HARDWOOD SEEDLING PRODUCTION IN THE STATE OF KENTUCKY

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Abstract.--Nurseries in the state of Kentucky have produced hardwood seedlings for over 25 years. Primary species grown are: Fraxinus americana, Fraxinus pennsylvanica, Platanus occidentalis, Quercus alba, Quercus rubra, Castanea mollissima, Alnus glutinosa, Elaeagnus umbellata, Lespedeza bicolor, Gymnocladus dioicus, Liquidambar styraciflua, Populus deltoides, Robinia pseudoacacia, Juglans nigra, and Liriodendron tulipifera. Presentations of hardwood seedling production methods are summarized.

The Kentucky nurseries have been producing 15 to 20 species of hardwood seedling for the past 25 years. Since the forest land of Kentucky is 90% hardwoods, we usually have a demand of 4,000,000 to 5,000,000 hardwood seedlings per year. With the large number and variety of hardwood sites available in Kentucky for reforestation, there is a demand for different species to be grown at the nurseries. Each species must be managed seperately to insure a successful crop of hardwood seedlings. The objective of this discussion will be to explain how we grow hardwood seedlings.

Soil preparation for all our hardwoods is standard nursery practices. The ground is subsoiled to two feet, plowed and worked to a fine, loose condition. The area is then fumigated with MC-2 at a rate of 350 pounds per acre for the control of weeds and fungi. Soil tests are taken and fertilizers are applied as the tests dictate. We usually apply 350 pounds of 15-15-15 per acre. We use the standard nursery beds, four foot of bed and six foot alley ways, which are made with the Whitfield bed former. When our beds are prepared we are then ready to seed. The following describes methods we use and have had success with in producing hardwoods.

WHITE OAK	NORTHERN RED OAK	CHINESE CHESTNUT
Quercus alba	Quercus ruba	Castanea mollissima

The Kentucky Division of Forestry has selected seed production areas located across the state which produces our white oak, northern red oak and chinese chestnut seed. We also have a chinese chestnut orchard under development in Western Kentucky. The seed is collected as soon as it falls, and immediately placed in cold storage. In late October the seed is examined for quality. Several seeds are broken to determine approximate germination rates which is highly variable.

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Within a standard nursery bed three evenly spaced trenches are made with plows about two to three inches deep. The seed is then planted by hand, 12 to 20 seed per linear foot of trench. The bed former is then lightly pulled over the beds covering the seed with 3/4 to 1 inch of soil. A mulch of wheat straw is applied after the beds are firmed with a bed roller. Densities of seedlings will vary, but usually we can expect 10 to 15 seedlings per square foot.

When germination starts in late March or early April we keep the beds wet. After germination is completed, normal rainfall is usually sufficient for moisture requirements.

Weed control is accomplished by using Poast, Treflan and minor hand weeding during the growing season. We usually propagate 50,000 to 100,000 northern red oak, 50,000 white oak and 50,000 to 75,000 chinese chestnut with a 1/4 inch caliper and 12 inch minimum top.

AUTUM OLIVE
Elaeagnus umbellata

From our local seed production areas we collect the autum olive berries in September or October. The berries are macerated with the DYBVIG macerator the same day they are picked, and the seed is air dried on racks. The spring seed must be stored in cold storage, and then stratified for 120 days prior to seeding.

Fall seeding, which gives us our best stands, is seeded with an eight row tree seed seeder at five pounds per 500 foot bed. With 40 to 80 percent germination, bed densities vary. We strive for 20 to 25 seedlings per square foot. Wheat straw is applied as a mulch.

Irrigation is applied in late March and the beds are kept moist until germination, then irrigated as needed. Applications of fertilizer, 33-0-0 at 100 pounds per acre, are applied, judged by color and growth of the seedlings. Weed control is accomplished with the herbacides Poast, Treflan and minor hand weeding.

Our production of 600,000 to 750,000 autum olive, with a caliper of 1/8 inch and eight inch minimum top usually meets the demand.

WHIM ASH
Fraxinus americana

GREEN ASH
Fraxinus pennsylvanica

White ash and green ash seed is collected from local seed production areas. Once we collect the seed in October it is spread out in a dry area, to finish drying the seed and to complete the ripening process. There is no other treatment of the seed prior to seeding.

In early November the seed is measured out in bushel units. The bed is then seeded by hand at a rate of 2 1/2 bushels per 500 foot of bed. With an average germination rate of 40 to 60 percent, we normally get ten to twelve seedlings per square foot. This will give us 20,000 to 25,000 seedlings per 500 foot bed.

After the seed is evenly distributed on the bed, 1/2 to 3/4 inch of saw-dust is applied, followed by a covering of wheat straw.

Irrigation is started in late March and 3/4 to 1 inch of water is applied per week. After germination, irrigation is applied as needed through-out the growing season. After September 1 no water is applied by the nursery so as to harden the seedlings for winter. With these practices we usually grow 200,000 to 250,000 seedlings of each species with a caliper of 1/4 inch and a minimum height of 12 inches.

KENTUCKY COFFEE TREE
Gyrnnocladus dioicus

The kentucky coffee tree is grown as a P.R. species. The official state tree is given to civic groups, schools and garden clubs to plant on Arbor Day, the first Friday in April.

We collect the seed pods from our local seed production areas. The seed, extracted by hand, is then stored over winter. Early May is when we seed the kentucky coffee tree. The seed is soaked in water for 24 hours, then in concentrated sulfuric acid for two hours. The seed is throughly rinsed and seeded by hand in three furrows per bed at a rate of 25 seed per linear foot of furrow. The bed former is then lightly pulled over the beds covering the seed with 3/4 to 1 inch of soil. With 75 to 90 percent germination we should get 15 seedlings per square foot.

Our standard irrigation practice is followed, keeping the beds moist during germination and as needed through the growing season.

We grow only 10,000 to 15,000 kentucky coffee trees per year, having 1-0, 2-0, and 3-0 stock for distribution. Seedling sizes range from 1/4 inch to 1/2 inch caliper and tops from 8 inch to 24 inch.

SUPERIOR COTTONWOOD CUTTINGS
Populus deltoides

Superior cottonwood cuttings are obtained from West Vaco orchards in early February. They are placed in cold storage until April when they are spaced in beds one foot by one foot. Normal irrigation is applied through the growing season.

The following spring, February, the cuttings are cut back in 15 inch sections with a 1/4 inch minimum diameter. We are able to harvest three crops from these cuttings before the root stock is discarded and we start over. Normally, 25,000 superior cottonwood cuttings meets the demand.

SWEET GUM
Liquidambar styraciflua

Sweet gum, like many of our other hardwoods is collected locally from seed production areas. After the seed is extracted, it is stored and then stratified for 60 days prior to seeding in early May. With 40 to 80 percent germination we seed 2 1/2 pounds of seed per 500 foot bed. The bed density will vary from 10 to 15 seedlings per square foot. Sawdust is applied at a rate of 1/2 inch prior to rolling the beds to firm them. Our standard irrigation practices are followed through the growing season. Weed control is accomplished with Treflan, Poast and minor hand weeding. Our demand of 30,000 to 50,000 seedlings, with a caliper of 1/4 inch and 12 inch top, is met using this method.

SYCAMORE
Platanus occidentalis

West Vaco seed orchards and our own local seed production areas produce our sycamore seed. The seed is collected in early February. The seed is then kept is burlap bags in cold storage at 30 to 35°F. until May 1. The seed is removed from cold storage and measured out in one pound units.

Sycamore is seeded by hand at a rate of one to three pounds per 500 foot bed depending on the quality of seed. Germination rates vary from 30 to 65 percent giving us 5 to 15 seedlings per square foot.

After the seed is sown, 1/4 inch of sawdust is applied. Any variance in depth of mulch will be detrimental to germination.

Irrigation is applied immediately after mulching with sawdust. It is critical to keep the beds wet until the cotyledons appear, so irrigation must be applied twice daily in small amounts.

We apply 100 pounds per acre of 33-0-0 per week during the growing season. This will give us a seedling of 1/4 to 3/8 inch caliper. Our normal production is 250,000 seedlings per year.

COTTONWOOD
Populus deltoides

Cottonwood is one of our more interesting hardwood species to raise. Seed is collected locally from our seed production areas when the catkins begins to open on the parent tree, usually middle of May. Twigs containing catkins are cut from the tree. These, "twigs", are then inserted in the beds at two foot intervals. The catkins continue to open and the seed is dispersed over the beds by the wind. The beds are roughed up with a tooth harrow prior to seeding for better adhesion of the seed to the bed surface.

Short "spurts" of irrigation, no more than thirty minutes , is required during seed dispersal and germination.

Ideally we like 15 to 20 seedlings per square foot using this method.

With a 100,000 to 150,000 yearly demand of cottonwood seedlings we have found the above practice meets our requirements.

BLACK LOCUST
Robinia pseudoacacia

Black locust is one of the few hardwoods we are able to raise similar to our pine species. Our seed is purchased from commercial vendors and stored in cold storage. The middle of June we seed the black locust at a rate of 12 to 14 pounds per 500 foot bed. Black locust is a fast growing species and when seeded earlier the stock gets too large. The shoes of the seeder **are set down 1/2 inch so as to seed 1/4 inch deep. The beds are rolled to firm them and sprayed with Treflan for weed control.**

Irrigation is applied at a rate of 3/4 inch to 1 inch per week for the first two weeks. The black locust seed will germinate within three days and after two weeks irrigation will be reduced to "as needed". Usually normal rainfall will be sufficient.

Two million black locust seedlings are raised yearly at the two nurseries in Kentucky.

BLACK WALNUT
Juglans nigra

Black walnut has been one of the most difficult species to raise at Morgan County Tree Nursery. We have had problems with disease, weeds, germination, growth and any other problems known, we usually run into them. **We have tried several methods of raising black walnut seedlings and have recently been fairly successful with the following.**

Cur seed is purchased throughout the state by our district personnel and transported to the nurseries in late October. Ridges are prepared with three foot alleyways instead of our standard nursery beds. The unhulled seed is then sowed in a four inch trench within these ridges. With a germination rate of 40 percent, a bushel of unhulled seed is sowed every 10 to 15 feet. The seed is covered two to three inches by remaking the ridges.

Irrigation is applied during germination and curtailed during the growing season. Normal rainfall is usually sufficient.

We strive for 150,000 to 200,000 black walnut seedlings per year. With the various problems we have, the demands for our seedlings usually are greater than our production.

BICOLOR LESPEDEZA
Lespedeza bicolor

Commercial vendors provide us with our bicolor lespedeza seed. Good seed with 50 to 80 percent germination is seeded in early May with the eight row nursery seeder. Two pounds per 500 foot bed is sown. The shoes of the seeder are set down 1/2 inch so as to sow the seed 1/4 inch deep. No mulch is used and the beds are rolled to firm them.

Our normal irrigation practices are followed during the growing season along with Treflan as a herbacide.

With this simply but effective practice we raise 250,000 seedlings with 1/8 inch caliper and 8 inch minimum top.

YELLOW POPLAR
Liriodendron tulipifera

Yellow poplar seed is collected following timber harvest operations, throughout the state by our district personnel. The cones are transported to the nurseries in late October and spread out to air dry. When the cones start to open they are placed on rat wire screens for the seed to filter through. We hand seed yellow poplar the first of November, at a rate of one bushel per 25 foot bed surface. The beds are then mulched with 1/2 inch of sawdust and a layer of wheat straw.

Irrigation is applied in early April during germination. Normal irrigation practices are followed during the growing season.

Topdressing of 33-0-0 is applied during the growing season at a rate of 100 pounds per acre when needed to facilitate growth.

With this practice we produce 200,000 to 250,000 yellow poplar seedlings with a caliper of 3/16 inch and 12 inch minimum height.

EUROPEAN BLACK ALDER
Alnus glutinosa

Local seed production areas produce our black alder seed. Cones are picked in October and the seed is extracted with the DYBVIG macerator after the cones open from air drying. The cleaned, air dry seed is then stored in kegs over winter in cold storage.

In March seed beds are prepared on ground fumigated the previous fall. With 40 to 60 percent germination, we seed by hand three pounds per 500 foot bed. March seeding is essential since emerging seedlings are highly susceptible to sun scald. Sawdust mulch is applied at a rate of 1/4 to 1/2 inch.

Daily irrigation is applied until germination is completed, then irrigated as needed through the growing season.

Pesticides applied are Poast and Treflan for weed control.

This practice gives us 10 to 15 seedlings per square foot. We normally raise 250,000 to 300,000 black alder with a caliper of 1/4 inch and a 12 inch minimum height.

The amount of hand labor involved, the amount of land space involved, and the diversity of many species, together make for a challenging but rewarding profession in producing hardwood seedlings.

The end result, a quality stand of hardwood timber, though many years in the future, justify all the headaches, problems, and frustations endured at the nurseries.