Improving on basic native seed storage

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In general, we store seed to maintain it in a viable condition from the time of collection until the time of sowing. Storage time varies according to the purpose for which you store the seed. The longer you need to store it, the more expensive it becomes. Careful storage may help alleviate problems of seed availability and large seed crops may be used for several years of revegetation activity, avoiding the need to rely on the current crop alone.

A basic approach to the storage of native seed for revegetation purposes is outlined in the FloraBank guideline, *Native seed storage for revegetation***.** The approach described is suitable for storing seed for the next growing season and in many cases for up to five years.

You can progressively improve on this basic storage practice should you need to store seed into the medium term (5 to 25 years). In this guideline we provide some relatively low-cost approaches to improving storage practices that should be within the resources of community and other seedbanks primarily involved in revegetation. The emphasis is on improving the life of seed in storage, but the practices included are also useful for storing seed that will not remain viable at room temperature and achieving greater quality assurance. These improvements may be adopted progressively or all at once, depending on your resources.

Even with good practices, however, there is a limit to the storage times that may be achieved. The Australian Network for Plant Conservation has produced excellent guidelines for long-term storage (more than 25 years) of native plant seed. If you are serious about long-term seed storage, we recommend you follow its *Germplasm Conservation Guidelines for Australia***.**

Thinking first

Before you launch into improving your storage practices, ask yourself why you need to. Is there any real need to keep seed longer than, say, five years? How much seed of which species do you intend to store? In what ways are your present practices failing you? Will further investment in equipment be out of proportion to the overall size or role of the seedbank? What standards of practice can reasonably be maintained over time in the seedbank? In cost-efficiency terms, what effect will increased investment have on the cost of producing seed?

It is a waste of money and resources to develop expensive facilities for maintaining seed viability in storage for 15 years if there will never be more than a few years between collection and sowing. It is equally wasteful to expend money and effort to collect, dry and clean seed if storage conditions are inadequate and the seed is largely dead by the time of use.

Think of seed storage as a learning process. There has been very little research on storing Australian indigenous plant seed and most guidelines are based on research conducted for agricultural industries. Sharing your experiences and understanding with others will help to overcome this lack of knowledge.

Keep in mind that there are three groups of seed according to storage behaviour.

> *Orthodox* seed can be dried to a very low moisture content (less than 5% of fresh weight) without loss of viability. In this state it may be kept at low or sub-zero temperatures without damage. Orthodox seed includes eucalypts, acacias, casuarinas, and virtually all the other myrtacea.

Recalcitrant seed becomes non-viable if dried below a certain moisture content; usually 40 to 50% of fresh weight. Recalcitrant seed includes syzigiums, mangroves, some of the tropical 'fruit' type species like Parinari, and some terminalias. Generally, where there is a fleshy fruit with no 'hard' nut or seed inside, storage will be a problem. The seeds of wet tropical forests and wetlands frequently require storage at high moisture content and often suffer damage from temperatures below 15^0 to 20^0C. Such seed is more difficult to store than orthodox seed.

Intermediate seed may only be dried to low moisture content (10 to 15% of fresh weight) without loss of viability. This group of seeds is also susceptible to damage from temperatures below zero.

There seem to be no reliable methods of determining the storage behaviour of seed of a particular species and the group into which it may fall, other than by experience. This is an area where you need to rely on your own experience and the experience of others. Look for the few published accounts available and people who are willing to share their knowledge of germination results following certain storage regimes for a species you are interested in.

Improving storage practice focuses on the temperature and humidity of the outside air, the storage environment. The temperature and moisture content of the seed itself are critical. These factors are related, though for convenience we sometimes discuss them separately. For orthodox seed, Harrington (1963, 1970) established that for each 1% reduction in seed moisture content, or 5^0C reduction in storage temperature, there is a doubling of storage life.

Air can only hold a certain amount of moisture at a certain temperature before it is said to be saturated and condensation (dew or rain) forms. The relative humidity of air is the ratio (expressed as a percentage) of water vapour actually present in the air to the quantity of water that would saturate the air at the same temperature. Air at a higher temperature will hold more moisture, but as it cools it will eventually reach saturation and the moisture will start to condense (dew point).

Moisture content refers to the amount of water in the seed and is usually expressed as a percentage; wet weight is the percentage of the fresh weight of the seed that is water and dry weight is the percentage of the seed that is water after drying. 'Wet' seed in 'dry' air will lose water and therefore weight. 'Dry' seed in 'wet' air gains water and weight. Seeds absorb or lose water until equilibrium is reached with the surrounding air. The higher the relative humidity of the air, the higher the seed moisture content at equilibrium.

So, what are our recommendations?

Focus on the critical areas of practice under your control for increasing the life of seed in storage. These are:

- drying methods
- packaging for storage
- storage temperature and humidity.

Steps for improving these practices are provided below, taking into account the ease of adoption and resources required for each.

Another critical factor for increased life of seed in storage is the quality of the seed collected. Gaining the best possible quality in collected seed is important and will be dealt with in other FloraBank guidelines.

Seed handling practices and the standard of record keeping are less critical, but also important, factors under your control. Seeds may quickly be spoilt by poor handling practices when coming out of storage. Inadequate record-keeping or seedlot tracking systems can place limitations on the future use of seed.

Drying methods

Orthodox seed should be very well dried. Seed moisture content is at least as important as temperature in determining seed longevity. Reducing moisture content slows respiration and the ageing of the seed, thus prolonging viability. Fungal activity is more easily controlled by low moisture content than by controlling temperature (FAO 1985).

Moisture content of recalcitrant seed is also important, though more in terms of the minimum point to which recalcitrant seed may be dried, rather than the maximum content for prolonged storage.

Seeds with high oil content contain less water at a given relative humidity than do seeds with greater starch content. Those seeds with higher oil content are easier to dry.

Air drying of seed achieves a variable moisture content from 6 to 12% of the dry weight, which is considerably less than the wet weight. Artificial drying achieves lower seed moisture content again, but how much lower depends on the method used and the species being dried.

For long-term conservation purposes, the Australian Network for Plant Conservation recommends drying to a seed moisture content of between 4 and 7% of dry weight (see *Germplasm Conservation Guidelines for Australia*). The quantity of seeds handled for conservation is usually very small, however, and the time in storage much longer than is the case in revegetation work.

It can be labour-intensive and costly, especially for large amounts of seed, to routinely achieve seed moisture content below 10%, much less 7%. Moisture contents below 6% may damage the seed.

Low seed moisture content is not an end in itself, but a part of the overall storage regime. For many seeds, including fleshy and recalcitrant seed, it may neither be necessary nor desired.

The important objectives and your first steps in improving drying practices are to ensure that:

- you measure the seed moisture content your drying practices achieve, and
- seed is consistently dried to *lowest practicable* moisture content.

Measuring seed moisture content

Establishing the moisture content of various seedlots (a unique batch of seed of a species from a location) you have dried by your regular methods allows a number of useful observations to be made. It is probably not necessary to routinely monitor seed moisture content unless long storage times are envisaged or seed is stored in high humidity environments.

Rather, measurement should be conducted as needed to refine drying techniques (as well as handling and storage techniques).

- Regular measurement of seed moisture content in seed of a particular species during the drying period should tell you when the seed is actually dry. This allows you to observe visual clues (some operators also go by the sound seed makes when rubbed) to dryness that you may use as a guide next time you dry that species.
- Wider testing of seedlots allows you to observe just how good your drying practices are across the species you handle and to identify any need for improvement. It will tell you which drying practices are more successful and assist you in trying out alternative practices to lower seed moisture content.

The most common and basic method for measuring seed moisture content is by drying in a low-temperature electric oven. This has become a standard method recommended by the International Seed Testing Association for crop species and widely adopted for use with Australian native species. The method is recommended by the Australian Network for Plant Conservation and described in *Germplasm Guidelines for Australia.* It requires access to a digital balance (accurate to three decimal places) and an electric oven with precise temperature control down to 100^0C, which includes some household electric and benchtop ovens.

Most agricultural, soil and seed-testing laboratories can perform the measurement for you on a fee for service basis. Alternatively, if you have the necessary equipment, the method is described in the above guidelines, the ISTA *Tree and Shrub Seed Handbook* (1991), and the FAO *A guide to forest seed handling* (1985).

Consistent drying to lowest practicable moisture content

Artificial drying is a first step in improving on open air or 'natural' drying, especially when weather conditions are less suitable for natural drying. Some low cost approaches are to:

- Use a propagation igloo or greenhouse to dry plant material and seed. A FloraBank fact sheet is available on *Using a Propagation Igloo for Drying Native Seed*.
- Make a solar tumbler, similar to a compost tumbler, using transparent polycarbonate roof sheeting wrapped around circular end pieces. Mount the tumbler on a wooden frame at waist height and include a handle for rotating the drum. Small holes may be drilled in the drum to allow seed to drop into a collection tray below. The drum should be vented, and perhaps shaded from hot sun, to avoid 'cooking' seed (maximum temperature 38^0C).
- Make a solar drying box, similar to a food drying cabinet. This is basically a large box with wire mesh or screen shelves and a transparent polycarbonate lid. It works in a similar way to the solar tumbler by trapping the sun's heat to improve drying. Again, ensure that the seed is not cooked.

At slightly higher cost, you might:

- Obtain a second-hand clothes drying cabinet or similar. Look for a cabinet that already has a thermostatic control setting down to about 30 to 35^0C, or to which such a thermostat may be fitted (costing about $100 or less). The trend today is toward lower-temperature drying using greater airflows, so the cabinet should have forced ventilation.
- Find contract drying services offered in your area by state agency forestry seedbanks and commercial (especially horticultural) seed suppliers using, for example, forced ventilation kilns. Here, seed can usually be handled by the trailer or ute load without difficulty. This will be especially useful to those collecting large quantities of seed for direct seeding. Such drying services may be offered near your location, so look around.

Air-conditioning after drying

Whatever drying method you use, an air-conditioner can improve consistency and achieve further drying during summer in most parts of Australia. Air-dried seed placed in an air-conditioned environment will adjust to the lower temperature and humidity by further lowering seed moisture content, provided that it is stored temporarily in 'breathable' containers, such as calico bags or sacks. This may also be the case for seed which has been artificially dried.

Some seedbank operators routinely place air-dried seed in an air-conditioned area for a week prior to sealing in air-tight containers.

See also 'Air conditioned storage' below.

Humid and tropical situations

In most temperate areas, the improvements to seed drying practice outlined above are considered more than adequate where seed is primarily stored for revegetation purposes. These improvements should routinely achieve the *lowest practicable* seed moisture content in orthodox seeds, but it is unlikely that this will consistently be below 7% by weight. Further lowering of seed moisture content may only be required for specific long-term storage projects or germplasm collections.

In very humid and tropical environments, simply raising the temperature of air may not alone accomplish drying of seed. This may, for example, be because the air temperature is already in excess of 35^0C or the relative humidity of the air at raised temperatures may remain the same as for room temperature.

In these conditions, air circulation must be increased by forced ventilation or moisture must be extracted from the air to induce drying.

There are few options at low cost:

- Make sure the drying area is well-ventilated. Use a domestic fan to circulate air in a propagation igloo or greenhouse.
- Use an air-conditioner to provide the drying action.
- Drying over silica gel (see below) is a practical solution for small quantities of seed up to about one kilogram. Bags of silica gel (or silicon dioxide) are available that contain an indicator dye which turns blue to pink when the gel has absorbed all the water it can. The gel may be re-used by drying in a low-temperature oven (130^0C for three to four hours) to drive off the moisture and then cooling in a sealed container. At 25^0C, a one kilogram bag of silica gel can absorb about 75 grams of water. The more silica gel used to dry a kilogram of seed, the lower the seed moisture content achieved. For quick drying, start with about equal weights of gel and seed in a sealed container. It is possible to over-dry seed below 4% moisture content, causing loss of viability. The exact weight of silica gel required to dry seed to a specific moisture content can be calculated based on relative humidity and measurement of the existing moisture content of seed (see p156 FAO 1985).

At higher cost you might:

- Investigate the use of domestic dehumidifiers. Though not commonly available in Australia, dehumidifiers are sold for domestic use in New Zealand for approximately the same cost as domestic air-conditioners. These systems are largely untried, to the best of the author's knowledge, for drying or storing native seeds in Australia, though one commercial seed supplier is currently experimenting with their use (using a TECO model).
- Investigate access to a dehumidified environment (such as at some government and commercial seedbanks) to dry seed prior to packaging for storage. Commercial dehumidifiers achieve relative humidity of 25% or better, but are considered unnecessary for seedbanks that primarily store seed for revegetation purposes, especially in temperate climates. Moisture may also be removed by blowing through a desiccant such as silica gel, and dehumidifiers that operate using silica gel (or another chemical desiccant) are available, though at high cost. Costs reported by seedbank operators for a dehumidifier range from $15,000 to $25,000 for each unit, plus maintenance.

Packaging for storage

FloraBank recommends drying all seed and sealing in airtight resealable press seal plastic bags as the best low-cost option. While this approach is suitable for revegetation purposes, it does not meet all needs, such as, for example, where large quantities of seed are stored for direct seeding or where some species are stored for longer than five years. Press-seal bags can be quite thin and do allow moisture in over time. Improving packaging for storage focuses on maintaining the seed moisture content over time and has little effect on the temperature in storage.

The important first steps in improving practices are to ensure that:

- seed is sealed from the air in storage
- oxygen in the storage container is replaced with inert gas
- excess air (or inert gas) is evacuated from the storage container.

Airtight storage containers

Good quality airtight packaging costs comparatively little and increases the storage life of seed. Where there is a need, FloraBank recommends upgrading to use heat-sealed laminated plastic or aluminium foil bags.

Heat sealers are commonly used in food packaging and prices vary from about $500 to $700 depending on the supplier and exact specifications. Laminated plastic bags are supplied in small and large sizes as well as continuous tubing that only needs sealing at the top and bottom to form a bag of varying size. Because of this, it may easily be used to store amounts up to 5 or 10 kilograms. Be sure to get a heat sealer wide enough to cope with larger bag sizes if you need to store such quantities.

Be sure to squeeze out as much air as possible from the bag before sealing it, and leave enough room at the top to reseal the bag after subsequent openings.

Laminated aluminium foil bags are also available. These ensure seed is kept in the dark and provide a higher standard of storage than laminated plastic. There is some variation in the quality of laminated aluminium foil bags.

The filled bags should be stored in strong containers for protection and to maximise storage space. If possible, use standard-sized opaque storage bins with well-fitting lids (though not necessarily airtight). It is recommended that you do not use recycled containers such as coffee tins or honey jars, as the primary airtight storage, but these may be used to hold or transport seed sealed in plastic.

Also very effective are the range of glass storage jars used in preserving and bottling, especially those with a rubber sealing ring under the lid and screw-top or clip-down closing. Glass preserving jars with good seals appear to be a most secure storage option for small amounts of seed. They have some disadvantages, however, when compared to laminated plastic or aluminium foil, Only small amounts of seed may be stored in them and excess air is difficult to purge from the jar. They may burst or crack if dropped, and present handling difficulties for contract storage.

There are few inexpensive airtight containers for larger amounts of seed. Larger quantities are best stored in black plastic drums with a sealing ring in the lid, which are commonly available in a 40-litre size. These may be rolled around or moved by hand-trolley. Sealed plastic drums in smaller sizes, such as used in beer and wine making, are available from plastics suppliers. Another alternative is to seal seed in laminated plastic at the largest convenient size and store many such sealed packages in a 40-litre drum. The drum may also be filled with carbon dioxide (CO_2) as described below.

In order to reduce moisture uptake by seed, you should fill the containers to reduce airspace and always ensure that lids are firmly closed and seals intact.

Using inert gas

Many seedbanks replace the air inside the sealed storage container with CO_2 on a routine basis, both as a fumigation measure and in recognition that metabolic activity in the seed is reduced when oxygen is absent. It is less convenient for stores where seedlots are accessed frequently.

The technique is simple and inexpensive, and cylinders of CO_2 are available from all bottled gas suppliers. Gas-impermeable storage containers such as laminated plastic and plastic drums must be used.

When using laminated plastic or foil, partially seal the bag (3/4-closed) and place a plastic tube from the gas cylinder into the bag. Fill the bag (like a balloon) with CO_2 and purge by squeezing in the hands. Do this twice, completely sealing the bag after the second purge. Fumigation effects may take two to three weeks.

When using plastic drums, fit rubber stoppers to two small holes in the drum lid. With the lid closed and a plastic tube from the gas cylinder fed into one hole, fill the drum with gas, allowing air to escape from the second hole. Securely stopper both holes when the air is purged.

The CO_2 must be replenished after the seal is broken.

Evacuating storage containers

A useful refinement in technique is to use a small vacuum pump to extract all the air or CO_2 possible from the storage container prior to sealing. An inexpensive fish tank air pump may be used or, if you have one handy, a laboratory-grade vacuum extractor.

The procedure is basically the reverse of that for injecting CO_2. Use a plastic tube to extract air through the opening in a partially-sealed bag or drum. Assist the purge of plastic bags by squeezing in the hands. A piece of fine gauze, nylon stocking, or similar material may be placed over the end of the vacuum tube to prevent seed being sucked out of the bag. Seal when the package is evacuated.

You may also evacuate containers you have just filled with CO_2.

Storage temperature and humidity

FloraBank recommends a basic standard for orthodox seed storage at room temperature and humidity. Much orthodox seed that is well-dried, sealed in airtight containers, and kept at room temperature, will remain viable well beyond five years (the short-term), including, for example, acacia, hovea, jacksonia, kennedia, oxylobium, daviesia, leptospermum and callistemon seeds. Starchy seeds tend to keep better in storage than oily seeds.

This standard of storage may be considerably improved by lowering the temperature and humidity of the storage environment using an air-conditioner, refrigerator or freezer. These approaches also provide flexibility for storing seed other than orthodox seed in a range of storage environments.

Lowering storage temperature and humidity reduces the rate of respiration and prolongs the life of seed in storage. The life of much orthodox seed that has been dried to a low moisture content may be prolonged in refrigerated storage. Seeds with higher moisture content, including many recalcitrant seeds, keep for longer periods at temperatures below room temperature, though few tolerate temperatures below freezing ($0^{o}C$).

The lower the temperature that must be maintained in storage, the higher is the cost. Low-temperature storage is not an end in itself, but a part of the overall storage regime. The decision to store seed at low temperature should be made on a species by species basis.

The important objectives and your first steps in improving practices are to:

- monitor the humidity and temperature in the storage environment

- increase your storage options to include air-conditioned storage space at the *lowest practicable* temperature and relative humidity conducive to a comfortable working environment
- increase your storage options to include refrigeration at 3 to 5^{o}C
- increase your storage options to include frozen storage at -18^{o}C or below.

Monitor storage humidity and temperature

Once seed is placed in storage, it is important the temperature and moisture content remain constant.

Monitor the humidity and temperature in your storage area (or fridge) with a simple digital humidity meter. These are typically battery-operated and measure temperature (0 to 60^{0}C), humidity (10 to 95% relative humidity) and the maximum and minimum for each. It is important to monitor the extremes in temperature and humidity. These meters are available from scientific instrument suppliers for $250 to $350 and are a better low-cost option than meters that produce a continuous readout on graph paper.

Air-conditioned storage

Installing air-conditioning allows for the reduction of temperature and humidity. Air-conditioners (refrigerated air-conditioners, not evaporative coolers) vary in their capacity to dry and cool the air. New prices for air conditioners vary, but start at about $1,500 for split systems. Get one that achieves the lowest temperature and relative humidity that you can afford. Typically, an air-conditioner may only achieve a relative humidity of 35 to 50%, but this is a lot better than humid tropical summer or temperate wet winter air.Air conditioning provides seedbank operators with options to:•
further dry air-dried seed;

- temporarily store seed that has not yet been packaged in storage containers and very large seedlots; and
- maintain a constant, cool storage environment that should further prolong the storage life of many orthodox seeds.

Set the temperature to a comfortable level (about 20^{o}C) that does not overwork the capacity of the air-conditioner. To maximise efficiency:

- air-condition a small room rather than a large one
- line and insulate the walls, floor and ceiling
- use curtains or double glazing on windows
- do not bring water into the storage area
- locate sinks, toilets, kettle, urn, washing and other wet working areas elsewhere.

Refrigerated storage

Some community seedbanks involved in revegetation already have a domestic refrigerator in which they store a little seed. This may be all that is necessary. Some community seedbanks have unnecessarily invested in large, or walk-in, refrigerators, assuming that this guarantees a better standard of storage. Yet, in most cases, the most important use for a refrigerator is to allow the seedbank operator to experiment with the storage of non-orthodox seeds and to provide greater freedom in the choice of storage environment and handling operations. In humid or high-temperature environments, refrigeration may have wider application.

Refrigerated storage should only be used for species that will not keep in airtight packaging at room temperature or in air-conditioning, which are inexpensive compared to the high cost of refrigerated and controlled humidity environments.

The most common options available are the domestic refrigerator, commercial display or drinks refrigerator, and the walk-in cool room or chiller.

Domestic and drinks fridges

Do not place refrigerators in the same storage space used for other seed as their operation will cause fluctuations in the temperature of the storage environment. Similarly, do not locate other heat sources such as drying ovens in the same space as refrigeration equipment.

Most refrigeration systems are not humidity-controlled and may deliver a relative humidity of 90% or more inside the storage cabinet. It is therefore crucial that seed is stored in airtight containers to ensure that moisture is not reabsorbed into seed in storage.

Ensure that refrigerated cabinets are well drained and door seals are in good condition.

Monitor temperature of the storage environment using a thermometer. Digital meters have the advantage of being able to monitor maximum and minimum temperatures and their portability allows them to be used for other purposes in the seedbank.

Walk-in cool rooms

Walk-in cool rooms or chillers are widely used for large collections or storage of seed in large quantities. Fully portable cool rooms may be moved or resold if the seedbank changes premises and may be cheaper than built-in facilities. The cost of such facilities is dependent on exact specifications and requirements. Seedbank operators report costs from about $20,000 for a demountable unit to $30,000 or more for built-in units constructed on a concrete slab.

Be aware that it is possible to buy a ‘wet’ or ‘dry’ refrigeration unit for a cool room at similar cost. The dry unit delivers a lower relative humidity and is preferred.

If seed is packaged in drums or other sealed containers, revegetation seedbanks can safely make good use of rented space in local cool room facilities (or another seedbank), particularly for bulk storage of seed collected for direct seeding operations. For many, this may be a better alternative than costly upgrading from domestic refrigeration to a cool room facility that may not be consistently or fully used.

Freezer storage

Freezer storage has limited application in general revegetation work. The Australian Network for Plant Conservation recommends frozen storage at -18^{o}C or below for long-term conservation purposes (see *Germplasm Conservation Guidelines for Australia*). This may be of use for specific medium to long-term storage projects, or for a reference or germplasm collection in a revegetation seedbank. More likely, is the use of frozen storage as a fumigation measure for seed in smaller quantities and as a cold stratification pre-germination treatment of seed. Do you really need a freezer?

If so, a domestic freezer should be adequate to meet the needs of most seedbanks and delivers temperatures of -18^{o}C or below. The moisture content of seeds should be between 4 and 7% of dry weight to avoid damage at this temperature.

Again, these systems are not humidity-controlled and it is therefore vital that seed is stored in airtight containers of the best possible standard. For use in a freezer, laminated plastic and aluminium foil bags are recommended.

A top-opening chest freezer is preferred to upright models, as they stay cold longer when opened and following power failures. If the freezer has only a small amount of seed in it, you may wish to increase the mass in storage by freezing containers of water. This will increase the time that the freezer stays cold on opening. Do not open the freezer on power failure unless absolutely necessary.

Seed handling practices

Poor seed handling practices can undo many of the gains in storage life achieved by measures such as those above. There are few hard and fast rules to follow in handling seed from storage and common sense is always your best guide, but a few do's and don'ts are listed here for your consideration:

- Avoid unnecessary fluctuations in seed temperature and humidity through handling:
  - Do not allow all the seed in a large container to reach work area temperature if a small portion can safely be removed and the bulk placed quickly back into storage.
  - Work on seed packages from storage in an air-conditioned, rather than ambient, air space if you can. Air-conditioned areas are cooler and drier than ambient air and may even be drier than cool rooms. Air exchange will increase the humidity in containers much faster than their seed mass will lose or gain temperature.
  - Do not work on seed packages from storage in heated air spaces during winter.
- Allow seed packages from storage to adjust to the temperature of the working area before breaking the airtight seal. Moisture will condense around and be absorbed by cold seed brought into a warmer air space. Wetting the seed initiates germination.
- Keep drinks, raincoats, wet hair, sinks, toilets and other moisture sources out of the work space in which seed from storage is handled.
- Depending on how seed is used, it is better to store large amounts in numerous packages than all in the one package. In this way, contamination is not so easily spread from one package to others, and may be treated when it is detected. Also, only a small part of the seedlot need be removed from storage at one time.
- Routinely expel excess air from storage bags prior to sealing, or replace with CO_2.
- Always replace CO_2 lost from containers in taking seed from storage.
- Individually label every package of seed in storage, including seedlot identification number and a code for the storage regime under which it is kept so the seed may be returned to the storage conditions it was removed from.

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