

# NEW BIOSPHERE AGRICULTURE

## Seed Bank



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## Seed seekers bank on success

Lesley Parker | July-5-2010



Roughly a quarter of all the world's plant species face the threat of extinction and scientists are working hard to preserve the future of our nation's flora.

**IT'S A RACE AGAINST** time. One more really warm day and the little black prizes the seed chasers are hunting will have been ejected from the rare boronia. Gone for another year. As with many plants, there is only a small window of opportunity to find *Boronia angustisepala* seeds. Any seed gathered by the two collectors must have remained on the plant until mature enough to survive on its own, yet they must capture it before it's scattered over the ground. One danger is that the seed will ripen too quickly for them to reach it in time. Another is that the sort of bushfire that ripped through this area five years earlier will wreck their plans.

Richard Johnstone and Graeme Errington have come to Gibraltar Range National Park, in northern New South Wales, with a shopping list of native seeds they hope to collect for storage at the NSW Seedbank, based at Mount Annan Botanic Garden in Sydney - and to send a copy sample to the Millennium Seed Bank (MSB) in England. From their four-wheel-drive packed with expedition gear - the four volumes of Flora of NSW alone weigh some 8 kg - Richard and Graeme head for a spot off the Dandahra Crags track.

They'd checked this location in spring based on research showing that they were likely to find *B. angustisepala* there. Sure enough, they'd found the boronia's showy pink flowers and estimated the seeds would be ripe in mid-December. *B. angustisepala's* tiny black seeds shoot out like bullets - the fruits forcibly squeeze them out - and can travel 1-2 m from the plant, far enough to be impossible to find once they have been dispersed.

"It would be lost - not to nature, but to us," Richard says. "We line things up in the flowering period because they're much easier to see. Then we go back and can see precisely where they are, even if the flowers are gone and they've become harder to spot."

Armed with a GPS, Graeme and Richard spend an hour walking the track and scrambling up and around rocks and boulders to reach the site. They turn up many more of the boronia plants than they did in spring, including a large number of immature specimens. It shows the population is healthy and reproducing well. Invasive weeds such as Crofton and lantana, which are known elsewhere in the park, aren't evident here.

The duo has arrived in the nick of time: Richard estimates the seeds would have popped within a few days. "Probably the next hot day," he says. It's relatively easy picking. Although the collectors have had to look hard to find the fruit, the walk hasn't been arduous. It's sunny and the small shrubs are little more than a metre high: no climbing or pruning poles required here.

However, because the plants don't have many fruits, the pair takes as few as five and no more than 20 seed capsules off each of about 50 of the 70 or so plants present. That will probably mean about 100 seeds once the material is cleaned and sorted back at the NSW Seedbank - a reasonable, but not overly rich, collection.

At this stage, the collectors' biggest enemy is rain. "It's essential when you're collecting seeds to keep them dry and cool," Richard says. "If you get them wet, they prematurely age or they rot." Soon the specimens are in a paper bag bearing the species' name and the number RJ2717 - Richard Johnstone's 2717th collection for the NSW Seedbank. At the end of the expedition, the paper bag is transported carefully to Mount Annan. Some seeds will be kept for study and others will travel 17,000 km to the other side of the globe.

### **Rescued from extinction**

Since the late 1980s, the NSW Seedbank has collected seed from about 30% of threatened plant species and nearly 40% of known plant species in the State. Mount Annan is part of Sydney's Botanic Gardens Trust (BGT), a cog in the huge global effort known as the [Millennium Seed Bank Project](#) (MSBP), based at Wakehurst Place, in southern England, to conserve the valuable genetic material held within wild plant seeds.

Seed banking involves collecting and storing seed from plants. It is both an insurance policy against extinction and a source of high-quality material for the restoration of habitats. It's labour-intensive work but is cost effective - it is estimated an average of AU\$5,000 is needed to save a species from extinction. The NSW Seedbank received an injection of funds from the State Government in 1999 and a major boost from the MSB upon joining its program in 2003. More recently, HSBC Bank Australia became a major BGT supporter and part of its funding was directed to seed banking.

What's learnt in the seed-banking process also aids the understanding and management of species in the wild. So far, MSB has banked seeds from 10% of the world's known wild plants, more than 24,000 species, including 12 now extinct in the wild. Its next target is to have saved seeds from 25% of plant species by 2020. Roughly a quarter of all the world's plant species face the threat of extinction, but twice that number could be at risk should the average planetary temperature rise 2-3°C, as climate change experts predict. Of Australia's 25,000 species, 23% are under threat.

"Our partnership with the Millennium Seed Bank means we can provide a lifeline for plants most at risk of extinction," says Dr Tim Entwisle, the BGT's executive director. "Our native flora is under threat from climate change, salinity, invasive weeds and landscape fragmentation, and seed banking is the kind of thing the Royal Botanic Gardens in Sydney has been doing for more than 190 years - right back to our first alliance with the Royal Botanic Gardens at Kew through Sir Joseph Banks."

Not all seed is physically suited to banking, however, and there's no point collecting and storing seed unless you can be sure it is living material and will survive long periods in storage. Many rainforest species, for example, don't take well to the drying process, and overcoming such obstacles is one of the goals of the research. It's also necessary to know how to break the seed's dormancy and germinate it - something that's not necessarily a simple case of 'just add water'.

"For many years, we were concerned about seed banking because there was this concept of whether we had a gene bank or a gene morgue," says Dr Cathy Offord, manager of horticultural research at the BGT. She says the knowledge and techniques built up during the past decade have "enabled us to be confident to say that we can successfully collect the majority of species that grow in NSW". Still, some species

continue to perplex. "There are still a lot of challenges," she says. "We could spend several lifetimes even on just one or two species."

### **Bag of tricks**

At Mount Annan, seed technology officer Leahwyn Seed (yes, really) tips the contents of the paper bag into a brass sieve. She removes larger material, such as sticks and leaves, and looks for insects. "You'd be amazed how long insects can live in the drying room," she says. Some seeds are already free of their casings, and the warmth of the room is causing others to pop, so it's quickly back into the bag and off to the drying room.

After a couple of weeks, most of the seeds have worked themselves free and it's time for further sieving and, if necessary, manual seed removal. *B. angustisepala* can be prised open with the fingers, but for other species Mount Annan uses techniques such as the 'banksia barbecue' - a blowtorch providing the heat necessary to get species such as banksias to release their seeds.

Separated from the waste material, the *B. angustisepala* seeds go into a jar and are returned to the drying room. The room is set at a cool 15°C and a dry 15% humidity and the seed may remain in here for weeks, even months. The lower the moisture content (preferably just 7%), the better they are able to survive long-term storage in the freezer.

Once drying is completed, some of the seeds are separated to test viability. Seed research officer Dr Amelia Martyn says boronias have some of the most difficult seeds to germinate. In research just published, Amelia and the Mount Annan team looked at 112 species in the *Rutaceae* family, of which boronias are part, and found that the presence of an embryo and endosperm - referred to as 'seed fill' - could vary from 0 to 100%. "Not all seed that looks good to the eye is filled," she says. "Even if you think you have 100 seeds in your hand, the seed fill might be as low as 20 or 30 seeds."

And even that handful of seeds still might not be viable. "Sometimes things happen while the seed is still being formed and they don't finish maturing," she says. In her study, 80% of seed collections had more than 25% unhealthy seeds. Some had no viable seed at all. To check seed fill and viability, some of the *B. angustisepala* seeds are sliced in half and examined under the microscope. One seed had a small hole – a sign of insect predation. Another was crumbled inside, but a third was healthy: white and full. Seed viability can also be checked with a stain test, during which live tissue shows as pink.

Next, the seeds have a germination test. Amelia's research shows that germination of boronia seeds can be significantly improved by using a combination of smoke water (water with smoke from burned vegetation bubbled through it) and the plant hormone gibberellic acid. (Applying these to seven different boronia species improved germination from 0-25% to 27-100%.) Ten *B. angustisepala* seeds are soaked for 24 hours in laboratory-made smoke water from Kings Park and Botanic Garden, in WA. The seeds are then placed on a plate of laboratory growth medium, known as agar, which incorporates gibberellic acid, and is placed into an incubator where the temperature is set to the equivalent of spring conditions in the Gibraltar Range.

Amelia says the results from other boronia suggest it may take from fifty to a couple of hundred days for germination. If the test is successful, the seedlings will be potted and nurtured in the Mount Annan

nursery, possibly one day making it into the gardens' display. Species that germinate well are also tested for seed longevity in an accelerated ageing test. Here, the seed is stored in an incubator at 45°C and 60% humidity and monitored to see how long it survives under these harsh conditions. That allows a prediction of its likely survival in the MSB freezers - and of the time when a new collection may be needed.

### **Freeze frame**

Before final packing, the seeds of each species are counted - by hand if it's a small collection or by weight for larger lots. Some are separated for testing and the rest go into two vacuum-sealed foil packs: one for the NSW Seedbank to keep; the other, as a fail-safe, to be air-freighted to the MSB, with a pressed botanical specimen made by the collectors at the time they gathered the seed.

Mount Annan's foil pack of *B. angustisepala* goes into a walk-in freezer set at -18°C, a temperature that will slow the seeds' metabolic activity and prolong their lives. The seed from some species may survive just 10 years under these conditions; others - such as wattle seed - may have a life of 1,000 or more years. In the meantime, the NSW Seedbank will move into a new phase.

"In this next phase we'd like to extend the genetic diversity in our collection," says Peter Cuneo, BGT's seedbank manager. So, rather than just collecting *B. angustisepala* from the Gibraltar Range, specimens might be collected from other places where it occurs. This diversity will be vital because seed banking is used for ecological restoration, Peter says. "Seed knowledge, I believe, is going to be quite critical over the next couple of decades."











## Seed Banks Around the World

Joel Nito/AFP/[Getty Images](#)

An employee at the International Rice Research Institute (IRRI) sorts out rice seeds prior to deep freeze storage at the IRRI rice germplasm bank in Laguna.

As stated earlier, there are more than 1,000 seed [banks](#) located all over the world. We obviously don't have the time or space to discuss each one here, so let's focus on a few of the major facilities.

The **Svalbard International Seed Vault**, also known as the Doomsday Vault, opened for storage in February 2008. It is located deep in the side of a frozen arctic mountain in Longyearbyen, [Norway](#), and can weather any disaster from



bombings to [earthquakes](#). The Global Crop Diversity Trust and the Consultative Group on International Agricultural Research (CGIAR) worked together to collect and organize samples from seed banks all over the world to be stored in the underground vault. Researchers chose its location -- remote yet accessible -- because of its climate and geology, both of which are optimal for cold storage [source: [Fowler](#)].

Rather than acting as an active seed repository, the Doomsday Vault is a global backup system for the planet's plant resources. The seeds in the vault are stored under "black box" arrangements, meaning that overseers of the vault will never open or test any of the seed packages. In fact, security is so tight that no single person possesses all the codes necessary to enter the vault [source: [Rosenthal](#)]. The responsibility for replacements and additions lies solely with the organization that provided the seeds in the first place [source: [Global Crop Diversity Trust](#)]. All major banks have contributed seeds, including all banks operated by CGIAR [source: [Svalbard FAQ](#)].

The Norwegian government funded the construction of the vault, and the Global Crop Diversity Trust is responsible for the annual operating costs [source: [Svalbard FAQ](#)].

The **Millennium Seed Bank Project** (MSBP) is located at the Royal Botanical Gardens, Kew, [United Kingdom](#). Its goal is to eventually store and protect more than 24,000 global species of plants. It currently stores samples of the country's entire native plant population, including several hundred endangered species [source: [Millennium Seed Bank Project Fact Sheet](#)]. The MSBP collaborates with other seed banking organizations around the globe by sharing information or assisting in seed collection. Seeds remain in their country of origin, but the Kew location stores duplicates for backup [source: [MSBP](#)].

Public and corporate donations, as well as grants and endowments, fund the MSBP [source: [MSBP](#)].

The **Vavilov Institute of Plant Industry** was established in 1894 in St. Petersburg, [Russia](#), and is the oldest seed bank in the world. Nikolai Vavilov, for whom the institute is named, was a Russian biologist and plant breeder. Vavilov was one of the first scientists to understand the importance of crop diversity and played a major role in raising awareness of the importance of genetic conservation. The institute is the only facility of its kind in Russia. Its global collection contains hundreds of thousands of specimens [source: [VIR](#)].

The institute has recently been in need of funding and has received grants in the past from the Global Crop Diversity Trust [source: [Global Crop Diversity Trust](#)].

Here is a sampling of other seed banks around the world:

- **Berry Botanic Garden** (Portland, Ore.): Seeds from endangered plants of the Pacific Northwest.
- **International Center for Tropical Agriculture** (Cali, [Colombia](#)): Cassava, forages, beans.
- **International Potato Center** (Lima, [Peru](#)): Potatoes.
- **International Institute for Tropical Agriculture** (Ibadan, [Nigeria](#)): Groundnut, cowpea, soybean, yam.
- **International Rice Research Institute** (Los Banos, Philippines): Rice.

## Why are seed banks necessary?



China Photos/Stringer/[Getty Images](#)

A farmer passes his hand over corn. Corn comes in many different varieties, depending on climate and region.

Although you might think the concept is rooted in the contemporary "green" movement, seed [banking](#) is not a new phenomenon. Scientists believe agriculture began as far back as 8000 B.C., in the mountains of Mesopotamia, now present day [Iraq](#). Even then, farmers realized their seeds needed protection in order to ensure the next year's harvest. As

a result, seed harvesting was one of the most important rituals in ancient farming communities. In Iraq, scientists have discovered evidence of seed banks from as far back as 6750 B.C. [source: [Seabrook](#)].

Back then, seed banks protected seeds from animals and extreme weather. Today, we store seeds for different reasons. The most essential reason is **crop diversity**. Just as humans have specific genetic traits, so do plants. And just as humans have evolved and adapted to specific conditions over time, so have plants. Different varieties of plants are suited for different things. A good example is corn. Corn is grown in different parts of the world and in different climates, which creates many varieties of corn [source: [Rosenthal](#)].

This sort of diversity must be preserved -- not because we need 50 varieties of popcorn, but because we don't want to lose any plants that may prove valuable in the future. For example, in the 1970s a widespread fungus cut United States corn yields in half. The blight was alleviated by use of genetic materials from a wild corn relative that was fungus-resistant [source: [WWF](#)].

### Crop Diversity and the Irish Potato Famine

The Irish Potato Famine of the 1840s devastated Ireland's population and economy. We know now that if Ireland's potato crop had been more diverse, famine may have been averted. Irish potatoes in the 1800s were mostly genetic clones of each other and therefore susceptible to the same diseases. If [Ireland's](#) crops had been more genetically diverse, certain varieties would have been disease-resistant, which could have prevented catastrophe. Scientists have since found a resistant strain in [South America](#) that now grows alongside the other potatoes [source: [Understanding Evolution](#)].

Aside from crop diversity, there are many other reasons we need to store and preserve seeds:

- **Climate change:** Scientists are concerned that climate change will cause extreme weather conditions and bring new pests into some environments. These events could cause certain species of plants to go extinct [source: [Rosenthal](#)].

- **Natural disasters:** Natural disasters can wreak havoc on a region's ecosystem. After the 2004 [tsunami](#) destroyed rice paddies in [Malaysia](#) and [Sri Lanka](#), international seed banks provided local farmers with varieties of rice to begin growing their crops again [source: [Roug](#)].
- **Disease:** Disease quickly and easily wipes out crops. For example, a recent strain of disease called stem rust (Ug99) may have the capability to infect up to 25% of the world's wheat supply [source: [Singh](#)].
- **Man-made disaster:** Man-made disasters can be as devastating to plant life as natural disasters. An obvious example would be war. In fact, one of Iraq's vital seed banks was looted during fighting [source: [Pearce](#)].
- **Research:** Indigenous people have used plants to cure sickness for centuries. One in every six wild plants is used for medicinal purposes [source: [Levine](#)]. Who knows what diseases the right plant or herb could eradicate?

Now that we understand why seed banks are necessary, let's learn which seeds get banked. Are all plants guaranteed a spot in the seed bank or are some deliberately shunned?

## How are seeds stored in banks?

A **genetically modified organism** (GMO) is an organism -- in this case, a plant -- that has had its DNA altered to achieve a different or improved product. Opponents of GMO crops claim scientists know little about the long-term effects. Proponents point out that farmers have been genetically modifying crops for centuries, through grafting and hybrids [source: [Pogash](#)]. At this time, the Svalbard Vault prohibits the storage of genetically modified plants, but the very concept of crop diversity and seed banking allows access to continued creation of GMOs. So in Svalbard's case, it seems like both sides win [source: [Svalbard FAQ](#)].

### Plant DNA

Seed collection, organization and storage will vary by seed [bank](#) facility. Let's take a look at how one facility manages its library of seeds to get a taste of how it's done. The following steps display how the Department of Environment and Conservation, a local organization in [Australia](#), banks its seeds:

- First, researchers decide what seeds to collect. Generally, they give priority to threatened plants.
- After plants are located, seed collection begins. Seeds are most viable for collection and storage when ripe. In the case of fruits, most release their seeds when ripe. However, some plants will retain their seeds for extended periods, which allows a longer collection time. Other plants might seed irregularly, and thus require repeat visits.
- Researchers collect the seeds manually with tweezers, pole cutters, seed traps or nets and buckets, depending on the type of plant.
- For each collection, they record details like location, plant description, habitat, soil type and other information. This information provides data about the local plant population and ensures optimal replanting conditions.
- Collectors then assign each sample a unique number.
- Collectors clean each sample to ensure high quality. Seeds can be cleaned by shaking them through a sieve or with a machine that blows air on them.
- To reduce the moisture content of the seeds, collectors dry them in a temperature- and humidity-controlled room. Afterwards, they place the seeds in sealed, airtight containers.

- The final storage step is to freeze the seeds at minus 4° Fahrenheit (minus 20° Celsius).

[source: [Nature Base](#)]

Difficult-to-store seeds may respond better to **cryopreservation**, or in-vitro storage. For example, the banana plant doesn't produce seeds, so alternative storage methods are necessary. **In-vitro storage** means that living plant tissues are stored, rather than seeds. Scientists then place these living tissues in liquid nitrogen -- around minus 320° Fahrenheit (minus 196° Celsius) -- to ensure better long-term storage [source: [Bioversity International](#)].

Although shelf life varies from crop to crop, most seeds can survive in cold storage for decades and some even longer. Eventually, though, all seeds will die. Before this happens, scientists remove seeds from storage and plant them to harvest and re-bank fresh seeds.

With all these seeds in storage, who gets ownership of the seeds? Usually the owners of the seed banks control their own seeds. But in the case of the Svalbard Vault in [Norway](#), depositors retain possession rights of the seeds they place in the bank [source: [Svalbard FAQ](#)]. Of course, these ownership rights don't preclude one country lending seeds to another country in need.

## What seeds are stored in banks?

Domino/[Getty](#) [Images](#)

A person holds seeds in a soy bean field.

A seed [bank](#) is only as good as the seeds it houses. Our planet hosts millions of varieties of plant species. Who decides which types of seeds should be stored? All of them? Only the "best" ones? How deep is this library of seeds?

There are about 1,400 seed banks around the world, so which seeds get chosen for storage varies from location to location. Local seed banks may focus on the storage of indigenous wildflowers or specialty vegetables, for example. Other banks have a more global focus. For example, the **Global Crop Diversity Trust** concentrates solely on a selection of priority crops determined to be the most globally beneficial. These crops include but are not limited to the following:

- Apple
- Banana
- Barley
- Bean



- Carrot
- Coconut
- Eggplant
- Lentil
- Maize
- Oat
- Pea
- Potato
- Rice
- Strawberry
- Sweet potato
- Wheat

[source: [Global Crop Diversity Trust](#)]

#### Marijuana Seed Banks

Type the words "seed bank" into the [Google](#) search engine and you'll see the first few pages of results are almost exclusively about [marijuana](#) seed banks. Are marijuana seeds included in global seed vaults? The answer to that last question is "yes," as scientists are attempting to make a Noah's Ark of seeds -- a few of everything. However, many of these marijuana seed bank Web sites don't have anything to do with saving the planet. These seeds are for sale for people looking to grow marijuana. The sites claim to offer this information only for countries where growing marijuana is legal; but they also advise against making any purchases with a traceable credit card. Ahem.

The Global Diversity Crop Trust works within the framework of a treaty intended to help conserve crop diversity worldwide. This treaty -- The **International Treaty on Plant Genetic Resources for Food and Agriculture** (PGRFA) -- was ratified by 40 governments in 2004 and established a global system to provide farmers, plant breeders and scientists with access to plant genetic materials, such as seeds [source: [PGRFA](#)].

The PGRFA permits access to these seeds for the purposes of research or agriculture, as long as the results are beneficial to all. Under the authority of the treaty, the **Consultative Group on International Agricultural Research** (CGIAR) holds the collections [source: [CGIAR](#)]. The reason all these organizations are necessary is that the task of managing seeds from every single country in the world is a daunting one. But crop diversity cannot be properly maintained unless seeds and plants are collected from different regions.

At these local and international seed banks, do the poisonous plants get a spot? The answer is "yes." Although it may seem dangerous to bank the seeds of poisonous or invasive plants, there's always the possibility of undiscovered uses for a plant. Kudzu, for example, is considered to be one of the most invasive and destructive plants in the [southern United States](#). However, some researchers are starting to look into the feasibility of using kudzu as a biofuel. Is it possible this rapid-growing vine could one day provide clean fuel for our cars? Only time will tell [source: [Gjerstad](#)].

## ANBG Seed Bank

Australian National Botanic Gardens



<http://www.anbg.gov.au/anbg/seed-bank/index.html>

Seed banks are increasingly being seen as an important conservation tool for maintaining the diversity of the Australian Flora. Large quantities of genetic material can be stored in a very small space in a seed bank. Compare the amount of space taken up by 10 *Eucalyptus* seeds with 10 *Eucalyptus* trees. It can be stored for very long periods of time if the conditions are suitable. Seed provides genetic diversity not found in cloned material (cuttings). Many plants cannot be propagated from cuttings and must be propagated from seed. Emphasis is placed on threatened species.

There are two main types of seeds based on their storage characteristics. Orthodox seeds which can be dried and stored frozen and recalcitrant seeds which cannot tolerate severe dehydration and so cannot be preserved using these traditional methods. The ANBG Seed Bank only stores orthodox seed.

The Seed Bank is one part of the Living Collection of the ANBG. The ANBG is currently the custodian of one of the largest collections (in terms of species) of seed of Australian native species with about 4,500 accessions from 2,300 taxa. It houses its own collection of seeds of threatened species which acts as a form of ex situ conservation, for the preservation and reintroduction of threatened species.

The Seed Bank consists of a fully equipped laboratory, a drying, cleaning and packaging area and a freezer (minus 18 degrees) for seed storage.

### Functions

1. To supply seed to the nursery to produce seedlings for planting at ANBG.
2. To act as a genebank for long term storage of rare and threatened flora.
3. To supply seed to other institutions through our plant release program.

### How to request seed

Seed is supplied for approved projects at other botanic gardens, universities and similar institutions. It is not supplied to private individuals. For information about obtaining seed from the ANBG see <http://www.anbg.gov.au/anbg/permits/plant-release/>



-18°C freezer

Applications for seed of species listed as threatened under the EPBC Act are assessed separately (<http://www.environment.gov.au/epbc/about/lists.html>)

## Using the Database

Seed records in the ANBG's IBIS database can be found at <http://www.anbg.gov.au/anbg/seed-bank/test-database.html>

## Managing the Seed Bank

### Seed collecting

Seed is collected by ANBG staff and collaborators under permits issued by State and Territory organisations or by written permission of private landholders. Herbarium specimens are collected at the same time as the seed and the provenance details are entered into IBIS, the ANBG database for all its collections.

### Fumigation and drying

Upon receipt seed is fumigated with carbon dioxide then dried at 20°C.

### Extracting seed

Fruits may be opened by drying e.g. *Acacia*; using tools e.g. *Macadamia*, or by heating e.g. *Banksia*.

### Identifying the seed

The seed is distinguished from chaff, fillers and dividers at this stage. Sample seeds are cut in half to identify good quality seed and check the percentage seed set.

### Seed cleaning

This can be done using sieves, blowing machines or by hand. Volunteers play an important role in this aspect of the work.

### Packaging

The cleaned dried seed is sealed into moisture-proof containers.

### Storage

Short term – room temperature or 4°C

Medium term – less than 0°C, 3-7% moisture content





Long term – less than -18°C, 3-7% moisture content

### **Germination testing**

On receipt of the seed an initial germination rate should be measured and subsequent tests at suitable intervals for the expected longevity of the seed e.g. after 5, 10, 15 etc years.

### **Regeneration / recollection**

The interval depends on the longevity of the seed. Ideally it is done when the viability falls to 85% of the initial value.

### ***Partnerships***

The ANBG Seed Bank is a co-partner in [Florabank](#), a [Natural Heritage Trust](#) initiative set up by [Greening Australia](#) to provide links between all native seed banks in Australia (<http://www.florabank.org.au/>).



## SEED and NURSERY

<http://www.greeningaustralia.org.au/our-services/seed-and-nursery>

**GREENING AUSTRALIA** operates commercial and non-profit seedbanks and native plant nurseries in locations across Australia, servicing the needs of commercial clients, community groups and revegetation projects. We can also help you with seed collection, identification and supply services.

Greening Australia also delivers Florabank, Australia's premier resource for native seed information, supply, training and industry best practice. Visit the Florabank website for resources and more information.

For a snapshot of the Seed and Nursery services we offer in your State or Territory, and a direct contact for someone to discuss your needs with, please use the services list below.

More detail on services we offer in areas where fee-for-service work plays a bigger role in our vision for landscape change, see the menu on the right.

### Capital Region OUR SERVICES

#### Seed bank

Australian National Botanic Gardens, Clunies Ross Street, ACTON ACT  
Community Nurseries - Stephen Bruce  
Email Stephen

#### Seed production areas - Bindi Vanzella

Phone: 02 6253 3035      Email Bindi

#### Provenance seed bank and supply - Bindi Vanzella

Phone: 02 6253 3035      Email Bindi

#### Nursery network

##### Greening Australia Nursery - The Gap, Brisbane

The Greening Australia Nursery is a vibrant community project. Our main roles are to propagate and grow native plants for South-East Queensland, and to provide extensive advice to the community on growing native plants. We have thousands of plants in stock, with 350 species providing a greater variety than ever before. We also grow plants to order for all sorts of projects, whether small or large. For more information, visit our comprehensive website.

**Greening Australia Nursery - The Gap, Brisbane**

Contact: Gavin Magarry - Nursery Manager

Phone: 07 3300 6304

Email the Nursery [nursery@qld.greeningaustralia.org.au](mailto:nursery@qld.greeningaustralia.org.au)

**Greening Australia Dry Tropics Nursery - Pimlico, Townsville North Queensland**

Our Dry Tropics nursery is a wholesale and retail nursery, which, as its names suggests, specialises in dry tropics native plants. All seed is sourced locally and the nursery propagates hardy, drought tolerant grasses, vines, herbs, shrubs and trees. The nursery provides a comprehensive information service to the local community on managing native vegetation. The nursery is open every Thursday from 12 noon to 4pm and on the first and third Saturday of each month, from 9am to 1pm. You can find the nursery at Pimlico TAFE (rear entrance), Desailly Street, Pimlico.

Contact: Belinda Bickley - Nursery Manager

Phone: 07 4796 0444

Email the Nursery

**Greening Australia Seed Bank - Rockhampton**

Seed Services

Seed collection - Central Queensland mature species  
Seed Collection by request  
Seed storage and distribution  
Seed viability testing  
Species lists

Plant Services

Sourcing of plants required for special projects

Phone: 07 4923 7542

Seedbanks

Melbourne Indigenous Seedbank: David Lockwood

Phone: 03 9250 6863

Email David

Maffra Seedbank: Bronwyn Teesdale

Phone: 5662 5201

Email Bronwyn

Nth East Seedbank: Sean Guinane

Email Sean

Portland Seedbank: Doug Phillips

Phone: 03 5523 6839

Email Doug

Western Australia

**AUSTRALIAN NATIVE SEED SUPPLIERS**<http://anpsa.org.au/seedsupp.html>

The following information has been compiled from details supplied by the various suppliers. All companies supply overseas customers unless otherwise indicated.

**OVERSEAS GROWERS PLEASE NOTE:**

•Many countries require Phytosanitary Certificates to accompany any consignment of seed to certify that the seed is free of disease and insect/fungus pests. Companies which export seed will arrange for the necessary documentation, however, the cost will be passed on to the customer. The cost varies depending on the company involved but would be at least \$AU40. Anyone ordering from overseas should check the import requirements of their own country and, when ordering, ensure that the company is advised if a Phytosanitary Certificate is needed.

•To telephone or fax any of the companies from overseas, dial your International Access Code, then dial the Australian Country Code (61), then the Australian phone number without the first zero. For example, to dial the Australian phone number (02) 747 1555 from the USA, you would dial 011 61 2 747 1555 (you would then be connected to Dial A Prayer in Sydney!).

If you contact any of these suppliers, please let them know where you found out about their services.

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 Arbor Australis  
 9B Brunei Place,  
 GRAFTON, NSW, 2460

Hardwood, rainforest and riparian tree species from temperate and sub-tropical east coast. The company can supply seed for forestry projects, the revegetation rehabilitation/landcare works of degraded lands and general horticulture. Both bulk and small lots supplied, as well as customised collecting. Phone or Fax (02) 6643 5018. Mob: 0402 907312. E-mail: [pfinnovations@optusnet.com.au](mailto:pfinnovations@optusnet.com.au)

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 Australian Bush Products  
 PO Box 131,  
 STRATHALBYN, South Australia, 5255

This company specialises in seed of South Australia and, in particular, that of the Murray Mallee, Lakes and Plains districts. Seed from all regions of South Australia and selected species from interstate are also available. The company supplies seed in quantities suitable for the home gardener, nurseries, farmers and schools. Phone (08) 8532 2698. Email: [ausbush@internode.on.net](mailto:ausbush@internode.on.net)

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 Australian Native Seeds Online

Located in Perth, Western Australia, Australian Native Seeds Online has access to a wide variety of Australian native seeds and specialises in those plants that are endemic to that region.

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Australian Seed Company  
PO Box 67,  
HAZELBROOK, NSW, 2779

This company supplies seed from a wide range of Australian trees, shrubs, ground-cover plants and wildflowers. Over a thousand Australian native species are represented, particularly from temperate and cooler regions and arid zones. The company has exported seeds world-wide since 1957 and regularly supplies many nurseries and Government organisations within Australia. Phone (02) 4758 6132; Fax (02) 4758 7022.

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Australian Wildflower Seeds Pty Ltd  
PO Box 3139,  
CARLISLE SOUTH, WA, 6101

Based in Perth, Australian Wildflower Seeds package and distribute seeds of native plants in small retail packets to retail nurseries and other retailers around the country. The company also provide a mail order service to individual customers around Australia and overseas. Phone (08) 9470 6996; Fax (08) 9470 6999; Email [wildseed@westnet.com.au](mailto:wildseed@westnet.com.au)

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AustraHort Pty Ltd  
PO Box 595,  
CLEVELAND, QLD, 4163

AustraHort supplies both bulk and small lots of Australian plant species including seeds and seedlings of trees, shrubs, palms and pasture seeds. The company can supply seed for forestry projects, the revegetation of degraded lands and general horticulture. Seed can be ordered using the on-line catalogue. Phone (07) 3821 0745; Fax (07) 3821 0746; Email: [info@austrahort.com.au](mailto:info@austrahort.com.au)

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Ballarat Region Seed Bank  
PO Box 3,  
CRESWICK, Victoria, 3363

The Ballarat Region Seed Bank (BRSB) was established in 1994 at the Victorian Land-care Centre, Creswick. With many years experience in the seed industry the seed bank has consistently demonstrated

its ability to deliver appropriately sourced indigenous seed for re-vegetation works throughout the seed bank service area. The seed bank has continued its operations on the site and now also co-ordinates seed supply for the Wimmera Region in partnership with the Wimmera Catchment Management Authority. An online catalogue is available for download from the website.

Phone (03) 5345 2200; Fax (03) 5345 1357; Mob 0428 570 243; Email: [andrew@seedbank.com.au](mailto:andrew@seedbank.com.au)

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Banksia Farm  
PO Box 132,  
MOUNT BARKER, Western Australia, 6324

Banksia Farm is an interpretative retreat for tourists, wildflower enthusiasts, botanists, Banksia lovers and students alike. It boasts the world's only full collection of all Banksia species. Most of these are well established specimens and many have flowered. Banksia Farm's facilities, products and services include a gallery, seed supplies, nursery and accommodation. On line seed list available.

Telephone/Fax: (08) 9851 1770. Email: [banksia@comswest.net.au](mailto:banksia@comswest.net.au)

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Diversity Native Seeds  
COONABARABRAN, NSW.

Diversity Native Seeds supplies a wide range of native seed including tree, shrub, grass and wildflower species. Phone (02) 6842 2959. Email: [info@diversityseeds.com.au](mailto:info@diversityseeds.com.au)

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Ellison Horticultural Pty Ltd  
267 Rous Road,  
ALSTONVILLE, NSW 2477

Ellison Horticultural is an established supplier of tree, shrub and palm seed and seedlings. Phone (02) 6629 5788; Fax (02) 6629 5766. Email: [sales@ellisonhort.com.au](mailto:sales@ellisonhort.com.au)

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Envirohort (Environmental Horticulture Australia)  
PO Box 4036  
SOUTH BUNDABERG, Queensland, 4670

Specialising in collection and distribution of seeds for horticultural and environmental purposes. Phone ( 61) 07 4155 6204; Fax ( 61) 07 4155 6986; E-Mail : [seeds@envirohort.com](mailto:seeds@envirohort.com)

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GHEMS Revegetation Environmental  
4 Duffy St,  
BASSENDEAN, WA, 6054

Producers and suppliers of all Australian tree, shrub, and pasture seeds. All relevant provenance information available with each seedlot. Seed treatment available e.g. scarification, smoke. Catalogue available. Consulting and contracting services for mine rehabilitation, civil projects, and international agricultural/rehabilitation project management and tenders.

Tel: (Aus 08)(Internat +618) 9373 7100  
Fax: (Aus 08)(Internat +618) 9373 7111  
Email: [enviro@ghems.com.au](mailto:enviro@ghems.com.au)

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Goozeff Seeds  
PO Box 3022,  
NORTH NOWRA, NSW, 2541

Goozeff Seeds is a wholesale seed company supplying a wide range of Australian native and exotic tree, shrub, grass and palm seeds. The company also supplies seed of aquatic plants on request. Seed is currently supplied to Asia, New Zealand and the USA. Phone or Fax (02) 4421 0731; Email: [admin@goozeffseeds.com](mailto:admin@goozeffseeds.com)

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Greening Australia NSW  
Nth Coast Farm Forestry Nursery,  
PO Box 227,  
DORRIGO, NSW, 2453

Hardwood, rainforest and riparian species for forestry, rehabilitation/landcare works. Small or bulk quantities, Rainforest seedlings. Excellent viability, provenance collections, all documentation supplied. Collections to order, Sydney to Queensland border, order form and catalogue available for seed in stock.. Phone (02) 6657 2411; Fax (02) 6657 2074; Email: [gancoast@midcoast.com.au](mailto:gancoast@midcoast.com.au)

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Harvest Seeds & Native Plants  
281 Mona Vale Road,  
TERREY HILLS, NSW, 2084

Harvest Seeds collects, supplies and exports an extensive range of native and exotic tree, shrub and wildflower seeds and offer Grow-Cell seedlings and plants including native grass seedlings. Species endemic to the Sydney area are a specialty. A comprehensive seed catalogue and periodical seedling/plant

list are available. Phone (02) 9450 2699; Fax (02) 9450 2750; Email: [marina@harvestseeds-nativeplants.com.au](mailto:marina@harvestseeds-nativeplants.com.au)

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R and K Horner  
1 Grundy Street,  
ALICE SPRINGS, Northern Territory, 0870

This company specialises in seeds of plants from central Australia. Phone or Fax (08) 8952 8583.

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Native Seeds Pty Ltd  
34/148 Chesterville Road,  
CHELTENHAM, Victoria 3192

Native Seeds specialises in growing and selling high quality seed of Australian native grasses and a range of other native species. Phone (03) 9555 1722 ; Fax (03) 9555 1799; Email: [enquiries@nativeseeds.com.au](mailto:enquiries@nativeseeds.com.au)

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Nindethana Seed Service  
PO Box 2121,  
ALBANY, Western Australia, 6331

Nindethana Seed Service is part of Greening Australia (WA) and supplies a large range of Australian native plant seeds, with over 3000 species available. The company caters for both the amateur grower by supplying small packets and the commercial grower with bulk supplies of most species. Seed Catalogue and Shopping Basket ordering system available online. Phone (08) 9844 3533; Fax (08) 9844 3573; Email: [nindseed@gawa.org.au](mailto:nindseed@gawa.org.au)

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Royston Petrie Seeds Pty Ltd  
14 Industrial Avenue,  
P.O. Box 1152 MUDGEE, NSW, 2850

Royston Petrie is a wholesale supplier to revegetation companies, forestry plantation companies, nurseries and the general public located within Australia and overseas. Stock includes Australian native trees and shrubs, native grasses and ferns, exotics, flowers, proteas and herb seeds. Hours - 8.30am to 4.30pm Monday to Friday  
Phone (02) 6372 7800; Fax (02) 6372 7077; Email: [roseed@bigpond.net.au](mailto:roseed@bigpond.net.au)

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Rural Conservation Service  
PO Box 136,  
QUEANBEYAN, NSW, 2620

Rural Conservation Service mainly supports large scale projects on the southern tablelands and the south west slopes of New South Wales and the Canberra region. Its main activities are native seed collection, seed collecting demonstrations, provenance seed collections, nursery services, whole farm planning and supply of export quality seed to Australian farmers and land managers. Phone (02) 6297 6604; Email [alpaca@dart.net.au](mailto:alpaca@dart.net.au).

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Seeds for Tomorrows Trees  
P.O.Box 11,  
LOWANNA, NSW, 2450

Seeds for Tomorrows Trees supply bulk or provenance collections of individual trees. Eucalyptus species from the east coast of Australia, mainly *E.grandis*, *E.saligna*, *E.pilularis*, *E.maculata*, *E.dunnii*, *E.microcorys*. Collection data supplied with all seedlots. Phone (02) 6654 5423; Fax (02) 6654 5423.

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Seedworld Australia Pty. Ltd.  
PO Box 1408,  
NOWRA, NSW, 2541

This is a recently formed company which supplies a diverse range of Australian native seed - from bulk Eucalyptus seed to *Kentia* palm seed. Seedworld can meet its customers requirements. New enquiries welcome. Phone (02) 4423 0894; Fax (02) 4423 5200; Email [sales@seedworld.com.au](mailto:sales@seedworld.com.au).

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Wildseed Tasmania  
91 Weston Hill Rd  
SORELL, Tasmania, 7172

An online supplier of seeds of Tasmanian species in small and large quantities. Downloadable catalogue (MS Excel format). Phone: (03) 6265 2651. E-mail: [helenka@wildseedtasmania.com.au](mailto:helenka@wildseedtasmania.com.au)

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#### CSIRO Listing

The Australian National Botanic Gardens has compiled a comprehensive list of over 30 Australian seed suppliers based on information from the CSIRO Division of Forestry. The list includes small regional collectors as well as Government agencies.

<http://www.startlocal.com.au/miningagric/seedsuppliers/>

[http://www.startlocal.com.au/miningagric/seedsuppliers/qld\\_brisbane/](http://www.startlocal.com.au/miningagric/seedsuppliers/qld_brisbane/)

<http://www.seedworld.com.au/>

<http://www.diggers.com.au/>



## **SEED MANAGEMENT**

### **How It Works**

To select the best seeds for better production, certain steps should be followed. First, the suitable seeds must be identified in the farmer's field. Then a careful study of the plant is carried out noting inputs which were used such as animal or vegetative compost, as well as pest and disease incidences and growth rate. On the basis of this study, the best seeds are selected and marked. At harvesting time, these seeds are separated from the overall crop yield and sent for processing to the Community Seed Bank. The Community Seed Bank then uses special equipment such as a solar seed dryer to ensure that the seeds are meticulously processed. Seeds are carefully stored at prescribed temperatures and levels of humidity to make sure they do not deteriorate over time.

It is worth noting that all of this is achieved without electricity or high-tech equipment. Plastic sheeting, shelving and traditional woven and clay containers are used to maintain the necessary conditions for each type of seed. Humidity sensors and frequent monitoring ensure that the seeds do not get damaged. Before being distributed back to the farmer, a few seeds from each variety and season, undergo a germination test in the small field next to the Community Seed Bank.

### **Ongoing Management**

A farmers' cooperative will be formed in Lalitpur with membership open to farmers who practise seed conservation and improvement. Members will purchase a minimum share capital in the cooperative. The membership will elect a management committee which will meet regularly to supervise the operation of the Community Seed Bank. An individual with both formal and informal training will be employed to run it.

Initially, the Seed Bank will receive operational and management funds from USC Nepal and USC Canada. This support will be gradually reduced year by year as the income from the sale of seeds and the Bank's services increases. It is assumed that it will take about three years for the Seed Bank to cover its costs and begin to make a profit.

### **Expectations**

While the Seed Bank is already in operation, in the long term it is expected to: \* process, store, distribute and sell a range of local seeds\* educate farmers on the importance and benefits of local seeds \* collect, process and distribute different varieties of cereal, vegetable, fruit, fodder and forest timber seeds\* preserve and build up the stock of local seeds in danger of extinction \* engage in seed exchange programs with farmers, farm organizations and other seed banks outside Lalitpur\* involve approximately 200 farmers in local seed production and improvement.

# Seed-Storage Times and Viability

(These notes are for the home garden enthusiast.)

<http://growingtaste.com/storage.shtml>

Virtually all home-garden-supply seed houses supply seed in far too great a quantity for the average home gardener (even those that famously sell small packets at lower prices). The home gardener will thus often want to save seeds bought one year for use in a later year. The question that must arise, then, is *how long can we keep seeds and still expect them to germinate and grow when planted?*

There are no exact answers: seeds are living things. Moreover, much depends on how the seed is stored. And there is no drop-dead cutoff point either, just reduced percentages of germination, and what is "too low" a germination rate may vary from gardener to gardener (and even fresh, newly bought seeds will not invariably germinate 100%).

Before going on to numbers, let us give you a few links that explain storage principles:

- [Giving Seeds What They Need In Storage](#) - good, commonsense information for the home gardener
- [Seed Storage Tips](#) - the basics for home gardeners

In short, best storage conditions are those that are the exact opposite of what makes a seed want to sprout. Seeds "know" to sprout when temperatures go up, and fluctuate greatly, when exposed to light, and when warm; so we want to keep storage seed in the dark, very dry, at a low, even temperature.

Those conditions are pretty easily achieved--surplus "ammo cases" are widely sold at low price, they make a watertight (and probably airtight) seal, and are of a size convenient for storing a lot of seed packets. Stash your seed packets in the case, drop in a packet or two of a dessicant (moisture-absorbing agent, like silica gel)--a thing also widely sold inexpensively--and put the box where it will stay at a cool (circa 50° F., 10°C) and *steady* temperature (you can, at an extreme, always bury it a foot or two down in the ground).

*(Those are approximate, not exact, instructions--read the web pages linked above for more detail.)*

But that doesn't answer the question. What does is the Tables below. The first is by rough longevity, the second sheerly alphabetical by vegetable. The data are our combining of information from several sources: those sources do not always agree perfectly, but we have taken the most conservative (fewest years) figures for these tables. But, again: *these are rough estimates for well-stored seed.*

<b>Relative Longevity of Well-Stored Vegetable Seed (by years)</b>	
<b>kind of seed</b>	<b>relative longevity (years)</b>
Collards	5
Corn salad (mache)	5
Cress	5
Cucumber	5
Endive	5
Lettuce	5
Muskmelon ("Cantelope")	5
Beets	4
Brussels Sprouts	4
Cabbage	4
Cauliflower	4
Chard, Swiss	4
Chicory	4
Eggplant	4
Kale	4
Pumpkin	4
Radish	4
Rutabaga	4
Sorrel	4
Squash	4
Tomato	4
Turnip	4
Watermelon	4
Asparagus	3
Beans	3

Broccoli	3
Cabbage, Chinese	3
Carrot	3
Celeriac	3
Celery	3
Kohlrabi	3
New Zealand Spinach	3
Pea	3
Corn, sweet	2
Leek	2
Okra	2
Pepper	2
Onion	1
Parsley	1
Parsnip	1
Salsify	1
Scorzoneria	1
Spinach	1

<b>Relative Longevity of <i>Well-Stored</i> Vegetable Seed (alphabetical by vegetable)</b>	
<b>kind of seed</b>	<b>relative longevity (years)</b>
Asparagus	3
Beans	3
Beets	4
Broccoli	3
Brussels sprouts	4
Cabbage	4

Cabbage, Chinese	3
Carrot	3
Cauliflower	4
Celeriac	3
Celery	3
Chard, Swiss	4
Chicory	4
Corn, sweet	1
Collards	5
Corn Salad (mache)	5
Cress	5
Cucumber	5
Eggplant	4
Endive	5
Kale	4
Kohlrabi	3
Leek	2
Lettuce	5
Muskmelon ("Cantelope")	5
New Zealand Spinach	3
Okra	2
Onion	1
Parsley	1
Parsnip	1
Pea	3
Pepper	2
Pumpkin	4
Radish	4

Rutabaga	4
Salsify	1
Scorzonera	1
Sorrel	4
Spinach	1
Squash	4
Tomato	4
Turnip	4
Watermelon	4

**GIVING SEEDS WHAT THEY NEED in STORAGE** <http://www.hillgardens.com/storeseeds.htm>  
 by Fred Davis, MG, Hill Gardens of Maine (To view other articles, click: [Archives](#))

Welcome through Fred's Garden Gate! On a recent visit to the home of dear friends—a family blend of professionals, gardeners, homemaker, outdoorsman, and delightful youngsters—we brought along a package of choice vegetable seeds that I knew would be accepted with appreciation, and probably shared with several of their friends as well. My heart sank as our host retrieved a Tupperware container from a cabinet above the stove. In it were small, labelled paper envelopes containing an assortment of their cherished seeds carefully saved from the previous season.

Temperatures in this cupboard that Thanksgiving Day had to have been over 90°F (32°C)—in all likelihood, they must frequently have soared to well in excess of 120°F as large dinners cooked and scrumptious desserts baked. Humidity levels must almost certainly have wildly fluctuated between a parched zero and a sloshy 100% as torrents of steam bathed those cabinets as well. Hot and cracklin' dry one day, hot and tropic-wet the next!

As you might already have guessed, those are not the ideal seed storage conditions. So, how and where *should* they be kept to maintain vigour and viability?

First, consider that only drying-tolerant seeds (those that can handle drying out) will enter into the following discussion: virtually all common flowers, herbs, vegetables, shrubs, and a great many trees. Drying-*intolerant* types—aquatics, some large-seeded plants, and the nut-like seeds of a number of trees like oak, chestnut, ginkgo and buckeye, for example—are normally planted fresh, and are usually not storable. In their natural setting, drying-*intolerant* seeds fall to the ground and then immediately germinate.

Nature—whose methods are age-old, tested and proven effective—almost always gradually matures and dries seeds on the plant. Nature has learned that, as seeds undergo this drying and transition from active growth to full dormancy, important physiological changes occur as food reserves convert from vulnerable



sugars to more stable (storable) fats and starches. In this more stable condition, a broad range of seed types can be stored for sometimes years. . . *assuming optimum storage conditions are maintained*. What are those ideal conditions?

As a general rule, **humidity levels** within the storage environment should be maintained in the range of 25-35%. The average home during northern-tier (USA) winters is exceptionally dry—often dipping into the low teens. Low humidity draws moisture from delicate seed structures and exerts a negative impact on vigour and germination rate. Drying seeds to zero moisture will, of course, destroy them. **The rule:** once seeds have dried (cured) to the correct moisture level (by weight), unless you have the kind of precisely-controlled storage conditions employed by seed companies like Johnny's Selected Seeds in Albion, Maine, store yours in sealed, air-tight containers like glass jars or doubled Ziploc bags. In the highly variable home or small farm environment, paper envelopes, cloth bags, or cardboard boxes allow for exchange of far too much (or too little) moisture for long-term storage.

**Temperature**, of course, must be maintained within a relatively narrow range. I've heard it said that the home freezer is the best place. Personally, I question the advisability of freezing temperatures in one- to two-season storage. While it is true that many seeds will store almost indefinitely if deep-frozen, those who have done the research recommend short-term home storage between just above freezing, to about 40°F or 45°F (4°C – 7°C). Properly sealed after drying, I've found an ideal location to be on the cellar floor in a corner furthest away from heat sources such as furnaces, water heaters, or warm-air ducting. Our new "root cellar"—an enclosed, insulated crawl space beneath our recently reconstructed solarium—to be perfect for our seed storage needs at a comfortable 25% humidity and 42°F nearly constant temperature.

**Darkness** is the third, yet equally important, requirement. Bear in mind that certain conditions (moisture, temperature *and light*—especially in some combination thereof) stimulate and support the process of germination—sprouting. Just as many foods, pharmaceuticals and chemicals rapidly deteriorate when exposed to light, so also is seed viability and vigour impacted by being exposed to illumination during storage. That cool corner of the cellar or root / vegetable storage area should also be very dark. The worse possible scenario: a sudden change to warmth, elevated humidity and light during mid-winter storage, followed by chilling, drying and return to darkness. Kiss them goodbye!

### ***Seed storage problems:***

**Mildew or Mould.** Seeds not dried to the correct moisture level before being sealed in glass or plastic, can—and *do frequently*—rot. A simple test: After "drying" and placing in closed glass jars or plastic bags, the appearance of condensation on the inside of those containers within a few hours indicates the need for further drying. Stay right on this one because damp seeds will decay (and die) very quickly!

**Insects.** Weevils, borers and small beetles that may have escaped notice will wreak havoc on stored seeds. A few pinches of diatomaceous earth (DE) is a safe, inexpensive, prudent, and non-toxic bit of insurance against insect damage. DE is available at some farm 'n garden stores and larger garden centres. (DE is used in swimming pool filters.) It doesn't take much; just be sure to lightly coat all seeds before final sealing and storage. Avoid the use of powerful commercial insecticides.

**Rodents.** Seeds in storage, unless precautions are inaugurated, can provide a virtual banquet for mice or other small vermin. Prevent damage by placing labelled seed containers in either metal or plastic storage containers, or enclose them in an unused picnic or camp cooler. Please don't use tanglefoot traps to capture, terrorize, and torture mice.

Following the above easy "rules" will ensure longevity and viability of the seeds of a new generation of flowers, herbs, fruits and vegetables. Have a warm, safe and pleasant winter and holiday!

[Extensive list](#) of flower and vegetable seeds, and how long they'll last in as close to *ideal* storage conditions possible in most homes.

## Seed Storage Tips

<http://www.zetatalk.com/teams/seeds/seedstor.htm>

Words of advice from [Geri Guidetti](#) of **The Arc Institute**

To sum up storage of seed, cool, dark and dry are the conditions you want. Temperature fluctuations, especially heat, and humidity are seeds' worst enemies. Generally the drier and cooler the better. You are shooting for a moisture content of about 8%. Seed that dry can be safely frozen for very long periods of time with little or no loss of seed viability. I have spoken with seed storage experts at the National Seed Storage Laboratory and was told that seed stored forty years ago under these conditions was highly viable.

A great way to get seed down to such low levels of moisture is to use a desiccant with your seed packets and seal them together in an airtight jar. A Kraft mayo jar, for example, is perfect for a new wide-mouth canning lid and ring. Hellman's and Best Foods mayo jars or standard canning jars will take a regular size canning lid. Add silica gel to the jar, add the seeds, still in their packets, to the jars, and seal. Small seeds will dry down to 8-10% moisture overnight, while large seeds may take several days. You can then recycle the silica gel and process more seeds with it, sealing the dry seeds into a new, dry jar and putting them in the freezer.

Now, if you want to store your seed for a year or two, shoot for the coolest, driest part of your home. Humidity is generally a greater enemy of viability than temperature, but both are important. Most vegetable seeds have a natural longevity of about 3-5 years under these conditions. Onions are less - one year or so. Lettuce, approximately 2 years. Store these in the freezer as above, or grow them out this year and multiply to get fresh seed. If you haven't already bought Suzanne Ashworth's great book, *Seed to Seed*, then kindly consider doing so.

