

NR Study-Note F120c TREE SEED PROCESSING AND TREATMENT



Based on the text and graphics in: TREE SEED HANDLING: A manual for field staff in Nepal. Field Document No. 11 HMG/EEC/ODA National Tree Seed Project HMG/UNDP/FAO Community Forestry Development Project by A.M.J.Robbins and N.B.Shrestha (1986)

Revised July 2004

PREFACE to the original document

Obtaining adequate supplies of high quality, healthy seeds for the Community Forestry Project is a recurring problem. This is made more difficult as we use astmany as 80 different species to suit the ecological requirements of the various sites, as well as to meet the preferences of the farmers who need tree species for fodder, fuel or multipurposes.

The original nursery manual published as a Field Document (No. 2b) devoted only one chapter to seed collection and the subject was. treated only in a very general manner. The present document has treated the subject of "Seeds" much more thoroughly with detailed guidelines for seed collection, seed processing and treatment, rules for seed storage and finally testing the seed that has been collected. It is primarily meant for those involved in reafforestation and afforestation. The document is well illustrated with sketches and written in both Nepali and .English making it easier to comprehend. It is highly commendable that complex scientific information about various aspects of seeds have been discussed in such plain and simple manner.

Seeds are the most essential basic resource material for raising successful plantations. Better seeds grow into better seedlings which ultimately, will grow into healthy trees. Therefore, this document will go a long way in solving practical difficulties in seed collection i.-e. from tree climbing and harvesting to seed storage and distribution and will encourage field staff to collect quality seeds to ensure good quality plantations.

We are appreciative and also indebted to Mr. Marcus Robbins, Silviculturist, ODA and-Mr. Narendra Bahadur Shrestha, Chief, Afforestation Unit, CFAD for preparing such valuable guidelines. We are sure that all concerned will find it purposeful and of practical utility.

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INTRODUCTION to the original document

Afforestation in Nepal is currently around 15 thousand hectares per year, equivalent to 30 million saplings. This production requires at least 150 million viable seeds, equivalent to 15 tonnes of seed per year or 150 tonnes of fruit. These amounts will double within 5 years. In view of this demand for seed, HMG/N has agreed to start a National Tree Seed Project (NTSP), with assistance from the European Economic Community (EEC) and the UK Overseas Development Administration (ODA), with the object of ensuring adequate supplies of high quality seed for all programmes of reforestation within the Kingdom of Nepal. The NTSP is based at the national Tree Seed Unit facilities of the Community Forestry and Afforestation Division (CFAD), which were established in 1981 under the Nepal Australia Forestry Project.

The geography of Nepal means that it is neither practical nor advisable to collect and distribute such quantities of seed as a centralised operation, and therefore each forest district or project must endeavour to become self-sufficient in seed supplies as far as is possible. The strategy of the NTSP is, therefore, to provide support to the districts in achieving this self-sufficiency, and to take responsibility for aspects of seed supply that the district cannot handle.

As a first step in providing such support, this manual has been written for District Forest Controllers and their staff, with the aim of ensuring that proper seed handling practices are used in each forest district. The manual was originally written as 4 separate technical leaflets which have been put together under one cover. The manual covers general techniques only, and detailed handling of individual species will be published by the NTSP as separate leaflets.

The authors are very grateful for the help of many people in the preparation of this guide, in particular to: Mr. B. P. Kayastha and Mr. M, S. Ranatunga for their suggestion and support in producing the manual as a field document of the Community Forestry Development Project; the staff of the Forestry Research Project for their invaluable help in commenting on the text; Mr. Debendra Amatya (Forestry Services) for his willing assistance in translation into Nepali; and to Secretarial Support Services for arranging publication.

Readers who require further information, or have any comments or queries about the manual, are asked to write to the authors at the CFAD, Hattisar, Kathmandu.

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NOTE on the current publication

The second leaflet of the original manual has been reformatted here, in electronic form, with some modifications, as a follow-up to a study commissioned by FAO, to make tree seed extension literature more widely available. I am very grateful to Pierre Sigaud at FAO for his original initiative and support in doing this. The current version is one in a series of NR Study-notes produced by the author, for use in training courses. The document may be freely edited, provided acknowledgement of the source is made. The graphics are available in TIFF format for editing, if required.

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1 INTRODUCTION

This leaflet explains how seed should be handled after collection and before storage or sowing in the Seed processing and treatment covers such activities as: after-ripening of the seed; removal of unwanted seed parts; separation of empty seed; cleaning; preparation for storage; treatment against pests; treatment to improve germination.

These activities are important as they can improve seed by: prolonging storage life; reducing the bulk of stored seed; facilitating sowing; improving germination; and reducing losses to pests.

1.1 Seeds are delicate!

Seeds may look inert, dead, and capable of rough handling. However, they are delicate living embryo plants which must be handled with care. All seed processing and treatment must be done carefully and correctly, otherwise the seed can be damaged by:- fermentation, overheating, excessive moisture, infestation by pests, or physical breakage of the seeds. Such damage will cause the seeds to become weak or die.

2 FRUIT STORAGE AFTER COLLECTION

2.1 Good storage is important:

After collection from the tree, all fruits must be stored carefully until ready for extraction. All fresh fruits respire, producing heat and moisture which can spoil the seeds within them, so they must be kept in a cool, dry and well ventilated place.

2.2 Use proper containers:

A suitable container is an open-weave hessian sack, doko, or open tray. Do not store fruits in deep piles. Keep containers well off the ground and away from dirt. Keep well protected from rodents, such as rats and mice. Do not store fruits in sealed containers eg. closed tins, plastic bags, etc.

2.3 Keep storage short:

Generally, it is best to extract the seeds as quickly as possible. This is most important for fleshy fruits that may ferment. However, some fruits may need some time in storage so that the seeds may become fully ripened, especially if collected before the fruit is fully mature eg. <u>Abies</u> spp.



3 REMOVING THE SEED FROM THE FRUIT

3.1 The method depends on fruit type:

The main fruit types can be described as follows:- (1) Dry fruits which stay closed, (2) Dry fruits which open, (3) Fleshy fruits with stones, (4) Fleshy fruits without stones, (5) Other types. These are now described

4 FRUITS WHICH STAY CLOSED

In this type, the fruits and seeds within cannot be easily separated, so that the fruits themselves are usually stored and sown. When mature, the fruits are relatively dry and not juicy. Such fruits can be of all shapes and sizes, such as lankuri, sal and khasru.

3.2 Separating unwanted parts:

Little processing is needed for these fruits. It may be possible to reduce their size to facilitate storage and sowing by;-Removing stalks; breaking off wings (eg. sal); removing husks or bracts (eg. teak, patlekatus); removing loose cups of acorns etc.. Do this carefully so as not to damage the seed. Loose material can be picked out by hand or separated using a sieve. Empty seed of Quercus or Castanopsis can be separated by placing them in water. Those that float are often empty and can be discarded. However, some may be full, so make a check of the discarded fruits by cutting a sample.

5 DRY FRUITS WHICH OPEN

In this type, the fruit naturally opens when dry, exposing the seeds inside. which can then be separated from the fruit. Examples are cones of pines and alder, legume pods, Eucalyptus capsules etc..

5.1 Drying and opening the fruits:

The fruits should be collected just before they open, and (if properly mature) spread on tarpaulins, mats or trays in the sun to complete opening. Fruits with light seeds that could be blown away by the wind should be placed in a protected area, or covered with netting.



5.2 Allow green fruits to ripen:

Green fruits should be allowed to go brown <u>before</u> putting in the sun, otherwise the fruit will dry too fast, and may not open completely or even remain closed. Excessive heating of the green fruits may damage the seeds within, too. The moister seeds are, the more likely they are to be damaged by heat.

5.3 Keep fruits protected:

The fruits should be covered at night so that they do not absorb moisture and begin to close up again. Take care that the exposed fruits and seeds are not eaten by rodents or birds. A peon may be necessary to keep guard by day.

5.4 Extracting the seed

Once the fruits are open, they should be shaken to remove the seeds. This can be done by hand, knocking the fruits against each other (e.g. pine cones), or by placing the fruit in a bag and shaking and knocking against a wall, or by raking or beating the fruits on mats, tarpaulins or trays.

5.5 Frequent shaking increases yield:

The yield of seeds from some fruits can be increased if the fruits are shaken frequently during drying, and not just once at the end of the drying period. This is particularly true of pine cones.

5.6 Don't damage the seeds!

While threshing the fruits, take care not to damage the seeds. Avoid rubbing fruits together too vigorously, and do not walk over fruits as the extracted seed may be crushed. A seed that has had its coat cracked or internal tissues bruised will be easily infected, may become weak, and will not store well.

5.7 Separating extracted seed:

Once all the seed has been extracted from the fruits, they should be separated by discarding the fruit parts by hand, using rakes, or using a sieve with holes just larger than the seeds so that the seeds fall through and the larger fruit parts remain.

5.8 Detaching seed appendages:

Some seeds may have appendages that should now be removed. The wings of pine seeds can be removed by putting the seeds in a cotton bag and gently rubbing the seeds together. The addition of moisture may help. Seeds embedded in kapok (eg. simal) can be removed by rubbing the kapok and seeds over a sieve, so that the seeds are forced through the sieve.



5.9 Cleaning out the rubbish:

After extraction, the seed may be mixed up with a lot of rubbish:- small broken parts of fruit; immature seeds; dirt and dust from the fruits and ground where extraction took place; and empty seed. This rubbish must be removed so as to reduce the chance of infection from spores, reduce the bulk of the seed being stored, and make sowing easier and more efficient in the nursery.

5.10 Cleaning by sieving:

The first step is to sieve the mixture, using two sieves. The first sieve should be just larger than the seeds, so that all material larger than the seed can be removed (this may already have been done). The next sieve should have holes just smaller than the seed, so that the seed is retained and all the rubbish smaller than the seed can be thrown away. For very small seeds only use the larger sieve (eg. Eucs).

5.11 Cleaning by winnowing:

The seed will now be mixed with rubbish the same size as the seed, but generally lighter in weight. This rubbish is removed by winnowing the seed in a light breeze or in front of a slow electric fan, just as for agricultural seeds. The winnowing can be done from one tray to another. or onto a sheet, or into a box.

5.12 Removing empty seed:

Besides removing rubbish, winnowing can also help to remove empty seeds, particularly in pines. To do this properly, it may be necessary to winnow in two stages:- first with a light wind to remove the very light material, then in a stronger breeze to separate the empty seed.

5.13 Don't waste seed!

Be careful to ensure that good seed is not discarded. Every so often, check the discarded rubbish and empty seed to see if there are too many good seeds being thrown out. If so, take more care in winnowing.



6 FLESHY FRUITS WITH STONES

In this type, the fruit typically consists of a thin skin covering a juicy flesh, within which is found one or more hard stones. The stone contains one or more seeds which generally are not separated from the stone. Therefore it is the stone itself which is stored and sown. Examples are paingyo and bhimal.



6.1 The flesh must be removed:

The flesh should always be removed from the fruit, although they may be small and easily dried, since the flesh often contains chemicals that inhibit germination of the seeds.

6.2 Don't leave until over-ripe:

In general, the fruits should not be left until the flesh is over-ripe and beginning to shrivel and become sticky, as it will be more difficult to remove. Fruits that have just matured and are still plump are more easily processed.

6.3 Soaking the fruits:

The fruits should firstly be placed in water for about 24 hours so that they become completely soft. It may help to break the skin by rubbing the seeds together before soaking. Do not allow the fruits to stay in the water until they ferment, as the fermentation may damage the seeds. However, slight fermentation may help in removing the flesh or pulp.

6.4 Macerating the flesh:

This can be done by one of the following methods; kneading the fruits under water by hand; rubbing the fruits over a rough sieve under a stream of water (the mesh should be just smaller than the stones); placing the fruits in a strong canvas bag with an equal quantity of sharp rocks just smaller than the fruit stones, and kneading the outside of the bag under water. The stones are usually quite resistant, and so no damage should occur to the seed within by vigorous rubbing (however, compare with next fruit type)

6.5 Separating the pulp from stones:

Once the flesh has been properly macerated, it can be separated from the stones by one of the following methods:- drain off the water and pick out the stones by hand; or stir the mixture in water such that the stones sink and the flesh floats - then skim off the flesh; or wash out the pulp in a stream of water on a sieve just small enough to contain the stones.

6.6 Washing and rinsing:

The stones should be washed thoroughly after separation, and if bits of flesh are found on the stones, repeat one of the maceration methods and wash again until completely clean.



6.7 Removing the seeds from stones:

It is sometimes possible to remove the seeds from the stones by carefully cracking open the stone. However, this is not usually advisable as it is very easy to bruise or crush the seeds inside. In stones that have several seeds inside, the best way of using them is to allow the seeds to germinate from the stone and then transplant.

7 FLESHY FRUITS WITHOUT STONES

7.1 This type generally consists of a fleshy part within which the seeds are imbedded, without any protection of a stone. There are generally many seeds. The fruit may have a thick skin which can be peeled off, and the inner flesh may be juicy or hard and crisp. Examples are berries, pome fruits (eg. apple) and citrus fruits (eg. orange).

7.2 Separation is similar to stone fruits:

The procedure for separating the seed is similar to stone fruits, but must be done with <u>much greater care</u>, as the seed is not protected. Some differences and precautions are as follows: 7.3 Before soaking and macerating, it may help to remove the skin (eg. figs) by peeling off with the hand.

7.4 Fermentation should not be allowed to happen at all, as the seed may be quickly weakened.

7.5 Maceration should be done gently, so as not to damage the seed coat. Do not use the method with rocks.

7.6 Sieving should be done with care if the seeds are small, to avoid washing them away. Separation of the pulp from seeds may be done more easily by using a sieve just larger than the seed, and gently pushing the, seed through into another container, such that the pulp is left in the sieve.

7.8 Wash the seed thoroughly several times to remove any jelly-like coating that often covers the seeds.

7.9 Removing empty seeds:

Washing may enable the empty seed to be removed, since they will tend to float. However, care must be taken as some viable seed can float if air bubbles stick to them.











conditions.

8 OTHER FRUITS

8.1 Some fruits are a combination of the types mentioned above A common type consists of a fleshy capsule that opens, revealing seeds inside that are covered with a thin, fleshy coat (aril) e.g. champ. Such fruits should be allowed to open naturally, the seed extracted by 'hand, and then carefully washed in water. If the coating is oily, then a bit of detergent may help to clean the seed. Rinse thoroughly afterwards.

9 TREATMENT BEFORE STORAGE

9.1 Moisture content is important:

If fruits or seeds are to be sown within a few days of processing, they can be surface dried and kept in cotton bags without any particular control of moisture content. However, if they are to be stored for sometime, the rules given in the notes on seed storage must be followed. In summary: *orthodox seed must be dried properly, whereas recalcitrant seed must be kept adequately moist and used as quickly as possible*

9.2 Some seeds require insecticide

As mentioned in the seed storage notes also, some species (eg. khayer, siris) will require dusting with an insecticide, to prevent attack by insects during storage. Normally, most insect infested seeds and insects themselves should be discarded, during cleaning, but these species often have seeds within which are eggs, and which can hatch, out during storage. (see note 3)

9.3 Moist seeds may need fungicide:

Recalcitrant seeds that must be kept moist for storage may need to be treated with fungicide, but this must be done carefully to avoid poisoning the seed itself. Seeds that can be dried do not need fungicide for storage.

10 TREATMENTS TO ENCOURAGE GERMINATION

10.1 Some seeds are dormant:

Many seeds will germinate immediately they are sown in the nursery and given adequate moisture, warmth, air and sometimes light. However, some species will only germinate after a very long period in the nursery (say 2-3 months) even though they have apparently ideal



10.2 Dormancy protects the seed:

Such seed, although they may seem to be dead, are in fact alive but dormant, and will only germinate after they have been subjected to special natural conditions such as:prolonged exposure to moisture; or rotting of the seed coat; or prolonged cold weather. In nature, such dormancy ensures that the seed will only germinate when the monsoon has properly arrived, and an adequate supply of moisture and warmth can be guaranteed for the successful growth of the seedling.

10.3 Seeds with water-resistant coats:

Many species have seeds that are distributed during the dry season. To ensure that they only germinate at the beginning of the monsoon proper, the seed has a water resistant coat which will only allow the seed to absorb moisture once the ground is thoroughly wet. Such seeds are typical of the legumes.

10.4 Treatment by cutting:

One way to enable moisture to enter the seed more quickly is to break the seed coat by cutting with nail clippers or pricking with a needle. This must be done at the end of the seed furthest from point by which the seed was attached to the fruit which is usually indicated by a small scar. This end is where the embryo radicle is normally found; and which must not be damaged. The method is suitable for small quantities. (see note 4)

10.5 Treatment with hot water:

Immersing the seed in hot water will make the coat more permeable to water. This is usually done by dropping the seed into about 4 times their volume of water that has just gone off the boil. The seed is then removed after a measured time, put in cold water, and allowed to soak for 24 hours. The time must be carefully measured to avoid cooking and killing the seed. (see note 5)

10.6 Treatment with sandpaper:

The hard coat of some species may be sufficiently broken down by rubbing with sandpaper. The best way to do this is to mix the seed with an equal quantity of sand, and place in a tin lined with sandpaper. The tin and seeds are then shaken vigorously until the seed coat has become dull.





10.7 Seeds with chemical inhibitors:

Another natural way of delaying germination is for the seed or fruit to contain a chemical which prevents germination. This can only be washed out or broken down naturally by constant wetting and rotting of the seed coat, and sometimes by heat.

10.8 Treatment by soaking:

Stone fruits often show this characteristic, which is why the flesh should be thoroughly cleaned off. Since the stone may contain the chemical too, soaking in cold water will help to remove it and also enable the seeds within to receive moisture more quickly. The water should be changed every 24 hours to remove any leached chemical. In general, soaking is beneficial to all seeds, whether dormant or not, and helps to promote faster germination. It also helps to remove empty seed, since these normally float, and can be picked off.

10.9 Treatment by wetting and drying:

Some seeds may benefit from this treatment, which both breaks down the chemical and helps to make the seed coat or stone more permeable. It is said to work for Teak. Once signs of germination are shown, drying should be stopped.

10.10 Treatment by dry heat:

Teak fruits have been shown to germinate best by subjecting them to high temperatures while dry, and this may be suitable for some other species.

10.11 Seeds with immature embryos:

Some species have seeds with immature embryos that only become ready for germination after passing through a period of cold while moist. This is typical of species growing at higher altitudes, with seeds disseminated during the winter. Although natural conditions may be quite damp, it would be too cold for seedling growth until the monsoon arrives.

10.12 Treatment by cold and moisture:

For such species, the only solution is to keep the seed moist and cold for sufficiently long until the embryo is properly matured. In the field this must be done by sowing the seed during the winter and allowing the process to happen naturally. If a refrigerator is available, then the seed can be mixed with damp sand and kept in a container in the bottom part (not freezer).



10.13 Reducing losses from rodents:

Care should be taken with over-winter sowing, so that the seed does not rot or become eaten by animals. It may be advisable to make special beds properly screened with netting, and then transplant when the seeds begin to germinate.

10.14 Avoiding dormancy:

Some species have seeds that only show dormancy once the fruits are fully mature. If the fruits are collected just before maturity, and the seeds sown immediately, germination may be rapid. However, if collection is delayed until the fruit is fully mature, the seed will not germinate until suitably treated. Examples are lankuri and some legumes. 10.15 This way of avoiding dormancy must be done with care, so as to avoid collecting seed that is too immature and will not germinate at all. Do not collect immature seed if it is to be stored, since it will loose viability very quickly.

10.16 Treat just before germination:

As a general rule NEVER carry out any treatment to improve germination before storage - only afterwards just before sowing.

11 TREATMENTS BEFORE SOWING TO AVOID PESTS

It is sometimes helpful to treat seed with a pesticide or repellant just before sowing so as to control pests in the nursery bed. Seeds can carry harmful fungi on the seed coat which will develop in the soil and harm the seed or seedling. These can often be controlled by dusting with a suitable fungicide. If birds or small rodents are a problem, coating the seeds with a repellent may be an answer.

12 TREATMENTS TO INCULATE SEEDS

Some species will only grow properly in association with a fungus or bacteria eg.: <u>Leucaena</u> (rhizobium), Pines (mycorrhiza), and it is often convenient to mix the seed with an appropriate inoculum before sowing. This should be done after any treatment that might kill the inoculum (eg. hot water).

Examples of seed processing equipment in a field store

(from: Forest Seed and Nursery Practice in Nepal. Ian Napier and Marcus Robbins 1989. Sahayogi Press, Kathmandu)



EXPLANATORY NOTES

NOTE 1: Not reproduced here

NOTE 2:

<u>Insecticide treatment:</u> The following species should have a small amount of a contact insecticide mixed with them as a matter of routine:

Acacia spp., Albizzia spp., Leucaena

A suitable insecticide is Malathion 5% dust at the rate of 1 gram per kilogram of seed. <u>Acrocarpus fraxinifolius</u> may need to be treated.

NOTE 3:

Seeds with water-resistant coats: following species will need treatment

<u>Acacia</u> spp., Acrocarpus spp., <u>Albizzia</u> spp., <u>Bauhainia</u> spp., <u>Cassia</u> spp., <u>Leucaena</u> spp., <u>Gleditsia triacanthos.</u> <u>Gliricidia sepium.</u>

In each seed lot, there may be many seeds which do not have fully-developed water resistant coats, and this is often due to differences in seed maturity.

NOTE 4

<u>Cutting treatment:</u> This is by far the safest method of treatment, provided the coat is cut away from the radicle. A typical seed is shown below, and the best place to cut indicated with a dotted line



<u>Hot water treatment:</u> Great care must be* taken with this method, as species listed above vary greatly in their ability to withstand hot water, and those seeds which do not have a fully developed coat can be killed by very short times in hot water. Appropriate times will be -checked by the NTSU,

The following should be suitable for:-

Leucaena leucacephala: Place seed in 4 times its volume of water that has gone off the boil. Remove after 2 minutes, and soak in cold water for 24 hrs.

The literature states that some species which are not legumes may germinate better after hot water treatment (eg. Lapsi, phusre, *Garuga pinnata. Celtis australis*). However, this should be avoided until properly *I* tested.

NOTE 6:

Cold moist treatment: The seeds of the following species require this treatment:

Abies pindrow, Castanopsis spp., Aesculus spp., Cedrus spp (?), Ilex excelsa, Juglans regia, Fraxinus floribunda (when mature), Juniperus spp., Larix spp., Morus alba (?), Quercus spp..

Most of these species naturally mature at the beginning of the winter, except for Morus.

It should be noted that this treatment is the best for prolonging the viability of recalcitrant seed (seed which should not be dried), and that several of the above species are in fact recalcitrant eg: *Casta<u>nopsis</u> spp., <u>Aesculus</u> spp., <u>Juglans spp., Quercus spp.</u>*

Some other species with recalcitrant seeds mature before winter, and nursery experience shows that these will retain their viability for several months if sown during the winter, and germinate when warm weather comes. However, a period of cold is not apparently essential for germination, and the species may germinate quickly under warm conditions (say in a heated room). Examples are: <u>Cinnamomum camphora, Litsea cubeba. Michelia champaca.</u>

Some fig spp. have delayed germination, and this may be due to the need of cold moist treatment, though most species germinate readily under warm conditions.

Some species apparently germinate better after a period of storage, and this may be in part due to maturation of the embryo under cool conditions. However, in this case the seed is dry, not moist. Examples mentioned in the literature are: <u>Adina cordifolia, Albizzia lebbek, .Lagerstroemia parvifolia, Melia azadarach.</u>

As will be noted, the effect of temperature on many species is *not* clear, and where appropriate, this will be studied by the NTSU.