

# Seeds and ECHO

ECHO provides options in the following ways:

- ◉ Technical Support
- ◉ **Seeds**
- ◉ Web site
- ◉ Training
- ◉ Publications



# Seeds and ECHO

Types of seeds ECHO provides:

## **ECHO provides trial packets of seed :**

- Vegetables
- Beans
- Fruits
- Multi-purpose Trees
- Cover Crops
- Pasture/Forage Species



# Seeds and Ag Development

Importance of trial packets

- Seed delivered in small quantities will enable farmers to learn about the new materials without compromising their production stability.
- Sizes should be small enough that any production loss will not dent harvests.
- Farmers in many African regions are used to the format of such 'peanut-sized packages' and have favorably received new varieties this way in the East, Central and Southern African regions.

*Quotes from CIAT "Seed Systems Under Stress" practice briefs  
(<http://webapp.ciat.cgiar.org/africa/pdf/pb1-5.pdf>)*

# Seeds and Ag Development

## Local Seed Systems

- Trial seed packets are not the whole answer
- Suitcase seeds often assume there is no solution locally!
- First learn about the formal and informal seed systems that are already in place in your area
- Seed security involves availability, access and quality
- Goals that drive seed system interventions are:
  - Food Security
  - Resilience
  - Nutrition
  - Income



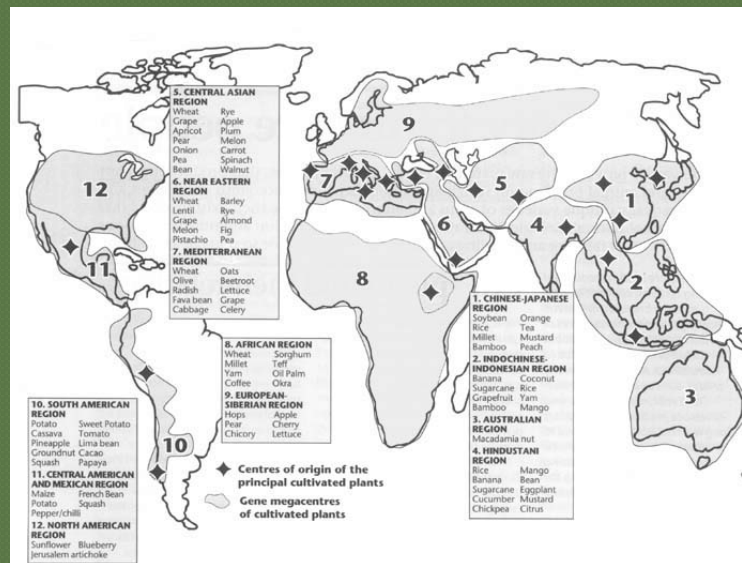
# Seed Saving Steps and Technologies



TAD I Course  
Holly Sobetski

# Gene loss

- It is estimated that 75% of all crop genetic diversity has been lost or gone extinct in the last century -- World Summit on Sus. Develop 2002
- How has that happened and what are the effects?



# Why save seeds?

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- ◉ Promote and retain biodiversity
- ◉ Retain cultural diversity (Agri + culture)
  - Seeds and techniques develop within particular cultures
  - Often seeds and varieties are developed to fit culinary niches
- ◉ Cost effective
- ◉ Give away
- ◉ Empower others
- ◉ Food security
- ◉ Retain local control
- ◉ Small and easy to transport
- ◉ Because it's fun
- ◉ No other option
- ◉ Breed/select new varieties
- ◉ Ensure quality

# The importance of seeds

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**Genesis 1:29 "I give you every seed bearing plant on the face of the whole earth and every tree that has fruit with seeds in it. They will be yours for food."**

# Introduction:

## Workshop goals

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- ① Understand the essential steps in seed saving
- ② Look at practical tools and technologies for seed saving



# Introduction:

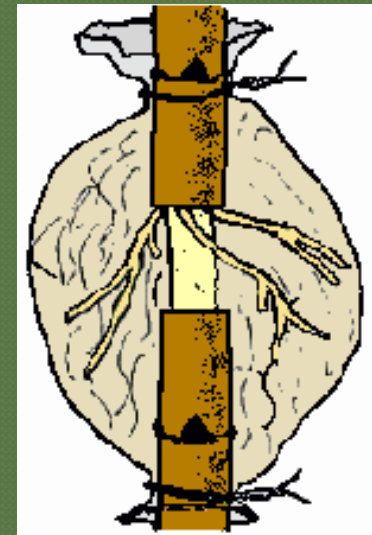
## Workshop content

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- ◉ Identify the importance of saving seeds
- ◉ Pollination
- ◉ Steps in saving seeds:
  - Decide what crops to work with
  - Seed multiplication
  - Seed collection
  - Drying
  - Seed storage
  - Seed viability testing
  - Seed distribution
- ◉ Harvest seeds on the farm and go to the seed barn

# Asexual Reproduction: Vegetative Parts

Allows for the duplication of a plant



# Sexual Reproduction: Flowers and Seeds

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Pollination and Seed Biology begins with:

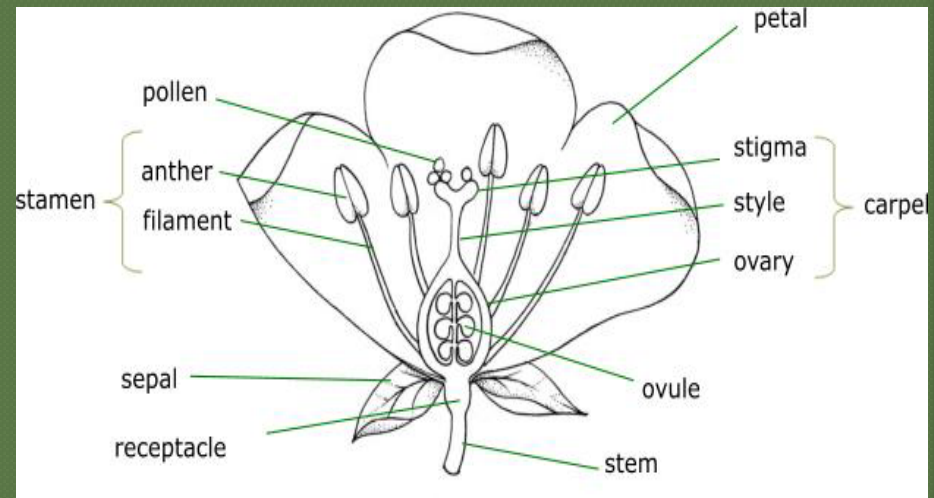
# Flowers and pollination

## ◉ Flower structures

- Male: stamen (anther and filament)
- Female: pistil (stigma, style ovary)

◉ **Pollination:** the transfer of pollen by wind or insects from the male to female flower structure

◉ **Fertilization:** when the pollen or sperm combines with a female gamete in an ovule. The fertilized ovule forms a seed. The ovary develops into the fruit.





Pollination and Seed Biology

# Flowers and pollination

- Self-pollination
- Cross-pollination





## Pollination and Seed Biology

# Flowers and pollination

- Self-pollination - occurs when pollen from one flower fertilizes the same flower or other flowers on the same plant.
- Cross-pollination - occurs only when pollen is delivered to a flower from a different plant.
- Cross-pollination can occur between plants that are naturally self-pollinated because insects and wind carry pollen to the flowers.
- How does this impact seed saving?



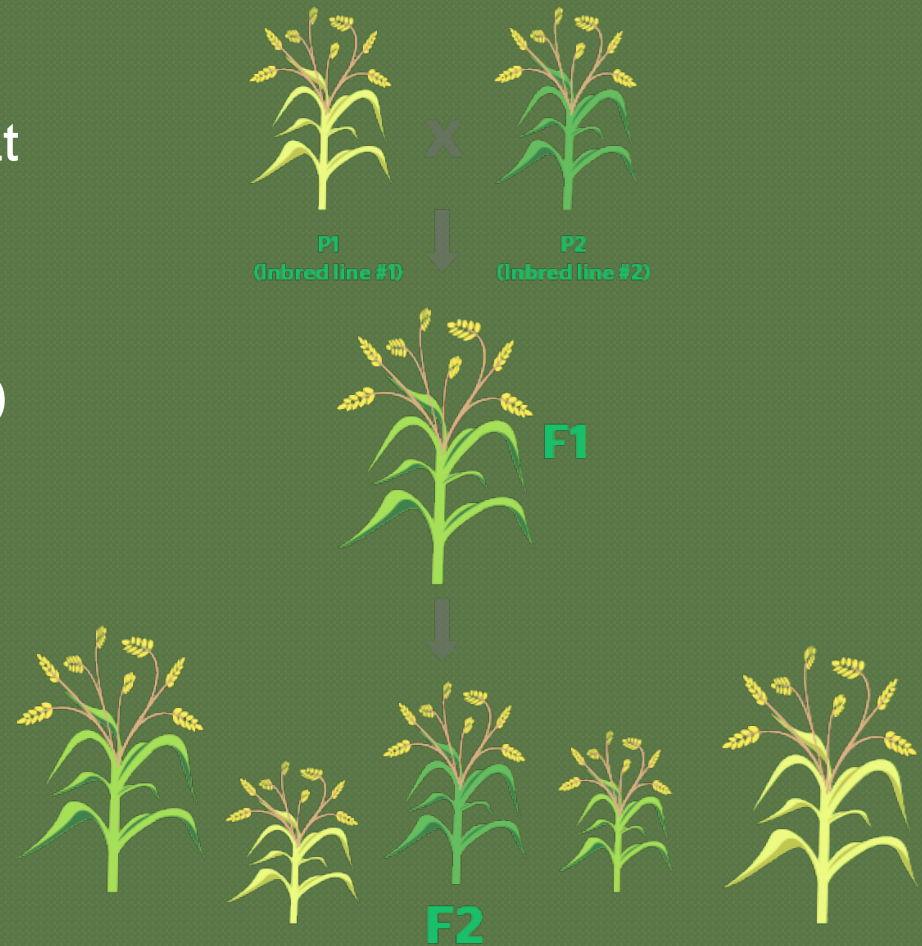
# Open Pollinated Seeds

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- Open pollinated - 'Heirloom', 'Traditional', 'Indigenous'
  - Plants that have been domesticated over time and produce 'true to type' seeds
  - Traits relatively stable over time; can be saved
  - Genetic makeup more diverse than hybrids
    - Under adverse conditions, some plants may die, but others may survive and have resistance
    - Crop harvest lengthened, as seeds/fruit do not all mature at the same time

# Hybrid Seeds

- A hybrid is created from the cross of two distinctly different parent plants that have been inbred for specific traits
- The offspring are uniform (F1)
- F1 hybrid plants do not produce 'true to type' seeds
- They lose 'hybrid vigor' in subsequent generations
- Saving seeds is not recommended and sometimes illegal



# Seed saving steps:

- ◉ Decide what crops to work with
- ◉ Seed multiplication
- ◉ Seed collection
- ◉ Drying
- ◉ Seed storage
- ◉ Seed viability testing





Decide what crops to work with

# How to know what to multiply

- ◉ Observe what farmers are already growing and look for better varieties of those crops
- ◉ Identify needs and possibly introduce new crop for a specific need
- ◉ Conduct small plot trials to test new varieties/species and get farmer feedback (and then send to ECHO!)





# Decide what crops to work with

## Farmer Seed Selection

- Can be as simple as farmers taking notice of valuable traits and tagging plants to harvest from later
- Can be by cross pollinating plants that have valuable traits
- Can be bagging fertilized flowers to prevent cross-pollination
- Thousands of varieties of plants have come about this way



Seed Multiplication

# Grow the crop



- Select land – consider renting
- Ensure adequate soil moisture and fertility
- Control pests
- Labor
- Plant sufficient quantities of seeds
- Label the varieties

## Seed Multiplication

# Be aware of cross-pollination

- Some plants are very susceptible to this, especially if they are flowering at the same time
- Ways to overcome
  - Grow them apart - consult literature for isolation distances for specific crops
  - Plant at different times
  - Bag flowers or use isolation netting
  - Hand pollination





# Selecting plants for harvest

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- Select for desired traits such as:
  - Pest resistance
  - Drought resistance
  - High yield of desired plant part
- Mark which plants you want to harvest from
- Rogue out undesirable plants so that they do not contaminate the good plants

# Seed harvesting/collection





# Harvest at the right time

- Harvest from desired plants
- Harvest with the aim of maintaining genetic variation so plants can adapt to changing conditions
- Often a compromise between moisture and seed loss
  - Harvest when fully mature and moisture content is low
  - Harvest before seeds potentially shatter (fall off plant) or rot
  - Harvest before bad weather



# Harvesting seeds

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- ◉ Can hand pick or cut in most cases
- ◉ In most cases you want to remove seeds from the pod, fleshy ovaries or inflorescence before cleaning/processing
- ◉ Label!



## Seed Collection: Cleaning seeds

### **For dry seeds (beans, peas, lettuce)**

- ⦿ Let seeds dry on the plant
- ⦿ Beans: mature when pods are brown and seeds rattle in the pod.
- ⦿ Thresh as appropriate
- ⦿ Remove unwanted particles:
  - Winnow
  - Sift using screens









Seed Collection: Seed Cleaning

## **For wet seeded fruits**

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- ◉ Cut the fruit open with a knife
- ◉ Scoop seeds into a container of water
- ◉ Float test:
  - Non-viable seeds float; scoop off and discard
  - Viable seeds are heavier and will sink
  - NOTE: This doesn't work with every type of seed!
- ◉ Dry good seed on screens

Seed Collection: Seed Cleaning

# For wet seeded fruits

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Seed Collection: Removing pulp from seeds like tomato

# Fermentation



- Squeeze pulp with seeds into a container and allow mold to grow
- Mold degrades pulp after a few days; wash seeds using a sieve
- Another way to remove pulp is to rub seeds with a small brush



Seed cleaning: Ensure seeds are pest/pathogen free

# Minimize pests in the field

- Controlling seed pests starts in the field
- Ways to avoid pest infestations
  - Avoid planting near neighboring crops/fields with high pest pressure
  - Study life cycles of pests and time plantings accordingly
- Use pesticides properly, as needed



*Cowpea seed damaged from piercing insect activity*



Seed cleaning: ensure seeds are pest/pathogen free

## **Control pests in harvested seeds**

- Diseases: Soak seeds in 10% bleach solution (for 5-15 min followed by rinse) to sterilize seed surfaces
- Insects:
  - Spread seeds out in the sun (be careful of high temp)
  - Place seeds in freezer for a time
    - Many tropical seeds will survive if dry beforehand
    - If unsure, freeze small quantity- then test germination
    - Monitor seeds in case eggs survive freezing
  - Try vacuum sealing - deprives insects of oxygen

# Seed Storage

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Seed storage: response of seeds to low moisture

# Seed Storage Behavior

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- Orthodox vs Recalcitrant seeds
- Orthodox or 'normal' seeds slowly lose viability over time
  - Cereals
  - Many kinds of vegetables
- Recalcitrant seeds quickly lose viability
  - Onions, mango, avocado, neem, jackfruit
- Remember that seeds are living organisms and can die in storage



Seed storage: Ways to pre-dry seeds before storage?

## Spread orthodox seeds out to air dry

- The ideal seed moisture content for storage is 5-10%
- You can dry seeds in the sun or shade, and use a method to recirculate, heat or remove moisture from the air
- Drying slows respiration, which helps longevity
- Be sure the temperature does not exceed 41C (105F) for tree or high oil seeds and 54C (130F) for most other orthodox seeds





Seed storage: how to know if a seed is dry enough

# Testing for dryness

- ◉ EDN 136: Are my seeds dry enough?
- ◉ Bite and bend test
- ◉ Salt jar
- ◉ Oven drying
- ◉ Moisture meter



# Some Appropriate Drying Methods



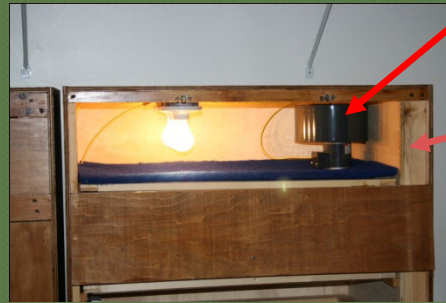


# Some Appropriate Drying Methods



Seed storage: How to dry seeds before storage?

# Indoor seed dryer



Squirrel cage fan mounted to blow air into this side-wall space with an opening at the bottom where air enters main chamber

- Seeds placed on screens
- Air circulated via a fan and heated with lights
- Thermostat- optional



Seed storage: How to dry seeds before storage?

# Air blown through PVC pipe



- PVC pipe- open at top end
- Small air blower to push air through PVC
- Screens inserted into top and bottom of PVC



ECHO Asia- Rick Burnette, Abram Bicksler: seed moisture ↓ from 45 to 9% in 1 hr

Seed storage: conditions in storage room or containers

# Proper conditions

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- 100 Rule for seed storage: Temperature (°F) + relative humidity (%) of the storage environment should not be greater than 100
  - $\text{Temp (°F)} + \% \text{ humidity} = 100 \text{ or less}$
- Goal - keep seeds dormant but alive
- The most important thing for long term storage of seeds is the amount of humidity (ambient moisture) seeds are exposed to in storage
  - High seed moisture increases respiration (use of oxygen/release of carbon dioxide), resulting in heat buildup and reduced storage life
  - Temperature used to be thought most important
- We are finding refrigeration not ideal: too humid unless you have an airtight container

Seed storage:

# Storage containers

- How to overcome humidity?
  - Climate controlled environment
  - Desiccant
  - Airtight containers (ziploc bags are not airtight)
  - Vacuum sealing



Rubber O-ring

Desiccant  
(silica gel)





Seed Storage: Keeping seeds dry

# Where there is no electricity

1. Heat rice in an oven to drive out moisture in grains.
2. Immediately afterwards:
  - a. Pour rice into an airtight container.
  - b. Close the lid
3. Open lid after 5 minutes and use tissue to wipe off condensation.
4. Place seeds in container and close the lid.



**Rice as a desiccant; Container can be placed underground to stabilize temperature**

Seed Storage: Keeping seeds dry

## Where there is no electricity

- Many people around the world store their seeds above the fire/cook place:
  - low humidity
  - smoke drives away insects





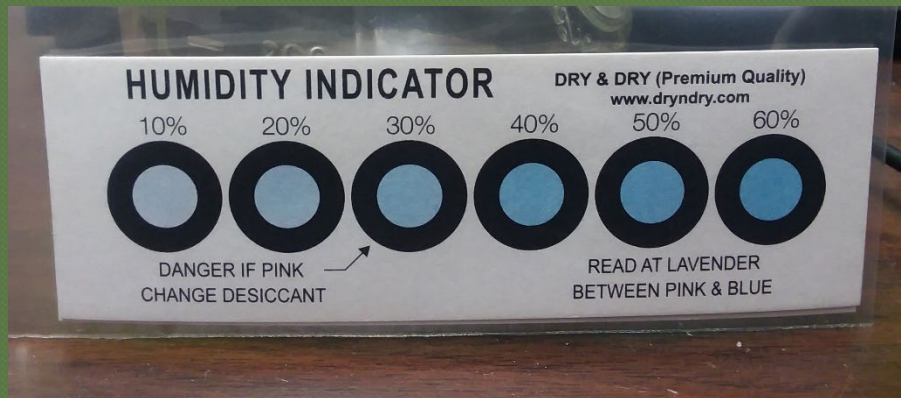






Seed Storage: Keeping seeds dry

# Where there is no electricity



# Seed viability/germ testing

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# Seeds

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## ● What is a seed?

- Embryo of a plant
- With stored food
- Surrounded by a coat

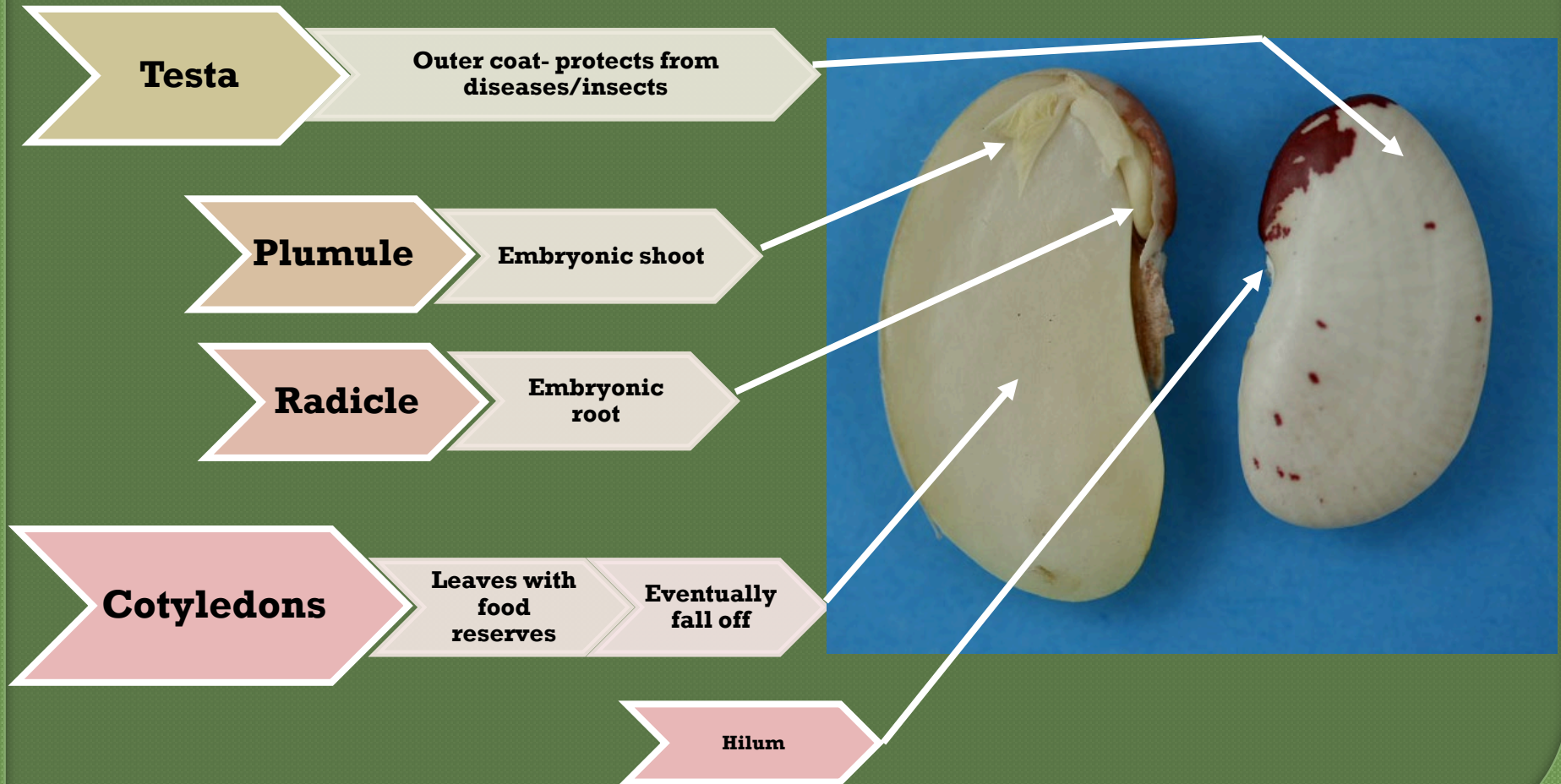


## ● What is the purpose of a seed?

- Means of dispersal of new plants
- Survival – transfers genes to the next generation

## Pollination and Seed Biology

# Structure of a seed



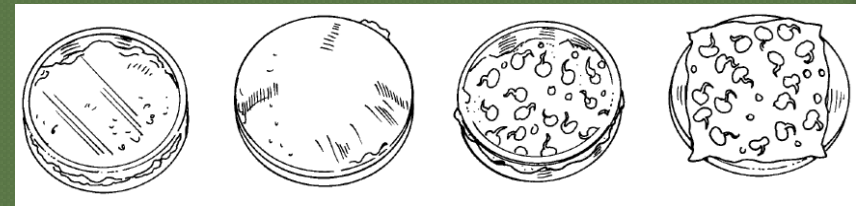
# Seed viability testing

## ◉ Why?

- To determine what % of your stored seeds have survived
- To determine how many seeds you need to plant

## ◉ How?

- By using a germination test
  - Plant in soil
  - Rag doll (damp paper towel)
  - Petri dish
- Obtain a representative sample of 10-100 seeds
- Break dormancy if needed





# Seed viability testing

## ● Aseptic Technique

- Most important aspect of seed viability testing
- Attempts to minimize contamination from fungi, molds, bacteria, etc.

## ● Key ways to overcome contamination

- Clean all tools, surfaces and hands thoroughly with alcohol or bleach
- Sterilize seeds before testing



Seed viability:

# Why seeds may not germinate

## ● Seeds are dead

- The embryos were dead or died in storage
- They died during the germ test due to fungi/disease
  - Clean (5-10% bleach solution) seeds and sterilize surfaces

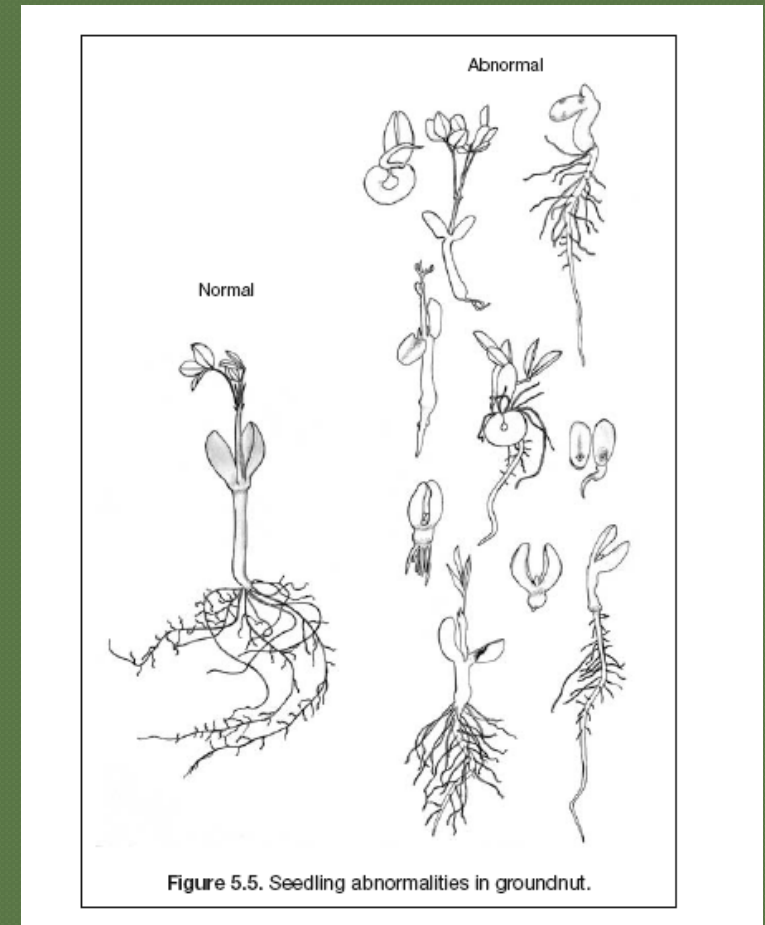
## ● Seeds are dormant

- Tropical seeds: hot water, file seed coat, smoke
- Temperate seeds: some have chilling requirements

Seed viability:

# Seed viability: abnormalities

- Seeds may germinate but not produce healthy plants
- Germinating seeds in soil indicates ability of seeds to push through the soil
- Abnormalities to look for: malformed roots/shoots, stunting



From IPGRI Genebank Manual



Seed viability:

# Some germination standards

**201.31 Germination standards for vegetable seeds in interstate commerce.**--The following germination standards for vegetable seeds in interstate commerce, which shall be construed to include hard seed, are determined and established under section 403(c) of the Act:

Percent	Percent	Percent	Percent
Artichoke . . . . . 60	Celery . . . . . 55	Eggplant . . . . . 60	Pepper . . . . . 55
Asparagus . . . . . 70	Chard, Swiss . . . 65	Endive . . . . . 70	Pumpkin . . . . . 75
Asparagusbean . . 75	Chicory . . . . . 65	Kale . . . . . 75	Radish . . . . . 75
Bean, garden . . . 70	Chinese cabbage . 75	Kale, Chinese . . . 75	Rhubarb . . . . . 60
Bean, lima . . . . . 70	Chives . . . . . 50	Kale, Siberian . . . 75	Rutabaga . . . . . 75
Bean, runner . . . . 75	Citron . . . . . 65	Kohlrabi . . . . . 75	Sage . . . . . 60
Beet . . . . . 65	Collards . . . . . 80	Leek . . . . . 60	Salsify . . . . . 75
Broadbean . . . . . 75	Corn, sweet . . . . 75	Lettuce . . . . . 80	Savory, summer . . 55
Broccoli . . . . . 75	Cornsalad . . . . . 70	Melon . . . . . 75	Sorrel . . . . . 65
Brussels sprouts . . 70	Cowpea . . . . . 75	Mustard, India . . . 75	Soybean . . . . . 75
Burdock, great . . . 60	Cress, garden . . . 75	Mustard, spinach . 75	Spinach . . . . . 60
Cabbage . . . . . 75	Cress, upland . . . 60	Okra . . . . . 50	Spinach, New Zealand . . . 40
Cabbage, trionchuda . . . . . 70	Cress, water . . . . 40	Onion . . . . . 70	Squash . . . . . 75
Cardoon . . . . . 60	Cucumber . . . . . 80	Onion, Welsh . . . 70	Tomato . . . . . 75
Carrot . . . . . 55	Dandelion . . . . . 60	Pak-choi . . . . . 75	Tomato, husk . . . 50
Cauliflower . . . . . 75	Dill . . . . . 60	Parsley . . . . . 60	Turnip . . . . . 80
Celeriac . . . . . 55		Parsnip . . . . . 60	Watermelon . . . . 70
		Pea . . . . . 80	

# Seed Distribution

- Seed Swap – A gathering of people, usually gardeners and farmers, who have come together to share seeds. The seeds can include locally saved seeds, excess bought seeds, seeds brought back from another country or seeds that a company donated. Its highest goal is networking.



# Review—pop quiz!!

- What are the three parts of a seed?
- For which type of crop is it most important to separate varieties when growing a crop for seed? **Self or cross-pollinated?**
- When is the best time to harvest seed?
- What is the 100 rule?
- Which is more important in seed storage, temperature or humidity?
- What are some ways to break dormancy in seeds?



# Literature

- ECHO Website ([www.ECHOcommunity.org](http://www.ECHOcommunity.org); see “Publications” tab)
  - Technical Note: Seed Saving Steps & Technologies
  - EDN 86: Extending the Life of Your Seeds
  - ECHO Asia Notes Issue 14: Vacuum sealing versus refrigeration
  - Info on making a vacuum pump from a bicycle tire pump
- ECHO bookstore:
  - Breed Your Own Vegetable Varieties (Carol Deppe)
  - Agrodok 25: Granaries (check Agromisa website for Agrodok 37)
- Online:
  - Saving Vegetable Seeds AVRDC: <http://www.avrdc.org/>
  - Seed Saving Chart - Seed Matters [www.seedmatters.org](http://www.seedmatters.org)
  - Seed Issues In Disaster-Struck Areas:  
[http://webapp.ciat.cgiar.org/africa/practice\\_briefs.htm](http://webapp.ciat.cgiar.org/africa/practice_briefs.htm)
- Books
  - Seed to Seed (Suzanne Ashworth)
  - The Seed Savers' Handbook (Michel and Jude Fanton)
  - Farmers' Seed Production (Conny Almekinders and Niels Louwaars)