A Decade of Progress in Tree Improvement

Clemens M. Kaufman
School of Forestry
University of Florida

Tree improvement research has been a part of the scene in American forestry for over half a century. Only in the last decade, however, has major attention been directed to it, A careful examination of the historical record probably would reveal a number of factors that contributed to the awakened interest. Two, I think, are significant. First is the influence of a number of prominent foresters who attended the Third World Forestry Congress in Helsinki, Finland, in 1949. These men, among whom can be named Dr. I. T. Haig and J. Herbert Stone, had the background to understand the significance of the advances in tree improvement that were being made in Northern European countries. Their recognition of this significance permeated their associates. I recall that the Appalachian Section of the Society of American Foresters devoted its annual meeting in January, 1950, to tree improvement at the suggestion of Dr. Haig, who helped set up the program. The second factor was an exchange of correspondence, beginning in the fall of 1949, between the Forestry Relations Division of the Tennessee Valley Authority and the Southern Forest Experiment Station on the possibility of a regional seed source research program. As an outgrowth of this correspondence the two regional forest experiment stations and the regional office organized the First Southern Conference on Forest Tree Improvement, held in Atlanta on January 9 and 10, 1951.

Somewhat unexpectedly, about 80 people attended the conference, As a result of the deliberations, Dr. Haig and C. A. Connaughton were instructed to appoint a standing committee to coordinate forest tree improvement research and to prepare information on the subject. A twelve-member committee was appointed to include representation from research and regional federal forestry activities, state forestry agencies, the Tennessee Valley Authority, schools and industry.

At its first meeting this group assumed the name Committee on Southern Forest Tree Improvement. Early in its existence it adopted a four-point program of purposes and objectives:

1. To advise and assist those interested in the improvement of southern forest trees in arranging and conducting research and development programs.

2. To provide a clearing house fog information on forest tree improvement.
3. To provide for or assist in coordination in the conduct of a South-wide program of tree improvement research and development.
4. To foster and encourage the advancement of knowledge of southern tree genetics.

In this Sixth Conference on Southern Forest Tree Improvement, advances in the tree improvement knowledge and practice will be presented. I shall summarize developments of the post ten years and point out the possible function of the Committee on Southern Forest Tree Improvement in these advances. Many people in public agencies and private industry have provided me with information. I am particularly indebted to Philip Wakeley and Dr. Keith Dorman for their accounts of happenings prior to 1951 and of the work of the Southern and Southeastern Forest Experiment Stations.

Early Studies

Wakeley points out that forest genetics work began in this country with studies of racial variation as related to geographic seed source. Tests were started with ponderosa pine in northern Idaho and in Colorado in 1916. Seed collection began in 1912 for an extensive study of Douglas-fir. Wakeley`s 4-source loblolly study was established at Bogulusa, Louisiana, in 1925, Ernest Schreiner and others started an extensive poplar hybridization program in Maine in 1924. And in 1925, James G. Eddy started the Eddy Tree Breeding Station, now known throughout the world as the Institute of Forest Genetics, at Placesville, California.

The South

With this very brief resume, let us direct our attention to the South where extensive beginnings in tree improvement research had been made prior to 1951. Almost exclusively the activity was limited to the Southern and Southeastern Forest Experiment Stations and to T.V.A .

I have cited Wakeley`s early study. He also did some crossing of pine species, The early work at the Lake City Research Center was done at a time when that center was still a part of the Southern Station. Most notable was the selection of high gum yielding slash and longleaf pine started in 1941 by Mitchell, Dorman and Schopmeyer. Rooted cuttings of nine high gum yielding clones and six average yielders were produced. By controlled and wind pollination of 12 high yielding and average trees a progeny plantation

of 629 trees was established. From this study have come a number of important publications on forest tree improvement.

At the Southeastern Station, the Appalachian Station at that time, a large study with open pollinated loblolly pine was started in 1934 by A. L. McKinney and L.E. Chaiken From the seed of each of 105 mother trees, 100 plantable seedlings were obtained and planted in four replications with 25 trees per plot. Early results of this study gave strong indications of rather wide inherent variation in loblolly pine. Flooding of the plantation by the Santee-Cooper power project terminated the study.

Leon Minckler established a pitch pine x loblolly pine hybrid plantation on the Lee Experimental Forest in Virginia in 1945. Also in that year he put in a racial variation study of loblolly pine from four geographic sources and shortleaf pine from five sources.

Under Dorman's supervision a cooperative program was started with the Ida Cason Callaway Foundation at Hamilton, Georgia, in 1949.

As a result of selection among wilt-resistant strains of mimosa in North Carolina, George Hepting and Richard Toole had 28 resistant clones by 1948. Several of these were given to the nursery trade and have carried forward the immunity to wilt. Hepting, Bratislav Zak, and others, in 1950 began making selections in shortlead pine for resistance to littleleaf disease.

The Tennessee Valley Authority started tree improvement studies in 1933 with the establishment of an experimental tree crop nursery at Norris Dam. Until 1949, the research was devoted mostly to selection and testing of improved nut trees and other crop trees suitable for planting on open land. Some limited attention was given to hard-wood species suitable for timber production. Since 1944, collections have been made of trees with unusual and attractivily figured wood, including yellow poplar, red maple, walnut, hybrid poplar, and birch. In 1950, studies on pine tree improvement were started in which vegetative propagation and seed source tests were stressed. Attention has also been given to blight resistant chestnut of which seven selections have been propagated.

Developments Since 1951

T.V.A.

By 1960, T.V.A.'s selection and testing of crop trees had resulted in the planting of 140 black walnut, 184 chinese chestnut, 115 filbert and 31 pecan plantations on the lands

of about 325 co-operators. Superior tree selections were started in 1957 with loblolly, shortleaf and Virginia pine. Other activities in the current program include seed source tests and studies on vegetative propagation.

Southern Station

Those of you who are intimate with developments in tree improvement know that both of the regional experiment stations have given tree improvement major attention since 1951 Wakeley's contribution to the Southwide Seed Source Study, started in the name of the Committee on Southern Forest Tree Improvement in 1951, has been outstanding. At the Crossett Research Center of the Southern Station the Crossett Company began financing a full-time researcher in tree improvement in 1952, carrying this support to the present. Changing the Gulf Coast Research Center at Gulfport into the Southern Institute of Forest Genetics, in 1954, firmly established the position of the Southern Station in this area of research. the institute, with supplementary work at Crossett, Arkansas, Alexandria, Louisiana , and with Hodges Land and Timber Co., Inc., at Mary, Louisiana , research is being carried on in southern pine hybridization; racial variation in southern pines; fundamental studies in forest genetics, including physiological investigations; and the inheritance of resistance to fusiform rust, Some beginnings have been made in hardwood genetics at Stoneville , Mississippi.

Southeastern Station

The Southeastern Station at the Lake City Research Center has continued the development of strains of superior gum yielding longleaf and slash pine. Tree selection techniques, vegetative propagation, aid insect relationships, are a part of the program. At the Callaway Foundation, studies on selection techniques and inheritance have been continued. In cooperation with the Georgia Forestry Commission and Georgia Forest Research Council, seed orchard establishment has received major attention at Macon, Georgia. In addition to these continuing programs, a longleaf pine study was started in South Carolina in 1955; a yellow poplar study in North Carolina in 1954, also a hemlock study in 1957 and a white pine study in 1959. A slash pine study was stated in Florida in 1954 and a loblolly study Florida and Georgia in 1956.

In addition to the pitch pine x loblolly pine plantation mentioned earlier for the Lee Forest, the Southeastern Station has shortleaf x loblolly pine hybrids plus back crosses planted at the Hitchiti Experimental Forest and other hybrids at the Callaway Foundation.

The Southern Region, Region 8, of the U.S. Forest Service is planning for 650 acres of seed orchards by about 1963, Some 3000 acres of seed production areas will be used to supply seed until the seed orchards provide the necessary supplies.

Industry

A Jorge part of the applied effort in forest tree improvement is carried on by the pulp and paper industry, usually in cooperation with a research center at a university or with one of the regional experiment stations, Several companies, however, do have independent programs in addition to participation in cooperative programs

Credit for some of the very earliest work must go to the Westvaco Research Center of the West Virginia Pulp and Paper Co. Here L. T. Easley, P. T. Lannon, and others, were making seed collections from selected trees as early as 1950 and at about that time began the establishment of a series of seed production areas in outstanding stands of loblolly pine,

The Buckeye Cellulose Corporation under the direction of Donald Stevenson has been doing tree improvement work as port of a broader research program since 1954. Current studies are concerned with chemical and physical characteristics of slash pine wood, racial variation in slash pine, and growth chamber evaluation of open-polinated plus tree slash pine progeny.

At the Southlands Experimental Forest, the International Paper Company has made tree improvement a part of the research program. Projects are concerned with heritability in pines, seed orchard pruning, seed orchard irrigation, species variation, and the introduction of exotics.

Other companies that have given considerable attention to tree improvement are Union Bag-Camp Paper Corp., Gaylor Division of Crown -Zellerbach, and the Crossett Company. A number of others are doing very fine work within the limits of the resources that they can devote to this activity.

Industries are giving financial support to tree improvement research as well as providing land and assigning personnel toward broadening the effectiveness of research agencies The program of the Texas Forest Service is receiving support from nine companies. The School of Forestry at North Carolina State College is being assisted by 13 companies Nine companies are cooperating in the program of the University of Florida,

The industries in the cooperative program of N C. State College and the University of Florida are basically concerned with the establishment of seed orchards, This has led to the selection of well over a thousand mother trees, The principal species have been slash and loblolly pine; however, selections of shortleaf, pond and Virginia pines have also been made, Several companies are making plans for programs with longleaf and sand pine, and possibly also hardwoods. At present between 1,300 and 1,400 acres of seed orchard are

in place in individual orchards comprising from 15 to over 50 clones. Current projections provide for well over 2000 acres of orchard. A number of companies are limiting their projections until part of the task of progeny testing has been accomplished and until research more clearly defines procedures and possibilities in tree improvement.

State Agencies

Except for the Texas Forest Service, state agencies in, the South do not carry out research; hence, tree improvement activity is restricted to seed orchard and seed production area establishment, Texas did initiate tree improvement research in 1951, as part of a broader research program. As pointed out in the Eighth progress Report for the program, the original objectives remain basically unchanged and are (1) to develop strains of pine capable of yielding increased volumes of straighter, higher quality timber than is now being grown, (2) to develop a drought resistant strain of loblolly pine to expand the pine region and for use on adverse sites, and (3) to develop pine strains with naturaly high or low wood density.

Seven states have some seed orchard acerage. Georgia started in 1954 and plans for 450 acres, Florida, beginning in 1959, now has 46 acres and expects to have about a 1000. Alabama has plans for 10 acres. Kentucky has two acres and expects to put in 10 in cooperation with T.V.A. Louisiana has protected 60 acres over the next three years. Texas has 20 acres with plans for 90 -- mostly loblolly and slash pine Virginia expects to expand the present loblolly acreage of 30 to about 65 and the nine acres of shortleaf to 20. Thought has been given to a white pine orchard. Several states have seed production areas.

Schools

Among the schools and state agricultural experiment stations Florida led off in 1952 with the appointment of Dr. Tom O. Perry. The program was expanded in a major fashion in 1954 with the organization of a cooperative industry supported program pointed primarily toward tree selection and seed orchard establishment. Inheritance of individual characters, racial variation and techniques of vegetative propagation were other areas of study. At present, various aspects of seed orchard management, heritability studies, and plot size studies for progeny tests are receiving major emphasis.

North Carolina State College launched an industry supported program in 1956, This has been promoted vigorously and effectively. At first, emphasis was on aspects of seed orchard establishment and heritability of wood characteristics, particularily specific gravity. The program has become quite diverse and now includes studies on heritability in loblolly

pine; physiological studies on growth, photosynthetic efficiency, and respiration; char acteristics of trachieds; seed orchard studies; hybridization; and including a number of studies on variation and heritability with hardwoods, particularily yellow poplar and sweet gum. These studies in an extensive graduate teaching program are a real factor in extending the breadth of the research.

The University of Georgia Initiated her program in 1954, It now includes work on heritability of southern pines, vegetative propagation, graft survival, and factors significant in the selection of breeding stock. Plans for more extensive physiological studies are being mode.

Auburn University has given some attention to tree improvement since 1953, beginning with geographic seed source studies. Increasing emphasis is being given to physiological studies on characteristics of seedlings of selected pines.

Louisiana Polytechnic Institute, Mississippi State University, Louisiana State University and the University of Arkansas have limited studies emphasizing geographic variation.

The University of Tennessee started a program in 1959 that now includes studies on variation and heritability of yellow poplar and breeding studies with yellow poplar, chestnut, and a number of other hardwoods.

In 1953 the University of Florida, with the help of the Texas Forest Service and the Southern Station, held a short course on tree improvement. Succeeding courses were held at Lufkin, Texas; Florida; Athens, Ga.; and Raleigh, N. C. These courses provided basic training for a large number of the foresters now envolved in one fashion or another in southern forest tree improvement.

Professional Manpower in Tree Improvement

Among the state agencies, Georgia has four foresters devoting most of their time to seed orchard and tree improvement work. Alabama has two part-time; Florida one full -time. Louisiana has one man who spends much of his time in the work. Virginia has two men full - time, Texas, more concerned with research, has a geneticist with the Ph. D, a second man with an M. S. and has plans for the employment of a physiologist.

Within industry some 10 or 12 men appear to be devoting full time to tree improvement. However, many foresters possibly 40 to 60, or more, have some direct responsibility in

tree improvement other than that of administration or general supervision. In many companies the identification of outstanding trees that might possibly serve as superior mother trees is a permanent assignment of all foresters who work in company forests,

The Southern Forest Experiment Station at the Southern Institute has six people assigned full time to tree improvement. Wakeley devotes some time to this work, There is one man at Crossett as previously pointed out, two part-time at Stoneville, Mississippi, and one part-time at Alexandria, To sum up, there are 13 researchers of whom 6 are full-time and at least two others better than half-time.

Four men devote full time to tree improvement for the Southeastern Station - two at Lake City and two at Macon. In addition, tree improvement is carried on part-time by one man at Cordele, Georgia; two at Charleston, S. C.; one at Franklin, Virginia; two at Charlottesville, Virginia; one at Asheville, North Carolina; two at Athens, Georgia; and one at Lake City.

T.V.A. has one full-time worker in tree improvement.

Among the schools, Florida has three full-time staff members on tree improvement research. North Carolina State has four. Georgia has two and two others part-time. Auburn has the equivalent of about three full-time. Tennessee has one full-time and two part-time. Louisiana Polytechnique Institute, Louisiana State University, and Arkansas, have one or more staff members who are doing some work in tree improvement.

In the aggregate this becomes at least 48 full-time workers in some phase of tree improvement research or development and development.

Summary of Activity

The basic effort thus far has been in the development of seed orchards and in related supplementary research. Species variation, heritability, breeding, and hybridization are all receiving attention. A most encouraging aspect of the developing research program is the increasing emphasis that is being given to the fundamental physiology-biochemistry of tree growth, including aspects particularly pertinent to forest tree genetics, by the Southern and Southeastern Forest Experiment Stations, N. C. State College, Auburn University and Georgia.

The Committee on Southern Forest Tree Improvement has expanded its membership from the original 12 to 18, and has been active in the assignments to which it set itself, At

two-year intervals it has sponsored a southwide conference. It has brought out 20 publications and reports, including the proceedings of the previous conferences, through the facilities of the employing organization of various members. A committee newsletter, scheduled for semiannual publication, has appeared annually with 450 copies for a mailing list of about 250. At the request of the Southern Forest Experiment Station, the Committee became advisory to the Southern Institute of Forest Genetics in 1955 and holds meetings at the Institute on an irregular schedule.

The effective influence of the southern committee has resulted in the organization of tree improvement committees in the Northeast, the Lake States, and the West.

In this decade of development, the influence of the Committee has been felt in the adaptation of practices, in the initiation of research, in the creation of a public consciousness of the importance of tree improvement, and in the acceptance of tree improvement as a part of industrial forest management. In the Committees short lifespan, we have seen the genetical improvement of forest trees advance from a scientific oddity to an honored position in forestry research and practice.

We now have ten years of developmental experience. We are beginning to form the reservoir of knowledge on the fundamentals of tree growth on which we must draw to further our research. The potential for progress is the challenge that lies ahead in forest tree improvement. Our attainments will depend on the financing and intellectual inspiration that we can bring to focus on the problem.