Agroforestry Tree Seed Training Handbook

A Handbook for Community Facilitators

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Vi Agroforestry

ABOUT VI AGROFORESTRY

Vi Agroforestry is a Swedish development organisation, fighting poverty and climate change through tree planting. This is done together with farmers and farmers' organisations in the Lake Victoria basin in East Africa. The foundation of Vi Agroforestry's work is agroforestry - planting trees and crops together. Since its inception in 1983, the organisation has helped to plant over 100 million trees and improved the lives of over 1.8 million people.

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ABOUT THIS HANDBOOK

The purpose of this handbook is to guide community facilitators when training farmers on identifying and establishing good tree seed sources, collect, process, carryout simple pre-sowing seed treatments store and distribute tree seed and earn income. This knowledge will contribute towards sustainable tree seed systems, and as a result improve and optimize productivity of agroforestry systems, environment and improve livelihoods of small-holder farmers.

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1. Seed sourcing

Good seed sources and proper seed collection is key to ensure better access to quality seed and that the right trees are planted in the right sites for sustainable tree production. There are two major ways of obtaining seed; collecting own seed or procuring seed from formal institutions (e.g. national tree seed centres), NGOs or other farmers.

Objectives of the chapter

Enable farmers to understand the basic principles of seed sourcing, both procuring and collection of good tree seed. Farmers will also be familiar with the tree seed source classification to ensure sustainable tree seed systems. This chapter should be taught as a theory lesson mixed with hands on demonstrations.

AT THE END OF THE TRAINING FARMERS SHOULD BE ABLE TO:

- Identify good tree seed sources; know different methods of seed collection, where to procure seeds and handling before processing.
- Make a sample of a wooden hook from a branch; know how to identify mature fruits and immature fruits.
- Demonstrate different seed collection methods used when harvesting tree seed.

Duration: 1 hour

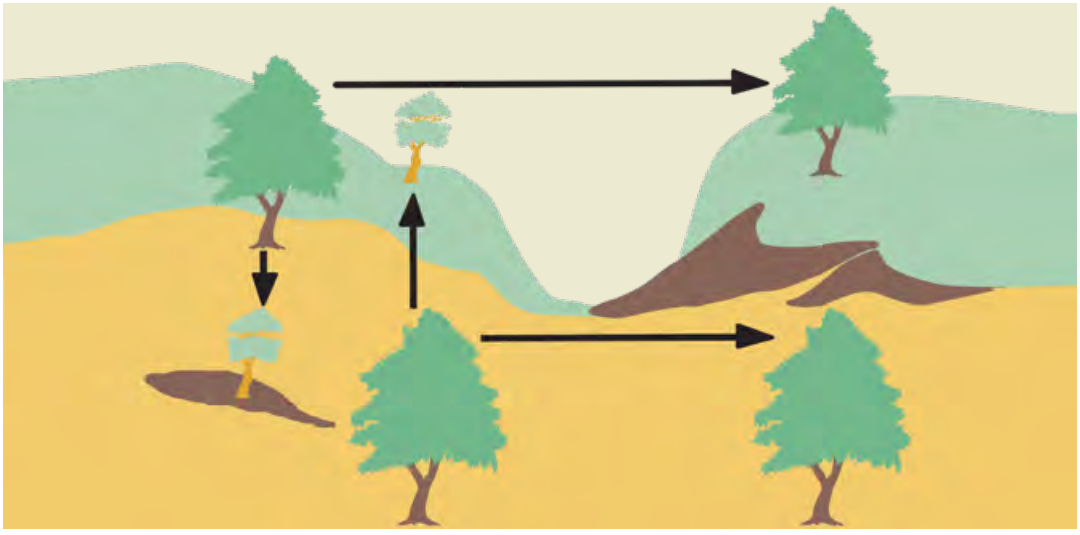
1.1 Tree Seed Sources

What is a seed source?

A seed source is where seed is collected. This may be an identified or established number of trees in a landscape; farmland, natural forest or a group of trees from which you obtain seeds.

Which are the best tree seed sources?

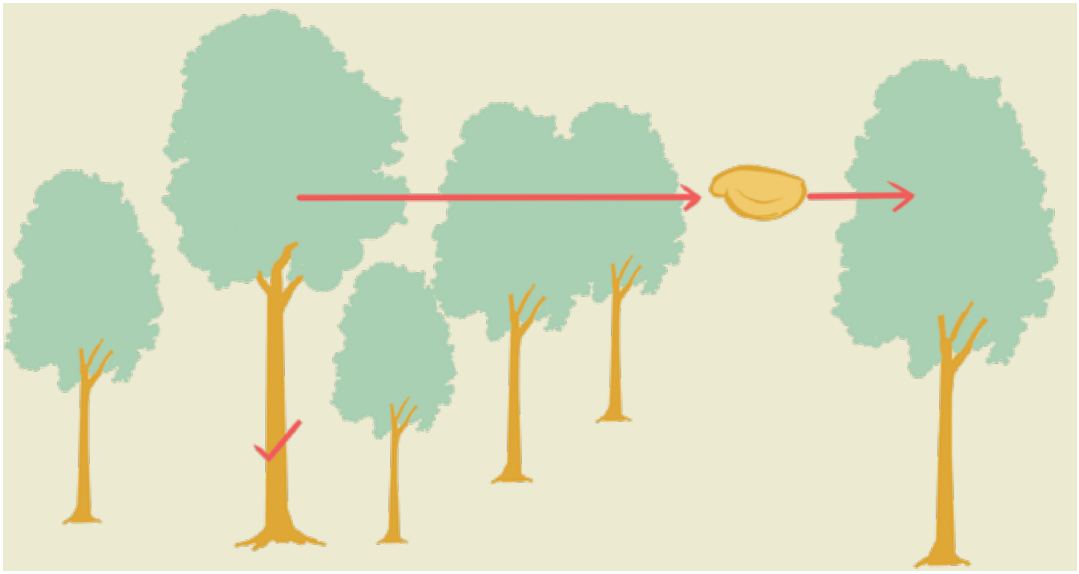
- Seed sources for particular tree species should be in a suitable agro-ecological zone for good seed production. Choose seed sources from areas which share the same climatic conditions (in terms of average annual rainfall and altitude) as one where the seed collected will be planted. This ensures that trees will be well adapted to that environment. Seed trees from lowlands fit well in lowlands, while seeds from highlands fit well in highlands. If seeds collected in highlands are planted in lowlands the trees grow poorly. The same applies if seeds collected from lowlands are planted in highlands.



Matching tree species seeds and seed source to appropriate habitat.

- A good seed source should provide fast growing, healthy and high quality planting material. Choose sources with trees with desirable traits such as fast growth, pest resistance, healthy and quality products.
- Use seed sources that have more than 30 trees to ensure good inherited (genetic) quality, as trees grow to be like their mother trees. Collect seed from adjacent farms in case you have less than 30 mother trees in your farm.
- Avoid identifying isolated mother trees since they normally have self-pollination. Normally many of their seed may be empty due to poor pollination.
- In natural forest, select mother trees of same species which are spaced 50-100m from each other. For exotic tree species, ensure that trees of same species are spaced at least 10-14 meters from each other. This prevents pollination between closely related individual trees (inbreeding) and allows good crown development.

Note: Selection of mother trees is related to the intended use of the trees to be grown. All seed trees should be trees growing vigorously and should be mature trees that produce ample quantities of seed.



Choose seeds from a mother tree that is surrounded with other trees with good appearance.

What are good mother trees selection criteria?

A good tree for seed to be used for timber trees should be tall, straight, with light branching and no forks. A bad tree for seed to be used for timber may have forks and low branches. A good tree for seed to be used for fodder trees have high nutritive values of leaves/pods, easy to coppice, fast growing, and dense foliage.

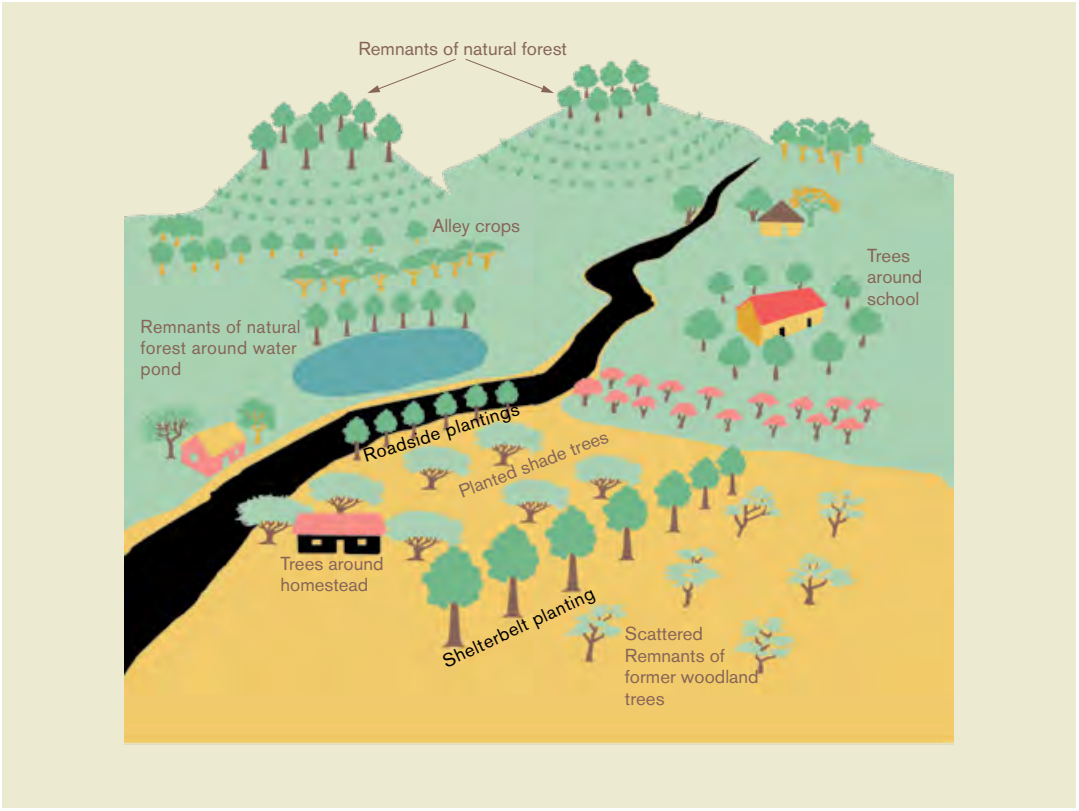
A good tree for seed to be used for fruit trees should have a reasonable amount of fruits.

A good tree for seed to be used for fuel wood should have many branches.

What are the main categories of seed sources?

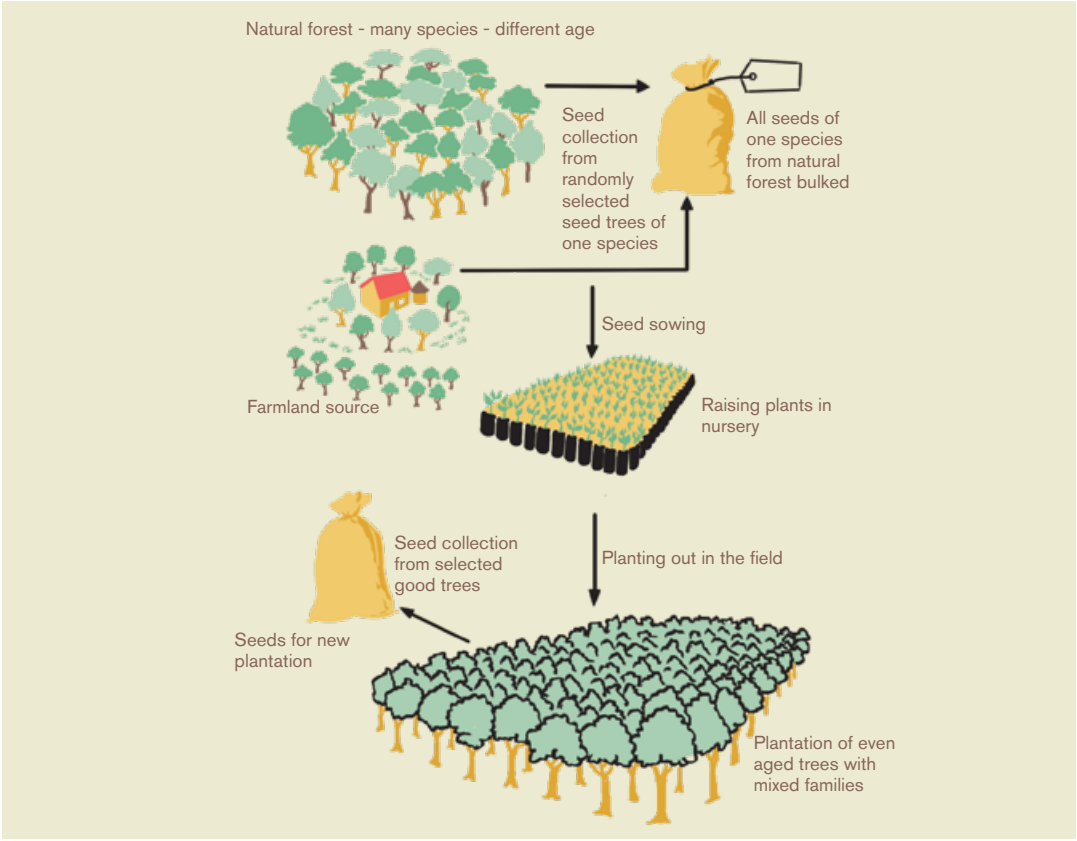
A tree seed source category is determined by the tree species, where the source is located and the seed source design. The four main seed source categories used for provision of planting material (seeds, cuttings and scions) are:

- **Farmland seed source** refers to trees on-farm and in urban areas e.g. on roadside which have been planted, or indigenous trees retained, for provision of services and other end-products e.g. fodder, timber apart from providing seed.



Farmland seed source

- **Natural forest seed source** refers to trees identified in natural forests (government forests), that are selected and managed for seed provision.

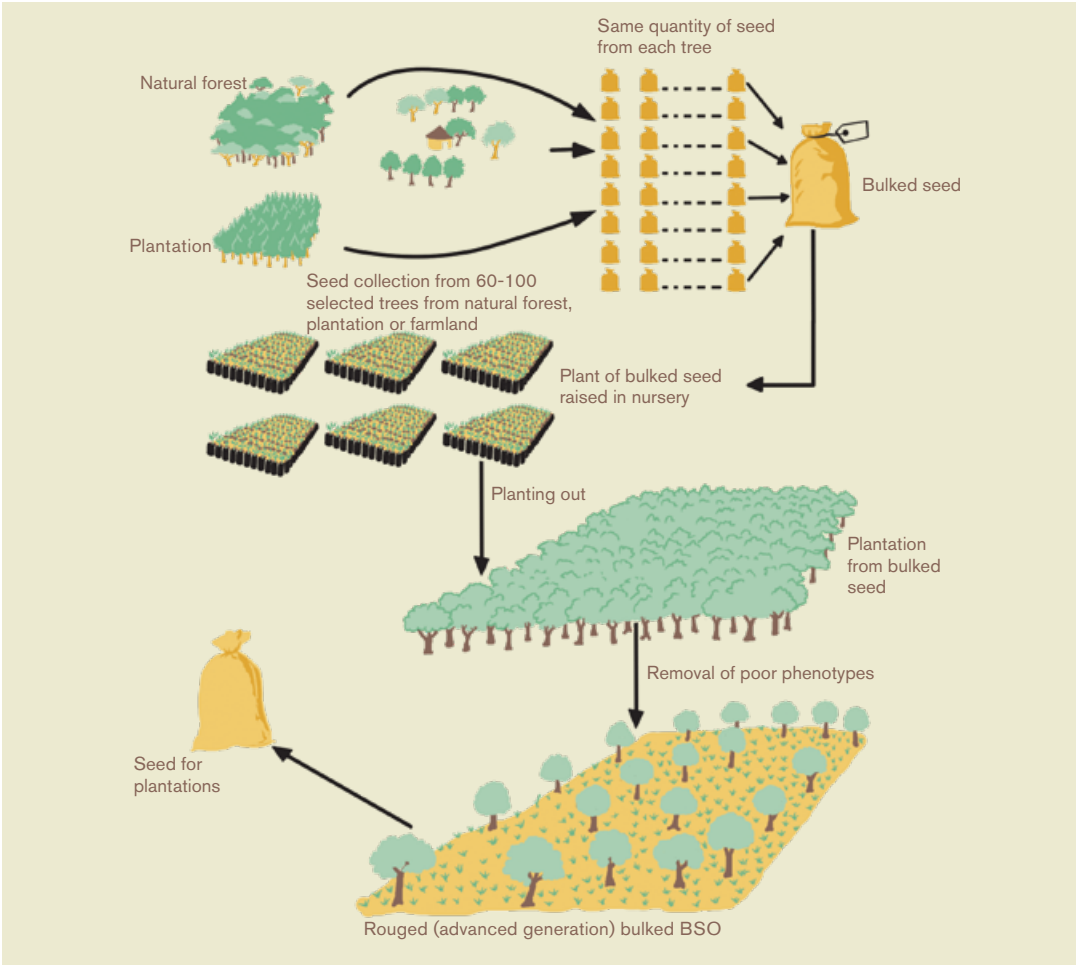


Plantation seed source

- **Plantation seed source** refers to superior tree stands planted in blocks of minimum one hectare. They primarily provide services or products but are also selected for seed provision due to the tree superiority. For example some stands have been selected by national institutions to provide seeds of pine and cypress.

Natural forest seed source

- **Seed orchard source** refers to trees that are planted from high quality seed or grafted plant material in blocks of minimum half hectare. They are specifically planted for seed or scion production, e.g. mango *(Mangifera indica)*.



Seed orchard source

How should farmland sources be managed?

- Seed sources should be managed well to increase seed production while maintaining seed quality. Record the altitude, average annual rainfall of seed source locality in a book.
- Seed production trees establishment should be managed by groups of farmers who occupy adjacent farms. Each farmer should have at least 4-10 trees of the same species for seed production. The seed should always be bulked before use by sub-dividing it according to how much seed each farmer had contributed to the bulked seed lot.

Note: Good seeds can be bought or acquired from authorized seed suppliers such as, Kenya Forestry Seed Centre (KFSC), Tanzania National Tree Seed Agency (TTSA), Uganda National Tree Seed Centre (NFA Uganda), Rwanda National Tree Seed Centre, Forest Department in Rwanda, Non-Governmental Organisations (NGOs), World Agroforestry Centre (ICRAF), Community-Based Organisations (CBOs), Farmers' associations, Farmers' cooperatives or authorized seed dealers. Avoid procuring seeds from market as the seed source is often unknown.

1.2 Tree seed collection

What are the main tools and materials used in seed collection?

The major seed collection tools and materials are hooks or pruning shear, ladders, ropes, baskets, buckets, bags, crates, plastic sheets, netting sheet, notebooks, labels to be put in seed containers and a pen.

Note: Ask for permission to collect from the landowner or land manager. This is important if you are collecting seed from private land, industrial forests or government seed sources. Collect fleshy fruit seeds only when you have an order or when you want to plant since they are difficult to store.

How do I tell when the seeds are mature?

Different tree species flower at different times. It is important to carry out a flower and seed survey to enable you to find out when majority of trees have mature seeds or the best harvesting time.

- Harvest when at least 30 trees have fruits or pods ready for harvesting.
- A mature fruit or pod can be confirmed by checking the size, colour and vigour of the fruit or pod. A mature fruit/pod is expected to be of optimal size as per the species.
- Seed shall be whole and firm inside - this is confirmed through cutting test. Pick a total of 100 seeds or fruits from various trees at random and carry out a cutting test using a knife or fingernail clipper. When you cut the seed in a cross-section, you get a firm-white sap if the seed is mature. If you get a moist sap or an empty seed then the seed is not mature.
- Check if there are pests or diseases.
- Observe if the fruits' or pods' colour changes from green to yellow, red, orange brown, black and/or purplish.
- Observe when fresh fruits start falling from the crown.

Example of a mature red mango (Mangifera indica) fruits

What are various ways of collecting tree seeds?

Tree seeds can be collected using various methods. The choice of collection method depends on growth form of the tree and the height. The major seed collection methods are:

- **Collection from the crown of cut down trees**: This method is used mostly on tall trees like silky oak (*Grevillea robusta*), elgon teak (*Olea capensis*) that have been cut for e.g. timber when seed is mature.
- **Collection of fallen fruits:** This method is used for large fruits like of mango (*Mangifera indica*), water-berry (*Syzygium cordatum*), avocado (*Persea americana*) or Musine (*Croton megalocarpus*). Remove the weeds under the tree or spread a polythene sheet, so that fruits can fall on a clean place.
- **Collection of seed by climbing the tree without using any equipment:** Climb the tree, pick seeds by hand and put in a bag.
- **Collecting directly from a tree without climbing:** This is done using a hook, a pruning shear or hands. The method is used for short trees such as fish bean (*Tephrosia vogeli*) and calliandra (*Calliandra calothyrsus*).
- **Collection from the crown by climbing the tree using a ladder:** After climbing you collect fruits or pods from the crown by pulling twigs or small branches with your hand. This method is used for tall trees like musizi (*Maesopsis eminii*). Safety measures must be taken into consideration.

Collection of fallen pods or fruits.

Seed collection from the crown using a ladder.

Seed collectors safety

During seed collection and handling, it is important to use protective clothing such as overalls and closed shoes. When collecting from trees which require climbing, it is advisable to work in pairs to ensure safety and to ease collection. Normally one person is left down as the other climbs to pick and drop the seeds down. Avoid climbing trees during wet season as trees become slippery and one can easily fall down.

How do I handle fleshy fruits and dry fruits between collection and processing?

- Use open containers such as baskets made to carry fleshy fruits such as mangoes.
- Place fresh fruits under shade, spread them thinly to enable good air circulation.
- Carry cones, samara, capsules and pods in sisal gunny bags or cloth bags.

Note: Record the altitude, average annual rainfall of seed source location. Collect equal amounts from each tree to ensure equal representation of good inherited traits. Place a label inside and outside the seed bag with basic information; species name (botanical and local name), date of collection, seed source location, seed sources type, number of trees seed is collected from and name of the seed collector.

2. Seed processing

After seeds are collected in form of fresh fruits, dried nuts, pods, capsules, cones or samara; seeds must be extracted before storage or distribution.

Objectives of the chapter

Enable farmers understand tree seed development and seed processing with the aim of improving seed quality. This chapter should be taught as a theory lesson. Farmers should be given a copy of the table showing different processing methods in the appendix.

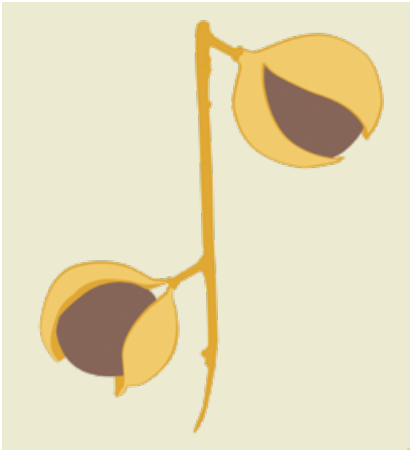
AT THE END OF THE TRAINING, FARMERS SHOULD BE ABLE TO:

Know different types of fruits and seeds, process different types of seed using various extraction methods and seed drying.

Duration: 30 minutes

2.1 Fruit and seed types

The type of fruit and seed determine how the seeds are handled before extraction, processed, stored and packed during delivery.

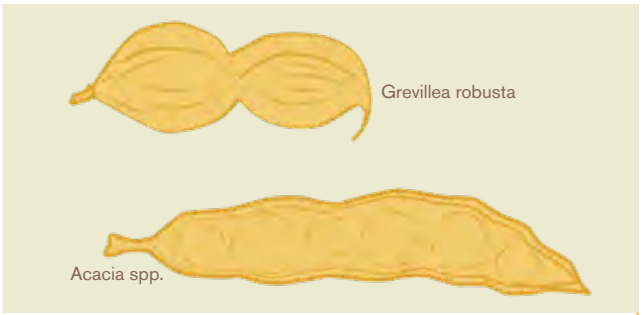


Nuts: Dry fruits formed by the fusion of the seed and the ovary wall and which do not open when dry. Examples: Macadamia nuts.

Capsule: A dry fruit which splits open to release many seeds. Examples: Hibiscus flower (Hibiscus sabdariffa).

Drupes: Fleshy fruits with hard stony endocarps surrounding the seed. Example: Mzambarau (Syzygium cuminii).

Berries: Fleshy fruits which contain several seeds inside and are extracted from fruits easily. Example: Kei apple (Dovyalis caffra), East African greenheart (Warburgia ugandensis).



Pods: Fruits which open when dry to release the seed. Examples: Sesbania (Sesbania sesban), markhamia (Markhamia lutea) and silky oak (Grevillea robusta).

Cones: Dry fruits in form of cones. Example: Whistling pine (Casuarina equisetifolia) and pine (pinus patula).

Samara: Dry de-winged seed with special wing surrounding it. Examples: Pride of bolivia (Tipuana tipu) and terminalia (Terminalia brownii).

Each tree seed type is processed in a different way, depending on the seed type. A few examples are mentioned below, see table in appendix for more species.

2.2 Steps in seed processing from legumes and coniferous (orthodox seeds)

EXAMPLES:

Calliandra *(Calliandra calothyrsus)*, sesbania *(Sesbania Sesban)*.

1. Orthodoxy seeds from pods, capsules, cones or samara can be sun-dried by spreading them in direct sun for 1-2 days.
2. Put them in a sack or spread on a polythene sheet and thresh by beating them with a stick. This is followed by seed cleaning (blowing or winnowing) to remove inert material, damaged seeds or infected seeds.
3. Sort out the left inert material and bad seeds by hand.
4. Dry the clean seeds to the right moisture. See table in appendix.

2.3 Steps in removing pulp from fruits (berries and drupes)

EXAMPLES:

Red Stinkwood (*Prunus Africana)*, Black water-berry *(Syzygium cordatum*), *East African greenheart (Warburgia ugandensis)* and Mango (*Mangifera indica*).

1. Soak fruits in water at a ratio of 1 part fruit to 2 parts water. Leave them for 1-2 days. Clean, rinse and sort the seeds.
2. Put the clean seeds in open trays and spread them in thin layers to maximize aeration and allow them to dry slowly under shade.

Note: Always maintain seed lot identity by putting a label with species name, collection dates, weight of extracted seeds and date of extraction.

3. Seed processes and procedures (seed technology)

Objectives of the chapter

Enable farmers understand tree seed processes and seed quality testing procedures with the aim of improving seed quality. This chapter should be taught as a theory lesson mixed with hands on demonstrations on pre-sowing treatments and simple moisture content testing. Each farmer should have a copy of the table in the appendix on pre-sowing treatment methods of various species.

AT THE END OF THE TRAINING, FARMERS SHOULD BE ABLE TO:

Know how to carry out various pre-sowing treatments to break seed dormancy of different tree species and how to test for the quality of seed before storage or distribution.

Duration: 1.5 hour

What is seed dormancy?

Seed dormancy is a state in which viable seed show no or only little germination within a certain time, although all environmental conditions (moisture, light, air) are adequate for germination. Seed dormancy prevents seed germination until a pre-sowing treatment is done.

What causes seed dormancy?

Dormancy of seed can be caused by the special quality of the seed coat such as hard layers of cells or water in-permeability of the coat or the existence of germination inhibiting substances in the seed coat such as oil. Some dormancy is also caused by undeveloped seed.

3.1 Pre-sowing treatment methods to break seed dormancy

What is a pre-sowing treatment?

Pre-sowing treatment is a treatment of the seed before sowing to break seed dormancy, accelerate germination or to enhance rapid and uniform germination. The best method depends on type of seed and the species you would like to plant.

Why should you carry out pre-sowing treatments?

- Necessary for some species to break seed dormancy.
- To obtain a rapid and uniform germination.
- To increase germination percentage.
- Save high quality and expensive seeds.
- Enables you to predict transplanting period and shorten the period the seedlings need in the nursery – thus conserving space.

Common pre-sowing treatment methods

Below are some of the most comment pre-sowing treatments methods. For detailed description per species – see table in the appendix.

Soaking seeds in cold water: Seeds are put in cold water (1 part seeds to 4 parts water).

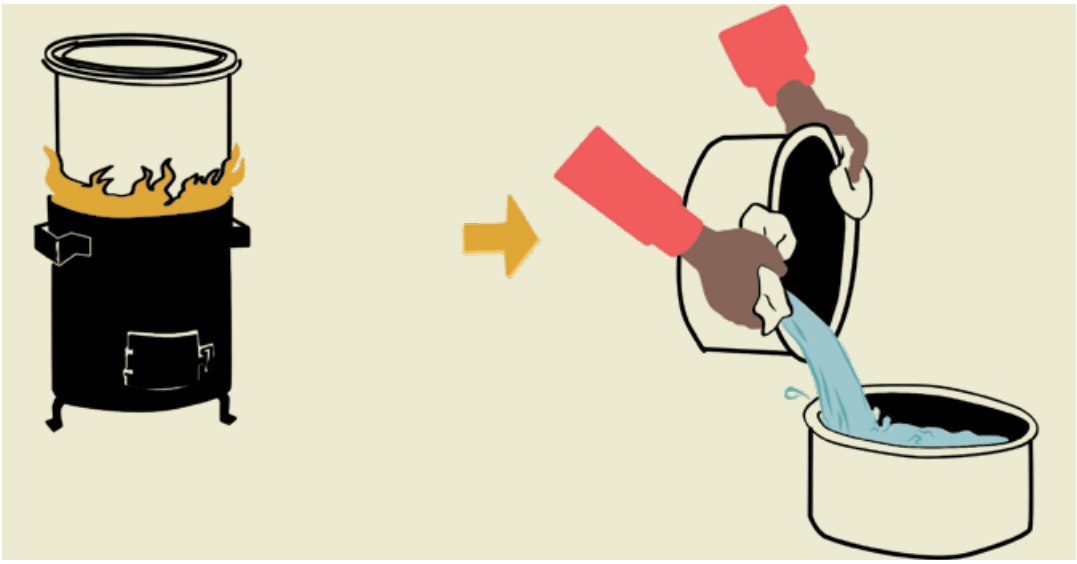
EXAMPLES:

Fish bean (*Tephrosia vogelii)* and sesbania (*Sesbania sesban*).

Soaking seed in hot water overnight: This is used for seeds with a thick seed coat. Boil water which is 4 times the seed volume. Remove from the heat source and pour the water in the container with the seeds. The container should be made of glass or metal to resist heat.

EXAMPLE:

Acacia (*Acacia mangium*).



Soaking seed in hot water overnight.

Seed coat nicking or cutting: This is used for species with a hard seed coat. Make a small cutting in the seed coat to allow water enter. The seed coat is cut or nicked using a knife, fingernail clipper, file or by piercing with a hot wire.

Nicking acacia (Acacia xanthopholea) seed pre-treatment

Nicked acacia (Acacia xanthopholea) seed ready for sowing

Cracking large seeds: Seeds with a very hard seed coat are cracked to break the seed coat and allow water to penetrate inside the seed. This is done using a stone or a hamer. Crack seeds with great care not to damage the seed. Examples: Melia *(Melia volkensii)* and podo (*Podocarpus falcatus*).

Removal of seed coat by having goats feed on fruits (biological treatment): Animals such as goats can feed on seeds. The seeds go through the digestion system of the animal and clean seeds are then released which germinate well. The eaten seeds are exposed to the hydrochloric acid in the stomach of the animal, and this breaks the dormancy without damaging the seed. Example: Desert date (*Balanites aegyptiaca*).

3.2 Seed testing to verify seed value

Seed test are used to verify seed quality and monitor seed conditions. These tests should be done immediately after processing or before storage or distribution. These tests include; seed cleanness, germination percentage testing, viability test and moisture content test (water in the seed).

Seed cleanness test

Seed lots contain debris including seeds of other species, pieces of fruits, twigs, leaves and dirt. *Pure seed* refers exclusively to clean seed of the specified species. This is a test to measure seed cleanness (purity) percentage.

1. Measure the total weight of the sample before removing all other matter. The sample size should be approximately one handful.
2. Separate the sample into two components: 1) Pure seed, and 2) All other matter.
3. Calculate seed cleanness percentage as follows:

$$\text{Cleanness (\%)} = \frac{\text{Weight of pure seeds (g)} \times 100}{\text{Total weight of the sample (g)}}$$

Germination test

1. Pick a sample of seeds at random. The sample size should be two samples of 100 seeds per replication. If seed quantity is limited, 50 seeds can be used.
2. Sow the seeds in open trays or in nursery in sand or soil.
3. Count all germinating seeds and record the number in a form. Germination period is 4-90 days depending on the species. (Germinating seeds can then be discarded or transplanted in the nursery).
4. Calculate germination % as follows:

$$\text{Germination (\%)} = \frac{\text{No of germinated seeds (g)} \times 100}{\text{Total seed sown}}$$

Viability test

Seed viability can easily be tested by sampling 100 seeds from a seed lot. Pick the seeds at random and use a knife or sharp object to do cutting test**.** Observations: seeds with firm white sap are viable while the empty or dark or black are not viable and may be dead. Count the viable seeds to get viability percentage.

Moisture content testing

The amount of moisture in a seed can easily be tested for dry seeds like all orthodox seeds such as legumes (calliandra (*Calliandra calothyrsus*) and coniferous). This is done by:

1. Filling one quarter of a glass jar with salt.
2. Adding the seed sample enough to fill half of the jar.
3. And then closing the lid tightly and shaking the jar well for some minutes.
4. Observation: If damp salt sticks on the sides of the jar, then the seeds are too moist for storage (moisture is above 13-15 %). If the jar is still dry and no salt is stuck on its sides then the seeds have less than 15% moisture content and can be stored safely.

Note: Tree seed quality can be best monitored and maintained by appropriate certification (e.g. Quality Declared Seed and Truth in Labelling schemes). It is very important for the seed dealer to declare the exact number of trees the seed is collected from and the real germination percentage or viability test for any seed lot.

4. Seed storage

Objectives of the chapter

Equip the farmers with good seed storage practices with the aim of maintaining good seed quality and avoid losses. This chapter should be taught as a theory lesson.

AFTER THE END OF THE TRAINING, FARMERS SHOULD BE ABLE TO:

Know different ways of storing and preserving seeds for different tree species.

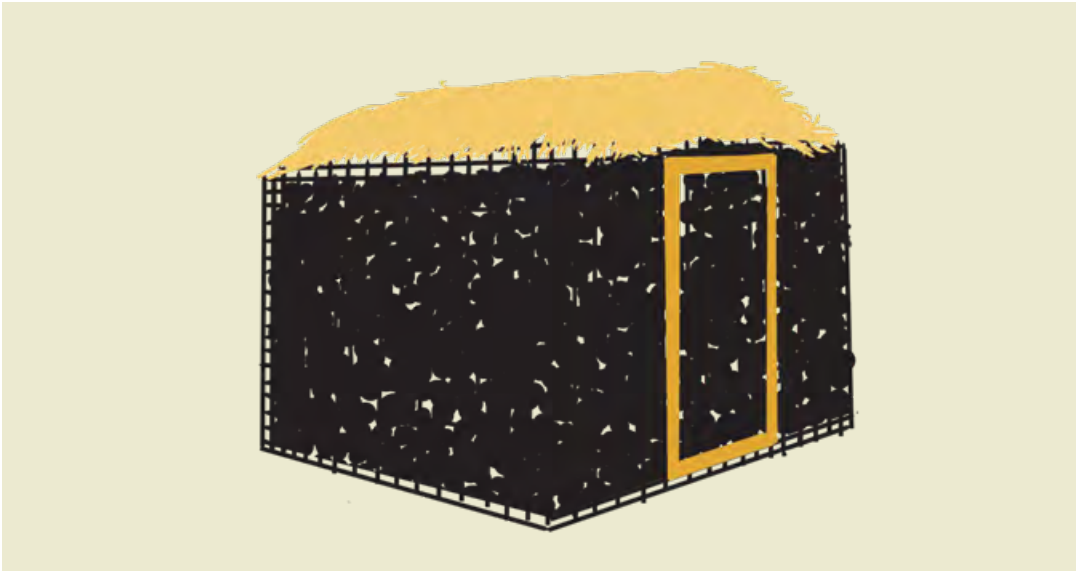
Duration: 20 minutes

4.1 Why should I store seeds?

- To keep them in good conditions until they are planted.
- To plant seeds in later years when trees produce few seed.
- In preparation for distribution.
- To protect them from pests or diseases.
- To prolong their life span and wait for increased demand from customers.
- For conservation purpose.

4.2 Where should I store my seeds?

The ideal seed storage room should have modified atmosphere with regulated temperature and humidity. However, it's also possible to use a simple storage structure such as a charcoal storage cooler. This is made of a grass roof and charcoal walls to keep it cool. The charcoal is enclosed in a mesh wire on both sides including the door. It is kept cool by pouring cold water on it to keep it moist. Seeds can be stored for different periods, depending on moisture content in seed and temperature during storage.



Example of moist charcoal seed storage

4.3 How do I store legume and coniferous seeds (orthodox seeds)?

Orthodox seeds are seeds from pods, samara, cones and capsules and also from some drupes which can be dried to low moisture and stored for a long period at low temperature.

EXAMPLES:

Calliandra *(Calliandra calothyrsus),* guava (*Psidium guajava)*, croton (*Croton megalocarpus)*, acacia (*Acacia aneura*), whistling pine (*Casuarina equisetifolia), and* mukumari (*Cordia africana)*.

1. Dry the seeds to the right moisture (water in seed) and test it to ensure that the moisture is 7-15 %.
2. Put the seeds in clean, dry and airtight containers. Ideal containers are thick

Example of Ideal plastic containers and aluminium packets for dry seed storage.

A gourd for storage of dry seeds or Orthodox seeds

polythene bags that are tightly sealed, plastic containers such as drums, aluminium packets, glass jars that have a rubber lining and screw lid or glass bottles that have a screw lid. You can also store dry seed in gourds, clay pots or bottles.

3. Store the containers in cool (room temperature), dark, dry and well ventilated place. Do not place containers directly on the floor. These seeds can be stored for 1-2 years.

Note: Avoid storing seeds directly on floors to avoid water absorption and rotting.

4.4 How do I store intermediate seeds (e.g. papaya, passion)?

Intermediate seeds are sensitive to low temperatures.

EXAMPLES:

Papaya (*Carica papaya*) and passion fruit (*Passiflora edulis*).

1. Dry the seeds under shade to an appropriate moisture level.
2. Put the seeds in clean, dry and airtight containers.

3. Store the containers in room temperature but with little moisture. You can store them for 4-6 weeks under ideal conditions.

4.5 How do I store seeds from fleshy fruits with a lot of water?

Fleshy fruit seeds (recalcitrant) must retain high moisture to remain viable. They cannot tolerate low moisture or high temperatures.

EXAMPLES:

Red stinkwood (Prunus africana) and east African greenheart (Warburgia ugandensis).

1. To maintain moisture, put the fresh seeds in a media that are slightly moistened, for example moist sawdust with a ratio of 1 part seed to 2 parts saw dust.
2. Store the seeds in room temperature, protected from high temperatures.
3. Seeds in moist sawdust can be stored for 1-2 weeks when the moisture content is maintained at 30-40%.

Proper

Storage of Tree seed from flesh fruits (recalcitrant) in moist saw dust

Note: Instead of storing, you can sow fresh seeds in the nursery as soon as possible and sell them as seedlings. For more information on storage for various species see table in the appendix.

5. Seed distribution

Objectives of the chapter

Guide the farmers on how to package and deliver seeds to the end user without adulteration the quality or encountering losses. This chapter should be taught as a theory lesson.

AT THE END OF THE TRAINING, FARMERS SHOULD BE ABLE TO:

Distribute seed effectively while avoiding losses and reduction of quality.

Duration: 10 minutes

Note: Distribute seeds only to areas that have similar agro-ecological zone to the seed source locally (in terms of altitude and average annual rainfall).

5.1 What are the steps of seed distribution?

- Weigh the seeds as per the customer's request and put in a packet.
- For seeds that are dried to low moisture: Use packing material that is moisture proof and strong enough to resist seed damage during handling. You can use for example polythene bags and use a sealing machine or a candle to seal them.
- For seeds from fresh fruits with high moisture: Pack them with moist sawdust in a container which allows air circulation, for example carton.
- Each packet should contain a label on the inside and outside, with basic information.
- Write down the same information in your seed distribution book including the name of the zone the seeds are destined to, date of when seed is distributed, the nearest town where the seed is distributed and name of customer who requested the seed.

Species (botanical and local):	Calliandra (Calliandra calothyrsus)
Seed source:	Malawi
Seed source category:	Farmland
No. of trees seed is collected from:	35
Date of collection:	31st August, 2016
Name of seed collector:	Amos Wekesa
Pre-sowing treatment:	Soak in hot water for 24 hrs
Germination % of seed:	70%
Weight (gms/kg):	500grms
No. of seed in packet:	9500

6. Documentation

Objectives of the chapter

Guide farmers on how to retain seeds identity from collection to distribution and traceability of the seed source or seed origin. This chapter should be taught as a theory lesson.

AT THE END OF THE TRAINING, FARMERS SHOULD BE ABLE TO:

Know different types of seed documentation during all stages of tree seed systems.

Duration: 10 minutes

6.1 Why is documentation in tree seed systems important?

Documentation gives seed an identity. Fruits and seeds are loaded and unloaded several times during seed handling and are prone to be mixed up, thus may lose identity, if no labels are put. A seed without identification cannot be planted as you don't know the species, when it was collected and where it came from. Below are the major seed documentation required to ensure high good quality and efficient seed systems.

Note: Always use two labels - one fixed inside and another fixed to the outside of the seed container.

	Seed Source Document	Seed Collection and Handling Document	Seed Quality Document	Seed Storage Document	Seed Dispatch Note
Purpose	Document the source of the seed	Seed identity and good quality maintenance	Seed identity and avoid seed mix-up	Seed identity and avoid seed mix-up	Seed identity and make it easy to trace the seed later
Botanical and local name of the specie/s/	X	X	X	X	X
Name of the place where seed source is located	X	X	X	X	
Agro-ecological zone of the seed source: altitude (m) and average annual rainfall (mm)	X	X		X	X
Type of seed source: farmland, plantation, natural forest, seed orchard	X	X		X	
Number of mother trees in the seed source	X	X			X
Average distance between trees where seed is collected from		X			
Age of seed source	X				
Date of seed collection		X		X	
Name of seed collector		X			
Date of seed testing			X		
Seed cleanness (purity) %			X		
Moisture content %			X		
Germination percentage or viable seed from cutting test of 100 seeds			X		X
Weight of seed stored in kg/grams				X	
Weight of seed issued					X
Dispatch date and customer information to help trace seed movement					X

7. Seed business and supply

Private individuals and farmer groups often supply tree seed to various organisations- they are key in filling the gap for seed not met by government institutions. However, having the right business skills in tree seed enterprise is crucial to make it a profitable and sustainable business.

Objectives of the Chapter

Enable farmers to market their seeds to have a sustainable tree seed enterprise. This chapter should be taught as a theory lesson, giving examples on crop seeds marketing.

AT THE END OF THE TRAINING, FARMERS SHOULD BE ABLE TO:

Know basic marketing of seed, know how to register a tree seed business and manage it to improve seed supply and make profits.

Duration: 30 minutes

7.1 How do I start a tree seed enterprise?

- **Market:** Do a basic market research to find out what seed are in demand from buyers and what are the prices? What area do you went to supply the seed to? Who are the buyers – your customers? Start the business with few tree species (2-4) to test the market and start it in an area where most customers are located.
- **Finance:** Ensure that you have money to start the business, for example to cover costs for tools, storage, containers, labels, transport.
- **Source:** Identify sources where to obtain seeds and get approval to collect.
- **Form a group:** To fulfil the requirements of a certified seed dealer, you can form a seed dealers-association, a cooperative, a Community Based Organisation (CBO) or self-help group. This will simplify registration and the group will jointly pay the fee for registration to the relevant government institutions.
- **Certify:** Ensure that the group is certified by the plant health services department in your country to ensure that your seeds operations are certified.

7.2 Why is it important to do seed enterprise as a group?

As a group, it is easier to collect market information, access more seed sources, meet big orders and purchase bulk quantities of hard-to-get tree seed species in demand. With a larger seed business, it is easier to keep costs down and set reasonable prices, ensuring more profit. As a group, you can more easily access training on seed business through government, farmers' organisations and NGOs extension. Representatives from the group can be trained and thereafter train the rest of the members. As a group you can represent the interests of all members to higher authorities such as the government. And finally; all business risks are spread among all members.

7.3 How do I ensure that my seed enterprise is sustainable?

- **Customers:** List your current customers and note what seed species they buy mostly. Target a specific type of customers and keep records of sales and customers.

- **Services:** Offer extra services that are needed by your customers; diversify the products, provide additional information on species use and their management, sell manure, set up a tree nursery for fleshy fruit tree species that you sell as seedlings, introduce new tree species seeds that other dealers don't have.
- **Point of sales:** Sell seeds from own outlets in combination with crop seed stockiest in order to reach different types of customers.
- **Packaging:** Package clean seed in a presentable packet and in small bags, which many customers can afford, e.g. 50gms, 100gms, 200gms or 300gms, depending on the species seed size.

7.4 What is the best seed selling prize?

The **selling price** of seed is determined by all the **cost** incurred for the business plus a **profit**.

$$\text{Selling price per kg} = \frac{\text{Total cost}}{\text{Total kgs of clean seeds}} + 25\% \text{ profit of the total cost}$$

Total cost shall include transport to and from the seed source during collection, basic salary for collector per day for days spent in collection, basic salary for processers for days spent in handling the seed, DSA for two days, packaging and delivery costs.

The **selling price** is calculated by dividing the cost by total kilos of clean seed obtained plus, and adding a profit of at least 25% of total cost.

The expected profit should be between 25% to 50% depending on demand willingness of customers to buy.

7.5 How do I promote tree seed enterprise?

- **Visibility:** Use sign boards so that your seed store is visible from the road, place posters at central locations, advertise on the radio or have displays in trade fairs.
- **Contacts:** Provide customers with your telephone number and have direct customer interaction. Business cards with all contact details is a good start.
- **Network:** Introduce yourself to extension officers, NGOs, Government institutions to find good contacts in seed business.
- **Packaging:** Packing seed in a presentable packet with your logo and contacts to spread your business name.

What are the most common problems associated with a tree seed enterprise?

Challenges in seed business are predicting customers' buying behaviour and being able to handle uncertain markets and fluctuating demand. Also, unfavourable weather conditions can make some tree species not seed in several years, challenging supplies.

References and Key terms used

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Key terms used

Mother trees: Trees from which seed is collected; also known as seed trees.

Seed quality: The value or standard of the seed. Seeds of high quality results to trees of the high value in the field and high quality end products and services.

Moisture content: The amount of water in the seed and is usually expressed as a percentage. A small change in seed moisture has a large effect on the storage life of the seed.

Tree seed systems: The flow of seed or other planting material (e.g. scions, cutting and buds) from tree production, collection, processing, storage, distribution and marketing of seed done by formal or informal sectors.

Informal sector: Farmers, Non-Governmental Organisations (NGOs), companies, tree seed dealers and Community Based Organisations (CBOs) who are producing or supplying seeds without formal quality checks.

Formal sector: Seed supply system which is highly organized, regulated and specialized in seed production and supply such as government institution and ICRAF.

Agro-ecological zone: Geographical areas exhibiting environmental conditions that determine their ability to support rained agriculture with reference to latitude, height above sea level and temperature.

Appendices

1. Handling of agroforestry tree seeds which do not require pre-sowing treatment

Tree Seed Species	Type	Seed Processing and Storage	Germination Period
Albizia gummifera	Pods	Drying in the sun, crushing the pods and then cleaning the seed. Dry the clean seed in the sun to 7-15 % moisture content before storage.	7-15 days
Alnus acuminata	Pods	Drying in the sun, crushing the pods and then cleaning the seed. Dry the clean seed in the sun to 7-15 % moisture content before storage.	6-15 days
Balanites aegyptiaca	Nuts	Removing the seed coat by having goats feed on fruits. Dry the clean seed in the sun to 7-15 % moisture content before storage.	7-30 days
Cajanus cajan	Pods	Drying in the sun, crushing the pods and then cleaning the seed. Dry the clean seed in the sun to 7-15 % moisture content before storage.	5-7days
Callistemon citrinus	Pods	Drying in the sun, crushing the pods and then cleaning the seed. Dry the clean seed in the sun to 7-15 % moisture content before storage.	20-28 days
Casuarina equisetifolia	Cones	Drying in the sun, shaking the cones to release seeds and then cleaning the seed. Dry the clean seed in the sun to 7-15 % moisture content before storage.	10-15 days
Cedrela odorata	Drupes	Soaking the fruits in water for 24 hours, removing the flesh from the seed by hand and then drying under shade to 30- 40% moisture before storing in moist sawdust for 1-2 weeks.	5-7 days
Chlorophora exelsa	Pods	Soaking the fruits in water for 24 hours, removing the flesh from the seed by hand and then drying under shade to 30- 40% moisture before storing in moist sawdust for 1-2 weeks.	21-60 days
Citrus reticulata	Berries	Softening in cold water for 12 hours. Dry the clean seed under shade to 10-12% moisture content and store the clean seed in airtight containers at room temperature (10-15°C).	10-15 days
Citrus sinensis	Berries	Softening in cold water for 12 hours. Dry the clean seed under shade to 10-12% moisture content and store the clean seed in airtight containers at room temperature (10-15°C).	10-15 days
Croton megalocarpus	Drupes	Drying in the sun and removing the seed from open drupe. Dry the clean seed in the sun to 7-15 % moisture content before storage.	6-60 days
Hibiscus sabdariffa	Capsules	Drying in the sun, shaking the capsules to release the seed and then cleaning the seed. Dry the clean seed in the sun to 7-15 % moisture content before storage.	4-7 days
Jacaranda mimosifoila	Pods	Drying in the sun, crushing the pods and then cleaning the seed. Dry the clean seed in the sun to 7-15 % moisture content before storage.	14-21 days
Khaya anthotheca	Drupes	Soaking the fruits in water for 24 hours, removing the flesh from the seed by hand and then drying under shade to 30- 40% moisture before storing in moist sawdust for 1-2 weeks.	7-30 days
Markhamia lutea	Pods	Drying in the sun, crushing the pods and then cleaning the seed. Dry the clean seed in the sun to 7-15 % moisture content before storage.	4-20 days
Moringa oleifera	Pods	Drying in the sun, crushing the pods and then cleaning the seed. Dry the clean seed in the sun to 7-15 % moisture content before storage.	9-30 days
Psidium guajava	Berries	Add water to the fruits and removing the flesh from the seed. Dry the clean seed in the sun to 7-15 % moisture content before storing in airtight containers.	5-7 days
Prunus africana	Drupes	Soaking the fruits in water for 24 hours, removing the flesh from the seed by hand and then drying under shade to 30- 40% moisture before storing in moist sawdust for 1-2 weeks.	10-30 days
Syzygium cuminii	Drupes	Soaking the fruits in water for 24 hours, removing the flesh from the seed by hand and then drying under shade to 30- 40% moisture before storing in moist sawdust for 1-2 weeks.	40-50 days
Toona ciliata	Pods	Drying in the sun, crushing the pods and then cleaning the seed. Dry the clean seed in the sun to 7-15 % moisture content before storage.	5-7 days
Warburgia ugandensis	Berries	Soaking the fruits in water for 24 hours, removing the flesh from the seed by hand and then drying under shade to 30- 40% moisture before storing in moist sawdust for 1-2 weeks.	15-20 days

2. Handling of seeds of key agroforestry species which require pre-sowing treatment

Tree Seed Species	Type	Seed Processing and Storage	Germination Period
Acacia mearnsii	Pods	Drying in the sun, crushing the pods and then cleaning the seed. Dry to 7-15 % moisture before storage. Store in air tight containers in a cool place.	3-14 days
Acacia nilotica	Pods	Drying in the sun, crushing the pods and then cleaning the seed. Dry to 7-15 % moisture before storage.	5-7 days
Acacia polycantha	Pods	Drying in the sun, crushing the pods and then cleaning the seed. Dry to 7-15 % moisture before storage	5-7 days
Acrocarpus fraxinifolius	Pods	Drying in the sun, crushing the pods and then cleaning the seed. Dry to 7-15 % moisture before storage.	7-20days
Albizia chinensis and Albizia coriaria	Pods	Drying in the sun, crushing the pods and then cleaning the seed. Dry the clean seed in the sun to 7-15 % moisture content before storage.	8-30 days
Albizia lebbeck	Pods	Drying in the sun, crushing the pods and then cleaning the seed. Dry the clean seed in the sun to 7-15 % moisture content before storage.	5-7days
Azadirachta indica	Drupes	Soak the fruits in cold water for few hours to soften the pulp and then rub the fruits with your hands to remove the seeds. Dry the clean seed under shade to 10-12% moisture content and store the clean seed in airtight containers at room temperature (10-15°C).	8-28 days
Calliandra calothyrsus	Pods	Drying in the sun, crushing the pods and then cleaning the seed. Dry the clean seed in the sun to 7-15 % moisture content before storage.	4-10 days
Carica papaya	Berries	Cut the fruit and remove the seeds. Dry the clean seed under shade to 10-12% moisture content and store the clean seed in airtight containers at room temperature (10-15°C).	7 days
Cordia africana	Drupes	Soak the fruits in cold water for about 24 hours to soften the pulp and then rub the fruits with your hands to remove the seeds. Dry the clean seed in the sun to 7-15 % moisture content before storage.	30-60 days
Cyphomandra betacea	Berries	Remove the seeds, wash and dry under shade to shade to 30- 40% moisture before storing for 1-2 weeks in moist sawdust.	4-6 days
Gliricidia sepium	Pods	Drying in the sun, crushing the pods and then cleaning the seed. Dry the clean seed in the sun to 7-15 % moisture content before storage.	7-10 days
Grevillea robusta	Pods	Drying in the sun, crushing the pods and then cleaning the seed. Dry the clean seed in the sun to 7-15 % moisture content before storage.	8-30 days
Leucaena diversifolia	Pods	Drying in the sun, crushing the pods and then cleaning the seed. Dry the clean seed in the sun to 7-15 % moisture content before storage.	4-15 days
Leucaena leucocephala	Pods	Drying in the sun, crushing the pods and then cleaning the seed. Dry the clean seed in the sun to 7-15 % moisture content before storage.	4-15 days
Maesopsis eminii	Drupes	Soaking the fruits in water for 24 hours, removing the flesh from the seed by hand, or removing the seed coat by having goats feed on fruits. Dry the clean seed in the sun to 7-15 % moisture content before storage.	24-90 days
Persea americana	Drupe	Removing the flesh from seed and drying under shade to 30- 40% moisture before storing in moist sawdust for 1-2 weeks.	4- 6 weeks
Podocarpus usambarensis	Drupes	Soaking the fruits in water for 24 hours, removing the flesh from the seed by hand. Dry the clean seed in the sun to 7-15 % moisture content before storage.	23-100 days
Senna siamea	Pods	Drying in the sun, crushing the pods and then cleaning the seed. Dry the clean seed in the sun to 7-15 % moisture content before storage.	4-20 days
Sesbania sesban	Pods	Drying in the sun, crushing the pods and then cleaning the seed. Dry the clean seed in the sun to 7-15 % moisture content before storage.	9-30 days
Tephrosia vogelii	Pods	Drying in the sun, crushing the pods and then cleaning the seed. Dry the clean seed in the sun to 7-15 % moisture content before storage.	5-7 days
Terminalia brownii	Samara	Drying in the sun, crushing the fruits and then cleaning the seed. Dry the clean seed in the sun to 7-15 % moisture content before storage.	10-90 days
Terminalia catappa	Drupes	Sorting the fruits and drying under to 30- 40% moisture before storing in moist sawdust for 1-2 weeks.	20-30 days
Terminalia superba	Samara	Drying in the sun, crushing the fruits and then cleaning the seed. Dry the clean seed in the sun to 7-15 % moisture content before storage	21-40 days

3. Pre-sowing treatments of major agroforestry tree species

Tree Seed Species	Type	Pre-sowing Treatment	Germination Period
Acacia mearnsii	Pods	Plant seeds in the nursery without covering with soil, cover them with crop residues and burn it. Leave the seeds to germinate.	3-14 days
Acacia nilotica	Pods	Soak in boiled hot water overnight or nicking the seed.	5-7 days
Acacia polycantha	Pods	Soak in boiled hot water overnight.	5-7 days
Acrocarpus fraxinifolius	Pods	Soak in boiled hot water overnight.	7-20days
Albizia chinensis and Albizia coriari	Pods	Soak in boiled hot water overnight.	8-30 days
Albizia lebbeck	Pods	Soak in boiled hot water overnight.	5-7days
Azadirachta indica	Drupes	Soak in cold water for 48 hrs.	8-28 days
Calliandra calothyrsus	Pods	Soak in boiled hot for 12 hrs or nicking the seed.	4-10 days
Carica papaya	Berries	Soak in cold water for 12 hrs.	7 days
Cordia africana	Drupes	Soak in cold water for 12-24 hrs.	30-60 days
Cyphomandra betacea	Berries	Soak in boiled hot water overnight.	4-6 days
Gliricidia sepium	Pods	Soak in boiled hot water overnight.	7-10 days
Grevillea robusta	Pods	Soak in boiled hot water overnight.	8-30 days
Leucaena diversifolia	Pods	Soak in boiled hot water for 4 hrs.	4-15 days
Leucaena leucocephala	Pods	Soak in boiled hot water for 4 hrs.	4-15 days
Maesopsis eminii	Drupes	Soak in cold water for 12-72 hrs or cracking the seed.	24-90 days
Persea americana	Drupe	Disinfection with hot water.	4- 6 weeks
Podocarpus usambarensis	Drupes	Cracking the seed.	23-100 days
Senna siamea	Pods	Soak in cold water overnight or nicking the seed.	4-20 days
Sesbania sesban	Pods	Soak in cold water overnight.	9-30 days
Tephrosia vogelii	Pods	Soak in cold water overnight.	5-7 days
Terminalia brownii	Samara	Removing the wings and soaking seeds in cold water overnight.	10-90 days
Terminalia catappa	Drupes	Soaking seed in cold water for 24 hrs.	20-30 days
Terminalia superba	Samara	Removing the wings and soaking seeds in cold water overnight.	21-40 days

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