

GUIDELINES FOR  
PRE-SOWING SEED  
TREATMENT:  
STRATIFICATION  
AND SCARIFICATION



RA Ministry of  
Agriculture



german  
cooperation

DEUTSCHE ZUSAMMENARBEIT

Implemented by

**giz** Deutsche Gesellschaft  
für Internationale  
Zusammenarbeit (GIZ) GmbH



**GUIDELINES FOR  
PRE-SOWING SEED  
TREATMENT:  
STRATIFICATION  
AND SCARIFICATION**

# SUSTAINABLE MANAGEMENT OF BIODIVERSITY (SMB), SOUTH CAUCASUS

## PRE-SOWING SEED TREATMENT

Pre-sowing seed treatment stimulates the natural conditions that allow seeds to germinate. Seeds of many plants and trees need a certain period for their immature parts to develop and their dormancy (factors preventing germination) to end, allowing for them to sprout. The environmental conditions that foster seed germination vary depending on the seed species; some require very wet and cold conditions while others must be kept in dry and hot environment. Depending on the volume of the lot, the species, the local factors, and availability of relevant equipment and facilities, different methods are used to support survival of seeds and to accelerate germination. Among these methods, stratification and scarification are the most recognized. The following guidelines provide basic information on the pre-sowing treatment of seeds, particularly on the process of scarification and stratification and the various regimes of the latter.

### 1. STRATIFICATION

The main broadly recognized method of stratification requires mixing seeds in moist media such as peat moss, ground perlite, vermiculite, composted bark, sawdust, or sand, chosen to best reproduce the conditions of the natural environment to expedite seed germination. The mixture with seeds can be stored in sealed containers like polyethylene bags or boxes made of clear plastic with tightly sealed lids. The containers with seed-media mixture are stored at room temperature for moist-warm treatment and in a refrigerator for moist-cold treatment. In continental climate, such as the climate in Armenia, most native tree seeds require a cold exposure (to simulate winter colds) before they can germinate (spring).

### THE PROCESS OF STRATIFICATION



**General preparations:**  
Label clean bags or containers with a waterproof marker, indicating the species, the date of stratification, and the future sowing date. Alternatively, clearly number the containers and make the respective entries for each numbered container in the seed preparation log or computer file.

Prepare the right amount of moist medium of the right type (sand, peat moss, perlite, vermiculite, composted bark, or sawdust) as appropriate for the species of the seeds being prepared.

Make sure that sufficient space is ready for storage of the bags or containers at the right temperature, humidity, and lighting conditions. Note that some seeds are recommended to be stored in dark or naturally illuminated conditions.

**Mixing and Stratification:**

Most growers recommend mixing equal amounts of dry seeds and moist medium (50:50 by volume, not weight). The water contents in the medium must be such as to feel moist to the touch but not form a layer of water at the bottom of the bag (container). Too much water in a sealed container will cause overgrowth of fungus. To prevent fungal damage to the seeds, many industrial facilities add fungicide preparations to the medium, taking caution to measure and add the right type of fungicide for assuring best results.

Place the sealed containers into 0–5 °C stratification environment. Never allow the seed–medium mixture to stay in stratification longer than the recommended stratification time, since the seeds rely on their stores of organic and chemical energy to stay alive. Very often during the stratification period it is common for the seeds to germinate as a result of temperature rise. This may prompt early termination of the stratification process. Thus, a careful handling of the fragile seeds and appropriate thermal and moisture levels are essential.

---

## 2. SCARIFICATION

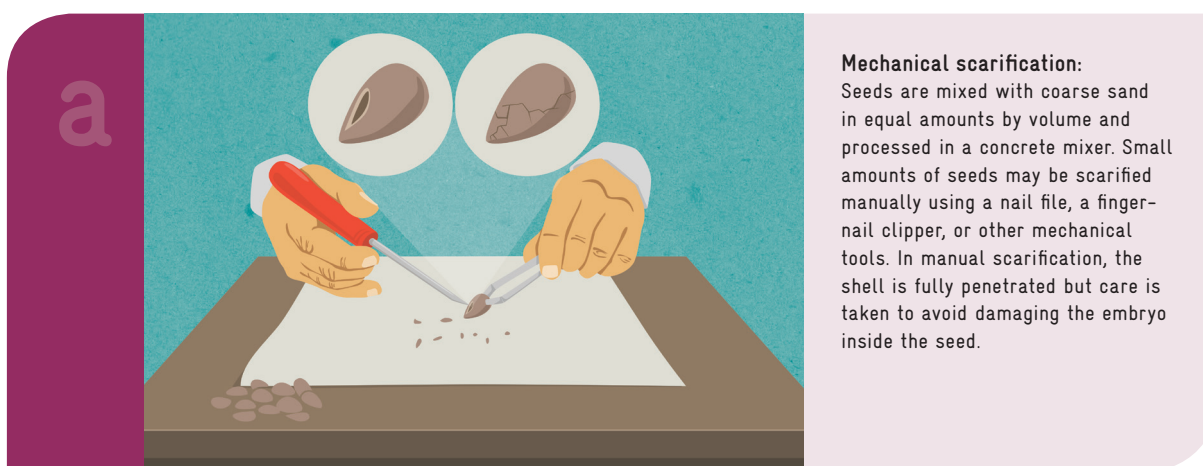
---

Many plant seeds have hard dry shells that in natural conditions require a long exposure to moisture and to warm temperatures to soften. To make water penetration into the shell easier, methods called scarification are used, which are aimed at breaking the integrity of the outer shell of the seed.

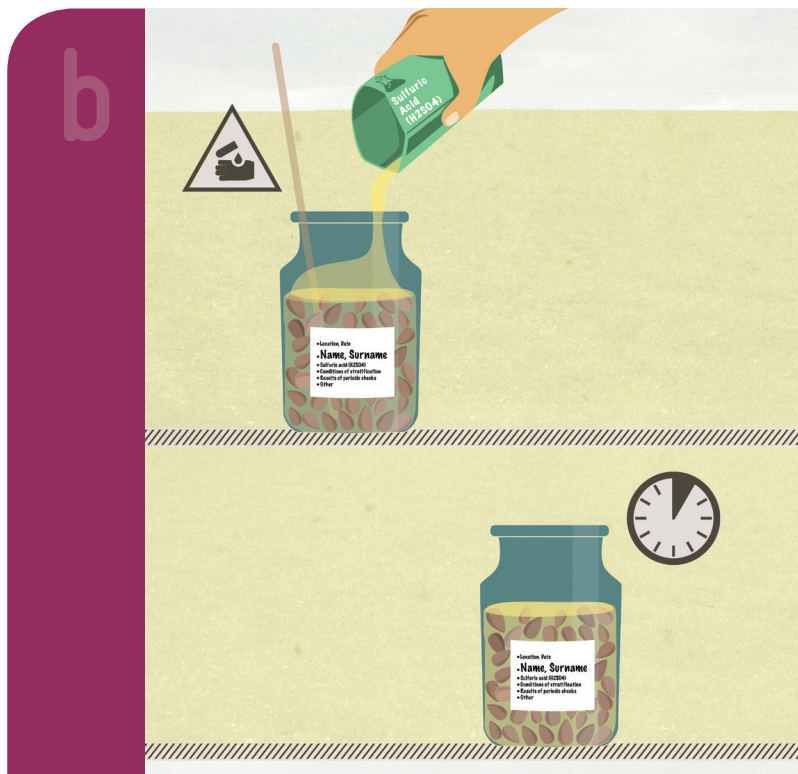
---

### METHODS OF SCARIFICATION

---

**Mechanical scarification:**

Seeds are mixed with coarse sand in equal amounts by volume and processed in a concrete mixer. Small amounts of seeds may be scarified manually using a nail file, a fingernail clipper, or other mechanical tools. In manual scarification, the shell is fully penetrated but care is taken to avoid damaging the embryo inside the seed.

**Chemical scarification:**

Seeds are soaked in acid solution (most commonly, sulphuric acid) from several minutes to several hours, depending on the species and the concentration of the solution. This may be the most effective method; however, it requires precision in acid concentration and timing, as well as extreme caution because the acids are caustic and require personal protective equipment for the skin and eyes.

**Soaking in hot water:**

Water of boiling temperature (up to 100 °C) is poured into the container with seeds to completely cover the seeds, and allowed to cool down to room temperature.

As mentioned above, each container or batch is labeled with appropriate information. The mandatory information includes:

- Number (s) and location of container (s);
- the species and the origin (vendor, batch, etc.) of seeds;
- scarification method if used;
- date of scarification or stratification, name (s) of the person (s) and their signatures for accountability;
- conditions of stratification (medium, temperature, lighting, proportion of the mixture, etc);
- date of expected maturity for sowing;
- results of periodic checks (frequency depending on the species);
- other information as appropriate.

### 3. PRE-SOWING TREATMENT OF SEEDS OF TREE SPECIES GROWN IN ARMENIA

Seed species should be divided into groups depending on the degree of dormancy and the pre-sowing treatment method.

**A. Seeds with light or no dormancy:** usually these types of seeds do not need to be stratified; however, stratification will speed up germination. Soak seeds for 24 hours in room temperature water and, thereafter, drain them. Afterwards, place them in plastic bags or containers and refrigerate (2 - 5° C) for 2 - 4 weeks.

Species which can be treated with the method described above are:

- Pine
- Fir
- Elm
- Platan
- Birch

**B. Seeds with "embryo dormancy":** these seeds will not germinate without a chilling period. Soak seeds for 48 hours in running water, then drain and mix them with sieved sand or perlite. Place them in polythene bags, tie lightly, and store in a refrigerator for 12 - 16 weeks depending on the species.

Species which can be treated with this method are:

- Beech 12 weeks
- Maple 16 weeks
- Walnut 16 weeks
- Wild pear 16 weeks
- Wild apple 16 weeks
- Hazel 16 weeks
- Sorbus 16 weeks

**C. Seeds with deep dormancy:** these seeds will not germinate unless they get both warm and cold stratification. Soak seeds for 48 hours in running water, then drain and mix them with sieved sand or perlite. Place seeds in polythene bags and tie lightly. Keep the bags in room temperature (20°C) out of sunlight for 2 weeks. Keep the seed moisture (but not wetness). Moisture the seeds 1-2 times per week. After the warm stratification put the seed bags into the refrigerator for 32-37 weeks depending on the species.

Species, which can be treated with this method are:

- Ash 32 weeks
- Tilia 37 weeks
- Juniper 34 weeks

**D. Seeds with "seed coat" dormancy:** these seeds need to be "scarified" before they can germinate. Boil water (100° C) and pour it over the seeds. Allow the seeds to soak until the water cools down to room temperature. Thereafter, remove the seeds from the water and sow them.

For example, one of the species, which can be treated with this method is:

- Robinia pseudoacacia

Seeds in group A-D belong to the Orthodox class of seeds, which means that they can be dried down to a moisture content of about 8% and then stored under long-term freezing conditions.

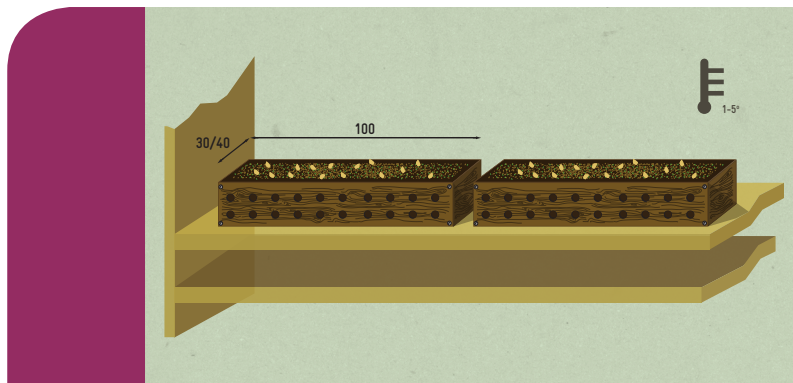
**E. Recalcitrant seeds:** these seeds will die if the moisture content in the seeds gets lower than 40%. If these seeds are not sown in the autumn they should be brought to the seed station for water treatment. Seeds should be put in a large bowl or barrel filled with water and should remain there for 24 hours. Bad or damaged seeds will float over the surface and can easily be removed, whereas seeds at the bottom should be drained and then put into net sacks and stored in a refrigerator over winter. Temperature should be 0 - 4° C and humidity should be over 90%.

Recalcitrant seeds are:

- ▶ Oak
- ▶ Chestnut

#### 4. STRATIFICATION IN BOXES, TRENCHES OR UNDER THE SNOW

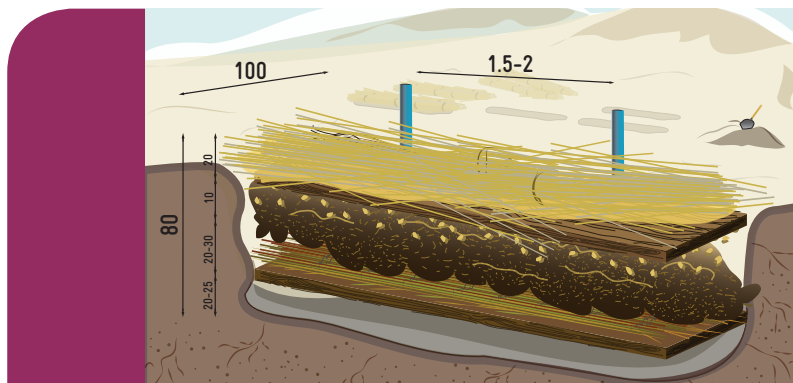
In case of larger seed lots used for production purposes, stratification can be carried out in boxes, trenches or under the snow.



**Stratification in boxes:** Tree and shrub seeds that do not germinate in the year of sowing without a pre-sowing treatment can be stratified in moist, well-ventilated conditions (for example, a cellar).

Seeds mixed with peat or sand are filled in wooden 100x30/40 cm boxes with 0.5-1 cm ventilation holes drilled in rows with separation of approximately 5 cm within each row and 10 cm between the rows. Boxes are placed in a cellar either on shelves or 3-4 cm thick wooden boards. Stratification is normally carried out at temperatures of 1-5°C. In case of early sprouting the boxes are placed over snow or ice. However, this method of stratification can also be carried out in cold, warm or summer trenches.

**Stratification in trenches:** Stratification can also be carried out in cold, warm and summer trenches.

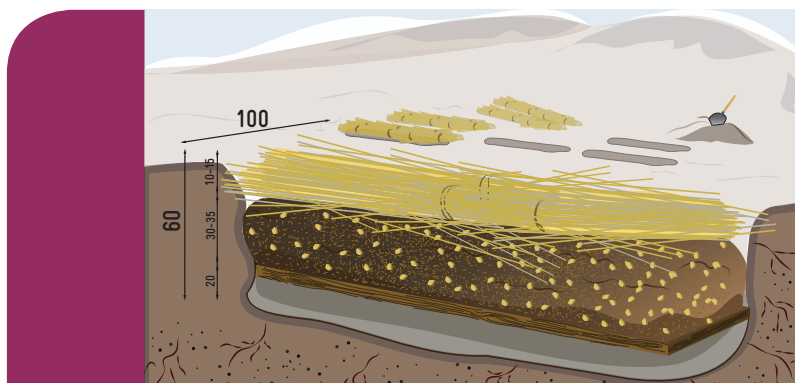


Warm trenches are used for seeds with pre-sowing dormancy period lasting longer than 4 months. A warm trench is commonly dug 80 cm deep and 100 cm wide, with length as needed, in a dry location.



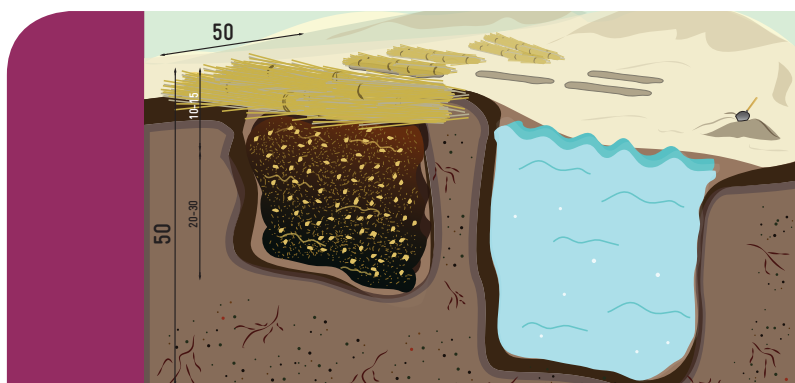
## GUIDELINES FOR PRE-SOWING SEED TREATMENT: STRATIFICATION AND SCARIFICATION

Wooden boards are placed on supports at the level of 20-25 cm from the bottom of the trench; ventilation tubes and 20-30 cm thick bundles of reed or brushwood are placed every 1.5-2 m. Thereafter, a 10 cm layer of sand or peat is spread over. The trench is then filled with the mixture of seeds and appropriate substrate (sand, peat) and closed with boards and covered with a 20 cm thick layer of thatch. The seed mixture is mixed with a shovel every 10 days before the beginning of the cold season. As the cold season begins, the layer of thatch spread over the boards can be thickened up to 50-75 cm, then thinned down to 35-40 cm when the snow cover appears.



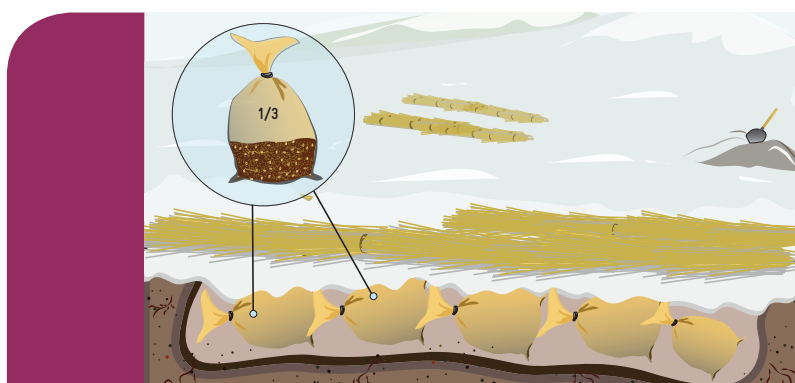
Cold (freeze-through) trenches are used for seeds with a dormancy period lasting for 2-4 months. The trench is dug with a depth of 60 cm and a width of 100 cm. Boards are placed in the trench 20 cm above bottom.

The wooden floor is covered with the 30-35 cm thick layer of seeds mixed with peat or sand and the latter is covered with a 10-15 cm thick layer of thatch. Before the beginning of stable frosts, the mixture is mingled once every 10 days, and moistened as needed. In the spring, the snow over the trench is covered by thatch or sawdust.



Summer trenches are dug with a depth of 20-30 cm and with a width of 50 cm. These trenches are used for stratification of fresh and newly harvested seeds with a long dormancy intended for autumn seeding or subsequent stratification in boxes in warm or cold trenches.

The summer trenches are fully filled with a mixture of seeds and sand or peat and then covered with a 10-15 cm layer of thatch. The mixture is mixed with a shovel once every 10 days, and moistened as needed. In order to protect the trenches from rodent damage they are surrounded by a water-filled trough 50 cm in depth and width.



**Stratification under the snow** requires seeds to be placed in 1/3 - full sacks that have a light texture. Seeds are often pre-moistened. The sacks containing seeds are spread flat then covered with compacted snow with a layer of sawdust or thatch completing the setup. Seeds are taken from below the snow right before sowing and drained if wet.

## GUIDELINES FOR PRE-SOWING SEED TREATMENT: STRATIFICATION AND SCARIFICATION

The seeds of each tree species require a specific approach to their pre-sowing treatment regimes and timelines. The following table shows the preferred treatment regimes and timelines for leading forest-forming tree species.

Tree species	Maturing of seeds (months)	Gathering of seeds (months)	Pre-sowing seed treatment method
Caucasian oak ( <i>Quercus macranthera</i> )	IX-X	IX-X	Autumn: no pre-sowing treatment required.
Georgian oak ( <i>Quercus iberica</i> )	IX-X	IX-X	Autumn: no pre-sowing treatment required. Spring: After removing bad or spoiled seeds, healthy and viable seeds should be mixed with sand and stratified in warm trenches or in boxes.
Oriental beech ( <i>Fagus orientalis</i> )	IX-X	IX-X	Can be sown without a pre-sowing treatment.
Field maple ( <i>Acer Campestre</i> )	IX-X	IX-XI	Strat. 140-160 days.
Trautvetter's maple ( <i>Acer trautvetteri</i> )	IX-X	IX-XI	Strat. 120-150 days.
Common walnut ( <i>Juglans regia</i> )	IX-X	IX-X	Soak for 10 days, strat. 40 days
Scots pine ( <i>Pinus Sylvestris</i> )	XI-XII	XI-XII	Autumn: no pre-sowing treatment required. Spring: soak seeds in water for 9-12 hours then stratify under snow for 1-2 months at 0°C.
Pallas pine ( <i>Pinus pallasiana</i> )	XI-XII	XI-XII	Soak for 9-12 hours or sow without a pre-sowing treatment.
Caucasian pine ( <i>Pinus sosnowskyi</i> )	XI-XII	XI-XII	Soak or sow without a pre-sowing treatment.
Common juniper ( <i>Juniperus communis</i> )	XI-XII	XI-XII	Strat. 210-250 days

---

**BIBLIOGRAPHY**

---

Deno, N.C. 1993, *Seed Germination Theory and Practice*, 2nd Edn., US Department of Agriculture, USA.

Moonshine Designs Nursery 2013, *Seed Stratification Directions*. [Online]. Available from: <http://www.djroger.com/stratification.html>. [Accessed: 04 July, 2014].

Sharma, V.K., 2005 *Propagation of Plants*, Indus Publishing Company, New Delhi, India.

Weber, F.R., Carol Stoney 1986, *Reforestation in Arid Lands*, Volunteers in Technical Assistance (VITA), Virginia, USA.

Փահլևանյան, Ա.Մ., 2008, *Անտառային սերմնաբուծություն և տնկարանային տնտեսություն*, չիրատարակված ձեռնարկ, Երևան:

Казарян, В.О., Л.В. Арутюнян, П. А. Хуршудян, А.А. Григорян, А.М. Барсегян, 1974, *Научные Основы Облесения и Озеленения Армянской ССР*, Издательство Академии Наук Армянской ССР, Ереван.

Министерство Природных Ресурсов Российской Федерации, Государственная Лесная Служба, 2003, *Справочник Лесничего*, Издание 7-е, Москва.

**Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH**

Address: Sustainable Management of Biodiversity South Caucasus  
4/1 Baghramyan Avenue, 0019 Yerevan, Republic of Armenia  
Tel.: +374 (0) 10 581877  
E-mail: [thomas.eberherr@giz.de](mailto:thomas.eberherr@giz.de)  
Webpage: [www.giz.de](http://www.giz.de)

**RA Ministry of Agriculture**

Address: Government Building 3  
Republic Square, 0010 Yerevan, Republic of Armenia  
Tel.: +374 (0) 10 541968  
E-mail: [agro@minagro.am](mailto:agro@minagro.am)  
Webpage: [www.minagro.am](http://www.minagro.am)

Authors: Stellan Karlsson, Forest Nursery Consultant, GIZ SMB, Armenia  
Alla Berberyan, National Expert for Bio-Resource Management, GIZ SMB, Armenia.

Editor: Armenuhi Pahlevanyan, Forest Nursery Consultant, GIZ SMB, Armenia.  
Illustrations © Jarakite Creative Partners  
Published by "Time to Print" Salon of Operative Printing, Yerevan, RA

October, 2014