Chapter 4: Seeds

Every time you choose to plant something on your land you are making a decision to use the space that could otherwise be used for something else. When planting annual crops, you can make a different decision the next season if what you planted does not provide the benefits you hoped for. With trees and other perennials, you want to be satisfied with the decision you make for a long time, as trees will often fill that space for many years. And in some case, you may not reap the benefits of them for several years. Just like any other living thing, if the tree you plant gets off to a poor start, for lack of nutrients or water or pests or disease, it is far less likely to grow into a healthy, fully productive tree. It may suffer from stunting, or be more susceptible to disease, or less resistant to drought. Ultimately an unhealthy seedling will likely provide produce of low quality and quantity. Yet it can still take up the same amount of space that a healthy tree would.

So it is particularly important that the trees you plant have a high likelihood of providing you with the maximum benefits you hope to reap from them. Growing a healthy tree starts long before you harvest the first fruit. It starts before you plant the tree, or even water the seedling for the first tie. It all starts in the nursery, with the seed you sow. In the following sections, we will explore the importance of selecting high quality seed, what to look for in the parent trees, and how to harvest and store the seed.

Seed Quality

Good quality seed yields good quality trees. So often we have seen seeds of poor quality planted that grow into poor quality trees and produce poor quality products. The tree from which seed is collected is called the parent (or 'mother') tree. Seed selection is the first, most essential, step of the propagation process. The quality of the seed has to do with its genetic makeup (which is directly influenced by the parent trees), its physical characteristics of the seed (if the seed is physically damaged, the tree is more likely to be as well), and the growing conditions of the parent tree (the seed is adapted to the climate from which it was collected). Here are some reasons why seed quality, and where you source your seed from, is important:

- Improved survival, better productivity and economic returns
- Inferior seeds lead to the poor performance of the trees, eroding tree planting incentives
- The higher the quality of the trees, the more likely farmers will continue planting them

- Seed collected from the agroclimatic zone in which it will grow will yield the best results

It is extremely important to pay close attention to the characteristics of the parent tree from which your seed is collected, as the growth habits of the parent will be passed to the offspring. If you are collecting it yourself, then the information below will teach you what to look for and how to collect and store the seed. If you are purchasing it from another supplier, this information frames the questions you should ask to ensure they collected the seed from good quality sources.

Characteristics to look for with Parent Trees

It is important to collect seed from healthy parent trees that display the characteristics that you are looking for in your Forest Garden. This will increase the chances that the trees you plant will exhibit similar characteristics. You also want to ensure that the seeds you sow have good genetic diversity, which increases resilience to climate, pests, and disease. The greater the genetic diversity represented in your tree seeds, the more likely your trees will adapt to the conditions in which they grow, and survive under adverse conditions. Here is what you need to look for when selecting parent trees and ensuring genetic diversity:

When selecting parent trees, look for those that exhibit the following qualities:

- **Good Health** – A healthy tree that is free from disease, pests, or physical damage (this extends to the seeds themselves; do not plant seeds that are deformed, stunted, or damaged by pests or disease).
- **High-quality production** – Whether the tree is selected for its fruit, timber, fodder, or anything else, it should yield products of the best quality possible.
- **High-quantity production** – The tree should yield an abundance of the product(s) you desire
- **Good Form** – The tree should have the shape and growth traits you desire of that species
- **Adapted to your local environment** – Trees, like any plant, are subject to specific biophysical limits (e.g. altitude, annual rainfall, and soil conditions). Be sure to collect seeds from trees that are well adapted to the agro-climatic zones where you will plant them.
- **Drought tolerance –** Look for trees that performed best in water stressed years without irrigation, as they will be more likely to survive droughts and require less irrigation
- **Pest and disease resistance** – Look for trees that have both survived and recovered from an attack, or that are in pest prone areas but took minimal damage. This will help preserve their resistant genes in future generations.

- **Mature but not too old** – Young trees and very old trees may produce a lot of seeds but the seed quality is generally not as good as healthy trees at the peak of maturity. Young trees are more likely to produce underdeveloped seeds, which will result in undesirable growth characteristics, whereas seeds from trees at the end of their life are likely to be less vigorous. Age can be difficult to determine for a tree, so when in doubt, collect seed from trees that appear to be well established, full-grown, and thriving in their environment.
- **Production timing** – Different trees of a given species may flower and fruit at different times of the year. When selecting fruit trees in particular, trees that are fruiting out-of-cycle relative to other trees in your area are a good way to capture market share with off-season produce

You can maximize genetic diversity in the seeds you plant by following the guidelines below, collecting your seeds from:

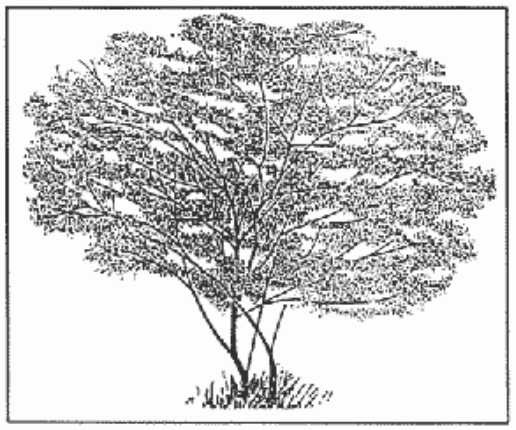
- **Multiple parent trees** – To promote genetic diversity within your seed bank, aim to collect seeds from a variety of parent trees that display the characteristics you desire.
- **Trees from throughout the growing range** – Identify trees that are growing at the highest and lowest altitudes within the species' range, as well as in-between. Healthy trees growing at the limits of their growth range demonstrate strong adaptive qualities, which is a good indicator of vitality and resilience in their genes.
- **Trees that are growing among other healthy trees of the same species** – Many tree species cross-pollinate with other trees of the same species near them. This naturally increases their genetic diversity, and if the surrounding trees are also healthy, high-quality trees, the seeds you collect are more likely to display the same genetic characteristics. Avoid collecting seeds from trees grown in isolation, as they are less likely to cross-pollinate and will have less genetic diversity represented in their seed.
- **Trees that are at least 100 meters apart** – Select mother trees that are not likely to cross-pollinate with other mother trees. Mother trees should be near other healthy trees of the same species but at least 100 meters from another mother tree from which you are collecting seeds.

Desired Parent Characteristics for Different Products

When identifying parent trees for your seed sources, the characteristics you are looking for very much depend on the product you want to harvest from the tree. Here are the characteristics to seek out for some of the main products you will raise in your Forest Garden, including fodder and fuelwood, fruit, and timber.

For fodder and fuelwood, good parent trees should:

- Be fast growing.
- Be multi-stemmed and multi-trunked
- Grow new leaves quickly after fodder harvesting.
- Grow back quickly when cut (coppiceable)
- Display fast and abundant production of leaf matter and pods preferred by local animals.
- Preferably produce leaves throughout the year

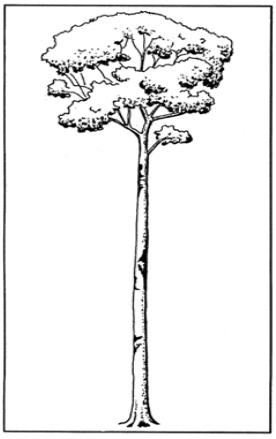


For fruit trees:

- Collect seed from trees of local varieties producing good quantities of tasty, healthy fruit of marketable size
- It is best to collect them from trees in your community. Collect them from market fruit as a last resort, but be sure they were grown nearby, in conditions similar to your farm
- Low branching trees are generally preferable as parent trees as it is easier to pick fruits from low branches
- For fruit trees, high quality varieties are usually grafted onto rootstock. To learn about grafting, read the Grafting section in this manual.

For timber trees:

- Parent trees should be fast growing, very straight, and have few, thin branches



Collecting Seed

Timing of Seed Collection - Trees produce seeds in a variety of ways. Most often, they are produced in seed pods, flowers, or fruits. In any case, be sure the seed is fully-developed before harvesting them. The optimum time for collecting seed is as soon as the seed is mature. Seed pods are generally mature when the pods turn brown, just before or after they open. On flowers, the seed is mature just before or after they fall from the flower. Fruit seeds are generally mature in a fruit when the fruit is ripe for eating.

Seed Collection Methods - There are various methods for collecting seed, some of which are described below. Trees produce and disperse their seed in different ways, often making some collection methods more suitable than others.

Collecting Seeds from the Ground – Collecting seeds that fall to the ground is sometimes easier than collecting seeds that are still on a tree, especially for larger trees that produce seed from pods or flowers. However, seeds on the ground are often more exposed to insects, moisture, and other environmental factors that can decrease their quality or viability. If seeds are small and of a similar color as the ground cover, it may be difficult to find the seeds, and more time-consuming to clean them before storing.

If you decide to collect seeds from the ground, there are few ways to simplify and expedite the process. When seeds begin to mature, place a tarp or a sheet beneath the tree to catch seeds that fall. Each day, check for seeds that fall on the tarp. Fold the tarp over to consolidate the seeds that fall from the tree and separate them from unwanted debris.

Do the following to encourage seeds to fall to the ground:

1. Shake the tree by its trunk or branches. Slight movements can dislodge loosely attached seeds from within the tree.
2. Beat low hanging branches with a stick to detach the seeds from the pods or flowers.
3. Use a rope to throw over a branch and strip the seed-baring branches of their seed.

Collecting Seed from a Tree - In some cases it is better or easier to collect seeds while they are still on the tree. When harvesting seed from fruits, it is usually better to pull fruits from branches when the fruit is ripe. Fruits often spoil quickly after falling to the ground, and are more prone to pest attacks. Some trees have seed pods or flowers that open to release winged seeds that fly far from the parent tree and are difficult to find after dispersal. Other trees produce pods whose seeds are highly susceptible to insect damage or mold once open. For such trees it is best to collect the pods or flowers after the pods mature, but before they release the seed.

Below are two common methods for collecting seeds on a tree:

1. Use a ladder or any other stationary object that allows you to reach seeds on the tree.
2. Using caution, climb the tree to collect the seeds from the branches.

Collect Seeds from Throughout the Tree's Crown –Seeds from different parts of the tree's crown cross-pollinate with different trees at different times. When collecting seed, try to collect them from all parts of a mother tree's crown (i.e. top, bottom, sides and center). In many cases, collecting from the top or outer most branches will prove very difficult.

Use safety measures (e.g. ropes, harnesses, etc.) and a great deal of caution when collection necessitates climbing the tree. Keep in mind that some trees' branches can be brittle and prone to breaking when climbing on them. If you are not able to collect seed safely from all parts of the tree, do your best to collect what you can with your available resources.

Seed Extraction and Drying

Some tree species release their seeds without any effort needed on the part of the seed collector. In these cases, seeds simply fall to the ground, ready for collection, further drying, and planting or storing. However, with many trees, you will harvest seeds from the mother tree when they are still inside or attached to their seed pods, flowers or fleshy fruit. In these cases, you can use either the *wet* or *dry* extraction methods to extract seeds.

Wet Extraction – Use wet extraction for separating seeds from fleshy membranes, usually in fruits or berries. To do this, remove as much flesh from the seed as possible, then submerge them in water and allowing them to become soft enough to separate the pulp from the seed. This may take as much as 2 to 3 days. When the flesh loosens around the seed, scrub the remaining flesh away with your hands, or against a wire screen. After removing the flesh from the seed, rinse it with fresh water and then either sow them or dry them for saving.

Dry Extraction – Use dry extraction for seeds enclosed in seed pods or other dry, organic material. You can remove seeds by dry extraction using one of several methods.

If you collected seed pods or cones containing mature seeds that did not open yet, place them in an area that is well ventilated and dry to encourage the pods to dry out, open, and release their seeds. If the seeds are small and light, place a tarp or cloth underneath the seed pods or cones to catch those that fall out. After the seeds are free, separate them from non-seed debris and set the seed aside for further drying.

If mature seeds are difficult to separate from pods or cones by hand or by drying, you may need to break them open. Two possible methods for breaking them open would be to: A) place encased seeds in a grain sack and beat it with a stick, or B) place seed pods in a mortar and use a pestle to crush the pods from the seeds. The strength of the pod or cone, and the sturdiness of the seed will determine the method you use. Be sure not to damage the seed. After the seeds are free, separate them from non-seed debris and set the seed aside for further drying.

Orthodox &. Recalcitrant Seeds – Before drying your seed, determine whether or not your seeds are orthodox or recalcitrant (non-orthodox) seed. Trees employ various methods to disperse seed and encourage germination under different conditions. Orthodox seeds refer to seeds that, due to their ability to maintain very low moisture content, can remain dormant (inactive) for long periods of time (from about 10 months to several years) under the appropriate conditions.

Recalcitrant seeds, on the other hand, do not maintain low moisture content, and therefore do not remain viable for long. Some recalcitrant seeds should be sown within weeks of being removed from their seed enclosure. Recalcitrant sees are usually bigger in size than orthodox seeds and need to be extracted from a moist environment using *wet extraction* methods. You should not allow recalcitrant seeds to dry completely. Either plant recalcitrant seeds immediately after extraction and cleaning, or store them in a moist place with good air circulation.

Drying Methods for Orthodox Seeds- After extracting orthodox seeds, using the dry or wet extraction method, you will need to dry them further to reduce the moisture content as much as possible. The best way to dry seeds is to place them in a lightly-shaded, well-ventilated area that is protected from pests. Extreme heat can damage most seeds. Avoid exposing them to intense heat from direct sunlight, or drying them on dark surfaces that increase the heat of the seeds. Thinly spread the seeds one layer thick on the drying surface, and turn them with a stick 2 to 4 times a day to be sure they dry evenly. For quick drying, use a mesh rack, cardboard, or anything that allows air to circulate around the seed.

Storing Seed

Orthodox Seed, Recalcitrant Seed, and Storability –Orthodox and recalcitrant seeds require different storing conditions to maintain their viability, vigor, and the amount of time they can be stored. Knowing that your seeds have more recalcitrant or orthodox properties will help you determine storage methods.

Storing Orthodox Seeds–Orthodox seeds can withstand low moisture content. You should dry them well before placing them in containers. Storage containers can be made of a variety of materials (e.g. plastic, glass, metal, or clay). For long-term

storage, it is important that the containers you select are water proof, air tight, and preferably opaque. Be sure the container lid forms a tight, air and water-proof seal when closed. For storage, keep the containers in a cool, dry, and dark place. With the right storage location and containers, some orthodox seeds can remain viable for several years or even decades.

Storing Recalcitrant Seeds –Recalcitrant seeds require moisture to remain viable for germination. However, maintaining high moisture content also makes them more prone either to germination during storage, or to pest and disease attacks, which makes storing difficult. To store recalcitrant seeds, maintain seed moisture by placing the seeds within a grain sack or other porous container that allows for airflow. According to volume, add 1 part of moist saw dust, charcoal, or peat moss for every 3 parts seed. You can leave the storage sack covered or uncovered, but keep them in a dark room, and off of the floor. Check on moisture content and seed conditions twice a week to be sure the seed remains moist and free of pests, and mold. Generally, recalcitrant seed can only be stored for a few weeks, up to several months, depending on the species.

Labeling Seed – Always record and clearly label the seed you are storing. This is particularly important if you are collecting and storing seed for sale. The label should have the following information:

Species Name – Many seeds of different species can look alike. Be sure to label the name of the species at the very least, to be sure you know what it is later on.

Date Collected – The viability of a seed deteriorates over time, so label each batch of seed you collect with the date it was collected. Do not mix seed collected during different periods.

Name of Seed Collector(s) – It is good to know who collected the seed in case there is a need to know, for instance, how the seeds were collected or details about the parent trees.

Seed Collection Sites – Include information on the location from where the seeds were collected. This information is useful for seed purchasers, both to inform them on the agro-ecological zones from which they were produced, as well as to verify the mother trees, if needed.

CHAPTER 4: REFERENCES

1. FAO Seed Collection and Saving - http://www.fao.org/ag/save-and-grow/en/index.html