A Guide for Farmers

Saving Your Own
Vegetable Seeds

AVRDC
The World Vegetable Center

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A Guide for Farmers

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AVRDC
The World Vegetable Center

AVRDC—The World Vegetable Center is an international not-for-profit organization committed to alleviating poverty and malnutrition through research, development, and training.

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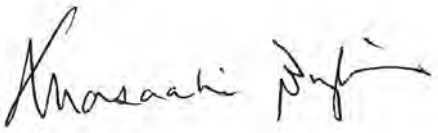
Foreword

Good seeds are undoubtedly one of the most important materials for farmers. The seeds must be healthy and, preferably, they must possess all the desirable properties that farmers need such as high yielding, high quality, and resistances to diseases, insect pests and environmental stresses.

The Asian Regional Center of AVRDC (AVRDC-ARC) has been conducting training on vegetable production technologies including seed production, seed testing and seed preservation at the regional training center in Kamphaeng Saen, Thailand in collaboration with Kasetsart University for 24 years. The number of trainees who have participated from Cambodia, Lao PDR, Vietnam and Myanmar numbered 205 by the year 2004. The regional training was conducted mainly for extension workers and researchers, and it has contributed to increasing the numbers of trainers in these countries. After going back to their own countries, the graduates of this training program have become resource persons. They engaged in in-country training on vegetable production.

Various kinds of in-country training have been conducted in relation to vegetable production. As an off-shoot, the production of vegetable seeds is now being conducted in these countries. However, it seems that the technologies for seed production have not yet reached down to the level of ordinary farmers adequately. Many farmers still need to learn the techniques required to produce vegetable seeds by themselves. Seed production of vegetables is not as simple as it is for many self-pollinated staple crops, including beans and some cereal grains. Specific techniques are required for every type of vegetable. Aside from this, F_1 hybrid vegetable seeds are now prevailing in the market, and farmers must be informed that the seeds obtained from the harvest of these crops cannot be used for sowing future crops. Therefore, the dissemination of seed production technologies based on reliable information is needed. The manual provided here was written by the teachers of Kasetsart University and AVRDC headquarters who have been working together with AVRDC-ARC. This edition is made in an effort to help extension workers who are directly in contact with farmers. I am hoping that this manual will help ordinary farmers and will contribute to the sustainable development of agriculture through vegetable production in developing countries.



Masaaki Suzuki
Director
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Overview of seed saving

Which seeds can be saved?

Vegetable seeds can be saved to sow new crops in the future, but not all seeds are suitable for saving. Varieties suitable for seed saving include local varieties that have been grown in one region for a very long time, self-pollinating crops (for example, beans and peas), and open-pollinated varieties of some cross-pollinating crops (for example, pepper, cucumber and carrot).

Commercial F_1 hybrid varieties are popular among many vegetable growers today. However, the seed of hybrid fruits should not be saved, because the F_1 hybrid seeds were produced by crossing two different parent varieties. Seed saved from hybrids will either be sterile or the plants of the next generation may show wide variation in characters, uniformity and maturity.

Seed saving involves selecting suitable plants from which to save seeds, harvesting seeds at the right time, and storing them properly. The seed saving techniques of many common vegetables will be introduced in this manual.

Before you start to save seeds, it is necessary to know a few things about the reproductive ability of plants. Many vegetable species produce flowers with the male part (anther) and the female part (stigma) in the same flower. These are called perfect flowers (Fig. 1). However, in maize and most varieties of the cucurbit family (cucumbers, melons, pumpkins, etc.), the anthers and the stigma are in the same plant but on different flowers. These are called imperfect flowers (Fig. 2).

Pollination occurs in plants when pollen from the anthers of the flower is deposited on the stigma. In some perfect flowers, self-pollination occurs. Lettuce, tomato, and okra have the stigma so close to the anthers such that the slightest wind movement can cause the pollen to drop onto the stigma within the same flower. In peas and beans, self-pol-

Fig. 1. Perfect flower of eggplant: the stigma (green) is surrounded by anthers (yellow)

Fig. 2. Imperfect flowers of squash: female flower with exposed stigma (left) and male flower with exposed anthers (right)

lination occurs even before the flower opens.

Other types of perfect flowers require cross-pollination. An external pollinator such as an insect is necessary. Onion, carrot, cabbage, and radish, for example, belong to this type.

Plants with imperfect flowers require wind or insects such as bees to transmit pollen from the anthers of the male flowers to the stigma of the female flowers. Maize, for example, is cross-pollinated by wind, while cucurbits are cross-pollinated by bees.

How to keep seeds pure?

Keep in mind that natural cross-pollination can always happen to some extent under a field situation, even in self-pollinating plants. It often occurs when pollen grains stick onto the bodies of insects visiting flowers, and then carry the pollen grains to the next flower they visit.

Isolation in distance. Pure seeds can be produced by leaving enough distance between two or more varieties to prevent cross-pollination by insect or wind-blown pollen. How far apart differs among vegetables; this will be described for each vegetable in the following chapters.

Bagging. When only a small amount of seed is needed, cover the unopened flowers with a paper bag. This is applicable for crops with a high but not 100% rate of self-pollination, such as pepper and eggplant. You can also bag the flowers of cucurbits (Fig. 3); in this case, both male and female flower should be bagged, but hand-pollination is required.

Caging. Cages can be used for vegetables that flower over a long time or to prevent insects from transmitting pollen from two nearby varieties of the same crop (Fig. 4). You can use bamboo rods stuck in the ground to make an arched tunnel and covered with nylon mesh. Because the cage will exclude all insects, you may need to hand pollinate the plant to ensure seed set, or you can introduce bees into the cage if they are cross-pollinated species.

What is the best way to store seeds?

After saving your seeds, it is important to keep them alive for future use. Newly harvested seeds should not be immediately stored in a plastic bag because the moisture content of the seed is still high and will lead to deterioration.

Fig. 3. Bagging bitter gourd flower for hand pollination

Fig. 4. Isolation of pepper selections in nylon net tunnels

Before keeping seeds in the storage, seeds should be dried. Keep in mind that seeds are alive—but they breathe very slowly. To keep seed alive for a long time, keep them under low temperature and low humidity during storage.

Humidity. Seeds will absorb moisture from the storage environment. High humidity levels cause seed to increase their respiration rate and use their stored energy. Make sure your seeds are dry enough (seed moisture content around 7–8%) before storage, and keep them in an air-tight container, such as a screw-top jar (Fig. 5).

Darkness. Exposure to sunlight will shorten the life of seeds. Use dark-color jars or nontransparent containers to protect seed from sunlight. If using clear jars, place them in paper bags to shield out sunlight.

Temperature. For most vegetable seeds, a temperature below 15 °C is ideal. You can keep the seeds in an air-tight container and place the container in the refrigerator. For short-term storage, keep the seeds in a cool and shady dry place.

Fig. 5. Seeds stored in air-tight containers to prevent them from absorbing moisture

Most vegetable seeds can be safely stored for at least three to five years. Place seeds in manila envelopes, cloth or mesh bags, plastic containers, or foil envelopes. The best containers are air-tight, such as a sealed glass jar, metal can, or foil envelope. Label each container carefully. Note the names of the line or variety, the year, and any other information you feel is valuable. Store seeds in a cool, dry place.

Amaranth

Production

Amaranth (*Amaranthus* spp.) is an important food crop in Africa and Asia, especially for subsistence farmers. It is a fast-growing crop that easily grows on a wide range of soils and climates. The plant prefers temperatures between 25 and 30 °C.

There are many *Amaranthus* spp. growing as weeds (for example, *A. spinosus*) around crop fields. For these reasons, local varieties are usually mixed populations.

Seed crops are often produced using transplants. Seedlings with desirable leaf and stem characteristics are transplanted about three weeks from sowing and spaced 45 cm apart in rows spaced 60–80 cm apart. Plants with a small apical inflorescence may be pinched four weeks after sowing to encourage production of secondary shoots.

Isolation

Amaranth is mainly wind pollinated. A minimum isolation distance of 1000 m between varieties is recommended. Keep plantings free from related weeds to prevent cross-pollination.

Selection

Plants may be rogued as young plants, removing types with undesirable or off-type color, size or leaf shape. Plants should be rogued again just before flowering, again removing off-types. Once flowering begins, plants with off-type flowers should be quickly removed.

Harvesting

A lightening or yellowing of foliage color is an indication that seeds are beginning to mature (Fig. 6). Types with an apical inflorescence are usually harvested once. Types with several side shoots are harvested several times as the seeds mature. The harvested seed stalks are placed on a clean tarpaulin or into very fine mesh nylon bags and allowed to dry in the shade.

Fig. 6. Maturing seed stalks of amaranth

Processing

Seeds are easily threshed by hand. The threshed seed is cleaned by winnowing.

Bean

Production

Seed production of French or common bean (*Phaseolus vulgaris*) is possible in the tropics as long as the maximum day temperature does not exceed 30 °C at the time of flowering. For best results, French bean should be grown during a season where temperatures begin warm but then gradually decrease. Under these conditions, seeds will germinate well in the warm soil and set pods as temperatures decrease. Dry weather is preferred while pods mature.

Isolation

French bean is a self-pollinating crop and no isolation is required.

Selection

Harvest seeds that grew on healthy, vigorous growing, high yielding plants (Fig. 7). Avoid harvesting seed from off-type plants as well as plants affected by diseases.

Harvesting

Pods are harvested when they have turned yellow but are not yet completely dry. The inner seeds will be firm, well developed, and beginning to loosen inside the pods. Harvesting is often done in the morning to avoid losses due to shattering.

Fig. 7. Maturing bean pods

Processing

Dry the pods in the sun and then place in a shelter for 1–2 weeks of curing. Pods are threshed by hand, being careful not to injure or split the seeds (injured seeds will germinate without primary leaves and grow poorly). Seed is further cleaned and dried after threshing.

Beet Family
(beet, spinach and Swiss chard)

Production

The beet family (Chenopodeae) includes beet and Swiss chard (*Beta vulgaris*) as well as spinach (*Spinacia oleracea*). Plants are grown as an annual for edible leaves and as a biennial for seeds. The crop prefers cool weather but is widely adaptable. Seed production can be done in cooler regions of the tropics and subtropics. Two methods are used:

Seed to seed. Sow seeds in late summer. Mulch in late fall to ensure winter survival. The following spring, select the finest young plants and transplant using 45-cm spacing. The optimum transplant diameter is 2.5 cm. The tops may be trimmed, but not the root.

Root-to-seed. Harvest first-year roots in fall. Select desirable roots and trim tops 2–5 cm above root. Store at 4 °C in a humid location. Replant in early spring at 45-cm spacing with tops just showing above soil.

In either method, only transplant the most desirable plants. Stalks may become tall (over 1 m) and are susceptible to lodging; support with staking if needed.

Isolation

The flowers are perfect and borne in groups of 2–3 in axes of leaves. Flowers produce pollen that is carried long distances by wind; thus, it is highly cross-pollinated. Isolate different varieties 500–1000 m apart. Beet and Swiss chard will cross-pollinate so isolate these as well. *Chenopodium album* (lambsquarters) should be removed from the area to prevent cross-pollination.

Selection

Rogue out off-types taking into consideration the shape and color of leaves and roots. Plants that bolt and go to seed early should be removed. Save seed from at least six plants to prevent inbreeding.

Harvesting

Seed does not ripen uniformly on the plant and sheds easily when mature. Cut stalks when most flowering clusters have turned brown and stalks have turned yellow and dried—the first seeds are shed at this time.

Processing

Store stalks in a cool dry location for 2–3 weeks to encourage further seed ripening. Do not heap stalks on top of one another since this causes seeds to ferment. Handle stalks as little as possible since seeds shed easily. Small quantities of seed can be stripped by hand as seed matures. Large numbers of stalks can be put into a bag and beat with a stick. Chaff is winnowed away.

Fig. 8. Seed stalk of beet

Brassicas
(broccoli, Brussels sprouts, cabbage, Chinese cabbage, kohlrabi, mustard and turnip)

Production

Brassicas (*Brassica* spp.) are one of the most important vegetable groups in the world. Most varieties are grown as temperate biennial crops, but tropical annual types are available. Brassicas prefer a cool climate and temperature is the most important factor for seed production. Seed can be produced either by the head-to-seed method or seed-to-seed method. The following describes the latter method, which is used for tropical varieties that require little or no cold weather to induce flowering.

The planting time is critical. The crop should be raised such that the plants face the coldest temperature at the time of maturity or head formation. A long cool season is also needed for seed pod development. Crops are typically sown/transplanted in early to mid-fall so that plants are heading in late fall, blooming in early winter, and developing seeds through the rest of winter.

Special techniques may be used to facilitate the emergence of seed stalks. For cabbage, an "X" crosscut is made at the top of the mature head, being careful not to damage the growing point of the inner core. A scooping slice may be done to the mature curd of cauliflower. The tops of mature Brussels sprouts plants are clipped to promote flowering. Other tropical brassicas will readily produce flowers. Seed stalks may require staking for support.

Fig. 9. Honeybee pollinating brassica flower

Isolation

All brassicas will cross with each other. Cabbage, cauliflower, broccoli and Brussels sprouts cross readily with each other, as do radish, mustard, Chinese cabbage and turnip. Cross-pollination is done by honeybees (Fig. 9) and an isolation distance of 1000 m between varieties is recommended.

Selection

Off-type plants can be removed at any time. Most growers rogue the field at the time of head/curd maturity so they can see the size, shape and firmness of heads/curds.

Harvesting

Brassica seed shatters easily. Harvesting is done carefully when 60–70% of the pods have turned brown and most of their inner seeds are light brown and firm.

Processing

Harvested seed stalks are cured for 1–2 weeks. Pods are then threshed with sticks and sifted by hand. Seed is brittle and should not be crushed when handled. Seed is dried in partial sun, then cleaned and stored.

Carrot

Production

Carrot (*Daucus carota*) seed production requires two years. Roots form during the first year and then require a cold period (at least 10 weeks of temperatures below 15 °C) to stimulate flowering and seed production. Two methods of production are used:

Seed-to-seed. Pencil-sized or larger roots are left in the ground overwinter. In late fall, plants are thinned to 5 cm apart, tops are cut back to 5 cm high, and mulched. Once temperatures rise in spring, the mulch is removed and leaves will regrow. After several weeks, a seed stalk will appear. Superior plants are thinned to stand up to 75 cm apart.

Root-to-seed. Harvest eating-sized roots for replanting in early spring. Clip tops to 5 cm and store at 4 °C in a humid location or layered in sawdust or sand. Replant roots 75 cm apart with soil just covering shoulders. This method is most reliable and allows for inspection of roots for seed production.

Isolation

Carrot plants produce perfect flowers (Fig. 10) that are pollinated by insects. Separate different varieties 800 m apart. Remove wild carrot weeds since they will pollinate with carrot.

Selection

Rogue off-types taking into consideration the root color and shape, plant habit, and plant vigor. Plants that bolt and go to seed early should be removed. Save seed from many carrots to maintain crop vigor.

Harvesting

The seed turns brown 6 weeks after pollination (Fig. 11). Before the seed shatters, cut and place umbels into paper bags to dry completely. Late-season rains will reduce seed quality. For small amounts, handpick each umbel as it dries brown. Large amounts of seed can be harvested by cutting the entire stalk as umbels begin to dry.

Processing

Allow seed to mature in a cool, dry location for an additional 2–3 weeks. Seeds can be removed by hand-beating or rubbing umbels between hands. Winnow to clean. Remove spines from dry seed by rubbing.

Fig. 10. Cluster of carrot flowers (umbel)

Fig. 11. Cluster of mature seeds

Cucumber Family
(cucumber, melon, squash, pumpkin and gourd)

Production

The cucumber family (Cucurbitaceae), commonly referred to as 'cucurbits', includes cucumbers, melons, squashes, pumpkins, and gourds. They are all warm season crops and very susceptible to frost. Many cucurbits are susceptible to foliar diseases that attack plants during periods of high humidity and rainfall. Therefore, regions having high temperatures and low humidity are ideal for the production of cucurbit seeds.

Isolation

Most cucurbit plants produce separate male and female flowers on the same plant. Female flowers can be identified by locating the ovary (a small looking cucumber, melon, gourd, etc.) at the base of the flower (Fig. 12). The flowers are insect-pollinated, and easily cross within species. However, seed savers can grow more than one variety at a time in a single location by using hand pollinating techniques:

Figs. 12, 13. Female (left) and male (right) flowers of squash

Hand pollination. Cap or bag female and male flower buds on the same plant or nearby plant of the same variety. Then select male flowers when they bloom, turn over their petals to expose their anthers, and gently roll the anthers over the stigma of the just bloomed female flowers (Fig. 14); you can see a layer of pollen has been transferred on the stigma. After pollination, cap or bag the female flower again to exclude insects (Fig. 15). Mark the pollinated female flower by wrapping a string to the pedicel.

Figs. 14, 15. Pollen on anther of male flower is rolled onto stigma of female flower (left) and the female flower is bagged (right)

Selection

Select early flowering, vigorous plants. Hand-pollinate the female flowers located 10–20 nodes from the base of the plant. Remove any deformed fruits.

Harvesting

The fruits should be left to fully ripen and turn color. The fruits of luffa and bottle gourd should be left on the plant until they dry (Fig. 16). For cucumbers, fruits will turn

Fig. 16. Mature luffa gourd fruits

brownish color (Fig. 17). Bitter gourd fruits will turn orange. Some wax gourds will be covered with a pale-white powdery wax on the surface of the fruit. After harvest, the fruits can be kept in a shed for a couple of weeks to allow the seed to further ripen.

Processing

For 'wet seeds' such as cucumber, wax gourd, bitter gourd and melons, cut the fruit lengthwise and scrape seeds out with a spoon (Fig. 18). Allow seeds and the jelly-like surrounding liquid to sit in a container at room temperature for 1–2 days (Fig. 19). Fungus may start to form on top. Stir daily. The jelly will dissolve and good seeds will sink to bottom while remaining debris and immature seeds can be rinsed away. Spread seeds on a paper towel or screen until dry.

For 'dry seeds' such as luffa and bottle gourd, keep the seeds in the fruit until they naturally separate from the flesh. This can be identified when you shake the fruit, the sound of seeds moving inside is heard. Cut off the bottom of the fruit and shake the seeds out, winnow to clean the remaining chaff, then place the seed on a screen for further drying before storage.

Figs. 17–19. Wet seed extraction: mature cucumber (left), seed extraction (center), and fermenting seed (right)

Eggplant

Production

Eggplant (*Solanum melongena*) is a warm season crop. It requires a long and warm growing season for successful production. It is more susceptible to lower temperatures than tomato and pepper. A day temperature of 25–32 °C and a night temperature of 21–27 °C are ideal for seed production.

Isolation

Eggplants produce perfect flowers, which may be cross-pollinated, but self-pollination is more common. The extent of natural crossing depends upon insect activity. To avoid this, isolate each variety by 20 m or with another tall, flowering crop. Another way is to bag a few flowers from each plant to exclude insects. Tie the paper bag onto the flowers before they open and remove as soon as the fruits are set. If there is only one variety of eggplant being grown, isolation is not needed.

Selection

Select the most vigorous and healthy plants, mark fruits on the second branch, and leave them until they are fully mature. Keep one or two fruits from one plant and several fruits from different plants of the same variety to maintain crop vigor.

Harvesting

Harvesting is done when fruits are fully ripe (the skin of fruit turns brownish-yellow in green varieties or brownish in purple varieties) (Fig. 20). Harvest and store the fruits in a shed for a week until the fruits get soft.

Fig. 20. Fruits at harvest

Processing

The outer covering is peeled off and the flesh with the seeds is cut into thin slices (Fig. 21). These are then softened by soaking until the seeds are separated from the pulp. If the material is allowed to stand overnight in this condition, the separation of seeds from the pulp becomes easier. After separation, the seeds are dipped into water. The plump seeds will sink to the bottom. The seeds should then be dried on a mesh for a couple of weeks in a cool, dry place before storage.

Fig. 21. Mature eggplant cut into small pieces for fermentation and seed extraction

Jute

Production

Native to Africa, jute (*Corchorus* spp.) is now cultivated over a wide range of environments today. The adaptable plant grows in humid to semi-arid areas throughout the tropics and subtropics. Jute responds especially well to warm, humid weather and is often grown near riverbanks. Jute grows well in many soil types.

Flowering is usually induced by short-day conditions; however, there is diversity among jute species in their daylength requirements for flower induction. Plants become taller and wider during the summer.

Isolation

Jute plants easily cross-pollinate with each other in the open field. Different varieties should be spaced 1000 m apart. Alternatively, varieties can be isolated using net cages. Insects are not necessary for seed reproduction inside the net cage.

Selection

Select plants that are uniform in appearance, healthy and vigorous (Fig. 22). Cover flowers before they open to protect them from being contaminated by pollinating insects.

Fig. 22. Healthy and vigorous jute plant with seed capsules

Harvesting

Among the more than 15 species of *Corchorus*, two are most common: *C. olitorius* and *C. capsularis*. The former produces long capsules while the latter produces round capsules (Figs. 23, 24). Both types of capsules are harvested when fully mature but before seeds begin to shatter.

Figs. 23, 24. Popular species Corchorus olitorius *(top photo) and* C. capsularis *(bottom photo) are closely related, differing mainly in pod shape*

Processing

Dry the capsules under shade. The seeds can later be separated from capsules easily.

Kangkong

Production

Kangkong or water convolvulus (*Ipomoea* spp.) can be grown successfully both as a leafy vegetable crop or for seed production under tropical conditions. For seed production, kangkong prefers a long period of warm weather and good irrigation. Kangkong can be planted on any type of soil, but prefers a slightly acidic soil as long as there is adequate sunlight and water. Lowland plantings give higher seed yields than do upland plantings, but take 5–6 months to complete the seed cycle.

Isolation

Kangkong is considered to be a self-pollinated crop, but cross-pollination may occur. Isolate varieties 100 m apart.

Selection

Select plants that are vigorous, disease-free and uniform in plant characteristics.

Harvesting

When seed pods are mature (Fig. 25), uproot plants when dry weather is expected for several days.

Processing

Remove plant roots with a hoe, and keep plants in the field for a few days to ensure that all the seeds will mature at the same time. The plant mat will then curl into a loose bundle. Each day, turn the bundles several times so they dry uniformly (Fig. 26). After 3–4 days of drying, the plants should be fully dry and ready for threshing. Use an appropriate mechanical thresher, such as a belt thresher (Fig. 27). After threshing, the seed should be cleaned by winnowing.

Storage

Kangkong seed will store for up to two years, a shorter time compared to most vegetable crops. Storage pests are a problem if seed moisture content is high.



Figs. 25–27. Mature seed pods (left); rolling plants seed plants into loose bundles for drying (center); mechanical threshing of dried plants (right)

Lettuce

Production

Lettuce (*Lactuca sativa*) can be grown easily as a vegetable crop in a cool climate. As a seed crop, it is a quantitative long-day plant, especially for headed types. It is advisable for seed savers to produce only leaf lettuce seeds. They require warm temperatures (26 °C or higher) to bolt and set seed.

Isolation

Lettuce produces perfect, self-pollinating flowers. But a small amount of natural cross-pollination can occur—from 1–6% when two varieties are grown side by side. A separation of 2–3 m or the establishment of a tall crop such as maize between different varieties is sufficient to reduce outcrossing.

Selection

Select the best plants at the edible stage when you normally harvest for consumption and mark them by putting a tag into the field near each selection. Early bolting plants are not usually kept for seeds because the seeds from the early bolting plants will also produce poor quality lettuce for consumption. Plants for seed production may need to be staked for support (Fig. 28).

Harvesting

When two-thirds of the flowers of the stalk are turning fluffy white, about 2–3 weeks after flowering, the seed can be harvested from single plants by shaking their heads into a canvas bag. This can be done every 2–3 days, or you can put the whole plant on a mat under shading. The seed will continue to ripen and shatter.

Processing

After completely dried with white pappis, seed heads are rubbed with hands to remove seeds. If necessary, separate seeds from chaff by winnowing.

Storage

Lettuce seed loses its viability quicker than most vegetable crops. Under ideal cool and dry conditions, seeds may maintain their viability for up to 3 years.

Fig. 28. Staked plants

Fig. 29. Shattering seeds

Malabar spinach

Production

Malabar spinach (*Basella* spp.), also known as Ceylon spinach and Indian spinach, is a climbing perennial plant. The vine is succulent with tender leaves.

Malabar spinach grows well in hot, humid climates and is adaptable to most soils. Trellised plants work best from the point of view of flower induction, fruit harvesting and crop management (Fig. 30). Short days (13 hours or less) are required for flowering.

Fig. 30. Malabar spinach growing on a trellis

Selection

Select seed from healthy, vigorous growing plants with uniform plant habit.

Isolation

It appears to be a self-pollinated species judging from the characteristics of its flowers and performance at AVRDC.

Harvesting

Harvest mature fruits with dark purple color (Fig. 31). The vines sometimes turn brown or yellow at this stage. Fruits may be harvested singly or in clusters.

Fig. 31. Flowers and mature fruits

Processing

Two methods may be used. One option is to remove the seed coats by washing with tap water, followed by drying of seeds in the sun.

The alternative method is to dry the fruits with their seed coats attached. Fruits are juicy and if drying is incomplete the seeds turn bad. Seeds are subsequently threshed, cleaned by winnowing, and later dried more completely in the sun.

Mungbean

Production

Mungbean (*Vigna radiata*) can be grown all year round but for seed production it should be planted in the dry season or late rainy season. Growing mungbean after the rainy season is usually the most suitable time; however, you should follow the recommended cultural practices of the extension office in your own location.

Isolation

Mungbean is a self-pollinated crop, but some cross-pollination can occur. An isolation distance of 3 m is usually enough.

Selection

Off-type plants should be removed as plants develop. Seed should be harvested from disease-free, vigorous plants.

Harvesting

Harvest pods when they have matured and turned dark (Fig. 32) and before they start shattering (Fig. 33). Small areas are usually harvested by hand. For plantings that mature over a wide interval of time, harvesting may need to be carried out two or three times.

Processing

Threshing must be done as soon as the pods are dry. Beat pods with a stick until pods are opened, or put dry pods in a burlap bag, place the bag on the floor, and walk on it. Remove any foreign materials by winnowing. Sun dry for 3–5 days. Collect only good seeds (free from diseases, seed coat cracking, split, or immature). If using a threshing machine, adjust the speed of the machine in order to avoid seed damage.

Fig. 32. Mature pods ready for harvesting

Fig. 33. Shattered pods

Okra

Production

Okra (*Abelmoschus esculentus*) can be grown on a wide range of soils with good drainage, but sandy loam soils are preferred. Temperatures between 27–30 °C promote rapid and healthy seedling development. Seeds will not germinate below soil temperatures of 17 °C. Seeds should be soaked in water for 24 hours before sowing. Plants grow well in raised beds (20–30 cm high).

Isolation

Okra flowers (Fig. 34) are often cross-pollinated by insects. An isolation distance of 500 m or more is recommended. An alternative method of keeping seed pure is to bag the flower buds and hand-pollinate once flowers have opened.

Selection

Plants for seed multiplication can be selected before flowering, taking into consideration the vigor and habit of the plants. Once flowering begins, plants with off-type flowers should be removed. After the first pods are developed, remove plants with off-type pods. Plants with viral symptoms should be removed as soon as symptoms appear.

Harvesting

The okra pods mature in a sequence from the base of the plant toward the top (Fig. 35). The pods have tendency to split along the suture when they are dried out. Exposed seeds may be damaged by rain or may drop to the ground; therefore, the pods must be harvested as soon as they have become fully mature (brown color) and before shattering.

Processing

Pods are easily hand threshed.

Fig. 34. Okra pod and flower

Fig. 35. Pods maturing from the base of the plant

Onion

Production

Onion, *Allium cepa*, is one of the most widely cultivated vegetables in the world. Onion forms its bulb in the first year and produces seed in the second year. Temperatures around 20–22 °C favor vegetative growth while temperatures around 12 °C favor seed stalk formation. Onion flowering is sensitive to daylength—for most varieties grown in the tropics, short days are conducive to seed production. One bulb can produce 20 or more stalks and may be in bloom for over 30 days. Onion produces perfect flowers, most of which are cross-pollinated. Two methods of producing seed are used:

Seed-to-seed. Plant seeds in summer. Immature onions are more winter hardy than larger, full-grown bulbs. Mulch in late fall to ensure winter survival. Thin to 30-cm spacing in the spring.

Bulb-to-seed. Harvest in the fall and select the largest bulbs (which naturally produce more seed). Clip tops to 15 cm and cure for three to four weeks. After the bulbs are dried, store for at least 2 weeks at 4 °C in a dry, airy location (a refrigerator is ideal). Before replanting, slice off the top one-fourth of the bulb to promote sprouting. Space bulbs 30 cm apart and cover with 2 cm of soil.

Fig. 36. Insects pollinating onion flowers

Isolation

Isolate from other flowering varieties at least 1000 m apart. Cross-pollination is performed by insects (Fig. 36). An alternative method of isolating superior plants is to place cages over them and introducing pollinators into the cages.

Selection

In using the bulb-to-seed method, replant only disease-free bulbs that are true-to-type. Discard doubles or long, thick-necked bulbs.

For bulbs preparing to flower, remove any types of undesirable shape or color; do this before flowering begins. Save seeds from several plants to maintain crop vigor.

Harvesting

Clip umbels as soon as most flowers have dried and before seeds begin shattering. Some growers harvest when the seeds are exposed in 10% of the umbels.

Processing

Fully dried flowers will drop clean seeds naturally. For small amounts, rub remaining flowers to free seeds. For larger amounts, rub heads over screens. Winnow to remove remaining debris. Allow to dry in cool, dry location for up to 2–3 weeks. Frequently stir the seeds. Artificial drying is often used.

Pepper

Production

Pepper (*Capsicum annuum*) grows best in the dry season with temperatures in the range of 21–33 °C. The night temperature is especially critical; generally, plants will not set fruits if night temperatures remain above 30 °C. Ideally, select a field where the previous crop was a legume or a cereal. Avoid fields where the previous crop was sweet potato or a solanaceous crop (tomato, pepper, eggplant, and white potato). This prevents the build-up of diseases and insects.

Isolation

Peppers produce perfect, mostly self-pollinating flowers. Solitary bees will pollinate if other more desirable pollen is not available in the area. Most growers will get satisfactory results if different varieties are separated by 20 m or with another tall, wind breaking crop. Closing the flower bud with a cotton ball when the distance of isolation is not sufficient is an ideal method to prevent cross-pollination.

Selection

The earliest maturing and more attractive plants should be marked and inspected during growth. Select healthy, attractive fruits for seed saving. Seeds from off-type plants or fruits should not be saved.

Harvesting

Harvest mature, fully-ripe peppers for seed. Most peppers turn red when fully mature.

Processing

Pepper seeds may be extracted from fresh fruits (Fig. 37) or from fruits that have been dried in the sun for a few days (Fig. 38). Seeds may be removed by hand or extracted by grinding the fruits and separating the seeds from fruits with a series of water rinses. Spread the seeds on a screen for drying under shade for 2–3 days but bring them inside every evening.

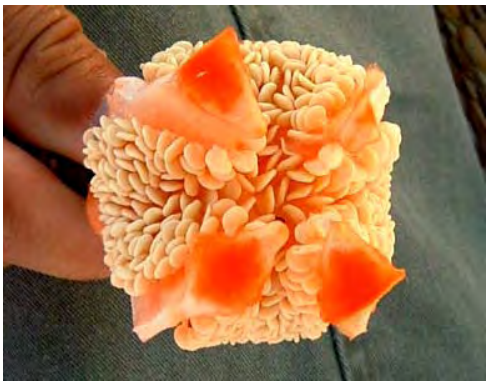

Fig. 37. Sweet pepper cut for fresh seed extraction by hand

Fig. 38. Chili pepper prepared for dry seed extraction

Radish

Production

Radish (*Raphanus sativus*) is a member of the cabbage family and grown worldwide. The harvested roots, prized for their pungent taste, come in a wide variety of colors, shapes and sizes. There are two major types. First, there are the biennials of temperate origin that require a cold period for flowering. These include the Japanese, American and European radishes. Second, there are radishes of tropical origin that do not require a cold period for flowering.

Radish grows best in a cool dry climate. Temperatures above 32 °C cause the stigma to drop and the pollen may fail to germinate. Two methods are used to produce seed:

Root-to-seed. Fully mature roots are harvested and selected for type (Fig. 39). The upper one-third of the root is cut and replanted at a spacing of 45 × 30 cm.

Seed-to-seed. Fall-winter plantings are allowed to go to seed naturally. Plants are carefully thinned to stand 45 × 45 cm apart.

Isolation

Radish flowers are cross-pollinated by insects, primarily honeybees. Isolation distances of 1000 m or more are recommended. Related weeds, notably wild radish, wild turnip and wild mustard, must be removed to prevent cross-pollination.

Selection

In the root-to-seed method, foliar characteristics, root shape, size, skin and flesh colors, pungency, pithiness and bolting behavior are considered. Hairy or forked roots and early bolting plants are removed. Selection is more difficult in the seed-to-seed method because one cannot see the entire root. Nevertheless, growers using this method should aggressively rogue out undesirable plants taking into consideration the same factors as with the root-to-seed method.

Harvesting

Threshing seeds from pods are difficult. Allow the plants to mature fully; then bring them to the threshing floor for drying.

Processing

Threshing is done by hand-beating with sticks. The seed is then dried further.

Figs. 39, 40. Radish roots (top) and ripening seed pods (bottom)

Soybean

Production

Soybean (*Glycine max*) grows well in well-drained, loamy soils. The minimum soil temperature for germination is 13 °C. The optimum time for planting soybean for seed production is usually in the dry season (December) or late rainy season (August); however, please follow the recommended cultural practices in your own country.

Isolation

Soybean is self-pollinating; cross-pollination by insects is possible, but rare. No isolation is required.

Harvesting

When soybean matures, the leaves turn yellow and drop, pods become dry, and seeds lose moisture (Fig. 41). Harvesting should be done just before pods begin to shatter; the plants may be cut at the ground level, tied up to a bunch or put in a mesh bag, then dried in the sun for 3 days.

Fig. 41. Pods ready for harvesting

Processing

Threshing must be done as soon as the pods are dry. Beat pods with a stick (Fig. 42) until pods are opened, or put dry pods in a burlap bag, place the bag on the floor, and walk on it. Remove any foreign materials by winnowing (Figs. 43, 44). Dry in the sun for 3–5 days. Collect only good seeds (free from diseases, seed coat cracking, split, or immature). If using a threshing machine, adjust its speed to avoid seed damage.

Storage

Soybean seed does not keep well in storage compared to the other legumes. The germination rate drops rapidly under room temperature conditions, especially in the tropics. If cool storage is unavailable, place seed in an air-tight container and add burned lime (calcium oxide) at the rate of 20–30% (w/w). Keep seed at room temperature.

Fig. 42. Threshing pods with a stick

Figs. 43, 44. Winnowing to remove chaff

Tomato

Production

Tomato (*Lycopersicon esculentum*) grows best in the dry season under day temperatures of 21–25 °C and night temperatures of 15–20 °C. Vines will struggle to set fruit if temperatures exceed 30 °C. Humidity levels higher than 60% at the time of fruit maturity will increase disease problems and reduce seed yields. Seed production during the rainy season leads to poor seed quality. Avoid fields where the previous crop was tomato; this prevents the new seed crop from being contaminated with seeds from volunteer tomato plants. Growing tomato after paddy rice reduces the incidence of diseases and nematodes. Training of tomato plants generally results in early ripening, fewer diseases, higher yields and better seed quality.

Isolation

Isolation of plants is usually not needed and a single plant can produce thousands of seeds. Tomatoes produce perfect, self-pollinating flowers (Fig. 45). Anthers are fused together into a little cone that rarely opens until pollen has been shed and the stigma pollinated. Older varieties may have stigmas that stick out beyond the anther cone. Purity may be ensured by separating varieties with short styles (most modern varieties) by at least 3 m. Varieties with long styles (heirlooms and some cherries) need at least 30 m to ensure purity. If solitary bees are prevalent, separate all varieties at least 30 m and place another flowering crop in between. Alternatively, bagging the whole flower cluster can prevent cross-pollination.

Selection

Look for early maturing and attractive plants. Selected plants should be marked, staked, and inspected during the growing season for resistance to diseases.

Harvesting

Allow tomatoes to completely ripen on the plant before harvesting for seed (Fig. 46). Seeds from green, unripe fruits will be most viable if extracted after allowing the fruits to turn color, but this is not advisable.

Fig. 45. Tomato flower cluster

Fig. 46. Tomatoes ready for harvesting

Processing

Cut each tomato into half at its equator, opening the cavities that contain the seeds. Gently squeeze out the jelly-like substance that contains the seeds (Fig. 47). Place the jelly and seeds into a small container for fermentation; add a little water if you are processing only one or two small tomatoes. Loosely cover the container and place in a warm place (around 25–30 °C) for 1–2 days, stirring daily.

A layer of fungus will begin to appear on the top of the mixture after a couple of days.

Fig. 47. Extracting seeds by hand

Fig. 48. Rinsing seeds

This fungus not only eats the gelatinous coat that surrounds each seed and prevents germination, it also produces antibiotics that help to control seed-borne diseases such as bacterial spot, canker, and speck.

After fermentation, fill the seed container with water. Let the contents settle and begin pouring out the water along with pieces of tomato pulp and immature seeds floating on top. Viable seeds are heavier and will settle to the bottom of the container. Repeat this process until water being poured out is almost clear and clean seeds line the bottom of the container (Fig. 48). Pour these clean seeds into a fine-mesh strainer. Let the excess water drip out and invert the strainer onto paper towel, fine mesh, or newspaper. Allow the seeds to dry completely in an oven (Fig. 49) or in partial shade (Fig. 50). Break up the clumps into individual seeds, label and store for later use.

Fig. 49. Preparing seeds for drying in an oven

Fig. 50. Drying seeds in partial shade

Yardlong bean

Production

Yardlong bean (*Vigna unguiculata* ssp. *sesquipedalis*) grows best under warm temperatures (25–35 °C) and full sunlight. Most varieties are day-neutral plants that flower all year-round.

Isolation

Yardlong bean produces perfect, self-pollinating flowers. Cross-pollination by insects is possible but rare as self-pollination occurs before the flower opens (the opening anthers push up against the stigma). Isolation is not necessary.

Fig. 51. Yardlong bean pods

Selection

At an early stage when pod color and desirable characters can be easily seen, select those healthy plants and mark them for seed production. Rogue out diseased plants.

Harvesting

Allow pods to dry brown before harvesting. The first harvest will be 8–10 weeks after sowing, followed by 2–3 harvests per week during the 6–8 week season. Cut pods with a sharp knife to minimize plant damage. Pods that are harvested 20 days after pollination will give the maximum seed quality.

Processing

Pods are dried in the sun for approximately 3 days (Fig. 52). For small amounts, pods may be opened by hand. For large amounts, hang the pods in a burlap bag and beat them with a stick, or put on the floor and walk on them. Remove large chaff by hand or winnowing. Discard blemished and shriveled seeds. Place remaining seeds under shade for 1–2 weeks for further drying.

Fig. 52. Yardlong bean pods hung in bundles for drying

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