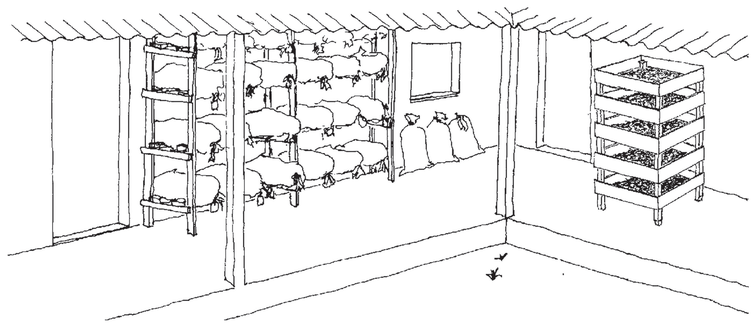
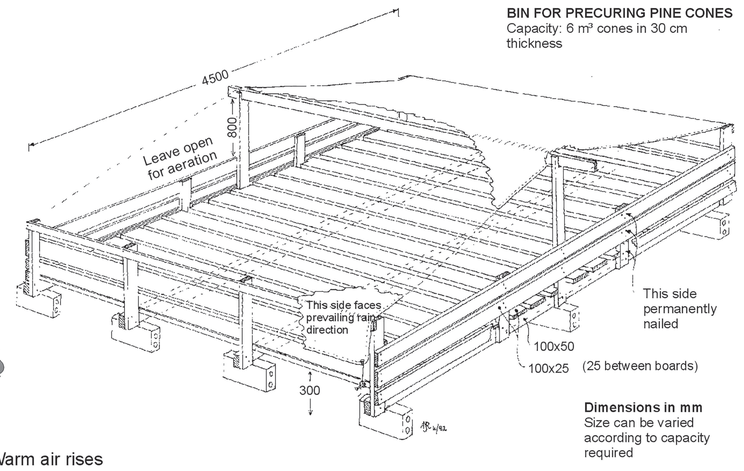
Fruit Handling

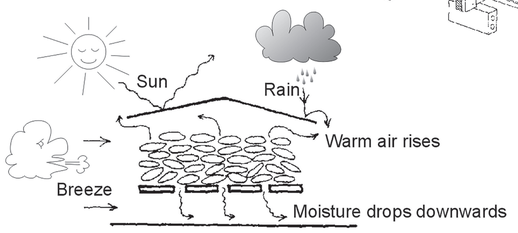




CONTAINER EXAMPLES

- Loose weave sacks, e.g. of hessian, cotton, mosquito netting, NOT plastic fibres
- Open mesh baskets, e.g. of steel wire, bamboo, rattan
- Wire netted trays
- Custom made wooden bins

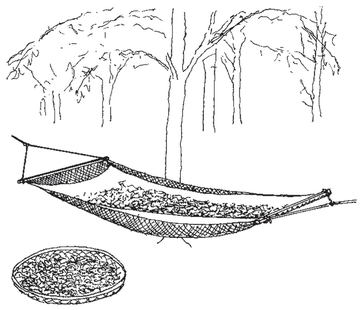
- **Never use plastic bags unless moisture content of the seeds is below 10 %.**

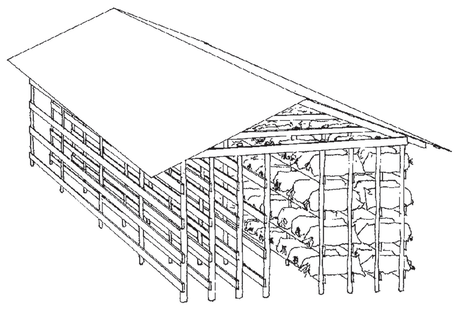


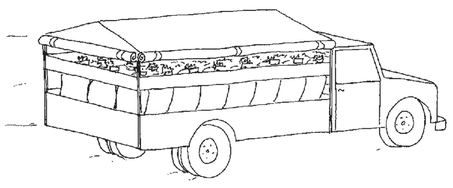
The bin keeps fruits cool, dry and aerated

The seed in moist fruits can be damaged by:

- High temperatures
- Fungi
- Insects
- Rodents
- Germination
- Suffocation







Fruits of dehiscent species shed their seed when they are mature. The fruits are therefore collected before maturity and stored under conditions where they can mature and where the seeds can be collected when they start dispersing.

The fruits have to be kept under conditions which favor the ripening process. As the fruits are living biological material with a high moisture content, they will respire, producing heat and moisture.

- ☑ The fruits should be kept as cool, dry and aerated as possible, i.e. kept under a roof and with the fruits in a thin layer allowing good aeration.
- ☑ Contamination from the outside should be prevented. The fruits should be kept clean and out of contact with the soil. Do no mash pulpy fruits.
- ☑ Do not keep moist fruits in piles on a concrete floor. The moisture will condensate near the cold concrete surface and this will promote fungal growth.

TRANSPORT OF FRUIT

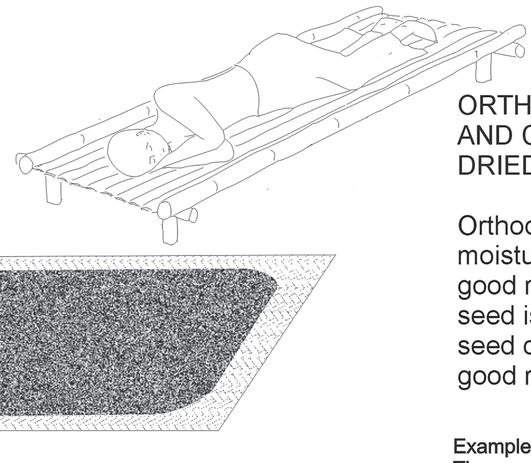
The same principles apply:

- ☑ Ensure ventilation
- ☑ Reduce transport time
- ☑ Avoid exposure to high temperatures (direct sunlight)
- ☑ Prepare to receive the fruits at the extraction site.

RECALCITRANT SEED

RECALCITRANT SEEDS DIE IF THEY ARE DRIED OUT !!

You may say that they are not real seed, that they are small germinating seedlings just beginning to sprout. They should be treated as such.



ORTHODOX SEED

ORTHODOX SEEDS BECOME DORMANT AND CAN BE STORED IF THEY ARE DRIED

Orthodox seeds can be dried down to low moisture content. They can be stored with good results if properly dried. If the dried seed is stored at low temperatures, the seed can be stored for a long time with good results.

Examples of recalcitrant seed
The dry seed in the glass jars are dead

Cempaka hutan
Elmerrillia ovalis

Damar
Agathis dammara

Eboni
Diospyros celebica

Examples of orthodox seed
The seeds in the glass jars are stored with low moisture content. The seeds are still alive.

Jati
Tectona grandis

Mangium
Acacia mangium

Tusam
Pinus merkusii

RECALCITRANT SEED

- Recalcitrant seeds die if they dry below a certain moisture content
- Recalcitrant seeds die if they are cooled below a certain temperature

The moisture content and temperature vary according to species. The possibilities of prolonging an already limited storage are therefore small. The period between collection of the fruits and sowing of the seeds should be as short as possible. Keep the fruits at a temperature between 20°C and 35°C (depending on species) and in a place where they can respire without drying out.

ORTHODOX SEED

- Seeds can be dried to low moisture content
- Seed can be stored at low temperatures if dried to low moisture content

Orthodox seeds can be dried to low (5-7%) moisture content and can, with low moisture content, be stored at low temperatures. Viability is prolonged by such moisture reduction and reduction in storage temperature (0-5°C) as the rate of metabolism and aging of seed is reduced. Under good storage conditions, seeds can be stored several years for most species, for some species up to several decades.

Planning Seed Collection

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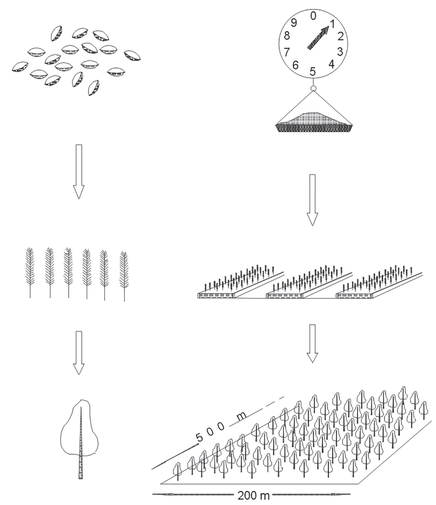
PLANNING THROUGH THE SEASON

Stage of development species	Operations	Co-ordination with other institutions
	Preliminary plan	Placement of advance orders Acquirement of planting data Acquirement of nursery data
Flowering Fruit development	Crop assessment Collection Plan	
Maturity	Harvest Processing Storage Testing Distribution	First confirmation of advance orders Confirmation of advance orders Publishing information on collected quantities (seed catalogue) Processing orders
Sowing		

EXAMPLE OF YIELD OF SEED, PINUS MERKUSII



1 KG SEED

containing
70,000 pure seeds
(with 70% germination and
1000 seed weight of 10 g)

Contains
50,000 viable seeds
Which are able to
produce

25,000 seedlings
(2 viable seeds per
seedling)
sufficient for

10 HA PLANTATION
(At 2x2 m spacing,
Assuming no
Replacement is needed)

CONVERSION OF PLANTING TARGETS TO SEED DEMAND

$$\frac{\text{planting target in ha} \bullet \text{seedlings/ha} \bullet \text{replacement (e.g. 1.2)}}{\text{germination\%} \bullet \text{nursery success\%}} = \text{number of seeds needed}$$

$$\frac{\text{number of seeds needed} \bullet \text{1000 seed weight}}{\text{purity\%} \bullet 1000} = \text{kg seeds needed}$$

Or

$$\frac{\text{number of seeds needed}}{\text{seeds/kg}} = \text{kg seeds needed}$$

FLOWERING, FRUITING AND AVERAGE TESTING RESULTS OF IMPORTANT FOREST TREE SPECIES IN BALI + NUSA TENGGARA

Local name	*Species Latin Name*	Age flowering	Flowering	Fruiting	1000 seed weight, g	Germ. Rate	Recalcitrant (R) Orthodox (O)
Cendana	*Santalum album*	4	Dec-Jan	Mar-Jun	160	80%	O
Gmelina	*Gmelina arborea*	4	Mar-Apr	May-Jul	400	75%	O
Jati	*Tectona grandis*	8--10	Oct-Nov	May-Sep	875	65%	O
Leda	*Eucalyptus deglupta*	2	whole year	Mar-Apr	0.4	1500/g	O
Mahoni	*Swietenia macrophylla*	15	Jul - Aug	Oct-Nov	450	75%	Intermediate
Mangium	*Acacia mangium*	4	Nov-Dec	May-Aug	10	90%	O
Panggal buaya	*Zanthoxylum rhetsa*	5--7	Dec	Feb-Mar	30--60	very low	O
Rambutan	*Nephelium lappaceum*	5--6	Apr-May	Aug-Sep			R
Saw o kecik	*Manilkara kauki*	6--7	Jan-Apr	Apr-Jul	600	80%	O
Sengon	*Paraserianthes falcataria*	3	May-Jun	Jul-Aug	21	90%	O
Tusam	*Pinus merkusii*	10--12	whole year	whole year	17--20	80%	O
Intaran	*Azadirachta indica*	4--5	Dec-Feb	Mar-May	220	55%	Intermediate
Bayur	*Pterospermum sp.*		Jun-Jul	Oct-Dec	16	70%	O
Padi	*Oriza sativa*	2--3	whole year	whole year			O

PLANNING THROUGH THE SEASONS

The seed producer preferably needs to know the demand for seedlings several flowering seasons in advance. The seed producer has to plan for the coming collection season, and the seedlings will normally require at least one season in the nursery. Some species do not fruit every year, and a buffer stock is therefore required.

To allow the seed producer to be able to plan for the next collection season, the seed user should preferably place orders in advance.

CONVERSION OF PLANTING AREA TO SEED DEMAND

The seed producer will have to try to calculate future demand if the seed consumers do not place advance orders

Some customers will place advance orders, but others will not. In many cases, the seed producer will have to estimate the future seed demand. One option is to look at the records of the consumption in previous years. Another option is to estimate seed demand from planting area targets of the species. The quantity of seed can be calculated from the above equations.

FLOWERING, FRUITING, AND AVERAGE TESTING RESULTS FOR COLLECTED SPECIES

To plan production, the seed producer needs to know the characteristics of each species. Some of the characteristics may vary between different seed sources of the same species.

AN EXAMPLE OF SEED PRODUCTION DATA

			calculation	year *1998*	year *1999*	year *2000*	year
		CROP ASSESSMENT					
1	*	Flowering yes/no		*y*	*(y)*		
2	*	No. of seed bearing trees		*300*	*400*		
3	*	No. of fruits/tree		*200*	*250*		
4	*	No. of seeds/fruit		*40*	*45*		
5	+	Last year's or estim.1000 seed weight, g	25	*50 (e)*	*55*	*56*	
6	-	Last year's or estim. conversion factor	26	*1 (e)*	*0.9*	*1.0*	
7	-	Estimated seed crop, kg	2•3•4•5•6 / 1000•1000	*120*	*223*		
		COLLECTION DATA					
8	*	No. of climbers		*8*	*10*		
9	*	Collection period		*1-8/9*	*1-10/9*		
10	*	No. of days		*8*	*10*		
11	-	No. of climber days	8•10 – absent	*64*	*95*		
12	*	No. of trees collected from		*280*	*350*		
13	*	Spacing of trees collected from	m or trees/ha	*100m*	*80m*		
14	-	Average no. of trees/climber day	12 / 11	*4.4*	*3.7*		
15	*	No. of sacks (100 litres) collected		*84*	*161*		
16	-	Average no. of sacks/climber day	15 / 11	*1.3*	*1.6*		
17	-	Average no. of sacks/tree	15 / 12	*0.3*	*0.5*		
18	*	Transport used: truck days/pickup days		*2t 16p*	*3t 20p*		
19		Collector		*Djoko*	*Djoko*		
		SEED DATA					
20	* +	Kg fruit collected		*4000*	*7400*		
21	+	Extracted seed, kg		*100*	*190*		
22	-	kg seed/kg fruit	21 / 20	*0.025*	*0.026*		
23	-	kg seed/sack	21 / 15	*1.19*	*1.19*		
24	-	kg seed/climber day	21 / 11	*1.56*	*2.0*		
25	+	1000 seed weight, g		*55*	*57*		
26	-	Conversion factor: actual/estimated crop	21•2 / 12•7	*0.89*	*0.97*		

*: field figure,
+: seed centre figure,
-: calculated figure

ASSESSMENT OF SEED CROP

Seed trees • fruits/tree • seeds/fruit = number of seeds in crop

$$\frac{\text{Number of seeds in crop} \bullet \text{1000 seed weight}}{1000 \bullet \text{1000 g/kg}} = \text{kg seeds in crop}$$

Or

$$\frac{\text{Number of seeds in crop}}{\text{Seeds/kg}} = \text{kg seeds in crop}$$

Fruits/tree
A conversion factor can be established between the amount of fruits that can be counted from one side of a tree of a species, and the total amount of fruits on the tree.

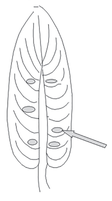
Example from *Picea abies*:

Cones/ tree	Factor	
1 -40	1.4	
41-70	1.8	E.g. 60 cones => 60 • 1.8 = 108 cones/tree.
>70	2.5	

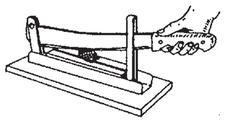
Seeds/fruit
A conversion factor can also be established between the number of seeds exposed in a lengthwise cut of a fruit of a species, and the total amount of seeds in the fruit.

Example from cones of *Pinus caribea*:

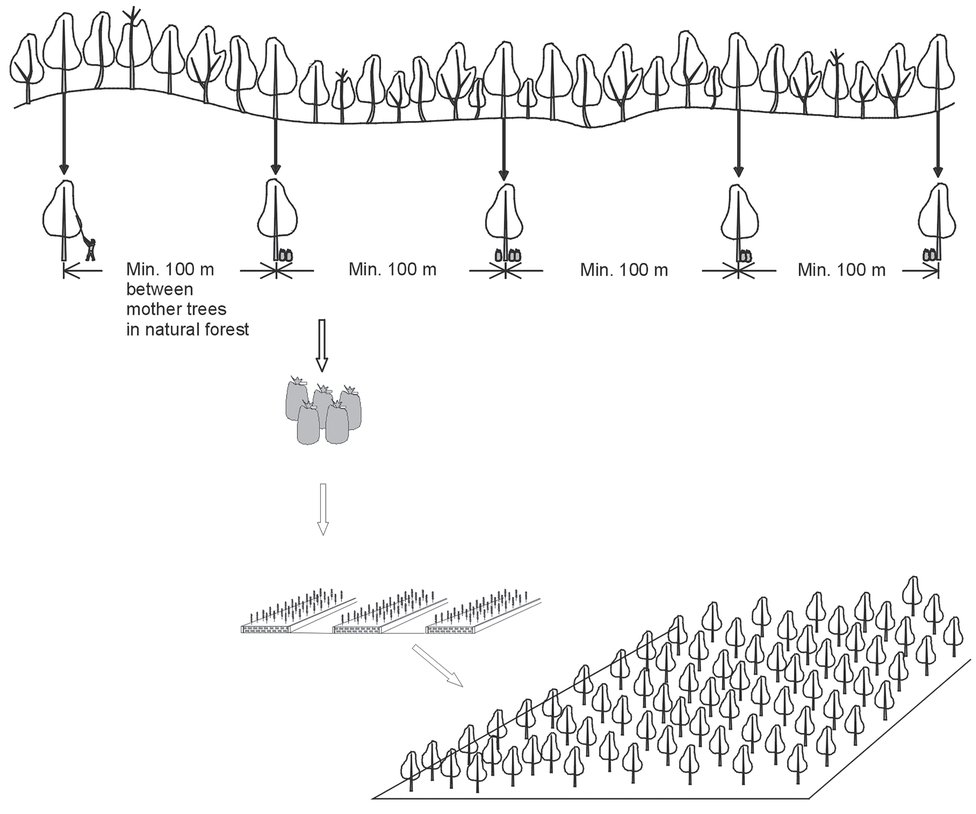
Each exposed seed represents 10 -18 seeds in the cone.



E.g. 6 cut seeds • 14 seeds/cut seed = 84 seeds in the cone.



USE THE RIGHT MOTHER TREES FOR COLLECTION



SEED PRODUCTION DATA IN SOURCE RECORD

A record should be kept for each seed source. The record should document used resources in seed collection and the production of seed. With the data in the record it is possible to plan and budget the seed collection of the coming season.

CROP AND MATURITY ASSESSMENT

Seed collections are expensive and time-consuming. It is therefore important to be certain that the seed crop is sufficiently large and mature before initiating seed collection. An assessment of the crop and the right timing of seed collection should be done in advance by an experienced person.

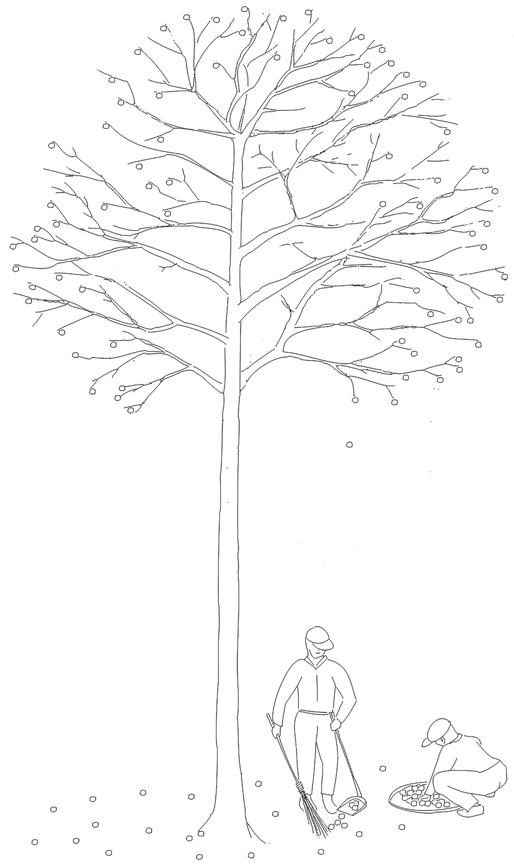
Maturity can normally be assessed by a change in color, consistency or water content of the fruit. Close to maturity, the consistency of the seed inside the seed coat will change from soft to more solid.

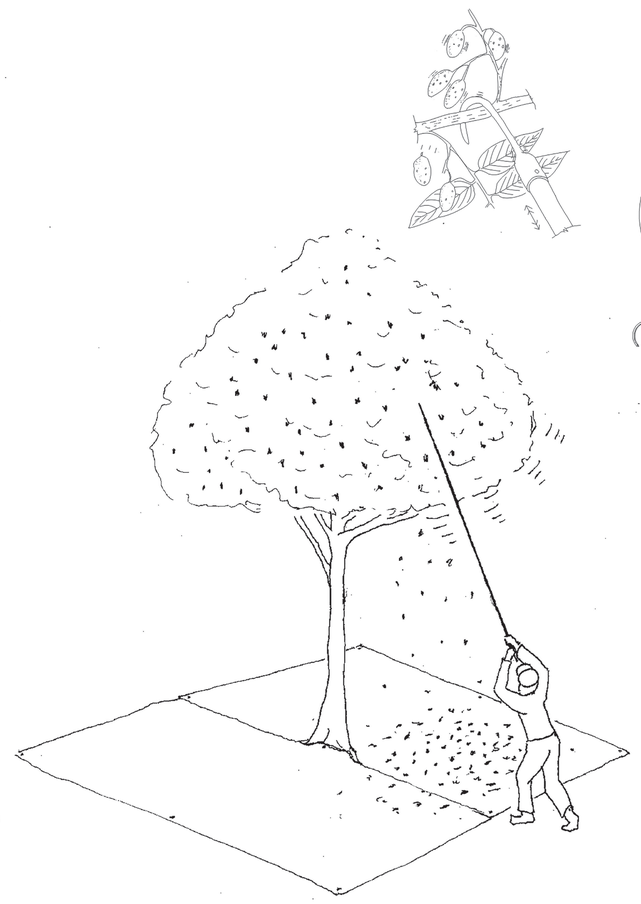
USE THE RIGHT MOTHER TREES FOR COLLECTION

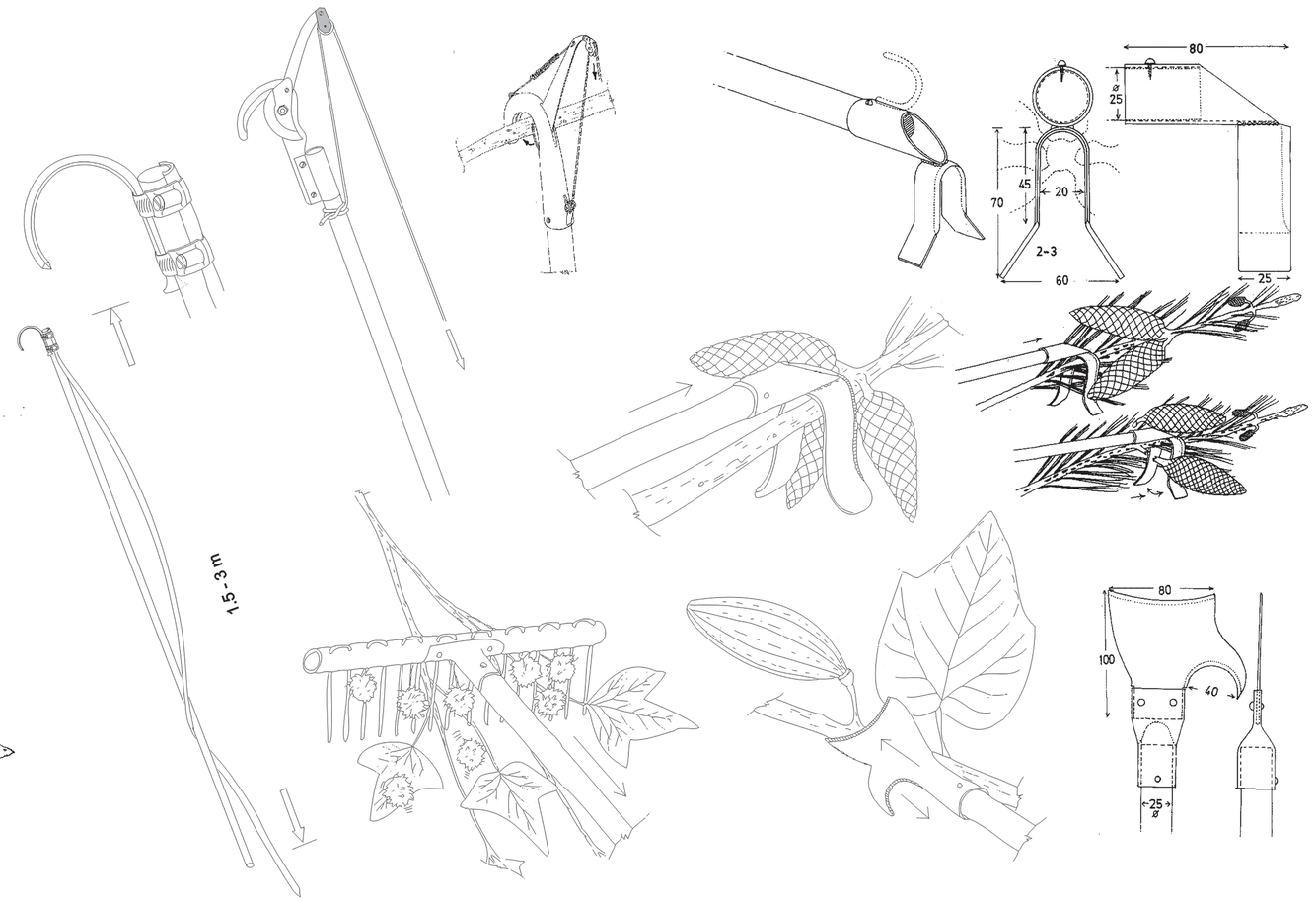
To get good quality for your plantings:

- Choose at least 30 healthy mother trees to collect from (to get sufficient genetic variation)
- Collect only from trees with superior quality (e.g. superior growth, straight bole, no forks, sweet fruits etc.)
- In natural forest, trees for collection should be at least 100 m apart to avoid collecting from related trees. In plantations, there is no restriction on distance.

Seed Collection







COLLECTION FROM THE FOREST FLOOR
Large indehiscent fruit can be collected from the forest floor when the mature fruits fall from the tree

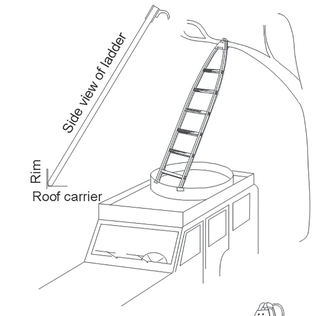
SHAKING
The seed quality can be improved by spreading sheets under the trees and shaking down the mature fruits with a hook stick. In this way, fruits will be less infested by soil-living fungi and insects. Furthermore, you will know the mother tree.

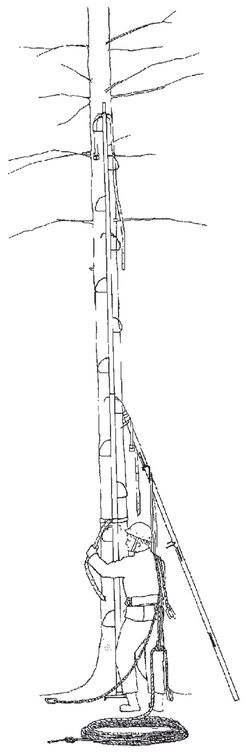
For small trees a hook-stick with a strap can be used: You pull down a branch with the hook-stick, you stand on the strap to hold down the branch, and then use both hands for picking the fruits.

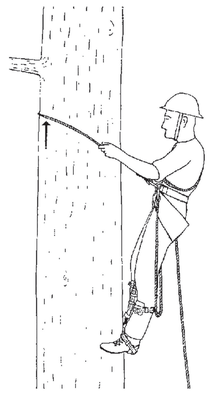
POLE MOUNTED TOOLS
Rakes can be used for pulling off big loosely attached fruits on trees with small leaves.

Pole cutters can be used for cutting branchlets with many small fruits, e.g. Eucalyptus

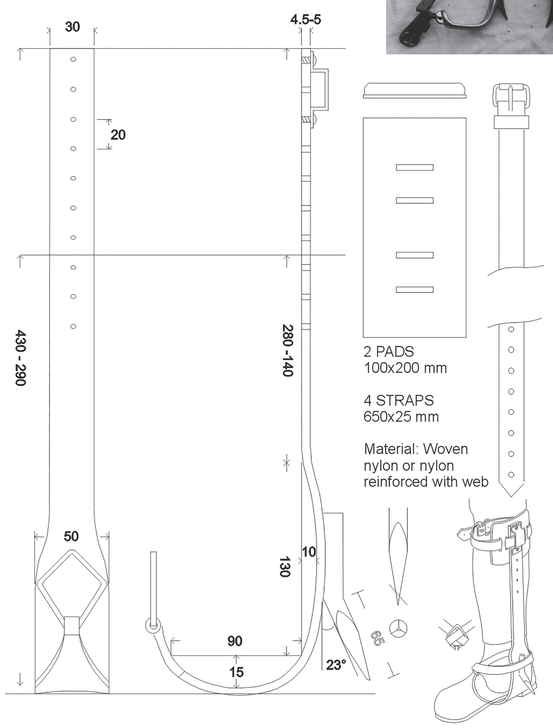
CUTTERS
Once you are inside the crown, cutters can be used. They are used to cut off the fruits by pushing out along the branch. Pulling in towards the centre of the crown will in many cases break the branch and spoil next years crop.

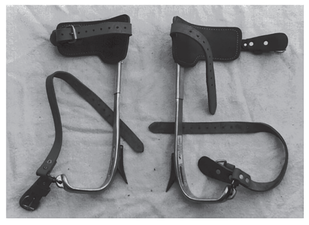


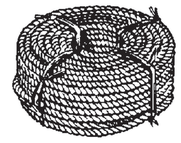


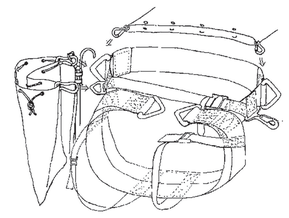


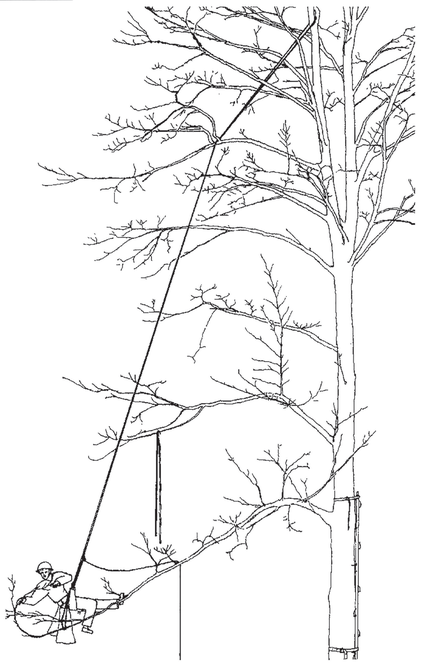
SPUR
Model DFSC
For local production
Shaft can be cut to fit length of shinbone











GETTING INTO THE CROWN
General purpose ladders can be used if the bole is not too long. A pointed ladder with a hook in the end can be used against a branch. A normal ladder can only be used against the bole.

SCALING LADDERS
For long boles and trees that bend easily (like e.g. young eucalypts) scaling ladders like the shown tube ladder can be used.

SPURS
Spurs can be used for trees with thick bark like e.g. Pines

SAFETY EQUIPMENT
Safety can be improved by using a climbing belt and a safety line in the crown.
The ability to move around in the crown and the production will also increase when both

Seed Processing: Cleaning

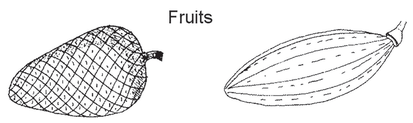
PAISPO

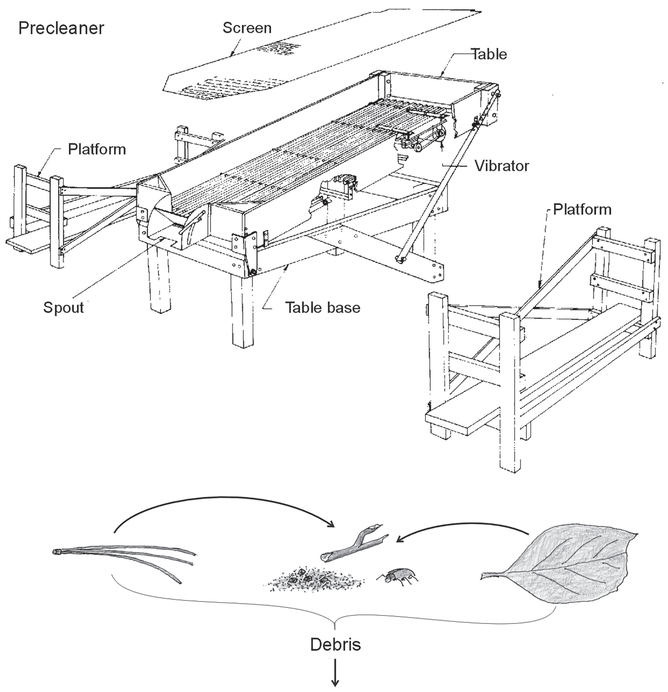
World Agroforestry Centre

Environment , Forest and Climate Change Commission
የአካባቢ ደንና አየር ንብረት ለውጥ ኮሚሽን

Norway's International Climate and Forest Initiative (NICFI)

PRECLEANING

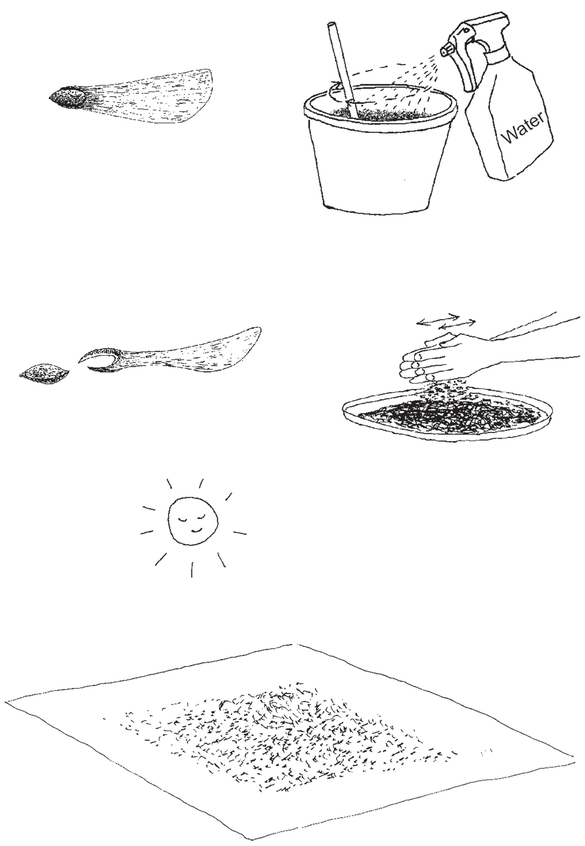




PRECLEANING
Precleaning of the fruits immediately after collection will facilitate the subsequent processing. It may also reduce the risk of the seed being infested by fungi or insects. Furthermore, it may be easier to remove some of the unwanted material at this stage compared to later on when the seed has been extracted.

Precleaning can be done on a rough screen. It may also sometimes be done by washing the fruits, or by manually sorting and removal of stalks and branchlets from the fruits.

DEWINGING OF PINE SEED



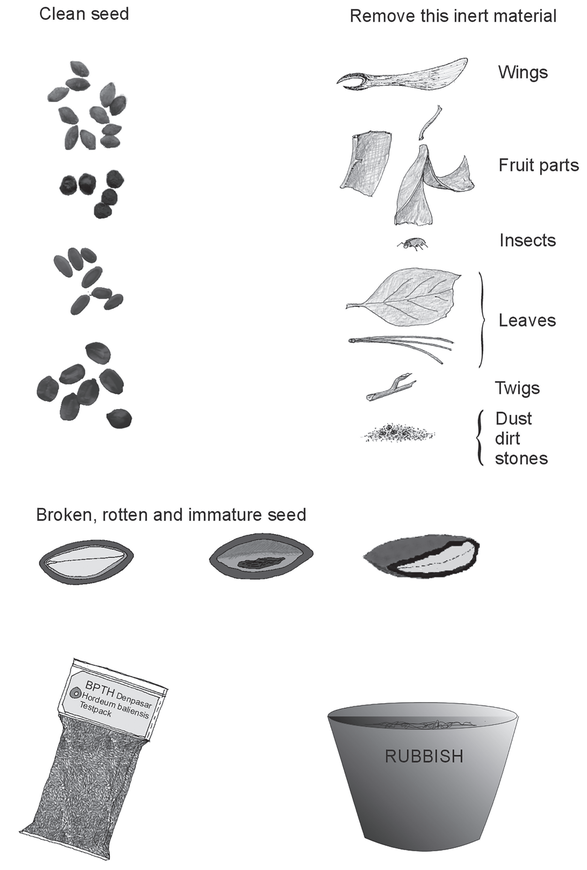
DEWINGING OF PINE SEED
On some winged seed, the wing is intended to fall off before germination. In nature, this usually happens when the dry seed is moistened for germination. The wing absorbs moisture and loosens the grip on the seed. This principle can be used for mechanical dewinging of e.g. pine seed.

On other types of winged seed, the wing is an integral part of the seed coat, and in nature the two parts remain together during germination. Sometimes parts of such wings can be removed without damaging the seed.

1) Stir the seeds for 10 -15 minutes.
2) Remove loosened wing parts by winnowing.
3) Apply 5-10 weight-percent water to dry pine seed with wings while gently stirring for 15 minutes.
4) Immediately dry the seed and wings again.
5) Separate the seed and wing parts (winnowing).

A concrete mixer can be used for dewinging of pine seed. In the shown example a hot air blower dries the seed and wing parts during tumbling after the mist spray of water has been applied.

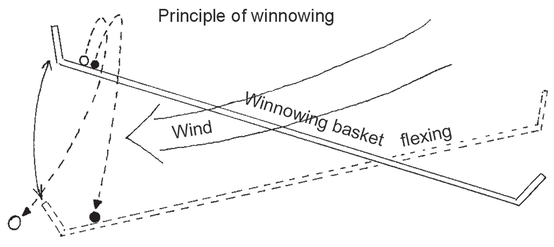
CLEANING



CLEANING
Cleaning separates fruit parts, leaves, twigs, debris, stones and dust from the seed. This increases the purity percentage. The separation process often also improves the germination percentage by removing empty seed.

The fraction of empty seed should be examined for full seed by cutting tests.

WINNOWING



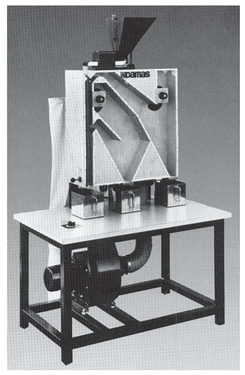
Using the wind for winnowing

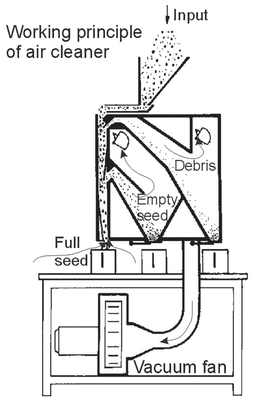
WINNOWING
Winnowing removes material that falls slower through the air than the heavy seed. This is material with a lower density (e.g. empty seed), or material with a larger surface compared to its weight (e.g. leaves).

Winnowing is traditionally done on a flat basket while flexing it to lift the material into the air and create an air stream along the basket. In some areas it is also done by gently pouring the material from one container to another in a gentle breeze.

A skilled person can sort the material just as accurately as most cleaning machines.

AIR CLEANER

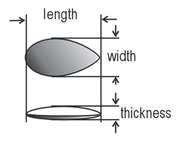




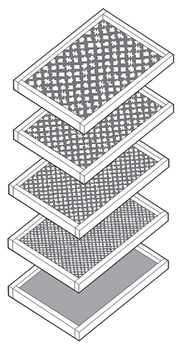
AIR CLEANER
Air cleaners or seed blowers are mechanical winnowers. In the one illustrated above the material falls down through an rising air stream. The air stream is adjusted so that the full seed falls down and empty seed and debris is sucked up.

SCREENS

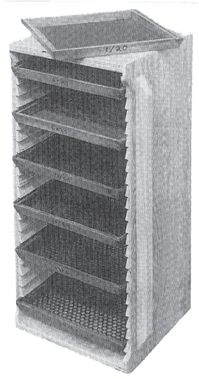
The size of a seed



Hand screens



Rack with hand screens

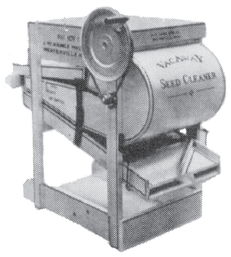


Hand screens for laboratory

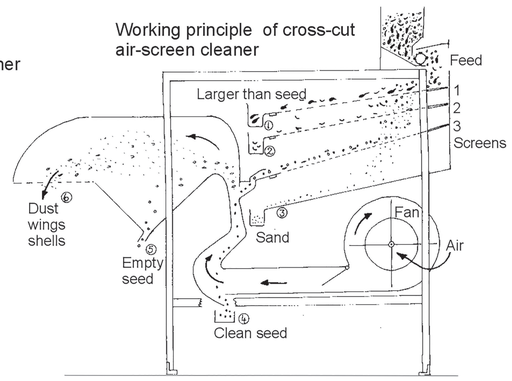
SCREENS
Screens sort the material according to size. A top screen may retain material that is larger than the seed. A bottom screen may let material that is smaller than the seed through. Screens can either be made of perforated metal plate or netting. A variety of hole sizes are necessary to be able to find two screens to clean the individual seed lot.

AIR-SCREEN CLEANERS

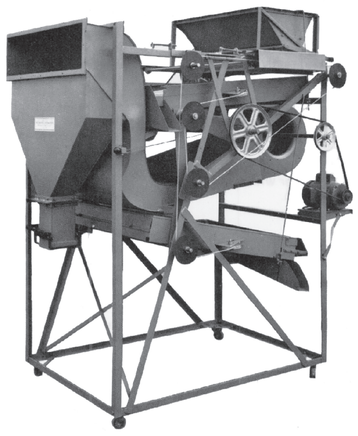
Hand driven air-screen cleaner



Working principle of cross-cut air-screen cleaner



Mechanical air-screen cleaner



AIR-SCREEN CLEANERS
In air-screen cleaners the cleaning process is automated.

An even stream of the material is fed onto one or two top screens where material larger than the seed is removed. The seed then passes over a bottom screen where material smaller than the seed is removed. In the end the seed passes through an air stream where light material and empty seed is removed.

Seed Processing: Drying

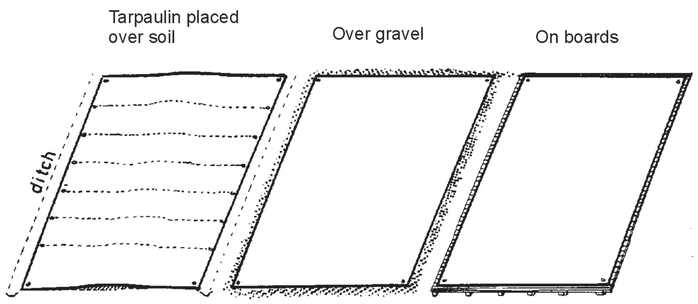
PRINCIPAL SEED PROCESSING OPERATIONS	CONES	DRY FRUIT	PULPY FRUIT	OTHER RECALCITRANT SEEDS
HARVEST	Picking	Picking/ collecting	Picking/ collecting	Picking/ collecting
TEMPORARY STORAGE	Precuring	(Precuring)	(Maturing)	
PREPARATION FOR EXTRACTION	(Precleaning)	(Precleaning)	(Precleaning)	(Precleaning)
	Serotinous: soaking draining			
PREPARING THE CONE/FRUIT	Drying in sun or kiln	(Drying)	Soaking	
		(Threshing)	Maceration	
EXTRACTION separation of seed and cone/fruit	Shaking or tumbling	Tumbling/ separation	Washing	(Separation)
			Recalcitrant	
separation of seed and external structures	(Dewinging whet or dry)	(Dry dewinging)	(Drying / depulping/ dehusking)	
		Orthodox		
CLEANING/GRADING screening/sieving/ sorting/blowing/ flotation/friction/etc.	Cleaning/ Upgrading	Cleaning/ Upgrading		Cleaning/ Upgrading
TESTING	Moisture content	Moisture content		Moisture content
FINAL ADJUSTMENT OF MOISTURE CONTENT	(Drying)	(Drying)		(Raising or lowering moisture content)
TESTING	Germination percentage, Purity percentage, 1000 seed-weight			
STORAGE AND DISTRIBUTION	Dry/cold	Dry/cold		Moist / temperate and **FAST**

SEED PROCESSING OPERATION

Fruits can for seed processing purposes be divided into 4 major groups: cones, fruits which are dried before extraction, pulpy fruits which are macerated, and finally other fruits which require special treatment or no extraction.

Seed processing is done to:

- Separate unwanted parts, e.g. leaves, dirt and bad seeds. This will reduce the risk of infection, and increase the viability and longevity.
- Remove fruit parts. This will increase longevity and germination, reduce storage space, and facilitate sowing.
- Dry the seeds. This will increase longevity.

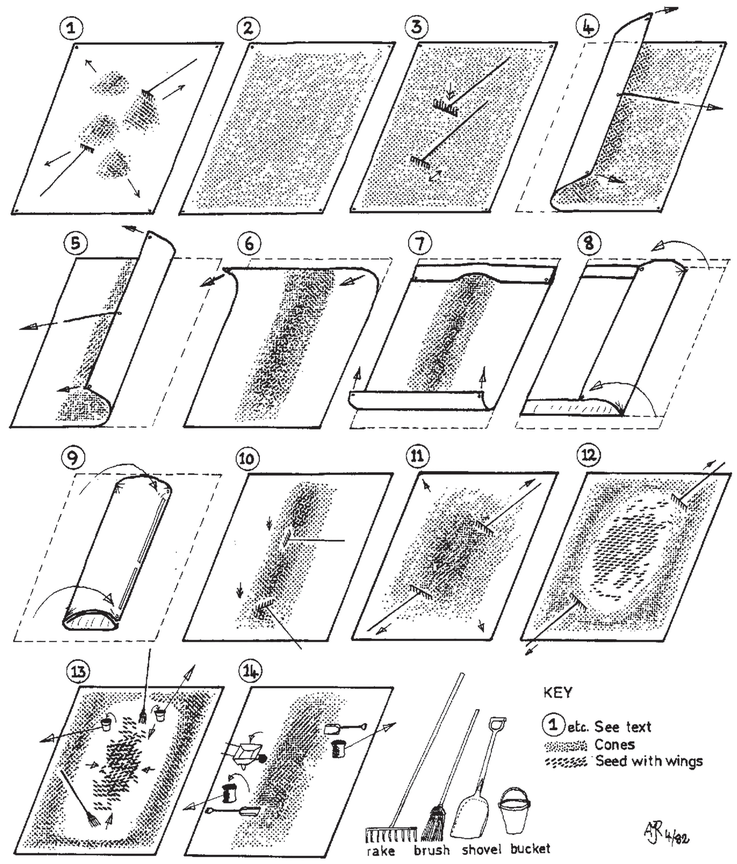


SUN DRYING

The fruits should be completely mature before they are put in the sun for drying. They should be spread out in as thin a layer as possible. The surface should be easy to keep clean, and it should be easy to remove the seeds.

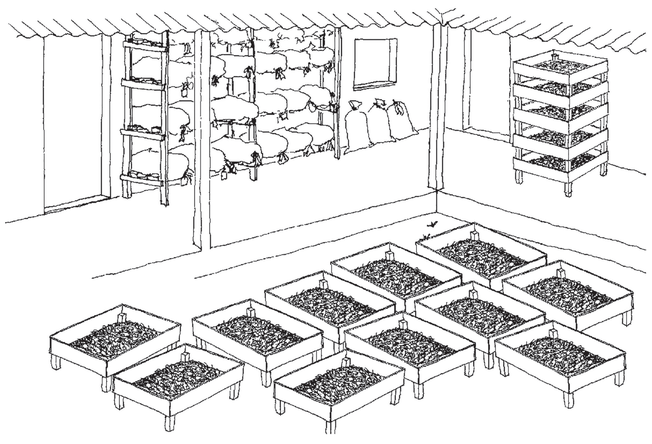
A canvas tarpaulin from 4x6 m to 5x10m in size is ideal. It is important that the tarpaulin does not absorb moisture from the ground. This is done by ensuring good drainage around and under the tarpaulin.

A concrete deck can also be used. The fruits should be spread in a thin layer to avoid condensation of moisture on the cold concrete surface.



SUN DRYING CONES ON A TARPAULIN

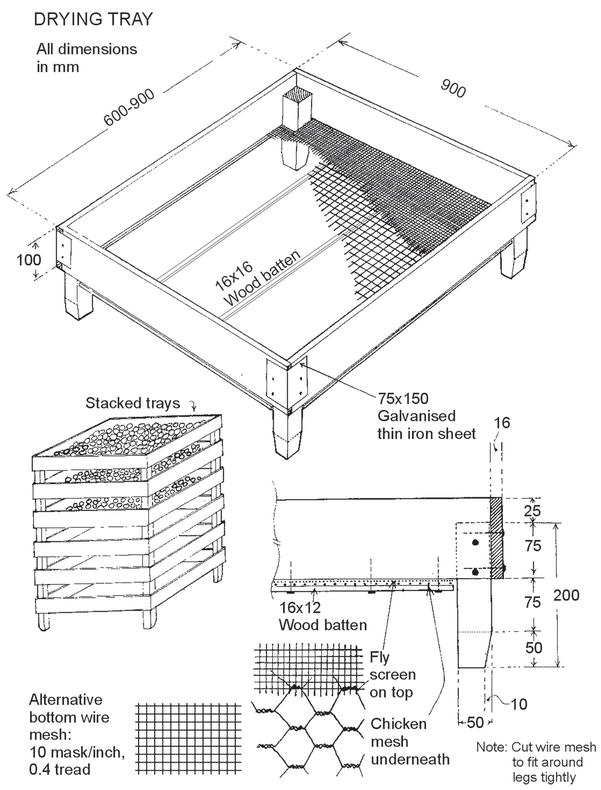
1) Spread the cones in a thin layer on the tarpaulin.
2) Leave cones to dry in the sun.
3) Agitate and turn over cones often, e.g. every hour.
4-9) 1½ hours before sunset, or before rain starts, gather the cones as shown on the pictures. The last fold (9) should be on the side facing the wind.
10-12) Remove seeds that have been extracted every day. This is best done when opening the pile. Gently rake the cones out on the tarpaulin, lifting more than dragging them. After removing the extracted seeds, spread the cones again as in (1).



WIRE NETTED TRAYS

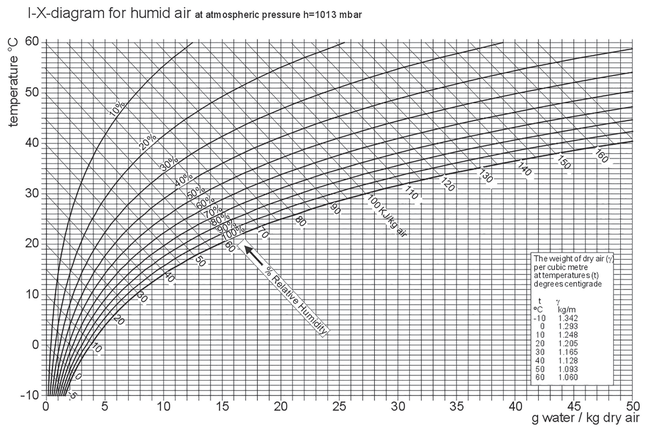
The trays can be used stacked for after-ripening. They can also be used for slow drying in the shade, or the trays can be spread out for sun drying.

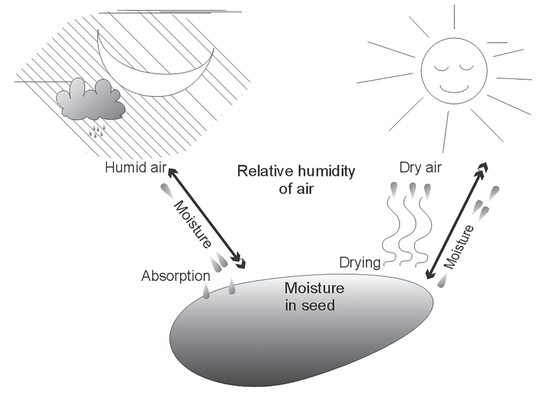
Before it starts raining, the trays can be easily moved under roof.

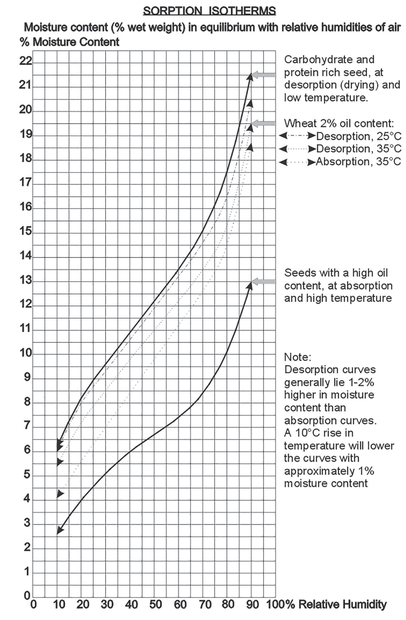


DRYING TRAY

The trays should be made of well dried wood.
Normally a size of 60x90 cm can be carried by one person.
Make sure the netting is corrosion resistant.







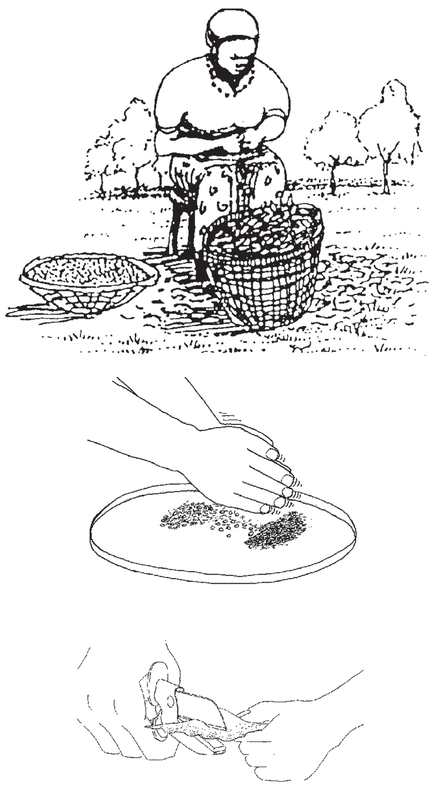
BALANCE BETWEEN MOISTURE CONTENT OF SEED AND RELATIVE HUMIDITY OF AIR

Seeds will dry, or absorb moisture, until the moisture content is in balance with the relative humidity of the air surrounding the seed. Seed dried to 8% moisture content will absorb moisture at night if left in the open. The minimum moisture content that you can reach during sun drying depends on the climate, how well you avoid shade during the day, and how well you cover the seed at night.

Seeds for storage should be dried down to 8% moisture content if possible. A general rule is that you double the period the seeds can be stored when you lower the moisture content 2.5%.

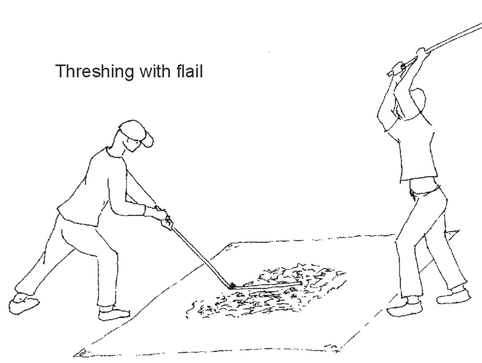
Seed Processing: Extraction

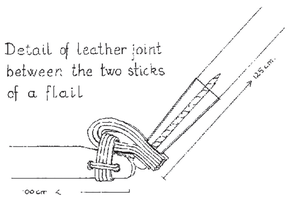
Manual extraction



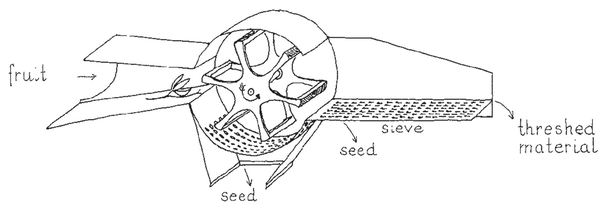
Threshing

Threshing with flail



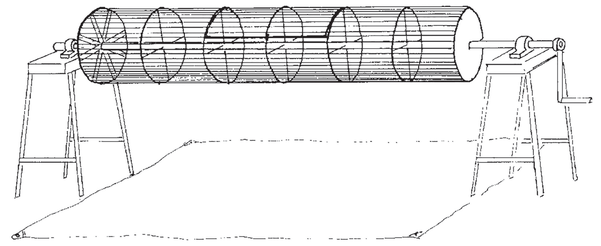


Working principle of mechanical thresher

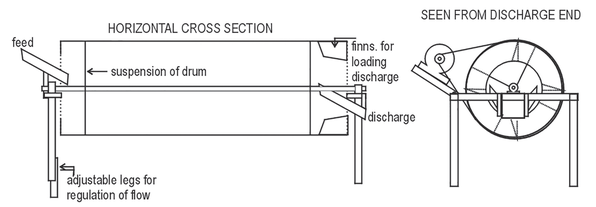


Mechanical thresher

Tumbling of cones



Cone tumbler, batch type



Cone tumbler, continuous operation

MANUAL EXTRACTION
Small seed lots are often extracted manually to avoid cleaning of equipment after each process.

A number of species have seeds which cannot be easily extracted. These are often indehiscent fruits which do not open when dried.

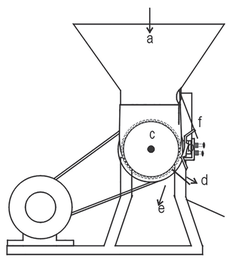
Fruits and seeds that are easily damaged are also extracted manually.

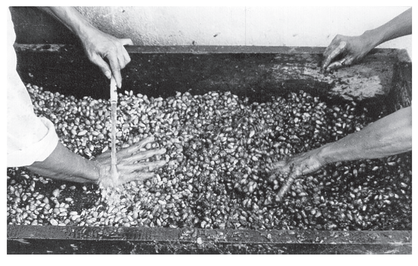
THRESHING
Dried fruits are often threshed to extract all the seed. This can e.g. be done by beating or rubbing the fruits in a sack (with a stick, against the wall or floor), or by beating the fruits on a canvas tarpaulin with a flail.

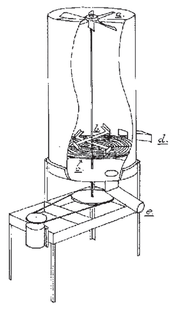
Mechanical threshers can be used for larger seed lots and often include a cleaning operation, partly a separating fruit parts and the seed.

TUMBLING
When the cones have been dried and are fully open, they are usually tumbled to release the seed. Cone tumblers are containers made of strong wire mesh mounted on a horizontal axle. When the tumbler is rotated the cones inside tumble around and release the seeds, which fall through the mesh.

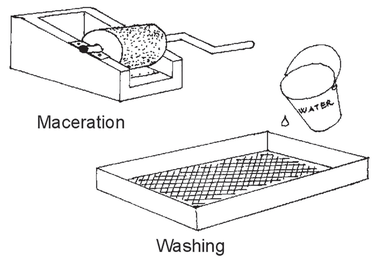
The tumbler can also be used for other species with dehiscent fruits, it the tumbler is lined with a finer mesh.

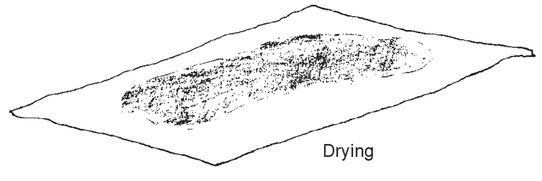




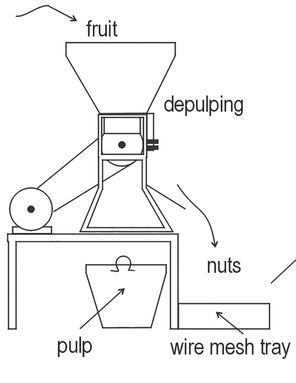


DEPULPING OF SMALL SEED LOTS

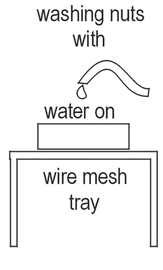




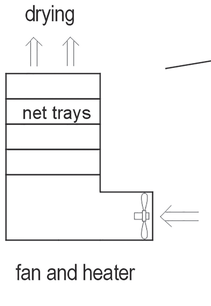
Soaking in plastic barrels



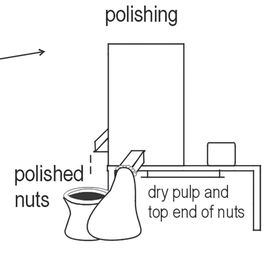
Maceration in coffee depulper



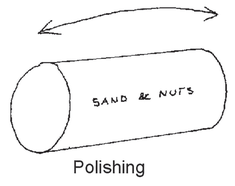
Washing in net tray

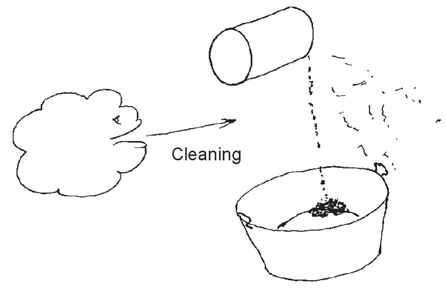


Drying with forced air in netting trays



Polishing in coffee dehusker





DEPULPING
The seeds of pulpy fruits are usually extracted in a wet process as soon as they are ripe. The process involves soaking to soften the pulp, maceration (a more or less gentle abrasion of the pulp), washing where the pulp is removed, drying, and polishing where the last fruit parts are removed.

Soaking:
The fruits are soaked in clean water that is often exchanged to avoid fermentation and oxygen depletion.

Maceration:
A coffee depulper can be used for maceration of many species. Some species can be macerated in a concrete mixer with water and sand or wooden blocks. Small amounts of small seeded fleshy fruits can be macerated in a bowl with water using a whisk.

Washing:
After maceration the seeds and pulp are separated on a screen or by flotation in water.

Polishing:
After drying, any remaining pulp or husk should be removed. This is often done by rubbing the seeds with sand or gravel, or mechanically, e.g. in the coffee dehusker shown.

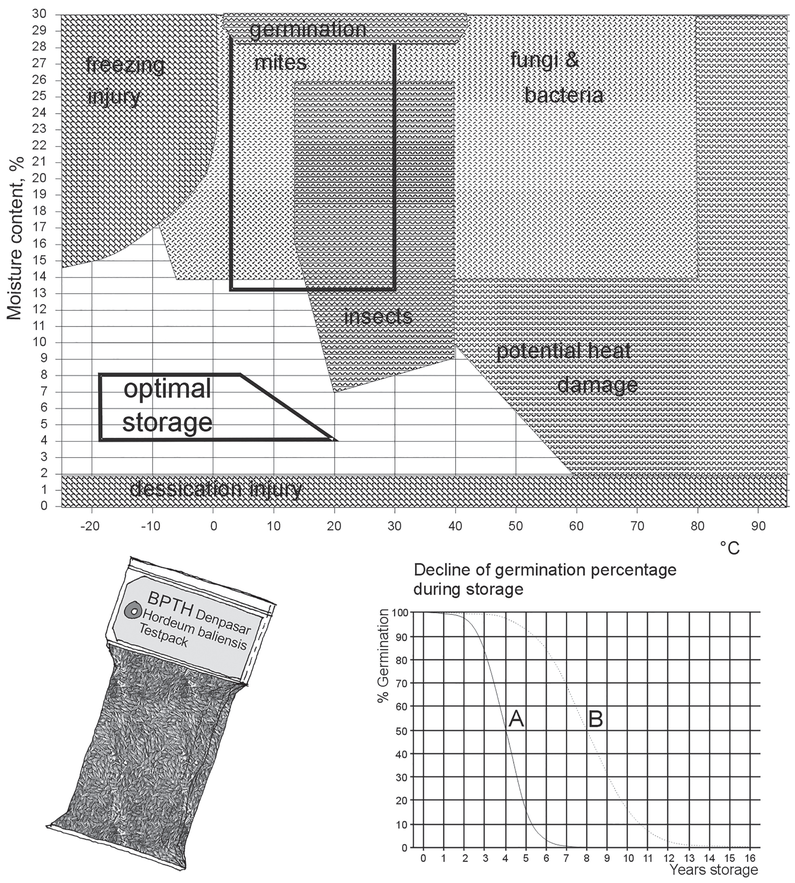
DEPULPING SMALL SEED LOTS
Small lots can be extracted by hand by the following methods:

- kneading the fruits under water by hand,
- kneading the fruits and fine gravel in a canvas bag under water,
- rubbing the fruits against a screen while applying water, treading in tubs.

Seed Storage and Maintaining Identity

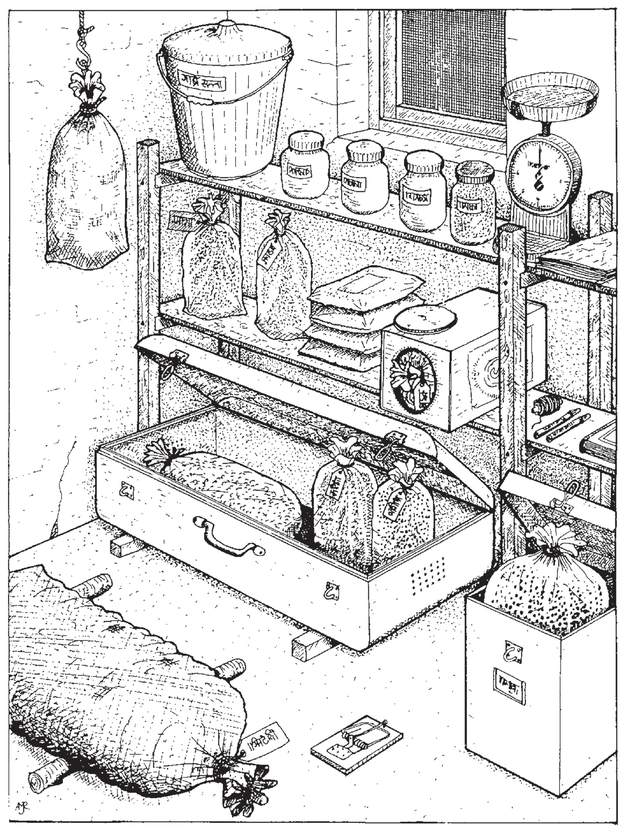
PAISPO · World Agroforestry Centre · Environment, Forest and Climate Change Commission · Norway's International Climate and Forest Initiative (NICFI)

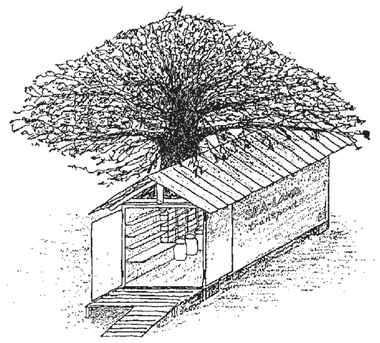
SEED SURVIVAL DURING STORAGE



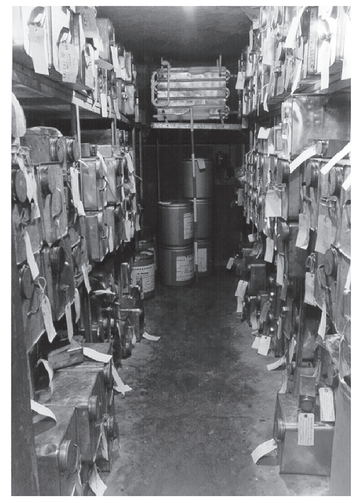
Decline of germination percentage during storage

A SEED STORE AND ITS CONTAINERS





Container converted to a seed store



Inside a cold store

Examples of good containers for seed storage

SEED SURVIVAL DURING STORAGE

Many factors in the storage environment influence the success of storage. Many factors in the storage environment threaten the seed. In practice, the aim is to store orthodox seed with a moisture content below 8% at temperatures below 20°C in airtight containers. **Seed with high moisture content will suffocate and die if placed in closed containers.**

Stored seed will eventually die. In the example above, one seed lot is divided into two and stored under different conditions (A and B). The example shows that the seed under conditions B can be stored twice as long as seed under conditions A.

As a general rule of thumb, you can store seed twice as long every time you lower the moisture content 2.5 % or the storage temperature 5°C.

SEED STORE AND CONTAINERS

- Seeds evaporate or absorb moisture until the moisture content is in balance with the air surrounding the seeds. Seeds with 8% moisture content are in balance with a relative humidity of 20-30%. Dry seeds in the store will therefore have to be packed in containers impermeable to moisture from the air in the store.
- The store and containers should also prevent rodents, birds, insects and other pests from getting to the seeds.
- The average temperature in the store should be as low as possible.

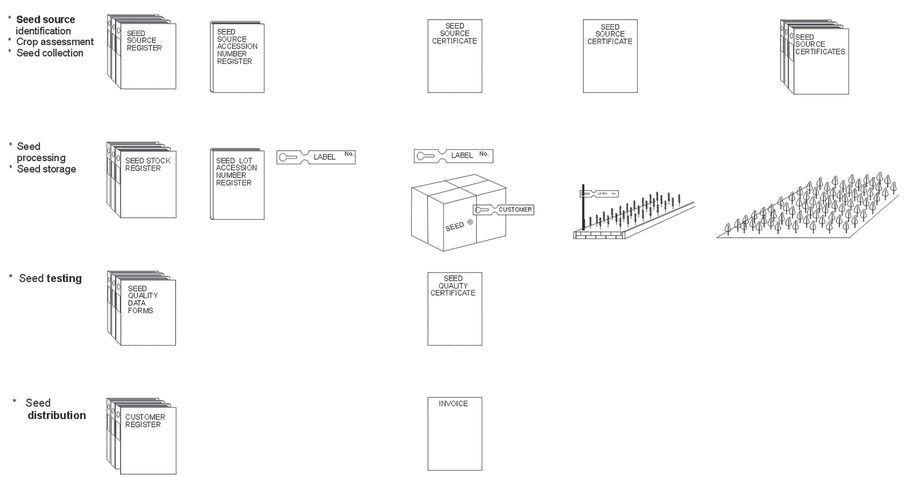
The store:
In practice the store is often constructed so rodents and birds cannot enter.

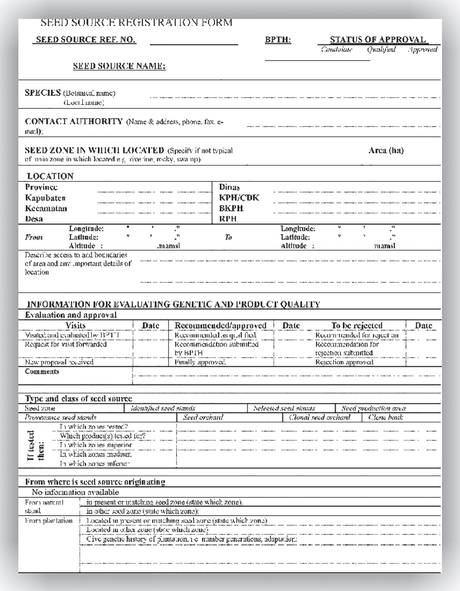
The temperature of the store is kept low by ensuring good ventilation between the ceiling and roof and that the sun cannot reach any of the walls. The compressor unit of an optional air conditioner or cooling unit should also be placed where the sun cannot reach.

The containers:
The container should be corrosion proof and have a large lid. The gasket of the container lid should be airtight if the seed is not packed in laminated plastic bags.

Small seed lots can be packed in plastic bags in a large container.

DOCUMENTATION OF THE IDENTITY AND QUALITY OF THE SEED





SEED SOURCE REGISTRATION FORM

SEED SOURCE REF. NO. _____ BPTH: STATUS OF APPROVAL: Conditional Qualified Approved

SEED SOURCE NAME:

SPECIES (Botanical name) (Local name):

CONTACT AUTHORITY (Name & address, phone, fax, e-mail):

SEED ZONE IN WHICH LOCATED (Specify if not typical of main zone in which located e.g. river line, valley, area top) Area (ha)

LOCATION

Province: Kapubaten Kecamatan Desa

Dinas KPH/CDK BKPH RPH

From — Longitude: ° ' " Latitude: ° ' " Altitude : masnal

To — Longitude: ° ' " Latitude: ° ' " Altitude : masnal

Describe access to and boundaries of area and any important details of location

INFORMATION FOR EVALUATING GENETIC AND PRODUCT QUALITY

Evaluation and approval

Visits	Date	Recommended/approved	Date	To be rejected	Date
Visit(s) carried out by BPTH		Recommended as qual. (list)		Reason(s) for rejection	
Request for visit forwarded		Recommendation submitted by BPTH		Recommendation for rejection submitted	
Now proposed/approved		Finally approved:		Rejection approved	
Comments					

Type and class of seed source

Seed zone	Identified seed stands	Selected seed stands	Need production area
Provenance seed stands	Seed orchard	Clonal seed orchard	Clone bank

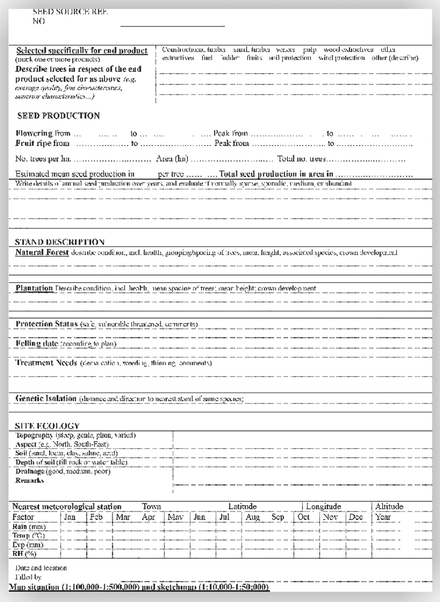
If tested then:
- To which no are 'worse'?
- Which product(s) tested?
- To which no are superior
- To which zones mailed:
- To which zones inferior:

From where is seed source originating

No information available

From natural stand:
- In present or suitable seed zone (state which zone):
- In other seed zone (state which zone):

From plantation:
- Located in present or matching seed zone (state which zone):
- Located in other seed zone (state which zone):
- Give genetic history of plantation, i.e. number generations, origin, etc.:



SEED SOURCE REF. NO

Selected specifically for end product (mark most or more provided): Construction, timber, wood, timber, veneer, pulp, wood-substance, other, extractives, fuel, fodder, fruits, soil protection, wind protection, other (describe)

Describe trees in respect of the end product selected for as above (e.g. average growth, form characteristics, universal characteristics...)

SEED PRODUCTION

Flowering from ... to ... Peak from ... to ...
Fruit ripe from ... to ... Peak from ... to ...
No. trees per ha. ... Area (ha) ... Total no. trees ...
Estimated mean seed production in per tree ..... Total seed production in area in .....
Where there is annual seed production over years, and evaluate from tally, course, consider, medium, or abundant

STAND DESCRIPTION

Natural Forest (describe conditions, soil, health, geographic spacing of trees, mean height, associated species, crown development)

Plantation (Describe condition, soil, health, mean species of trees, mean height, crown development)

Protection Status (as E, vulnerable threatened, conservation)

Felling date (according to plan)

Treatment Needs (form as cutting, weeding, thinning, pruning)

Genetic Isolation (distance and direction to nearest stand of same species)

SITE ECOLOGY

Topography (steep, gentle, plain, varied)
Aspect (e.g., North, South-East)
Soil (sand, loam, clay, saline, acid)
Depth of soil (till rock or water table)
Drainage (good, moderate, poor)
Remarks

Nearest meteorological station — Town — Latitude — Longitude — Altitude

Factor	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain (mm)													
Temp. (°C)													
Evp (mm)													
RH (%)													

Date and location
Edited by
Map situation (1:100,000–1:500,000) and sketchmaps (1:10,000–1:50,000)

EXAMPLES OF PREPRINTED MANILLA LABELS

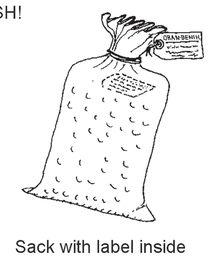
DANIDA FOREST SEED CENTRE
KROGERUPVEJ 21
DK-3050 HUMLEBÆK - DENMARK

1644/86
Acacia nilotica ssp. nilotica
Wad. Nimir, Eddum, W.Nile
Sudan
14°30'N, 32°10'E
400m a.s.l., 200-400mm

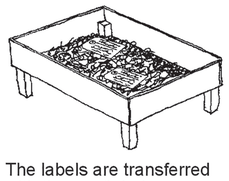
PREPRINTED HEAD WITH NAME AND ADDRESS OF THE SEED CENTRE OR SEED PRODUCER

Written or printed with label form:
Identity of contents of container:
Species, Seed source, Collection
Possible additional information:
Collector, weight, container number of, date, receiver/owner, etc.

SEED WITHOUT LABELS IS RUBBISH!



Sack with label inside and outside

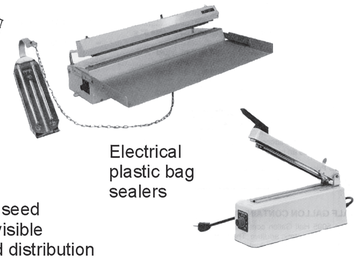


The labels are transferred with the seed during processing

BPTH Denpasar
Seed test envelope
Species:_____
Seed source:_____
Owner:_____

When samples are taken they should also be labeled

The identity of the seed should be clearly visible during storage and distribution



Electrical plastic bag sealers

Possible preprinting on the reverse of label

Seed lot provisional number_____:
Species:_____
Seed source (ref.):_____
Sack number_____of total_____bags
Quantity in sack_____kg/g_____litres
Collected by:_____
Collected date:_____

DOCUMENTATION OF THE IDENTITY AND QUALITY OF THE SEED

The documentation system to secure the identity and the quality of the seed should be strictly followed throughout all processes: description of seed source, collection, fruit handling, processing, storage, distribution, nursery and plantation establishment. This to ensure that relevant data is available for planning of future operations and breeding activities.

The seed producing units should maintain registers of seed sources, seed collections, seed testing results and seed lots in stock.

SEED WITHOUT LABELS IS RUBBISH

Seed should be properly labeled through all the processes from collection to storage and distribution. You cannot guarantee the identity of seed in a container without a label.

Sacks should be labeled with one label outside and one label inside, in case the one outside should fall off. Seed in open containers should be labeled so that everybody knows what is in the container. When seeds are sealed in a plastic bag, the label can be sealed in a separate compartment of the bag.

INFORMATION ON LABELS

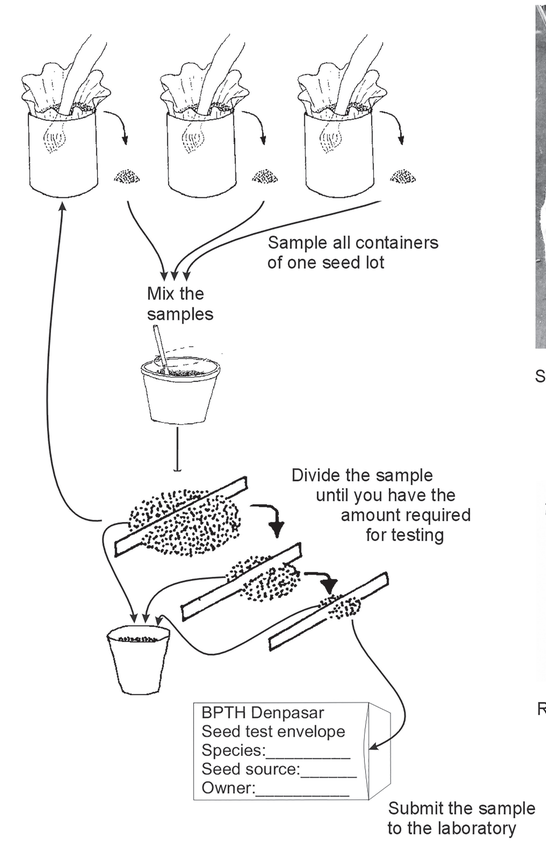
The labels should be strong, reasonably water proof and easy to fix to the container. They should be pre-printed with the name and address of the seed producer.
The labels should as a minimum hold information on species, seed source, and seed collection. The labels are made during collection and follow the seed lot through processing. They should be renewed when necessary.

Finn Stubsgaard, DFSC; 2000

Seed Testing

PAISPO · World Agroforestry Centre · Environment, Forest and Climate Change Commission (ኮሚሽን) · Norway's International Climate and Forest Initiative (NICFI)

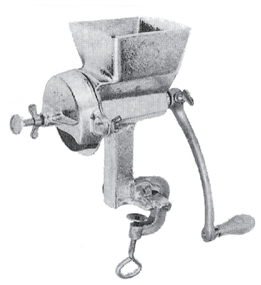
TAKE A REPRESENTATIVE SAMPLE OF THE SEED LOT



Stick type sampling probe

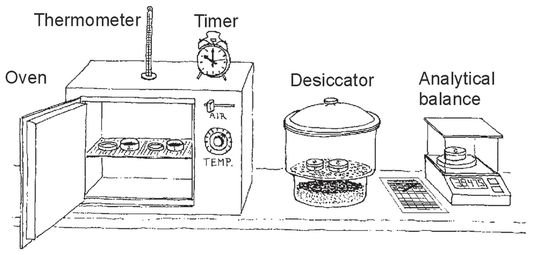
Riffle type seed divider

TESTING THE MOISTURE CONTENT OF THE SEED LOT



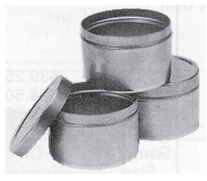
A coffee grinder can be used for grinding seeds for the moisture test.

All the moisture inside a seed with a thick seed coat will not evaporate during the oven drying.



The weighed containers are placed open in the oven at 103°C ±2°C for 17 ±1 hours.
When opening the oven the container lids are put on immediately, and the containers are placed in the desiccator for ½ hour.
The containers are then weighed again and the moisture content calculated.

3 sieves of 0.5, 1.0 and 2.0 mm plus a bottom blank are used to remove seeds not sufficiently grounded.

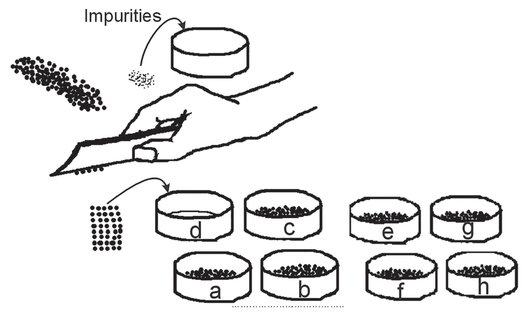


Containers for oven drying should be of non corrosive metal, 4-8 cm diameter, and bottoms and lids should be numbered in pairs.

Quick moisture metres based on a measurement of the electrical conductivity of the seed can be used for a quick measurement of the moisture content if they are calibrated against the oven method.

THE 1000 SEED WEIGHT AND PURITY

Analytical balance with an accuracy of 0.001g (1mg) for the 1000 seed weight and moisture content.



The laboratory counts 8 x100 seeds.

The eight containers with 100 seeds and the container with the impurities belonging to the 800 seeds are weighed on an analytical balance and the 1000 seed weight and the purity percentage are calculated.

If the difference between the weight of the eight replicates is too big, then the sampling and mixing has not been accurate enough.

TAKE A REPRESENTATIVE SAMPLE OF THE SEED LOT

The sample should be representative of the seed lot. The seed lot should be well mixed and samples should be taken from different positions in the lot. If the seed lot is in more than one container, samples should be taken from all containers.

The samples are then mixed and divided in halves until the amount required for testing remains. This is usually around 2000 seeds + 4 -10 grams for the moisture test.

TESTING THE MOISTURE CONTENT OF THE SEED LOT

It is important to know the exact moisture content of the seeds as it determines how long you can store the seeds for.

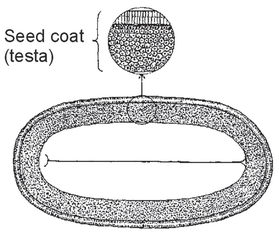
The moisture content is measured as a percentage of the weight of the seeds.
The moisture content is calculated as the weight loss of two sample replicates during drying at 103°C ±2°C for 17 ±1 hours, divided by the original weight of the samples (percent moisture content fresh weight basis).

THE 1000 SEED WEIGHT AND PURITY

The laboratory counts 8 x100 seeds and weighs the 8 x100 seeds and impurities belonging to them to calculate the 1000 seed weight and the purity percentage.

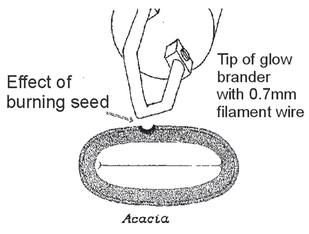
The 8 x 100 seeds are then germinated to calculate a germination percentage.

PRETREATMENT

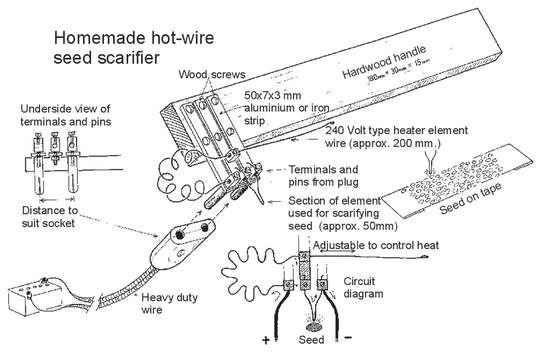


Cross cut section of Acacia seed showing the outer impermeable palisade layer of the seed coat

Burning pretreatment to overcome seed coat dormancy



In the laboratory burning is often used to pretreat hard coated seeds



Cold water pretreatment for seeds without seed coat dormancy

Soak the seeds in plenty of water for 24 hours, or until the seeds are imbibed.

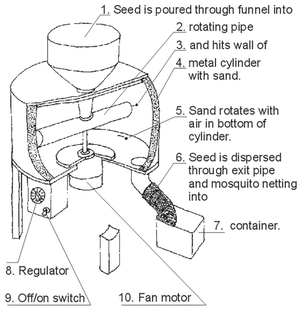
Hot water pretreatment for seeds with seed coat dormancy

Place the seeds in water that has just been boiling.

The time the seeds are left in the hot water vary among species, from 10 minutes to 24 hours.

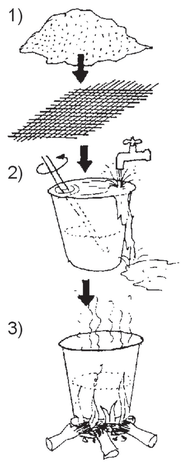
During the treatment remove any seed that has imbibed.

Mechanical scarification of hard coated seed



Cracks in the outer impermeable layer of the seed coat can also be made mechanically by impact against a hard heavy surface as in the Seed Gun shown above.

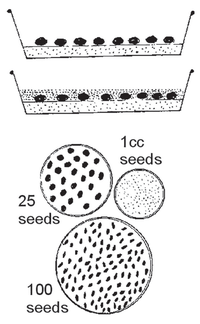
GERMINATION



Preparation of sand for germination

1) Use sand without soil from a river bed. Sift to a size smaller than the seed.
2) Wash the sand.
3) Sterilize the sand by boiling with a little excess water.
4) Dry the sand again.

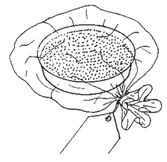
Sowing the seeds



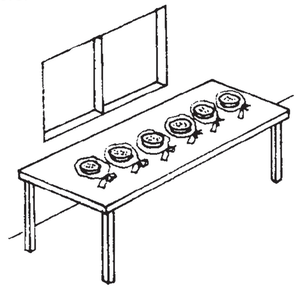
Sow the four replicates in separate marked sterilized containers. If the seeds are large and the containers small, more than 4 containers can be used. The space between the seeds should be larger than the size of the seeds.

Place 20 mm packed sand in the bottom of a container. Add a volume of water equal to between 1/3 and ½ of the sand. Place the seeds on the sand. Gently sift a layer of sand on top and press the surface.

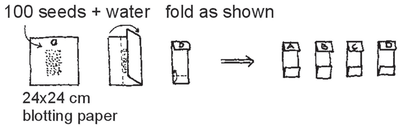
Place the containers in a thin transparent plastic bag to reduce evaporation.

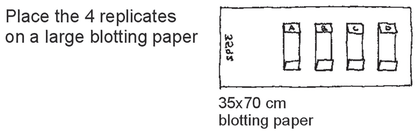


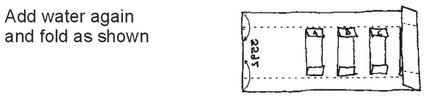
Label the bag and container and place the containers in a light environment where the sun cannot shine on the containers.

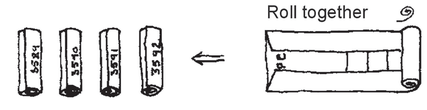


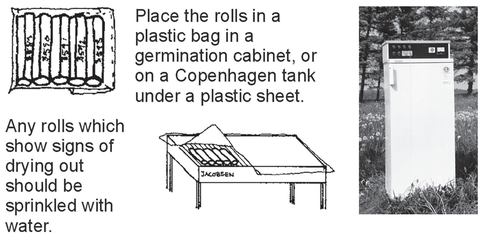
Germination in rolled paper packs











PRETREATMENT

Some seeds are dormant and require a pretreatment before sowing to be able to germinate. A common type of dormancy is a hard seed coat preventing the seeds to absorb water. This kind of dormancy can be broken by making cracks or holes in the seed coat which is done by immersing the seeds in hot water, or by other methods as shown above.

Another type of dormancy is the presence of chemical inhibitors in the seed coat that prevent germination. Here the dormancy can sometimes be broken by leaching out the chemical by placing the seeds in running water.

GERMINATION

Testing the germination tells you what percentage of the seeds that are alive and able to germinate under optimal conditions.

The seed you have in store will be slowly losing their germination percentage. You should therefore monitor the germination percentage at regular intervals.

The number of viable seeds per kg can be calculated with the results from the test:

$$\frac{100 \times \%\text{purity} \times \%\text{germination}}{1000 \text{ seed weight:}} = \text{number of viable seeds /kg}$$

E.g. a seed lot with 88.2% purity, 85.0% germination and a 1000 seed weight of 25.0 g:

$$\frac{100 \times 88.2 \times 85.0}{25.0} = 30.000 \text{ viable seeds / kg}$$