Evaluation of zeolite seed ‘Drying Beads®’ for drying seeds to low moisture content prior to long term storage

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Introduction
- Genebank and seed drying
- Drying chamber and desiccant drying system
- Drying beads

Objectives of the study

Results and discussion
- Drying seeds to target moisture contents
- Seed drying using different desiccant-to-seed ratios
- Germination after drying and storage with beads

Conclusion
Genebank and Seed Drying

• Undisputed importance of drying to extend the longevity of orthodox seeds

• Maintain seed viability for many decades

• FAO/IPGRI Genebank Standards
  - dry seed germplasm as soon as possible after receipt
  - 10-25°C, 10-15% RH
  - 3-7% (fresh weight) seed moisture content
  - air-tight containers
Introduction

Drying Chamber

• 15°C, 15% RH

• Sufficient size to ensure efficient drying of large numbers of freshly harvested germplasm samples

Desiccant drying

• Practical alternative, low-technology, low cost

• Principle: dry desiccant will take up moisture from the wet seed until they come into equilibrium
  - silica gel (sodium silicate), lithium chloride, calcium chloride, molecular sieve, charcoal, other seeds, etc.

* drying beads
Zeolite seed Drying Beads®

- Aluminum silicate ceramics
- Type of molecular sieve with very small, uniform pores where water molecules can be adsorbed
- More rapid drying
- Greater affinity for water, particularly at low humidity
- No hysteresis effect
Zeolite seed Drying Beads®

Amount of beads to use

- Ratio of beads-to-seeds to use: beads with a capacity for water of 20% of their initial weight

<table>
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<th>Target moisture content ↓</th>
<th>Initial seed moisture content (% fresh weight)</th>
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<tr>
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- Drying beads are placed over water and weighed after 24 hrs to determine its initial capacity for water
Objectives

• Examine the potential of the drying beads to dry rice to the low moisture contents required for long-term genebank storage

• Monitor the rate of drying

• Determine the final moisture contents of seeds dried using different bead-to-seed ratios

• Examine the effect of storage on seed germination

• Provide practical recommendations on the use of beads for drying rice seeds to target moisture content
Results and Discussion

Drying rice seeds to target moisture contents

- There was a rapid water uptake by the beads, and a rapid decline in the moisture content of the seeds
- Rate slowed earlier with lower drying temperature
- Final seed MC was slightly lower the higher the drying temperature
- Final seed MC was considerably higher than the target moisture content (6.1% FW)
Results and Discussion

Seed drying using different desiccant-to-seed ratios

- Lower seed MC with greater desiccant to seed ratio
- Silica gel was more efficient at the lowest ratios (on a weight-to-weight basis)
- Drying beads were more efficient at ratios greater than 0.75
- Seed MC achieved was always higher than expected if the beads adsorbed 17.5% of their weight
Results and Discussion

Germination after drying with beads

- generally high germination after drying using silica gel or drying beads for 28 days
- rapid rates of drying do not appear to impair germinability
Results and Discussion

Storing seeds with drying beads

- germination after 371 days
- high germination for all samples for seeds stored at 5°C with beads
- lower germination for seeds stored at -20°C
- germination increased the longer the drying period for seeds dried at 30°C; seeds dried at 5 or 15°C were still dormant even after 28 days of drying
Conclusion

- Seeds can be rapidly dried to low moisture contents by mixing with drying beads and sealing in a suitable airtight bag or box.
- Final moisture content reached depends on the initial capacity of beads for water, initial seed MC, bead-to-seed ratio and drying temperature to some extent.
- Rapid drying did not appear to impair germinability: >95% germination observed after drying for 28 days, or drying and storage for 371 days.
- There was a large discrepancy between the target seed MC (6.1%) and the actual seed MC reached.
- Beads did not work to their full potential in the bead-seed system.
- Calculating the amount of beads to use is not straightforward as expected.
- Further work is required to determine a protocol for calculating optimum bead-to-seed ratios to reliably dry seeds to target moisture contents.
Thank you!