

Implementing Drying Systems to Preserve Seed Quality

Kent J. Bradford, Lead PI
University of California, Davis

2013 Horticulture CRSP Annual Meeting

Nairobi, Kenya

May 6-9, 2013



Collaborators

Kent J. Bradford (PI), Peetambar Dahal, University of California, Davis, California, USA

Noah Phiri, Richard Musebe, Daniel Karanja, Roger Day, CABI, Nairobi, Kenya

Indra Raj Pandey, CEAPRED, Kathmandu, Nepal

Jwala Bajracharya, NARC, Kathmandu, Nepal

Luke Colavito, International Development Enterprises (IDE), Kathmandu, Nepal

Rajiv Pradhan, IDE, Dhaka, Bangladesh

Keshavulu Kunusoth, ANGRAU, Hyderabad, India

Ganesh Shivakoti, Asian Institute of Technology, Bangkok, Thailand

Johan Van Asbrouck, Patcharin Taridno, Rhino Research, Phitchit, Thailand

Collaborators



Roger Day



Noah Phiri



Peetambar Dahal
UC Davis



Indra Raj Pandey
CEAPRED



Jwala Bajracharya
NARC



Luke Colavito
IDE



Daniel Karanja

**CABI
Kenya**



Richard Musebe



Keshavulu Kunusoth
ANGRAU
India



Krishna Timsina
(Nepal)



Rajiv Pradhan
IDE Bangladesh



**Rhino
Research
Thailand**

Patcharin Taridno



Johan van Asbrouck



Ganesh Shivakoti

**AIT
Thailand**



Soma Mallick
(Bangladesh)

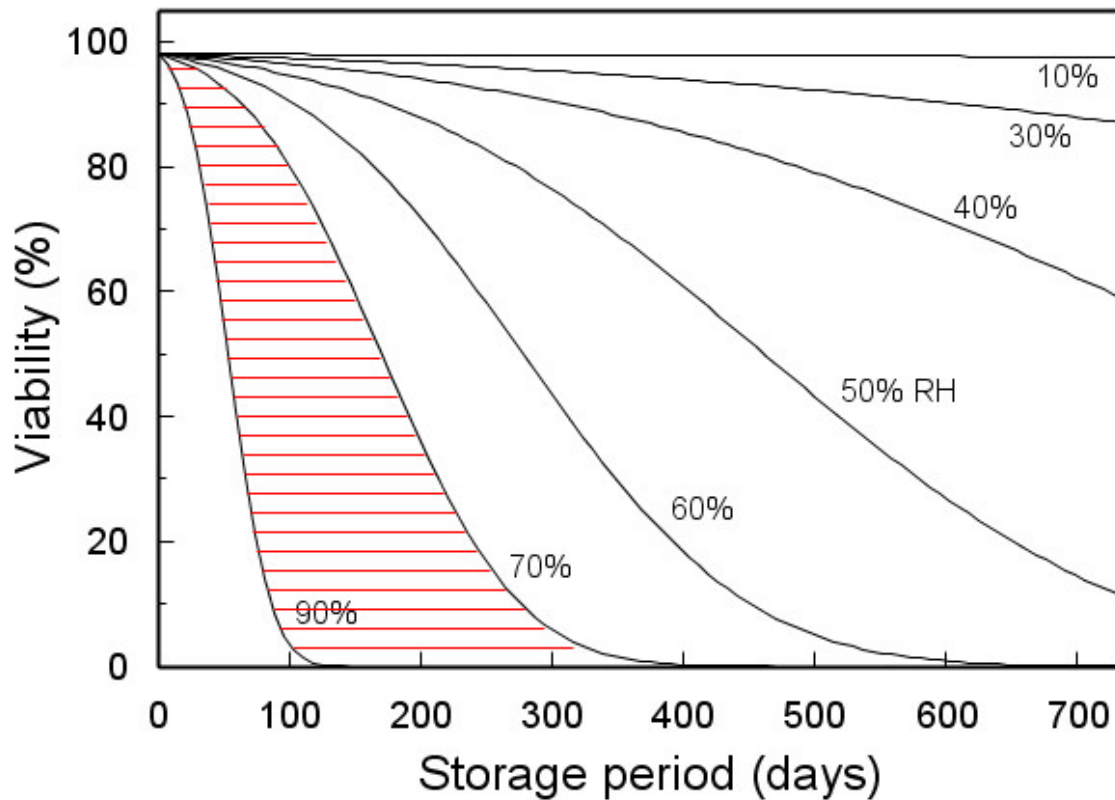
Humid Conditions in Tropical Regions Cause Rapid Loss of Seed Viability

Ambient conditions in tropical regions often exceed 75% RH and 30°C, resulting in rapid seed deterioration in open storage.



High Relative Humidity Shortens Seed Storage Life

Pepper 30°C



Seeds are very sensitive to the ambient relative humidity (RH) of the air.

Seed storage life is dramatically reduced at high RH.

Traditional Drying Methods Cannot Reduce Seed Moisture Sufficiently under Humid Conditions



Nepal



Nepal

Seeds equilibrate with air humidity. Air drying cannot reduce seed moisture content to safe storage levels in humid climates.



India

Alternative: Drying with Desiccants

Desiccants can be used to absorb moisture from seeds.

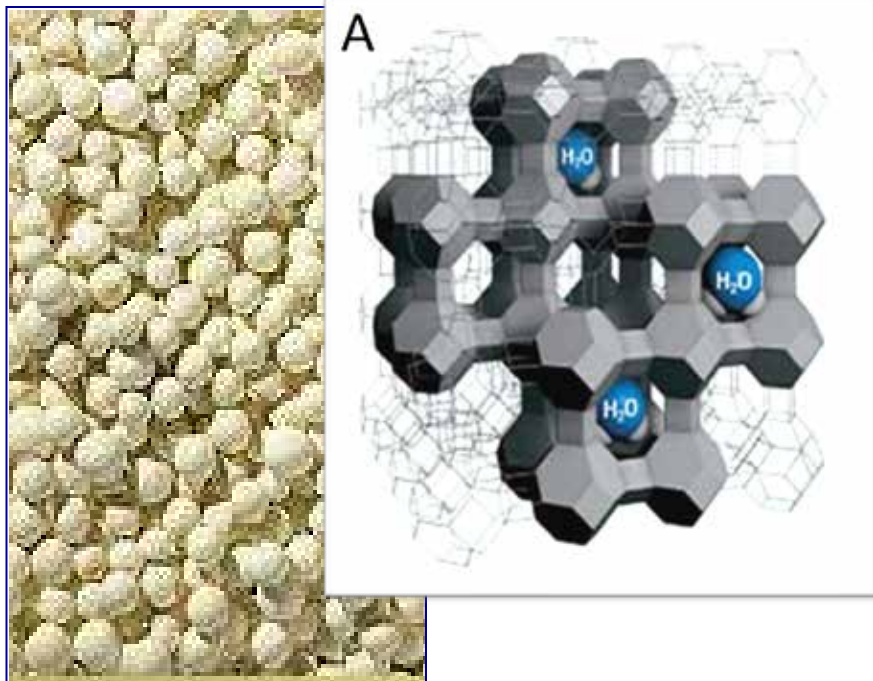
Current desiccants have drawbacks that have prevented their widespread use for seed drying and storage.

Novel seed drying beads based on zeolites (molecular sieves) make it feasible to efficiently dry and store seeds at low RH.

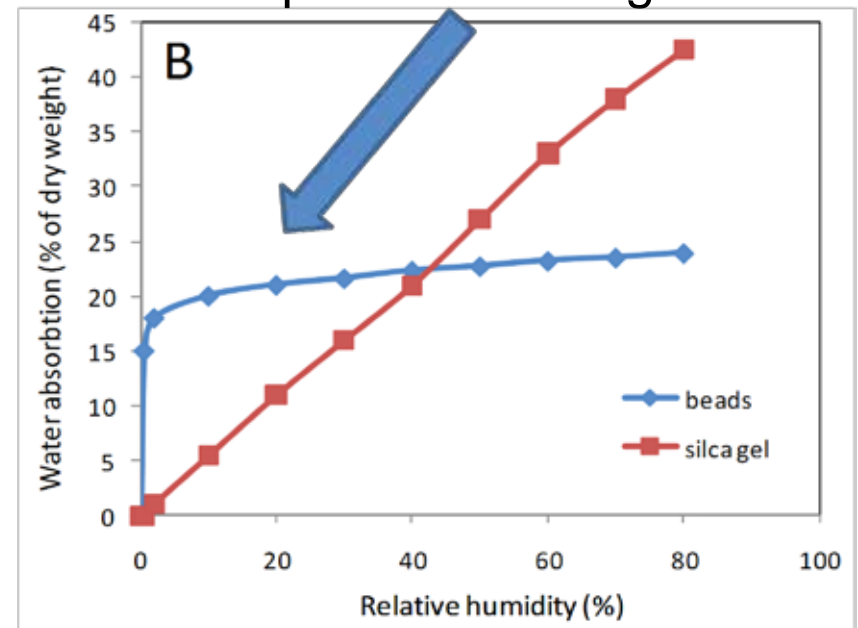


Novel Desiccant Has Unique Properties

Zeolite desiccant beads absorb only water and bind it tightly until released by heating.

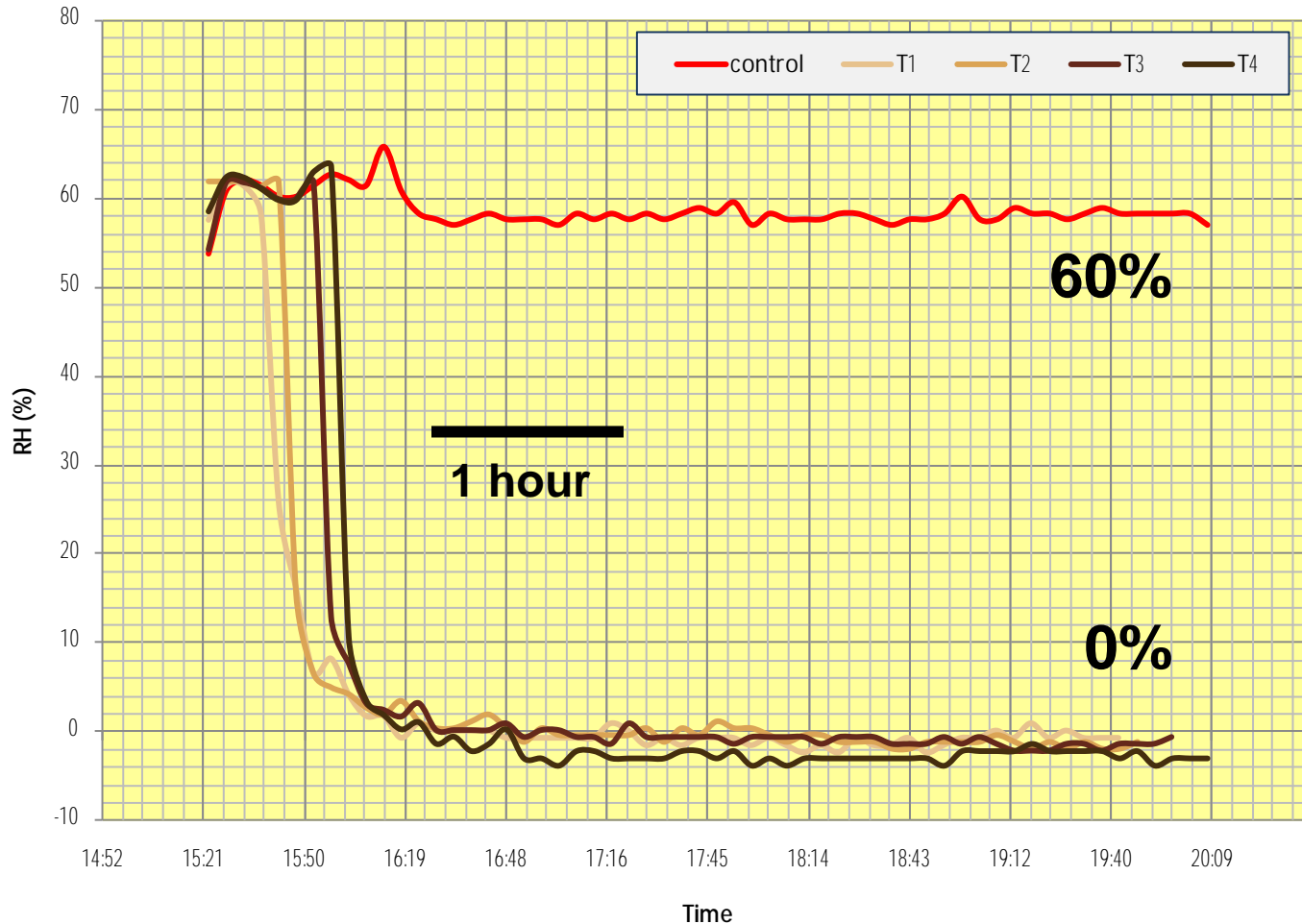


Improved drying at low RH compared to silica gel.



Beads Efficiently Reduce Air RH without Heat

RH air during cucumber trial on 6 November 2008 - TSA



Bead Reactivation for Reuse



Heat beads at 200°C for 2 h.



Cool briefly
in covered
container
until safe to
handle.

Package for storage in
airtight containers.



Can also be reactivated using other heat sources.

Local Hermetic Containers and Packaging



<https://ag.purdue.edu/ipia/pics/>

Indicating Containers (DrumDry)



Hygrometer



Indicator (silica gel)



Indicating Containers (BoxDry)



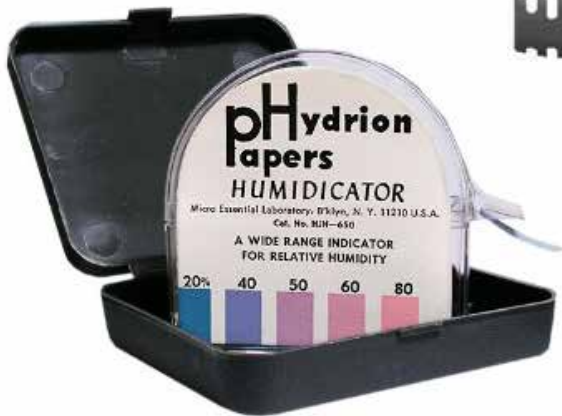
Dry seed

Moist seed



Monitoring Relative Humidity

- Monitoring RH is as essential to the “dry chain” for seeds as a thermometer is to the “cold chain” for fresh produce.
- We are distributing the both dataloggers and inexpensive meters for monitoring of RH to our collaborators.
- RH indicator strips are even cheaper and may be adequate.



Technology Support Package



www.dryingbeads.org

- Basic information on drying and storage methods to preserve quality
- Practical application protocols for using drying beads
 - Electronic, print and video
 - Visually based
 - Multiple languages
- Charts and calculation tools
- Technical information
- Research reports and publications
- Diverse applications
- Educational events calendar
- Sources and distributors
- Contacts

Drying Beads Calculator

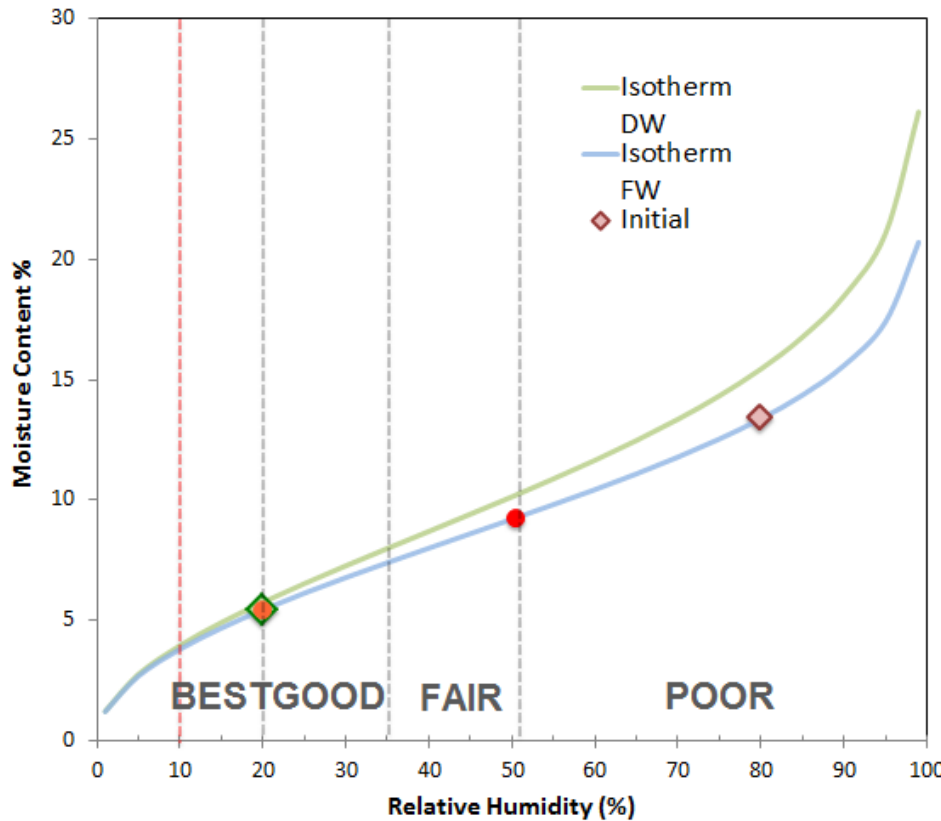
Hort CRSP **Drying Beads Calculator** **UCDAVIS**
DEPARTMENT OF PLANT SCIENCES
College of Agricultural and Environmental Sciences

Common name	Tomato	Temperature (°C)	25		
Common name	Solanum lycopersicon	Bead capacity (%)	17.5		
Basis	Initial MC (%) - Fresh Weight basis	13.38	Initial RH (%)	80	
RH	Desired MC (%) - Fresh Weight basis	5.44	Desired RH (%)	20	
Amount of seeds (g)	1000	Beads available (g)	300	Beads needed (g)	554.18

Repeated Drying needed!

Drying Beads Calculator

Moisture Release Curve and Drying Steps



Repeated Drying

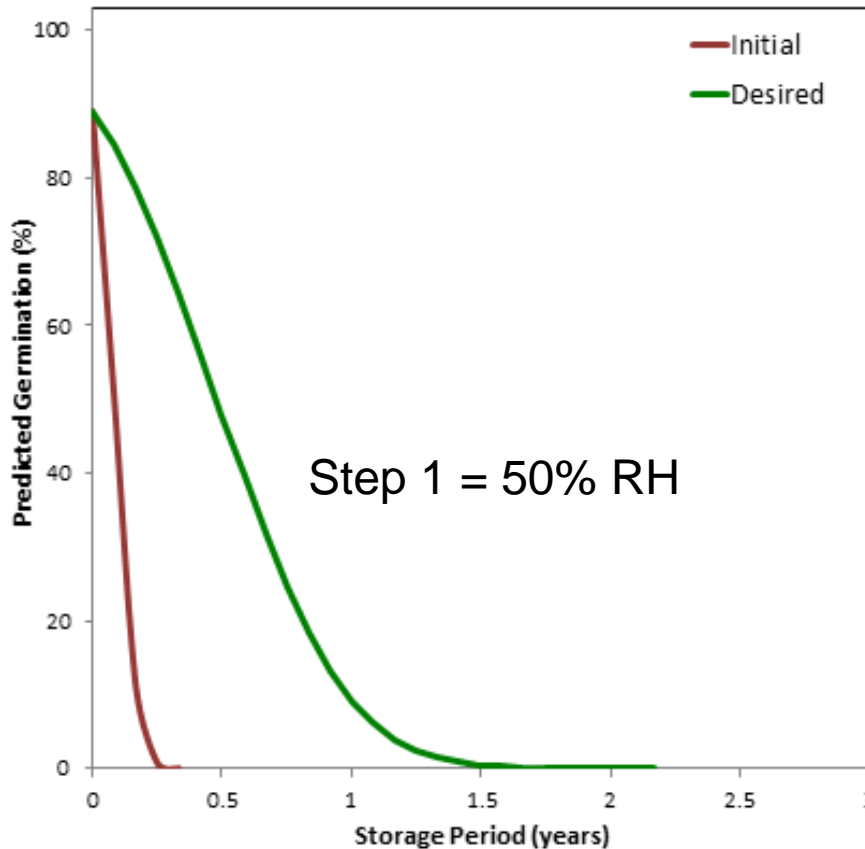
Same amount of beads for all steps?

Final RH Difference(%) Acceptable?

Steps	Final RH	Final MC	Beads Needed (g)
● 1	50.4	9.26	300
● 2	20.0	5.44	255

Drying Beads Calculator

Predicted Seed Storage Life



Initial Germination (%) **89**

Storage Temperature (°C) **25**

Initial MC (FW)
13.38

Desired MC (FW)
9.21

Constants			
MC		Temperature	
Ke	Cw	CH	Cq
7.767	4.67	0.035	4E-04

Predictions for illustrative purposes only based on the Ellis-Roberts model. Specific results may vary.

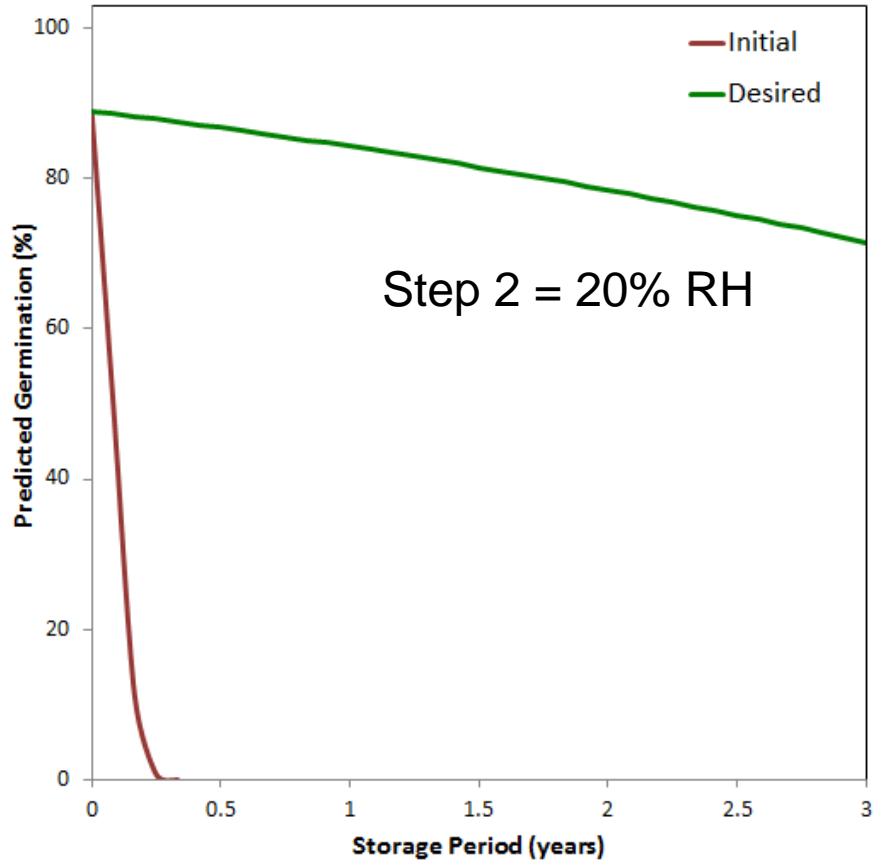
Developed by:



Drying Beads Calculator

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Developed by:



Trials and Demonstrations

- Kenya
 - Spider plant, groundnut, green gram, amaranth, maize
- Tanzania
 - Amaranth, African eggplant, onion, green gram, nightshade, tomato
- Nepal
 - Cucumber, bean, okra, onion, tomato, pea, cauliflower, maize, rice, wheat
- Bangladesh
 - Tomato, chili, okra, soybean, green gram, radish, bittergourd
- India
 - Drying beads have been approved for research study by the Indian National Seed Program

Onion Seed Storage in India

Open bags

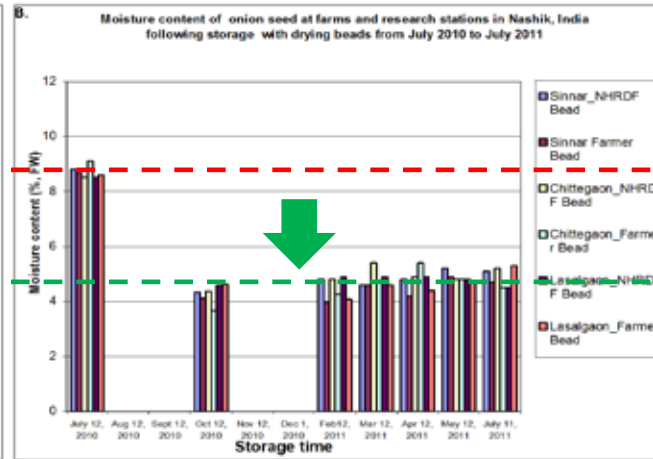
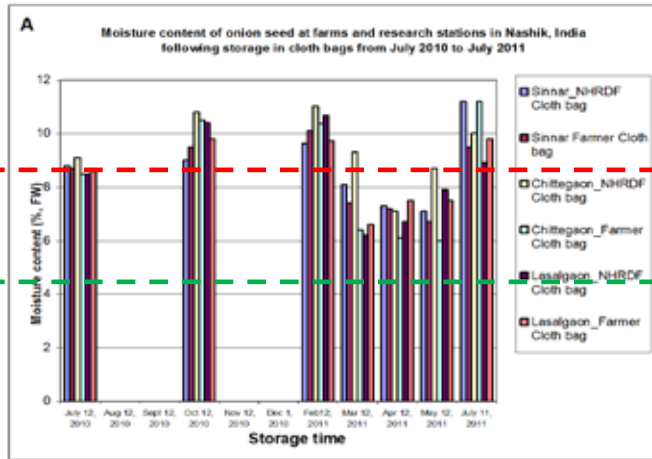
With beads

Stored for
1 year by
farmers

%

9

5

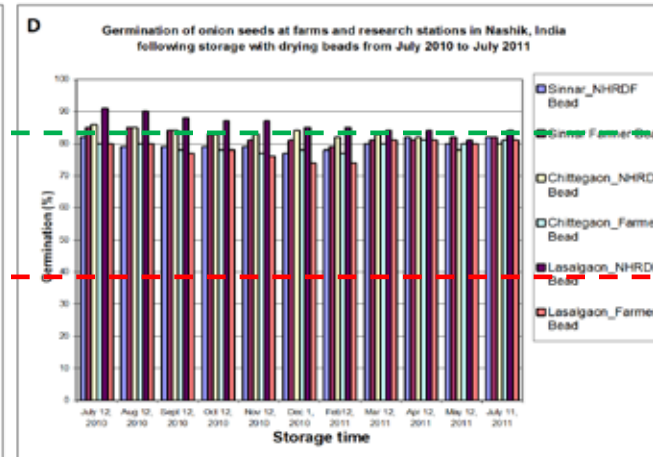
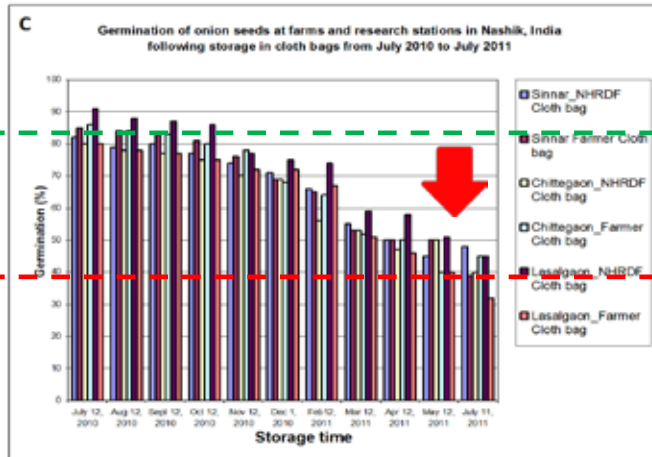


Seed MC
reduced by
4% with
beads.

%

85

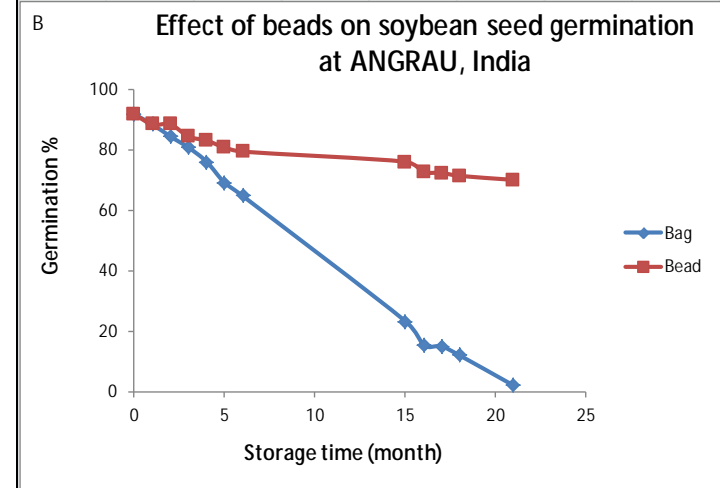
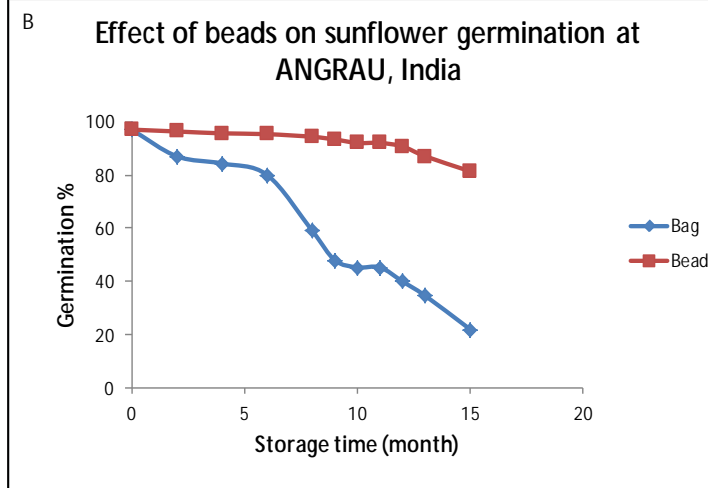
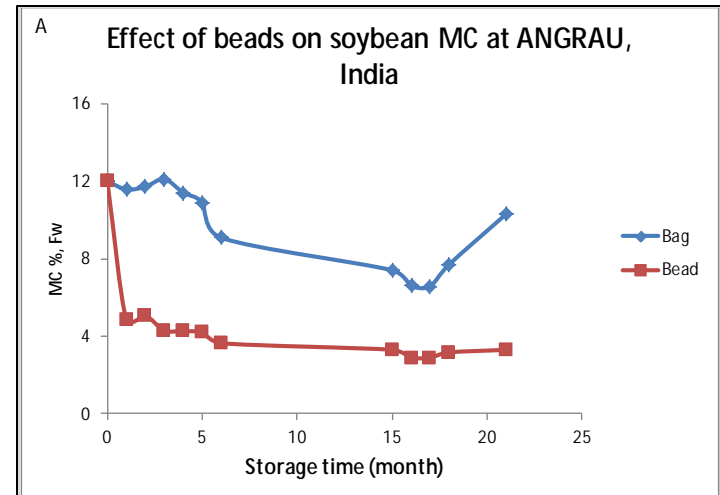
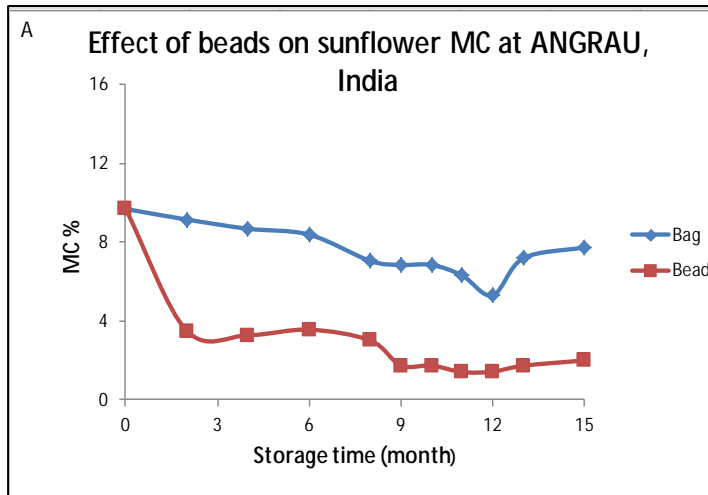
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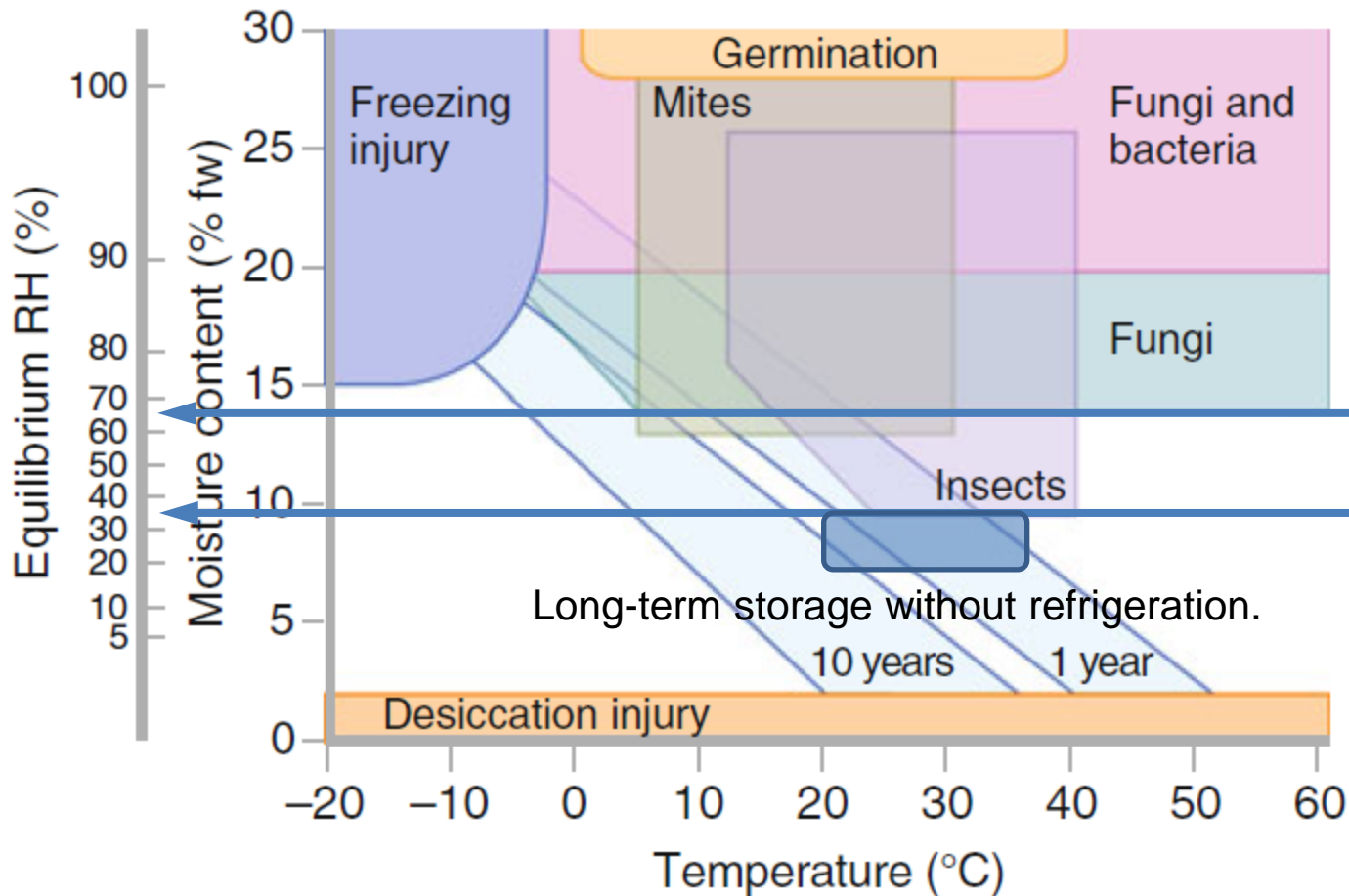
Germination
decreased by
45% in open
bags vs no
change with
beads.

1 year of storage

Seed MC and Longevity



Safe Storage at Low Moisture Content



Drying below ~35% eRH prevents all storage pests, and the production of mycotoxins in stored commodities.

Roberts EH (1972). Viability of Seeds. Chapman and Hall Ltd., Syracuse, NY, pp 14-58.

Drying Prevents Insect Damage

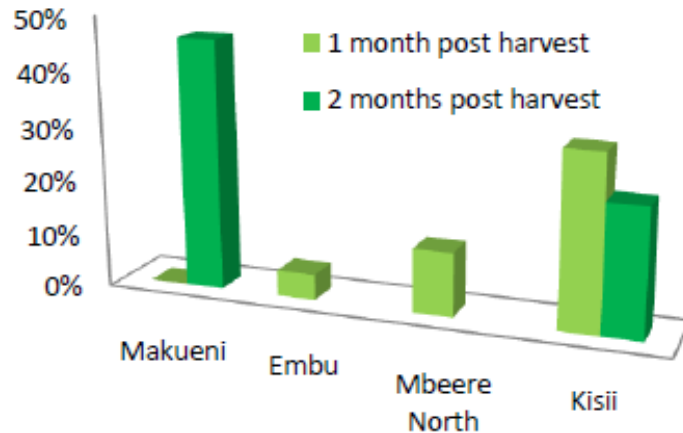


Bead-dried seeds were not consumed by bruchids.
Keshavulu Kunusoth, ANGRAU, Hyderabad, India

Potential for Mycotoxin Reduction



Figure 2⁵: Percent of maize samples from markets with aflatoxin levels > 20 ppb, Sept – Dec 2009 (1 and 2 months post harvest)



- Mycotoxins (e.g., aflatoxin) can accumulate in storage.
- Drying at harvest and maintenance of a “dry chain” could dramatically reduce postharvest losses and improve health.

Many Commodities Can Be Dried



Flowers, spices, fruits, vegetables, shrimp, meat, etc.

Potential Economic Benefits

- Surveys and market analyses by Krishna Timsina (PhD student) and Ganesh Shivakoti (Co-PI) in Nepal indicate that preservation of seed quality would result in:
 - **Onion seed:** \$35 per kg net increase in income and \$7.1 million national incremental return
 - **Chili seed:** \$514 per kg net increase in income and \$4.1 million national incremental return

Demonstrations and Education



Many local workshops have been conducted with farmers in the target locations.

Community-Based Approaches

A key feature of drying beads is that they are only needed for a short period to absorb moisture, then can be removed, reactivated and reused.


A local agro-vet or seed vender could invest in beads and an oven and could “rent” the beads with the user only paying for the drying cost.

Similarly, a community or cooperative could invest in beads and an oven and lend beads to users who would return them for reactivation.

International Workshops



A Better Way to Dry Seeds



Seed Drying using Desiccant Beads

Demonstration and Training
February 7, 2012
HortCRSP Innovation Center
Kasetsart University
Bangkok, Thailand




Topics covered:

- Seed drying with beads
- Applications for smallholders
- Preserving seed quality
- Preventing loss due to mold and insects
- Regeneration and reuse of beads

Who should attend:

- Seed producers
- Seed companies
- Government scientists
- Farmers
- Extension personnel
- NGOs

To register, contact:
Patcharin Taridno (ann@rhino-research.com)
Rhino Research Group, Phitchit, Thailand
Tel: +66 56650 646 Web: www.rhino-research.com

HortCRSP   

- Invite a broad range of participants
 - *Govt. agencies, NGOs, seed companies, researchers*
- Demonstrate use of drying beads
- Invite additional collaborators
- Initiate new demonstrations and trials

Completed international workshops:

Dhaka, Bangladesh, 30 January 2012

*Bangkok, Thailand, 7 February 2012

Nairobi, Kenya, 14-15 February, 2012

*Bangkok, Thailand, 25-26 October 2012

*Nairobi, Kenya, 9 May 2013

**Associated with HortCRSP Innovation Centers*

Drying Beads Showcase

Bangkok, Thailand October 25-26, 2012



HRH Princess MahaChakriSirindhorn



Contacts

- Kent J. Bradford, Peetambar Dahal
Seed Biotechnology Center, University of California, Davis, CA, USA
Telephone: +1 530 752 6087; +1 530 752 9098
Email: kjbradford@ucdavis.edu; pdahal@ucdavis.edu
Web: sbc.ucdavis.edu
- Johan van Asbrouck, Patcharin Taridno
Rhino Research, Phitchit, Thailand
Telephone: +66 56 650 646; +66 81 971 2411
Email: johan.rhino@gmail.com; ann@rhino-research.com
Web: www.rhino-research.com
- Noah Phiri, Richard Musebe, Daniel Karanja, Roger Day
CABI, Nairobi, Kenya
Telephone: +254 (0)20 7224450
Email: n.phiri@cabi.org
Web: www.cabi.org