



# ||| GENETICS CASE STUDY

## VALUE VALIDATED FOR LANDOWNERS

Advanced genetics delivers added value to forest plantations  
in a mid-rotation aged Loblolly Pine plantation

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A typical loblolly pine nursery bed holds 20 to 25 seedlings per square foot. The crop is grown and managed to produce a finished seedling roughly 10 to 12 inches tall and 4.5 to 5 millimeters in root collar diameter.

Seedlings from different genetic families appear to be the same when in the nursery, however, the stands they grow into are anything but identical. Today, landowners can choose among numerous levels of genetic categories. These “genotypes” and their associated productivity and financial gains differ widely and represent an important opportunity for landowners. Unfortunately, the choice of the type of seedling genetics is not a priority for many landowners due to a lack of education on the topic or a lack of confidence in how the trees will perform.

### ||||| Choosing wisely for your next plantation ||||||||||||||||||

The decision of what type of seedlings to purchase is critical to productivity and log quality of the new stand. Although planting is near the end of the regeneration process, the decision of what to plant and the seedling order to be placed should be reviewed well in advance of planting. Selecting a family that is susceptible to fusiform rust can be catastrophic to the financial value of the stand. Selecting a family without superior straightness can lead to poor quality sawtimber, and compromising on growth rate will prevent maximizing the yield potential. Good silviculture is critical for great genetics but cannot overcome a choice of poor genetics.

In the last few years there has been an increase in genetic choices for reforestation. With loblolly pine, landowners can choose among open-pollinated (OP), control-pollinated (CP) or varietal seedlings. Information about these different seedling types is readily available, but what do we make of it? Will it help landowners add value to their plantations?

### ||||| A Real World Value Added Example ||||||||||||||||||

Let’s take a look at a genetics comparison study that was established in 1998 in South Carolina’s Berkeley County by MeadWestvaco. Following harvest, typical lower coastal plain site preparation was completed including bedding and chemical application.





controlled. (Control-pollinated seedlings are marketed as MCP® Seedlings by ArborGen.)

The trial initially was planted at 605 trees per acre (TPA) on a 7'x10' spacing but was systematically thinned to 303 TPA at age five because the stand was growing quickly. The stand was fertilized with nitrogen and phosphorus at five years. At the end of the 12th growing season the stand was operationally thinned along with the surrounding commercial plantation.

Pre- and post-thinning measurements allowed an analysis of growth and yield, along with stem quality both at thinning and a projected final harvest. Stem quality for each tree was assessed by evaluating for defects such as stem galls from fusiform rust infection, excessive sweep and crooks, and stem forks. All of these traits were combined into single quality score called “sawtimber potential” (STP).

### |||| The Results |||||

The control-pollinated family CP-1 had the greatest growth rate in the MeadWestvaco trial and both CP-1 and the other control-pollinated family, CP-2, had significantly higher proportions of sawtimber quality trees both before and after thinning (Table 1). Family CP-1 was exhibiting a growth rate of 9.5 green tons/acre/year compared to the OP families that ranged from 7.57 to 8.22. The combination of superior growth rate and high quality stems is the basis of the

financial returns that are possible with control-pollinated trees.

### |||| Thinning, Basal Area & Sawtimber Potential |||||

At the time of thinning, all families were exceeding the previous stand's site index with good silviculture and strong genetics, but they were not the same. After 12 years of growth, CP-1 was exhibiting a site index of 97' followed by OP-1 at 94'. However, because growth rate is not the only factor creating stand value, log quality traits such as reduced fusiform galls, log forking, and straightness were measured. The inventory data were processed to build stand tables, and these were projected to an optimal economic rotation age of 24 using ForesTech's SiMS 2009 growth and yield simulator.

After thinning, the differences in STP percentage became closer among the families, but the OP families had much lower stocking thus reducing future volume and value. For example, OP-1 was “up-graded” from 53 percent to 80 percent STP. However, the residual basal area (BA) was 48 ft<sup>2</sup>/acre, well below the desired target of 70 due to the large number of defective trees removed.

The control-pollinated CP-1 was improved from 80 percent STP to 90 percent STP but unlike the control, CP-1 had many more sawtimber quality trees and a desirable BA level of 71 ft<sup>2</sup>/ac was achieved. Perhaps

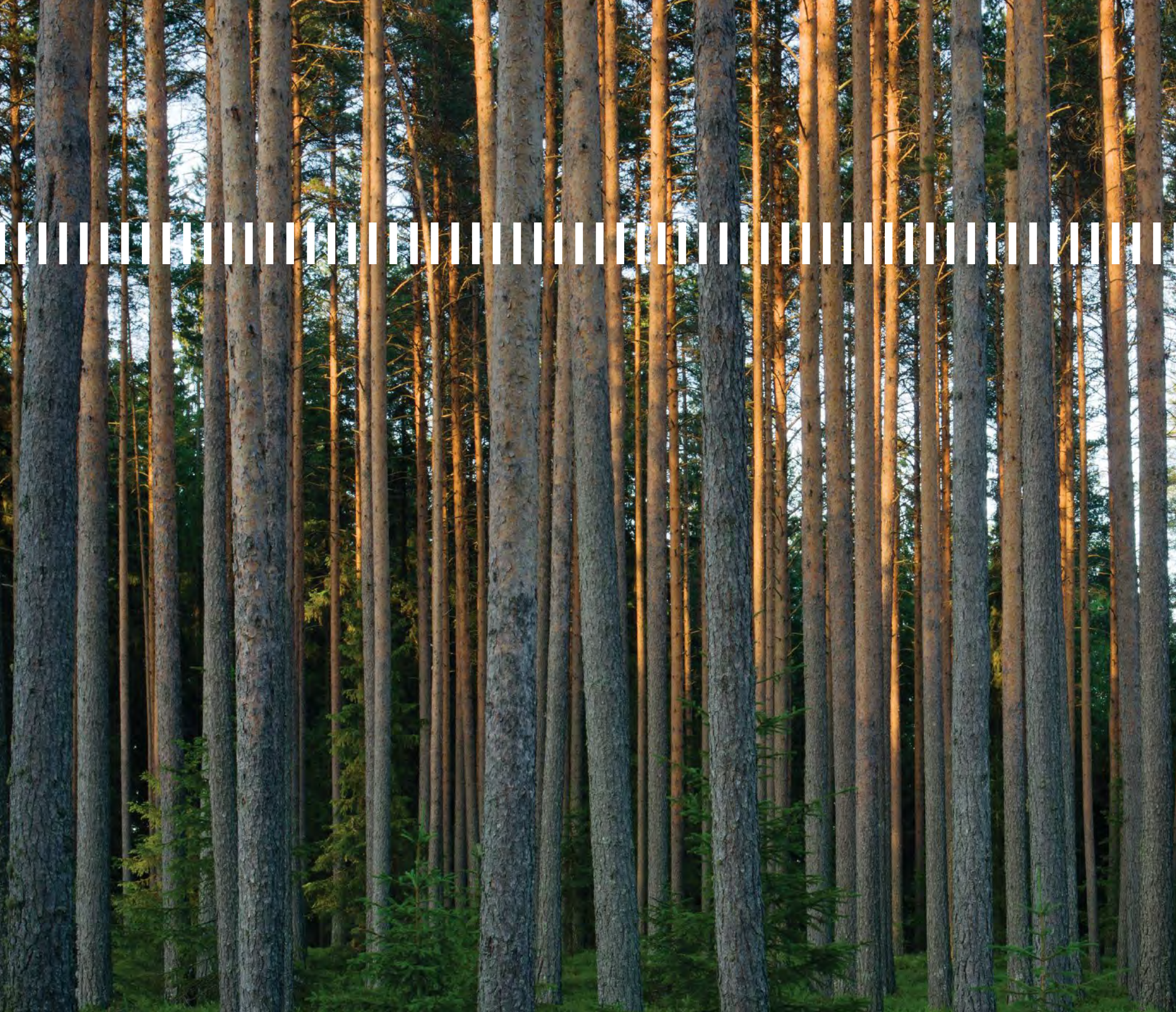
The previous stand exhibited a site index (base age 25) of 78 feet. Three open-pollinated families were planted along with two control-pollinated families in 64 to 72 tree blocks with four replicates of each family. With control-pollinated seedlings, both male and female parents are known and

TABLE 1  
Growth, Site Index & Sawtimber Proportion by Genotype

| Genotype | Improvement Level | SI Projected | MAI tons/ac/yr | Sawtimber Potential After Thinning |     | Sawtimber Potential Before Thinning |     |
|----------|-------------------|--------------|----------------|------------------------------------|-----|-------------------------------------|-----|
|          |                   |              |                | Yes                                | No  | Yes                                 | No  |
| OP-1     | OP                | 94           | 7.86           | 80%                                | 20% | 53%                                 | 47% |
| OP-2     | OP                | 93           | 8.22           | 81%                                | 19% | 66%                                 | 34% |
| OP-3     | OP                | 88           | 7.57           | 71%                                | 29% | 58%                                 | 42% |
| CP-1     | CP                | 97           | 9.50           | 90%                                | 10% | 80%                                 | 20% |
| CP-2*    | CP                | 91           | 8.27           | 93%                                | 7%  | 83%                                 | 17% |

\*CP-2 is no longer commercially produced.





**TABLE 2**  
**Summary of Product Yields\* (tons/ac) and Financial Metrics (\$/ac, % )**

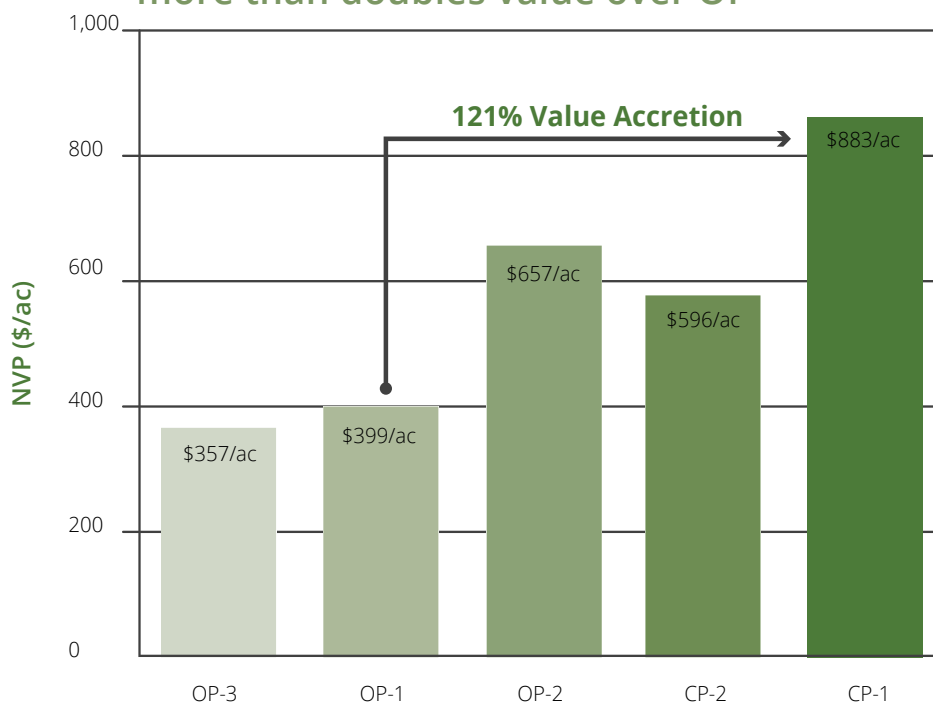
| Genotype     | Thin: Yr. 12 |     | Clearcut: Yr. 24 |     |      | BLV    | NPV   | Regime | Revenue (\$/ac) |          |        |
|--------------|--------------|-----|------------------|-----|------|--------|-------|--------|-----------------|----------|--------|
|              | PW           | CNS | PW               | CNS | ST+P | \$/ac  | \$/ac | IRR(%) | Thinning        | Clearcut | Total* |
| <b>OP-1</b>  | 12           | 20  | 9                | 39  | 56   | 530    | 399   | 9.7%   | 474             | 2,480    | 3,294  |
| <b>OP-2</b>  | 15           | 24  | 10               | 36  | 81   | 873    | 657   | 11.3%  | 583             | 3,198    | 4,228  |
| <b>OP-3</b>  | 13           | 23  | 19               | 52  | 38   | 474    | 357   | 9.5%   | 545             | 2,230    | 3,058  |
| <b>CP-1</b>  | 5            | 37  | 7                | 39  | 107  | 1,1173 | 883   | 11.7%  | 720             | 4,034    | 5,329  |
| <b>CP-2*</b> | 8            | 35  | 4                | 59  | 65   | 791    | 596   | 10.5%  | 720             | 3,023    | 4,167  |

\*Total Revenue: arithmetic summation





## Control-pollinated family more than doubles value over OP



The highest revenue differential between the control and the other genotypes was again between OP-1 and CP-1 plots, with a gain of \$2,035 per acre for CP-1 or 62 percent. In comparing all of the family categories, planting control-pollinated CP-1 generated higher returns compared to the OP seedlings, including the control family, OP-1, an industry benchmark. These dramatic financial gains were achieved with a modest cost increase of at \$55 more per acre for the CP-1 vs. the control, OP-1 and resulted in a 15 percent rate of pre-tax return.

Landowners now can select and purchase genetically superior loblolly pine seedlings having a wide array of improvement. Advanced products such as control-pollinated pine trees and varieties offer additional value over traditional OP seedlings but, heretofore, there has been little data from older stands confirming the expected performance. This genetic comparison study by MeadWestvaco offers real numbers that validate the superior performance of control-pollinated over some of the best OP families in the market. Financial returns on this site were all good, but CP-1 demonstrates the value that is possible for all landowners who invest in control-pollinated seedlings with a 121 percent increase in NPV, a 61 percent

increase in revenue and a 15 percent marginal rate of return over OP family OP-1.

## Perspective

The commercialization of control-pollinated seedlings (such as control-pollinated with this genetic technology) is not a new development as more than 325 million full sib seedlings have been planted (NCSU, 2013) on 500,000 acres, more than 40 percent of which have been produced by ArborGen. Control-pollinated seedlings clearly have the potential to create enormous value for forest landowners willing to aggressively practice progressive forest management. With this analysis of realistic estimates of the validation of control-pollinated seedlings' delivered value, and the continuous improvement in forest genetics, new control-pollinated plantations will likely exceed the estimates we have presented in this article. ■

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more simply, the CP-1 had 132 sawtimber trees per acre versus 106 for the control, OP-1. Therefore, the CP-1 stands had higher volume per acre, have higher sawtimber potential and will generate much greater revenue at final harvest.

## Financial returns from elite genetics in this trial

Table 2 contains yields, Net Present Value (NPV) and simple revenues for the five genotypes in this study. The highest BLV differential between the control and the other genotypes was for the OP-1 and CP-1: a \$484 per acre increase for CP-1 or 121 percent.