TVET CERTIFICATE III in Forestry

Seed collection

FORSC 301

Perform seeds collection

Competence

Credits: 11

Learning hours: 110

Sector: Agriculture

Sub-sector: Forestry

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Purpose statement

Forest sector encountered a lot of challenges like forest seeds shortage on the markets. This module develops skills and knowledge required to collect seeds. At the end of this module the learner of level 3 will be able to select tools and equipment, identify tree species, apply seed collection and handle seed quality

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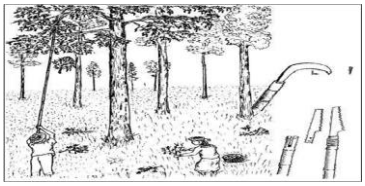
Learning Unit 1 Select tools, and equipment

LO 1.1 Identify seed collection tools and equipment

Topic 1: Description of some seed collection tools and equipment

Tools and equipment use for seed collection are those that can be used for cutting branches of trees, like saws, those used for climbing like ladder and those for storing collected seeds like sacks. Among them, the following are listed out:

Equipment	Picture	Use
1. Machette		It is a handtool used in removing branches that contain seeds over the tree.
2. Axe		Axe is a handtool used in cutting down trees for easy removing of branches with seeds.
3. Pole pruner		Pole pruner is a saw equipped with long handle that facilitate the collection of seed on a standing tree that seems difficult for the height of the worker.

4. Ladders		Ladders are used are used for climbing up the tree to collect seeds above the height of the worker.
5. Steel cable/rope		Steelcable is also tool that helps in pulling tree when falling for easy seeds collection and to avoid accident.
6. Hooks		It is a handtool used to rip the branch down for seed collection.
7. Seed baskets		Baskets are also used in small sized seeds during transportation.
8. Sac/bags		Transportation of seed to the ware house require the used sacs of bags to avoid loss or damage to them.
9. Mat/tarp/plastic sheet		These are materials onto which seeds are put during collection process.
10. Field books, notebooks, labels for seed containers and writing utensils.		Recording of information is necessary during seeds collection by using the said materials.
11. Personal Protective Equipment (**PPE)**		Personal Protective Equipment composed of gloves, helmet, boots and

		overall. Are wore by worker to prevent any form of injury during seeds collection.

LO 1.2 Adjust the tools and equipment

Adjustment of tools and equipment refers to the check of conditions of them if they ready to be used if not simple repair can be done.

Some tools and equipment require their adjustment before their use. The adjustment consists to make slight changes on them so that to make them fit or function better.

The basic adjustment of forest tools and equipment consists to:

- ✓ Put the tool or equipment to the wanted sizes;
- ✓ Check if the handle is in the working condition;
- ✓ Check if the blade is not cracked or twisted;
- ✓ Check if the handle fit to the metal.

Tools and equipment used for seeds collection should be adjusted differently according to their proper use.

LO 1.3 Maintain the tools and equipment

During maintenance, we can make simple repairing, cleaning and store them in appropriate place to avoid any kind of damage.

Topic 1: explanation of maintenance types of some seed collection tools and equipment

Types of Maintenance

1. Breakdown maintenance

It means that people waits until equipment fails and repair it. Such a thing could be used when the equipment failure does not significantly affect the operation or production or generate any significant loss other than repair cost.

2. Preventive maintenance

It is a daily maintenance (cleaning, inspection, oiling and re-tightening), design to retain the healthy condition of equipment and prevent failure through the prevention of deterioration, periodic inspection or equipment condition diagnosis, to measure deterioration. It is further divided into periodic maintenance and predictive maintenance. Just like human life is extended by preventive medicine, the equipment service life can be prolonged by doing preventive maintenance.

2a. Periodic maintenance (Time based maintenance - TBM)

Time based maintenance consists of periodically inspecting, servicing and cleaning equipment and replacing parts to prevent sudden failure and process problems.

2b. Predictive maintenance

This is a method in which the service life of important part is predicted based on inspection or diagnosis, in order to use the parts to the limit of their service life. Compared to periodic maintenance, predictive maintenance is condition based maintenance. It manages trend values, by measuring and analysing data about deterioration and employs a surveillance system, designed to monitor conditions through an on-line system.

3. Corrective maintenance

It improves equipment and its components so that preventive maintenance can be carried out reliably. Equipment with design weakness must be redesigned to improve reliability or improving maintainability.

4. Maintenance prevention

It indicates the design of new equipment. Weakness of current machines are sufficiently studied (on site information leading to failure prevention, easier maintenance and prevents of defects, safety and ease of manufacturing) and are incorporated before commissioning a new equipment.

4.1. Maintenance procedures

The following aspects should be considered with respect to Maintenance Procedures:

- ✓ Human factors;
- ✓ Poorly skilled work force;
- ✓ Unconscious and conscious incompetence;
- ✓ Good maintainability principles;
- ✓ Knowledge of failure rate and maintainability; and
- ✓ Clear criteria for recognition of faults and marginal performance.

Learning Unit 2 Identify tree species

LO 2.1 Systematic classification of native and non-native tree

Topic 1: identification of tree species by architecture and phenology

2.1.1. Identify and define the tree

A. Morphology

Knowing when, where and how to collect seeds from wild trees is a first step towards banking seed and/or growing rare or threatened species. However, poorly designed or followed procedures may result in the collection of low quality seed or, worse, may harm populations of tree species already at risk from extinction. The purpose of this brief is to provide guidance on how to sustainably collect high quality seed from rare or threatened species in order to aid their conservation in the wild.

Plant morphology or phytomorphology is the study of physical form and external structure of plant.

Concerning morphology, the tree from which seeds can be collected should have the following characteristics:

1. Vigor
2. Healthy it means not diseased
3. Up straight

B. Adaptation

The tree for seed collection should be adaptable to various environmental condition not only where it is planted that is to say having high resistance.

C. Origin

Existing information on your target species should be collected and stored in one place, with backup copies kept elsewhere. Review published literature, reports and flora, visit botanic gardens or herbaria, consult specialists or interview people living in the areas where the species occurs. If time is limited, at least make sure you know what to look for, when to collect seeds and where to go.

2.1.2. Tree architecture

A. Conifers

Is a tree one of various types of evergreen tree which produce fruit/seeds in the form of cones the following are example of conifers: pinus patura, cupressus etc.

B. Broad leaves

Is a group of tree species which has flat leaves and produces seeds inside of fruits. They are deciduous but some of them are coniferous examples: Eucalyptus,

C. White leaves trees

These tree are located in central and Southern Europe example of these tree species is poplar

2.1.3. Phenology

Plant phenology is the study of periodic plant cycle event and how these are influenced by seasonal and interannual variations in climate, as well as habitat factors.

A. Leave phases is a plant growing stage characterized by leaves formation

B. Flowering is a plant growing stage characterized by flowers formation

C. Fructification is a plant growing stage characterized by fruits formation

2.1.4. Nomenclature

It is a system of names or terms, or the rules for forming these terms in particular field or arts of sciences based on internal and botanical congress which is the meeting that take place every six years with location rotating among different continents.

Binomial system of nomenclature is two term naming system or two name naming system of naming living things giving each a name composed of two parts, bath of which use Latin grammatical forms although they can be based on words from other languages.

Generic name is defined as a name of biological genus, then specific epithet is known as the second element in the Latin binomial name of a species, which follow generic name and distinguish the species from others in the same genus.

Plant taxonomy is the science that finds, identifies, describes, classifies, and names plants. Plant taxonomy is closely allied to plant systematics, and there is no sharp boundary between the two. In practice, "Plant systematics" involves relationships between plants and their evolution, especially at the higher levels, whereas "plant taxonomy" deals with the actual handling of plant specimens. The precise relationship between taxonomy and systematics, however, has changed along with the goals and methods employed.

Plant taxonomy is well known for being turbulent, and traditionally not having any close agreement on circumscription and placement of taxa. See the list of systems of plant taxonomy.

Three goals of plant taxonomy are the identification, classification and description of plants. The distinction between these three goals is important and often overlooked.

1. Plant identification

It is the determination of the identity of an unknown plant by comparison with previously collected specimens or with the aid of books or identification manuals. The process of identification connects the specimen with a published name. Once a plant specimen has been identified, its name and properties are known.

2. Plant classification

It is the placing of known plants into groups or categories to show some relationship. Scientific classification follows a system of rules that standardizes the results, and groups successive categories into a hierarchy.

2.1.5. Selection of the forest

Where will you find your target species? If your target species has been surveyed recently, you may already know where to find candidate seed-producing trees (known as mother trees). However, if no such data exist, you may need to carry out your own reconnaissance trips or surveys to understand the distribution of the species.

For example, the family to which the pinus belong is classified as follows:

1. **Kingdom: Plantae**
2. **Division: Pinophyta**
3. **Class: Pinopsida**
4. **Series(Order): Pinales**
5. **Family: Pinaceae**
6. **Genus: Pinus.**
7. **Species: P. patula**

The classification of plants results in an organized system for the naming and cataloging of future specimens, and ideally reflects scientific ideas about inter-relationships between plants. The set of rules and recommendations for formal botanical nomenclature, including plants, is governed by the International Code of Nomenclature for algae, fungi, and plants abbreviated as ICN.

3. Plant description

It is a formal description of a newly discovered species, usually in the form of a scientific paper using ICN (International Code of Nomenclature) guidelines. The names of these plants are then registered on the International Plant Names Index along with all other validly published names.

2.1.6. Identification of most important forest and agroforestry tree species in Rwanda

Important forest and agroforestry tree species both of them should show better growth, diseases resistance (or not diseased) and adaptation to a wide range of environmental conditions.

Learning outcome 2.2 Select the forest

Topic 1: Determination of forest maturity

2.2.1. Determination of forest maturity

Forest maturity can be determined by growth rings, height as well as diameter at breast height. For complement to these parameters, appearance of fruits and seeds is obvious.

2.2.2. Forest composition

Based on species, a forest can be pure means composed of same species, or it can be mixed for having more than one specie. For example, a forest composed of Eucalyptus is a pure forest while another composed with Alnus and Eucalyptus is a mixed forest.

2.2.3. Forest regime

Based on forest regime we can we can classify forest as follow:

1. A full grown forest as a forest grown from nursery seedlings
2. A coppiced forest as a forest grown from coppices or sprouts after harvesting (notice: this kind of forest is only said for species with coppicing ability)
3. Full grown under coppice as a forest composed of coppices and full grown trees.

Generally, selection of forest for seed collection consider the following

1. Good location with easy access and proximity, as much as possible, to the area where the seeds are going to be stored or used so as to avoid transportation problems

2. Matching the planting site to the seed collection site is necessary for the optimal tree growth
3. The growth conditions of the planting site should match the growth conditions at the seed collection site
4. The altitude, latitude, longitude, rainfall, temperature, and soils should be appropriate for the target species
5. The terrain should be level or gently sloping

Learning outcome 2.3. Identify the location of mother tree

2.3.1. Provenance of mother tree:

Topic 1: Choose of mother tree for seeds collection

Proper mother tree selection will help maintain and improve the quality of the seed collected

1. Mother trees should be selected from the best stand available on homogenous (uniform) site. Tree performance (phenotype) is determined by the genotype (genetic characters), the environment and their interaction.

2. Mother trees should be selected by comparing the trees with their neighbors. For instance, seed trees for timbers species should be straight, tall and not affected by disease or insects. Small crooked trees with many branches should not be selected.

3. Do not select isolated trees, those that are separated from other trees of the same species by a distance of 100m or more. Isolated trees produce seed by in-breeding (self-pollination) which often results in growth depressions and susceptibility to pests and diseases in progeny.

In addition, adaptation to agro-climatic condition should be considered (soil, altitude, temperature and rainfall). For maintaining genetic variation of mother trees, seeds should have collected from a large number of trees-at least 30 trees.

1. Out-crossing among a large number of trees maintains a broad genetic base, which will maintain adaptability to a wider range of environmental conditions

2. When the number of trees available is limited, a farmer group or cooperative approach to seed collection can help maintain genetic diversity.

3. Spacing between trees is an important consideration when selecting seed trees

4. Seed trees should be spaced at a distance greater than that associated with seed dispersal

5. Seed dispersal distances vary by tree species and environmental conditions of the site

Generally, the distance between selected seed trees should be at least 50m

1. Trees spaced closer than 50m have a higher possibility of being closely related, i.e. share common parents or earlier ancestors

2. The genetic variation will be reduced when seed is collected from closely spaced trees.

Learning outcome 2.4. Selection of individual mother tree

2.4.1. Tree purpose

Topic 1: Description of mother tree

A. For fruit trees

The following are criteria for choosing mother tree for timber production

1. Good growth
2. Abundant, sweet, and big fruits
3. Uniform crown with low branches
4. Free of pests and diseases
5. Mature tree that produces ample quantities of seed

B. For timber production

The following are criteria for choosing mother tree for timber production

1. Above average tree height and stem diameter
2. Straight stem form
3. Long, clear merchantable bole
4. Uniform crown without heavy branches or double-stem
5. Free of pests and diseases
6. Good quality timber
7. Mature tree that produces ample quantities of seed

C. For fodder production

The following are criteria for choosing mother tree for fodder production

1. Rapid growth
2. High leaf production
3. High nutritive values of leaf
4. Good coppicing ability
5. Tree stature and shape that fits the intended planting system and site
6. Free of pests and diseases
7. Drought resistance
8. Mature tree that produce sample quantities of seed

2.4.2. Trees morphology

Topic 1: Description of mother tree characteristics of a mother tree on which seed should be collected

1. Healthy
2. Vigor
3. Up-straight
4. Without showing growth defect

2.4.3. Massal selection

During massal selection more trees are considered for seeds collection in order to maintain genetic diversity**.**

2.4.4. Flowering period

Flowering period is referred to us phenology which is one of growing stages in year marked with appearance of flowers on a plant. in spring, the season of the year between winter and summer, lasting from March to June north of the equator, and from September to December south of the equator, when the weather becomes warmer, leaves and plants start to grow again and flowers appear:

2.4.5. Phytosanitary state

The phytosanitary state of the plant on which we can perform seeds collection, should be healthy, not diseased, not showing growing defects.

Learning unit 3: apply seed collection

Learning outcome 3.1: identify mature seeds

Topic 1: Characteristics of mature seeds based on morphology and physiology are the following:

Seed quality is comprised of three components:

1. **Physical quality**:

Quality related to physical characteristics, such as size, color, age, seed coat condition, occurrence of cracks, pest and disease attacks, or other damage.

2. **Physiological quality**:

Quality related to physiological characteristics, such as maturity, moisture content, or germination ability.

3. **Genetic quality**:

Quality related to characteristics inherited from the parent trees. Tree seed quality is affected by any activity associated with: seed source selection and management; seed collection, cleaning, drying, packaging, and storage; and seedling production and tree planting.

Learning outcome 3.2: Choose seeds harvesting techniques.

3.2.1 Seed collection methods

Topic 1: choosing of seeds collection methods

A. Shaking the tree

Fruits or seeds of some trees do not naturally fall simultaneously, so we should shake the trunk or branches so that the ripe fruits or seeds fall together. It is an easy method of seed collection.

Steps of seeds collection by shaking the tree:

1. Clear the ground under the tree, then lay down the mat or plastic sheet;
2. Shake the trunk or branches by using a long picking stick; and
3. Collect by sorting out fresh from dried fruits.
4. Seed can be collected using telescopic shears, hooks, secateurs or ropes

Disadvantages of seed collection by shaking are:

1. The method cannot be applied for every tree
2. Tree branches may be too high to access without climbing
3. Branches should break when you bend them
4. Small seeds may be dispersed too far away from collection area, especially under windy conditions

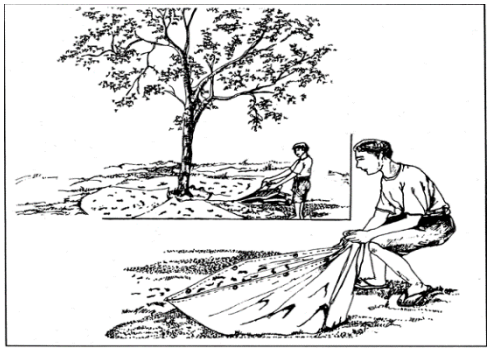


Figure 1: Shaking the tree for seed collection

B. Hand picking:

1. An easy and cheap method for seed collection
2. The collection of fallen fruits is the easiest method, *Podocarpus spp* and some other species, which have fruit with wings.
3. Collection tools: rakes, knives, and baskets, palm-leaved mats or plastic sheets

Steps:

1. Clear the ground beneath the seed tree (remove fallen leaves, grass and weeds) before the ripe fruits fall, to ease collection;
2. Lay a plastic sheet under the tree to collect the falling fruits; and
3. Collect the fruits daily and clean them by sorting out the rubbish.

Seed collection from the ground has some disadvantages:

1. Fallen seed are prone to pest and disease attacks thus putting the greater pressure of pests and disease attack to mother tree
2. It is not ensured that seed are from the mother tree under which you collect seed; since animals and wind disperse some seeds over large distances
3. Some seeds will die quickly after they have fallen, or will start germinating immediately and cannot be stored
4. It is almost impossible to collect small seeds.

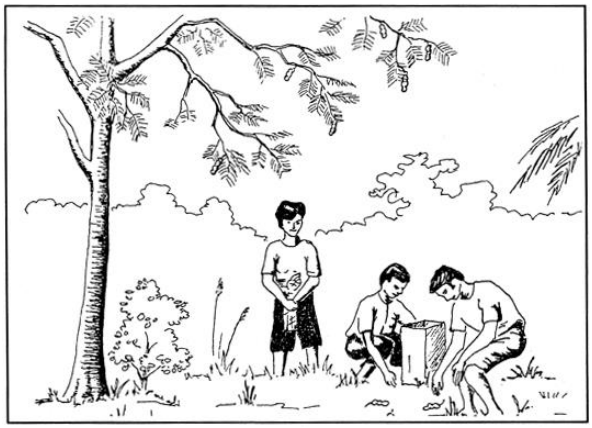


Figure 2: Seed collection from natural seed fall

C. Seed collection by climbing

1. For this method, the seed collector climbs the tree using either ladders, a pair of climbing iron, a tree bicycle, an equipment.

2. Although farmers are excellent climbers; it is better to use trained climbers to limit the risks

3. The fastest and safest way is to use steps. Aluminum steps, which are portable, and easy to use, are recommended.

4. However, farmers could also use a self-made bamboo ladder (7-9 m).

5. Alternatively, farmers can climb the tree and use a saw, adze, machete, or other similar means to cut down small branches, which bear fruit, for collection on the ground.

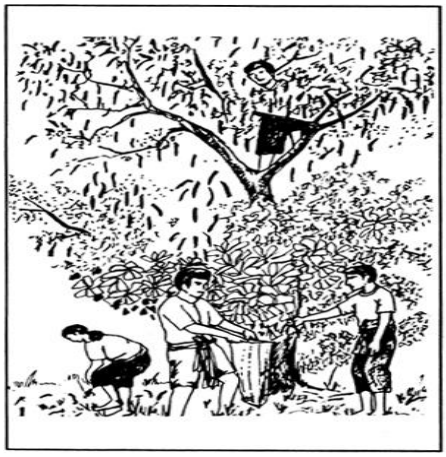


Figure 3: seed collection by climbing the tree

D. Pruning of seed bearing branches

When the seed is out of reach for hand picking various pole implements may be used for pruning branches.

1. Select branches with a heavy load of good looking pods.

2. Carefully locate the ground sheets so that pods and seeds will fall onto them from pruned branches.

3. If necessary, prune out “windows” so that seed bearing branches are able to fall to the ground and not get entangled in the tree as they fall.

4. Cut the branches.
5. Collect the pods.
6. Remove the seeds.

To use this method, you will need:

1. A special pole pruner with shears attached, or,
2. A long pole with a saw or hooked knife attached.

Light, rigid bamboo, aluminum or plastic poles 4–6 meters in length can also be used. A hooked branch can substitute if the other tools are unavailable branch can substitute if the other tools are unavailable.

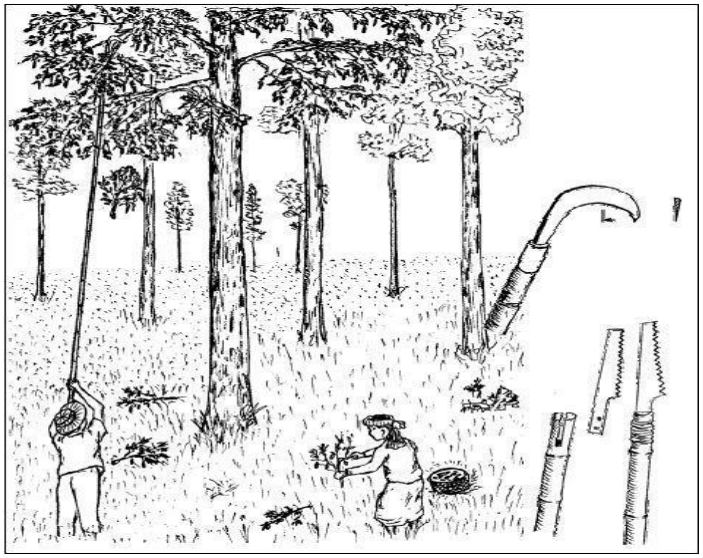


Figure 4: Seed collection from standing tree with a long handle pruning saw

E. Collect seeds from felled trees

1. Seeds can be collected from trees that are normally felled for other purposes such as timber
2. It is an easy and cheap method but requires that logging corresponds with the period of seed maturity
3. The disadvantage is that when you collect from trees that have been felled for a while, the fruits or seeds are often too dry and many will have died
4. Obviously, felling the tree is a destructive method that does not allow for further collections from the same tree.

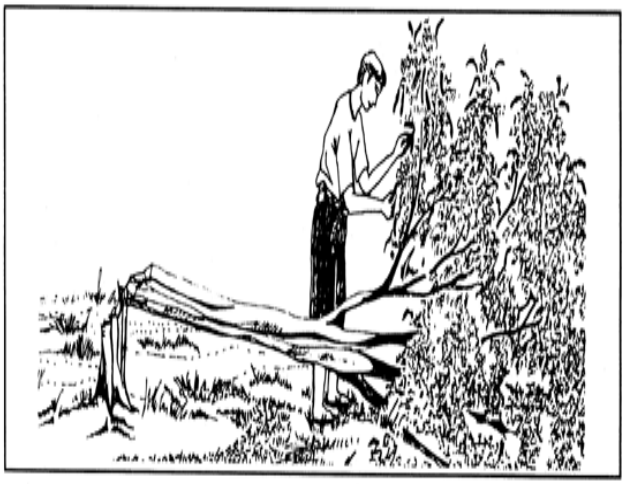


Figure 5: Seed collection from a felled tree

F. Throwing a rope with weighted end to break off a seed bearing branch

As the last possibility this destructive method may be used to reach high seed bearing branches from the ground, without having to climb the tree. Branches up to 12 meters from the ground can be reached. Skill is required to throw the rope over the selected branch and in the correct position for ease of breakage.

You will need:

1. A strong 5 millimeter diameter rope about 25 meters in length; a 400 grams stone, or small bag of sand or soil.
2. Attach the weight at one end of the rope.
3. Throw the weight over the seed bearing branch.
4. Break off the branch by holding the two ends of the rope, and pulling

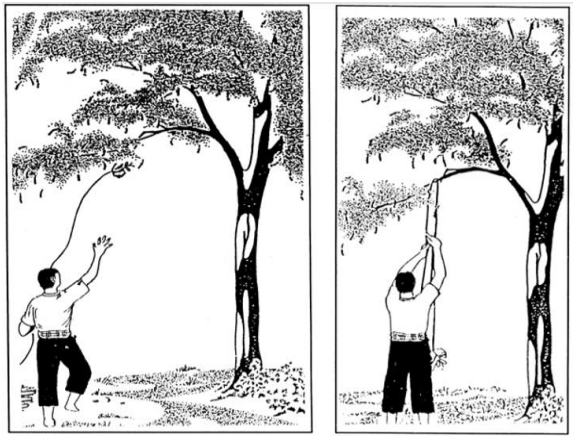


Figure 6: Seed collection using cable

Learning outcome 3.3: record the data.

Topic 1: Explanation of seeds data collection

A. Site description: during seed collection bear in your mind to mention the following information of the site where seeds are collected; **climatic conditions** of the site because these help you to grow plants next time in same climatic conditions. **Topography** of the site reflect adaptation of plants to site conditions and help to identify appropriate site and **vegetation types** that reflect also the rate of fertility of the site.

B. Time of collection of seed is very important because it is not every day or month seeds are collected but a specified time is planned. Generally, this question can be asked by one

When should seed be collected?

1. A few tree species produce seed all year
2. Most of tree species produce seed during a given period in year
3. The ideal time to collect seed from a given tree species, have to be documented according to species phenology.
4. For many species, their phenology is available from books, forestry professionals and farmers
5. Seed should be collected when majority (60%) of seed is mature.

Time limits for seed collection

A good time for collecting seeds is when the fruits of the trees are all fully ripe. In general, we can identify ripe fruit through the following characteristics:

1. **Color of the fruit:** the skin changes from green to dark brown/yellow, or the skin becomes dry.
2. **Color of the wing:** for any fruit with wings, fibers appear slightly on the wings, become hard and dry and turn from pink to purple red, and sometimes turn from light green to dark green with light red.
3. **Smell:** the fragrance of some fruit is noticeable when they are ripe.
4. **Being eaten by animals:** animals frequently eat ripe fruit, providing a good indicator for collection.
5. **Splitting fallen fruit:** fruit of some trees are ripe and loose in their pod.

C. Quantity of seed collected will much depending on the following aspects:

1. Consider the number of plants that are needed
2. Estimate the number of seed or plants that could die during storage, in the nursery of after planting
3. Calculate the cost of collection. Think of the distance to the seed source, the number of collectors, and how much they can collect per day.

D. Species

It is very important to identify the species on which are collected for ensuring good storage it means not mixing seeds from various species and the specie chosen for seed collection should have the following characteristics:

1. Having maturity;
2. Not showing growing defects (malformations);
3. Not diseases and pests damaged;
4. Not isolated from others for maintaining genetic diversity.

Learning unit 4: handle the seeds

Learning outcome 4.1: Extract the seeds

Topic 1: perform seeds extraction from pods

Definition: Seed Extraction is the process of removing seed from fruits or pods.

Seed is collected while embedded in ripe fleshy fruits, dried fruits, in pods, or as single seeds. Depending upon which, proper extraction and cleaning require slightly different treatments. Cleaning seed before storage is easy, but vital to maintaining seed quality.

Most seed extraction requires pre-drying of the fruit. But some may require pre-soaking in order to extract the seed easily.

- Dry seeds whose pods are known to shatter naturally.
- Soak seed borne in fleshy pulpy fruits or pods that have dried but do not shatter naturally.

The following are step-by-step lists of how to extract seed from dry, and fleshy fruits:

For dry fruits (pods or cones)

1. Sun dry on concrete, canvas sheet, or inside cloth sacks until pods split open. (Pods or cones may also be placed on a wire mesh with a container below it so that when pods or cones split, seeds fall down into the container).
2. Trample with feet, toss around, or beat pods inside a sack to speed up seed separation. Pods which do not easily split open may be opened manually, or threshed by pestling.
3. Clean seeds by blowing or winnowing.
4. Immerse seeds shortly in a container of water.
5. Discard those that float. They are not viable.

Drain the water, and re-dry the seeds. When seeds are to be planted immediately, re-drying is unnecessary.

Beat a sack full of dry pods or fruits with a stick to thresh out the seeds.

Use a mortar and pestle to thresh seeds which are strongly attached to the pods.

Winnowing the seeds.

Figure 7: extraction from pods

Fleshy fruits

1. If possible, seed extraction should be done at home.
2. Do not delay extraction for too long and never store fruit piled up and undisturbed. (Heating and fermentation in the pile could kill the seeds or reduce their quality).
3. Immerse in water until the fleshy tissue becomes soft (1–2 days).
4. Scrape, crush, or rub seeds with hands to separate thoroughly from pulpy flesh. (Be careful not to be so rough as to damage the seed).
5. Remove all floating seeds and pulp.
6. Drain off the water.
7. Re-wash the seed.
8. Air dry for 2 days.
9. Re-clean the seeds by winnowing

Figure 8: Cleaning the seeds by hand.

Learning outcome 4.2: Dry the seeds

Topi1: Explanation of seed drying process

If seeds will be stored for future use, they must be sun dried.

1. Spread the seeds thinly and evenly on a mat, canvas sheet, light-colored plastic sheet, (a black sheet may cause seed to overheat), winnowing basket, or screen where the sun shines all day.
2. Stir and turn the seeds 4–5 times a day for uniform drying. If possible, keep seeds (especially moist ones) shaded during intense heat. (Noon to 2:00 PM.)
3. Before it rains or gets dark, take the seeds indoors.
4. Drying will take 1–3 days, depending on how wet the seeds are.
5. Protect the seeds from rodents and birds during drying.

The same drying procedure may be used for seeds of most fruit trees. Exceptions are seeds of rambutan, durian, mangosteen, mango, jackfruit, avocado, rubber, cacao and mahogany. These should be air dried only for a day or two before storing, or they must be planted immediately after extraction.

1. Dry the pods under the sun on a cement floor, plastic sheet or cloth until the pods crack.
2. This method is used for *Acacia*, *Casuarina equisetifolia*, *Pinus merkusii* and *Cassia siamea*. The pods can be dried in a large basket or colander with a mat underneath.
3. When they crack and open, the seeds drop onto the mat.
4. Some pods do not crack even if we dry them on the sun.
5. In this case, we should crush them by stepping on them with our feet, or by putting them into a sack and beating them a pestle.
6. Others do not crack and cannot be beaten because by doing so the seeds inside the pods will be damaged.
7. In this case, we should pick them manually, such as *Moringa oleifera*.
8. Clean the seeds by winnowing or sprinkling to remove the pollen

Drying pod with flesh seeds inside

- It would be more comfortable if we could pick the seed from its pod at home.
- Heating or sour smelling while seed are piled on each other could decay or reduce the germination quality of seeds.

Below is the method to pick and clean seed:

A. Soak the pod in water (1-2 days) until the flesh becomes soft enough for cleaning;
B. Clean the pod by hand thoroughly and carefully, separate the seed from the flesh;
C. Sort out the floating pods and flesh then drain the water from the bucket;
D. Dry the seed in the wind; and
E. Winnow the seed to sort out the waste.

Applicable for species like *Podocarpus falcatus, Maesopis eminii* etc.

4.2.1. Seed drying for long storage

Seeds shall be dried under the heat of the sun so that they can be stored for a long time.

Below are appropriate seed drying methods for long storage:

- ✓ Spread and level the seeds on a palm mat, plastic sheet, and bright-colored plastic sheet or winnowing basket, then choose a location where there is sun for the whole day.
- ✓ Stir the drying seed 4 to 5 times per day to ensure that the seed is thoroughly dried.
- ✓ If possible, we should keep the seed in the shade when the weather is too hot (from noon till afternoon).
- ✓ Before rain, the seed should be kept in the house.
- ✓ Dry the seed for 1-3 days depending on the moisture level of the seed.
- ✓ When drying, you should prevent damage by rodents or birds.

Determining seed moisture content: Moisture content of seed is defined by the International Seed Testing Association (ISTA) according to the following formula: In order to determine the percent moisture content of fresh seed, a sample of fresh seed is weighed, and then an equal weight of fresh seed is dried slowly to remove the moisture, and then re-weighed. This will enhance store period.

$$\text{Seed moisture content (\%)} = \frac{\text{fresh seed weight - dry seed weight}}{\text{dry seed weight}} \text{ X } 100$$

Figure 9: manual seeds extraction during drying

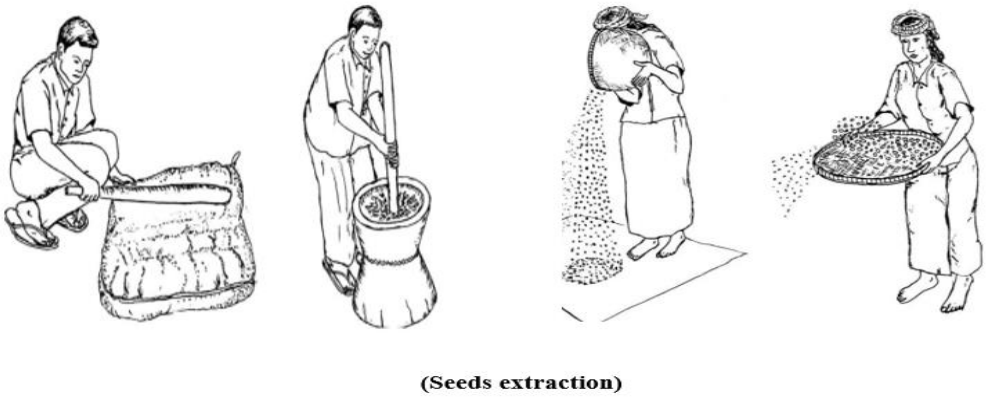


Figure: mechanical seeds extraction

Learning outcome 4.3: Clean the seeds

Seeds cleaning is process of removing litter or external materials from needed good seeds (dust, stones/sand and pods residues). It is done by winnowing, sieving and sorting by hands.

Dry seeds are seeds that are matured in a dry state rather than inside of a fruit. In the harvesting process and after threshing, dry seeds are usually mixed with other plant materials such as sticks and leaves, dirt, stones, and weed seeds that are inadvertently collected with the harvested seed. The seed is then cleaned (separated from the other material) by techniques based on differences in weight, size, or shape of the seed. There are also machines that separate the seed from other materials based on electromagnetic charge or on the color of the seed, but these machines are expensive and typically only used by larger seed companies.

Learning outcome 4.4: Determine the germination rate of the seeds

Topic1: Calculation of seeds germination rate

Germination percentage (germination rate) is an estimate of the viability of a population of seeds. The equation to calculate germination percentage is:

GP = seeds germinated/total seeds x 100.

The germination rate provides a measure of the time course of seed germination. Germination rate is determined by calculating the GP at different time intervals after planting and then plotting these data.

Learning unit 5: package and store seed

LO 5.1 Prepare seed for storage

Topic 1: perform seeds extraction

Seed collectors generally aim to sow or dispatch their seed soon after acquiring it. For various reasons, they may need to store the seed for future use. But remember, the longer seed is stored, the greater chance that viability will be reduced or lost.

A. Seed extraction

Seed is collected while embedded in ripe fleshy fruits, dried fruits, in pods, or as single seeds. Depending upon which, proper extraction and cleaning require slightly different treatments. Cleaning seed before storage is easy, but vital to maintaining seed quality.

Beat a sack full of dry pods or fruits with a stick to thresh out the seeds

Use mortar and pestle to thresh seeds which are strongly attached to pods

Winnowing the seeds for removing external material

Figure: 10 mechanical seeds extraction

Most seed extraction requires pre-drying of the fruit. But some may require pre-soaking in order to extract the seed easily.

- Dry seeds whose pods are known to shatter naturally.
- Soak seed borne in fleshy pulpy fruits or pods that have dried but do not shatter naturally.

The following are step-by-step lists of how to extract seed from dry, and fleshy fruits:

B. For dry fruits (pods or cones)

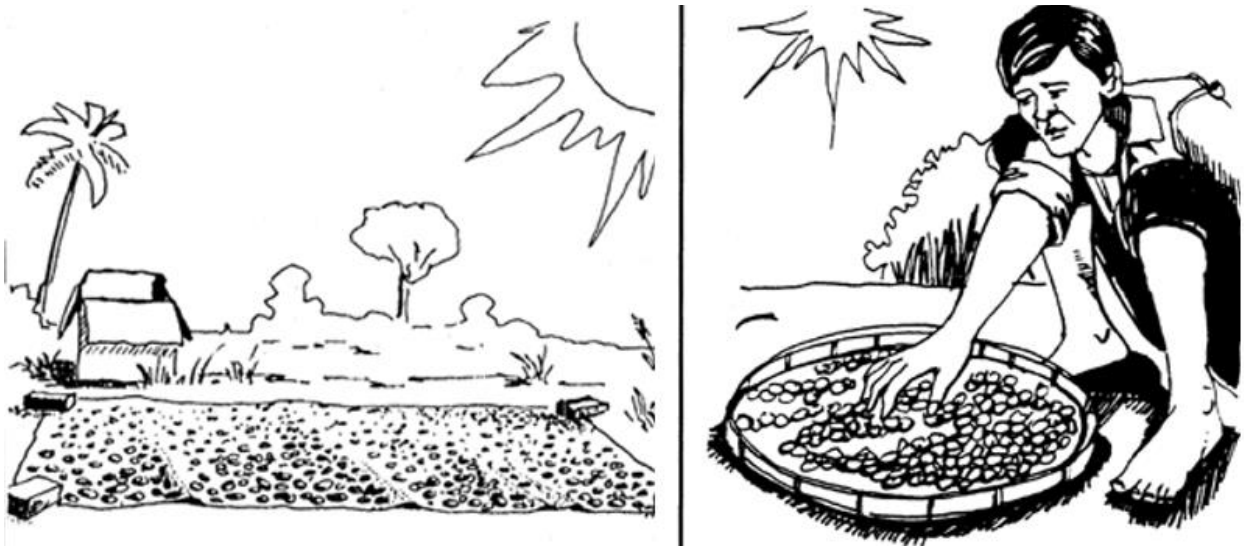
1. Sun dry on concrete, canvas sheet, or inside cloth sacks until pods split open. (Pods or cones may also be placed on a wire mesh with a container below it so that when pods or cones split, seeds fall down into the container)
2. Trample with feet, toss around, or beat pods inside a sack to speed up seed separation. Pods which do not easily split open may be opened manually, or threshed by pestling.
3. Clean seeds by blowing or winnowing
4. Immerse seeds shortly in a container of water.
5. Discard those that float. They are not viable.
6. Drain the water, and re-dry the seeds. When seeds are to be planted immediately, re-drying is unnecessary

C. If possible, seed extraction should be done at home.

1. Do not delay extraction for too long and never store fruit piled up and undisturbed. (Heating and fermentation in the pile could kill the seeds or reduce their quality).
2. Immerse in water until the fleshy tissue becomes soft (1–2 days).
3. Scrape, crush, or rub seeds with hands to separate thoroughly from pulpy flesh.
4. (Be careful not to be so rough as to damage the seed).
5. Remove all floating seeds and pulp.
6. Drain off the water.
7. Re-wash the seed.
8. Air dry for 2 days.

D. If seeds will be stored for future use, they must be sun dried.

1. Spread the seeds thinly and evenly on a mat, canvas sheet, light-colored plastic sheet, (a black sheet may cause seed to overheat), winnowing basket, or screen where the sun shines all day (Figures 23 and 24).
2. Stir and turn the seeds 4–5 times a day for uniform drying. If possible, keep seeds (especially moist ones) shaded during intense heat. (Noon to 2:00 PM.)
3. Before it rains or gets dark, take the seeds indoors.
4. Drying will take 1–3 days, depending on how wet the seeds are.
5. Protect the seeds from rodents and birds during drying. Re-clean the seeds by winnowing.



Drying seeds on a plastic sheet

Dying seeds on a winnowing basket

Figure 11: seeds drying

Learning outcome 5.1: selection of container

Topic 1: Description of seeds packaging materials

For good seed storage, always use sealed containers.

After seed has been dried properly, store it in tin cans, metal boxes, glass jars, or plastic bags or container with lids that can be sealed.

5.1.1. Packaging materials and containers for seed storage:

A. Materials for short-term storage:

There are a wide variety of materials that can be used to store seed for short-term storage. Most of these are non-rigid materials such as cotton, burlap, paper, and composite materials such as multi-wall paper and plastic film, or polyethylene bags. Materials used for short-term storage are generally porous. They adequately contain and protect the seeds from mixing, but do not provide protection from moisture or loss of seed viability.

B. Materials for long-term storage:

Metal and glass containers, properly sealed to prevent the exchange of moisture and gas, are the most commonly used containers. They are the only reliable means of protecting seeds against humidity, insects, rodents, floods, and mechanical damage. Plastic should not be used for long-term storage.

Learning outcome 5.2: package the seeds

Topic1: explanation on seeds packaging process

Under ordinary room conditions (= open storage), viability of many seeds is reduced by half within 6 months.

- Seeds with harder seed coats tend to live longer than those with thin coats.

- For improved storability, seed moisture and storage temperature must be kept low and controlled.

5.2.1. To store seeds, follow this simple procedure step-by-step:

1. Store only new, mature, healthy and well-dried seeds.
2. Keep them in dry and cool place to extend their viability.
3. Seeds easily re-absorb moisture. To maintain dryness, keep seeds in air-tight containers like tin cans or glass jars with tight fitting lids.
4. Put in some moisture absorbing material. Dry wood ash, dry charcoal, powdered milk, toasted (cooled) rice, or small pieces of newspaper are all good. The drying material should take up about one-fourth of the container space.
5. Label the containers with the type of seed, place, and date of collection.
6. If possible, include the initial percent viability of the seeds. To do this, plant some seed to see how many germinate. If 8 of 10 germinate, for example, percent viability is 80%. This information will help you to learn about how much each type of seed loses viability between collection and planting.
7. Protect seeds from insects and fungi. Before storing in containers, mix with dry ash, powdered seeds of black pepper or neem leaves. Or use extract of neem, peanut, castor bean, or cotton: 1 teaspoon oil/1 kg seed. Or use naphthalene balls: 1 or 2 pieces/10 kg seed.
8. Protect from rodents and birds during storage.

Learning outcome 5.3: apply labelling

Topic 1: Perform labelling on seed package

Labeling refers to all the information that you might receive from the company or its sales representative about the product. This includes brochures, fliers and other information accompanying the seed product.

Familiarity with the seed label is crucial to selecting the most appropriate products for use and therefore receiving maximum benefit from their use. Although the label may seem

overwhelming at first, it takes only a few minutes to gain the information needed once the various parts of a label are studied.

5.3.1. Read the seed Label

- ✓ Before purchasing the seed to ensure it is the species you need
- ✓ Before sawing to know climatic condition for species
- ✓ Before to know survival rate.
- ✓ Before to know storing condition.

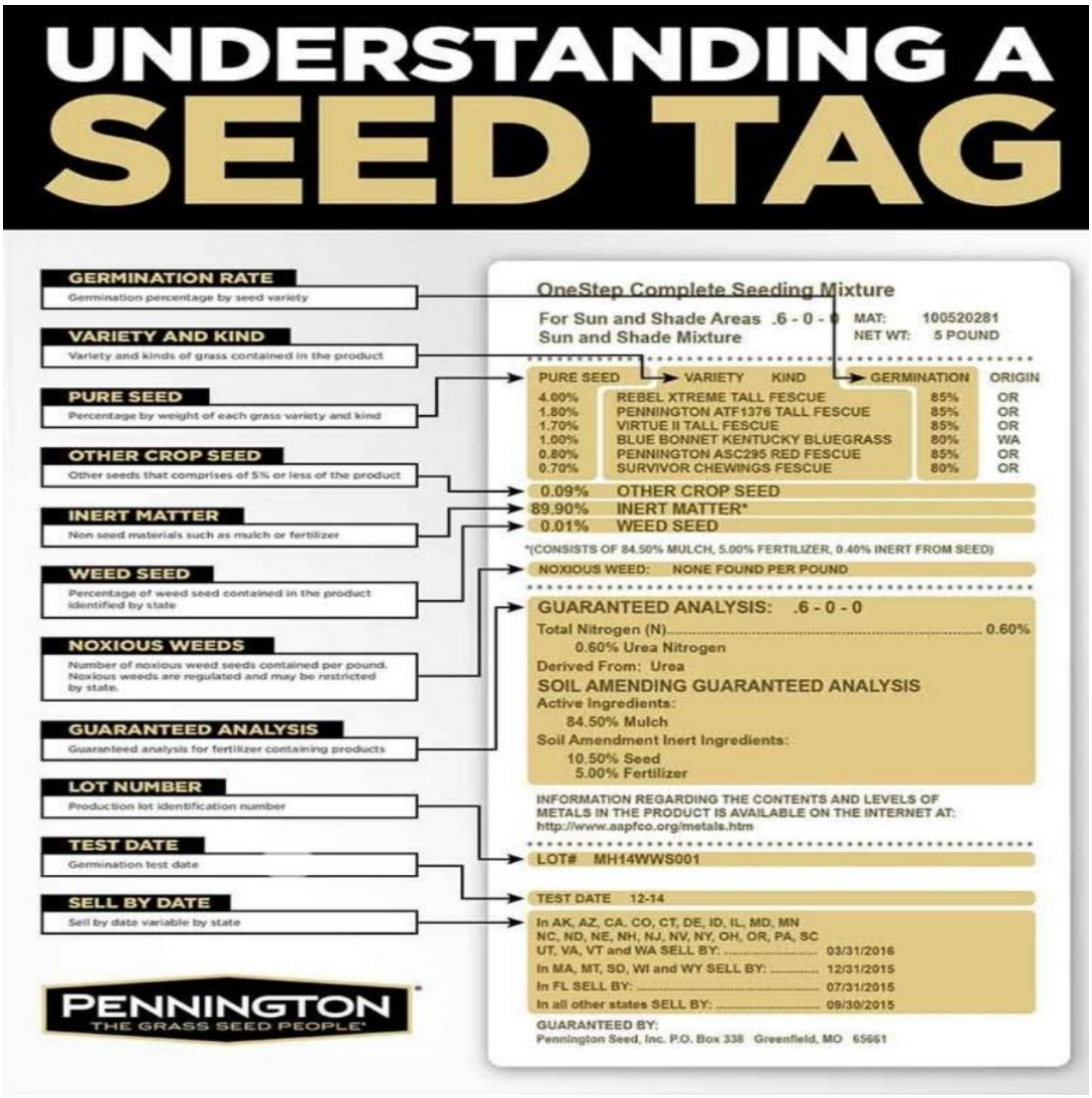


Figure 12: Seeds label

5.3.1 A Simplified Guide to Understanding Seed Labels

- **Introduction**

One of the most important parts of establishing cover for any conservation practice is making sure that the correct species, variety, and amount of seed is planted. With many conservation species, it is essential to know and properly interpret what is in the bag. Understanding the seed label will allow proper decision making when planning and installing a seeding.

- **Components of the Seed Label**

The law requires that each seed lot offered for sale must be truthfully labeled. This is regulated by the Federal Seed Act as well as state seed laws. In addition, all state certification agencies comply with the minimum requirements and standards of the Association of Official Seed Certification Agencies (AOSCA) to insure uniform testing methods and minimum standards of seed quality. The format of seed labels may be variable, but all labels will have some semblance of the following as required by the Federal Seed Act for seed in interstate commerce.

1. Variety and Kind – Cultivar/release name, species, and common name;
2. Lot number – a series of letters or numbers assigned by the grower for tracking purposes;
3. Origin – where the seed was grown;
4. Net weight – how much material is in the container;
5. Percent pure seed (purity) – how much of the material is actually the desired seed;
6. Percent inert matter – how much of the material in the bag is plant debris or other materials that are not seed;

7. Percent other crop seeds – other non-weed seeds;
8. Percent weed seeds – seeds considered weed species;
9. Name of restricted noxious seed (with number per pound of seed). Noxious weed species vary by state. There are 2 types of noxious weeds – restricted and prohibited. Restricted weeds are listed as seeds per pound of material in the bag. There should be no prohibited weeds;
10. Percent germination (germ) – how much of the seed will germinate readily;
11. Hard seed – seed which does not germinate readily because of a hard seed coat;
12. Dormant seed – seed which does not germinate readily because it requires a pre-treatment or weathering in the soil. (Some suppliers may combine hard and dormant seed on the label.);
13. Germination test date – date should be within 12 months of the planned date for using the seed;
14. Name and address of company responsible for analysis (seller or grower).

You may also see the following additional information on the label:

- Total Viability/Germination – this may or may not be stated. Add Germination + Hard Seed + Dormant Seed. Total Viability may not equal 100%. This just means that some of the seed is not viable and will not germinate.

Learning outcome 5.4: store the seeds select

Topic1: Perform seed packaging

1. Packaging

Seed packaging helps to maintain the quality while facilitating handling and identification of the product. Packaging is a very powerful seed marketing tool and several factors have to be taken into account when deciding on appropriate packaging to be used:

2. Maintaining quality

The quality of the seeds has to be maintained from the time of packing to the time of use by the farmer. The packing material and pack type chosen will depend on the nature of the product and the environment but packaging has to be resistant to moisture penetration, pest damage, and adulteration, slipping in the stack and to rough handling.

3. Ease of handling and convenience

It is important that the pack is adapted to market requirements in terms of size, weight and unit cost. A serious consequence of an over-large pack size is that the retailer will break bulk to sell the seed. This will provide the opportunity for deterioration and adulteration, and may invalidate the legal status of the labelling.

Thus a number of factors need to be considered when planning for pack size. These relate the package size to the seed's value, its use and the area normally being sown. Likewise, handling, portability and onward transport at the retail level are important so that retailers do not have to break bulk to sell the seed. Local knowledge can be important in determining if people are charged by weight or number of packages when transporting seed.

4. Identification

Presentation is a vital aspect of successful marketing. Packaging materials must be suitable for printing ant should be carefully designed to attract attention as well as being distinctive, in order to give the product and the supplier instant recognition. The packaging should form an association in the mind of the farmer between the seed and the supplier (known as the brand image) as well as providing information about the product and giving information on safety, storage and use of the seed. Finally, the package should provide as much protection from counterfeiting as is feasible.

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