

**SEED SAVING TECHNIQUES  
OF THE  
NATIONAL COLONIAL FARM**

by  
**Mary Ann Klein**



**THE NATIONAL COLONIAL FARM  
RESEARCH REPORT NO. 25**

**The Accokeek Foundation, Inc.**



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SEED SAVING TECHNIQUES  
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"Wisdom is not a knowledge of many things, but the perception of the underlying unity of seemingly unrelated facts." -- John Barnet

## INTRODUCTION

Vegetable and herb seed production requires a knowledge of a plant's complete life cycle, the factors affecting its culture, and its seed producing characteristics. For example, does a plant produce seed the first year, as with beans: or is it a biennial, which requires over wintering to produce seed at the end of the second growing season, as with carrots or onions? Is the crop self or cross pollinated and is it wind or insect pollinated? If crossing can occur between varieties, what distances must be maintained to preserve seed purity?

Seed production is further complicated by the fact that seeds of the common vegetables occur in different types of fruit. For example, tomatoes have a fleshy fruit whereas those of beans occur in pods. For each vegetable or herb, certain seed saving criterion must be met. The common vegetable and herb crops occur in nature by botanical families and these will be the categories used in the following treatise on seed saving.

### A. Purpose

This booklet is written to assist living historical farms to develop and maintain heirloom seed and plant collections. It is based upon the experience and research



undertaken at the National Colonial Farm of the Accokeek Foundation, Inc.

#### B. Heirloom Varieties Are Standard Varieties

Standard varieties are open pollinated and their seed breeds true. They are a reliable and stable source of seed which reproduce themselves. Open pollinated varieties have been the basis of all the crop plants throughout most of the agricultural past. Handed down from generation to generation and selected over the centuries of agriculture, they are an important part of our heritage.

Hybrids are "manufactured" seed. They will not breed true. Although they are high performers for one generation, their improved vigor is short lived and must be rebred into them. To do this, breeders maintain two or more separate parent lines, then hand pollinate each time the hybrid seed is produced.

To determine whether seed is open pollinated or hybrid, check the seed packet. By law, seed producers must list whether seed is hybrid or not. Terms like "F-1" and "hybrid" indicate it is not open pollinated, while "standard" and "open pollinated" on the label indicate a non-hybrid or standard variety. If you obtain your seed from a friend or through a seed exchange, you can check this information

against the "Non-Hybrid Seed Inventory" of the Seed Savers Exchange (listed in the bibliography), provided you have the varietal name.

### C. Germination Rates and Seed Vigor

Seed marketers are required by law to print the germination rate on the seed packets or containers of seed sold for that year. The seed inside may be from the last season or from earlier years. There is no way the consumer can tell. A germination rate of 75% or more is acceptable; if lower, the seed company must include more seed in its packets to insure a good crop stand. Along with the lowering of the germination rate, the seed vigor will be reduced after seed has been stored a long time. Gardeners want seed that not only will germinate, but seed that has enough vigor to go through a normal season, produce a crop and seed for the seasons to follow.

Two very substantial reasons to save seed from our gardens are that we know what the parent plants looked like, whether they were healthy individuals full of vigor and productivity and we know that the seed is fresh. There is nothing more disappointing to a gardener than to sow seeds and to get a poor stand of plants or worse yet--no plants at all.

The National Colonial Farm has undertaken this project to develop simple and cost effective procedures for heirloom seed cultivation and preservation. Many heirloom varieties are threatened with extinction for various reasons, including changes in public tastes, low yields and disease susceptibility.

## SAVING SEED

### A. Getting Started

Saving seed is not much more difficult than growing plants from the crop that is harvested. It is all a matter of knowing what to do and when to do it. After trying some of the simple crops from which to save seed, go on to the more difficult and complex. A good crop to begin with is lettuce, then continue on to carrots, and finally to the cole crops and some of the cross pollinators, such as corn.

Three very important rules that all seed savers should keep in mind during the entire proces are:

1. Label everything from seeds in the rows in the garden through harvest, threshing, cleaning and seed storage. A complete label includes common name, variety name, date planted (or harvested) and any other pertinent information that seems necessary. Example:

Green Pepper, "Bull Nose"  
seed collected 10/2/84  
Largest pepper this season, 7 oz.

2. Never plant all of the seed at once. Save 1/3 to 1/2 of the supply. Some heirloom varieties could be lost forever due to a heavy hand at sowing time.

3. Store seed at low moisture and low temperatures to maintain high seed viability. Do not become careless during the growing season by leaving containers of seed exposed to the open air.

B. A Glossary of Seed Saving Terms

1. Annual: A plant that lives and produces seed in one growing season.
2. Biennial: A plant that lives and produces seed the second season.
3. Chaff: Excess plant material that should be removed before storing seed.
4. Cross-Pollinated - see Pollination
5. Cultivar: Literally means "cultivated variety" and as such, one knows that the desired plant has been reproduced under cultivation. For example - Red Bliss Potato was selected from a larger genetic base, then propagated because of its desirable traits.
6. Diversity: Refers to the maintenance of new varieties of a given species. Varieties are unique, and they evolved due to environmental and applied selection (due to man) over the centuries. A large and diverse genetic base of all the important crops is good insurance for a reliable food supply in the future.
7. Hybrid: Refers to plants that have been derived from two or more separate lines. Hybrids are produced occasionally in nature, but are most often produced by plant breeders. By selecting traits from a large genetic base, breeders are able to select desirable

traits and incorporate them into the genetic make-up of hybrids. Hybrids do not reproduce themselves reliably and their seed is often sterile.

8. Insect Pollination - see Pollination
9. Isolation: Usually refers to whether a plant should be separated from other varieties of the same species to maintain purity of the strain.
10. Perennial: A plant that lives through several growing seasons and may bear seed each season.
11. Open Pollinated: Refers to plants with a stable genetic make-up and similar (almost identical) traits generation after generation. Synonymous with non-hybrid and standard varieties.
12. Pollination: The process by which plants form viable seed and set fruit. Pollen is transmitted from the male portion of the plant (anthers) to the female portion of a flower (the stigma).

The following descriptive terms have been applied in determining isolation distances, crop timing, and cultural notes in the text:

- a) Cross-pollinated - actually means the transfer of pollen from one flower to another. It may be from different flowers

on the same plant or between two or more plants.

- b) Self-pollinated - the flower has the ability to pollinate itself. In some cases, pollination occurs before the blossoms are fully open as with beans and peas.
- c) Wind pollinated - the pollen is fine and dust-like, and easily carried by the wind. An example is corn.
- d) Insect pollinated - the pollen is mainly transferred by insects visiting flowers. Bees and wasps are important pollinators of many major food crops.

- 13. Propagule: The portion of a plant used in reproducing itself. Most often this is the seed as with beans; but it may also be a root, as with sweet potato; or a shoot, as with many herb and fruit varieties.
- 14. Roguing: The removal of off-type plants. A selection process whereby undesirables are eliminated from the gene pool.
- 15. Root to Seed: The production of seed from plants that were set out as roots (stored from the previous season). An example is beets set out in the spring and seed collected during the summer.

16. Seed to Seed: The production of seed from plants that were set out as seed. An example would be fall sown spinach and seed collected in early summer.
17. Selection: A process by which the genetic make-up of a variety changes over time. Regionally adapted varieties evolved after their dispersal so that a tomato grown in Michigan is somewhat different than the same variety grown in Florida.
18. Self-pollinated - see Pollination
19. Species: In the plant kingdom this refers to a breeding population of a plant that reliably reproduces itself, true to type.
20. True-to-Type Plant: Describes a plant that is typical of the strain from which it was derived. It will retain all the desirable traits of the strain and therefore, would be a good plant for seed production.
21. Variety: A smaller group than the species and, in which there are traits obviously different than those of the general species type. For example, within the cole crops there are several varieties: broccoli, cabbage, kale, etc., but they are all one species.
22. Vigor: This means retaining a large enough genetic base so that genetic diversity is maintained in the seed strains. A good example of not maintaining vigor



would be saving seed from only one plant or fruit of a particular variety. If this process of limiting the gene pool was continued for several generations, much vigor in the original strain would be lost and losses due to disease and pests may become prevalent.

23. Wind-pollinated - see Pollination
24. Windrowing: The process of stacking the seed containing plants in a pile and allowing to dry in the open air under favorable weather conditions.
25. Winnowing: A process by which chaff and debris is removed from the seed. A good method is to toss the seed in the air above a large container and allow the wind to blow off the chaff.

C. Some Common Herb and Vegetable Plant Families and Representatives for Each:

1. Compositae: Daisy family. Chrysanthemum, dandelion, lettuce, marigold.
2. Leguminosae: Pea family. Beans, peas, peanuts, soybeans, clover, alfalfa.
3. Umbelliferae: Parsley family. Carrot, dill, fennel, parsley, parsnip.
4. Solanaceae: Nightshade family. Eggplant, peppers, potatoes, tomatoes.
5. Labiatae: Mint family. Mints, bee balm, oregano, catnip, rosemary, sage.
6. Liliaceae: Lily family. Onions, garlic, leeks.
7. Chenopodiaceae: Goosefoot family. Beets, spinach and swiss chard.
8. Poaceae: Grass family. Corn, wheat, rice, oats, rye, grasses.
9. Cruciferae: Mustard family. Cabbage, mustard, radish, turnip.
10. Cucurbitaceae: Gourd family. Cucumber, gourd, melon, pumpkin, and squash.

D. An Encyclopedia of Food Crops by Plant Families Grown for Seed Production

We will begin our treatise on seed saving techniques with the easiest family - the Compositae, then work toward the more difficult - the Cruciferae and Poaceae.

1. Compositae: Daisy family. This family includes lettuce, salsify, garden mum, marigold and tansy.

### Flowering and Pollination:

These plants are naturally self pollinating. Because of this, lettuce varieties can be grown side by side without the danger of crossing.

### Seed Production:

It is best to spring plant lettuce that is being grown for seed. This allows you to select plants that bolt later in the season, one of the traits that is valuable to prolong the lettuce harvest. It is well to tie a strip of cloth on the plant being saved for seed production, especially if there are two or more gardeners. The flagged plants are reminders that these plants should be cared for accordingly. At living historical farms, these plants easily lend themselves to interpretation in demonstration gardens.

The plants will send out a long stalk when they reach maturity and begin to flower. Your best plant, if it flowers late, is a good candidate for seed saving. It may be necessary to stake the stalks because they produce many small dandelion-type flowers. The seed is mature when the flowers begin producing white fluff as with dandelions. Place a paper bag over the seed heads and gently shake the

plants. The seed should easily fall out. Another method is to pull the entire plant as the seeds mature and place in a paper bag to dry. A week may be required for seed and plant to be dry enough for seed harvest.

#### Harvest and Cleaning:

After the seed is dry, shake it loose from the stalks onto a canvas or sheet. Be sure to do this indoors, or your seed may blow away. If the seed needs further cleaning, rub through an eighth inch (1/8") screen to remove the chaff and the fluff.

An additional note on head lettuce is that you may need to cut an "X" into the head, allowing for the emergence of the seed stalk. A single lettuce plant may produce up to 30,000 seeds, therefore, one or two plants is more than enough for seed production.

2. Leguminosae: The Pea family. Beans and peas.

#### Flowering and Pollination:

Leguminosae contain perfect flowers and pollination occurs before the flowers open. Therefore, these are self pollinated under most circumstances. Bees may cross pollinate so if absolute purity is desired, separate varieties of the same species by 100 or more feet. Species

can be checked in the "Non-Hybrid Garden Seed Inventory" listed in the bibliography. For example, scarlet runners and half-runners are more apt to be cross pollinated by bees. Keep these separated or grow only one variety.

#### Harvest and Seed Production:

On most bean and pea varieties the seed will be ripe about 1-1/2 months past the snap state. Do not harvest the pods until 90 percent of the leaves have fallen and plants are dry and lifeless. With peas, the seed will rattle in the dry pods. With shell beans, mature seed will be ready about a month after eating maturity. Pull the entire plant and keep under cover.

#### Seed Processing:

Small lots can be shelled out by hand. Larger lots may be done by threshing and flailing, but make sure the bean seed is thoroughly dry before you do this. Since bean weevils are a common problem, thoroughly dried beans should be placed in sealed jars in the freezer for at least 24 hours to kill weevils. Store beans and peas in unsealed containers for the best shelf life in a controlled temperature and humidity area. The seed is dry enough for storage when if bitten into, it should be so hard that biting will not leave a dent.

A cultural note to remember on the pea family is that zinc is needed for good seed formation. One way to ensure this is by using seaweed kelp as a foliar fertilizer, or applying the liquid to the soil where legumes are to be grown.

3. Umbelliferae: The Parsley family. Many herbs and a few vegetables belong to this family. Among them are coriander, carrots, dill, caraway, fennel, anise, parsnip, and parsley. All have similar flower structures and are biennial.

#### Flowering and Pollination:

These flowers are cross pollinated by bees, therefore only grow one variety of each within a species. Be careful with carrot flowers, they belong to the same species as Queen Anne's Lace. Do not allow this weed to be in flower at the same time as the carrot flower.

#### Production:

Most of these family members are very cold hardy so it will not be necessary to bring the roots under cover through the winter. It would be well, however, to dig up the carrot roots in the spring, make selections from the best formed roots and replant them for seed production. Both dill and fennel will grow to four feet or more and staking may be necessary. The flowers are formed into umbels, flat top

structures with many flowers in one umbel. It may take three weeks to a month for the seed to ripen on the plants after flowers appear.

#### Harvest and Cleaning:

Check the flowering plants daily because the seed heads will dry in succession. Once dry, the seed heads will shatter easily. Cut the heads and place in a paper bag to dry completely under cover. The seed can be rubbed from the head between the fingers and palms. Sifting and sieving may help to remove more of the chaff. Store seeds in a clean glass jar with a sealable lid. The seeds are normally not long lived.

4. Solanaceae: The Night Shade Family - Tomatoes, pepper, eggplant and potatoes.

#### Flowering and Pollination:

These plants are mostly self-pollinating, but varieties do require some isolation because bees visiting the flowers may induce crossing. Separate varieties from each other by a tall crop, or the length of your garden. Sweet and hot peppers should be isolated or mixing may occur in the seed to be saved.

### Harvest:

Choose overly ripe fruit just past the eating stage for seed. Tomatoes will be soft and mushy, peppers will begin to shrivel, and eggplant will come off the plant easily.

### Seed Production (Eggplant and Tomatoes):

The fermentation process is recommended for eggplant and tomatoes. The pulpy flesh is scooped out of the fruit into a glass jar containing water. Stir and allow to ferment for two or more days at 75-80<sup>o</sup> F. Frequent stirring facilitates the process. When fermentation is complete, the good seed will sink to the bottom and the liquified pulp and poor seed may be carefully decanted. Rinse the remaining seed by adding water; stir and allow to settle. Pour off the water and repeat twice more. Dry the seed and store. It may take up to three days for the seed to dry. An added benefit of the fermentation process is that seed borne diseases such as bacterial canker are eliminated.

### Special Notes for the Night Shade Family

#### Tomato:<sup>1</sup>

Recent research has shown that tomato flowers can easily be cross pollinated by visiting bees. Both the bumble bee and sweat bees gather pollen from tomato flowers, occasionally.



Varieties, therefore, should be isolated from each other by at least 10 feet. A tall crop between the varieties is beneficial. If absolute purity is necessary, isolation of 500 feet or more is desirable - or only grow one variety.

Pepper Seed:

Remove the seed from the fruit by hand, rinse, then dry thoroughly.

Potatoes:

These are normally propagated by storing the tubers through the winter, and planting potato pieces the following year. Therefore, the new potatoes are duplicates of their parents. Sometimes potato flowers will form fruit, and they are similar in appearance to tomatoes. Handle and save seed from these as is recommended for tomatoes.

5. Labiatae: The Mint Family. Like the Umbelliferae, the members of this family include many herbs. Among them are the true mints, spearmint, peppermint, rosemary, sage, thyme and basil.

### Flowering and Pollination:

These flowers are cross pollinated by bees; therefore, grow only one variety of each species or practice long isolation distances. If true-to-type plants are your goal, it is best to propagate most of the mint family members from root divisions or cuttings, but seed propagation is possible. Some varietal forms like yellow or red sage are best handled as cuttings, as would be the case with lavenders and rosemarys. A good reference on herb propagation and uses is the Rodale Herb Book, listed in the bibliography.

The flowers will form on long spikes on the plants. The flowering time varies from early spring as with rosemary and thyme to mid-summer for peppermint and lavender, and over a period of time as with horehound and basil.

### Seed Production and Handling:

When the flowers have lost their petals and the spikes appear to be dry, cut them and dry indoors on screens for a week or two. Thresh out the seed very carefully because they are tiny and it is difficult to separate the seed from the chaff. Store in glass jars.

6. Liliaceae: The Onion family. Onions, garlic, shallots, walking onions, chives.

### Flowering and Pollination:

The onion family is insect pollinated. Grow only one variety of each species, or at the very least, know when the seed heads are formed on each variety - then stagger their timing.

### Production:

Onions are a biennial crop, therefore, the bulbs need to be over wintered to produce seed the following season. Chives are perennial and will produce seed heads each spring after they are mature. The seed stalks on all members of the onion family are similar in appearance. They will be very thick and tall so as to require staking. On elephant garlic, the seed stalk can easily reach four to five feet. The umbels easily shatter, so collect seed as soon as it turns black.

The novice seed saver can learn much about the onion family by doing the following:

- Select a healthy onion from the grocery store.
- Plant it in the early spring.
- Observe the seed stalk emergence and umbel formation.
- Collect and save the seed, if it is a variety you like.
- Grow from seed the following year.

Since there is no risk in doing this, I encourage you to do this before trying it out on a rare heirloom variety. The process is the same and you really will gain much confidence from the exercise.

#### Seed Handling and Harvest:

Cut the umbels from the plants as the seeds become exposed. Pile on screens in an airy place and allow to dry. Thresh out by hand rubbing when they are thoroughly dry. If debris remains, the chaff may be washed away by water. The seed is heavy so the debris can be poured off with the water. Dry for several days on screens - then store in airtight containers. Onion seed is not long lived.

#### Additional Notes:

Where winters are not severe, the roots may be allowed to over winter, but this does not contribute to the selection process. When the bulbs are dry in the fall and stored, the best keepers can be replanted the following spring. By selecting for this desirable trait, your future onion crops will be better keepers.

7. Chenopodiaceae: The Goosefoot family. Both beets and spinach are members of this family as are rhubarb and Swiss chard. All members can be over wintered for seed production the following spring. Beets are best stored in damp sand in

a root cellar - then planted out the following spring. The advantage here is that selection can be made from the best stored roots.

#### Flowering and Pollination:

All members are wind pollinated. Therefore, only one variety of each species should be grown at one time. Swiss chard will cross with beets, so do not save seed from these unless their flowering times are greatly different. Seed growers set isolation distances for this family at one mile or more. It might be well to investigate your neighbors' garden, or share seed with them of only one variety.

#### Production:

Technically, beets are biennial and spinach is an annual. Both can be over wintered by planting in the fall to produce seed in the spring. Spinach may bolt earlier in the spring if it is over wintered, but there are earlier harvests from a fall rather than spring planted crop. Save seed from plants that bolt late compared to the rest of the crop.

Spinach is an interesting plant in that there are four types of individual plants: extreme males; non-flowering males; plants that produce both male and female flowers, and female plants. It is best to rouge out the extreme males,

noted by their slender stature and early bolting. If these are removed from the lot, eventually this undesirable trait will be eliminated from your seed stocks. The other three plant types can remain and should to ensure good diversity in the crop.

Spinach seed will form on a long seed stalk. With spinach, the plants can be cut at the base when the seed stalk turns yellow - usually in the mid-summer. The plants can be dried under cover and the seed either threshed or removed by hand.

Beets should be fall grown 2-1/2 to 3 months before frost, if seed production is your goal. Pull several medium sized roots before black frost and store in damp sand in a root cellar over the winter. Good storage temperatures are 40-45<sup>o</sup> F. Select the best keepers from this lot and replant in early spring. Trim off the old leaves to within one inch. Plant out, barely covering the crowns. Branches will form producing many seed balls, each containing several seeds. Seeds are mature when they become dry and brown. The seed near the root will mature first. When most of the seeds are ripe, pull the plants, cut off the roots and bring the seed stalks under cover to dry completely. The seed can be removed by hand followed by winnowing to remove the chaff.

Please note that beets need some chilling to induce flowers and seed. Temperatures close to 40<sup>o</sup> F are better than conditions just above freezing.

8. Poaceae: The grass family. The main types of these plants are the small grains, such as wheat, rye and oats, and corn, Zea mays. Because corn is very different from the small grains it will be treated separately.

#### Flowering and Pollination (Corn)

The flowers of corn are dioecious, both male flowers (the tassels) and the female flowers (the ears and silks), occur on the same plant. They are wind pollinated, and because of this isolation distances of one mile between varieties is recommended. Sweet corn will cross with field corn and popcorn and vice versa. Through thousands of years of selection, the Native Americans isolated and created the known different types of corn, but because they are all varieties of the same species, all may cross pollinate.

#### Production:

The following procedure is almost mandatory to ensure varietal purity. If you do not want to follow this, or a similar practice, do not save corn seed. A close watch on tasseling and silking out will be necessary to keep a corn

strain pure. When the corn tassels are out, silking can occur from three days to two weeks later depending upon the variety. Corn silks are receptive to pollen for about three days after they appear. As the corn forms tassels, cover several with large grocery bags and tie onto the plants. As the ears form and before the silks emerge, tie smaller lunch bags on to each ear. Gather pollen into the large bags by bending down the tassels and shaking vigorously. A small amount of yellow (powdery) pollen will collect in the bag. Mix the pollen from several plants into a bag. Use a camel hair brush, such as a shaving brush and apply pollen to the silk - do this thoroughly. You will need to replace the lunch bags on the ears and repeat hand pollination the next day or two after the first application.

It is necessary to cover the tassels because bees will fly from plant to plant and could easily contaminate the pollen you intend to use in the process if other corn is growing nearby.

Incidentally, super-sweet corn can be ruined for eating, if foreign corn pollen should fall on its silks. Some varieties of sweet corn should never be grown except in complete isolation because their kernels become starchy and tough when cross pollinated.

It is safe to remove the small bags from the ears about five days after the first application of pollen. By then the silks will no longer be receptive.



### Production and Handling:

Allow the ears to remain on the plants until they are very dry. A frost probably will not hurt the seed, if it is dry and mature, but plan on bringing in the ears at least two-to-three weeks before a hard frost. For late maturing corn, the season may exceed 120 days, so plant your corn as early in the year as possible.

When the ears are gathered, pull back the husks but do not remove them entirely. Use the remaining husks to hang several ears together for further drying. Shell any corn saved for seed by hand to prevent damaging the kernels. Corn seed is dry enough for storage when you bite on a kernel - no dent remains. If insects are a problem, place the dried seed in tightly sealed jars in a freezer for two days. Then store in unsealed jars (plastic milk containers are ideal for large amounts).

### Small Grains - the Cereal Crops:

The small grains of oats, barley, wheat, rye and rice are treated very differently from the prescribed practice for corn.

### Flowering and Pollination:

In the small grains, isolation between varieties is not necessary because cross-pollination seldom occurs. It is well to separate crops by soil strips sufficiently wide to ensure the harvest of pure seed.<sup>2</sup> In small sized plots, be

careful to keep the seed of weed grasses to a minimum to eliminate contamination of the crop seed.

Production and Handling:

Because the mature seed heads do not shatter easily, one may leave the seed on the plants for a short time up to a few weeks before collecting it.<sup>3</sup> Do protect the plants from the birds, however, as one may easily lose the seed if the garden is left untended near harvest time.

The grain will be mature when the plants dry almost completely. Don't allow rain to fall on the grain near harvest, as some may germinate. Cut the grain by hand. Thresh by hand the portion intended for seed saving. Grain should be stored at a moisture content of 12-20 percent.

**Barley:** This grain will have a chalky white appearance and will snap easily when mature. If it is still springy or doughy, it is probably not ripe.

**Wheat:** This is one small grain that should shatter readily when ripe. About 75% seed shattering when the plant is shaken, indicates the time of harvest. (Some heirloom wheats are very tightly held, however).

Rye: The grain is mature when it no longer feels doughy, as with barley.

Oats: Time the harvest of oats one week later than when the grains first lock dry. Use the winnowing process to remove any chaff.<sup>4</sup>

Dry all the above seed a few days longer even if you are sure it is very dry. Store clean seed in glass jars or zip-lock bags. Grain may be frozen after proper drying to kill off any insect problems as with corn and beans.

9. The Cruciferae: The Mustard Family. This family has members that fall into two categories - annuals and biennials. All the cole crops are members of one species and all can cross with one another if they are in flower at the same time. The varieties are as follows:

Broccoli	<u>Brassica oleracea</u> v. <u>botrytis</u>
Brussel sprouts	<u>Brassica oleracea</u> v. <u>gemifera</u>
Cabbage	<u>Brassica oleracea</u> v. <u>capita</u>
Cauliflower	<u>Brassica oleracea</u> v. <u>botrytis</u>
Kale -	<u>Brassica oleracea</u> v. <u>acephala</u>
Kohlrabi	<u>Brassica oleracea</u> v. <u>caulo-rapa</u>

### Pollination and Flowering

The best practice is to grow only one variety or at the very least separate the plants by at least 200 feet because they are insect pollinated. At least two plants must be

saved of each variety to get fertile seed, as each needs pollen from another plant to set fruit. All of the above brassicas are biennial, with the exception of broccoli, which is an annual. The flowers in all of these are perfect and yellow; they are followed by seed pods called siliques which shatter easily upon drying.

#### Biennial Harvest

Allow the siliques to turn yellow, then pull the entire plant or just the flower stalk for further drying in a warm place or in full sun. Care should be taken to retain the seed because the pods may shatter at any time. A good method is to lay the plants on a sheet while drying. Later, you can gather up the seeds or dry pods for further processing. Thresh out the seed and clean off the chaff by winnowing and screening.

Overwintering the mature plants is the only difficulty in attempting seed saving with the biennial cole crops. They may require special protection where winters are cold and temperatures remain below 0<sup>o</sup> F for a period of time. If this is the case, the mature plants are pulled before black frost and placed in a cold, damp root cellar. An alternative would be to pull the plants, rogue out undesirable ones, and replant in a trench, then cover well with soil. In trenching the plants, bury them so only the uppermost portion is

visible. This should provide protection to 5-10<sup>o</sup> F. In early spring the stored plants are replaced 2 1/2 to 3 feet apart or the trenched ones are uncovered. In mild areas, no special treatment would be required to carry the plants through to the seeding stage. To facilitate seed stalk emergence on cabbage, a cross is cut into the head about one inch deep when the plants are set out in the spring.

#### Annual Harvest

The annual members of the mustard family include broccoli, radish, turnip and Chinese cabbage.

#### Flowering and Pollination:

All the flowers are perfect and require pollen from another plant of the same variety for fertility. Remember, broccoli can cross with other B. oleraceae so isolation is the general rule. Radish will cross with other varieties of radish, and Chinese cabbage may cross with any of the true mustards. Isolation of 200 feet or more is recommended because all are insect pollinated.

#### Seed Production:

All crucifers form long pods containing the seed (siliques) and are handled the same as biennial crucifers. The root crops are fall planted and seed is produced the following spring. Chinese cabbage and mustard form seed

stalks in the late summer if spring planted, or they may be overwintered.

Harvest and Cleaning:

Thresh out the seed after thorough drying as described for the biennial crucifers.

10. Curcubitaceae: The Gourd family.

Flowering and Pollination:

All the members of this family have both male and female flowers and a few have perfect flowers. Bees transfer pollen from one flower to another so isolation is necessary between members of the same species. A good authoritative reference to check on a species is the "Non-Hybrid Garden Seed Inventory," of the Seed Savers Exchange. It is best to grow only one member of a species. For example, only grow one variety of cucumber, if you wish to save seed. Also, check with your neighbors, if they are gardeners, or your efforts may be for naught. An alternative is to cover your plants' flowers and hand pollinate. Instructions on this will follow.

There is much confusion among members of the gourd family as to which plants may cross with others. A general rule is that one species will not cross with another. Therefore, cucumbers will not cross with melons, squash,

pumpkins, or gourds. However, some squash, pumpkins and gourds may cross with each other. As a quick reference, the following are the botanical names and representative common names and descriptive notes on each of these.

- Cucumis sativis: Cucumbers
- Cucumis anguria: West Indian Gherkin (They may cross with cucumbers)
- Cucumis melo: Cantaloupe, muskmelon, honeydew, persian, and casaba melons.
- Citrullis vulgaris: Watermelons (may cross with citron)
- Cucurbita pepo: All the summer squashes, acorns, scallops, yellow-flowered gourds, and many traditional pumpkins. These have five angled, hairy stems with deep grooves.
- Cucurbita maxima: Buttercup, hubbard, banana, and turban squashes. These have round, hairy stems and huge leaves on long vines.
- Cucurbita moschata: Butternut squash, cheese squash, and Kentucky field squash. These have large leaves and spreading

vines with five sided smooth stems; fruit stem flares as it joins the fruit.

Curcubita mixta: Cushaw squash. These have stems similar to C. moschata, but they will not cross with it, or the other species of Curcubita.

Legenaria siceraria: All the hard shelled bottle gourds with evening blooming, white flowers. A few of these species are edible, such as Cucuzzi and New Guinea Buttervine.

In regard to seed saving of squashes, it is best to remove the seed about twenty days after the fruit is ripe.<sup>2</sup> This may be done by leaving the fruit on the vine, or after it is cut and brought indoors, although after ripening seems to be very beneficial.

The following is the method of hand pollination that is recommended to all serious seed savers. Squash is a nice plant to use as a learning subject because the flowers are large and easily distinguished as to male and female parts.

To begin, take a close look at the flowers on your squash plants. The male flowers are the ones that appear



first - they have long stems and usually are held well above the trailing main stem of the plant. Several male flowers will appear before any female flowers are formed. The female flowers are held closely to the main stem and just below the petals you will see a swelling that resembles the mature fruit. Ordinarily, bees will visit both types of flowers, carrying pollen as they go. Since bees are early risers, it is best to select the female flowers for your seed-saving fruit the evening before that flower is expected to open. A flower that is about to open will have fully formed petals that are yellow. In order to exclude the bees, either tape or clip the female flower closed (use a spring clothes pin). Do the same to a male flower from a different plant.

On the following morning, clip away the petals of the male flower to expose the anthers. The anthers contain the pollen and are formed into a yellow cone. Remove the male flower from the plant, open the female flower (which was clipped shut the night before), and brush pollen onto the stigma of the female flower. Then cover the entire treated flower with an envelope and tape it shut. Leave the envelope on the flower for two to three days. Then gently remove it. By this time, the female flower will no longer be receptive to any pollen because the young fruit will be formed and developing.

This may sound like a long process, but in practice it only takes a few minutes and it is a certain method for absolute purity. Be certain to hand pollinate several flowers, because squash and other cucurbit members are often subject to rot diseases. A rotten fruit will prevent any success with seed saving. Therefore, do at least one more flower than you think you will need for seed saving.

#### Seed Production and Handling:

Many fruits of the gourd family are ready for seed harvest when they are ripe. These include pumpkins, winter squash, and muskmelon and watermelon. Simply remove the seed and wash well to remove any pulp. Then set on screens or paper until dry. The seed is dry when it breaks, if bent. Cucumbers require ripening on the vine. When they are golden colored, pick and cut open the fruit. Scoop out the seeds and flesh. The fermentation process works well on these and muskmelon. Carefully rinse the seeds - again, the good seed will sink and the immature seed and pulp will wash away. Dry the seed on paper towels and store.

#### An Additional Note:

Be sure to label everything from each sowing in the garden to final collection and storage. Many of these seeds look very much alike; your memory will not always serve you well. 2

## FOOTNOTES

<sup>1</sup> Jeff McCormack, Ph.D. "Isolation Distances for Tomatoes," in the Seed Savers Exchange Winter Yearbook, 1984, p. 247.

<sup>2</sup> Stevens, Harlan and John R. Goss, "Seeds of Oats, Barley, Wheat and Rice," in Seeds, the Yearbook of Agriculture, 1961, p. 154.

<sup>3</sup> Bubel, Nancy, The Seed Stater's Handbook, p.287.

<sup>4</sup> Ibid., p.288

<sup>5</sup> "Seed Saving Guide," in the Seed Savers Exchange Winter Yearbook, 1983, p., 209.

## STORING SEED

### A. Seed Storage Conditions

The worst enemies of seed viability are moisture and high temperature. Most at home seed storage areas are not right for seed storage. If seeds are stored constantly at ambient conditions, their ability to germinate is greatly reduced.

For example, seeds stored above 25<sup>o</sup> C and over 45 percent relative humidity will suffer a low germination rate after storage. Seed viability, under any storage, varies with the species, in that some are naturally long lived, whereas others may only remain viable for a period of days or weeks. Short lived seeds include some maple species, corn, and members of the carrot and onion families. Long lived seeds include the cabbage family, cucumber, watermelon, pumpkin and squash.

It is advisable to maintain low humidity and temperature<sup>s</sup> for another reason; insect activity will be reduced to almost nil, if the moisture content of the seed is 8 percent or less and the temperature remains less than 18<sup>o</sup> C. A comparable relative humidity of 30 percent combined with a temperature of less than 70<sup>o</sup> F will contribute greatly to maintain a moisture content of most seed at 8

percent or less. A general rule is that the sum of the temperature (in degrees Farenheit) and the relative humidity (in percent) should be less than 100.<sup>1</sup>

The space requirements for seed storage is not very large considering the area of the garden that the seed storage serves. In our experience, we have stored enough seed for an acre of corn, an acre of tobacco, and more than an acre of herb, kitchen, and research gardens in a space of less than 25 cubic feet. Some of the seed is very bulky, such as nut seeds, corn and beans. In addition, we are active members of the Seed Savers Exchange, and have shared many of our heirloom seeds with various living historical farms and museums.

Since our emphasis is preservation of heirloom seed through propagation, the most effective mode of action is to store seed for the short term rather than long term storage. It is our belief that the freshest possible seed grown out on an annual basis is the most certain method to keep heirloom varieties from becoming extinct.

#### B. Containers for Seed Storage

There are many containers that are suitable for seed storage. They need not be expensive or fancy.

The following items have been used for storage:

- standard letter envelopes
- business sized envelopes

- zip-lock polyethylene bags (best if 3 ml or thicker)
- baby food jars
- one gallon plastic milk jugs
- mason jars with lid and ring seal
- mayonnaise jars - use a standard canning lid and ring to seal
- 4 liter size jar with rubber seal and lock-on wire bail
- large gallon sized pickle jars
- peanut butter jars
- jelly jars

Other types recommended:

- seal-a-meal bags
- sealable foil pouches
- tin or metal cans with metal lids
- plastic and metal photo film containers

Do not use coffee cans with plastic lids for seed storage. They simply do not exclude moisture from the seed inside. If any glass jar is used for seed storage, be sure that the jar lid has plenty of sealing compound on it. This will ensure a tight seal. If your jar lacks a seal, make one from old inner tube material.

A good method for storing many small lots of seeds is in labeled paper envelopes - then place these inside a large glass jar and tape a list of what is stored inside on the outside of the jar. These envelopes and packets also store well in zip lock bags. You can get over a dozen of the small lots in a zip lock bag and use a 3x5 card to list what is in the bag and slip that inside also.

In order to ensure that the seed remains at a constant moisture content, it is helpful to enclose a desiccant in

the container. Silica gel, available at hobby stores, is a recyclable desiccant. It can be oven dried and re-used. A cheap and readily available desiccant is powdered milk. Either one can be used in the following manner. Take four sheets of facial tissue, and place two tablespoons of the desiccant on it. Roll up carefully in a butcher's wrap fashion and fasten with string or tape. Place the desiccant inside the jar or zip lock bags with the seed packets or envelopes. Replace with fresh desiccant material every six months.

If you do not have a special seed storage room, a very good place to store seeds is in your refrigerator or freezer. Just be sure the seeds are sufficiently dry (8% moisture content or less) and that they are in well sealed glass jars. If the seeds are to be frozen, they must be as dry as possible, because frozen water particles within the seeds will break open their cells and kill them. Also, when you take the seed container from the refrigerator or freezer, allow the entire unopened container to warm up to room temperature before removing the wanted seeds. Replace the containers in the freezer or refrigerator as soon as possible. If you open the jar upon removal from the cold storage - water vapor will condense on the seed packets and they would require re-drying before setting them in cold storage again.

To restate the important conditions: Store seed at low moisture and temperature to retain vigor and long viability. Be certain to label each seed packet or container with the varietal name and the year the seed was produced.



FOOTNOTE

<sup>1</sup> Jabs, Carolyn, The Heirloom Gardener, p.232.

#### IV. DIVERSITY - WHAT IT MEANS IN THE LONG RUN

We live in a country that has long enjoyed a very productive agricultural base. Every one of us, even the most sophisticated computer designer is involved in agriculture, at mealtime. Directly or indirectly, all of us owe our well-being to the natives, early explorers and founders of this Country.

None of our major crops is native to this continent. Except for a few crops such as blueberries, cranberries, strawberries, and Jerusalem artichokes, all of our agricultural plants are imported. "It is believed that agriculture began independently in Southwest and East Asia, Mesoamerica, and probably South America and Africa in prehistoric times and gradually spread to other lands. The different grains and vegetables as we know them did not exist, for their present form is the result of thousands of years of evolution and domestication." <sup>1</sup> Even in the New World, crops of corn, potatoes, beans and pumpkins that originated in South America were brought to our continent by early Native Americans more than five thousand years ago.

But what has this to do with diversity and preservation of heirloom varieties? If it were not for the people who first collected the food plants from the wild, there would

be no crop diversity. At some point in prehistoric time, these food gatherers recognized that certain foods could be made more accessible, if their seeds were saved and planted. Thus, the first agriculture began. Later, as the new gardeners grew out their crops, selections could be made according to taste, yield, and any number of a variety of desirable traits expressed in these plants. "Millions of years of natural selection go into the creation of the assortment of genes that make up a species. In addition, thousands of years of selection and protection by humans result in a plant type with desirable characteristics."<sup>2</sup>

"Heirloom varieties are often ones derived from relatively stable ethnic communities where they have been fine tuned to the local environment."<sup>3</sup> Frequently, a regionally adapted variety arises that is in tune with its local ecology - even in modern times. The regionally adapted forms contain what is called a 'gene pool.' "To keep a gene pool from losing valuable genetic material -- diverse plant varieties must continue to be conserved and to evolve in agricultural environments."<sup>4</sup> "It is a fact that there is strength, including survival, capability...in diversity."<sup>5</sup>

Unfortunately, "America's abundant food supplies are at risk because our crop varieties lack sufficient genetic diversity."<sup>6</sup>

The plant breeders are as much aware of this perplexing problem as anyone. The key issue in this paradox is that many of our food crops rely on a very narrow genetic base to keep ahead of any diseases or environmental problems that the future may hold. For example, although there were once over a thousand varieties of wheat imported to this country, only a few hundred are available as seed, and fewer than a dozen varieties are grown in the vast wheat lands of the United States. One only needs to recall the corn blight of 1970 to realize that we are gambling with time, when so much crop land is planted in monoculture or, at best, in similar gene-containing hybrids, as is the case with sweet corn and wheat.

Although the seed repositories contain a large assortment of crop varieties, only a few of these have been used to create the familiar high yielding hybrids of today's agriculture. The farmers want high yielding crops, so the breeders continue to reshuffle their small stock of genes as they continue in their fight against disease and possible famine.

Although these hybrids have their place in modern agriculture, they simply have no adaptable value to the home vegetable grower or to the heirloom gardener. As Kent Whealy so aptly put it, when speaking of traditional

varieties, "Far from being obsolete or inferior, the varieties being dropped from seed catalogs (and ignored by breeders) are the cream of the vegetable crops.... A possible effect of any crop breeding...is that farmers and gardeners cease to plant their traditional varieties with the result that the existing pool of germplasm may be lost."<sup>7</sup>

"When traditional plant varieties are lost, their genetic material is lost forever. Each variety is genetically unique, containing genes not found in other varieties. Because of inbreeding, new varieties are no longer resistant to certain insects or diseases. Unless we have living seeds that carry genes to confer disease resistance, it may not be possible to breed resistance back into wheat or any other crop."<sup>8</sup> In a 1978 report from the National Academy of Sciences, "Conservation of Germplasm Resources," it was stated that the only reliable method to preserve endangered species is their natural habitat. In the case of fruits and vegetables, this means the home orchard and garden. It is here that the heirloom gardener can play an important role in the preservation of genetic diversity.

For the sake of brevity I will only mention the Federal System of seed storage facilities in the United States.

First there is the National Seed Storage Laboratory at Fort Collins, Colorado, the primary seed bank in the U.S. responsible for 200,000 seed varieties as of October 1981. Secondly, there is the Small Grains Collection at Beltsville, Maryland, which contains the seed for wheat, oats, barley, rye, etc. Thirdly, there are the Regional Plant Introduction Stations at Geneva, New York; Ames, Iowa; Pullman, Washington; Experiment, Georgia; and Sturgeon Bay, Wisconsin. Each of these has responsibility for testing and maintaining certain plant introductions as they enter the United States. Additionally, Clonal Repositories are maintained to ensure the propagation of woody species such as fruits and nuts. To keep abreast of the happenings at these facilities, it is recommended that you subscribe to the National Plant Germplasm System's bi-monthly publication, Diversity, Laboratory for Information Science in Agriculture, P.O. Box 2160, Arlington, Virginia 22202.

Access to the germplasm in the seed banks is generally limited to persons who show they have a need to obtain the seed of a particular variety. Acceptable reasons to acquire a seed sample may be for plant research or historic purposes. Simply liking the name of an ancient variety is not enough. In this case, I believe that living historical farms have a distinct advantage in obtaining old varieties of seed.

Besides the National Plant Germplasm System of the United States, there are private collections where the home and heirloom gardeners can obtain many traditional varieties. Some of these sources are the Seed Savers Exchange, the Blue Ridge Seed Savers, and the Southern Exposure Seed Exchange. Fortunately, in the United States, no law has prohibited the practice of growing and saving seed from plants of an open-pollinated variety. In many foreign countries, it has recently become illegal to grow any plant variety that is not listed in their prescribed lists of plants for that purpose. Most of the entries are hybrids, so seed saved from these plants are often sterile. In this way, the precious genetic reserves are being eroded ever more quickly.

The genetic make-up of the world's economically important plants is a resource that is being depleted at an alarming rate. If we were to account for the loss of the unique vegetable varieties, at the turn of the 20th Century, available through seed catalogs in the United States, we would find that 80% of the diversity is already gone. Of the 20% that remains, fewer varieties are being carried in mail order seed catalogs each year. According to Kent Whealy, "the varieties that are dying out today, may be just the ones needed in the future. We don't know what we'll

need. So we can't let anything go down the drain. A plant that doesn't look terrific to us now may have just the qualities that will allow it to thrive in the conditions of the future."<sup>9</sup>

The scientific community is aware of these genetic losses, also. "Conservation of the sources of diversity requires a minimum of two basic activities: collection from the geographic centers of diversity and maintenance of collections under controlled environments"<sup>10</sup>. These geographic centers of diversity are the locations where the first gardeners collected food plants and placed them under cultivation. These wild relatives of economically important plants, although they may not seem to have any inherent value, do indeed, have the value of survival in their natural habitat. Similarly, the genetic resources contained in heirloom varieties, have the survival advantage on a regional scale.

The problem that exists between these newly acquired "old" plants and the seed banks is that "although exotic germplasm provides a diverse array of genes, this diversity cannot quickly be molded or siphoned into....well adapted materials."<sup>11</sup>

Because our Nation's seed repositories have limited access to their stored germplasm and their collections are



so large, there is a real danger of losing many varieties, at least as they exist today. Keeping seed viable while it is in storage is really a two fold problem. First, it is difficult to maintain life in seed that is held in long term storage, even under ideal conditions. Therefore, the seed needs to be removed from storage and grown out every few years to maintain all of the germplasm resources contained in each open pollinated variety. The paradox is that seed held too long in storage begins to show genetic changes (mutations) as the seed lots are grown out. Secondly, all germplasm needs to be subjected to the processes of natural selection (placed in normal growing conditions) in order that its genetic make-up may evolve along with the changing environment. If seed is held too long in storage and it is only grown under experimental conditions, it may eventually lose its ability to change genetically to keep pace with the changes in the environment through time.

In other words, it is virtually impossible to hold any life form in cold storage too long, simply because it is not the natural thing to do. Therefore, both the breeders and heirloom seed savers want the germplasm to remain the same, while at the same time, the varieties need the constant exposure to the environment so that the process of natural selection may take place.

As recently as a few generations ago, it was considered normal to raise vegetable and fruit varieties that had something to offer besides that which was now in vogue or possibly high yielding. Many of this nation's immigrants brought with them seeds or plants that were familiar to them and that represent ethnic or family traditions. These simple folks carried not only the traditional varieties, but also, each in his own way, brought the makings of the great genetic diversity we have enjoyed in this country. They, as we do now, had no way of knowing what the future may hold.

FOOTNOTES

<sup>1</sup> Fowler, Cary. "Reaping What We Sow," in The 2nd Graham Center Seed and Nursery Directory., p. 16.

<sup>2</sup> Nabhan, Gary Paul. "The Seeds of Pre History" Garden May-June, 1980.

<sup>3</sup> Ibid.

<sup>4</sup> \_\_\_\_\_ . "Handing Down the Seeds", unpublished paper. By permission of the author.

<sup>5</sup> Nilsen, Richard. "Plant Patenting" Co-Evolutionary Quarterly, Winter 1979, p. 33.

<sup>6</sup> "Plant Breeding Research Forum Persuades Legislators of Critical Need to Support National Plant Germplasm Systems", Diversity No. 6, 1984. Fort Collins CO., p. 9

<sup>7</sup> "The PVPA and Genetic Diversity", Diversity, No. 6, 1984, p. 8 [PVPA = the Plant Variety Protection Act].

<sup>8</sup> Fowler, Gary, "Plant Patenting", Co-Evolutionary Quarterly, Winter, 1979, pp. 34-35.

<sup>9</sup> Jabs, Carolyn, The Heirloom Gardener, p. 49-50.

<sup>10</sup> Smith, Stephen. "The Plant Breeder's Perspective on Genetic Diversity: A Reply to Pat Mooney's The Law of the Seed," Diversity, No. 6, p. 19.

<sup>11</sup> Ibid.

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