



Seed Saving Steps and Technologies

By

Tim Motis

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Seeds and ECHO

ECHO provides options in the following ways:

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



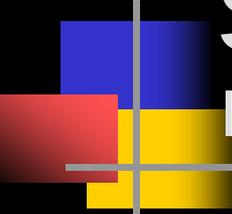
Seeds and ECHO

Types of seeds ECHO provides: <http://echonet.org/content/SeedBank>

**ECHO provides
trial packets of seed :**

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



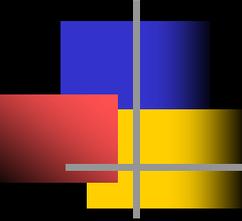


Seeds and Ag Development

Importance of trial packets

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

- 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.

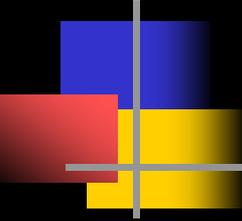


Importance of seeds



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.”

- **Seeds save lives:**
 - Used to plant this year’s crop
 - Represent next season’s crop
- **Seeds as a means of introducing new crops**
 - Small, easy to transport
 - Less risk of disease transmission
 - Useful in plant breeding/selection



Introduction: presentation content

- Seed biology- a few basics
- Processes in saving seeds:
 - Seed growout
 - Seed harvesting/collection
 - Seed storage
 - Seed viability testing

Seed biology- begins with:

Flowers and pollination

■ Flower structures

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

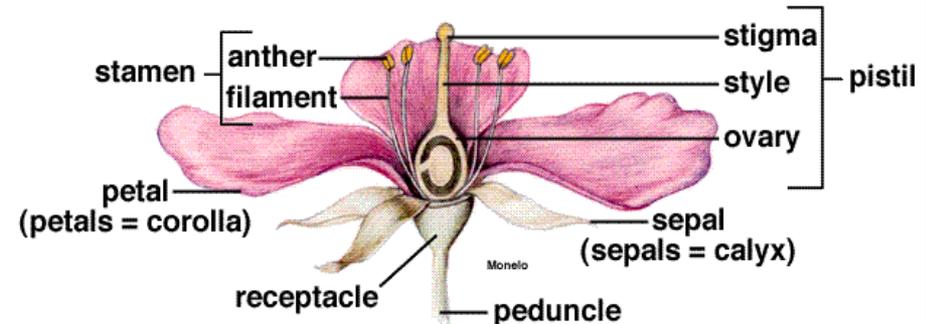
- **Pollination:** transfer of pollen from male to female flower structures

■ Types of pollination

- Self- pollination within same flower (e.g. lettuce, tomato, okra, peas, beans)
- Cross- pollination between flowers on same or different plants (e.g. onions, carrots, parsley, celery, cabbage, broccoli)

Kingsley R. Stern, Botany Visual Resource Library © 1997 The McGraw-Hill Companies, Inc. All rights reserved.

Parts of a Typical Flower



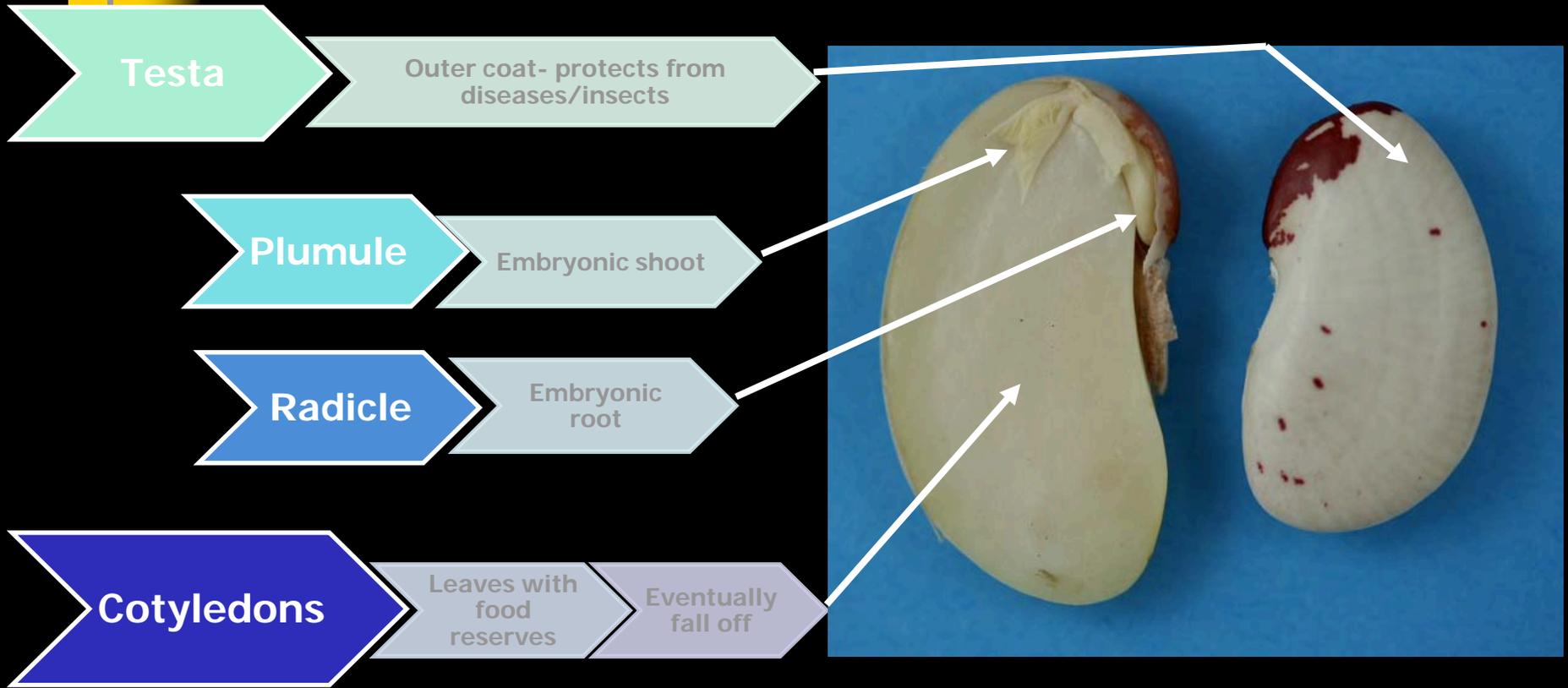
Seed biology- pollen transfer/fertilization results in:

Seeds: what is a seed?

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

Seed biology:

Structure of a seed



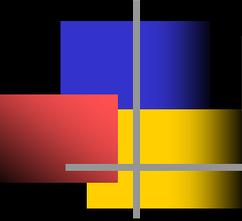
Seed biology

Germination: requirements

- Water must penetrate the seed coat
- Right temperature
- Light- needed for some crops



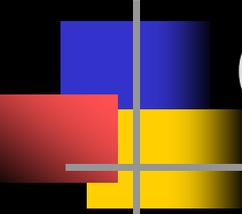
Seed biology- hybrid vs. open-pollinated varieties



Hybrid Seeds

- Result of carefully controlled crosses between parent lines with distinctly different traits
- “Hybrid vigor”- plants from hybrid seed often more vigorous than either parent, but plants of subsequent generations may lack vigor and uniformity.

Seed biology- hybrid vs. open-pollinated varieties



Open-Pollinated Seeds

- From one parent population of plants
- Traits maintained without carefully controlled crossing
- Traits stable over generations of seed saving
- Benefits to small farmer:
 - Can save seeds year after year
 - Advantages of less uniformity than hybrid seed
 - Some plants may die but others may resist a particular pest.
 - Crop harvest lengthened as seeds/fruits do not all mature at the same time

Seed saving steps:

- Seed growout
- Seed harvesting/collection
- Seed storage
- Seed viability testing



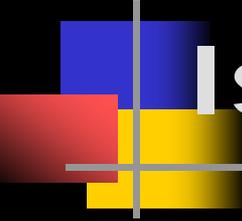
Seed growout:

Grow the crop



- Select land
- Ensure adequate soil moisture and fertility
- Plant the crop
- Label varieties
- Control pests

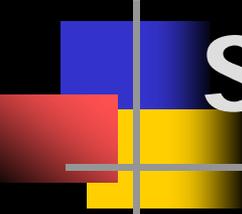
Growout: ensure purity of cross-pollinated crops



Isolate varieties by:

- **Growing them apart**- consult literature for isolation distances for specific crops
- **Planting at different times**- prevents varieties from flowering at the same time
- **Bagging flowers or caging entire plants**

Seed growout:



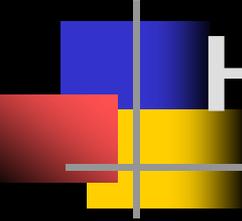
Select best plants for seed

- Look for plants with desired traits such as:
 - Pest resistance
 - Drought resistance
 - High yield of desired plant part
- Mark which plants you want to harvest from
- Remove undesirable plants before flowering

Seed harvesting/collection



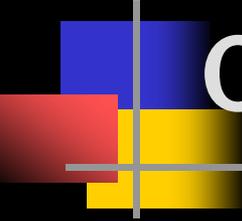
Seed Collection:



Harvest at the right time

- When seeds are mature
- Before damaged by insects or disease

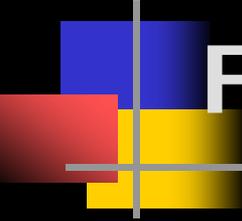
Seed Collection:



Cleaning seeds: Why do it?

- Freshly harvested seeds can contain a lot of “trash” (e.g. chaff, weed seed)
- Debris can harbor insects and plant diseases

Seed Collection: Seed cleaning



For fleshy fruits such as pumpkin

- 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
- Dry good seed on screens

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 Collection: Cleaning seeds

For dry seeds (beans, peas, lettuce)

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



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 chemicals properly, as needed



Cowpea seed damaged from piercing insect activity

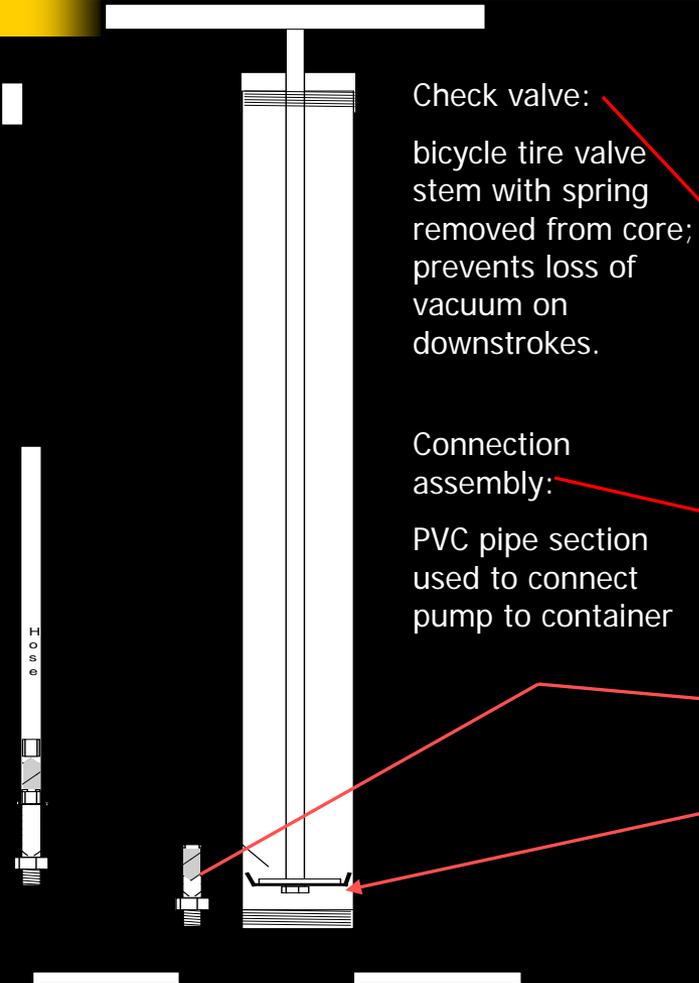
Seed cleaning: ensure seeds are pest/pathogen free

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- deprives insects of oxygen

Seed cleaning: use of vacuum to kill insects

Modified bicycle tire pump



Check valve:
bicycle tire valve stem with spring removed from core; prevents loss of vacuum on downstrokes.

Connection assembly:
PVC pipe section used to connect pump to container



Seed cleaning: modified bicycle tire pump

Steps to draw vacuum



1. Make a small hole in lid
2. Place tape over but not covering the hole



3. Place rubber such that the hole in the rubber is over the flap of tape.

Seed cleaning: modified bicycle tire pump

Steps to draw vacuum



4. Place PVC connection assembly over flap of tape, taking care not to push the tape down against the hole in the lid.
5. Press assembly downwards while drawing vacuum.

Seed cleaning: modified bicycle tire pump

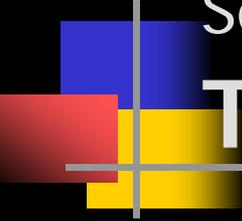
Steps to draw vacuum



6. While on an upstroke (so as not to lose vacuum), quickly flip the PVC assembly sideways and away. The higher air pressure outside the jar forces the tape down over the hole. Can add extra layers of tape to protect against loss of vacuum.

Seed storage

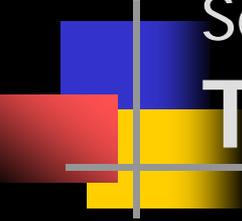




Seed storage: response of seeds to low moisture

Two types of seed

- Orthodox seeds- can be dried down to a low moisture content and be stored for a long period of time (years); e.g. cereal grains
- Recalcitrant seeds- lose their viability rapidly (days, weeks or months) and cannot be dried/stored for long periods time; e.g. Jackfruit, Carambola and other fruits



Seed storage: process for orthodox seeds

Two-part process

- Preparing seeds for storage- to ensure seeds are dry enough to be put into storage
 - Need to slow respiration to prevent heat buildup and rot
 - Seeds tolerate fluctuations in temperature better when dry than moist
- Maintaining proper temperature and humidity in containers or room where seeds are placed for storage

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

Spread seeds out to air dry

- Sun will dry seeds (will also kill insects), but beware of heat damage
- Avoid temperatures over 45°C (113°F)
- Works best during dry periods when humidity is low



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

- Rule of thumb: $\text{Temp (}^\circ\text{F)} + \% \text{ humidity} = 100$
- Goal- keep seeds dormant but alive
- Humidity more important than temperature
 - High seed moisture increases respiration (use of oxygen/release of carbon dioxide), resulting in heat buildup and reduced storage life
 - Fungal diseases not a threat at a humidity of 65% or less. At 65% humidity, seed moisture content is:
 - 7% for oily seeds (soybean, peanut)
 - 13% for starchy seeds

Seed storage:

Storage containers

- Ideal container: something that is airtight to keep humidity out



Rubber O-ring

Dessicant
(silica gel)



- Examples: buckets, ziplock bags, mason jars

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 viability (germ) testing



Seed viability (germ) testing

- Why?
 - Stored seeds gradually lose viability
 - To ensure quality/credibility
 - To know how many to plant
- How?
 - Obtain a representative sample of 10-100 seeds
 - Break dormancy if needed
 - Plant in soil (ice cube trays work well), or place on damp cloth or paper towel



Seed viability:

Why seeds may not germinate

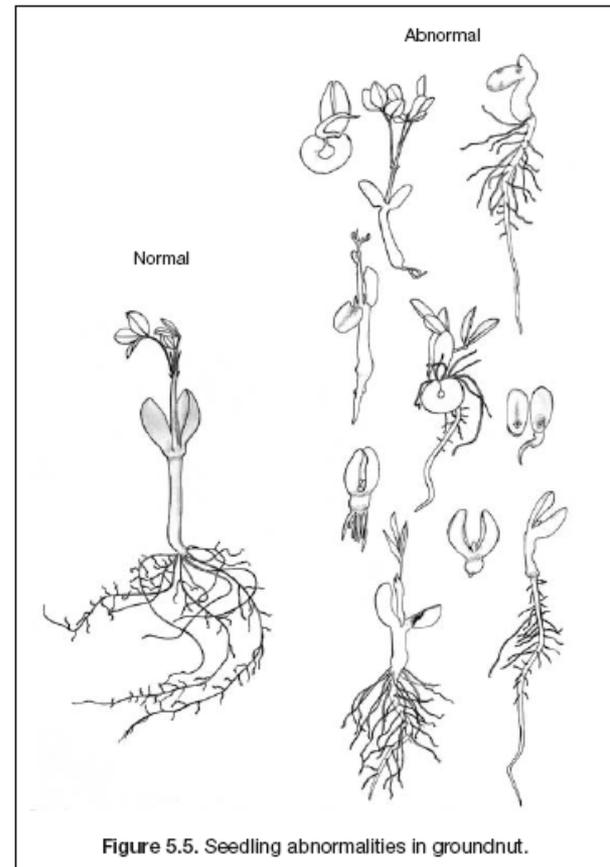
- Seeds are dead
 - They were dead to begin with
 - They died during the germ test
 - Possibly due to fungi/disease
 - Clean (5-10% bleach solution) seeds and sterilize surfaces and watering containers

- Seeds are dormant
 - Tropical seeds: hot water, file seed coat
 - Temperate seeds: some have chilling requirement

Seed viability:

Seed viability: abnormalities

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



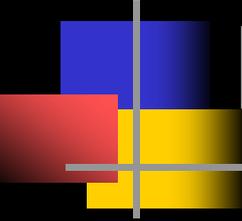
From IPGRI Genebank Manual

Seed viability:

Some germination standards

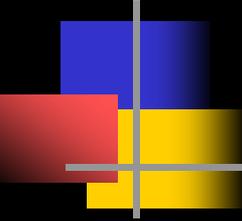
201.31 Germination standards for vegetable seeds in interstate commerce.--The following germination standards for vegetable seeds in interstate commerce, which shall be construed to include hard seed, are determined and established under section 403(c) of the Act:

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, trouchuda 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	



Main points

- Seeds can play a crucial role in development
- Seed saving is a science, but can be done without expensive resources
- Store seeds under proper conditions
- Viability testing is critical



Literature

- ECHO Technical Note: <http://echonet.org/content/agriculturalResources/611>
- Saving Vegetable Seeds AVRDC: http://www.avrdc.org/pdf/PROD6-saving_your_own_vegetable_seeds.pdf
- M and J Fanton *The Seed Saver's Handbook*
- Agrodok 37: *Small-Scale Seed Production*
- Collection, storage and treatment of tree seeds:
<http://www.fao.org/DOCREP/006/AD226E/AD226E00.htm#TOC>
- Seed Issues In Disaster-Struck Areas:
http://webapp.ciat.cgiar.org/africa/practice_briefs.htm