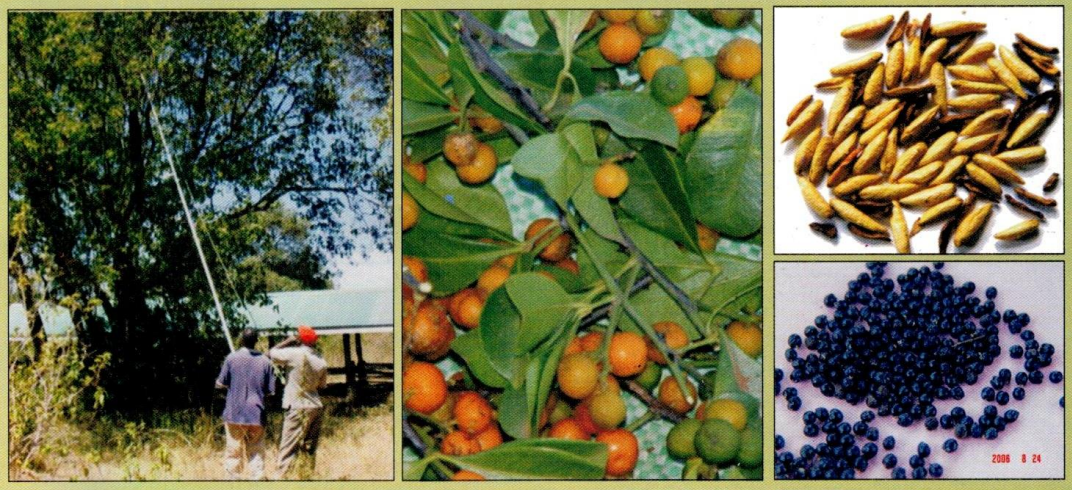
TREE SEED COLLECTION , HANDLING AND SEEDLING PRODUCTION.



TRAINING AND REFERENCE MANUAL

William Omondi, Peter Angaine, Michael Meso and Victor Otieno

KENYA FORESTRY RESEARCH INSTITUTE (KEFRI)

TREE SEED COLLECTION, HANDLING AND SEEDLING PRODUCTION.

William Omondi, Peter Angaine, Michael Meso and Victor Otieno

TRAINING AND REFERENCE MANUAL

Cover photos: Front: Seed collection from the crown using looping shear; Fruits of *Cordia sinensis*; seeds of *Terminalia brownii*; seeds of *Zanthoxylum gilettii*
Back: *Acacia seyal* tree and seeds

Photos by: William Omondi, Peter Angaine, Michael Meso , Victor Otieno and David Meroka

Kenya Forestry Research Institute
P.O Box 20412 – 00200 Nairobi, Kenya.
Tel:+254 – 02 – 2010651/2, +254 – 724 – 259781/2
Email: director@kefri.org
Website:www.kefri.org
Printed by: Gakinduri Enterprises,
Tel: +254 02 313748

ACKNOWLEDGEMENTS

The authors wish to acknowledge all those who provided vital information and comments that enabled the production of this manual. Special thanks go to Ewaso Nyiro North Development Authority (ENNDA) who facilitated the production of this manual. We wish to thank Ms Ambia Abdi Osman- DFO Wajir for her valuable and timely contribution to this manual. Finally the authors wish to acknowledge KEFRI Seed Centre Staff for their valuable comments and contributions.

ACKNOWLEDGEMENTS

The authors wish to acknowledge all those who provided vital information and comments that enabled the production of this manual. Special thanks go to Ewaso Nyiro North Development Authority (ENNDA) who facilitated the production of this manual. We wish to thank Ms Ambia Abdi Osman- DFO Wajir for her valuable and timely contribution to this manual. Finally the authors wish to acknowledge KEFRI Seed Centre Staff for their valuable comments and contributions.

ACKNOWLEDGEMENTS

The authors wish to acknowledge all those who provided vital information and comments that enabled the production of this manual. Special thanks go to Ewaso Nyiro North Development Authority (ENNDA) who facilitated the production of this manual. We wish to thank Ms Ambia Abdi Osman- DFO Wajir for her valuable and timely contribution to this manual. Finally the authors wish to acknowledge KEFRI Seed Centre Staff for their valuable comments and contributions.

TABLE OF CONTENTS

LIST OF PLATES

1.0 INTRODUCTION

Trees, shrubs and all other forms of wild plants have an important role to play in the general livelihood. They further play a major role in farming systems in terms of supply of a range of products, improvement of the environment, soil, water and biodiversity conservation, and income generation for most communities. The provision and use of high quality seed is therefore the first and most important decisive step towards improved plant and plant products productions. In the absence of an organized seed production and distribution systems, many rural communities continue to use seeds and planting materials of unknown source and quality. This situation often results in reduced yields and low quality products.

The quality of seed is determined by several processes prior to sowing. Good quality seeds translate to better forest. It is therefore important to consider all the procedures involved in seed handling to realize desired results.
Communities utilize trees and shrubs for various purposes but rarely plant as much as they cut and harvest. Trees and any other plants which are utilized must be replaced to ensure continued supply in the future and to prevent their extinction. Demand for wood and non wood products is increasing due to communities turning to wild plants as source of food, medicine, fuel wood and furniture and also due to population pressure.

2.0 PRODUCTS AND SERVICES PROVIDED BY PLANTS

- Food for our survival
- Timber for construction and building
- Fuel wood for cooking
- Wood for furniture and other useful implements
- Shade and windbreaks in homes, markets, schools etc.
- Medicine for our health and well-being
- Soil conservation by preventing rapid rain-water run off
- Prevention of floods and regulation of rainfall

- Forests catch, store and release rain water, which supports human life, wildlife, agriculture and industry.
- Natural habitats and ecosystems are homes to many animals, birds, insects and other living organisms all of which are beneficial indirectly or directly to our lives.

3.0 THE SEED

3.1 What is seed?

Seed is a product of fertilization of an egg within the embryo sac of an ovule or the small hard part produced by a plant, from which a new plant can grow or that part of a plant developed from a fertilized ovule, or a mature ripened ovule capable of producing a new plant.

3.2 What are good seeds?

Good seed is that which can germinate and produce healthy and strong seedlings and plants and that which can effectively be stored until the time it is required for use.

3.3 Advantages of using high quality seeds

- The use of high quality seeds is a guarantee to production of expected quality plant product and good yields.
- High quality seeds guarantee quality products and desired services of plants raised for them. Use of high quality seeds, minimizes cost of production by ensuring high rates of survival, fast growth and low infection and infestation by pests and diseases.

3.4 Types of seeds

Some seed are collected when sufficiently dry or require drying to facilitate safe handling and storage. However, seeds of some plants mature when they are still relatively wet and loose viability when too much water is removed from them by drying. Those seeds must therefore be sown fresh after extraction. Most of this seed types are borne from fleshy fruits most of which are large.

4.0 SEED SOURCES

4.1 What is a seed source?

This is any plant or group of plants from which seed is obtained. These sources occur in different areas and forms

- Private farms and around homesteads
- Forest: natural and plantations
- Established seed stands and plantations

4.2. Selection of seed sources

Seed sources can be selected based on their accessibility and growth performance of the plants. The target seed collection area must therefore provide a good population of plant for target collections. Trees and plants from which seed is collected are selected according to the uses and requirements for any given species, e.g.

- Timber: long cylindrical straight bole
- Fodder: high production rate of leaves
- Fuel wood: multi-stemmed, heavy branching and fast growth

Plate 1: Seed source of *Aloe sp.*

Plate 2: A tree with long cylindrical straight bole depicting a good seed source for a timber species.

5.0 SEED COLLECTION

5.1 What is seed collection?

Seed collection involves obtaining plant genetic material for production, research, restoration etc. The main reason for collecting seed is to ensure the provision and supply to seedling production programmes, research and conservation.

5.2 Planning for seed collection

5.2.1 Why plan?

Planning for seed collection is an important requirement in all production programs. Knowing the species to collect, its distribution, phenology, cost of collection e.t.c. determine the success or failure of any seed production activity. All the collection equipments and other requirements must be assembled and made available at the onset of the collection time. Information on maturity status of local plants should therefore be gathered and used as a guide.

5.2.2 Flower survey

Survey is carried out to monitor flowering patterns in the seed source and to determine their abundance and distribution. The purpose of the survey is to determine the following,

- Distribution of flowering plants in the seed source
- Infestation of flowers by pests and diseases

5.2.3 Seed survey

Seed survey enables the collector(s) to observe the different stages of maturation and also helps in determining the timing for collection. During the survey a cutting test is carried out to ascertain the stage of maturity. A firm endosperm/embryo confirms maturity while the soft milky endosperm/embryo will confirm immaturity. The test also provides information on the infection level of some fruits and seeds. This process enables collector(s) to collect mature fruits.

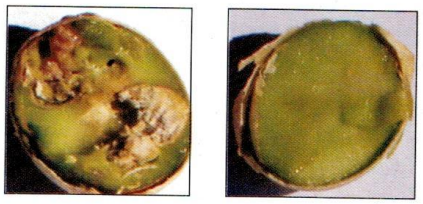


Plate 3: Cutting test of seed to determine maturity level and extent of pest and disease infestation.

5.3 Other Collection requirements

- Permits /authority from land owner, game park e.t.c.
- Containers for carrying collected seeds/fruits e.g. cloth, paper and gunny bags.
- Record books for documenting information of collected material.
- Tools to facilitate the collection e.g. pangas, tarpaulin e.t.c.

5.4 What to collect

- Collect only mature pods or fruits from which high quality seeds can be extracted. Seeds should be collected from as many plants as possible.
- Maturity indicators may be signified by color changes of the pods or fruits. Some plants may show fruit hardiness and many legumes, seeds are dispersed when the pods naturally open.
- Don't collect seeds that appear infected or fallen on the ground for unknown reason and duration. Such seeds could be contaminated by soil pests and diseases or may have been aborted before completion of maturity. Infected seed could lose viability and render them useless for sowing purposes.

5.5 When to collect

Seeds are collected during the season when most of the trees of the desired species are mature and at their dispersal time. This is normally during dry season and after the rains for many species. Local experience is very useful to provide information on maturity periods for many plant species.

5.6 Seed collection methods

5.6.1 Collection from the crown

Crown collection may involve climbing tall trees, hand picking from crowns of short trees, shaking the crowns with hooks or cutting the fruit stalks with looping shears. Crown collection from felled trees can be done if seed collection is synchronized with felling operations.

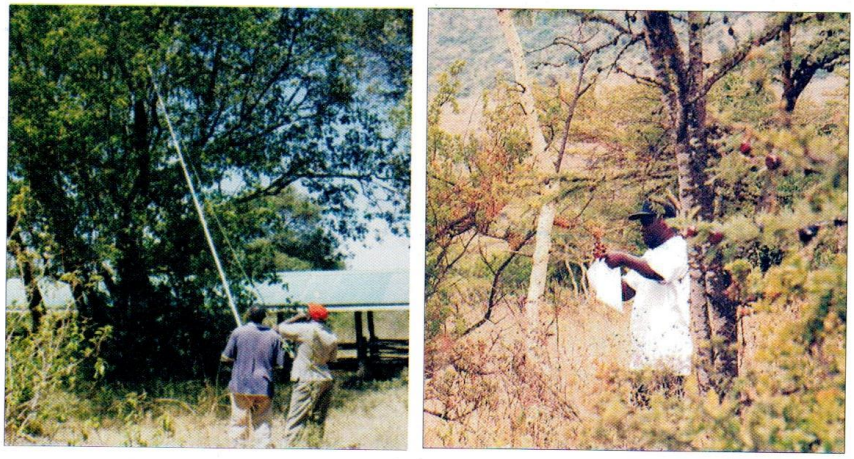


Plate 4: Seed collection from the crown.

5.6.2 Ground collection

This may involve collection of fruits from the ground following natural fall but may be applied to large fruited species only. There is the risk of collecting immature, empty, and diseased and pest infested or otherwise unsound seeds. Furthermore, there is uncertainty in identifying the mother trees from which the seeds are collected. To facilitate collection and minimize the risk of picking unsound seed, the forest floor should be cleared of vegetation and any debris, including seeds from the previous seasons, prior to the anticipated seed fall. Canvas should be spread on the ground so that seeds fall onto it.

6.0 HANDLING OF FRUITS, PODS, NUTS AND SEEDS AFTER COLLECTION

6.1. Temporary storage

Free air circulation is essential for any freshly collected material. This prevents overheating and fermentation and infestation. Such materials should therefore be held in open or ventilated containers such as trays with holes or wire-mesh or in nylon-net or sisal bags preferably in a cool dry place.

6.2.1 Seed extraction methods

Different methods are used in this process depending on the nature of fruits or pods must be done carefully to avoid damage of seed. It makes seed, packaging, storage and sowing easier as it removes the bulk structure attached or enclosing the seed. For most pods, drying and threshing can extract seeds while for pulpy fruits it involves the soaking in water, squeezing, washing, and separating the pulp from seed by washing

6.2.2 Extracting seeds from fruits

Seeds should be mature before extraction. If not, it may be necessary to ripen the fruits with the seeds inside by leaving them in a cool, well-ventilated environment. Storage conditions should simulate those on the parent plant.

6.2.3 Extracting seeds from non-pulpy fruits.

Non pulpy fruits can be extracted using the following methods;

- Drying
- Shelling/threshing

6.2.4 Extracting seeds from pulpy fruits.

Pulpy fruits can be extracted using the following methods;

- Rubbing against wire mesh
- Pounding using mortar/pestle
- Rubbing between hands

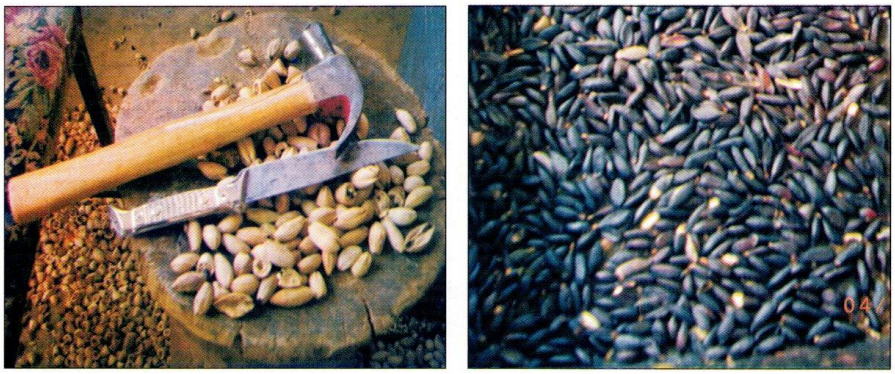


Plate 5: Extraction of *Melia volkensii* seeds from nuts.

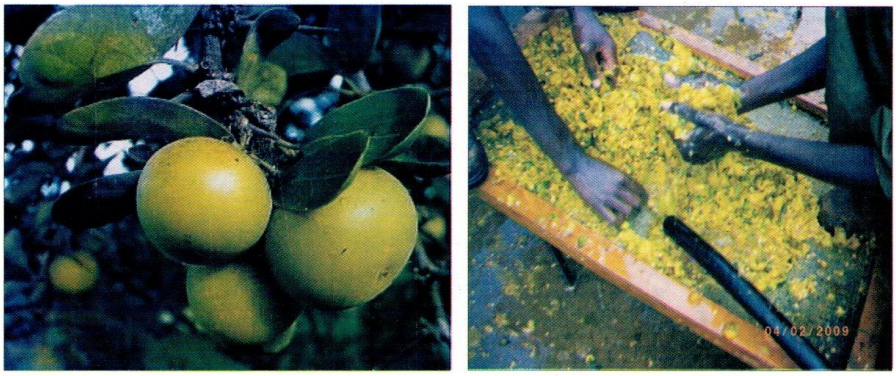


Plate 6: Mature Kei apple (*Dovyalis caffra*) fruits and seed extraction by squeezing and washing on a wire mesh. The method is used for species with similar fruit types e.g. Neem (*Azadirachta indica*)

6.3 Seed cleaning

6.3.1 How and why are seeds cleaned?

Cleaning involves the removal of unwanted materials in the seed batch e.g. pulps, small leaves, infected seeds thus improving its quality and bulkiness. Hand sorting is most appropriate for small seed samples and large seeds. Winnowing is useful for light seeds and is appropriate on a windy day while floatation in water is appropriate in separating empty (light) and full (heavy seeds).

Sieves can also be used to separate seeds from large or small parts of unwanted material.

6.3.2 Advantages of clean seeds

- Reduces bulk during transportation.
- Improve sample purity by removing damaged and immature seeds; and
- Optimize storage space and reduce costs.
- In fruit crops, some pre-cleaning may be necessary to remove leaves and twigs in order to reduce bulk and prevent the possible spread of diseases and pests.

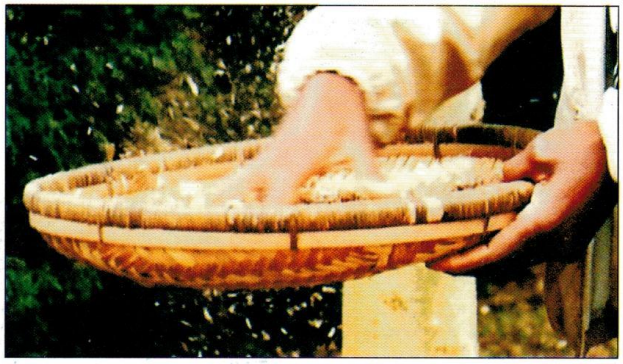


Plate 7: Winnowing as a method of separating light material from seeds

6.4. Seed drying

6.4.1 The importance of drying seeds

Drying removes excess water from seeds thus preventing rotting and allowing effective storage. Extracted seeds must be dried and cleaned effectively as soon as they are collected. The low moisture content of dried seeds ensures longer storage period. Freshly harvested seeds can have high moisture contents which promote respiration and growth of seed embryos, insects and fungi. Seeds must therefore be dried to an appropriate moisture content to prevent damage, heating and infestation during storage. This should be done as soon as possible to avoid deterioration. It is important to ensure that

seeds are not left in sheds, stores or corridors but placed in a well-aerated and cool environment immediately after collection.

6.4.2 How are seeds dried?

Seeds can be dried in the sun or under shade by spreading thinly on canvass and is most effective on windy days. However during sun drying, seeds must be protected against over-heating and predators. Some seeds, especially those with pulpy fruits, require gradual drying in the shade before they are exposed to direct sunlight.

6.4.3 Seed drying methods

- Sun drying
- Drying room with controlled conditions
- Shade drying
- Use of drying agents e.g. silica gel, charcoal

6.4.4 To what extent should seeds be dried?

Seeds should be dried to a level where their risk of overheating is minimized. The optimal moisture content of dry seeds should therefore be low enough to prevent such risks. This can be verified by constant weighing until there is no more change in weight. Another method is to gently crush the seeds at intervals during the drying period to ascertain their dryness.

It is important to adopt an appropriate drying method, which ensures faster drying. However, very high temperatures should be avoided.

Plate 8: Seed drying in drying beds

7.0 SEED STORAGE

Objective of storage is to preserve seed for future use without losing its quality.

7.1 Storage facilities and containers

- A good seed storage facility and container is that which maintains seed quality aspects throughout the storage period.
- Must limit changes in temperature and moisture content between the seeds and the surrounding environment.
- Easy to handle e.g. open and release and with minimum wear and tear.

Plate 9: Types of storage containers; polythene/plastic containers, glass jars and bottles, and traditional guards.

7.2 Storage facilities

Cold storage e.g deep freezers, refrigerators and cold rooms

7.3 Other traditional storage methods include:

Calabash, earthen pots, hanging around fireplace and paper bags and traditional granaries.

8.0 SEED QUALITY CONTROL

High quality seeds are products of activities undertaken through seed collection and processing in the correct way. This involves planning for seed collection, collecting seeds from good seed sources and healthy individuals, collecting mature seed using appropriate methods and using correct seed processing methods. In this way, the seeds so produced guarantee the production of desired plant products and services

Seed quality is essential in providing consumer protection concerning purity, germination capacity, genetic integrity and freedom from diseases. It also aims to ensure provision of high quality seeds to users. Quality seed is a product of specialized selection and handling. The high physiological status of seed at maturity must therefore be maintained during processing and storage.

9.0 TREE NURSERY ESTABLISHMENT AND MANAGEMENT

9.1 Introduction

A number of tree species can easily be established through direct sowing in the field. However a large number of species require careful production in a tree nursery, where the young seedlings can be protected and hardened to survive the harsh field environmental conditions.

A nursery is a protected area or environment for production and tending of seedlings and other plant materials before onward transplanting in field conditions.

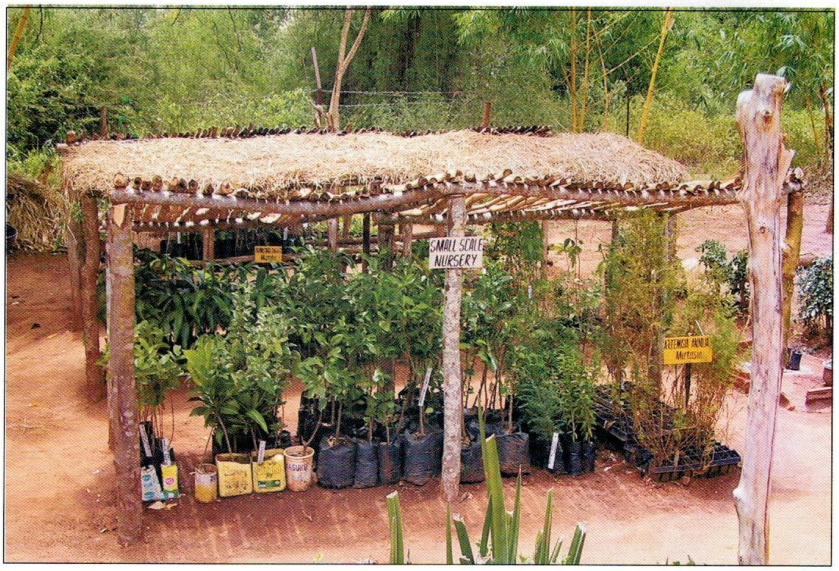


Plate 10: Some common containers used in seedling production in the nursery.

9.2 Planning a nursery site

It is important that tree nurseries are

- situated close to reliable water source
- well protected and accessible
- situated in a well drained site

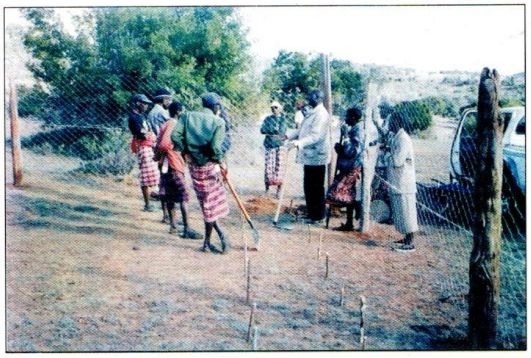


Plate 11: Participatory site selection of community tree nursery.

9.3 The main components of a nursery are

- Shed for soil mixing and potting
- Seedbed for germinating seeds.
- Shed for potted seedlings.
- Nursery bed for hardening
- Store for implements
- Equipment: water storage containers (drums, tanks), watering cans and wheelbarrows
- Implements: which include; shovels, jembes, pangas, soil sieves, pruning knives buckets, spade, labels, secateur, rake, polythene tubing

9.4 Nursery operations

- Obtain nursery soils from a good source rich in humus
- Allow 3-6months full decomposition of organic matter and elimination of weeds (soil from fertile sources can be used directly after sieving).
- Sieve the soil to remove stones and other unnecessary materials.
- The soils can be mixed with farmyard manure and sand to facilitate water drainage.
- Choice of tube depends on the area e.g. dry land areas 10cm wide 15cm long. Black polythene bags last longer than clear ones. Alternative for small nurseries are milk packets, perforated tins.

- Tubes are carefully filled with soils, grouped in clusters of 100. The filled tubes are placed in seedling beds.
- Record keeping

Data collection in the nursery is important. The following is what the nursery personnel should strive to record;
Name of species, origin or provenance or exact place of collection, date of collection, total seedlings sown, record of sales, sowing date and any pre germination pretreatment applied or fertilizer used if any.

9.5.0 Important points in nursery technique

9.5.1 Seedbed soil
The soil should be light easily drained. Sidewall might be necessary along the seedbed e.g. split bamboo sticks, timber or cemented.

9.5.2 Potting soil
The ratio of forest soil, sand, ballast and manure vary from place to place especially requirements for drylands could be based on experience.

9.5.3 Seed sowing
Thinly sown seeds give good germination percentage and the quality seedlings. The depth of sowing should be twice the actual seed size using sand or sieved soil. With small species such as Eucalyptus, only a very light covering is required.

9.5.4 Seed germination and pre-sowing treatments
- Germination refers to the emergence of seedling from a seed after sowing. It begins with seed uptake of water and requires suitable conditions oxygen, temperature and sometimes light. The seed must be alive (viable) and vigorous for it to produce a normal seedling. If one or more of these factors are unfavorable, the seeds will not germinate.

- Not all seeds will germinate when sown even with appropriate conditions. In nature, seed remains dormant until the conditions are favorable for germination. Treating the seed to allow the absorption of water before sowing them in suitable conditions can eliminate this "resting period." For many dry seasons e.g. legumes, this may involve soaking in water to soften the seed coat. Cold, warm and hot water can be used depending on species.

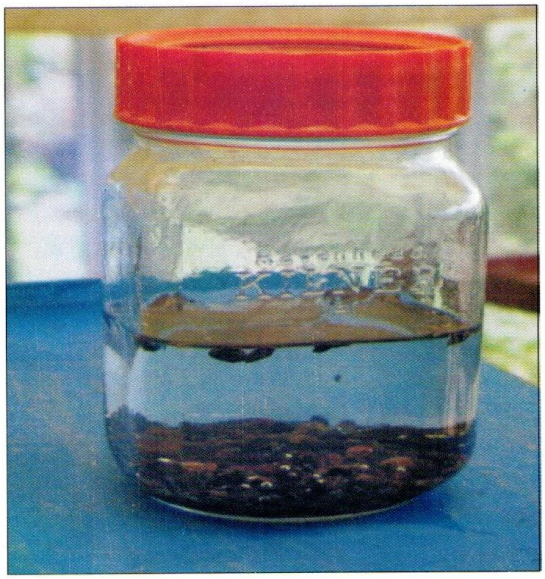


Plate 12: Soaking seeds in water to improve germination by softening the seed coat.

Other methods of improving germination include:

- Piercing the seed coat with a sharp object to facilitate water entry
- Filing parts of the seed-coat
- Gently cracking the seed-coat

9.5.5 How do you germinate seeds in a seedbed?

- Sow seeds thinly and evenly
- Cover with a thin layer of soil
- Spread dry grass to prevent drying

9.5.6 Direct sowing and seeding

Some seeds can be sown directly in the prepared sites. This can be done by broadcasting e.g. grasses and smaller seeded plants for restoration and rehabilitation. Some larger seeds can also be sown directly into the soil e.g. Balanites

9.5. 7 Preparation of containers/tubes

Moist soil should be used for filling containers/tubes, sprinkle some water on the soil prior to filling. Watering should be done 3 to 4 days before transplanting. Place an initial amount of soil and firm the soil at the bottom.
Fill to about ½ inch from the top. Do not compact the soil very much, gentle firming will ensure that growth can occur.

9.5.8 Watering regimes

Seedlings should be watered at least twice a day; early in the morning and late in the afternoon. Avoid over watering especially seedlings which have just been transplanted.

Plate 13: Pricking out of seedlings

Plate 14: Potted seedlings in a nursery.

9.5.9 Shade

After transplanting, seedling should be maintained under shade for 2 to 3weeks after which exposure to sunlight should be gradual.

9.5.10 Mulching

This is a beneficial and efficient means to conserve soil moisture. Local products can be used e.g. grass, wood shavings, straw, chopped leaves e.t.c.

9.5.11 Root pruning

Seedlings in open pots usually develop long taproots at the bottom which should be cut to encourage lateral root growth and to prevent damage at the time of transplanting.

9.5.12 Hardening off

This involves gradually introducing the seedlings to field conditions.

9.5.13 Culling or grading

Culling or grading is the separation of healthy, vigorous plants from stunted, abnormal and spindly ones. The aim is to get the best seedlings to the field. This should be done before distribution.

9.6 Good nursery practices

A number of factors influence the production of quality seedlings in a nursery. These include; seedling handling, type of containers, sowing media, fertilizing, nursery hygiene, nursery environment, time management, labeling and record keeping.

9.7 Species selection

Seed selection for establishing a nursery should be demand driven. The nursery owner should strive to make a nursery work as an enterprise that besides contributing towards general goal of afforestation will also earn him money to enable him or her cover the overheads.

9.8 Quality seedlings.

- Have a well-developed root system and are able to produce new roots quickly
- Anchor in the ground quickly and start assimilating and growing after planting out
- Have a balanced shoot/root ratio

Other propagation methods and techniques widely used in nurseries are as follows

- Cuttings
- Budding
- Grafting
- Layering

10.0 REFERENCE:

1. KEFRI (2004) Tree seed handbook of Kenya (2nd Edition) edited by Omondi, W.; Maua J. O.; and Gachathi, F. N.

2. Kindf R. et al (2006): Treee Seeds for Farmers; A Tool Kit and Reference Source. World Agroforestry Centre Nairobi.

3. Lars Schmidt (2002); Guide to Handling of Tropical and Subtropical Seeds. Danida Forest Seed Centre, Humleback, Denmark.

4. Rao, N.K. et al (2006) Manual of Seed Handling in Genebanks. No. 8 Bioversity International, Rome, Italy.

5. Hannah Jaenicke (1999): Good Tree Nursery Practices, Practical Guidelines for Research nurseries. ICRAF, Nairobi.

6. Wachira A., Mugga, C., Munane A., (2005): Macmillan Secondary Agriculture, Students Book (Form Four). Macmillan Kenya (Publishers) Limited

7. Vegetative Tree Propagation Agroforestry, Tree Guidelines and Reference, edited by Hannah Jaenicke and Jan Beniest (2002), ICRAF, Kul Graphics Ltd.

8. Valerie Mailler (1981), Nursery Management Manual, Ministry Agriculture, Nairobi.