

## HARDWOOD NURSERY MANAGEMENT

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Abstract.--The Natchez Forest Seedling Nursery has produced quality hardwood seedlings for the past seven (7) years. Some of the major species produced are Fraxinus pennsylvanica, Platanus occidentalis, Populus deltoides, Quercus spp. (acutissima, alba, shumardii, macrocarpa and virginiana), Liquidambar styraciflua, Taxodium distichum, Juglans nigra and Lespedeza bicolor. The guidelines used to produce these quality hardwoods are discussed.

### METHODS

#### Fumigation

Soil is worked into a fine, loose condition to a minimum depth of 8-10" and is as free of clods as possible. Green organic matter is cut or chopped into the soil a minimum of 3-4 weeks prior to fumigation. Soil moisture should be neither too high nor too low--for heavy soils, 50-75% of field capacity. Soil temperature should be above 50<sup>0</sup>F at the 6" depth.

MC-2 fumigant is broad spectrum for nematodes, weeds and most soilborne fungi. MC-33 fumigant is particularly effective against soilborne fungi with resistant developmental stages. Fumigant dosage is calculated as (concentration) x (time) and is determined by injector nozzle size, fumigant pressure and tractor speed. Fumigant is injected at a minimum of 8" soil depth. A minimum 2-mil thick tarp should be used.

Fumigation exposure time should be a minimum of 72 hours at soil temperatures above 60<sup>0</sup>F at the 6" depth. At lower temperatures and during wet weather following fumigation, the exposure time should be doubled. A minimum of 48 hours should be allowed for aeration. This time period varies with fumigant, soil type, soil temperature, soil moisture, etc. Double the aeration period in wet weather or at soil temperatures below 60<sup>0</sup>F.

The level of soluble salts and nitrogen in the soil may be increased due to decreased population of nitrifying bacteria. Fertilizer application should be based on the soil test made after fumigation.

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### Mycorrhizal Management (Endo- and Ecto-)

Mycorrhizal management is extremely beneficial to hardwood seedling production. At the present time, we fumigate with MC-2 0 400 lbs./ac. to reduce soil pathogen populations. The natural mycorrhizal fungal populations are also reduced; therefore, we inoculate with specific mycorrhizal fungi.

Inoculum is spread on the fumigated field in a fairly even layer and incorporated by mechanical means (disk, rotterra, etc.). Fertilizer is applied, and a cover crop of millet or sorghum-sudan is planted and grown for 2-3 months. This time period is sufficient to increase mycorrhizal fungal populations to acceptable levels. After sufficient decomposition time, seedbeds are prepared, and seed is planted on standard beds.

### Weed and Insect Management

Keeping equipment clean of weed seed and plant cuttings that could contaminate nursery soils is an excellent help in controlling weed populations. Another management tip is to keep windbreaks, fence lines, riser lines, ditches and all adjacent areas as weed-free as possible. Several herbicides are registered for this use and provide excellent results. Also, herbicides should be used with every cover crop.

Insect management is usually done with fumigation, Diazinon(R) (granule and spray), Furadan(<sup>R</sup>) and Malathion (<sup>R</sup>). Cover crops should also be monitored for insect development.

### Fertilization

Soil fertility must be near optimum and in balance to grow physiologically balanced, quality hardwood seedlings. Large seedlings produced by heavy applications of fertilizer often have succulent tissues, unbalanced top-root ratios and other unsatisfactory morphological and physiological properties that may adversely affect field survival.

No optimum nutrient ratio is applicable to all soils and all species. Each soil and species require individual attention and treatment. To maintain the soil fertility level near optimum seedling growing condition, a regular soil testing program should be established. The Natchez Forest Seedling Nursery presently uses a program that involves input from A & L Labs, Auburn University and North Carolina State University. A regular soil test program is valuable in developing and maintaining the proper soil fertility.

### Cover Crop

Cover crops aid in soil erosion control, soil-moisture retention, organic matter buildup and weed infestation control. A winter cover crop can be especially beneficial when planted on rotation land behind lifting. This winter crop can also prevent severe winter soil erosion.

Cover crops used at the Natchez nursery include millet, sorghum-sudan and soybean during the summer season and oats, rye, vetch, winter wheat and sorghum-sudan during the winter season. The grasses are the best choices for mycorrhizal fungal population development.

### Organic Matter

Maintenance of soil organic matter is best accomplished by making small, frequent additions of organic materials that will decay rapidly. On a 2-2 rotation, a large amount (2-3") of organic matter can be added the first year with no additions the second year. A green manure crop planted on this area for two years with the addition of organic matter will result in a higher organic matter content. This method is being used at the Natchez nursery with hardwood bark as our organic amendment.

### Planting

Some hardwood species should be fall-planted to attain earliest possible germination and to replace stratification. With fall planting there is a risk of losing your crop to winter erosion due to heavy rains. The area where fall planting is to take place has to be carefully considered. Some species of hardwood must be hand-planted, but some can be planted with a single-bed fertilizer distributor, pine planter or vegetable planter. Spring-planted acorns, sweetgum and green ash require some stratification. Acorns planted in January, sweetgum planted in February, and green ash, sycamore, Lespedeza bicolor and smooth sumac planted in May will produce excellent results. Hardwood cuttings need to be planted in April in order for the root system to become established. This root system establishment will put the cuttings in-line with May-planted hardwoods.

A germination test on seed lots to be planted is necessary. Germination tests on some species are obtained from the IPCo. Seed Center, Nacogdoches, Texas. If time or small quantities of seed do not permit a germination test, then a simple cutting test or flotation test will help sort out bad seed from good seed. This testing is extremely important. Some sycamore lots require 60-100 seed to the square foot of bed space in order to achieve the number of plantable seedlings desired.

Nursery sowing procedures, stratification procedures, pre-plant treatments and average seed per pound can be obtained from Schopmeyer (1974).

### Watering

Hardwood seedbeds need about an inch of water per week depending on soil type and stage of crop development. Light soils may require slightly more water than heavier soils. The required amount of water should be applied until mid-September.

Seedbeds must be thoroughly moist after sowing and kept continuously moist until germination is complete. Drying of the surface soil will result in severe germination losses, especially if the seed has been stratified.

Timing of watering is more important than the exact amount of water applied. Timing is most critical until the roots have reached a depth of 4-5 inches, and primary foliage has been produced to shade the soil.

Excessive watering should always be avoided. This excess increases cost, leaches nutrients and deprives the root systems of oxygen. Excessive watering during the early part of the season also causes soil splash that is detrimental to small seedlings.

### Inventory and History Plots

There are two types of seedling inventories: germination inventory and plantable seedling inventory. The germination inventory is taken about a month after planting, or when full seed germination is achieved. The fall plantable seedling inventory is important in that it should provide an estimate (within 10%) of the crop that will be available for shipment.

History plots provide accurate records of nursery cultural treatments and their effects in terms of germination, size of seedlings, crop monitoring and soil nutrient levels. History plots will enable the nurseryman to produce a higher percentage of plantable stock.

More detailed information on inventories and history plots can be found in Wakeley (1954), May (in preparation), Williams and Hanks (1976).

### Lifting and Grading

Nursery stock is lifted in December, as soon as the hardwood trees have defoliated. The lifting blade is run 6-8" into the soil. Trees are then lifted by hand, loaded on a wagon and hauled to the packing shed for grading and packing. Close attention is paid to treatment of seedlings during the lifting process. Exposure to sun and drying winds is avoided as much as possible. A water spray tank is mounted on the front of the lifting tractor, and root systems are kept moist as they are placed on the

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wagon. When the wagon is full, wet burlap is placed over the roots for the trip to the nursery. The wagon is stopped on the way to the building, and the roots are wet down again.

Grading is accomplished from the wagons and on the grading tables. Hardwoods should have a quarter-inch root collar and 30" shoot height. Shoot and root systems are examined for insect, disease and mechanical damage. Seedlings are tied in bundles of 25 each, and 100-150 seedlings are placed in each bag. Pulp-fiber mulch is used as the packing medium, though kaolin clay slurry gives good results for short-term storage (i.e., less than 3 weeks).

#### Storage

After grading and packaging, seedlings are placed in cold storage at temperatures of 35-38°F. The humidity is maintained at 95% or higher. Using this criteria for storage, hardwoods have been successfully stored for 4-5 months. After the first month, seedlings should be monitored for water retention in the mulch around the root systems.

#### CONCLUSIONS

The methods listed here are general guidelines which have been successfully used for a seven-year period at the Natchez nursery. However, every nursery has to be managed in a manner that is particular to that nursery. A nurseryman knows that a successful crop comes from hard work, knowledge, intuition and a lot of help from Mother Nature.

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