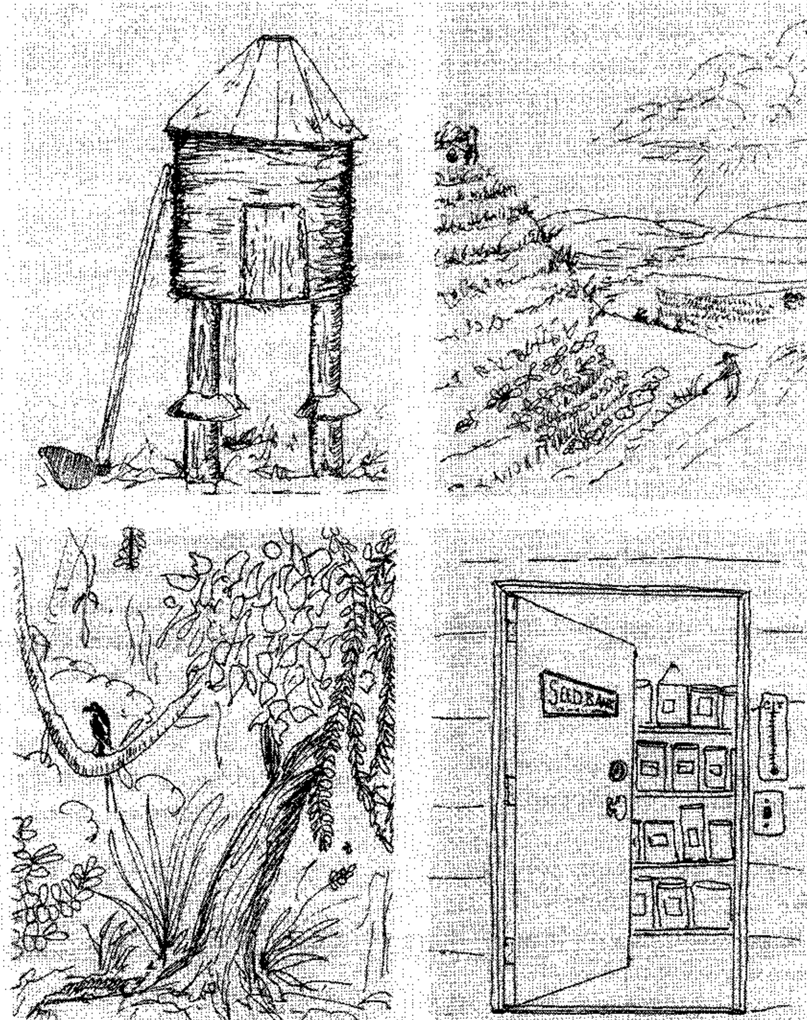
PRACTICAL APPLICATION

BUILDING THE BANK



The best conservation is in the field and forest. Community seed storage is a back-up or second-choice system when the fields are no longer safe. Nevertheless, a community seed bank can compare favourably with its High-Tech cousin. It replaces money with labour; text-books with intimate knowledge; and long-term storage with the ability to safely grow out the sample again.

As we have said elsewhere, success in conserving plant diversity will be in direct proportion to the involvement of human diversity in the process.

ON OBJECTIVES AND ORGANIZATION

OBJECTIVES:

The objective of this kit is to identify, monitor and conserve as much community-important agricultural diversity as possible. By far the best way to preserve plants and seeds is to keep them growing in gardens, fields and forests. Even garden-size biosphere reserves may adequately safeguard wild herbs and spices. For crop plants, the ongoing cultivation of mini-plots may be the best and least expensive solution to their survival.

A seed bank can and should be a living, functioning farm. Any lost income to the farm family due to the use of less marketable or profitable traditional varieties should be compensated for by the entire community and/or agnecies and governments concerned with conservation.

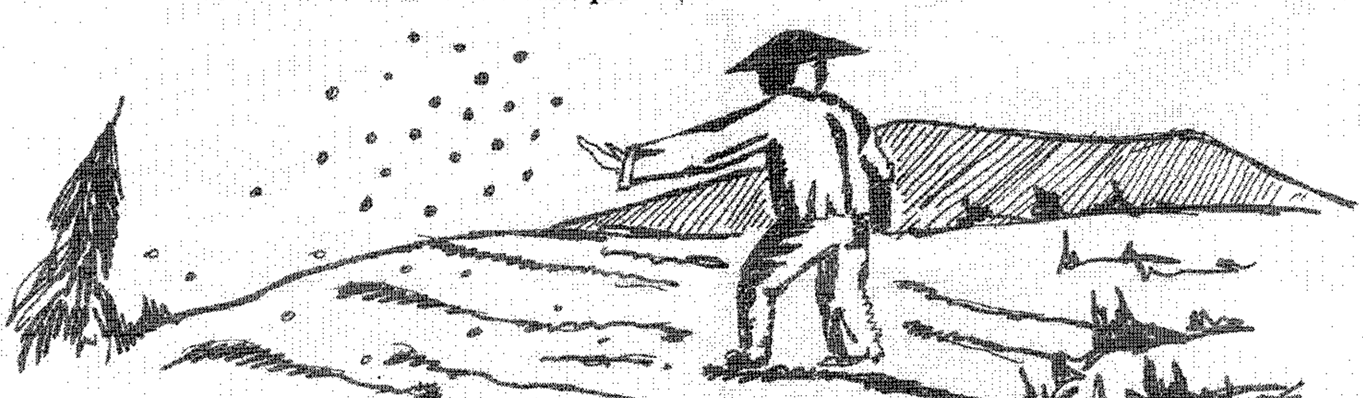
A seed bank can also be a controlled temperature and humidity storage unit ranging from a multi-million dollar institute to a hole in the floor of a family home. Because it is not always possible to keep all traditional varieties in the field and because large institutes make mistakes and remove seed from community control, this kit focuses on the basic procedures needed to collect and conserve local seed in very modest community seed banks.

The steps outlined in this kit are for the inexpensive collection and storage of endangered plants. Following these steps does not mean that community seed will be saved forever. You will have a short-term seed bank. The germination level of the seed must be monitored closely and you will probably have to re-grow the seed every three to five years (depending on the crop). The job is never done. In effect, you are supplementing a high-tech, capital intensive and highly-vulnerable institute with your own labour, experience and genius.

ORGANIZATION:

It would be both presumptuous and silly for RAFI to propose a detailed organizational strategy for community conservation. People are even more diverse than the foods they eat. There are some basic steps, however, which are universal . . .

1 *Planning Group:* Wide representation and participation is essential to ensure the conservation of the community's botanical heritage. Herders, wood-gatherers, farmers, gardeners, medicine-makers, artisans and fishermen all use and notice



different plants. They need to be consulted. They are the "expert" committee.

2 *Survey:* The planning group should assemble a list of all the plants used by the community. (This list will never be complete but it will help to orient the group.) Then discuss the human and environmental pressures that are or may threaten these useful plants. From this discussion, draw up a list of endangered plants most in need of conservation now.

3 *Warning System:* Do not assume that the other plants are safe. Work out a community early warning system that will help you identify when changing conditions might put pressure on other important plants or plant varieties. (We have listed a number of possible conditions in the section of this kit for Voluntary Agencies.)

4 *Collection:* Organize a series of collection expeditions (one will never be enough) designed to gather the diversity of endangered plants at the most important times of the year. Carefully document where the seeds were gathered and the environmental conditions in which each sample was found.

5 *Conservation:* Following the kit and your own knowledge of the plants, gather together the appropriate storage materials and arrange for the cleaning, drying and storing of seed samples (in more than one location if possible). Also arrange for the on-going monitoring of the collection viability and for subsequent grow-outs.

6 *Utilization:* Only that which is used survives. Unless traditional varieties of proven merit are actually put into use in (for example) school garden programmes and community feeding programmes—and in ceremonies and festivals and displays—interest in their conservation will eventually die. We are not in the business of building museums. Diversity must be documented (for future selection and breeding work), used and celebrated.

7 *Liaison:* Establish and maintain contact with sympathetic scientists and institutes and other concerned organizations that may help the community to save and develop its agricultural resources.

You cannot and need not collect everything. Begin by collecting from the most endangered plants most important to local people. This means more than just "crops"—but important wild plants used for food, fibre or medicine or having some other value. It also means the wild or weedy relatives of local crops. Unlike outside explorers, local people know what plants need urgent collection. And they can often recognize unique qualities that escape the eyes of others.

SETTING THE COLLECTION PRIORITIES

CULTIVATED CROPS:

1 *Save what is locally rare or unique:* If there is any simple rule-of-thumb, it is this: collect any live plants, seed, roots or cuttings of cultivated varieties that local farmers and gardeners consider either *rare* in the area or *unique* to the region. If only a few people grow it, it is rare. The fact that official publications say that a variety can still be found elsewhere, or that it "looks" like many other varieties is both unreliable and irrelevant to the area's farmers

and gardeners. If local growers can name it and describe it, *save it.*

2 *Save it regardless of its pedigree:* Not everything you save has to be ten thousand years old or be certified to have come from your locality. To be a priority for saving, it only has to be rare or unique for local cultivators. Although the centre of diversity for tomatoes is an ocean away, the Philippines has nurtured local strains of immense global significance. Maize in Ethiopia is still further away from its native home, but the local landraces are invaluable to the folks that grow them. Even "commercial" varieties with modern names may have adapted themselves to local conditions and be worth conserving. Another rule-of-thumb: if its important to growers—it's important.

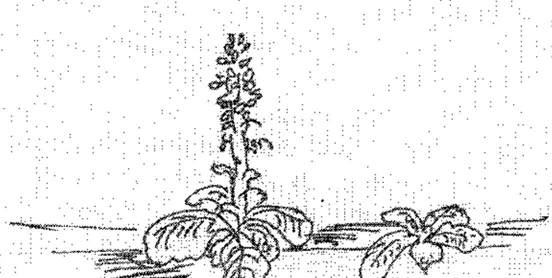
3 *Don't forget mutations:* In checking for endangered varieties, don't overlook "sports" or chance mutations that show up in the field and appear to offer something special. Although not independent "varieties" or "landraces", they are worth saving. A salt-tolerant wheat strain or disease resistant watermelon vine could become an important new community resource.

WILD AND WEEDY PLANTS:

1 *Fencing and watching are in order:* Modern potatoes and tomatoes depend heavily for their survival on infusions of genes from their wild relatives. Even the scruffiest and least productive cousin can carry invaluable genes and deserves preservation. Most rare wild plants are better left in protected natural habitats than made more vulnerable with the collection of the few seeds they produce! Investing in fencing, or encouraging volunteer "guardians" may be worthwhile.

2 *Weeds can be collected:* While we are not suggesting that farmers should encourage the spread of higher-yielding and hardier weeds, remember that these "next of kin" to your crop often do contribute genes that improve landraces. Weedy crop relatives should be collected from fields only if it appears that changing farming practices are causing them to disappear. For instance, the introduction of tractors and herbicides to the Guatemalan tropics is reducing the frequency of potentially-valuable wild cucurbits. Since they are not common in truly "wild" vegetation, collection is in order.

National and International Collection Expeditions sample a field once on one day and can only hope to have arrived on a good day when the seed harvest is at its peak. They are bound to miss early or late-maturing plants and plants that manifest other qualities at other times of the year. By contrast, local farmer/conservers can gather seed from the plant when the plant is ready—not only when the scientist is present!



THE BEST TIME TO COLLECT

1 *Check and collect more than once:* You can't collect seeds or roots until there are seeds or

waned. Depending on your purposes, you may want to remix late and early subsamples from the same field, or keep them separate.

2 *Some crops need special treatment:* Crops such as squashes, gourds, and watermelons require a period of after-ripening before the seeds within reach maximum viability. For cucurbits (like those mentioned here), about forty days are needed after pollination—or twenty additional days after full fruit enlargement—before seeds should be taken. Otherwise, the germination level may be zero.

roots to collect. But, unlike a farmers' harvest, you can do your collecting over a longer period (thus not interfering as much with your own harvest) since you will want to gather both early and late-maturing plants. If possible, go into fields early, when most plants are still immature and collect a subsample of the quickest ripeners. Then go back again when your own crop is in and look for the late-maturers—often thick with fruit—that offer other genetic qualities. You may also want to ask farmers to let a few green leafy vegetables bolt and "go to seed" rather than pulling them out as soon as leaf production has

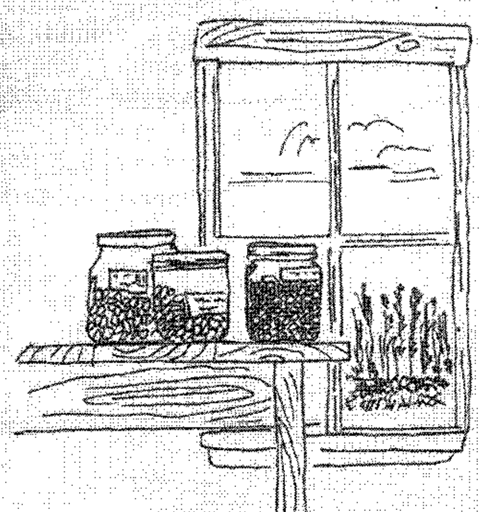
Diversity and Adversity are the Keys. Be methodical enough to gather the diversity you cannot see—and observant enough to collect unique forms. They may save your crop tomorrow.

THE COLLECTION STRATEGY

1 *Remember—Overview and Etiquette:* First, collect a random sample. Then collect seeds of unusual or noteworthy plants. Look at a field population of a landrace or mix and get a visual sense of its variation. Also, look at the plant as a whole—not only its fruit or seed characteristics. Don't just collect from the best-looking or most prolific plants. Be careful to collect as much seed from low-bearing plants as from those that have many seeds. When collecting a representative sample of seed from a field, remember: you cannot make value judgements about which seed should or should not be collected. Get a sense of how much seed can be spared. Talk with the farmer. Never take a sizeable portion of what a farmer has left of a rare seed. It belongs—first and foremost—to the farm family.

2 *Be methodical and seek variation:* A random sample from the field (a storage bin sample is second-best) is not enough to capture rare forms or variants within the population. Take a single plant harvest every few paces on several passes through a field to get a random sample, then go back and search for rarer types to make the collection more comprehensive. Avoid "swamping" the random sample with too many unique types. Only a small portion of the total sample should be represented by your conscious collection of these unique types.

3 *The special problem of diseased samples:* If your sample contains seed-borne or insect infestation,



the whole collection could be destroyed. Usually, such problems can be controlled with local management practices (which may include the use of chemicals) but keep the seed separate from other samples in case the danger spreads. Remember, seeds that can "tolerate" infestation and still bear fruit can be extremely valuable.

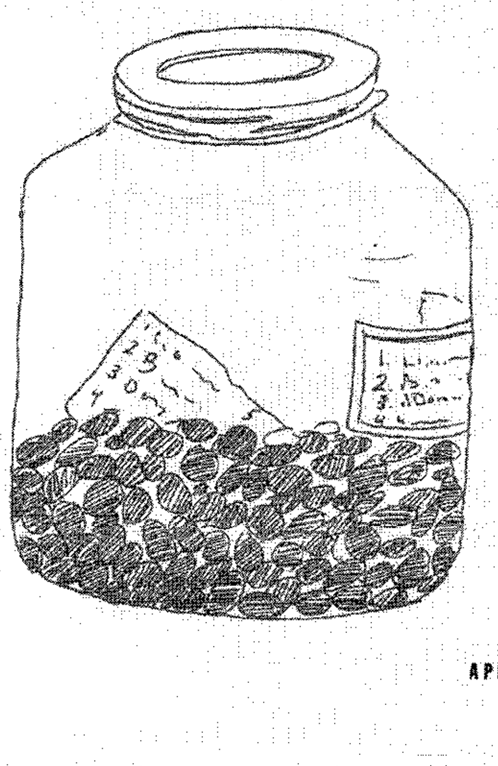
4 *Sample size varies:* The size of your collection sample will vary depending on the availability of seed and how you want to divide the sample after collection. If possible, the sample should be divided into two or more equal sets that can be stored in different locations.

Remember, too, that you need enough seed so that some may be grown out while the rest remains in storage. Collect as large a sample as you and those in your Community Seed Bank Network can safely and efficiently conserve. As a rule, collect more seeds from open-pollinated crops like maize than from self-pollinated crops. For tree crops requiring grafting, take two to three cuttings from each randomly selected tree.

Ten minutes of field note-taking and talking with the farmer may tell you more about the potential value of the seed sample than a year of lab experimentation. Unlike standard expeditions, you can take the time to involve the farmer and do a field-level evaluation. Documentation is vital.

COLLECTION DOCUMENTATION

1 *Labels are essential:* Seed bags, jars or boxes need to bear moisture-proof labels, preferably both inside and outside, and a separate label or data sheet should be kept in a card file. Labels and files are essential to the collection's long-term usefulness. Both the seed sample and its records must be made to out-survive both your project and you.



2 *Information must be brief but thorough:* If the amount of information required is too time-consuming or arduous, the job will never get done. Label information should be gathered while still in the field and should be brief. The minimum information that should be placed on the materials, and in the file, includes: vernacular name of plant (as specific as possible, such as la manzana dorada-temprana de Don Carlos Ortiz); the locality and state of collection (including exact distance from a well-known landmark); date of collection; collector's name (and if used, collection number); and donor's name and address.

3 *Files can be more thorough:* Additional documentation needs to be filled in once you are out of the field—altitude, scientific name, etc.—most of which can be obtained from standard references. It is a seldom-extended courtesy to provide the

donor of the seeds with a copy of this information and the addresses of where the seed will be grown out and stored, in case he or she loses a crop and needs to start again. As an added courtesy, you might ask the donor if there are other kinds of seeds that he or she has lost or is looking for that you can help recover.

There are other important notes that may be optional, depending on how self-explanatory the collection is. Be sure to note special features of the plants collected that are not apparent by looking at the seeds or cuttings themselves. If local consultants or seed donors claim that the material is resistant to a disease, or early-maturing, or frost-hardy or rare, note this on th field collection label and on the file card or sheet. If photos, herbarium specimens or collections of other crops or weeds were made in the same field, note this. If the habitat is unusual (e.g. saline) or the plant can only be found grow ing well in one particular micro-environment, consider this valuable information.

ON SEED CONTAINER

LABELS:

1. One outside seed container
2. One inside seed container
3. One attached to file card or sheet

LABEL INFORMATION:

1. Local crop and species name
2. Local variety (landrace) name(s)
3. Scientific name
4. Farmer's name and address
5. Collector's name and address
6. Collection location (local description)
7. Date of collection
8. Date of storage
9. Location of further documentation

ON CARD/SHEET FILE

FILE:

1. Two copies separately stored in case of fire or loss

FILE INFORMATION:

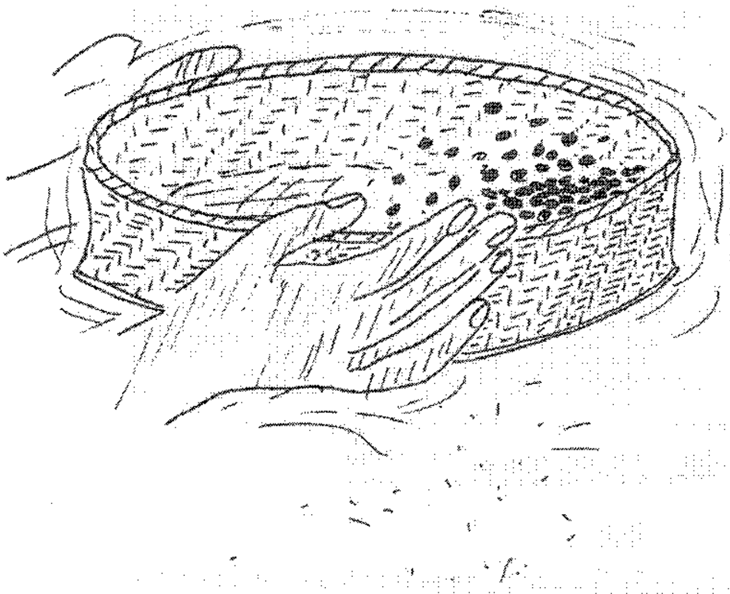
1. Duplicate of label information
2. Detailed description of sample location
3. Storage location(s) and status
4. Germination test and grow-out records
5. Farmer's and collector's observations
6. Unusual plant/seed characteristics
7. Unusual features of collection site
8. Confirmation of notification of farmer of storage and file information

The cleaning and drying of seed for storage can become very technical and tricky—particularly for so-called recalcitrant seed. Farmer/Conservers have some natural advantages, however. First, they are familiar with the crop and landrace and are accustomed to saving it from growing season to growing season and much longer. Second, landraces tend to be a hardier lot than many modern varieties. The old strains were selected to survive and a little common sense will solve a lot of problems.

SEED CLEANING AND DRYING

CLEANING SEED:

1 *Keep only the seed:* Community techniques for harvesting and cleaning seeds for consumption storage can apply to longer-term seed storage as well. For instance, in Ethiopia, seed-sifting baskets are specially made to allow teff and nig seeds to fall through the mesh, but keep the ch sorted out. Because of the threat of pests, it is



best to separate seed from chaff, cobs or pods.

2 . . . *But observe community customs:* There are exceptions, however. Some ethnic groups prefer to keep maize on the cob because of the vulnerability of some shelled corn to certain molds or beetles. Pay attention to the local logic of seed cleaning, drying and sorting. Usually customs exist for good reason. At the same time, don't close your mind to scientific techniques.

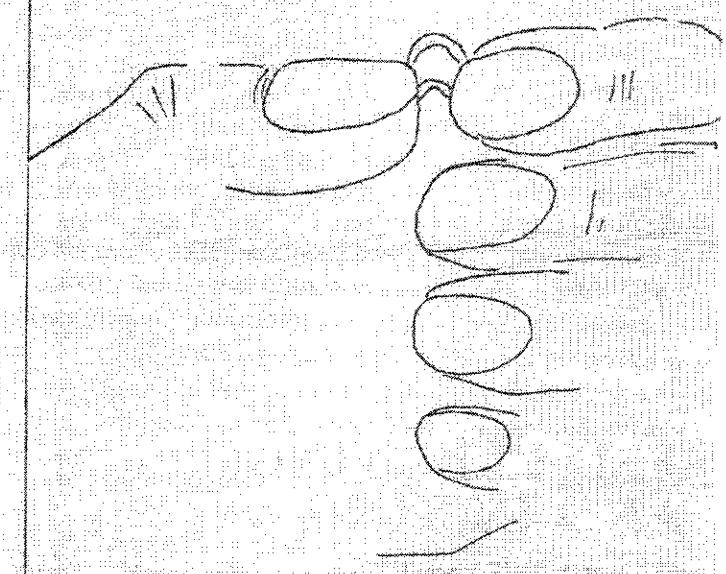
DRYING SEED:

1 *Drying without baking:* Most seeds need to be dried down from their fresh harvest condition. To dry seeds to a suitable moisture level, place them between screens in partial shade, being careful to turn them frequently, over a one to three day period. Avoid rapid drying by heating in an oven or by direct sunlight exposure. Many kinds of seed will die in temperatures above 60 degrees Centigrade (140 F.) and some will die in temperatures as low as 40 C. (105 F.).

Low seed moisture content is the most important factor in maintaining the longevity of normal seed. High humidity during brief rainy seasons is enough to severely reduce viability of seeds kept in room conditions. Other things being equal, the highest monthly losses of seed viability in any environment will be during the rainy season when humidity is highest. During this season additional care is important. For seed which matures early in the rainy season, it may be necessary to actively dry them for storage—otherwise insects, mold and humidity will reduce viability. For those that fruit as the dry season begins, passive drying on screen is usually sufficient.

2 *With a little chemical help:* In places where granular silica gel is sold (try pharmacies or photography supply stores), such drying material can be placed in a closed container next to the seed. The gel "pulls" additional moisture out of the seed. Certain brands of silica gel change colour when saturated. Remove saturated gel and dry it in the sun or oven before re-using. If you cannot obtain gel, try powdered milk. What milk lacks in sophistication it gains in practicability.

3 *How low is "low"?* Most vegetable seeds need to dry down to a moisture content of 8-11%. Grains are fine at 10-15%. Not easy percentages to determine without sophisticated equipment or sensitive scales! Yet, there are rules-of-thumb for certain seeds. For instance, squash and pumpkin seeds need to be dried down to the condition where they can bend when placed between your thumbs and index finger, but will neatly crack if bent "in half" with considerable pressure. If springy but not crackable, these seeds are too moist. Local agriculturists or crop experts can help you determine other tests for crops for your area. Low humidity (in seeds and in storage rooms or bags) reduces the risk of microbial activity and slows down physiological deterioration.



4 *Take care of the recalcitrant seed:* Recalcitrant* seeds of tropical fruits are one major exception to the low moisture rule. With recalcitrant seeds, plant as soon as possible after field collection. In the intervening time between collection and sowing, keep seeds in an inflated polyethylene bag half filled with seed, and open the bag to exchange air once a day. This treatment will reduce moisture loss so that the recalcitrant seeds will not fall below 20% water content and will keep detrimental anaerobic conditions from damaging the seeds.

5 *. . . and other deviants:* Seeds of eggplant, tomato, squash and melon may be obtained by fermenting the fruit in water. The pulp of the fruit including the seed can be scooped into a bucket, and water added. This should be stirred occasionally over a 3-5 day period. When fermentation is complete, the fermented liquor from the pulp and water can be poured off. The good seed will have sunk to the bottom. Pour the remaining liquid through a screen, then dry the seed for 2-3 days on the screen before bagging.

Just as local growers know how to clean and dry seed, they also know how to store seed for the next growing season and the one after that. Longer term seed storage comes down to doing the same things you always do—but more so.

SEED STORAGE

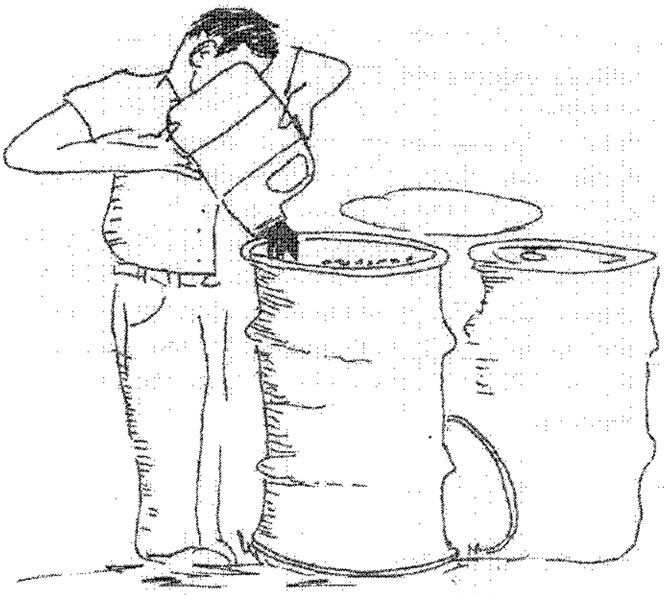
STORAGE CONTAINERS:

1 *Heat and humidity control is crucial:* Drying the seed before storage is not enough. Moisture and high temperature are major threats to long-term seed survival even after the sample is "bagged." Warm, moist conditions encourage insect, mold and microbial activity. Seeds are stored best where the sum of their environment's temperature (in degrees F.) and relative humidity (in %) remain less than 100. For instance, an air humidity of less than 30% and a temperature of less than 70 degrees F. (21 C.) are good seed-storage conditions readily obtainable in many Third World countries.

2 *Silica gel or milk powder control moisture:* Plastic bags and glass jars may be water-proof, but moisture condenses and accumulates within them. If they must be used, a drying agent such as silica gel, or (lacking this) dry milk powder can be inserted into the larger container to absorb moisture. Do not have the seeds in direct

MAJOR THREATS TO SEED SURVIVAL

1. High or varying humidity
2. High or varying temperature
3. Damage by molds and microbes
4. Consumption by insects
5. Water damage
6. Programme/Project closure
7. Human error
8. Disasters such as fires, earthquakes, hurricanes, etc.



contact with these agents. Prop the seed up above the gel, or place the seed in separate breathable bags within the larger container.

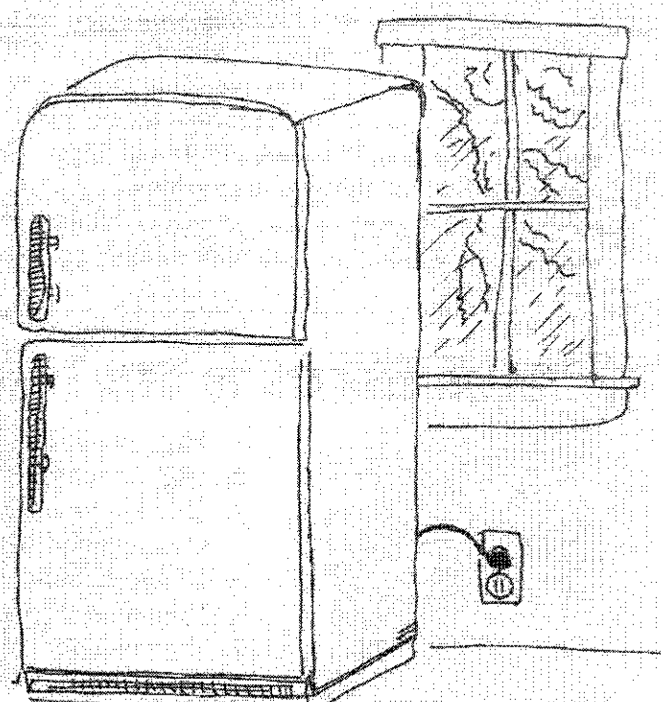
3 *Small samples can go in envelopes:* For medium sized projects, inexpensive multiple-layer moisture proof envelopes can be ordered from paper supply houses. These heat-sealable foil-plastic-paper envelopes take up less room than jars or cannisters, and if silica gel is placed within them, provide state-of-the-art storage for smaller seed samples.

4 *Plastic pails and barrels for larger samples:* For larger seeds (such as dry beans) or larger quantites of seed (grains), plastic barrels with snap-lock lids or metal 50 gallon drums might be in order. Where grain-eating insects are difficult to control, and where seed quantities are too large to contemplate even short-term freezing, used motor oil can be poured over the seeds to smother insects. It is an inelegant process, but the seeds can be thoroughly washed just before planting.

COMMUNITY SEED BANKS:

1 *A community seed bank may already exist:* Local community methods of storing seed for future growing seasons may already be adequate for maintaining seed germination for several seasons. Probably, however, more attention could be paid to the quality of the storage containers and to keeping temperature and humidity variation under control. Often the major difference between your existing seed-saving system and a longer-term system boils down to more methodical monitoring of the seed. This lack of human attention in the world's high-tech gene banks is a major cause of genetic erosion. Major gene banks often spend money on everything except people. Farmer/conservers are better able to avoid this failure. A moisture-proof pit in the dirt floor of a shed or storage hut can offer the right balance of temperature and humidity control. If rock caves or stone-lined cold cellars are found in your area, you may have the makings of a high-quality medium term gene bank.

2 *Freezers can also be seed banks:* If your project has access to a reliable freezer, you may want to take advantage of its low temperature qualities. Freezers and refrigerators do have their problems however: (1) long-lasting or recurring power failures could go unnoticed and destroy the collection; (2) energy costs could prove too expensive; (3) other storage demands (from medicines to beer) could displace seeds. Unless the freezer can be well-monitored, or have a back-up generator, it may be best to use more traditional storage methods and use the freezer as a "back-up" if other problems arise. No matter how you store your seeds, have an alternative plan in mind in case of problems.



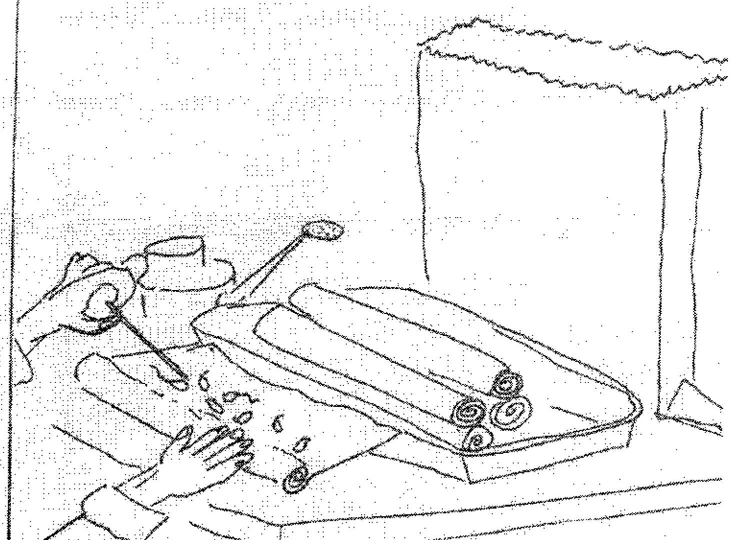
Monitoring and growing out seed is careful, painstaking work. Farmer/Conservers have a major advantage over standard gene banks, firstly, because they may be able to collect a whole new sample from the original field; secondly, because local conservers are more likely to apply the human energy needed to monitor properly, and; thirdly because—unlike most world-class gene banks—seeds can be resown in their own micro-climates.

COLLECTION GROW-OUTS

The growing out of a seed sample is the riskiest part of the whole Farmer/Conserver endeavour. At the point when the sample is at its weakest (low germination and/or low seed count), you have to divide it up and take a chance that it will multiply safely in the field and not be devoured by insects or wiped out by wind, rain, cold or blight. Only multiply seed when absolutely necessary and rely upon regular germination tests to tell you when the time has come.

1 *Regular germination tests are in order:* If seeds are stored for two years or more, their moisture-proof labels should clearly indicate when they were first placed in storage, and how frequently germination tests have been done on them. Generally, a sub-sample of seeds should be checked every 3-12 months. Ten to one hundred seeds should be placed in rows in a moist paper towel, rolled up into a cigar-like cylinder, then placed in a paper bag in a warm, sunny place. Keep the paper towel moist. Every two days, for 6-12 days, this roll should be checked. Total percent germination should be tallied. Whenever a seed accession falls below 50% germinability, plans should be made to regrow it.

2 *Grow-outs are unnecessary if . . .* Gene banks containing seed samples that originate thousands of kilometers from the bank face a tremendous problem when it comes to grow-outs. Either they have to risk multiplying the seed under alien soil and climatic conditions (meaning that many genetic traits may not be expressed and some important genes may disappear with repeated grow-outs) or bear the risk and high cost of shipping the seed back to its natural climate for multiplication and return. By contrast, community seed banks facing the same grow-out need may have a very easy third option . . . go back to



COLLECTIONS SHOULD BE GROWN OUT WHEN . . .

1. Germination tests indicate that sample viability has dropped below 50 percent;
2. Original collection sample was too small to ensure safe storage or to permit adequate distribution to farmers;
3. Distribution to others has dangerously depleted the number of seeds in the accession;
4. In order to make a duplicate collection available to another gene bank as a "back-up".

the farmer and ask for more seed. If the farmer is still using the same landrace and other conditions remain the same, a repeat collection may prove to be the fastest and safest way to re-stock your collection. Nevertheless, don't count on there being more seed available all the time. Genetic erosion moves swiftly.

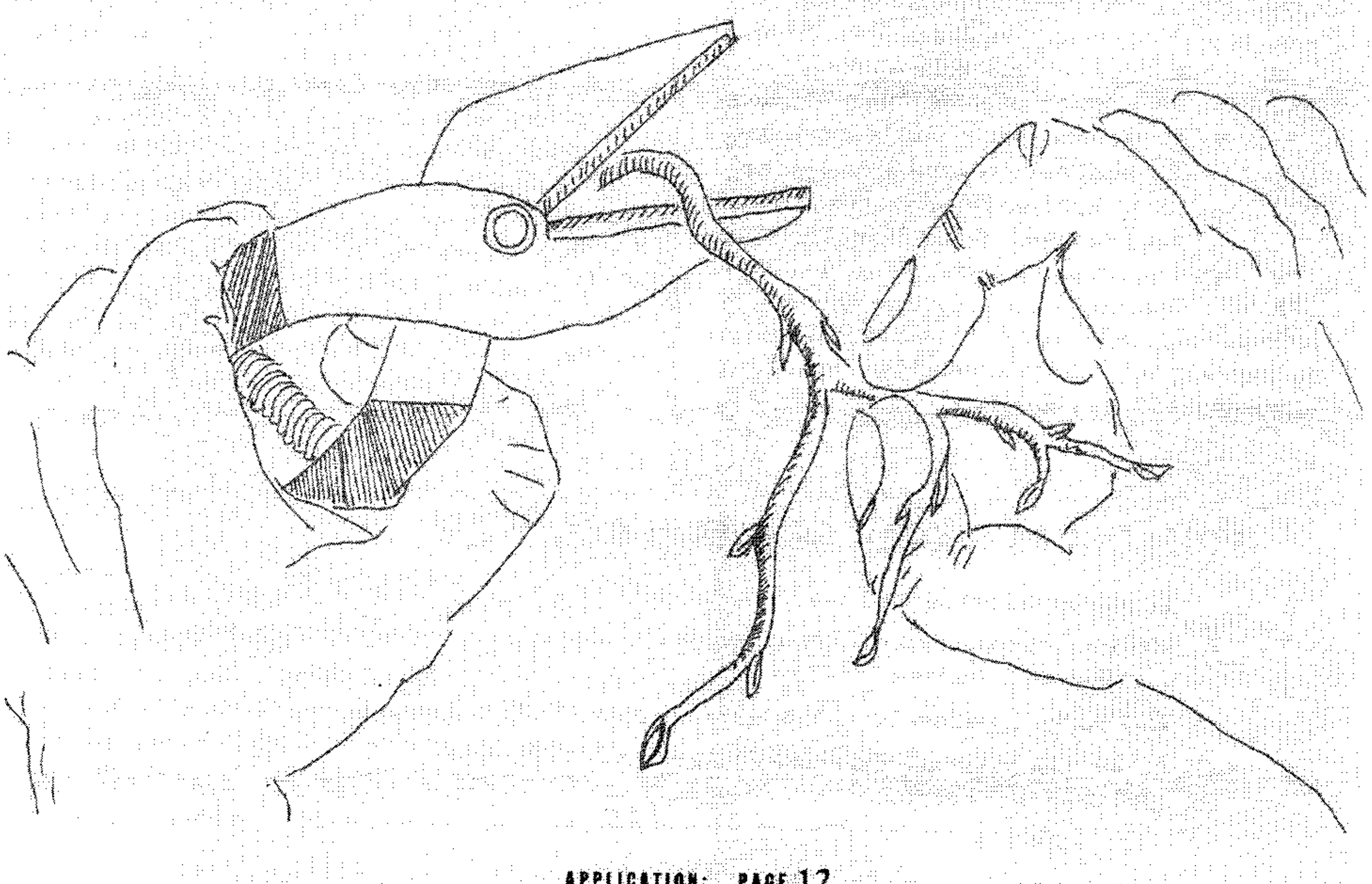
3 *Don't put a collection at risk by growing it out in just one field:* Never take all the remaining seed and put it into an immediate grow-out in the same plot. Depending upon the quantity remaining, divide the sample for two grow-outs in separate locations, and leave a few seeds in storage as a precaution.

4 *Select appropriate soil and climate conditions:* Consider where the seed originally came from, and choose a similar environment and planting time for the grow-out. To do otherwise means that, inevitably, some of the genes that made the landrace unique and special will be lost.

5 *Keep grow-outs apart from compatible plants:* Make sure that no other varieties of compatible cross-pollinated crops are grown near your grow-out site. For maize, you need an isolation plot separated from other maize (including other grow-out plots of maize) by 500 meters. If windbreak vegetation forms a natural barrier, then the distance can be reduced to 150 meters. If this seems like a wide separation, bees can carry the pollen of squash for as much as a kilometer (although a gap of 60 meters is often adequate).

6 *The grow-out plot need not be big:* It does not take a large amount of land to grow out samples. In 1985, the Seed Savers Exchange grew out 500 bean samples, 120 peppers, 280 tomatoes, 50 lettuce and 50 peas on about ⅓ of a hectare. On a little more than one hectare they were able to grow out 400 squash, 130 watermelon, 100 muskmelon and 30 cucumber samples. Though the size of their samples was somewhat small, it is clear that grow-outs for a Community Seed Bank can be done on very little land. If the community participates there may be many small grow-out sites scattered about.

7 *The size of the grow-out depends on the breeding orientation:* The number of seeds that need to be grown out to maintain the collection's genetic variation should be considered. The more "mixed" or diverse the collection is in seed shape, colour, and size, etc., the larger the sample that is needed. For an original mix of eight colours of beans, you would need at least 64 randomly-selected seeds for a 99 percent chance



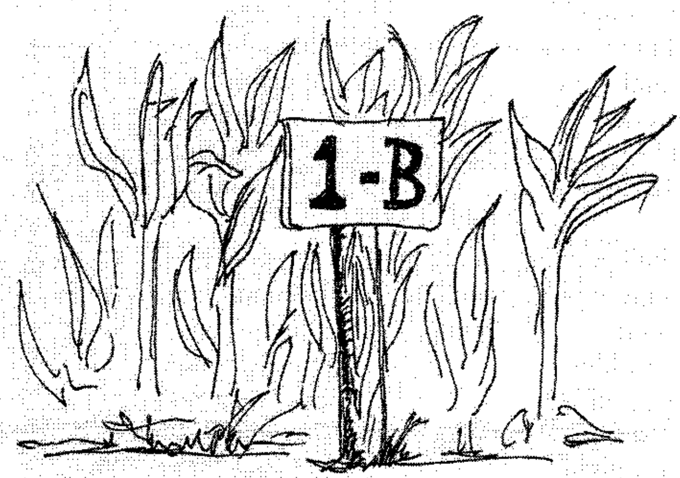
of having all eight kinds represented. You might want 250 seeds at a minimum to adequately represent the variants in a predominantly self-pollinated crop such as beans. For a cross-pollinated crop like maize, plant at least 500 seeds and take equal sized samples from each ear in the stored collection.

8 *Don't recollect only the "best":* As with your original field collection, be careful not to select only the most attractive seeds from the grow-out plot. Diversity is essential. Take special care to collect a representative sample or you will be guilty of selecting out and losing potentially valuable genes.

9 *The special case for tubers and tree cuttings:* For tubers or tree cuttings, take 2-3 offshoots from each parent plant. Given the limitations of space, try to have as many individual plants progeny represented as possible.

10 *Special care is needed:* Give the plants more attention than you normally would for the same crop when grown as a commodity. Provide the seed with enough water and nutrients. Disease and pests need to be carefully managed, particularly if they infest the seed directly.

11 *Signs and documentation are useful:* Finally, on-site signs and maps—clearly showing what is growing where in grow-out plots—are important to avoid confusion.



SEED SAVING TABLE

COMMON NAME	SCIENTIFIC NAME	SEED TYPE N = NORMAL R = RECALCITRANT[1] H = HARD A = AFTERRIPENING[2]	PREDOMINANTLY CROSS = C OR SELF = S POLLINATING	RELATIVE STORABILITY INDEX[3]
CEREALS				
Amaranths	Amaranthus spp.	N	C/S	3
Barley	Hordeum vulgare	N	S	2
Maize (corn)	Zea mays	N	C	1-2
Millet	Eleusine indica	N	S	1-2
Oats	Avena sativa	N	S	2
Quinoa	Chenopodium spp.	N	S	—
Rice	Oryza sativa	N	S	2
Rye	Secale cereale	N	S	1
Sorghum	Sorghum bicolor	N	S	1
Teff	Eragrostis tef	N	S	1
Wheat	Triticum aestivum	N	S	2

COMMON NAME	SCIENTIFIC NAME	SEED TYPE N = NORMAL R = RECALCITRANT[1] H = HARD A = AFTERRIPENING[2]	PREDOMINANTLY CROSS = C OR SELF = S POLLINATING	RELATIVE STORABILI INDEX[3]
LEGUMES				
Beans	Phaseolus spp.	H	C	1
Cowpeas	Vigna spp.	H	C/S	1
Fava/Broad beans	Vicia faba	H	C/S	1
Garbanzos	Cicer arietinum	H	S	1
Lentil	Lens esculenta	H	S	1
Peas	Pisum sativum	H	S	2
Soybeans	Glycine max	H	S	1
VEGETABLES				
Asparagus	Asparagus officinalis	H	C	1
Beets	Beta vulgaris	N	C	—
Cabbage	Brassica oleracea	N	C	2
Carrot	Daucus carota	N	C	2
Chiles and peppers	Capsicum spp.	N	C/S	1
Eggplant	Solanum melongena	N	C/S	1
Lettuce	Lactuca sativa	N	S	1
Melon and cucumber	Cucumis spp.	NA	C	2
Onion	Allium cepa	N	C/S	1
Radish	Raphinus sativus	N	C	2
Squash	Cucurbita spp.	NA	C	2
Tomato	Lycopersicon esculentum	N	C/S	3
Watermelon	Citrullus sp.	NA	C	2
ROOTS AND TUBERS				
Cassava or manioc	Manihot spp.	N	S	see note [4]
Potato	Solanum tuberosum	N	S/C	3
Sweet potato	Ipomaea batatas	N	C	—
Yam	Dioscorea spp.	R	C	1
FRUITS AND NUTS				
Apple	Malus spp.	NA	C	see note [4]
Apricots and peaches	Prunus spp.	NA	C/S	
Banana	Musa paradisica	N	C	
Coconut	Cocos nucifera	R	C/S	
Fig	Ficus carica	N	C	
Grape	Vitis vinifera	N	S/C	
Mango	Mangifera indica	R		
Orange	Citrus sinensis	R C/S		
Papaya	Carica papaya	N	C	
Pear	Pyrus spp.	NA	C/S	
Pineapple	Ananas comoso	N	C	
Strawberry	Fragaria spp.	?	S/C	
Walnut	Juglans regia	?A	C	

COMMON NAME	SCIENTIFIC NAME	SEED TYPE N = NORMAL R = RECALCITRANT[1] H = HARD A = AFTERRIPENING[2]	PREDOMINANTLY CROSS = C OR SELF = S POLLINATING	RELATIVE STORABILITY INDEX[3]
INDUSTRIAL CROPS				
Olive	Olea europea	?	C/S	see note [4]
Sesame	Sesamum indicum	N	S/C	1

FOOTNOTES TO SEED SAVING TABLE

[1] **RECALCITRANT.** Seeds which lose germination capacity rapidly when exposed to dry air, in most cases within ten days of harvest.

[2] **AFTER-RIPENING.** Seed types which require post-harvest ripening of 40 to 60 days before removal of seeds.

[3] **RELATIVE STORABILITY INDEX.** The numbers (1-3) refer to the length of time seeds can be stored at room temperature in low humidity conditions (as normally found in temperate climates). The index is a relative scale; in tropical, high humidity conditions the seeds would be safely stored for a shorter time period; under refrigeration for a longer time.

1 = Germination begins to drop below 50 percent after *three* years.
2 = Germination begins to drop below 50 percent after *six* years.
3 = Germination begins to drop below 50 percent after *nine* years.
[SOURCE: Compiled by G. Nabhan and K. Dahl, with particular assistance from the following texts:
E. H. Roberts, *Viability of Seeds*, Syracuse University Press, 1972, and H. F. Chin, I. C. Enoch, and R. M. Harun, *Seed Technology in the Tropics*, Tropical Press, Kuala Lampur, 1976.]

[4] No "Relative Storability" rating is given for many of the tree and root crops as they are usually collected as cuttings and tubers and grown out through vegetative propogation.