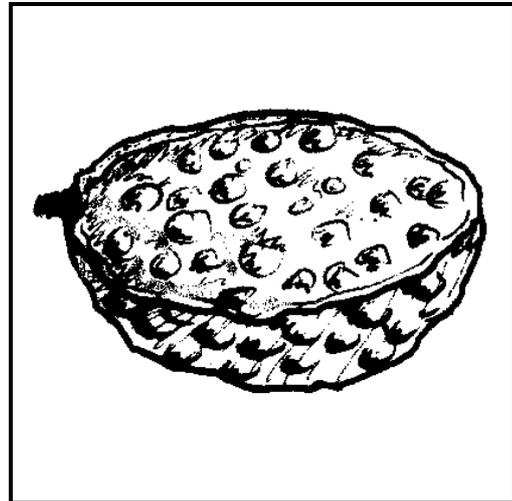
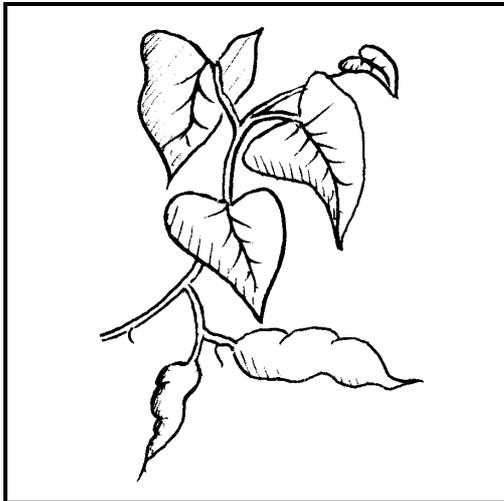
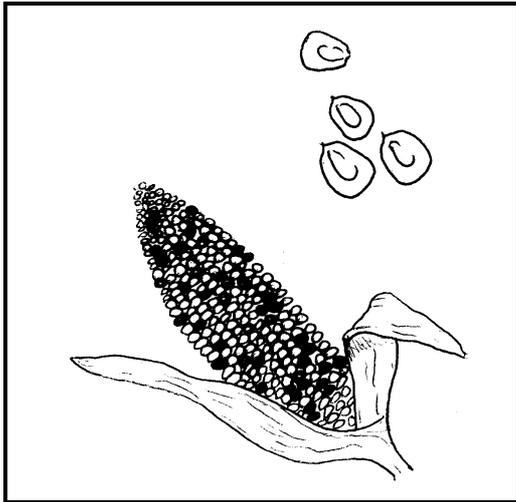


Farmer Seed Saving



H D
R A
the organic
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Produced by
HDRA-the Organic Organisation

Introduction

Traditional plant selection and breeding

This booklet provides a simple and practical guide to plant selection and saving vegetable seeds.

For centuries, farmers all over the world have selected and saved seeds to grow the next season. Farmers have also cross-pollinated plants by hand, or by mixing varieties within the same field, to maintain and adapt their crops.

As a result of this relationship between the farmer and plant, these locally adapted crops are able to withstand changing growing conditions. Some varieties may be resistant to certain pests, while others may be more tolerant of salty soil or may need less water. Some varieties may be planted or harvested earlier or later in the season, and others may have fruit that are tastier or grains that are easier to cook.

In this way, farmers have been able to maintain a mix of crops suitably adapted to their own local needs.

Organic farming works with nature using techniques to achieve good crop yields that are sustainable for the farmer and the environment. Seed saving and breeding locally adapted crops are important activities in organic agriculture in order to produce crops that are better adapted to local growing conditions.

The conservation of local crop varieties is important because:

- Crops that have been developed locally are suited to local conditions and are likely to provide a more reliable harvest than plants from outside the local area.
- The use of different varieties will mean that there is less risk of losing the whole crop if, for example, there is a new pest in the area or a change in climate, as some plants may be more tolerant to the changes.
- Farmers can breed for new characteristics that are useful to them and their community.
- Farmers can domesticate wild plants and breed crops from outside the area to be suitable for local cultivation.
- Farmers do not need to buy new seed each year.

The main sources of seed

In rural communities, the main sources of seed are:

- **Farmers and gardeners**

For many generations, all over the world, farmers and gardeners have saved seed from their crops every year to plant and to exchange or sell.

- **Community seed banks and other local community institutions**

Some areas have community seed banks, or other social institutions, which collect, grow and store seed to distribute to farmers.

Even a small group of people can start a seed bank to conserve local seeds and crops so farmers can use them.

- **National and international seed banks**

National, government and international organisations collect and store seeds from different crop varieties. These are maintained by 'growing' out every few years.

Although large seed banks can store many different varieties, they cannot maintain all of the local varieties or adapt varieties to farmers' changing local conditions.

- **Seed companies**

Seed companies develop and sell seeds for different crop varieties. Commercial seed companies usually select for characteristics such as high yield, quality and resistance to pests and diseases. However seed companies are not able to select for crops that are adapted to specific local conditions. Some commercial varieties need additional inputs such as chemical pesticides, fertilisers and high levels of water.

Many seed companies produce *F1 hybrid* seeds. These are made by crossing two different varieties to mix their characteristics. The first generation of plants from hybrid seeds holds desirable characteristics, but it is not useful to save the seeds because these characteristics will not be passed on to the next generation. As a result, growers that use hybrid seed must buy new seed each year.

Although large-scale farmers may be able to buy seeds every year, this is less affordable for small farmers .

In addition, many people all over the world now realise how important it is for farmers to maintain their own local genetic diversity.

Traditional and exotic plants

New crops have been introduced in many different countries. These are called *exotic* crops. For example, maize, potatoes, tomatoes and chilli peppers are originally from South America, but they are now grown all over the world. These crops are now well adapted to the different local conditions, but this has taken many generations.

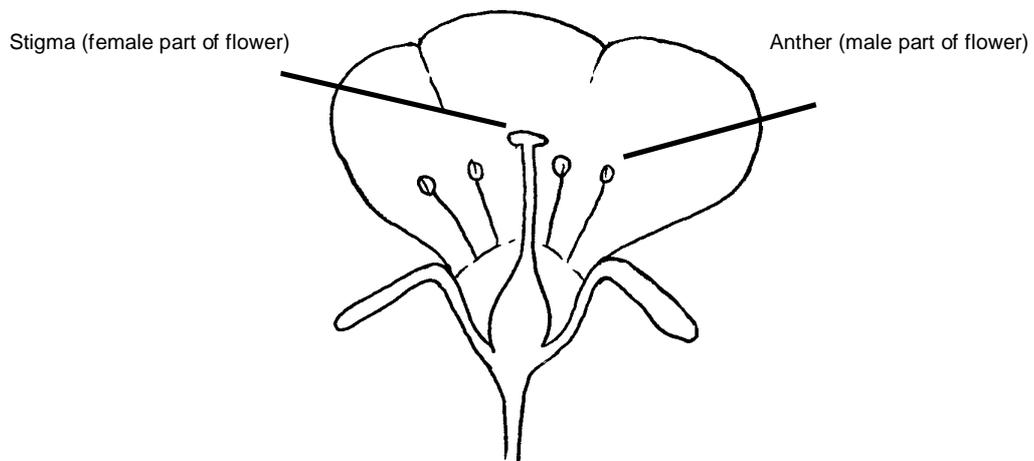
Exotic plants can be very useful, but it is important that they do not replace *traditional* crops. Traditional crops are crops that have a long history in a region and are adapted to local conditions, especially in times of stress or hardship where resources like water and nutrients are less available. They also provide a wide range of nutrients to the diet.

Some exotic crops are unable to produce seed in the new climate and so the farmer must purchase the seed each year.

Some people may think that they do not have a wide variety of traditional crops or they may think that crops from other countries are better than their own. Other farmers, gardeners and older people in the area may have knowledge about traditional crops and how they are used. The seeds of traditional crops and the knowledge about their growth and use are important resources and should be conserved and used.

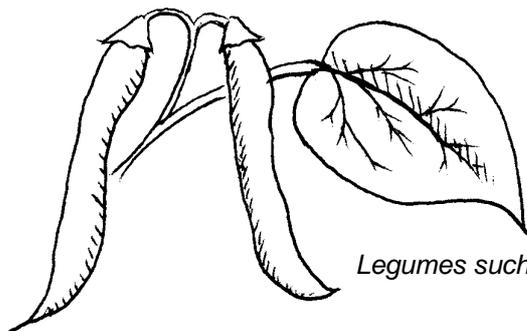
Seed production

Seeds are produced in fruits which develop from flowers. Normally, for seeds to develop, pollen (the plant's own fertilising powder) is moved from the male part of the flower (the anther) to the female part of the flower (the stigma).

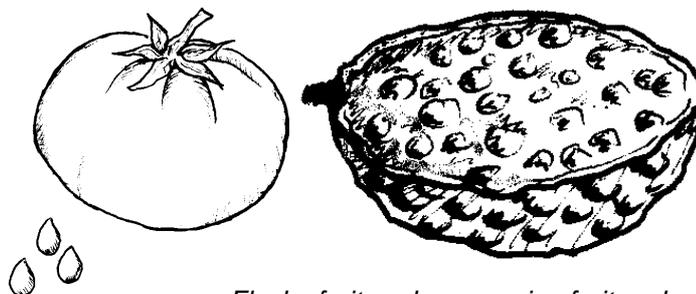


Some plants have flowers that contain both the male and female parts (e.g. tomatoes), and some have separate male and female flowers (e.g. squash).

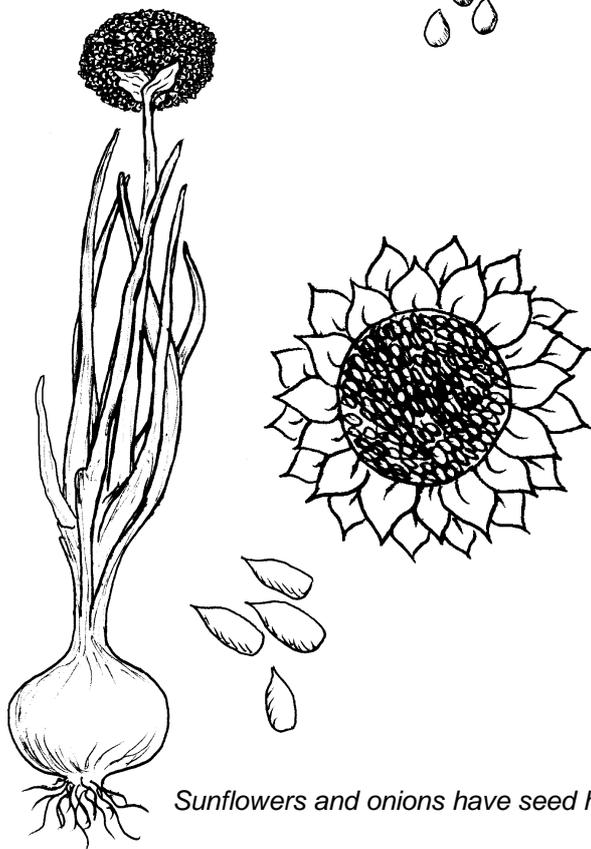
Seeds are held in seed heads, pods or fleshy fruit. Usually plants whose useful parts are the seeds, bulbs, roots or leaves, such as sunflowers, spinach or onions, have seed heads; plants whose useful parts are the flesh of the fruit, such as papaya and tomatoes, hold their seeds in the flesh; and legumes (pulses), such as beans, have pods.



Legumes such as beans have seed pods



Fleshy fruit such as passion fruit and tomatoes hold their seeds in the flesh.



Sunflowers and onions have seed heads.

Pollination

Some plants are usually self-pollinated and some plants are usually cross-pollinated. On self-pollinating plants, the pollen that will fertilise the female stigma comes from the male anthers on the same flower, or a different flower on the same plant. Plants that mostly self-pollinate include maize, tomatoes and lettuce. The seeds will grow into plants with very similar characteristics to the parent plant.

In plants that tend to cross-pollinate, the pollen must come from a different plant. The plant will produce fewer, or less vigorous seeds if they are not pollinated by a different plant. Pollen can be carried to other plants by the wind, insects or animals. Examples of plants that tend to cross-pollinate are carrots, onions and cabbage. The seeds will produce plants with some characteristics from each of the parent plants.



Propagating without seeds

Some plants can be reproduced or propagated without seeds. For example Irish potatoes can be propagated using tubers; sweet potatoes can be propagated through cuttings or tubers; and bananas put out 'suckers' (small shoots growing from the base of the parent plant) which may be planted to grow into a new plant.

Plants that are propagated in this way are genetically identical to the parent plant.

Sweet potatoes can be propagated through cuttings from the vines or the tubers.

Seed selection

Seeds can be selected from plants that have desirable characteristics such as:

- Pest and disease resistance
- Good taste
- High production
- Long fruiting season
- Fast cooking time

The plants grown from the seeds will have similar characteristics to the parent plants, unless the parent plants come from F1 hybrid seeds.

Seeds should be selected from strong and healthy plants to harvest and save. It is very important to remove unhealthy or diseased plants from the field as soon as they are seen. Also try to remove plants with undesirable characteristics from the field before they flower and pollinate other plants, but make sure that there is a diversity of characteristics in the field.

Plant breeding for specific characteristics

If a plant breeder or farmer wants to develop or introduce specific characteristics in a plant, they can do this by controlling the pollination of plants for seed production. To combine desirable characteristics in plants, the farmer or plant breeder can transfer the pollen from a chosen individual plant to fertilise another chosen plant.

For plants like squash, which are usually pollinated by insects, the farmer can rub the pollen onto the stigma, by using a small brush, or by rubbing the anther directly onto the stigma.

For plants such as maize, which are usually wind pollinated, the farmer can shake the male flower over the female flower to transfer the pollen.

Isolation from unwanted pollination

If plants are being cross-pollinated for particular characteristics, the farmer must stop the flowers being pollinated by pollen from plants with other characteristics. This can be done by isolating the plants.

If the plant is wind pollinated, the selected flowers can be covered with cloth or a paper bag. This will isolate them from other pollen carried by the wind.

If the flowers are usually insect-pollinated, they can be isolated by protecting them with fine cloth or mesh to stop the insects reaching the flower.

Genetically Modified Seed (GM)

A recent method of developing new crop varieties is through *genetic modification*. A gene is a segment of DNA, which is a part of the plants biological composition, passed from one generation to the next. Each gene holds information about certain characteristics of the plant. Genetic modification is a process where a gene is taken artificially from one plant (or animal) and inserted into another in order to introduce a new characteristic.

There are already GM varieties of some crops, such as rice, maize, tomatoes and cotton.

Advantages and disadvantages of genetically modified seed

Advantages

It is possible to add a useful characteristic into a plant, which may not be possible using traditional plant breeding methods.

It may be quicker to introduce new characteristics than using traditional plant breeding methods.

Disadvantages

The cross may not happen under natural conditions; there may be a good reason for this that we do not yet understand.

The transferred genes may have an unpredictable effect on the plant.

GM varieties are not necessarily adapted to specific local conditions and may require more inputs to be grown successfully.

GM crops may cross with and pass on their characteristics to other related plants; for example this may produce very strong weeds.

GM seeds are normally patented (owned) by commercial companies. As a result they cannot legally be saved by farmers – new seed must be purchased each year.

Developing a GM variety costs a lot of time and money. It may be more effective to use this on improving other growing problems (see example on next page).

**Action for drought resistance:
example of GM versus ecological approaches.**

A government has \$2 million to invest in improving agriculture in drought prone areas.

This money could be spent on developing one GM drought-tolerant variety. This would include providing jobs for researchers and maintaining their laboratories.

Or the money could be spent on working with farmers to:

- a) identify, multiply and use existing drought-tolerant crops;
- b) involve farmers in breeding new varieties that are drought tolerant and also have other locally adapted characteristics; and
- c) improve water harvesting and soil and water conservation techniques, so that the whole farming system becomes more resilient and less vulnerable to drought.

Which would you choose?

Organic agriculture does not support genetic modification. Organic agriculture is concerned with complex, natural systems. It concentrates on enhancing the potential of this diversity to adapt to local environmental and social conditions.

Seed harvesting cleaning and storage

Once the seeds to save have been selected, they must be harvested, saved and stored for the next seasons planting.

Seed harvesting

In many plants, the seed becomes mature some time after the fruit is mature. To avoid the fruit or pods being harvested for eating, some farmers put a label on plants that they want to collect seed from. If there is a risk that they may be eaten by birds, these plants can be harvested before the seeds are mature and left on the plant until they are ready.

It is a good idea to harvest more seeds than will be needed for planting, as some may be damaged during storage or may not germinate.

Seed extraction and washing

Seeds from 'wet' fruits

Seeds from wet, fleshy fruits such as gourds and papaya, often have the flesh of the fruit attached to them. Seeds can be extracted from the fruit by hand, and washed until all the flesh is removed.

A method called *fermentation* can be used for fleshy fruit whose seeds are surrounded by gel that is difficult to wash off, such as squash or tomatoes. Squeeze the seeds into a container and mix with a little water. Leave the container for one to four days until foam appears on the surface. Then strain and wash the seeds in water and lay them out to dry.

Dry seeds and seeds from dried fleshy fruit

Seeds from dry seed heads such as onion, sorghum and corn, fruit such as dried okra and chilli peppers, or pods such as beans can be extracted by hand. If there is a large quantity of seeds, place them in a bag and beat them carefully with a stick to remove their outer casing.

Seed drying

Seeds must be dried before storing them to improve their storage life. This is because moisture in the seed may encourage mould, bacteria or other pests and diseases. However, seeds should not be dried too much or too rapidly as they may crack or lose their ability to germinate. They can be dried outside in the morning sun or half-shade, but should not be left in strong sunlight.

To dry seeds, spread them out thinly on paper, cloth, flat basket or plate in a warm place off the ground. They should not be dried on metal as this may become too hot. Turn them over several times a day to ensure that they dry evenly.

They should not be left outside at night as they may become damp or be eaten by rodents.

The length of time that they take to dry will depend on the weather and the size of the seeds. Leave the seeds to dry for several days before storing them. When the seeds do not feel damp or stick together they are likely to be ready for storage.

Preparing for storage

Visual inspection

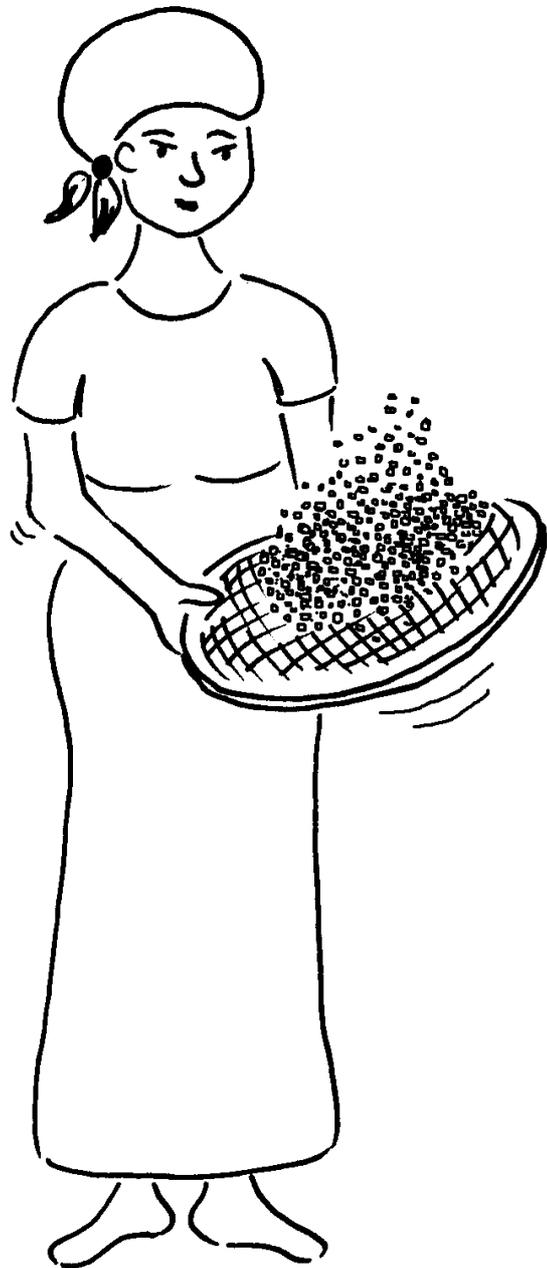
Any seeds that are immature, broken, diseased or infested with pests should be taken out. Stones, dirt and seeds from other plants should also be removed.

Winnowing

Winnowing can remove smaller contaminants such as dust and dry leaves.

To winnow the seeds, place them in a large flat container and toss them into the air when there is a gentle wind, then catch them in the container.

The light dust and leaves will be blown away by the wind.

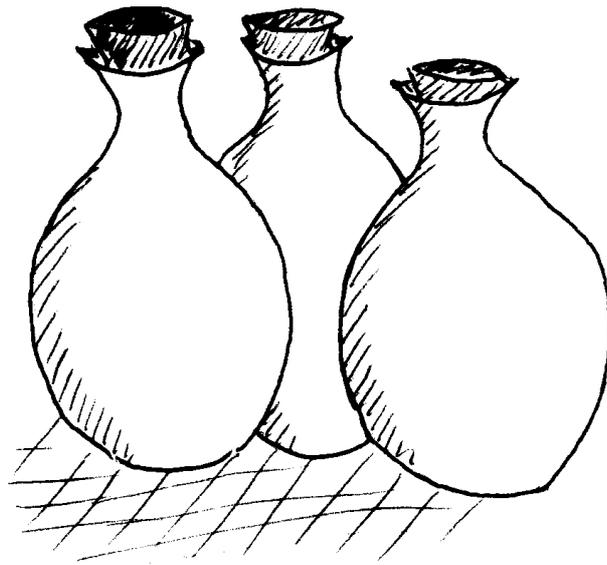


Seed storage

Seeds must be stored in a way that prevents them from being attacked by pests or diseases, and that maintains their quality. Some seeds can be stored for a long time without losing their germination rate, and others can only be stored for a few months. This depends on the type of seed, the moisture content of the seed and the storage conditions.

Good storage conditions for seeds are:

- Low moisture
- Low temperature
- Low light
- Protection against rodents
- Protection against insect pests and diseases



Seed should be stored in an airtight container

Moisture

Seeds should be sufficiently dried before they are stored. To stop the seeds becoming damp when in storage, they should be stored in an airtight container such as a glass jar, a tin can or a ceramic vessel with a tightly sealed cover.

Dry charcoal or toasted white rice can be added to the seed container to absorb water and to help prevent the seeds from getting damp. These should be replaced if the containers are opened.

Seeds that are held in pods, hollow fruit such as chilli peppers and maize seeds on the cob, may be dried and hung near the smoke from cooking fires. This technique also helps to keep away insect pests.

Temperature and light

High temperatures can encourage biological activity in the seeds and shorten their storage life, particularly if there is any moisture in the seeds. Bright light can also be damaging to stored seeds. Seed containers should be kept in a cool area and out of direct sunlight.

Rodents

To keep rodents such as rats and mice away from seeds, they should be stored in a clean hygienic area. The floor should be swept so there are no scraps of food that may attract rodents. Seed containers should be well sealed and if possible kept off the ground so that rodents cannot get in. Sometimes seeds are stored in specially built huts that are raised off the ground.

Pests

Storage weevils, fungi and bacteria can infest seeds when in storage and damage them.

Only seeds that are free of pests should be stored. Weevils, fungi and bacteria start to multiply in warm and moist conditions. To prevent this from happening, the seeds should be kept dry and cool.

Some substances may be mixed with the seeds to help prevent pests and diseases:-

Sand

Mixing the seeds with clean, dry sand and filling the container will prevent weevils moving around.

Aromatic plants

Some aromatic plants can prevent pests from multiplying and may kill them.

Neem (*Azadirachta indica*): Dry Neem leaves or seeds in the sun, then grind them into a powder. Mix 6-8 teaspoons (30-40 grams) of powdered Neem leaves, or 3-4 teaspoons (15-20 grams) of powdered Neem seeds, for every kilogram of seeds to be stored.

Hot peppers or chilli (*Capsicum frutescens*): Mix 4-6 teaspoons (20-30 grams) of dried and powdered chillies for every kilogram of seeds to be stored.

Black pepper (*Piper nigrum*): Mix 6 teaspoons (30 grams) of powdered peppercorns for every kilogram of seeds to be stored.

Turmeric (*Curcuma longa*): mix 4 teaspoons (20 grams) of powdered root of turmeric for every kilogram of seeds to be stored.

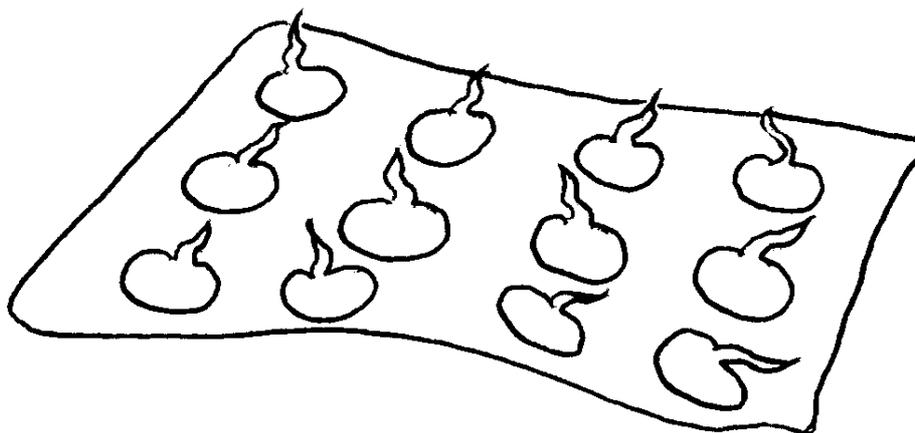
Seeds of yambean (*Pachyrrhizus erosus*): Mix- 1-2 teaspoons (5-10 grams) of powdered seeds of yambean, for every kilogram of seeds to be stored.

(From *The Bio-intensive approach to small-scale household food production* (1993) International Institute of Rural Reconstruction)

Testing the germination rate and quality

The quality of the seeds affects how well they will store and their ability to germinate and grow well in the field. Testing the seed before storage ensures that only good quality seeds are stored. A germination test gives an idea of the proportion of plants that are likely to grow from a certain quantity of seed, and will show how many seeds must be sown in order to obtain the desired number of plants.

Use between 10 and 100 seeds, depending on how many seeds there are. To test the germination rate, place the seeds some distance apart on a clean damp cloth or paper towel. For large seeds it is better to use sterilised soil. Soil can be sterilised by pouring boiling water over the soil to kill germs.



The seeds should be placed somewhere warm, but out of direct sunlight. Keep the seeds damp, but not too wet, by sprinkling with water or covering with a clean damp cloth or paper towel.

After a few days the seeds should start to germinate. If none of the seeds have germinated it may be necessary to leave them for more time, keeping them warm and damp.

If most of the seeds have germinated and have healthy looking roots and shoots, the rest of the seeds from that harvest should be viable and suitable for storage and planting.

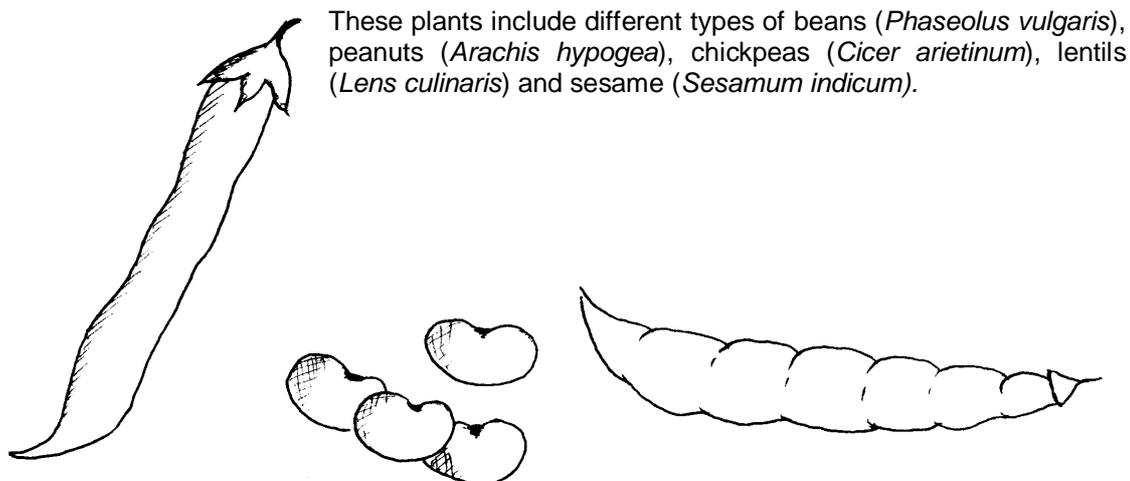
If less than half of the seeds have germinated, or if many of them are unhealthy, the rest of the seeds from that harvest are probably also unhealthy with low germination rate. The farmer may decide not to store these seeds. If seed is in short supply, these seeds may still be stored and planted, but a note should be made that they are not good quality seeds.

It may be useful to test the quality of seeds before storage, and to test home saved seeds and seeds that have been bought or exchanged, before planting them.

Seeds from different plants

Each plant species produces seeds in distinct shapes and sizes, and are found in different parts of the plant. This section describes some of the main plant types and how to collect and dry their seeds.

Plants that hold seeds in pods



The pods may be left on the plant to dry, and harvested when the seeds rattle in the pods. However, if necessary, pods that are still green but are mature may be picked and dried separately. It is very important to handle legume seeds very carefully, especially after they have been dried, as they can easily be damaged.

The seeds should be removed from the pods and then dried for about 5 days before storing. The amount of time they need to dry will depend on their size. In humid conditions, the seeds may be left in the pods and hung in the smoke above the cooking fire.

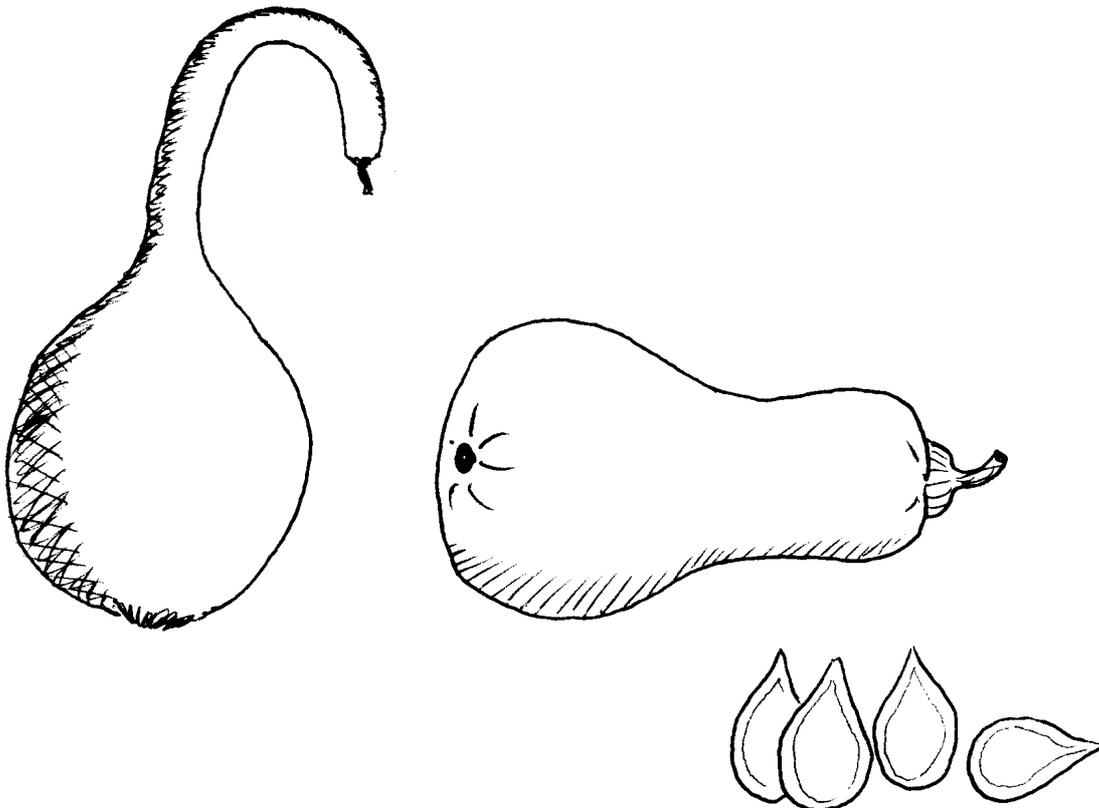
Plants that hold seeds in fleshy fruit

These plants include squash (*Cucurbita pepo*), tomatoes (*Lycopersicon lycopersicum*), peppers (*Capsicum annuum*), cape-gooseberry (*Physalis peruviana*), okra (*Abelmoschus esculentus*), papaya (*Carica papaya*) and passion fruit (*Passiflora edulis*).

Squash, melons and gourds

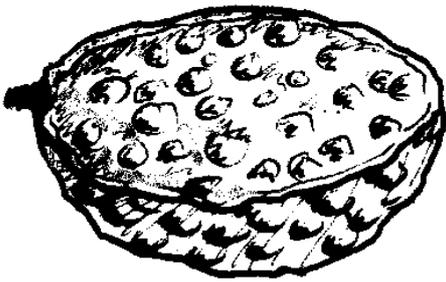
For seed collection, the fruit should be harvested when it is fully mature. The fruit should be stored for a few weeks so that the seeds can continue to mature. After this time, the fruit can be cut open and the seeds removed. The flesh of the fruit can be removed from the seeds by hand or by the fermentation process which is described on page 13.

After cleaning, the seeds should be dried out of direct sunlight. When the seed is brittle enough to be broken in half it is dry enough for storage.

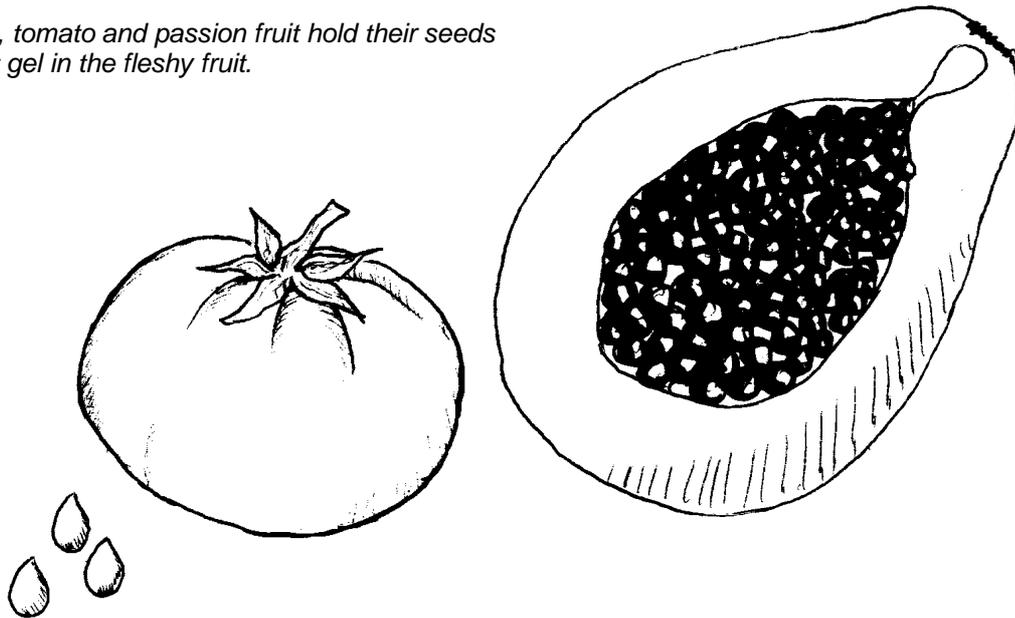


Plants with their seed in moist fleshy fruits

Seeds should be taken from fully ripe fruits. The seeds of moist and fleshy fruits, such as tomatoes, passion fruit and cape-gooseberry, should be scooped out of the fruit and cleaned by hand or using the fermentation method described on page 13. The seeds should then be laid out to dry out of direct sunlight. The seeds should be lightly shaken twice a day while they are drying to prevent them from sticking together.



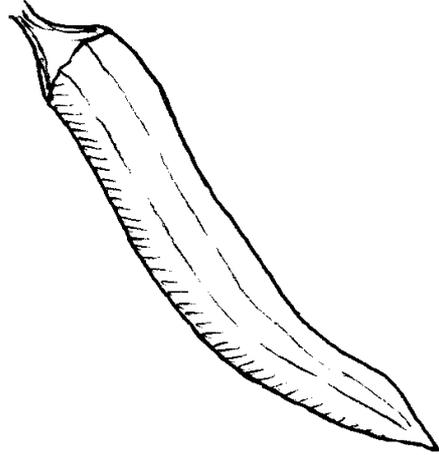
Papaya, tomato and passion fruit hold their seeds in moist gel in the fleshy fruit.



Plants with their seeds in hollow fruits

Seeds of hollow fruits, such as sweet peppers, chilli peppers and okra, can be removed by hand. The seeds do not need to be washed and should be laid out on a plate to dry out of direct sunlight.

Okra pods can be left on the plant until they are dry and brown and the seeds rattle, or may be picked when green and left to dry for a couple of weeks.

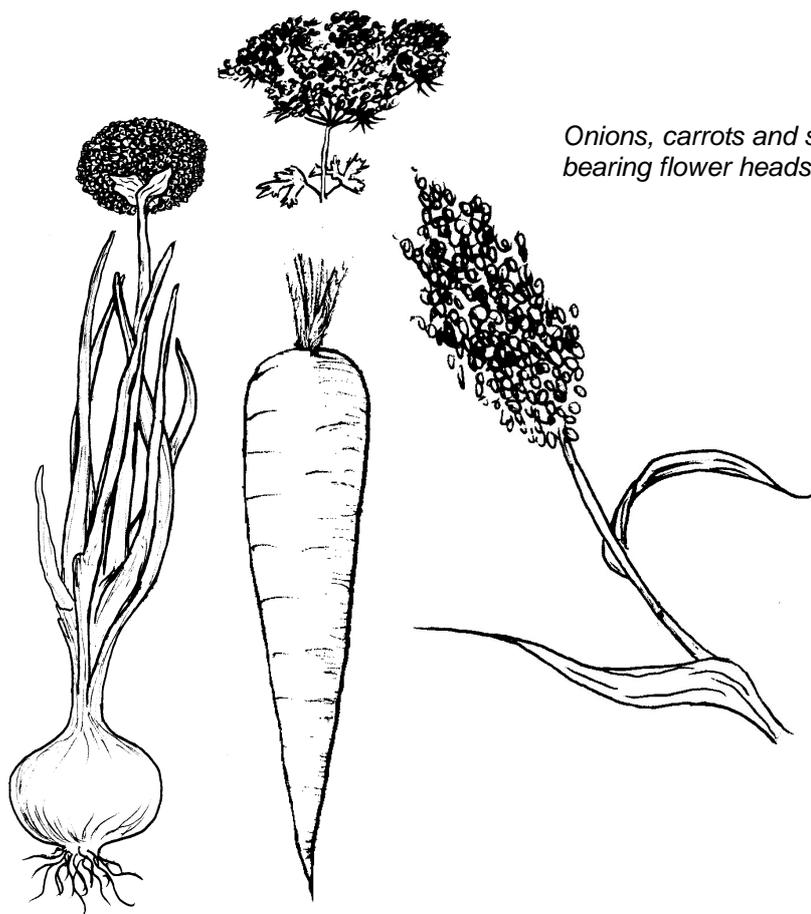


Care should be taken when removing seeds from chilli peppers and okra, as their juice can irritate the skin. Hands and utensils should be well washed after contact with chilli peppers and okra.



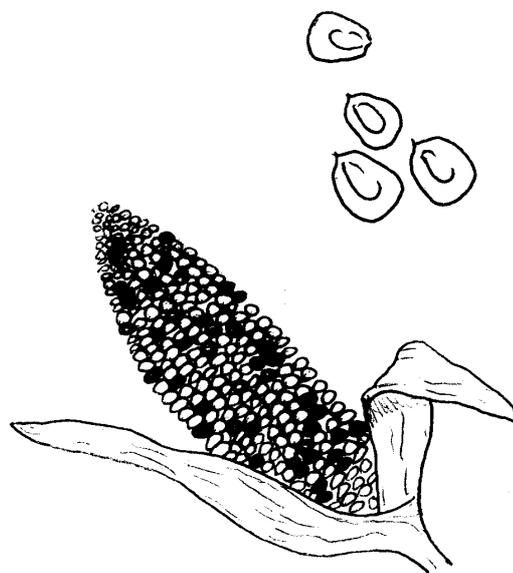
Plants with seed-bearing flower heads

Plants with seed heads include sunflower (*Helianthus annuus*), onions (*Allium cepa*), amaranth (*Amaranthus spp.*), carrot (*Daucus carota*), sorghum (*Sorghum*), spinach (*Spinaca oleracea*) and quinoa (*Chenopodium quinoa*). The seed heads should be picked when they are dry, and can be left out of direct sunlight to finish drying if necessary. When completely dry, the seeds can be removed by rubbing or shaking the seed heads.



Onions, carrots and sorghum all have seed bearing flower heads.

Maize (*Zea mays*) bears seeds on a cob, which can be harvested in the same way as seed-bearing flower heads.



Further reading

The Bio-Intensive Approach to Small-Scale Household Food Production (1993) International Institute of Rural Reconstruction, YC James Yen Centre, Silang, Cavite 4118, Philippines

Food from Dryland Gardens (1991) DA Cleaveland and D Soleri. Centre for People Food and Environment, 344 South Third Avenue, Tuscon, Arizona 85701, USA

The Seed Savers Handbook (1993) M&J Fanton. Seed Savers Network, PO Box 975, Byron Bay, NSW 2481 Australia

Many thanks to HDRAs Heritage Seed Library and Research Department and to the Seed Savers Network, Australia for help with producing this booklet.

Further information on seed saving, and tropical organic farming generally can be obtained from the International Development Programme at HDRA. Other booklets in this series include Composting, Natural Pest and Disease Control and Agroforestry, as well as information sheets on crop pests and diseases and their control, natural pesticides and green manures. This information is available to download from our website or can be obtained by writing to:

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HDRA - the Organic Organisation is dedicated to researching and promoting organic gardening, farming and food. For more than two decades, HDRA's International Development Programme has promoted sustainable farming practices in the tropics and sub-tropics through research, information provision and capacity building of local organisations.

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