Hardwood Production Techniques at Midwestern Nurseries

A. F. Stauder, III [1,2]

Stauder, A.F. 1994. Hardwood production techniques at Midwestern Nurseries. In Landis, T.D.; Dumroese, R.K., technical coordinators. Proceedings, Forest and Conservation Nursery Associations. 1994, July 11-14; Williamsburg, VA. Gen. Tech. Rep. RM-GTR-257. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 26-30. Available at: http://www.fcnanet.org/proceedings/1994/stauder.pdf

Abstract—Hardwood seedling nurseries throughout the Midwest play a vital role in assisting area landowners with their conservation programs. Proper seedling production techniques are necessary to produce quality seedlings that will survive and grow to maturity. These techniques differ somewhat from those in other areas of the country.

The nurseries across the Midwest consist mainly of governmental, state and federal, operations. A very limited number of private or industry nurseries are located throughout the area. Approximately 24 million hardwood seedlings of over 75 species are produced in the Midwest states, including Illinois, Indiana, Michigan, Minnesota, Missouri, and Wisconsin.

SEED COLLECTION

As previously mentioned, over 75 species of hardwood species are produced at nurseries in the Midwest. The largest component of the total seedling production are black walnut and oak species. Because of the large, bulky size of the seed from many hardwood species, special handling problems exist. The large seed is difficult to collect, transport, process and sow. For these reasons most nurseries plant as much of their needed seedbeds as possible during the fall months.

Seed is obtained in one or more of several methods:

1) Nursery staff collections.

2) Department of Corrections inmate collections.

3) Other organization personnel collections such as district. foresters or wildlife biologists.

4) Donations.

5) Purchase from seed dealers.

6) Purchase from private individuals.

Most seed is collected by nursery staff or more so by the purchase from private individuals. The main problems from seed collected by private individuals or seed dealers is the unknown seed source. Buyers must make absolutely sure of the seed source of the seed before it is collected and purchased. For these reasons many states have established seed collection zones to insure as much as possible that local seed is being obtained.

Of the Midwestern states, Indiana has probably the most intensive seed purchase program. All seed is purchased on a live

[1] International Paper, Bullard, Texas.

[2] The author wishes to express his appreciation to the nursery managers from the Midwest states who provided slides for the presentation and input regarding their managem ent activities.

seed basis, where price is determined for the individual full seed. This requires cut tests on each seedlot, but does insure the quality of the seed. Most of the other nurseries purchase seed on a per pound basis while adhering to specific quality standards.

SEEDBED PREPARATION

Seedbed areas are typically levelled, subsoiled, and disced prior to forming the seedbed. Most of the nurseries fumigate their seedbed areas. The preferred method is contract fumigation performed by a licensed professional contractor; although some operations still fumigate using their own nursery personnel and equipment. Fumigation is performed to control weed seeds, pathogens and detrimental fungi pests. The fumigation activities are usually performed in late summer, which allows for higher soil temperatures and to allow ample time to prepare the area for fall sowing.

Seedbeds are formed in several ways. The Whitfield bed shaper is used as well as several types of shaper tillers. A new machine, the FOBRO tiller shaper is currently being introduced at some facilities. It provides a one pass method to the bed shaping process. The choice of method and equipment depends on the nursery manager, the soil type, and the area where the nursery is located.

SEED SOWING

Most nursery operations sow as much seed as possible in the fall months. Sowing at this time provides natural stratification and eliminates the need for winter storage of the seed. Some exceptions to the fall sowing are species such as sumac, black locust, and redbud which require no stratification or can be scarified using an acid or hot water treatment.

For heavier seeded species, most operations have developed and built a sower specific to their needs (Figure 1). These machines use a belt or chain driven system with a hopper to sow the seed at the desired rate. Black walnut probably presents the most problems for the nursery manager, simply because of its large seed size. Iowa uses a modified fertilizer spreader which drops the seed into preformed furrows made into the formed beds. Some nurseries dehusk the black walnut seed while others sow the seed directly in the seedbed with the husk attached.

Removing the husk does allow the nursery personnel the ability to float the seed to remove some of the empty seed before planting. However, most nurseries report good results in both cases.

For small seed, several different machines have been used. Currently several operations use a Love Ojyord seeder or a Whitfield seeder. The sowers can accurately be calibrated using seed purity, seed germination and expected seed efficiency information.

Figure 1. Sower for use with large hardwood seed.

One problem inherent throughout the area is that of predicted seed efficiency. Hardwood seed is much more variable than the seed of conifer species. Seed crops are very sporadic for most heavy seeded species, and the seed variability and performance may fluctuate greatly from year to year. Seed efficiencies generally range from 20 percent to 85 percent depending on the species, the year collected, and the duration of storage. By using a five year moving average, nursery managers can partly overcome the yearly fluctuations in predicting seed efficiencies.

Several different types of seedbed mulch are used throughout the Midwestern nurseries. Examples of the materials used are sawdust, sand, bark, wood chips, and hydromulch. Nurseries such as those in Iowa use local material such as ground corn cobs. The main purpose of any mulch is to provide protection and insulation to the newly planted seed until germination.

Probably one of the most innovative use of mulch is that of using a green overwinter mulch. Two different methods can be used and example of those are at the nurseries in Indiana and Illinois (Wichman 1993, Stauder 1993). The Indiana operations actually plant winter wheat in the same drill while planting the seed. The wheat germinates and grows throughout the winter providing excellent protection to the stratifying seed. This method provides several advantages, such as:

1) Seed insulation from extreme cold.

2) Protection from predators.

3) Delayed spring germination to reduce frost damage.

4) Seedbed protection from washing.

The main disadvantage is that the wheat must be sprayed with a herbicide to kill it before the seed germinates. The herbicides used are Roundup before the tree seed germinates or Fusilade if germination has begun.

The nurseries in Illinois operationally use hydromulch. In addition, spring oats are added at a ratio of approximately 50 pounds per acre to the hydromulch mix. The oats germinate in the fall and usually grow to six or seven inches before repeated frosts or freezing temperature kill the oats; however, the oats continue to provide protection and insulation to the stratifying seed after planting. In the northern part of the Midwest area many nurseries rely on persistent winter snow cover. Snow has excellent insulation properties and provides good physical protection for the seedbed. However, snow cover is not very dependable throughout the central and southern part of the range.

CULTURAL PRACTICES

Hardwood seedlings generally require approximately one inch of rainfall or irrigation per week for a sandy loam soil. Of course this amount will vary depending on soil type and region. Sandier soils especially in the southern areas, obviously, will require more moisture than heavier textured soils.

Fertilization occurs throughout the growing season. Soil tests are required each year to determine the need for pre-plant fertilizers or lime. The optimum soil pH to produce hardwood seedlings is from 6.0 to 6.5. Most operations apply approximately 150 pounds of actual nitrogen per acre per year to produce a quality crop. Several different types of nitrogen are used; these include ammonium nitrate, ammonium sulfate, ammonium phosphate, and calcium nitrate.

Root morphology has become an ever increasingly important concern among nursery managers. Research has clearly shown that quality seedlings must have a minimum number of first order lateral roots to insure survival and excellent growth (Schultz 1989). Therefore most nursery managers have begun to under-

cut their hardwood seedlings. For 1-0 seedlings undercutting is usually performed after the second flush is completed for the oak species and July for black walnut. The remaining hardwood species are undercut in mid to late summer when 80 percent of the seedlings have attained 80 percent of the target height. For 2-0 seedlings, undercutting usually begins after the first flush in the spring when the new leaves reach 85 percent of full size. Hardwood seedlings are usually cut to a depth of seven to eight inches below the root collar.

Some nurseries such as those in Wisconsin top prune hardwood seedlings. The 2-0 hardwood seedlings are top pruned, if necessary, to a height of 12 to 14 inches during late summer or early fall. Some extremely fast growing species such as sycamore, elderberry or sumac may need to be top pruned during the first year of growth to control height. No major problems have been observed by top pruning alternate branching species; however, nursery managers do not top prune opposite branching species, such as green ash or white ash, because severe forking may result.

A few nurseries practice lateral pruning on hardwood seedlings; however, the practice is not widely used or accepted. Because of the large size of the hardwood seedling, lateral pruning is difficult in many cases.

LIFTING AND PACKING

Seedling lifting generally begins in the late fall months depending on the area. Nurseries are currently using several types of lifting machines, either home-made or industrial manufactured, with the FOBRO Lifter Shaker preferred by many nursery managers (Figure 2). Nursery personnel at most nurseries attempt to lift as many seedlings as possible during the fall, since the ground may freeze for extended periods during the winter. The seedlings are lifted, then placed into cold storage as soon as possible. Many nurseries store seedlings bareroot on open carts or boxes in the cooler. Since hardwood seedlings are deciduous, they possess no leaves to transpire and dessicate the seedling. The main factor in storage is to maintain the temperature at approximately 34 degrees F and to maintain a high humidity in the cooler. In some cases the seedlings are stored just below freezing which allows the seedlings to be stored for a longer duration. These trees are stored awaiting grading and packing during the winter months when lifting cannot occur due to frozen ground or severe weather.

Once seedlings are lifted and stored, the next step is the grading process. Most nurseries grade seedlings in a building

Figure 2. Hardwood seedling lifter.

where cull seedlings are separated from the quality plant material. Each operation has its own grading specifications, but a general rule is for seedlings to possess at least 0.25 inches diameter and 12 inch height. Root systems are extremely important, and seedlings should possess at least a six inch taproot with a minimum of five first order lateral roots.

Several different types of packing systems are used throughout the Midwest. Seedlings are wrapped in bales, placed in boxes or packed in 3-ply kraft bags for transport to the planting site. Packing mediums also vary; these include sphagnum moss, peat moss, synthetic gel, or no medium. Several operations using bags do not use a packing medium. Since the lifted hardwood seedlings have no leaves to cause water loss through transpiration, seedlings have actually been stored for several months with no detrimental effects.

SHIPPING

Like most other nurseries throughout the United States, operations throughout the Midwest depend on the landowner or purchaser to pick up their seedlings. Seedlings are also sent to the landowner using parcel post or a commercial package delivery company. In most cases seedlings arrive at their destination in excellent condition.

CONCLUSION

Hardwood seedling nurseries throughout the Midwest provide valuable tree and shrub seedlings for conservation purposes. These operations play a vital role in landowners' goals of proper land stewardship.

LITERATURE CITED

Schultz, R.C., and J.R. Thompson. 1989. Nursery cultural practices that improve hardwood seedling root morphology In Proc. Northeastern Area Nurserymen's Conference. pp. 17-39.

Stauder, A.F., III. 1993. The use of green overwinter mulch for the Illinois State Nursery Program. In Proc. Northeastern and Intermountain Forest and Conservation Nursery Assoc. Aug. 2-5. pp. 51-54

Wichman, J. 1993. Use of wheat as a living mulch to replace hydromulch for fall sown seedbeds. In Proc. Northeastern and Intermountain Forest and Conservation Nursery Assoc. Aug. 2-5. pp. 55-56.