The Impact and Value of Tree Improvement in the South

By David Todd, John Pait & James Hodges

Abstract. -- Anytime a review of impacts are done, one must summarize or account for activities of the past that have led us to the present -- How did we get to now? The impacts of tree improvement are significant. However, we are now just beginning to reap the increased wood and economic returns that have taken nearly 40 years to develop, implement and produce tree crops. And what a time it is for these benefits to be realized as available fiber resources are being pushed to the limit.

Impacts of tree improvement in the South can be classified as direct and indirect. Direct impacts are those which provide direct economic value, either cash or present value to affect owner equity. These direct impacts are associated with increase wood supply or quality and their net present value. An example is the planting of over 1 billion genetically improved seedlings each year in the South. This has a significant direct impact on owner equity.

Indirect impacts are associated activities that eventually will result in direct impacts, but in themselves do not have direct impacts. Examples would be research and developmental work. Such impacts have played a large role in attracting research dollars, furthering knowledge/understanding, and educating new generations of tree breeders. The value/benefit of such impacts is much harder to delineate and calculate than direct impacts.

Each type of impact is absolutely necessary for the long-term payoff of tree improvement. The interplay of these activities has been a catalyst to produce more and better quality trees and served as a model for other aspects of forestry. The tree improvement university/industry cooperative model has lead to a myriad of other cooperatives that have focused resources on forest productivity. This has placed the South at the forefront as a major wood fiber supplier.

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IMPACTS

Impacts from tree improvement can be classified as either direct or indirect. Direct impacts are:

a) **Those that increase wood supply or**
b) **Result in better wood quality**

Direct Impacts

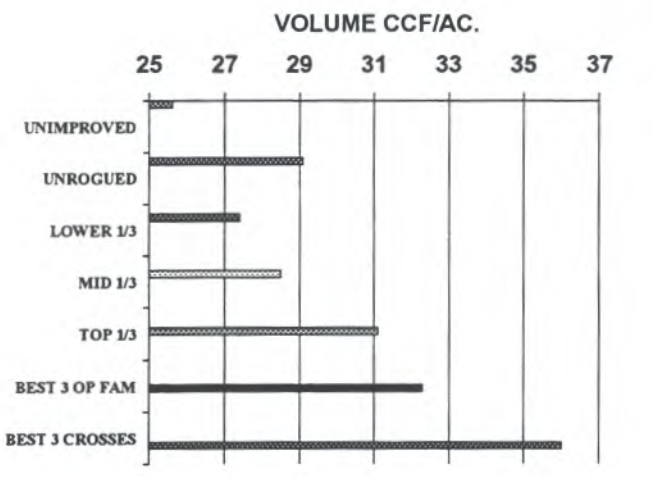
Species -- Although we do not think that much about species selection today, one of the great impacts of tree improvement has been on the choice of species to plant. In the 1950's nearly 80% of all planting was slash pine *(Pinus elliottii* Engelm. *var. elliottii)* and about 20% loblolly *(Pinus taeda L.).* The early fast growth of slash was deceptive in yield at rotation compared to loblolly on most sites. With the advances in tree improvement, we recognize loblolly will out perform slash on non-slash sites in volume yield at rotation. We learned a great lesson. Today, nearly 80% of planting is with loblolly and 20% with slash pine.

Potential Volume Gain -- Yes we can produce trees that grow bigger! Figure 4 is an example of the ways potential volume gain has been captured. The key to additional gain is information. At first, only seed from unrogued orchards was available and provided good potential to increase wood supplies. Then as more information became available orchards were segregated into bulk lots; the best, middle and lowest performers. With the planting of the best bulked families, potential gains increased. Then individual open-pollinated family lots were developed. And again, potential gain increased. Today controlled-pollinated family lots are being made and soon may be the standard for regeneration in the South. The reason -- increased potential volume gain.

Fusiform Rust Resistance -- Fusiform rust *(Cronartium quercuum* (Berk.) f sp. *fusiform)* is the major disease of slash and lobllolly pine. It causes great mortality in slash pine stands. However, markedly less mortality and damage occurs in lobllolly stands. Another reason loblolly is being planted more than slash.

There has been great progress in improving rust resistance in both slash and loblolly pine. Specialty orchard have been used or resistant families have been identified and deployed in high rust hazard sites. Recent progress in the understanding and identification of the genetic mechanism for resistance will likely mean great progress in controlling this disease.

Figure 4. EXAMPLE OF METHODS USED TO CAPTURE GENETIC GAIN IN VOLUME



Straightness -- Straightness is generally considered a wood quality characteristic because it has great impact on the value of both solid wood and pulpwood products. Although straightness value gains are obvious for solid wood products, this is acute in the chipping of pulpwood. Today with tree length processing, very crooked stem will not physically fit in the throat of the chipper. One generation of selecting for straightness has resulted in significant gains in the straightness of loblolly pine.

Wood Quality -- Wood quality by what characteristic you wish to choose; specific gravity, tracheid length, etc, are traits that we do not quit know what to do with. Some traits for solid wood products have been specifically determine and are incorporated into product specification.

We know theoretically, for example, that specific gravity should make a difference in yield and quality in pulp and paper products. However we cannot measure the economic value in the mills. If we did change specific gravity, how would we determine the value?

Economic Value -- We are not going to go through any detailed economic evaluation. There are enough economist here to criticize our economic misgivings. But a simple valuation of tree improvement will serve to make the point of the magnitude of the revenue that is being generated in the South from tree improvement. A simple net present value of one year's regeneration in the South should illustrate this adequately.

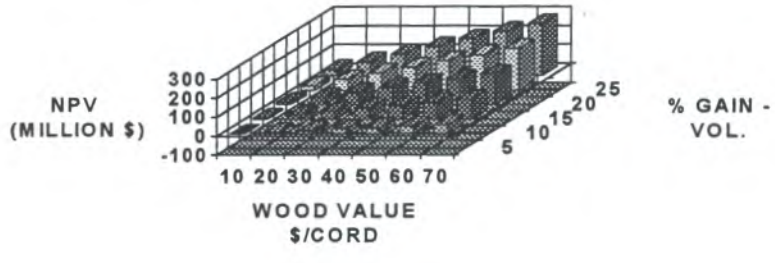
Simplifying Assumptions:

Annual planting of 1.5 million acres (1.7 million acres planted in the South in 1992 with 90% being planted with genetically improved stock.)
Rotation age of 25 years
Tree improvement cost of $7.50/acre
Discount rate of 4%

Net present values were calculated for a matrix of wood values and potential genetic gain in volume growth (Figure 5).

Since everyone has their own idea of gain and wood value, we will let you choose the one you like the most. However, the point is that we have a tremendous economic impact. Using reasonable gain and wood value assumptions, tree improvement has an impact in the hundreds of millions of dollars annually. At worst, genetic gains have to be less than 5% and wood value of $10 to break even. It is very difficult to make tree improvement not pay for itself

Figure 5. NET PRESENT VALUE OF PLANTING GENETICALLY IMPROVED SEEDLINGS IN THE SOUTH



		wood value ($/cord)						
		10	20	30	40	50	60	70
	5	0.9	7.2	15.4	23.5	31.6	36.8	47.9
volume	10	7.2	23.5	39.8	56.0	72.3	88.6	104.8
gain (%)	15	15.4	39.8	64.2	88.6	112.9	137.4	161.8
	20	23.5	56.0	88.6	121.1	153.6	186.2	218.7
	25	31.6	72.3	112.9	153.6	194.3	234.9	275.7

Indirect Impacts

Cooperatives -- Cooperatives between universities, government agencies and industry are the backbone of tree improvement in the South. Enough cannot be said about these cooperatives. These organization have succeeded beyond anyone's expectation for over 40 years. Most are based solely on the word and commitment of the members. The secret to their success seems to be the genuine cooperation of the financial as well as the physical work. Industry's in-kind commitment is estimated to be 10 times the annual dues of any given tree improvement cooperative. Additionally, these cooperative formed the model for almost all successive cooperatives in the South. Southern tree improvement and related cooperatives include the:

Western Gulf Tree Improvement Cooperative
NCSU/Industry Cooperative Tree Improvement Program (Pine and Hardwood)
Cooperative Forest Genetics Research Cooperative - University of Florida

Southern Forest Tree Improvement Conference
NCSU Biotechnology Consortium
Institute of Paper Science & Technology

Silviculture -- Forest regeneration in the South leads any other forest region in the world in acres planted. This scale and commitment to afforestation and reforestation in the South, has intricately incorporated tree improvement with regeneration silviculture.

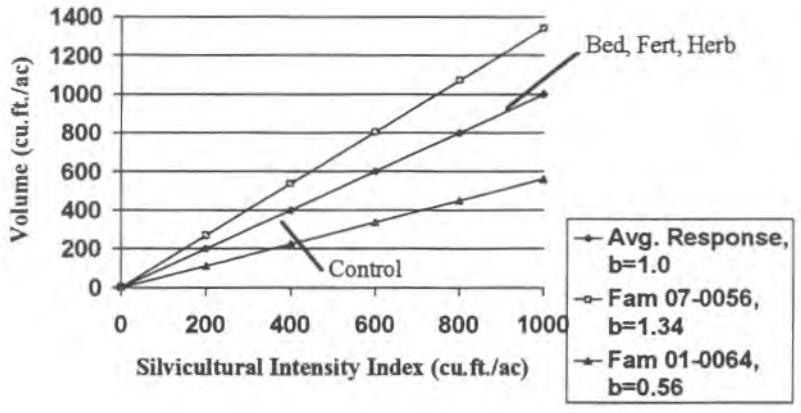
To begin the regeneration process, seed orchard are intensively managed to provide not only the best genetically improved seed available, but also to produce abundant, high quality seed. This has allowed the use of the best family lots on many more acres.

Seed processing has reach a very high level. Improvements in extraction and cleaning have led to higher seed yields and seed quality. The U.S. Forest Service's efforts in this area have been are extremely valuable. Additionally, information from the seed processor can help greatly in orchard management for higher quality.

Nurseries have also played a big role in tree improvement. Intensive management of seedling crops has made available large quantities of high morphologically quality seedlings that help allow the genetic expression of the traits desired. Today the growing of large numbers of family and specialty lots is challenging nursery operations.

Intensive site preparation and site specific management is being employed to insure maximum growth and take advantage of the improved stock. Research results generally show that tree improvement for growth and silvicultural intensity are at least additive. Figure 5 illustrates the relationship between family performance and silviculture intensity. Basically, most families interact with intensity of silviculture in a positive

Figure 5. **AVERAGE RESPONSE TO** VARIOUS TREATMENTS AND PREDICTED RESPONSE OF TWO FAMILIES



manner. That is, an increase in intensity has a corresponding increase family performance. Some individual families, however, perform much better than the average of all families. Family 07-0056 is such an example. This family performs on average 34% better when planted on better sites or when planted in conjunction with more intense silviculture (McKeand 1992).

Research -- Research has truly been a commitment on everyone's part in the South. The universities have undoubtedly been the leaders and major players in this area. For the most part, research results have been freely shared to increase the total wood supply. Research results have been aggressively pursued and implemented. Today, such efforts are in even greater demand. Everyone involved in tree improvement research should pat themselves on the back for a job well done. However, the best on most important research is yet to come.

Government -- State and federal agencies have played a tremendous role in the success of tree improvement in the South. Remember that the NIPL's plant almost as much land and forest industry in the South. The state agencies by being members of cooperatives or managing their own tree improvement programs have been the major source of improved stock for the NIPL.

The U.S. Forest Service has provided so much help in research & practical development. From orchard and seed technology to quantitative genetics and biotechnology, This group has been a tremendous resource for landowners and the industry. One area that first comes to mind is the work by the Forest Service to help control seed insects. Without this

work, tree improvement in the South would be much different, or at least much more difficult.

Southern Culture -- There is something unique about tree improvement in the South. Yes, it could be just the shear scale of the regeneration program. But it is different. The level of cooperation and commitment collectively and individually is different from any other part of the world. No where else has the commitment been so consistent for such a long period of time. Even more surprising is the fact that most of this effort has been sustained without formal contracts. It exists primarily on the will of those involved. Even those that move to the South become inoculated with the culture.

In summary, we have worked for over 40 years at developing improved trees. Today, we are just beginning to reap the rewards of these efforts. The first stands of genetically improved trees are just now starting to be harvested. With the current concern for sustainable wood supply, the timing of such harvest could not be better. These efforts should provide good evidence to the value of tree improvement and its value to sustainable forestry in the South and the world.

Today we are at the dawn of a new era in tree improvement. The era of "can we do it?" has past, the new era places higher expectations on tree improvement for higher productivity and to do it faster!

ACKNOWLEDGEMENTS

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