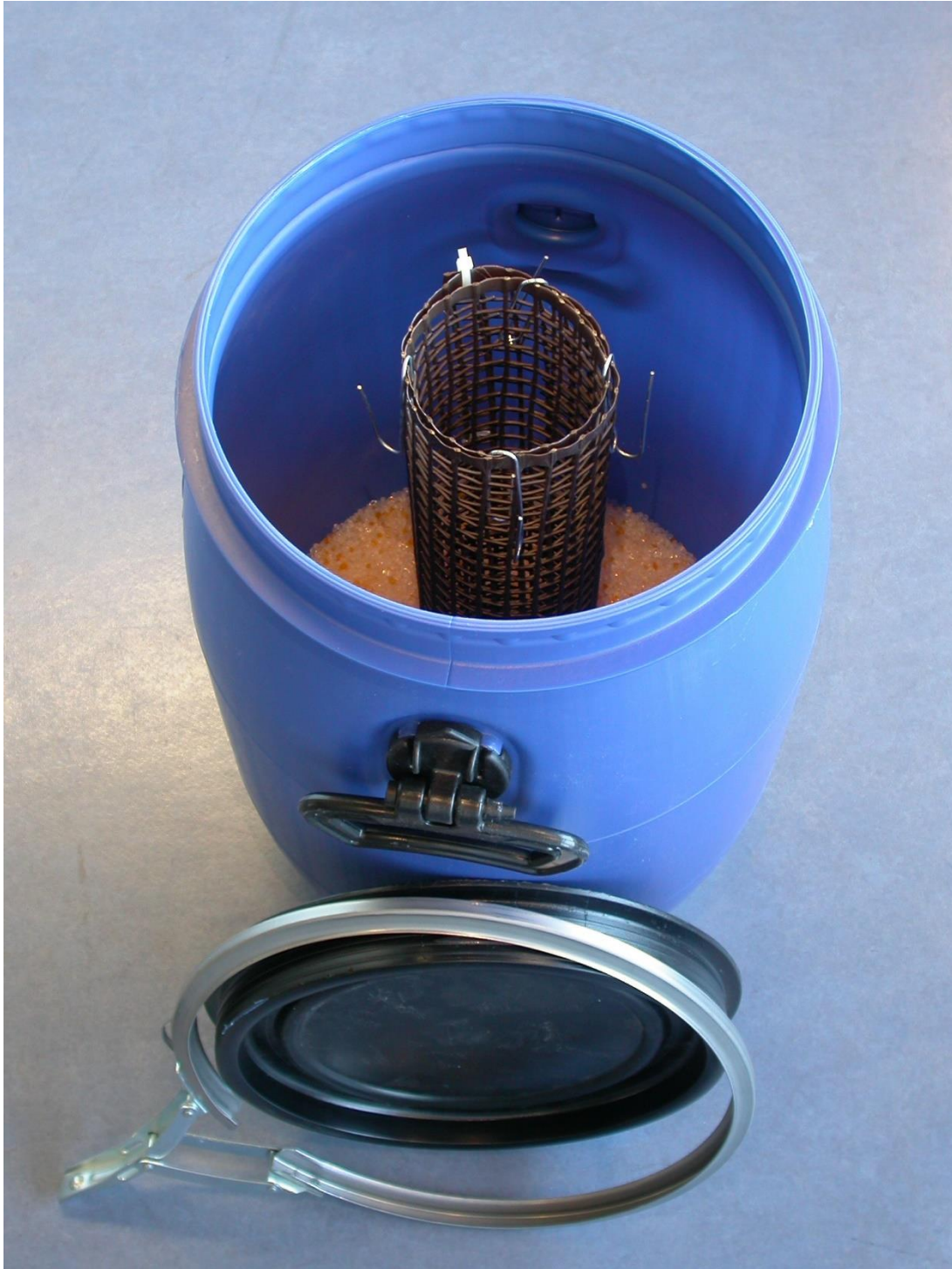


# Silica gel drying of seed material (Blue Drum dryers)

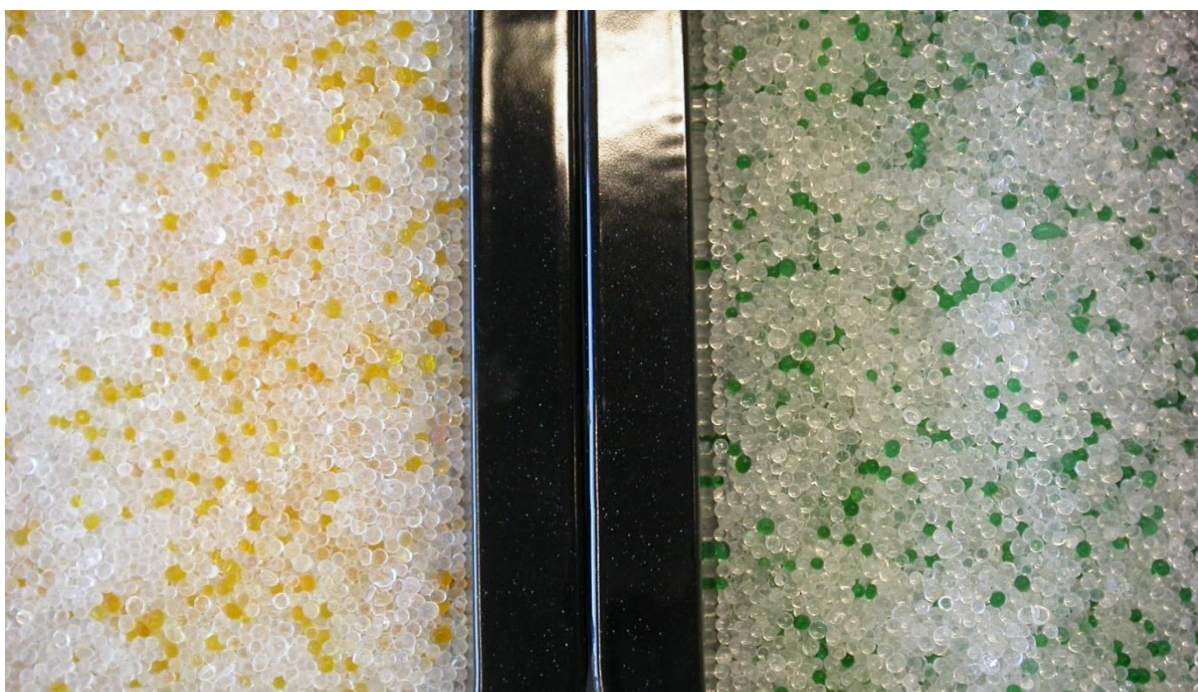


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## Introduction

Silica gel is a useful desiccant and can be used for drying seeds. It is available as either non-indicating clear beads or indicating beads incorporating a non-toxic indicator which changes colour according to the state of hydration. For example, with orange/green silica indicating beads, they turn orange when dry (below 20% RH) and dark green when wetter (above 50% RH) (Fig. 1). The colour change between the two extremes occurs at approximately 25% RH, which is close to the ideal 15% RH which is used for long-term seed storage. A mix of 10% indicating to non-indicating beads are routinely used in the MSB, as this can make the indicator colour changes easier to detect. If you are using a different silica indicator check the manufacturer instructions before starting\*.



**Figure 1:** The two states of orange/green silica gel at different humidity's

## Seed Drying

The process of drying using silica gel, consists of 4 main steps:

1. Choose a suitable container of appropriate size with a tightly fitting lid which will seal effectively (e.g., a plastic box or plastic / metal drum). If you are using a blue drum, make sure the red plastic clip used for air shipping is removed, as it prevents the lid sealing.
2. Fill the container to approximately 20% by volume with dry (oven dried) silica gel beads.

\*this guidance note is based on research done at the Millennium Seed Bank using green/orange indicating silica gel. Different indicator gel may give different results, if you unsure we recommend running your own tests for colours at different humidities.



3. Place your seeds and/or associated plant material within either paper or cloth bags above the silica gel whilst ensuring adequate air circulation around them (Fig. 2). In blue drums this can be done by hanging the bags on a central mesh column (Fig. 2).
4. Mix the loose silica gel in the bottom of the drum/container and the seeds within each collection, on a weekly basis to ensure even drying. Those seeds towards the outside of the bag will dry quicker than those at the centre due to the moisture gradient created. Mixing the seeds ensures more even drying.

Typically, drying may take in excess of one month. the exact length of time needed for drying will depend on:

- The initial moisture content of the plant / seed material
- The quantity of plant / seed material,
- The type of seeds, e.g., large seeds or those with a hard-seed-coat will take at least a month to dry entirely, and false low RH values could be found if early hygrometer readings are taken.
- The moisture status of the silica gel.

As the silica gel absorbs moisture from the seed material, the indicator colour will change from orange to green. Ideally the silica gel should be maintained at less than 25% RH, for orange/green indicator gel this means they should remain orange in colour).



**Figure 2:** The inside of a blue drum, the seed bags are hanging off a centre rack to allow air circulation.

To avoid the risk of over-drying small seeds, we suggest keeping the ratio of silica: seed approximately 1:1. If the total volume of seed to dry is very low and of small seeds it is recommended to use a smaller container rather than the blue drum so that the 1:1 ratio can be maintained. As long as you are able to get an air-tight seal, any small container can be used e.g., a jam jar, trilaminate foil bag and clip etc. (Fig. 3).



**Figure 3:** Small scale drying options for small seeds e.g., using a jam jar or a kilner jar with approximately a 1:1 ratio of seeds to silica gel.

### Determining the Relative Humidity (RH) of seeds and / or silica gel

At any point during drying, the exact RH of the seeds or silica gel can be tested using a suitable hygrometer (see '[Measuring seed moisture status using a hygrometer](#)' Technical Information Sheet 05). Remember if using a hygrometer, you must fill your container to at least 20% with seed before sealing. This is difficult with small collections of small seeds. If you do not have enough seeds to fill 20% of the space then you can use an inert material to fill the bottle. Where this equipment is not available, approximate moisture levels of the silica gel in the drum / container can be determined by the colour of the indicating silica gel, or by the inclusion of a 1 gram indicating silica gel sachet within each collection and comparing it with the colour chart provided (Fig.'s 4 & 5). Such checks should be done

regularly (at least weekly) and the contents of the bag mixed at the same time. For small seeds that will dry quickly aim to check more regularly.









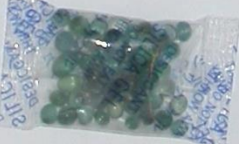







**Figure 4:** 1 gram silica gel sachets within bags of seeds



## Orange/green indicator Silica gel sachets at different relative humidities (RH)

November 2008

0% RH		4% RH	
11% RH		12% RH	
18% RH		24% RH	
32% RH		46% RH	
62% RH		67% RH	
77% RH		84% RH	
93% RH		96% RH	

**Figure 5:** Silica gel colour chart for orange/green indicator\*.

\*this guidance note is based on research done at the Millennium Seed Bank using green/orange indicating silica gel. Different indicator gel may give different results, if you are unsure we recommend running your own tests for colours at different humidities.

## Storing the dried seeds

When the seeds are dry (as indicated by the orange colour of the sachet or by a hygrometer reading), place the entire collection, including the silica sachet, into a foil bag. Each collection needs to be appropriately labelled inside and outside the foil bag with collection number and species name (it is best to do this before transferring the seeds to minimise the time the seeds are out of dry conditions). Note: the indicator sachet will continue to monitor the moisture status of the collection during storage and shipping. For short-term storage (e.g., shipping to a partner institute or the Millennium Seed Bank (MSB)) seal the foil bags with a plastic closure strip (Fig. 6). These bags can be placed somewhere cool and dry or in a fridge/freezer until shipment. Plastic closure strips should not be used for storing seeds for more than 1 year.

Alternatively, for longer term storage (-20°C) each foil bag should be sealed with a constant temperature foil bag heat sealer. For example, 2 seconds at 200°C to 1 cm depth on the bag. It is a good idea to test the seal of your bags by including a sachet of indicator silica gel. Further information on container testing can be found in Technical Information Sheet 06 – [Selecting containers for long-term seed storage](#).



**Figure 6:** A foil bag sealed for short term storage with a plastic closure strip.



## Regenerating (oven drying) the silica gel

When the silica gel needs regenerating (as indicated by a green colouration for orange/green silica gel\*), remove from drum / box, and spread out into a relatively thin layer in a shallow metal tray (such as a roasting tin or baking tray) and dry gently in a ventilated oven at not more than 100°C for one to two hours or until indicator turns orange again (Fig. 1). Allow the silica gel to cool, preferably covered and then return to the blue drum or drying chamber. If the oven used might go above the set temperature, it is safer to set it to a lower temperature, e.g., 60-80°C. Overheating of the beads can damage the colour change properties of the indicators, resulting in a permanently dark orange colour that does not turn to green when humid. An option is to test a little quantity of silica in order to identify the optimum procedure with your oven. It is also a good idea to periodically test your silica gel to ensure it has not been overheated. This can be done by placing the indicating silica gel in ambient conditions and seeing if the colour changes. Indicator sachets can be dried by placing them into the blue drum with dry silica gel. Indicator sachets can also be turned green by leaving in ambient conditions (assuming ambient conditions are above 50% RH).

## Further resources

Additional guidance on small scale seed drying methods can be found in [Technical Information Sheet number 8](#), available on the Millennium Seed Bank Partnership Website.

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