Improved Returns on Forestlands:

A Financial Analysis of Mass Control Pollinated and Varietal Seedlings

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Only recently have seedlings with the genetic quality of mass control pollinated (MCP) and varietal material been available for non-industrial private forest landowners. MCP planting stock consists of seedlings produced by the application of pollen collected from the best father tree to the flowers of the best mother tree. This approach produces the very best growth, stem form, and disease resistance possible from loblolly pine orchards. Varietal planting stock derives from selection of the best individual from the "best MCP parent cross" and replication of this individual. The use of varietal planting stock means that every planting spot is planted with a seedling that has the highest genetic gain possible.

Recently, MeadWestvaco gave a group of forest landowners and managers an exclusive tour of its Charleston, South Carolina, loblolly pine plantations established with some of the most advanced genetically improved planting stock. The opportunity to see experimental forest stands ranging in age from two to 13 years that were derived from this advanced genetic material was a real eye-opener! Seeing stands that are projected to attain heights of 93 to 105 feet by age 25, versus standard plantations capable of heights of 65 to 75 feet at the same age certainly necessitates a reevaluation of the potential returns possible from forestlands in the southeastern United States.

The increased returns from using enhanced genetic seedlings can help to offset the higher cost of forestland today and can help landowners in the southeast remain competitive global wood suppliers. Two of the primary factors that determine returns from pine plantations are the genetic quality of the seedlings planted and the silvicultural treatments used to channel site resources to the planted seedlings. For this article, Dougherty &

Product	Stumpage Price	Product Specifications
Pine Sawtimber:	$45/ton	13.0" dbh o.b. to 8" top dib
Pine Pulpwood:	$8/ton	4.0" dbh o.b. to 2" top dib
Pine Chip-n-saw:	$22/ton	9.0" dbh o.b. to 6" top dib

Genetic Option	$/Seedling	$/M
Bareroot OP	$.05	$50
Bareroot MCP	$.11	$110
Bareroot Varietal	$.40	$400
Containerized OP	$.11	$110
Containerized MCP	$.15	$150
Containerized Clone	$.50	$500

Estimates include treatment and shipping

Activity	Cost
Handplanting Labor	$45/acre
Chemical Site Preparation	$105/acre
Chemical Site Preparation — Wide Row Spacing	$65/acre
Mechanical Shear	$140/acre
Mechanical Shear — Wide Row Spacing	$100/acre
Mechanical Bed	$90/acre
Mechanical Bed — Wide Row Spacing	$60/acre
Herbaceous Weed Control Band	$40/acre
Herbaceous Weed Control Broadcast	$60/acre
Herbaceous Weed Control Directed Spot	$50/acre
Herbaceous Weed Control Directed Total Acre	$100/acre
Herbaceous Weed Control Banded Wide Row	$30/acre
Fertilization — Heavy Dose	$120/acre
Fertilization — Lighter Dose	$100/acre
Machine Planting Labor	$70/acre

Evaluation Methods, Carrying Costs, and Assumptions

- Net Present Value
- 7% Discount Rate
- Land Cost of $1,000/acre
- "Real," Non-inflated Stumpage Values and Management Costs
- Annual Taxes Assumed Offset by Hunt Club Leases

Figure 1: Prices, costs, and discount rate assigned for financial evaluation of MCP and varietal seedlings

Despite the much higher per seedling cost, the varietal plantations showed potential for the highest return rates, overcoming the added cost with improved productivity potential and the highest percent grade.

Dougherty Forestry Services Inc. conducted an independent analysis (using the assumptions and choices in Figure 1) that compares the benefits that can be attained by varying genetic quality of seedlings used to regenerate loblolly pine stands in the southeastern United States, such as tour participants saw on MeadWestvaco's plantations in Charleston.

Figure 1 provides a list of assumptions and choices regarding costs, stumpage prices, and economic variables that allow for the comparisons of the potential impacts of deploying enhanced genetics on future stand value. (Because markets vary considerably, Tree Farmers and forest management professionals should make their own assumptions and choices for making their personal or corporate evaluations, and should make estimates of future yields, as well). In this particular analysis, growth and yield (G&Y) projections were provided by MeadWestvaco, whose G&Y model is developed for the area in which the tour was conducted and has been validated for high yielding stands. The predicted yields correlated well with the volumes actually observed in the toured stands.

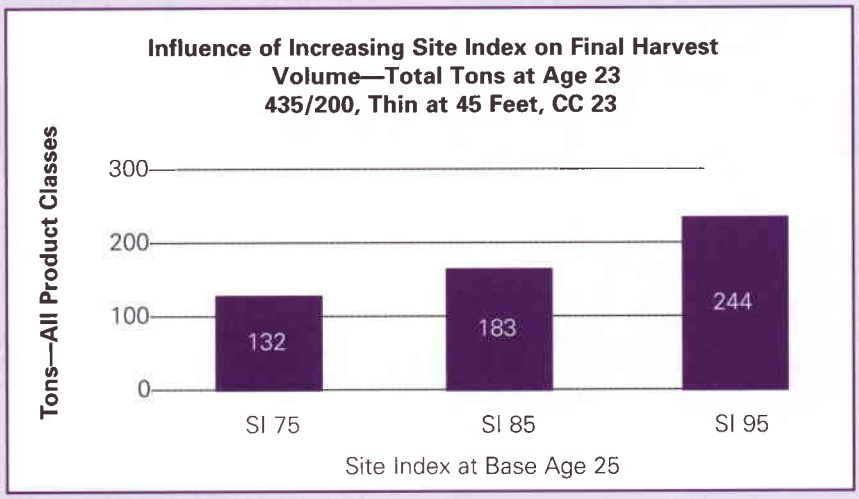

Figure 2: Increases in productivity can be obtained through either increased genetics or improved silviculture. For the standard evaluation regime, an increase of 20 feet in exhibited site index increased final harvest volume by 112 tons/acre in a 23-year rotation.

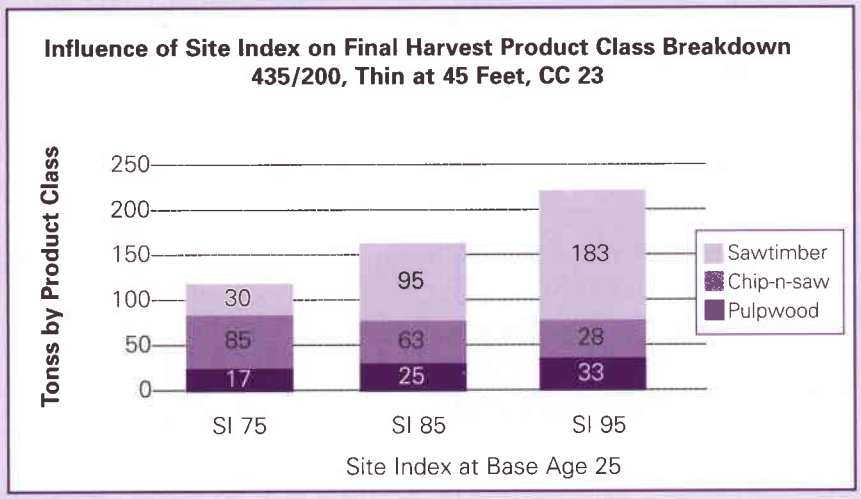

Figure 3: Assuming 100% grade (all trees meeting diameter requirements are sufficient in quality to make the higher valued product class), increasing productivity from an exhibited SI 75 to SI 95 at base age 25, increased sawtimber production from 30 tons/acre to 183 tons/acre at final harvest at age 23.

Increased Site Productivity: Genetic Vs. Silvicultural Contributions

Most landowners, without detailed studies, cannot separate the results obtained from silvicultural techniques from the gains obtained from planting enhanced genetic planting stock. What they see standing in the forest is the tree's phenotype, which is the exhibited growth resulting from the tree's genotype and its interaction with its environment; thus it is hard to isolate the direct genotype results. However, we can say with certainty that if Tree Farmers increase productivity, either through enhanced genetics, improved silviculture, or a combination of the two, they increase potential value of stands as demonstrated in Figure 2.

For demonstration purposes, we projected stand values for a standard regime at three site productivity levels, including site index (SI) 75 feet (growth potential to produce dominant and co-dominant trees that are 75 feet at age 25), SI 85 feet, and SI 95 feet. The standard regime we used for this analysis included intensive site preparation, planting of 435 trees per acre, herbaceous weed control treatment, thinning to the best 200 trees per acre when the dominant/co-dominant pines reached 45 feet, and clear-cutting at age 23. The resulting volumes removed at the final harvest were 132 tons, 183 tons, and 244 tons for the increasing productivity levels. An increase in site index of 20 feet increased final harvest volume significantly: by 85 percent. The major increase in value comes from pushing a larger portion of the trees into the higher valued product classes as noted in Figure 3. Estimated final harvest values for the increasing productivity levels were as follows: $3,356, $5,801, and $9,115. Thus, in this example, an increase in site productivity of 20 feet created a potential gross harvest value increase of 172 percent.

The Isolated Effect of Percent Grade/Crop Trees

Not many people have seen loblolly pine plantations worth $9,115/acre at age 23, primarily because few managers have reached this level of productivity, but also because the product allocations (breakdowns between pulpwood, chip-n-saw, and sawtimber) predicted in the models do not always meet what we see in the real world, because the percent grade (the percent "crop" trees), or the inherent percent of trees in a plantation that will make sawtimber or higher product classes in a reasonable time, are limited in traditional open-pollinated stands.

In most existing plantations on non-industrial private forest (NIPF) land, only 25 to 50 percent of the trees in the original planted population, prior to the first operator-select thinning, will show the potential to make multi-log trees in the sawtimber product

class. The remaining 50 to 75 percent are forked, crooked, suppressed, or diseased. After one typical operator-select thinning in these stands on NIPF lands, there are still often only 50 to 60 percent of the residual trees that are capable of making the higher product classes. While there is certainly wide variability in quality percentages for open-pollinated seedlings, we used 55 percent in this analysis as a residual, post-thin percentage for operator-select plantations. In comparison, mass-control pollinated stands, with a known flower and pollen supplier combination, may average 80 percent quality crop tree potential after one operator-select thinning. In theory, varietal plantations, with the best tree and the identical genotype at each planting spot, should have 100 percent crop trees. In this analysis, we used a 95 percent grade trees estimate after thinning, simply to acknowledge that environmental factors, not only genetics, can limit actual percent grade trees in a stand.

To isolate the effects of percent grade, we set the productivity or site index at 90 feet, estimates of 55 percent grade for open-pollinated, 80 percent grade for MCP, and 95 percent grade for varietal; we made projections utilizing the same standard management regime as listed above. The results in product allocation are shown in Figure 4. The results in gross harvest value, as shown in Figure 5, were $4,927 for open-pollinated, $6,348 for MCP, and $7,246 for varietal plantations, showing clear potential for value increase from improvements in percent grade alone.

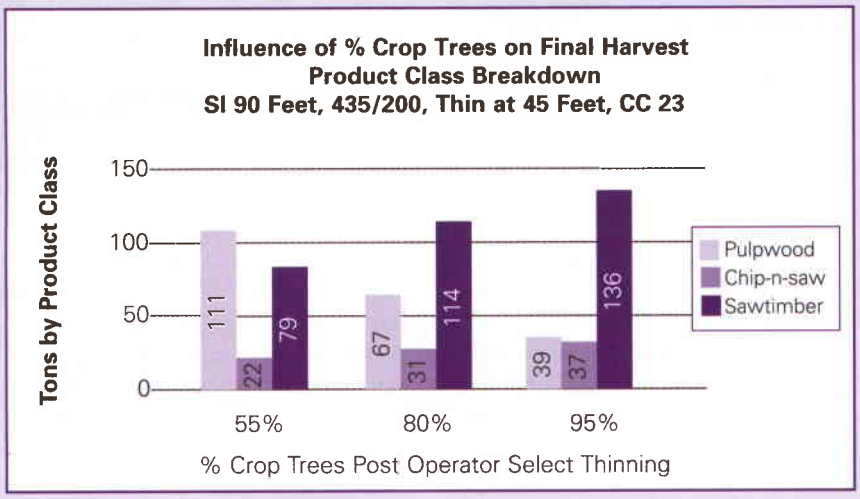

Figure 4: At a fixed level of productivity, the percent of grade or quality potential "crop" trees has a major effect on the production of higher-valued timber.

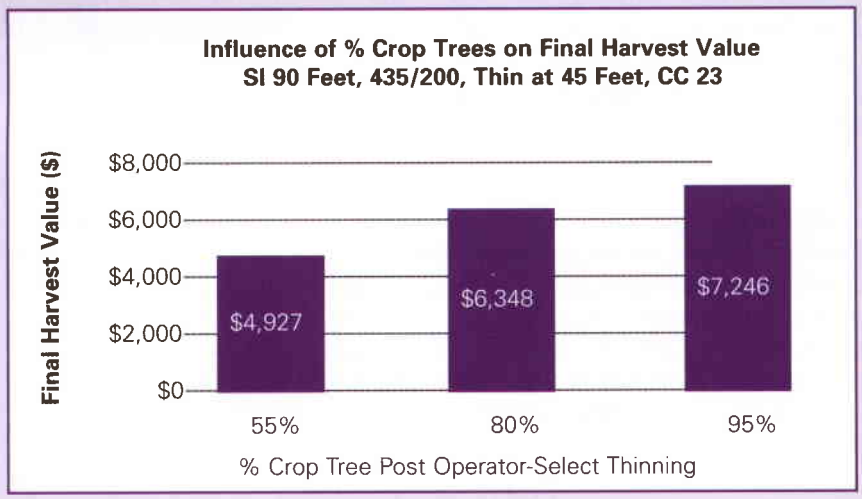

Figure 5: At a fixed level of productivity, increasing the inherent percentage of trees capable of making sawtimber versus just pulpwood from 55% to 95%, increased final harvest value by 47% at age 23. The only way to improve the inherent percentage of quality trees is through improved genetics.

The Combined Effect of Increased Site Productivity and Percent Grade

To reach full potential, Tree Farmers need to plant seedling genotypes with high efficiency that also have strong inherent grade potential. If they do this, control competition for water, meet stand nutrient requirements, and control density to focus growth into higher product classes, what is the potential stand value? To evaluate this, we assigned the potential productivity for the three levels of genetic improvement based on actual yield levels; choosing site indices of 87 feet for open pollinated seedlings, 92 feet for mass control pollinated seedlings, and 99 feet for varietal seedlings. The previously chosen percent grades expected for each level of genetic improvement were then applied to the harvest volume predictions to determine product class allocation volumes by genetic level. This exercise estimates the potential gross harvest value of open-pollinated plantations to be $4,267/acre for the chosen comparative management regime, $6,755 per acre for mass-control-pollinated seedlings, and $10,036 per acre for varietal plantations, under the provided assumptions. In this example, the MCP plantation was capable of producing 58 percent more value, and the varietal plantation was capable of producing 135 percent more value in the same time period as compared to the open-pollinated plantation.