

## Silviculture for Your Varietal Loblolly Pine Plantation

—Jeff Wright and Derek Dougherty

Varietal pine seedling availability is rapidly increasing and will continue to capture a larger share of the traditional open-pollinated seedling market. Varietal seedlings offer greater stand uniformity, increased productivity potential, and a much lower percentage of stem defects. The cost of production for varietal seedlings, through the advanced somatic embryogenesis process, is higher than traditional seedlings. Because both the production potential and cost are increased, purchasers have to give additional consideration to the silvicultural treatments and scheduling necessary to allow these advanced seedlings to attain their full potential.

Initially, forest managers based potential stand volume and value estimates on the soil quality; basically how much timber the soil is capable of producing without management. They soon realized that they could improve site productivity above the inherent productivity levels of the soil through silvicultural activities, such as quality site preparation, weed control, and fertilization.

Now, with varietal seedlings managers gain much greater control over the genetic influence on productivity and stand quality. Previously, with open-pollinated seedlings the mother tree (cone) was known but the father tree (pollen) was unknown. This introduced substantial variability. In contrast, with varietal seedlings, not only are the mother and father trees controlled, but the best of the best offspring is chosen and replicated repeatedly. Thus, when managers establish a varietal plantation, they have the best tree and an identical tree placed at every planting spot. This removes the variability from the genetic side of the production potential equation.

Planting the same variety at each planting spot still leaves substantial variability in individual tree and plantation growth, but now this variability can be attributed and isolated to a combina-

tion of soil characteristics, site environment, and silvicultural actions. Given everything a variety needs to grow (water, nutrients, light, carbon, and time), the varietal seedlings will exhibit their full potential under the climactic conditions that exist; thus, managers can determine the potential for a given variety in a defined area. This is important because it allows a comparison of the potential of the variety versus what is actually produced. The difference can be termed "fall-down," with fall-down being the lost growth or value that could be potentially gained or captured if our management can be improved.

For instance, as estimated and summarized in the evaluation exercise in the accompanying article on page 15, the difference in value potential between a forest manager growing varietal loblolly pine plantations and operating at a site index (SI) 75-foot level of productivity (growing 75-foot tall pine plantations in a 25-year period) and a forest manager operating at a SI 95 level of productivity (95-foot tall plantations in a 25-year period) may be a gross harvest value difference of \$5,759 per acre. In this evaluation, \$5,759 per acre is the reward to be gained perfecting systems of management and providing these trees with all that they need to grow. In this article, we will discuss the silvicultural processes that would decrease factors limiting growth in varietal plantations.

### VARIETAL SELECTION

While we are talking about varietal forestry, in which each individual tree within a specific variety is identical, realize that there is tremendous variability between the different varieties that are coming on the market. Varieties differ in nutrient use efficiencies, stem form, branch size and angle, internode length, crown characteristics, growth rate, and stability. This is important from a diversity standpoint and it is a responsibility of the tree improvement community to



preserve and actually attempt to broaden the variability. Broadening the varieties available will help in meeting specific tree improvement goals now and better preparation for unforeseen challenges and opportunities in the future.

While a varietal plantation manager has little control over the actual development of these varieties, it is very important to understand the traits and requirement of the variety you select and purchase to optimize its growth potential. For instance, if you purchased Mead-Westvaco Variety ON-10 through Arborgen, which has narrow crown characteristics and small branch characteristics, you might be able to plant 350 seedlings per acre without concerns of large branch production, which lowers wood quality.

Other considerations affecting the variety you select for your property should include the variety's zone of origin versus the location of the land base, the geographical area the variety was tested in, your individual timber management objectives, and varietal availability. Your varietal seedling salesperson should be able to assist you with the details of this decision process.

#### INITIAL PLANTING DENSITY DECISIONS

Varietal seedlings offer a couple of major advantages regarding initial planting density. For decades, foresters have planted high numbers of seedlings to insure survival and to reach an adequate number of potential crop trees per acre. For instance, to get 200 quality sawtimber trees per acre for final harvest with an open-pollinated seedling mix averaging 30 percent quality trees (no forks, fusiform rust, crook, or suppression) foresters would have needed to plant 667 trees per acre. With survival concerns, the forester might have planted additional trees on top of that, perhaps 700 or more seedlings per acre. In contrast, with a quality varietal selection having potentially 100 percent crop trees (all identical and chosen for form), the number of initial seedlings needed drops significantly. Also, many varietal seedlings are now being produced as containerized stock, improving the

#### Planting number Category

500-600 per acre	Landowner's site preparation or herbaceous weed control commitment is minimal
400-500 per acre	Landowner will purchase and plant wider crowned varieties and apply intensive silviculture
350-400 per acre	Landowner will purchase and plant elite, narrow-crowned varieties with small branching characteristics and apply intensive silviculture

chance of survival.

Varietals are still of concern regarding environmentally-influenced defects and survival. Opinions regarding initial planting numbers differ greatly. The authors' opinion and recommendations for varietal plantation establishment are above.

#### SITE PREPARATION FOR VARIETAL PLANTATIONS

Any inherent site limitations that decrease growth potential must be addressed prior to the establishment of varietal pine plantations, including soil drainage and density problems and existing competing vegetation. If the soils on a landowner's tract or a portion of his or her tract to be planted are in the somewhat-poorly to very-poorly drained classes, these areas should be "bedded," similar to the furrows created in row-crop agriculture, only larger. A single-pass bed may be sufficient for the somewhat poorly to poorly drained areas. However, the very-poorly drainage class areas would benefit from "double bedding."

If the bulk density of soil is such that it will impede root growth, some sort of tillage must be considered. If the soil's bulk density is higher than 1.4 g/cm<sup>3</sup>, depending on texture, the soils should be sub-soiled or "ripped". Ripping involves using a dozier or large tractor to pull a deep "shank", generally 18 to 24 inches in length, through the soil of the cut-over or field to be planted. The ripping process will help to decrease soil density, improve porosity, and help insure that a quality planting job will be completed. Some managers choose to use a three-in-one type tillage operation which incorporates subsoiling, tillage,

and bedding in one pass.

All tracts have competing vegetation in place. Some competing vegetation is harder to control than others. Imazapyr will control many hardwoods and broadleaf weeds. A major key in quality control is correctly identifying and not missing any of the tougher competitors to insure application of the best tank mix of herbicides at the appropriate time to control them. Some to watch for are waxy-leaf brush, invasive species like bermuda or kudzu, and natural pines. Failure to fully control these species before establishment will result in lessened growth and increased risk to herbicide damage.

#### HERBACEOUS WEED CONTROL

Early growth of a varietal plantation is primarily driven by available soil moisture. If a varietal plantation has all the water it needs, it may end up with trees of average heights between 4 to 6 feet at the end of the first growing season. In contrast, left sitting and competing in the weeds, growth will be considerably lessened, generally only 1 to 2.5 feet tall at the end of the first growing season. Water deficits can develop even without weed competition, but they can become severe, even to the point of causing mortality, without weed control. Quality herbaceous weed control is crucial to permitting varieties to express their potential.

Herbaceous weed control treatment success, like chemical site preparation or hardwood release treatments, requires proper herbicide tank mixes and application timing. Prevalent chemicals for weed control include imazapyr, sulfometuron, hexazinone, metsulfuron methyl, and glyphosate. These are



applied either in a spot (generally 5 to 6 feet centered on the seedling), a band (often 4 to 5 feet centered along the row), or broadcast (covering the entire area). Treatments will either be applied "over-the-top" or directed (directly to the competition, not in contact with the seedling). Timing is critical. Most of these chemicals are best applied as pre-emergents, prior to the competition sprouting or becoming too established. Directed treatments require sprouting.

The first treatment of the year will generally be applied in March or early April, but can be even slightly later if there is soil active carryover from the previous year's chemical site preparation treatment. Carryover is common when higher rates of imazapyr or two to three ounces per acre of sulfometuron methyl are added to the site preparation tank mix and the application is made late in the year from September through November. Some managers will choose to complete a follow-up herbaceous weed control treatment in the summer of the first growing season on very fer-

tile sites and on converted agricultural land. This treatment will often be completed between mid-May and early July, when the first chemical herbicide treatment begins to break down, or when the harder, later-sprouting weed seeds begin to sprout in the converted agricultural land.

#### **FERTILIZATION**

If landowners have prepared their sites well, chosen a quality variety, and controlled the herbaceous competition to jump-start the plantation, the varietal timber stands will have fully occupied the site resources. Near the time of crown closure or thereafter, nutrients may become limited. The actual timing of nutrient deficits occurring will depend on the inherent nutrient supplying capacity of the site and the demand of the variety. More fertile sites may not be limited as early in the forest rotation. To maximize growth in a varietal plantation, nutrition deficits should be identified and eliminated.

Nutrition deficits can be identified

through the completion of foliar nutrient analysis throughout most of the rotation. On a lesser percentage of sites, primarily on poorly drained sites in the lower Coastal Plain areas, growth may be limited very early in the rotation by low phosphorus. These limitations can be identified through soil tests and, in some cases, visually. If the plantation gets off to a strong start, but then growth appears to slow dramatically, the trees show a hesitancy to produce leaf area, and the crowns are not full and do not tend to close, landowners should test for low phosphorus. When concentration levels fall below critical levels for phosphorus, nitrogen, or other important nutrients, fertilizer can be added either by ground-mobile or aerial application. Application rates, estimated growth responses, and preferred application timings have been researched in detail by the Forest Nutrition Cooperative, so co-op members can make solid recommendations for you to meet site limitations.



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## Thinning

Mid-rotation commercial thinning is a common practice in loblolly pine plantations in the southeastern U.S. The purpose of the thinning is to select the best crop trees for sawtimber production, lower the number of tree on each acre, and decrease competition for limited resources of light, water, and nutrients. Because of the limited number of trees in the stand that were inherently capable of producing higher valued product classes, it has often been a struggle to lower density while protecting the qual-

ity trees. Varietal plantations will make forest management much easier when it comes to thinning, due to the substantially increased percentage of grade or quality "crop" trees. When thinning a varietal plantation, landowners will be able to focus quality control concerns on the number of residual trees, getting it just right to grow a target size tree, rather than having to leave a lot of extra trees that take away resources, just to make sure that there are enough good trees to make a financial crop.

Landowners will still want to inspect

their varietal stands prior to thinning to make quality recommendations. While the inherent crop tree percentage will be very high in the chosen varieties, they can still be affected by the environment. Issues like ice storms, hurricanes, tip moth attacks, or deer predation can cause variability in the stand. Similarly, the forest manager's decision-making skills and contractor quality control can still introduce considerable variability. During a pre-thinning inspection, managers should consider the number of quality trees and make sure that they do what is necessary to protect them if the percent crop trees have been lowered by environmental or silvicultural variability effects.

## Conclusion

Research and innovation have given the landowners of working forests new opportunities to utilize today's best technologies, which include varieties and silviculture. The potential for increased volume and value production from varietal plantations is real and substantial. Collectively, the managers of private forestland in the southern U.S. have tried and tested many intensive silvicultural regimes over the last 50 years. Some currently implement these regimes with open-pollinated pine plantations. Others focus on cost control and settle for the combination of inherent soil productivity with some gains simply from second generation genetics and quality hardwood control.

Now, with the substantially stepped-up potential of varietal forestry, there is strong justification for re-evaluating and assessing the methods, intensity, and timing of many of these management activities. Because the total potential has been increased with varietal forestry, the potential marginal rates of return for even the individual management activities are increased as well. Implementation of site-specific and variety-specific management regimes will be needed for landowners to reach the potential of varietal forestry.

