Our Roots: The Start of Tree Improvement in the South

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Most of the earlier foresters in the US believed that the characteristics of a tree were primarily determined by the environment in which the tree lived and that parentage was of little concern. For example, one of my professors (F.S. Baker, a famed silviculturist) told me in the late 1930s that to work with genetics of forest trees was useless and we could never change trees in the desired direction by genetic manipulation in our lifetime. Much before this, some was known about the genetics of forest trees but was used in operational forestry mostly in Japan. For example, Miyazaki in 1696 stated, relative to growing *Cryptomeria*: "For sawing, it is important to select seed of red and handsome trees showing vigorous growth - cuttings must also be collected from young and handsome trees". Since that time, parentage of *Cryptomeria* has been considered important in commercial production of this species and has been standard in operational forestry there.

Much later, especially studies made in Australia, Sweden, Denmark and South Africa proved that inheritance patterns existed in forest trees and some important characteristics of forest trees were inherited strongly enough so that they might be used as a part of silviculture. The main emphasis on variation in those earlier years related to the importance of seed source. Also, the potentials for the use of vegetative propagation were being assessed. A few excellent and useful results were obtained, some of which are still generally used. However, the opportunity for changing individual trees through control of parentage was mostly ignored, despite the positive information available.

The Application of Forest Genetics:

The general opinion of most foresters was that even though there were some genetic differences with parentage, the use of this information was too difficult and long term to be used operationally. The concept was still strongly held that differences among trees were mainly the result of the differing environments in which the trees developed. Individual tree variation was not well known, and when I started in Texas, persons like C.C. Doak, (a well-known biologist) suggested that I start my genetics program using radiation on loblolly pine. I refused, pointing out that how could we assess results from radiation studies when we did not even know the natural variation patterns among stands or individual trees of the species. Until about the 1950s the subject of genetic control was somewhat known and talked about but few foresters were involved in the actual application of this 'new science'.

Forest Genetics in the Southern Pine Region:

Some early forest genetic studies were done in the early 1900s on southern pines, like those of Phil Wakeley, Keith Dorman and Francois Mergen. Information was obtained on seed source variation. Much of the activities done on the seed sources of the southern pines was primarily

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related to the huge program headed up by Phil Wakeley, but assisted both by industry and state forest services. Phil's geographic variation study set the stage for most later genetics work in the southern pines, and yielded excellent results. In addition, the first intensive genetic assessments were related to resin production, which is now only of minor importance. Especially the US Forest Service developed a viable program to improve yields in amount and quality of the resins produced, with most emphasis being on slash pine.

The details about the start of applied genetics on a large scale in the south is unusual and interesting, even though most operational foresters were still antagonistic to the idea of using parentage in silvicultural planning. A major source of interest in the genetics of forest trees was from Syrach Larsen (from Denmark) who wrote a couple of books about the application of genetic principles on forest trees. (Most of his ideas were good, but some were incorrect; however, that did not bother those who read the books because they had little detailed knowledge about genetic principles). The books were well written and translated, and read by some of the leaders in Southern Forestry. In fact, several companies made it mandatory that all their trained foresters should read them.

About that time, Ake Gustafson, a world renowned specialist in radiation in agricultural crops, was asked to give a weeks' seminar on his work while in Houston, Texas. Ake liked forestry and felt that genetics should be used in silviculture, so he asked that he be given one lecture to express his ideas for forestry use. It so happened that the governor, the head of Texas A&M University and the head of the Texas Forest Service were at his presentation, as well as several persons from the press. Gustafson's talk was so well done and interesting that later the administrators got together and decided that Texas should do something about the use of genetics in forestry.

Start of the Texas Forest Tree Improvement Program:

During World War II I was working as a logging engineer harvesting in the redwoods of California after graduation from the University of California. One day, during the worst of the fighting in the islands, I received 'greetings' from the U.S. president inviting me to be drafted into the military services. I asked for the engineers but they said with my background I had to go to the navy. We were then lined up and a major from the Marine Corps walked in and said that 15 of us would have to go into the Marines. He pointed at me and said: "Hey, you" and that was it. Numerous things developed during the war that enabled me to become the only forestry officer in the Marine Corps at Camp Lejeune, NC after obtaining my Lieutenant's commission. During this period the 'bomb' had been dropped on Japan and all of us who were training to invade Japan were suddenly without assignments. While waiting for directions, another forester and I talked the General into developing a forestry plan for the 125,000 acre Marine base (Camp Lejeune NC) which had some fine forests. The next day the other man was transferred to China and I spent the rest of my service time as only forestry officer for the Marine Corps, selling pulpwood, running a sawmill and making a Forest Plan for Camp Lejeune. This enabled me to learn a lot about southern forestry.

After release from the Marines, I was offered a good job managing redwood forests but decided to go back to the University and get my advanced degrees. I was interested in forest genetics,

largely through Jack Duffield, who worked at the Forest Genetic Institute at Placerville, California. There was no such thing as a forest geneticist under which to study at the Univ. of Calif. so I had to be a 'floater' at the university, with an office in Forestry, laboratory in Botany and studies in Genetics.

When I graduated with the PhD degree in 1951, the people in Texas heard that there was a forester trained in genetics so they hired me to head an industry cooperative they were to create for using forest genetics. The objective was to improve growth and form, find drought tolerant trees for east Texas and help obtain disease resistance. We knew practically nothing about individual tree variation in important characteristics in loblolly pine. We studied various agricultural programs and adjusted ours into a simple selection and breeding program that could be applied to forest trees. The first emphasis in Texas was on drought resistance and wood properties. It was successful and widely advertised which resulted in a period when many administrators obtained the idea that if one used genetics in forestry, all problems in forestry could be easily solved. It was particularly hard to get the foresters to support working on genetics even though some higher administrators actually visualized the practicality of a breeding program; their confidence made it easy to get funds from the industry and granting agencies. (For example, we had obtained a 5 year grant from the National Science Foundation to establish a huge genetic study of loblolly pine on the lands of International Paper Company in Bainbridge, Georgia. As that grant was ending, the National Institute of Health asked if it could support the NSF study for 5 more years. Also there was support by individuals; an example was Gunnar Nicholson, president of pulp companies in Georgia and Tennessee. He insisted in giving us annual financial support for studies in the application of genetics, because "it was needed" even though his company in the east had no direct benefits from the more western studies. MY HARDEST JOB AT THIS TIME WAS TO GET PEOPLE TO RECOGNIZE THAT TREE IMPROVEMENT WAS JUST ANOTHER PHASE OF SILVICULTURE AND NOT A CUREALL and SHOULD SO BE USED. When this aspect of forest genetics was being promoted, it was not really believed in, especially by most operational foresters. To make it more acceptable, we entitled it 'tree improvement'.

The Spread and Use of Tree improvement:

Groups in the south became interested in tree improvement, and in a few years Cooperatives were established in Florida (1954) and then at N.C. State University (1956). My coming to head the program in the Carolinas was an interesting 'accident'. Dean Preston from NC State University had pressures from the Eastern Companies to start a genetics cooperative. He asked if our family had ever visited North Carolina, so when I said no, he paid to have our family make a visit there. Meanwhile he had arranged for a meeting of those companies interested in a forest genetics cooperative to discuss their proposal with me. He then offered me the job of setting up a cooperative at NC State University, funded largely by industry. I said no, that I liked what was being done in the Texas Cooperative operating west of the Mississippi River. My boss in Texas heard about our visit and (being an ex-colonel in the army) had me stand at rigid attention while he harangued me about not being loyal to Texas and what opportunities there was there and why did I seek a job in North Carolina. He did not give me a chance to tell him that I had said "no" to North Carolina. His 'attack' made me angry so I went back to my office and called up Dean

Preston and said that I would take his job after all - he said: "Great, we had just decided to offer double the salary if I would reconsider the no I had given them."

The Texas, Florida and North Carolina cooperatives worked very closely together exchanging ideas and plant material when suitable.

A Few Suggestions

Later, after official retirement from the NC State cooperative in 1979, I had the opportunity of starting a number of cooperatives overseas. These were done through our company, Zobel Forestry Associates, and some general observations about cooperative organization became clear:

1. Every program, no matter whether it is supported by industry, the government or university will be asked after 3 to 5 years: "What are we getting for our contribution? What will be the payoff for our organization?" This is difficult to answer for a forest genetics program because results take some time to develop. We satisfied our contributors by emphasizing wood and its uses, its variation and its importance with increased utilization. A major problem was the utilization of juvenile wood produced when shorter rotations are followed. Our supporters were quite satisfied with the wood information and the word genetics was hardly mentioned in our early annual reports. The point is that one has to make sure you can answer this question in a satisfactory way, which will surely be asked. We observed several really good cooperatives that were abandoned because they could not satisfy the question to their sponsors.

2. Make sure that you know the species with which you are working. Many decisions must be made before sound facts are available and one can only make suitable estimates if you know the species and its reactions. You will initially know very little about the extent and kind of genetic variation with which you are involved.

3. Make tests simple and understandable. I did a terrible job early in Texas when I wanted to get information about how to manage seed orchards. Being young and eager, with limited experience, I designed a 'super study' including all kinds of variables (like species difference, spacing, kind of grafts, fertilization etc). About ten years later, when I was in North Carolina, I had a phone call from Hans van Buijtenen who headed the Texas cooperative, (my first graduate student) as follows: "I hate you". Then he hung up. Later he explained that the study design was so complex with so many unknown variables that he could get practically no useful provable data from this huge study. Keep the studies simple as well as the explanations of what has been found or being done. This is particularly true when using advanced things like biotechnology because too often the report can become completely non-understandable to the general forester.

4. In forest genetics, the forester usually must take action before the real facts are known. This can only be done if one knows the species he is working with which enables some assumptions to be made. Sometimes one is right, as we found for the inheritance of wood density in pines. It was a required character in our early seed orchards and my boss was horrified that we were asking the members of the cooperative to spend millions of dollars working with a characteristic for which we really did not know about the genetic variability. We were lucky with wood

density! However, we were wrong in getting material to root. We knew that branches from older pines would not readily root. But we had the idea that if we grafted an old shoot to a seedling that the ease of rooting seedlings would somehow be passed from the seedlings to the graft. We found that this was not so and the graft continued to respond as if it were still from the old tree. But we did learn the facts that made it easier to get earlier production out of seed orchards through earlier flowering of the grafts because they maintained their physiological age.

Summary:

There is no question about the importance and use of genetics as a silvicultural tool. One who works with more sophisticated systems must always remember that basic plant breeding is necessary if success is to be achieved. Genetics is a good and useful tool for the silviculturist. Of primary importance is vegetative propagation; if foresters do not take advantage of this method of regeneration they will be left behind. I consider vegetative propagation to be a major objective so one can us both the additive and non-additive genetic variation and can develop large numbers of individuals that have special woods, or are resistant to diseases or adverse sites, as has been done so well with some eucalypts in the tropical areas with which I have worked for many years.