Technical Session 2
Desiccant Beads for Efficient Seed Drying and Storage

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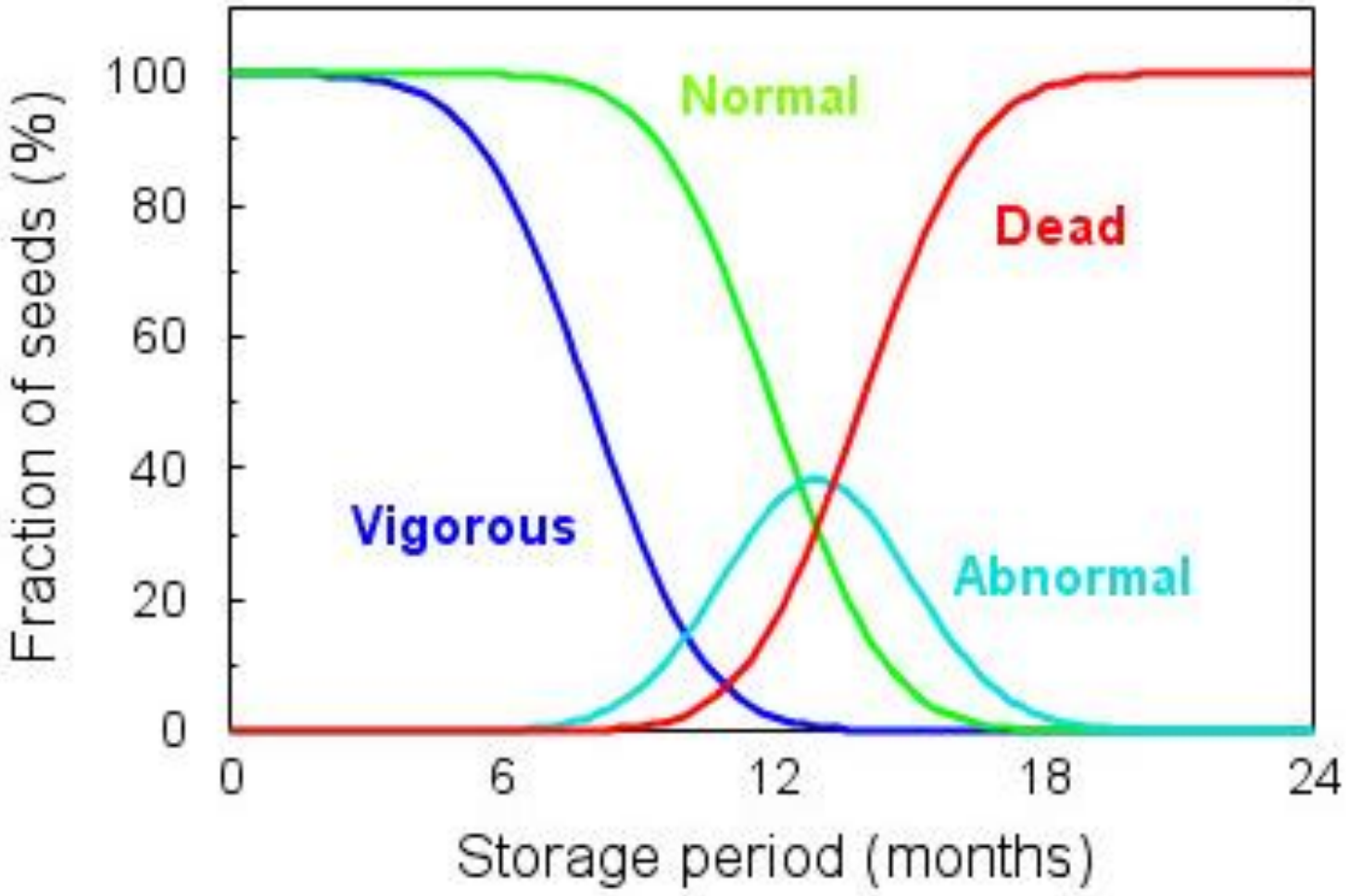
Seed Deterioration



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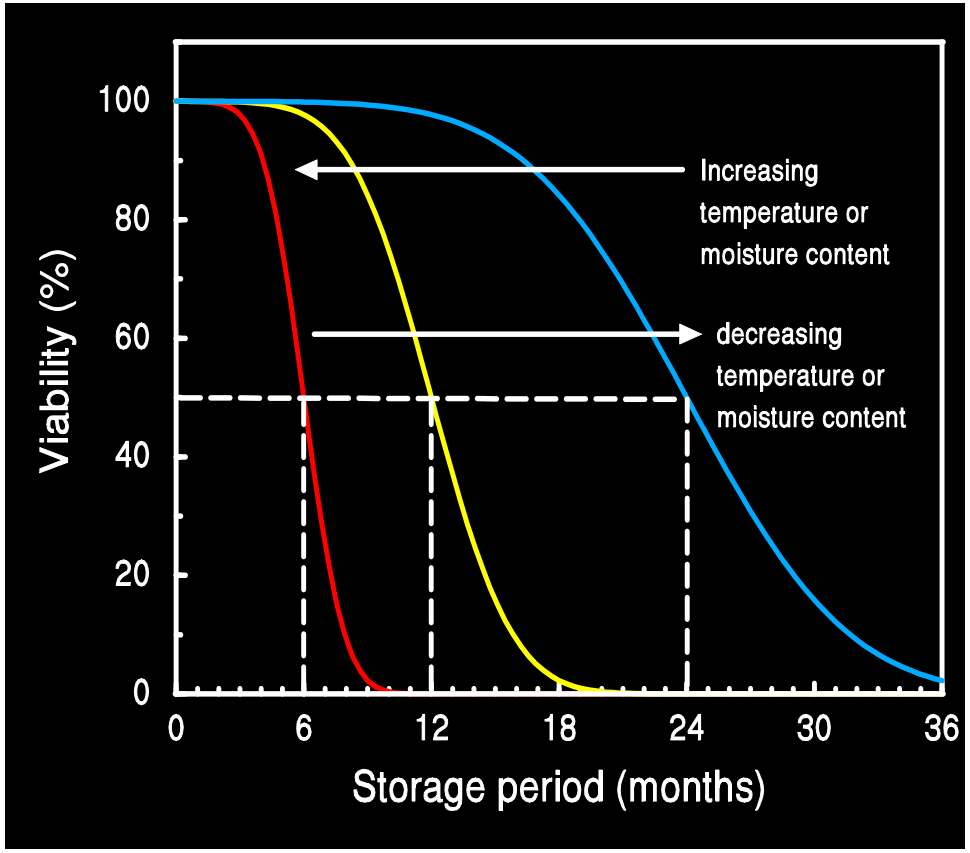
Factors Affecting Seed Longevity

The period for which seeds can remain viable is greatly affected by:

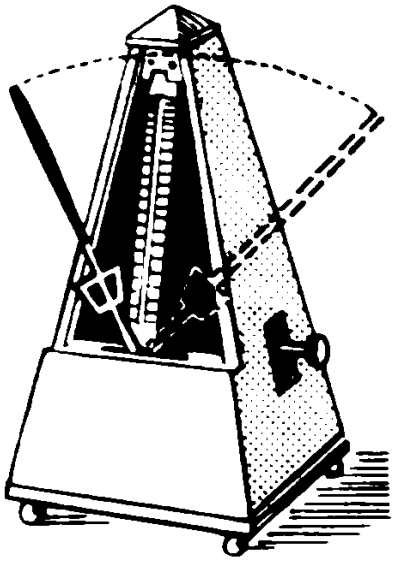
- Species
- Quality at the time of collection
- Conditions between collection and storage
- Conditions of storage
  - Temperature
  - Moisture content
  - Oxygen

Thumb Rules for Seed Storage



James' Rule:
Temp (ºF) + RH (%) < 100
Temp (ºC) + RH (%) < 60

Harrington's Rule:
Seed longevity decreases by one-half for every 1% increase in moisture content or every 10ºF (6ºC) increase in temperature.



Bradford's Metronome Rule:
The "clock" starts running as soon as the seeds are mature and they have a total number of ticks before death. The rate at which the metronome ticks depends upon the temperature and moisture content.

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Seed Moisture Content vs. Relative Humidity

Seed type	Relative Humidity (%)				
	15	30	45	60	75
	Seed moisture content, fresh weight basis (%)				
Snap bean	5.0	6.5	8.5	11.0	14.0
Pea	5.0	7.0	8.5	11.0	14.0
Sweet corn	7.0	8.0	9.0	10.0	12.5
Spinach	7.0	8.0	9.5	11.0	13.0
Onion	6.0	7.0	8.5	10.0	12.0
Carrot	5.0	6.0	7.0	9.0	11.5
Tomato	6.0	7.0	8.0	9.0	11.0
Lettuce	4.0	5.0	6.0	7.0	9.0
Turnip	4.0	5.0	6.0	7.0	9.0

J. Harrington

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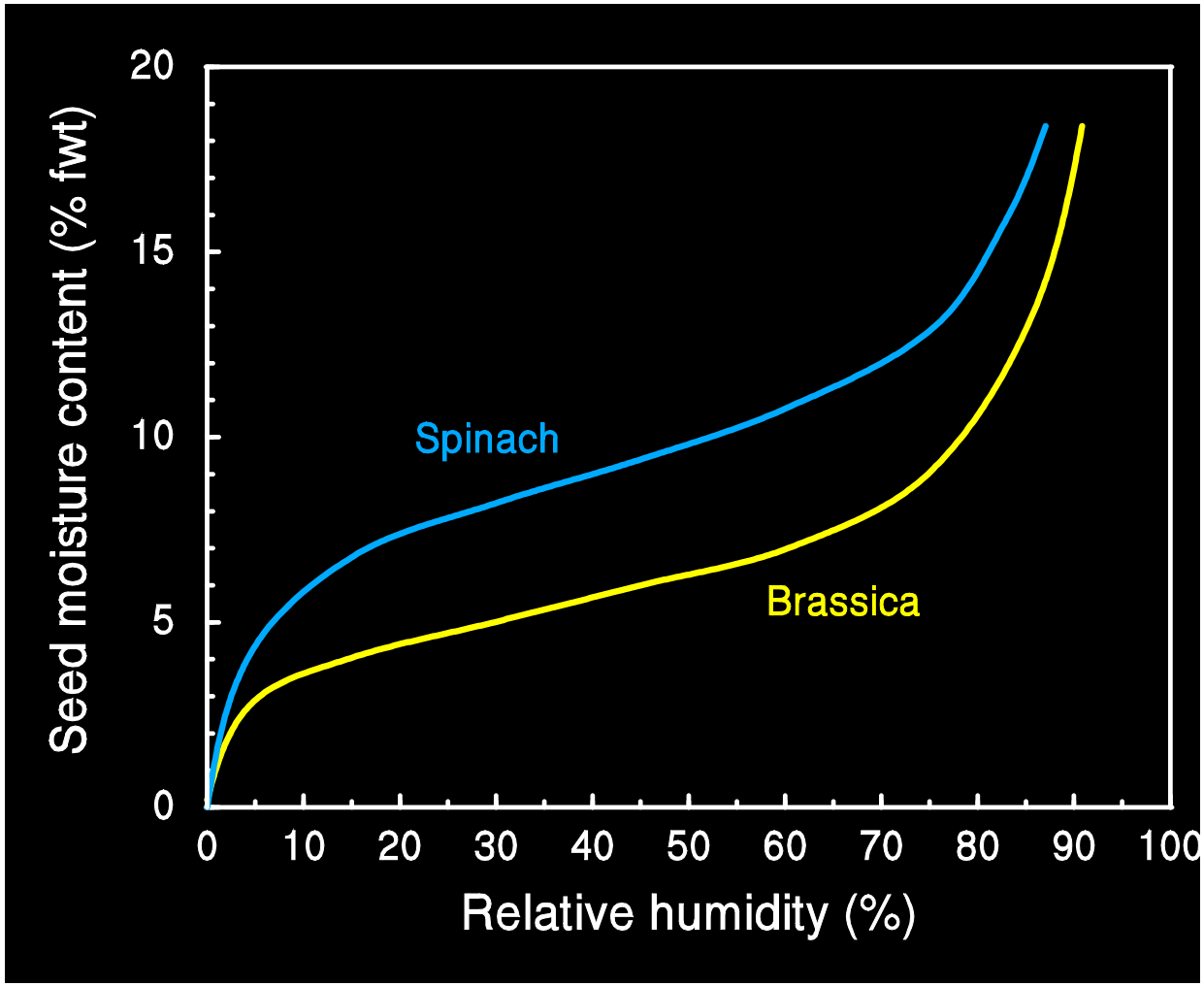
Seed Moisture Isotherms



The relationship between seed MC and ambient RH at a given temperature is called a moisture isotherm.

Seed composition, particularly oil content, results in different seed MCs at the same RH.

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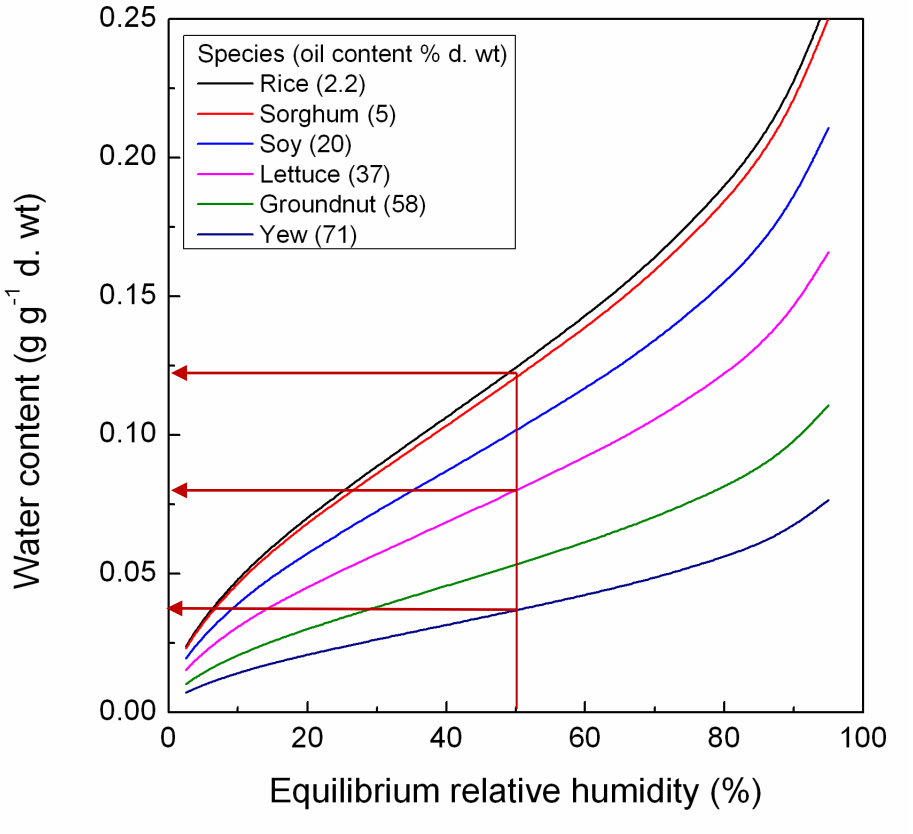
Seed Moisture Isotherms and Oil Content

The higher the seed oil content, the lower the seed MC at a given RH.

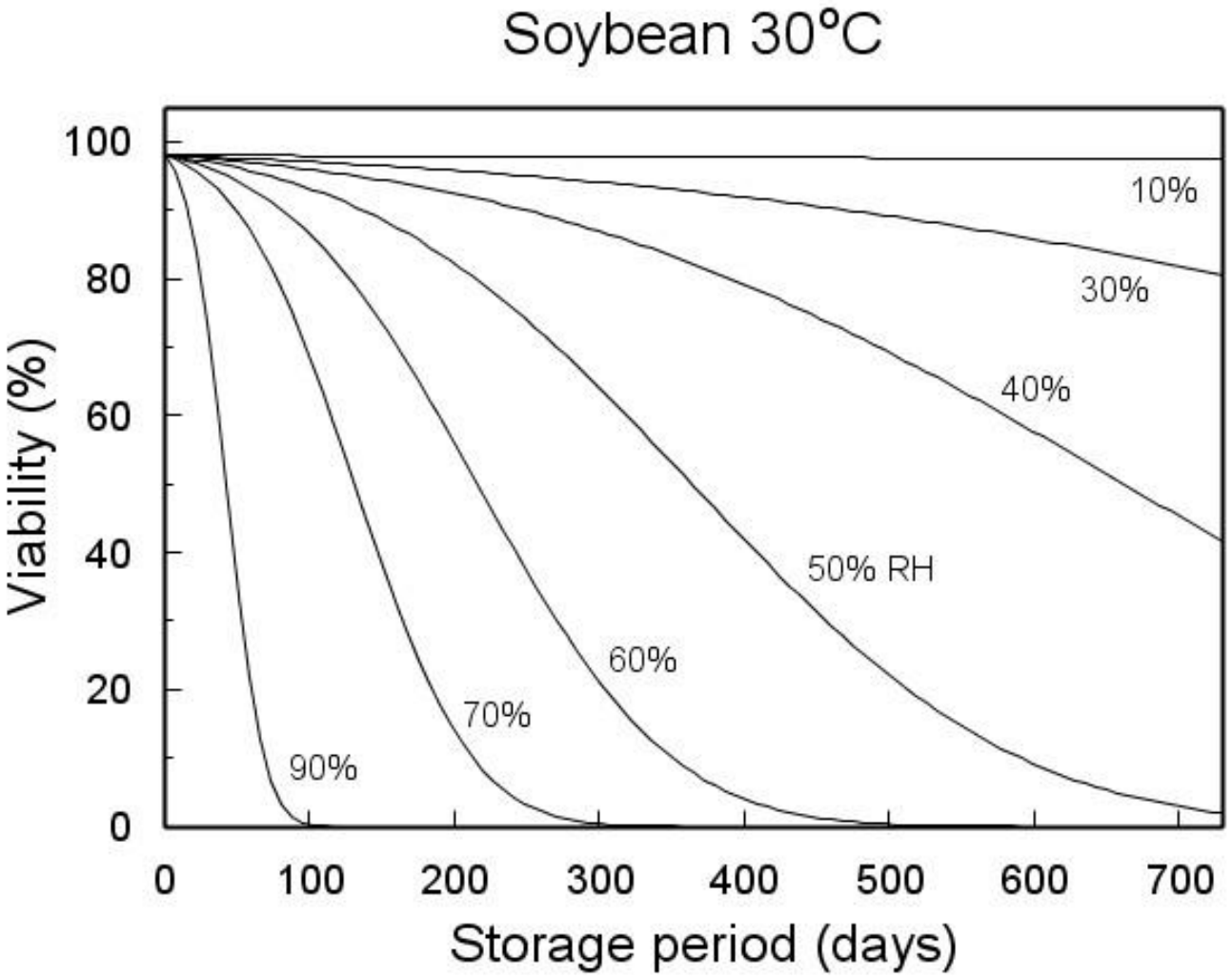
Volume in the seed occupied by lipids excludes water, so seed MC decreases as lipid content increases.



Seeds of different oil content will have different MC at the same RH.

Courtesy of Fiona Hay

Relative Humidity and Seed Longevity



Seed longevity is dramatically affected by RH (MC), particularly as RH increases above about 40%.

http://data.kew.org/sid/viability/

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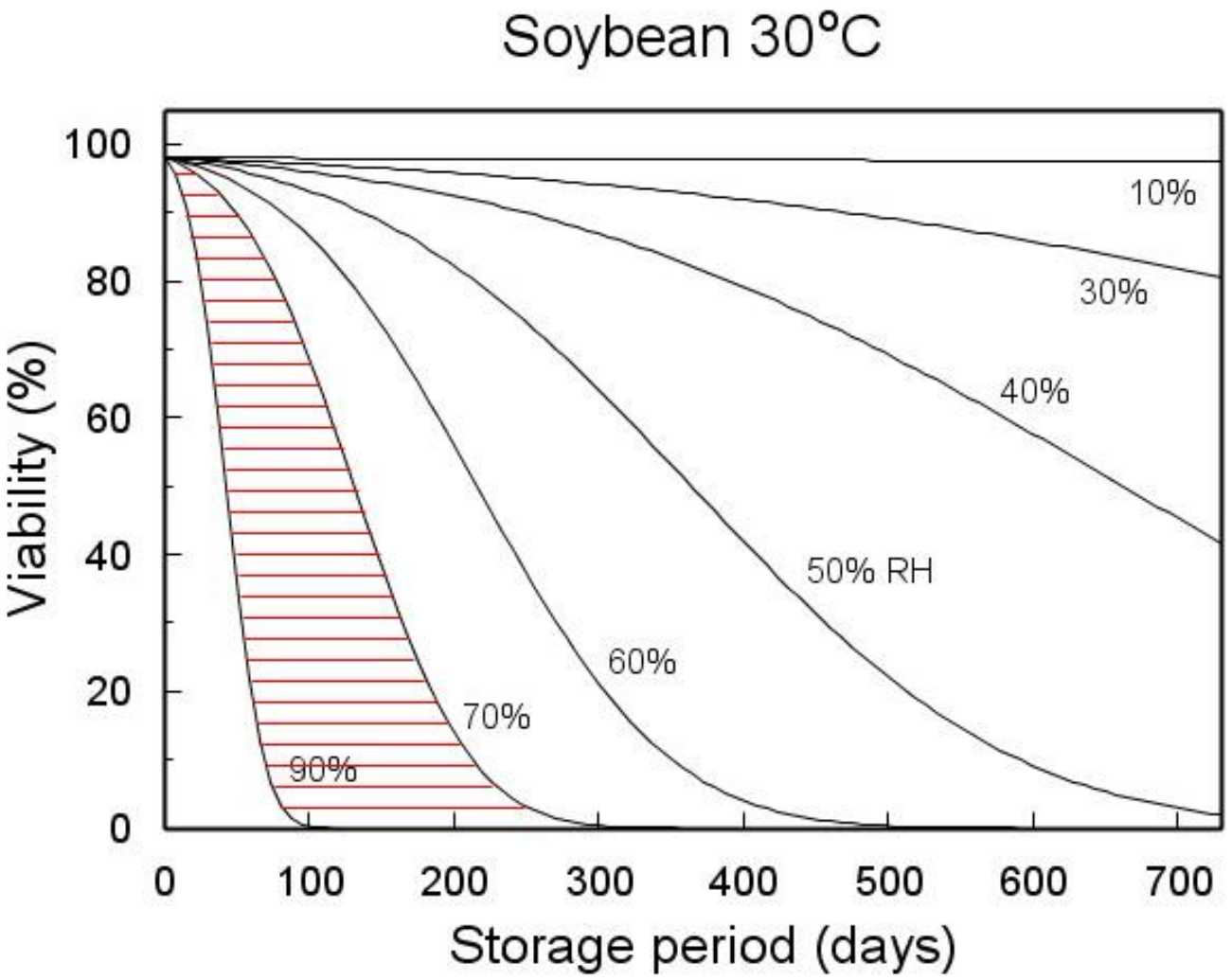
Relative Humidity and Seed Longevity



RH in tropical regions is often in the range where seed deterioration is rapid.

http://data.kew.org/sid/viability/

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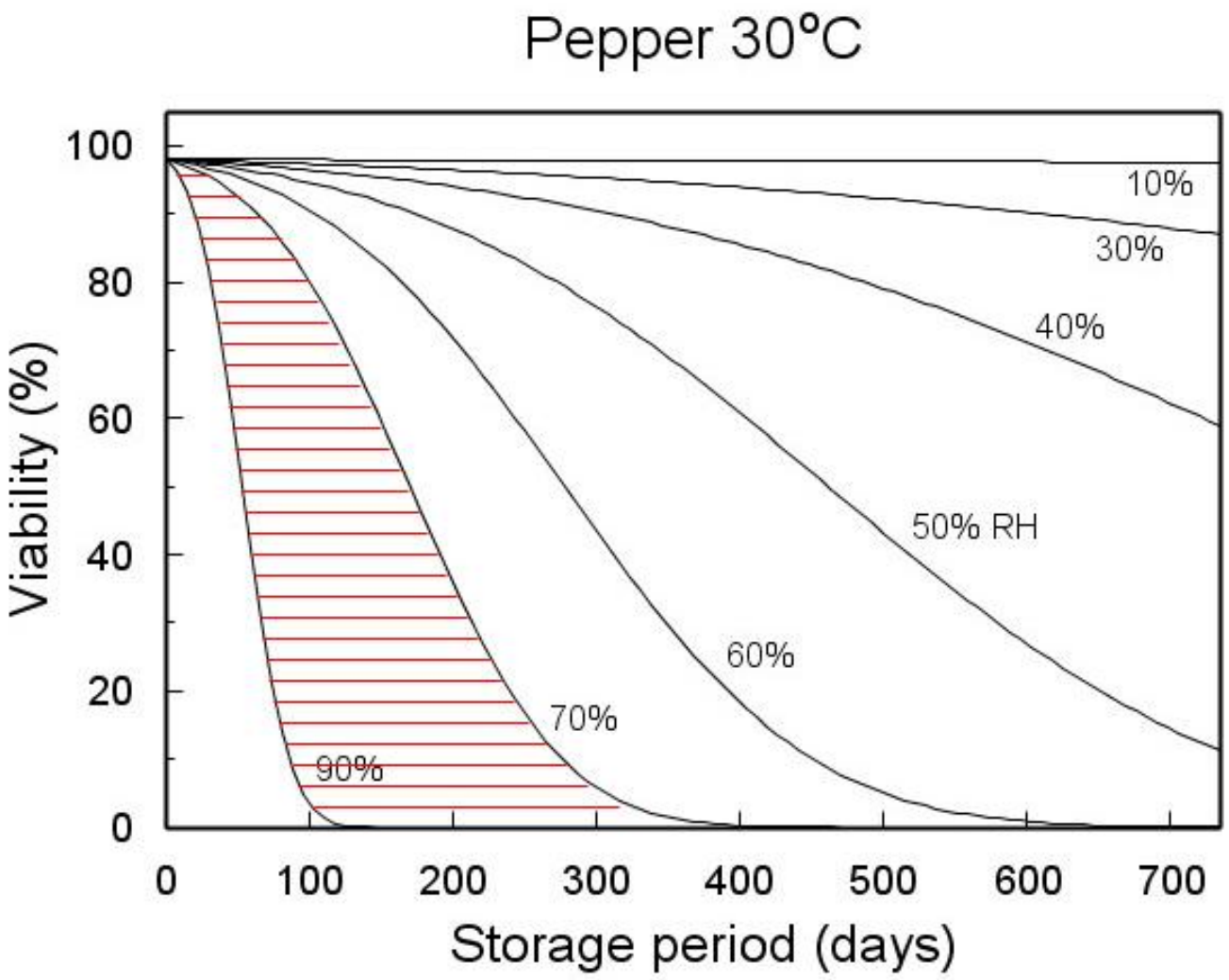
Relative Humidity and Seed Longevity



Very similar relations hold for horticultural seeds as well.

http://data.kew.org/sid/viability/

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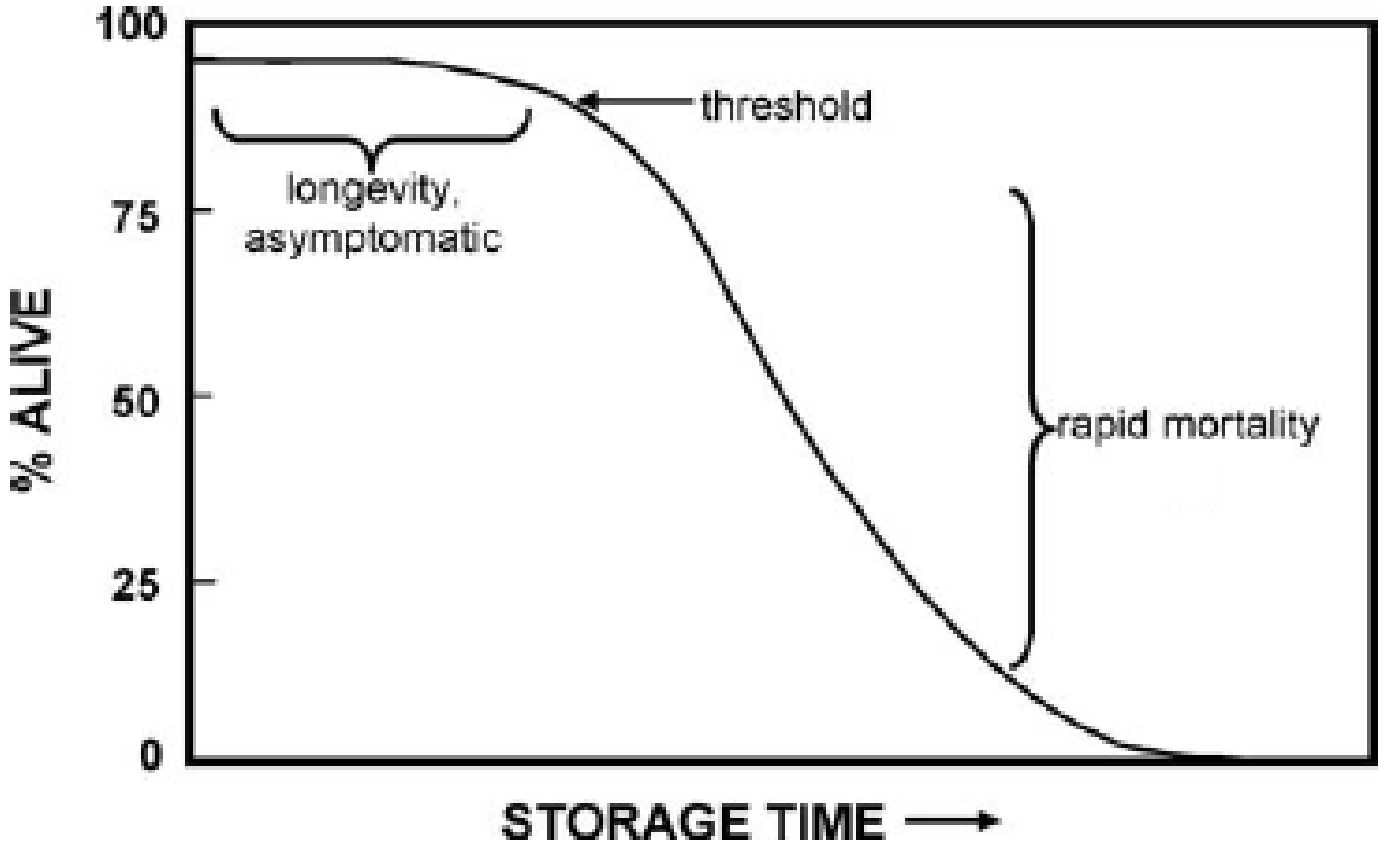
Loss of Viability Shows a Threshold Pattern



In many cases, seeds tend to survive well during storage for a period of time, then die over a relatively shorter period, but the relationships with MC are the same.

Walters et al. (2010) Plant Science 179: 565-573.

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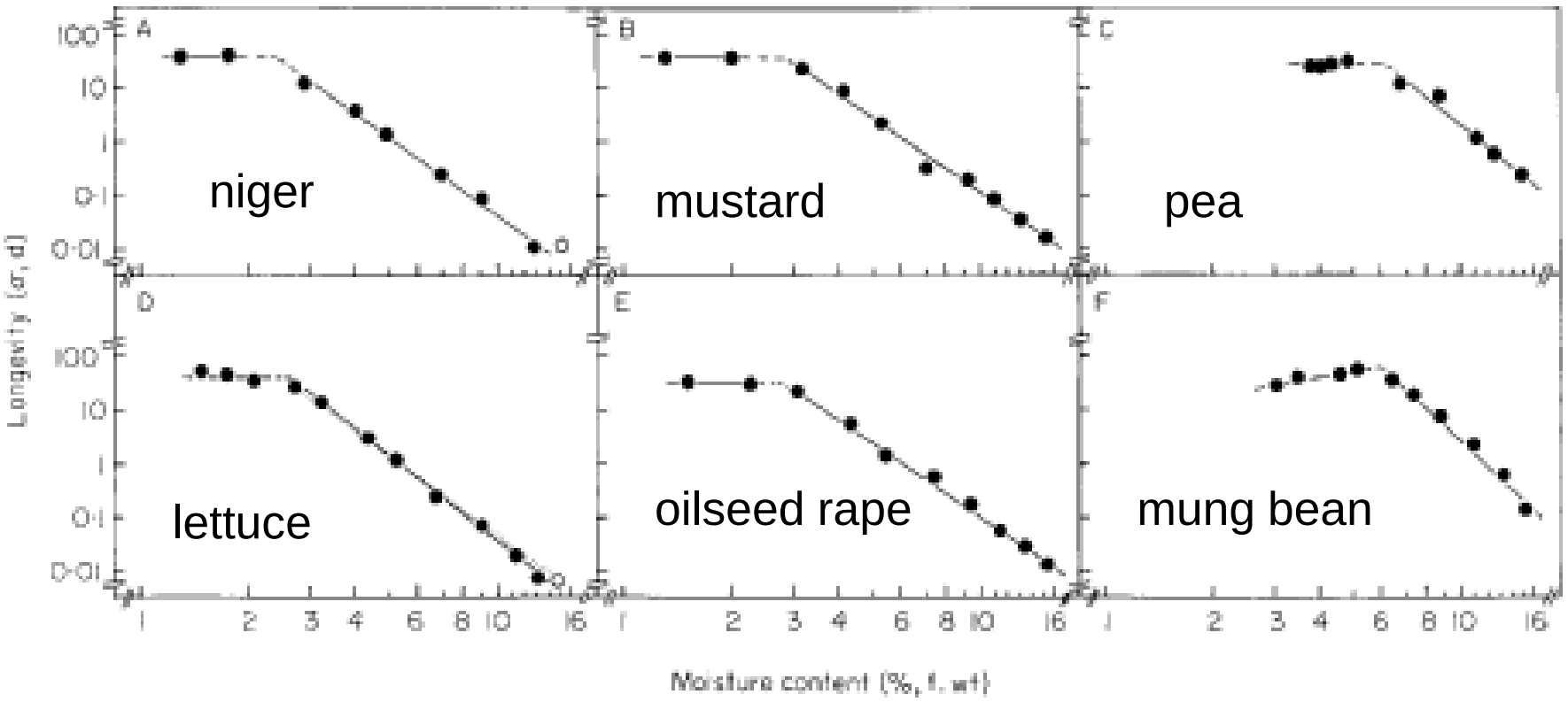
Seed Moisture Content and Seed Longevity



The relationship between lower MC and increased longevity holds for many seeds down to between 2 and 6% MC, depending upon species.

Ellis, Hong & Roberts (1989) *Annals of Botany* **63**: 601-611.

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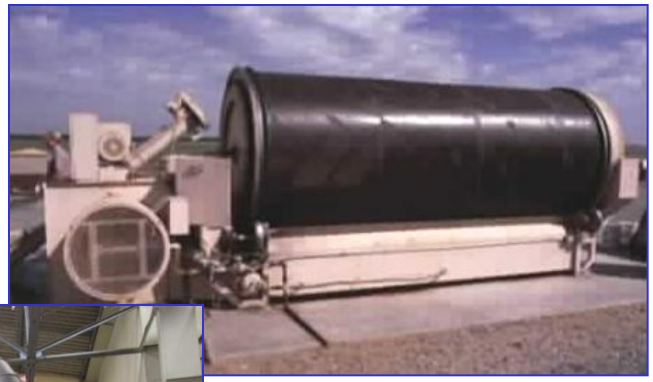
Drying Seeds Will Increase Their Longevity

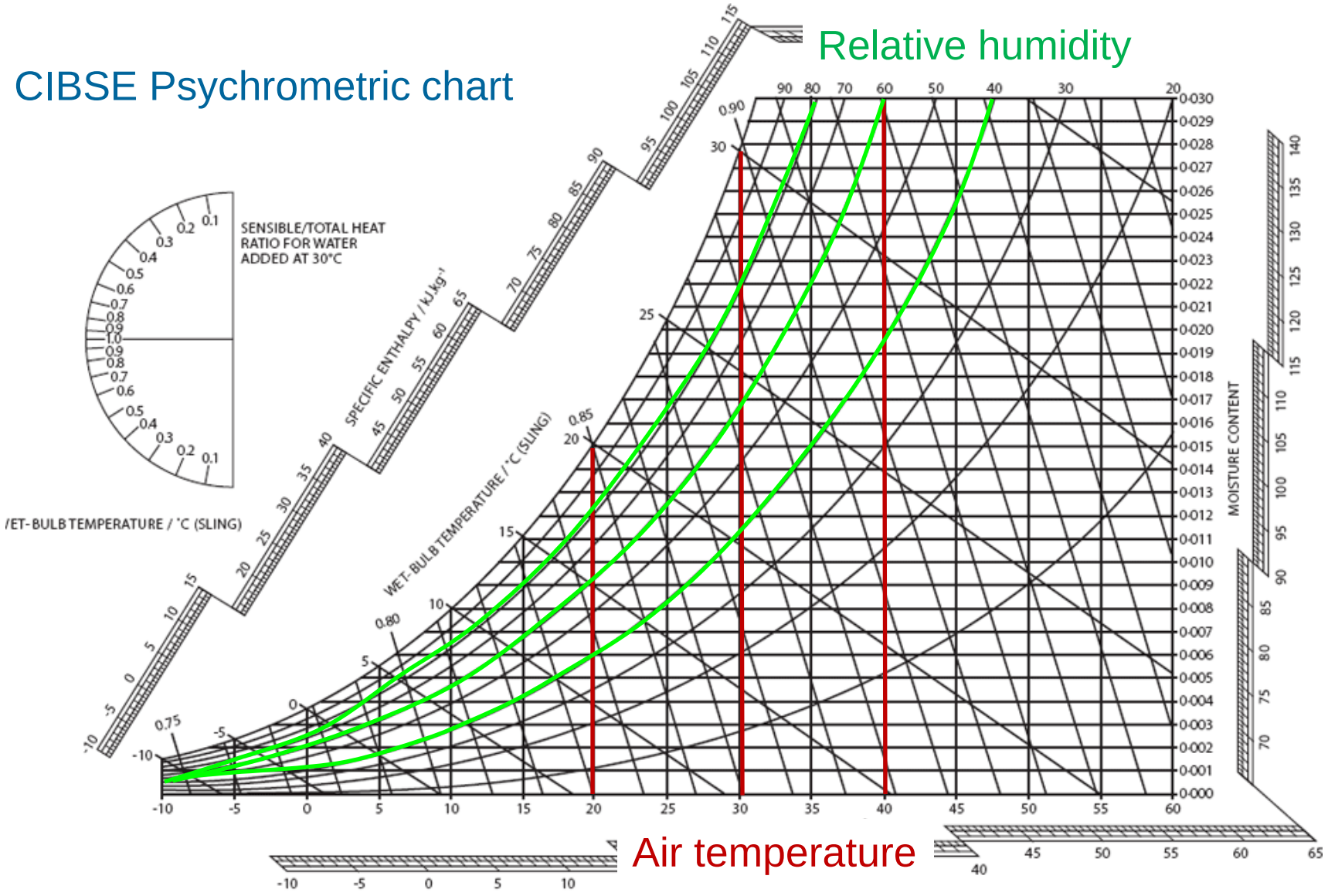
Seeds are often dried in the sun, but this cannot reduce the seed MC to low levels if ambient RH is high.

Drying Seeds Will Increase Their Longevity



Seeds can be dried using heat, but this is also relatively ineffective in hot and humid conditions.

Temperature/RH Relationships



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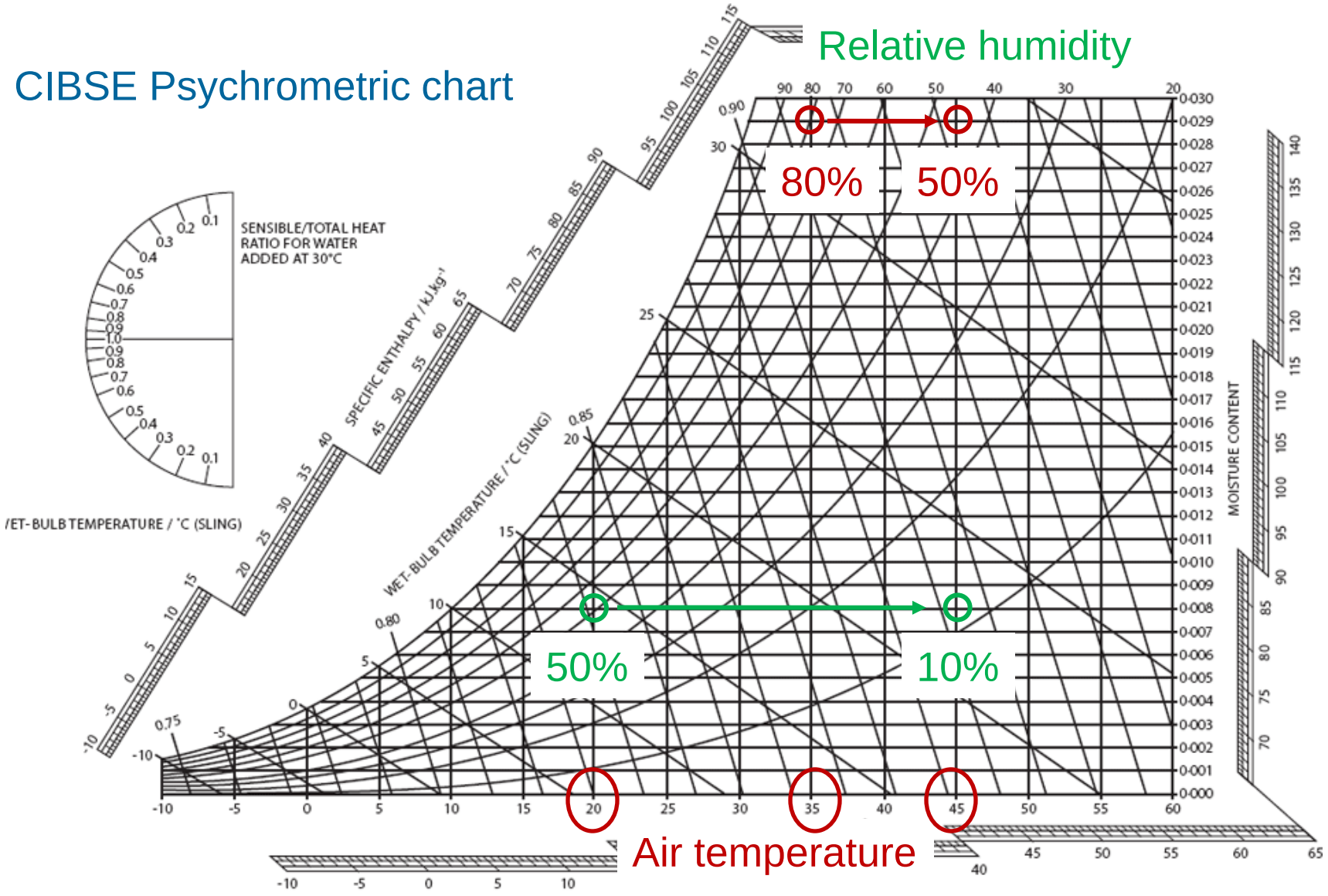

Packaging and Long-Term Storage

- **Packaging of seeds**
  - In open storage, seed MC varies with RH
  - Sealed packaging maintains low MC

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Alternative: Drying with Desiccants

Desiccants are well known and can be used to absorb moisture from seeds.

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

Today, we want to describe and demonstrate novel seed drying beads that make it feasible to efficiently dry and store seeds at low RH.

SEED BIOTECHNOLOGY CENTER

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New Technology for Post-harvest Drying and Storage of Horticultural Seeds

- Supported in part by the Horticulture Cooperative Research Support Program of the US Agency for International Development.
- Demonstrate simple and efficient methods for drying and storing seeds, particularly for resource-poor farmers.

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New Technology for Post-harvest Drying and Storage of Horticultural Seeds

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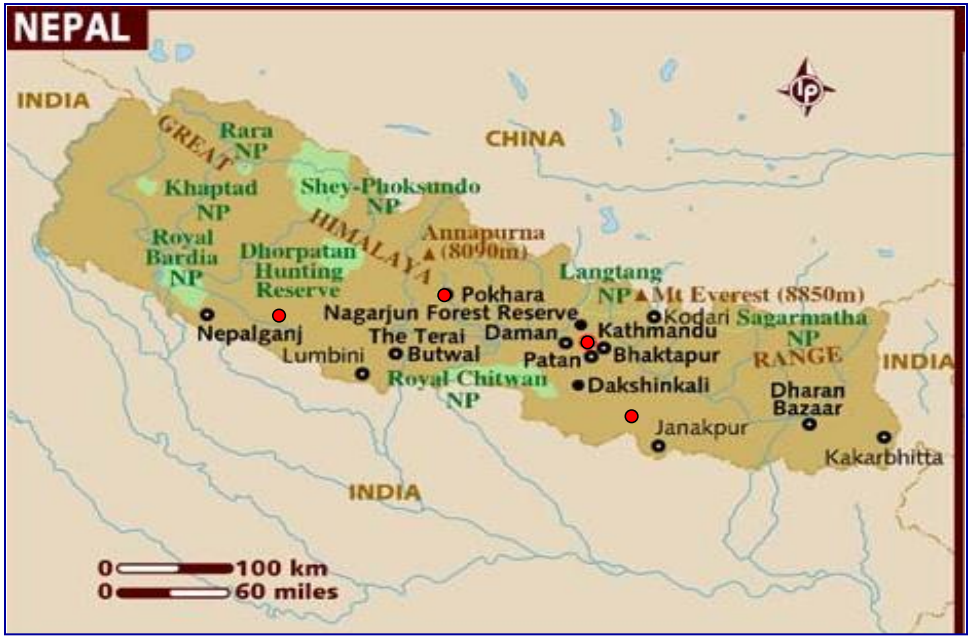

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