PRODUCTION OF CONTAINERIZED AFGHAN PINE SEEDLINGS

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Continued interest in Pinus eldarica (Afghan pine) in the Southwest has prompted growers to call for a more complete knowledge of the growth characteristics and cultivation practices of the tree. The first phase of cultivated tree production is seedling production. This paper will describe the basic practices involved in containerized Pinus eldarica seedling production as accomplished at the Silviculture and Woody Crops Research Unit (SWCRU) at New Mexico State University.

The first step in seedling production is to establish an appropriate site on which the growing structure is to be built and operated. The site must have an adequate supply of quality water to accomplish production objectives. The site should also have good road access to facilitate future moving of the seedlings to their outplanting site. These and many other factors must be considered by the producer and gauged against his anticipated costs and benefits. It is recommended that professional growers be consulted if only for some suggestions based on local experience.

After a suitable site has been chosen the producer must decide if the controlled environment of an enclosed greenhouse is necessary or if the element-exposed conditions of a shadehouse are adequate. Once again, consultation with professional greenhouse people will be informative.

There are advantages and disadvantages to either approach. A shadehouse may be constructed relatively cheaply and quickly but limits seedling production to the warmer months and exposes fragile early-stage seedlings to the vicissitudes of the weather. A controlled environment greenhouse requires a much larger initial capital investment than a shadehouse but provides the grower with a year-round "growing season", thus enabling a producer to grow two to three crops a year as opposed to the one grown under shadehouse conditions. Also, a producer may alter greenhouse environmental conditions to optimize seedling growth (e.g.temperature, humidity, carbon dioxide enrichment).

After a producer has decided on a structure he must procure the seed and the necessary growing supplies. These should be ordered well in advance of the desired sowing date. The seed may be ordered through a registered seed dealer or collected if one has access to a stand of cone-producing pines. In either case the seed should be tested for germination potential before it is used. Testing can be done by a seed laboratory or by simply sowing a representative sample and observing the number of healthy

germinants. This number divided by the total number of seeds sown will provide the germination percentage. Germination percentages lower than 60 are considered unacceptable for commercial scale seedling production.

Growing supplies must include:

1. containers
2. a growing medium (such as peatmoss or soil)
3. slow release fertilizers
4. water-soluble fertilizers
5. medium amendments (such as vermiculite or perlite)
6. hose and fine nozzle for applying water and water-soluble fertilizers
7. fertilizer injector or hoze on attachment

The containers used may be any of a number of types, the most commonly used being Styroblocks, Spencer-Lemaire root trainers, and the Ray Leach single cell tube. At N.M.S.U. we use the Ray Leach (RL) tube as it facilitates moving large quantities of trees and maximizes in-house greenhouse space as well as permits easy sorting out of culls. If containers are to be reused, they must be cleaned and sanitized after each crop. This is accomplished by rinsing with a 10 % chlorox bleach solution.

Once the containers are ready the growing medium must be prepared. The N.M.S.U. greenhouse operations recommend a 2:1 peatmoss to vermiculite mix. Both materials are pathogen free and permit uniformity in packing and watering. Local soils may be used more cheaply, but one runs the risk of introducing diseases into growing operations. Also, soil may not provide optimum physical characteristics nor a uniform medium owing to the possibility of soil disimilarities (both vertical and circumferential) within a small area of land.

The peat and vermiculite are then mixed, either by hand for small operations, or by an automated cement or plaster mixer for larger operations. During the mixing process moisten the medium so that a handful of compressed mix will stick together, yet water does not run freely from it.

A slow release fertilizer source is commonly added to the mix at this time but is not necessary if a constant feed approach will be used (i.e. if fertilizer is added to the irrigation water at every watering). The slow release fertilizers used at the N.M.S.U.operations are Osmocote and Triple Superphosphate added at a ratio of 3 and 5 lbs., respectively, per cubic yard of compressed peat. These provide a supplemental source of N and P to the plants during a long irrigation interim.

Containers filled with the growing medium should be lightly tamped on the ground to prevent large voids within the cells. Avoid packing the peat mix so densely as to make fragile root growth difficult. Wet the cells down

thoroughly. The wetting down process may or may not include a fungicide.

The cells are now ready for sowing. At N.M.S.U. we use a seeding template which neatly fits over a rack containing 98 cells (see illustration). This template has 98 holes drilled and spaced in such a way as to align one hole over each cell. Seeds are brushed over the holes and then brushed back until each hole is filled with seeds. The amount of seeds that a hole is capable of holding is a function of the hole size and this can be altered by having templates of more than one hole size on hand. Once the seeds are caught in the holes a bottom supporting panel is slid back and the seeds drop from the template into their respective cells. One may also sow the seeds by hand depending on the quantity and time-cost factors.

Perlite is then spread over the seed at a depth of no more than one-eigth inch. The perlite helps maintain a moist seed environment while holding the seed in place; yet too much will impede germinant emergence.

The grower must now wait until the germinants emerge and the only chore is to make certain that the seed environment stays sufficiently moist. Temperatures should be maintained within the 65-75^{o}F range for optimum germination. It will take from 10 to 14 days before the germinants emerge usually with the seedcoat still clinging to the juvenile needles. After the majority of seedcoats have dropped off (20-25 days) begin adding fertilizer to the watering process.

There are many good commercial fertilizers available and some are even pre-mixed specifically for conifers. See Table 1 for the SWCRU fertilizer regime. Consult a local fertilizer dealer for options. Remember that the seedlings need a healthy supply of N during the rapid growth phase but this supply should be curtailed when desired seedling height has been achieved.

It is important to remember that watering must be thorough, i.e. completely soak the entire cell medium until there is drainage out the bottom. By so doing one can be assured that moisture will be available to all roots and that excess salts are leached from the root plug. The other benefits to thorough watering are that seedlings grow uniformly and require watering less frequently.

The optimum temperatures for seedling production fall within the 70-85^{o}F range. Temperatures much lower than this will slow down seedling growth dramatically.

The seedlings will need supplemental light to maximize rapid growth. Interruption of the night with a brief period of red or white light will contribute to the prevention of dormancy induction, provided that temperatures and fertilization remain optimum.

Afghan pine seedlings may take from 60 to 120 days to reach a desirable height (6-10 in.), depending on growing conditions and grower objectives. At this point they are usually very succulent with little woody tissue present. Seedlings must be hardened off before field planting.

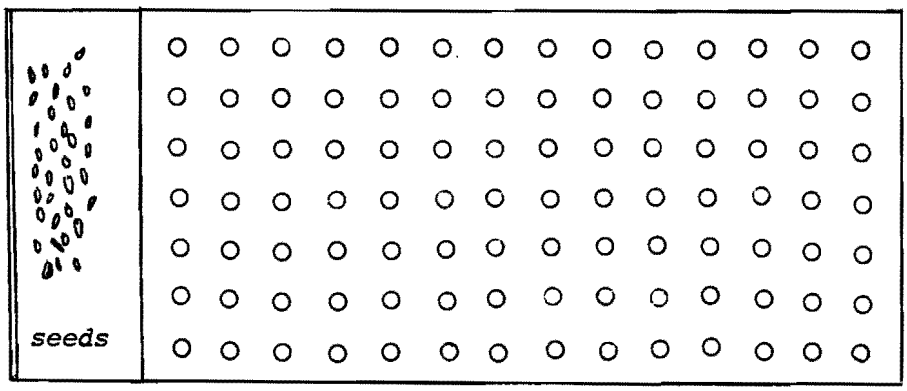
TABLE 1

AFGHAN PINE SEEDLING FERTILIZER REGIME

Fertilizer	*Concentration/1 Gallon
Potassium Nitrate	2.8 grams
Urea	2.9 grams
Magnesium Sulphate	8.3 grams
Ammonium Nitrate	14.5 grams
Iron Chelate (10% Fe)	1.0 grams
Phosphoric acid	1.8 milliliters

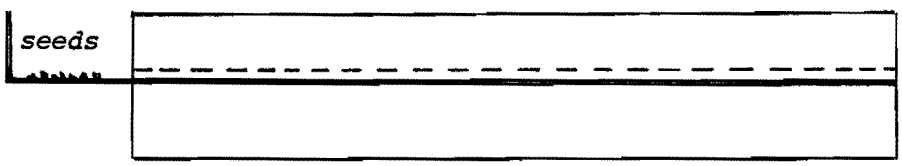
* **CAUTION** This fertilizer regime is meant to be applied with a 1:16 Hoze-on nozzle attachment i.e. it is 16 times more concentrated than what should actually go on the seedlings. If one is going to apply directly to seedlings or if a different dilutor is used, rates must be adjusted accordingly. Failure to make minumum dilutions will result in salt damage to the seedling roots.

FIGURE 1. SEEDER

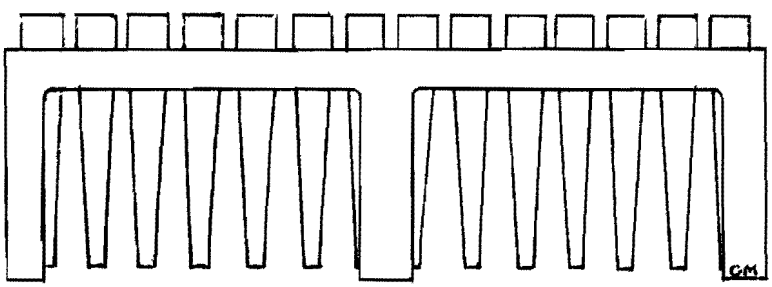


TOP VIEW

seed brush



SIDE VIEW



RACK CONTAINING RL TUBES

Place succulent seedlings outside where exposure to the vicissitudes of the weather will harden them off. In the warmer months this can be done directly (and if a shadehouse system is being used will be required) but in the cooler months there will need to be a gradual adjustment to the lower temperatures. This can be accomplished by reducing the greenhouse temperatures in a step-wise fashion. By all means do not expose seedlings to freezing temperatures if they are succulent. This is a period of stem caliper increase and increase in woody tissue. If there is still a need to continue fertilization at this point, use very little N in the fertilizer mix and increase the P. See Table 2 for the hardening-off formula. This ratio alteration encourages caliper and root growth.

In southern New Mexico seedlings may be held over for spring planting with a minimum of attention required. Just don't let them dry out completely.

It is commonly recommended that the seedlings may be planted year-round in the lower elevation sites in southern New Mexico, but the authors have seen some seedling freezing and subsequent death occur on seedlings planted in winter. This is a function of the seedlings not having extended their roots deep enough into the soil to avoid the deleterious effects of an unusual cold spell or shallow soil freeze (soil temperatures in this area fluctuate very little at depths greater than 15 inches.) Therefore it is suggested that seedlings be planted in late summer or fall or the traditional early spring season to avoid incurring the damage caused by these unusual temperature drops.

TABLE 2

AFGHAN PINE SEEDLING HARDENING OFF FORMULA

Fertilizer	*Concentration/1 Gallon
Potassium Nitrate	4.1 grams
Magnesium Sulphate	4.5 grams
Iron Chelate (10%)	0.8 grams
Phosphoric acid	2.5 milliliters

* **CAUTION** This fertilizer regime is meant to be applied with a 1:16 Hoze on attachment. See warning on Table 1.