seeds are generally sold by weight rather than number of seeds. The quantity can be calculated by using the 1000 seed weight, or number of seeds per gram (see Module 10 – Seed Quality Testing). Your seed supplier should be able to provide average counts for the species you are interested in to assist with this, and may also be able to provide this information for specific seed lots.
- Keep in mind that you may not be able to purchase all the seed you need in one year due to lack of seed availability, especially if you are restoring large areas of land. In that case, decide on whether you need to order several years in advance to implement in one year, or buy seed annually and implement in stages over several years.

If you are buying seed that has already been collected, ask for information about the seed you are purchasing.

- Ascertain where and when it was collected, for how long it was stored, and what the storage conditions are.
- Ask for the number of seeds per gram.
- Ask if there is any quality information, such as purity percentage, seed fill and seed viability.
- Basic quality information will allow you to make informed decisions about the relative quality and compare seed lots.
- The cheapest seed lot may not be the best value for money. See section below 'Calculating value for money using testing data'.
- Be aware that some information (i.e. seed quality testing) may cost extra. However, this information may be cost-effective.
- Be aware that if you purchase seed and don't know how it has been stored, and it hasn't been quality tested, seeds could be empty or dead, or the seed lot diluted with chaff (non-seed material).
- Be aware that for small seed lots (e.g. worth less than $200) it may not be cost-effective to undertake all seed tests.

If you are commissioning a seed collection, ask for quality testing to be done on all seed lots.

- As an absolute minimum, ask for the number of seeds per gram.

Know how much you are willing to pay or what your budget is, and ask for a quote in advance.

- Some collectors may sell seeds by weight, others may require payment per day if they are collecting solely for you at a certain location.
- Different species cost different amounts, and this generally depends on the amount of time it takes to collect and clean that species. Species that do not seed prolifically, are less common in the landscape, and are difficult to process will be more time consuming to collect and therefore cost more than fecund, common species with easy to clean seeds.
- For some species it is impossible to give a price by weight in advance, particularly for uncommon species, seed with very light seed, or seed from remote or difficult to access sites. Be prepared to pay for collection based on an hourly rate.
- Be prepared to pay more for seed which has a higher purity and higher seed fill, as this may take longer to clean and process.
- Seed suppliers will generally have a catalogue and set rates for their seed. These rates may be annually reviewed subject to seasonal productivity.
- Keep in mind that you may not be able to afford all the seed you need in one year. If you have an annual budget, you may need to purchase it in stages over several years, and restore your land in sections (e.g. progressive rehabilitation, such as is undertaken in parts of the mining industry), rather than all at once.
- Be aware that seed pricing may differ between contracted and opportunistic collections. Seed that is collected especially for your project at a specific location may cost more than seed purchased from a seed store which was opportunistically collected.

Pre-treatment

A pre-treatment may be applied to the seed prior to incubation or sowing. A pre-treatment may alleviate dormancy and increase germination. In some cases, such as nursery propagation, it is generally beneficial if seeds germinate synchronously. In the field, there may be benefits to synchronous germination, or benefits to augmenting or reinstating a soil seedbank. Pre-treatments depend on the dormancy class of the species, and are often used to mimic the natural environment experienced by the seed between dispersal and germination. Stratification, after-ripening, heat and smoke are all examples of pre-treatments.

- Determine whether or not the seeds need pre-treatment to enable them to germinate, and what the pre-treatment is.
- Determine who will pre-treat the seeds; the collector, the seed bank, the nursery, the restoration practitioner, or yourself.
- Ensure that the person/organisation pre-treating the seeds has the expertise and equipment to be able to do it correctly and safely.

- Some seed pre-treatments may be relatively quick to implement, whereas others could take several months (see Module 11 – Seed Germination and Dormancy). Ensure that seeds are pre-treated at an appropriate time so that they are ready in time for seeding or sowing.
- Put the pre-treatment times into the project timeline.

End use

Seeds can be used for a variety of purposes – for propagating seedlings in a nursery, hand seeding, seeding with machinery, or research. Seed also may need to be stored if it is not going to be used immediately.

Before you purchase your seed, make sure you know what you're going to do with it.

- Are you going to direct seed it or send it to a nursery for propagation straight away? Or do you need to store it? If you need to store it, do you have the correct storage facilities? If not, can the collector keep it in better storage conditions until you need it? (See also Module 9 – Seed Drying and Storage)

Know what the end-use of your seed is, as this will dictate the quality of seed that you are prepared to accept.

- Is the seed for research? If so, pure seed may be easier to work with.
- Is the seed for hand seeding? If so, seed lots containing chaff are probably fine, as long as you factor this into your quantity calculations.
- Will the seed be direct seeded with machinery? If so, will chaff in the seed lot interfere with the machinery?
- Do you have limited storage space? If so, you may want pure, filled seed, so that the seed lot has a smaller volume, and empty seed or chaff doesn't take up precious storage space.

What are your seeding rates (if broadcast or direct seeding)?

- Work them out for each species individually. Some species will need to be sown at higher rates if they are required at higher density and/or if they have lower germination rates. Other species, which have high germination rates, may need to be sown at lower rates so that they don't become dominant in the restoration and out-compete other species. (See also Module 14 – Direct Seeding).
- Always keep good records of your seeding rates, and check which species emerge in your restored area (assess density too, if you can), so that you can adjust seeding rates for next time. Keep rainfall records too, as rainfall may explain inter-annual variation in seedling emergence.

Record keeping

Record keeping is essential for all aspects of the seed supply chain. It will help keep track of seed lots and their quality information, know which seed lots were used for which project and when, ensure that information is not lost when staff leave, and enable adaptive management and continual improvement of methods.

Make sure you have a good record keeping system to record all of the data from each seed lot (see also Module 4 – Record Keeping).

- Record collection location, collection date, viability, seeds per gram, total weight of collection etc. Your seed supplier may be able to pass these details onto you in a format you can continue to add to, such as a spreadsheet or database.
- Ensure that this record keeping system also allows you to track which seed lots are used for which purpose, e.g. field/glasshouse/lab trials, nursery propagation, direct seeding. Therefore, if you have success or failure with a particular species or seed lot you can trace the origin and investigate why.
- Document everything that you learn, i.e. which species emerge in restoration, which don't, results of any trials, propagation tips from the collector or nursery, etc.
- Ensure the seed label also contains all of the relevant information, in case the separate records are lost, and to distinguish between seed lots of the same species. Always ensure the label displays the unique seed lot number.
- Have a knowledge management plan to pass on the information about the seed orders and seed use, should you be temporarily away from, or leave the organisation.

For seed purchasers in Western Australia

- The Revegetation Industry Association of Western Australia (RIAWA) has developed a native seed accreditation scheme. Suppliers can choose to become accredited under the scheme by committing to RIAWA's native seed standards for collection and supply. The standards cover items such as sustainable harvesting, provenance (collection location), processing, storage, seed grading and seed labelling. Seed sold with RIAWA accreditation must have been collected by accredited collectors and sold by an accredited supplier. RIAWA accreditation can provide seed purchasers with peace of mind that they are purchasing seed of known quality. Other states may consider a similar scheme. The RIAWA website also has a public database for seed purity, setting a minimum industry standard for commercial purity.

Licencing and permission

Seeds must be collected lawfully and with the permission of all relevant landowners, including Traditional Owners.

Find out what licences and permissions are required, and make sure that the collector has the appropriate licences and permissions for collecting and selling seed (see Module 3 – Approvals, Principles and Standards for Seed Collection).

- They may need to get permission from multiple landowners. If they are collecting threatened flora, or from multiple sources they may need additional licences or special authorities.
- Ask for copies of their licences/permissions so that you know your seed was collected lawfully, and so you can prove it if anyone wants to check.
- Be aware that some licence conditions restrict the collection/use of seed for particular purposes and seed may not be able to be sold commercially.

Calculating Value for Money Using Testing Data

Calculating value for money to compare different seed lots (from the same or different suppliers) can only be done fairly if the seed of the same species is already collected, processed and quality tested. To do this comparison, you can calculate the price per seed.

For instance, if one seed lot has 100 viable seeds per gram, and another has 250 viable seeds per gram, is it fair to charge the same for them? Purchasers are usually charged per gram of seed. E.g. if the cost is $0.02 per seed, the first batch could be sold at $2 per gram (i.e. 100 x $0.02), and the second at $5 per gram. See equation 1.

$$sale\ price\ (\$\ per\ gram) = number\ of\ viable\ seeds\ per\ gram\ \times cost\ per\ seed$$

Equation 1. Calculating the sale price if quality (viable seeds per gram) is known.

$$cost\ per\ seed\ (\$) = \frac{cost\ per\ gram}{seeds\ per\ gram}$$

Equation 2. Calculating the cost per seed if sale price is known

Here's a worked example on calculating the cost per seed to compare batches. Batch A costs $10 per gram and Batch B costs $50 per gram, therefore on face value Batch A seems to represent the best value for money. However, what isn't factored here is that they have different numbers of seeds per gram, and therefore the value for money differs.

Batch A: $10 per gram, 100 seeds per gram

$$cost\ per\ seed\ (\$) = \frac{\$10\ per\ gram}{100\ seeds\ per\ gram}$$

$$cost\ per\ seed\ (\$) = \$0.10\ per\ seed$$

Batch B: $50 per gram, 250 seeds per gram

$$cost\ per\ seed\ (\$) = \frac{\$50\ per\ gram}{250\ seeds\ per\ gram}$$

$$cost\ per\ seed\ (\$) = \$0.20\ per\ seed$$

Although Batch B costs more per gram, based on this information it is actually cheaper per seed and represents better value for money. However, this does not account for viability. A higher seeds per gram does not necessarily mean it is better value for money as the increase in seeds per gram may be due the presence of lighter or smaller non-developed seed.

If these examples were to take viability into consideration, we would get the following:

Batch A: $10 per gram, 100 seeds per gram, 50% viability

$$cost\ per\ viable\ seed = \frac{\$10\ per\ gram}{100\ seeds\ per\ gram \times 50\%\ viability} = \$0.20\ per\ viable\ seed$$

Batch B: $50 per gram, 250 seeds per gram, 20% viability

$$cost\ per\ viable\ seed = \frac{\$50\ per\ gram}{250\ seeds\ per\ gram \times 20\%\ viability} = \$1.00\ per\ viable\ seed$$

So, considering all the information available, Batch A indeed represents the best value for money. This example shows the importance of gathering all the available information when making purchasing decisions.

Calculating value for money can really only be done when comparing two suppliers of the same species in the same year, if seed is already collected, processed and quality tested. A few points to note however:

- Seed lots with higher quality may have been subject to extra processing time, hence may attract a higher cost.
- In poor seasons where seed fill may be low, the cost of collection (and processing) could be the same as in a good year. Hence, in some circumstances, quality may fluctuate from year to year, but this may not necessarily be reflected in the cost.
- Price also fluctuates according to supply and demand – if supply is high and/or demand is low, the price may change accordingly.
- In some circumstances, seed may not be sold on a $ per gram basis as seed collectors may charge a set price per day for collecting.

The main point to note is that seeds should be sold with quality information, so the purchaser can make informed decisions about purchasing, knows what they've bought and can adjust their seeding rates accordingly.

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Online resources

Revegetation Industry Association of Western Australia
https://www.riawa.com.au

Seed Information Database, Royal Botanic Gardens, Kew
https://data.kew.org/sid/

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