Collection, Treatment, Storage of Seeds

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Kenya Forestry Seed Centre

1.0 Introduction

The growth rate of Kenya's population results in an expansion of agricultural acreage and an exponentially increased need for timber, firewood and charcoal, fodder, erosion-control, water catchments and other enviromental effects of planting trees. It is estimated that Kenya's wood consumption exceeded the increment of the resources by 4.3 million tonnes per year (BEIJER INSTITUTE cited in OWINO, 1988).

The demand for woodfuel and the supply projections to the year 2005 indicate a shortfall of 27.5 million tonnes (GATHAARA, 1988).

OWINO (1988) judges the increase in the number of trees grwon in maturity to be almost 10 fold to provide the services. One of the basic requirements to meet these needs is the large scale production of vigorous and locally adapted plants derived from seeds of high quality and defined provenances (RODE, 1988).

It is the essential objective of the Kenya Forestry Seed Centre to procure forest seeds in sufficient quantity and quality from seed orchards, certified seed stands and selected trees.

Seeds are expansive and delicate goods, which have to be treated carefully. Every person involved in seed handling is therefore requested to make the best use of seedlot. That means for the Seed Centre to optimize the organization of seed collection and extraction to develop and recommed suitable pretreatment and storage method and to minimize the period of delivery to the consignee .

2.0. Organization

The Kenya Forestry Seed Centre at Muguga is a sub-programme within the Tree Improvement Programme of the Kenya Forestry Research Institute (KEFRI). The Seed Centre incorporates and handles the processes of final extraction, seed cleaning, testing, storage and distribution. Seed Collection is largely decentralized to six seed Collection Centres in :

- Gede
- Kakamega
- Kibwezi
- Londiani
- Nyeri
- Turbo.

Thus all the different ecological zones ~~of the~~ are covered, special emphasis has been put on semi-arid areas and on indigenous species. The Collection Centres forward the seeds after extraction to the Seed Centre, which supervises the work in the Collection Centres, but also conducts seed collection within the vicinity of Muguga.

3.0. Seed Collection

3.1 Seed Sources

Seeds of the two most important plantation species Cupressus Iusitanica and Pinus Patula are collected mainly in clonal seed orchards, where we have a broader genetic base than in plantations or - it is ~~also~~ the case with Eucalyptus species - from certified seed stands with a size of at least 5 ha and with a superior phenotypical performance. Indigenous plantations species from high potential areas like Juniperus procera , Maesopsis Eminii, Prunus, Africanum and Vitex Keniensis, Prema Maxima are obtained from selected seed stands in various districts

The Selection criteria for seed stands are

- Superior volume production
- Uniformity
- from and growth habit
- fine branches
- minimum area of 5 ha, exception for seed stands of rare indigenous species 1 ha.
- adequate age for long term seed production
- accessibility

The selection occures in plantations only as (1) frequently the size of the remaining natural forest area is too small, (2) the natural forest is not accessable, (3) species to be selected are mixed and scatterec over a large area in a number of different forest types and (4) there is no possibility of demarcating the collection units. Seed stands ir Kenya are subjected to thinning and other treatments to improve the genetic quality. Due to their inpartance for seed supply and gene conservation, the selected seed stands should not be felled without authority from the seed centre.

Until 1988 42 new seed stands were selected with a total of 456.3 ha comprising 5 species exotic to Kenya (Eucalyptus saligna, Gmelina arborea, Grevillea robusta, pinus aribaea, P. patula) and 7 indigenous species (Brachylaena ~~Braensis~~, Prunus africanum, Juniperus, Maesopsis eminii, Polyscias Kikuyuensis) stands were recommeded for long term protection to the Forest Department (JESTAEDT and RODE 1986.

Within the natural forest and in the semi-arid and arid land the important indigenous species can only be found scattered over a large area. Selection and protection of identifiable units as seed stands is thus not possible. The phenotypical selection of individual trees within a defined area of homogenous climatical and if possible soil conditions was considered the alternative. It proved to be good to restrain the area to the vicinity of forest station, as only there protection and actual collection from the selected and marked trees are ensured. Within the defined area 20-50 individual trees per species are selected with a minimum distance of 50 m apart. In this connection criteria are taken into account, which distinguish the selected tree from the other trees of the same species on the same site. The selected trees are thus phenotypically better than population mean. The selection standards depend absolutely on the purpose the respective species is used for. Heavy branching and a large crown are desired for firewood-, fodder- or charcoal- species. On the other hand, species providing quality

timber are selected with emphasis on straightness of stem and vigour. The selected tree must have fully developed their characteristics.

In case the nature distribution of the species allows to do so, individual trees of the same species shall be selected in different forest regions of the Country to obtain seeds from various provenances.

Recording of all individual trees on detailed maps is necessaay containing all information about geographic location, ecological and phenotypical date. Similar to the selection of dry zone species in Central America (HUGHES, 1984) are collectable populations frequently difficult to locate and the number of desired parent trees cannot always be reached due to rarity in the respective area. The genetic gain might be low since the selection criteria can show little heritability but it will extend the little knowledge we have about these species so far.

The demand for seed of the agroforestry species spectrum has increased considerably in the last years in Kenya. Seed of e.g. Calliandra calothyrsus, Gliricidia sepium, Grevillea robusta, Leucaena leucocephala, Parkinsonia aculeata, Prosopis chilensis, Sesbania sesban, etc. can only be obtained in small quantities from stands (Grevillea robusta) or scattered single trees (Parkinsonia aculeata, Sesbania sesban). For this reason a programme was set up which aims at the establishment of seed stands or seed production areas as immediate source of suitable origin. In 1986 one stand of Prosopis chilensis was planted, others followed 1987 and 1988 including species like Calliandra calothyrsus, Albizia falcataria, Gliricidia sepium and Parkinsonia aculeata. The size of the stands is usually 2 ha, but depends on the respective possibilities in the area. Seeds of species in high demand which cannot be obtained locally, are imported in small quantities and subsequently used as a seed source for the establishment of a seed stand. In some cases a so called "general collection" of a particular species has to be accepted due to a very high demand but the Seed Centre does not tolerate any seed lot without a clear information about the origin (RODE, 1987).

3.2

Method of Seed Collection

After checking the maturity by colour change of fruits or cones and the examination of seed contents by a cutting test on the spot seeds are collected using different methods

- Collection from the standing tree by harvest climbers
- Collection from the ground by cutting off seed bearing branches
- Collection from felled tree
- Collection from the ground.

3.1

Collection from the ground

The collection of fallen fruits or cones is possible with large and heavy fruits and cones.
SEEBER and AGPAOA (1976) recommend collection from the ground of species with

a) heavy fleshy fruits;
b) medium sized fruits with hard kernel (e.g. Gmelina, Tectona,);
c) large pods (e.g. Delonix regia, Tamarindus indica);
d) large capsules;
e) large winged fruits (e.g. Pterocarpus, Dipterocarps)

Seeds can thus be collected easily and cheaply. Skilled labours are not required, but control of collection might be necessary to make sure that collection takes place under the desired trees. Collection should avoid to take the first fruits as they are often of poor quality. Collecting should be delayed for some time until the greater portion has fallen. In Thailand for example seed shedding of Tectona starts in March, the main collection is postponed until April.

On the other hand, some species lose viability within a few days so that collections must be timed with the seed-fall.

It is ~~proved~~ necessary to clear the ground under the trees from vegetation, layer and debris. Vitex seeds are collected after this preparation. Spread canvas, plastic sheeting or similar things for catching the seeds make the work easier. Other types of catchments cannot be recommended (TURNBULL 1975).

Seeds should be collected immediately when mature and fallen to avoid losses by rodents, birds, insects and fungi.

Some species hold their seeds only a while after reaching maturity (e.g. Eucalyptus, Pinus eliotti, P. taeda).
Cutting tests on the spot can prevent collecting seeds from sources with unsound or empty seeds.

For fruits which are easily detached but not in a concentrated time, this process can be influeenced by manual shaking either by hand or by long poles with or without hooks and ropes. Poles with shears or saws are used to detach the fruits directly or fruit - or seed-bearing branches. Bamboo, aluminium or plastic poles (4-6m) are usual, but with telescopic poles one can reach higher parts of the crown. It is important to know that collection is more recommended in the upper half of the crown because fruits or cones on the lowest branches may yield little seed as a result of lack of pollination.

Besides this fruits can be picked easily from the ground provided the treees are small and branches low. In Australia seeds of smaller Acacias may be collected by this method.(TURNBULL 1975).

3.2 Collection from trees on the ground

Seeds can be collected either following normal logging or trees are felled especially for seed collection. The first method must be well timed with logging, ripeness and collection and subsequently the stand is felled (TURNBULL 1975).

Special felling has the advantage of a high collection method for large goodphenotypes, but the tree is lost as a future seed source.

3.3 Collection from standing trees

Climbing into the crown is often the only collection method for for large quantities. According to WILLAN (1985) this method can be divided into.

a) Climbing into the crown by way of the bole
b) climbing into the crown directly
c) climbing and picking of fruits within the crown

In some Countries seed collectors climb without supporting devices or with an axe successively notches are cut into the bole. These methods are dangerous and make the collector choose trees for their ease rather than for their quality (TURNBULL 1975). Mechanical aids like climbing irons, tree bicycles and ladders are recommended.

Climbing irons have the advantage of cheapness, simplicity and portability but on the other hand, they can cause damage to trees and require skilled climbers.

Basically they consist of a stirrup to support the foot, a shank with straps for attaching to the leg and a gaff or spike.

The length of the gaff varies, depending on the bark type and ranges from 5 cm. (thin barked trees) to 9 cm. (thick barked trees).

The equipment also consists of safety straps and belts, which support the torso of the climber and are attached to both sides of the climber's waist. In the tropics they should be made of canvas, because leather would quickly rot.

As a safety precaution the climber should wear tough clothing which cannot catch in branches, boots with rubber soles and probably safety helmet.

The following advice is given by ISSLEIB 1964 (quoted in SEEBER and AGPAOA 1976):

- Checking of equipment: spikes of the climbing irons, safety belt, rope;
- Decide on the climbing route when still on the ground, especially for the branchy crown region;
- Climb calmly with regular movements, make short steps;
- Hit the trunk with the spikes of the climbing iron in a slanting direction from above;
- Always use three points for a hold (2 feet and 1 hand or 1 foot and 2 hands);
- Do not press the upper part of the body and the knees against the trunk of the tree;
- In ascending the tree avoid dead branches and resin spots, break dry branches;
- When detaching fruits, have a safe stand by fastening the safety belt;
- Do not climb when it rains, when it is windy, or in darkness; also not when you are exhausted or tired.

Ladders must be light enough to be easily pulled by the climber. They can be made of aluminium, wood, magnesium alloy. A ladder consists of several sections, each section is between 1.8 and 3 m long and weighs not more than 3-6 kg. For example, the swedish cone picking ladder is made fo 3 m sections of 5.5 kg each. The sections have a stem support and a safety chain with a quick-release buckle. The legs of the ladder should be places on adjustable platforms for stability. Each section is carried up the tree and fitted into the lower one and after it the section is fastened to the trunk by a chain or belt.

3.4 Seed Handling after Collection

The stage after collection can be very delicate to the seeds since they are frequently not transported to a seed processing place in due course (WILLAN, 1985). Seeds may loose their viability and identity, especially when transport problems occur. All the collected seed lots have to be provided immediately with a label indicating the details of collection. All the seeds or fruits are transported in gunny bags (hessian sacks) to the processing place to avoid deterioration through mould and overheating (except smallest seeds like Eucalyptus), polythene bags for transport operations are no longer in use.

Seeds are dried and extracted by using covered sun-drying beds or in case of high temperatures under a shelter. It is tried to ensure a slow and gradual decrease in moisture content of fruits and seeds. The cones, fruits or pods are placed on top of a wire-mesh to promote free air-circulation, which is of great importance.

Fleshy fruits are usually depulped by soaking in water and gentle abrasion, if necessary. Fruits of Vitex keniensis are dried first, and then pulp is removed by a concrete mixer, others by hand maceration. Another method of depulping or extracting seeds is the use of a mortar or in future of a coffee-depulper. A new drying unit allows the drying of fruits more gradullyy, which will especially be suited to indigenous species from the highland forests.

4. Seed Storage and Testing

Seed storage is an integral part within the process of seed procurement. The need for storing seeds is to ~~avoid~~ provide a viable supply whenever it is required (STEIN et al. 1974). According to WILLAN (1985), storage period will vary, this depends on seed longevity of the species and the storage conditions.

In order to supply seeds of a known quality to the users, monitoring and regulation of seed conditions from collection through handling to storage is a prerequisite. This involved seed testing. To access the value of the seedlot, both physical and biological characteristics are measured (BONNER 1974). Tests carried out at KFSC include: purity analysis, weight determination, germination, occassional indirect testing of viability (Tetrazolium salt test) and moisture content determination.

4.1 STORAGE

Storage involves maintaining the viability of a seedlot from collection time to the time when the lot is required for sowing. Since longevity of seeds in storage is affected by their storage condition WILLAN (1985), has stressed that even under ideal conditions, seed will soon lose viability, if it is defective from the start. Therefore, factors to be considered before storage are:

(1) Seed maturity. Fully ripened seeds retain viability longer than immature seeds.

(2) Parental and annual effects. In seed harvest, quantity and quality often go together. When there is a good yield, the seed quality is also high and vis-a-vis.

(3) Freedom from mechanical damage. Seeds damaged mechanically during extraction, cleaning, sewing etc, rapidly lose viability.

(4) Freedom from physiological deterioration. Poor handling in the forest, during transit or processing cause physiological deterioration of seeds even when mechanical and fungal damage are absent.

(5) Freedom from fungi and insects. Collection of crops showing a high incidence of fungal or insect attack should be avoided. All operations of collection, transport, processing, etc. have to be carried out as quickly as possible to ensure seed is not already damaged before it goes into storage.

(6) Initial viability. Seedlots with high initial viability and germinative capacity have a higher longevity in storage that those with low intial viability.

In most cases it is necessary to store the seed for varying periods. It is generally agreed that storage conditions and longevity of seeds vary from species (WILLAN 1985); STEIN et al, 1974); HARRINGTON 1972). The storage periods are generally:

(1) Up to one year. When both seed production and afforestation are regular annual events.

(2) 1 - 5 years or more. When a species bears an abundant seed crop at intervals of several years and enough seed must be collected in a good year to cover annual afforestation needs in intermediate years of poor seed production.

(3) Long-term storage. For purposes of conserving genetic resources and also for research work.

The KFSC is in a position to store seeds at room temperature (+24°C to +28÷C), cool room (+3°C) and freezing (-18°C), due to modern and improved storage conditions . This also facilitates investigiations on differnt storage methods to match with the increase in species diversity required. Most of the species apparently store well at +3°C, and are in storage for approximately 0 to 5 years only.

Some species require to be sown when fresh due to rapid loss of viability. These include: Warburgia ugandensis, Vitex keniensis, Azadirachta indica, Olea spps., etc. These species require further investigations. The other groups of species can be stored for 3 to 15 years; and for more than 15 years, for example, the Acacia spps.

There are different methods of storage depending on the avialabity of equipment. Where equipment is available the most important factors to be considered for seed storage are moisture content and temperature. There are seeds that are killed by excessive drying. Moisture content should be above 15% and temperature above 0°C. Most of these seeds cannot be stored for long durations and require aeration.

The other group of seeds are those that can be dried between 5 to 10% moisture content and are stored for long durations in sealed containers under low temperatures (freezing).

The KFSC is in the process of categorising species into their appropriate storage conditions.

4.2 SEED TESTING

Seed tests are important after extraction and cleaning of seeds in order to store seeds of a high quality and viability. Before planting, it is necessary to know the viability of the seeds.

At KFSC, all the incoming seeds are tested before storage or dispatch for purity percent, seed weight, moisture content and germination.

4.2 Tree seed samples often contain impurities, for example, detached seed structed, leaf particles and other objects. Purity analysis is conducatd in order to determine the composition by wig weight of the sample being tested. Two samples are div ded into eight replicates each. The replicates are weighed sp separately (Appendix 2). Seeds of some species cannot be separated from their impurities, for example, some Eucalyptus spp.

Weight is determined by use of the pure seed component separated by the purity analysis. At the KFSC the weight of 10 replicates of 100 seeds each, from which the standard deviation and and coefficient of variation may be calculated, as well as the final mean of the sample (Appendix 3)

Moisture content is determined by drying seeds in an oven for 17 hours (slow method) at 103°C. The weight loss of the original material is used as a measure of moisture content (Appendix 4)

Moisterial is content can also be determined by use of the fast method. the seeds are heated for 2½ hours at 130°C in an electric moisture meter, which is not as accurate as the slow method.

Potential germination of seeds is the most important factor in the measure of quality (BONNER 1974). The germination test is used as an estimate of the number of seeds which can germinate at a given time AT the KFSC, seed are germinated in the laboratory, nursery and glasshouse. In the laboratory the seeds are either germinated in germination boxes under controlled temperatures in a Rodewald apparatus, germination tank or germination cabinets. The germination media used in the nursery and glasshouse is sand. These different conditions give varying result, which aid in better approximation of seeds sown in different nurseries. In general the result from the laboratory are higher compared to the other two locations, due to conditions being more controlled in the laboratory.

A sample of 4 replicates of 100 seeds each is normally used for germination tests (Appendix 5 and 6), except for small seeds mixed with impurities, for example, Eucalyptus spp. whereby, 4 replicates of equal weights are used.

Some species have been found to have germination problems. Hence the KFSC has an on-going research programme on these species. Recommendations are listed whenever a/some pretreatment/s is/are successful. Some papers have been written on some preliminary germination results (e.g, RODE, 1986; KARIUK,1987; KARIUKI and FODE, 1988).

3274

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