SUMMARY OF THE SIXTH SOUTHERN FOREST TREE IMPROVEMENT CONFERENCE

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It is a real pleasure to be back in Florida, and to see so many of my friends who are connected with tree improvement activities throughout the South. After helping to start off the Southern Forest Tree Improvement Committee just ten years ago, it has been most gratifying to hear Dr. Kaufman's excellent account of "A Decade of Progress in Tree Improvement," and all these other accounts of current progress. And believe me there is no better way to catch up than to consent to prepare a summary of the entire meeting. This summary will have served its purpose if it helps to etch upon your mind, as it has on mine, some of the new knowledge that all these speakers have assembled for us.

Wakeley's report on "Results of the Southwide Pine Seed Source Study through 1960 - 61" is the first comprehensive report on this vast study. The report substantiates earlier evidence of very limited racial variation in slash pine. The other three species did show distinct racial variation. In loblolly and shortleaf pine, this variation was considerably greater among origins from a north-south transect than from an east-west transect. If loblolly or shortleaf is moved too far toward either the north or south portions of its range, height growth is reduced.

Local stocks were above average in performance, but were usually excelled in survival by certain individual westerly sources, and in height growth by certain individual westerly sources, and in height growth by certain individual easterly or southerly sources.

Fusiform rust resistance of loblolly pine was greater in stocks of westerly origin than those of easterly origin, regardless of where planted.

This study is a real accomplishment of the Southern Forest Tree Improvement Committee, and a real tribute to the efforts of Phil Wakeley and all his many cooperators in the undertaking.

Eyvind Thor, in "Variation Patterns in Natural Stands of Loblolly Pine," reported differences in the seeds, cones, and leaves of loblolly pine from the Eastern Shore of Virginia to eastern Texas. In all of 18 characteristics studied, he found that a considerable proportion of the total variation was accounted for by tree-to-tree variation within seed source areas. Of the 13 traits which showed highly significant differences between areas, the majority did not show any regional trend. Five traits did show some degree of pattern in their regional variation.

The strongest clinal pattern was an increase in seed-coat thickness from Texas toward the east and from the interior toward the southeastern coast, in agreement with the trend in precipitation-evaporation ratio. A similar clinal pattern was found in stomatal frequency, increasing toward the east. This is consistent with the stomatal pattern Mergen found in slash pine.

Seed form, cone weight, and cotyledon number all showed unique geographic patterns with no obvious biological significance.

Thomas Zarger's "Ten-Year Results on a Cooperative Loblolly Pine Seed Source Test" covers roughly the span of the life of this committee. The study is one of several in which a few seed sources seemed to do best at most of the planting locations, and generally out-performed the local strain. In general, the TVA study the inland sources survived better than the Atlantic Coastal Plain sources and are recommended for planting beyond the natural range in the interior. Inland sources were also superior in diameter growth, but their initial superiority in height growth at 5 years of age had evaporated 5 years later.

Various people have sought to find or develop a type of longleaf pine seedling with a fibrous root system in an attempt to improve the low survival of longleaf after planting on poor sites. In his talk on "Racial Variation of Root Form of Longleaf Pine Seedlings," E. B. Snyder told us that seedlings from origins west of south-central Georgia had fewer roots and lower total root length than those from farther east. This difference might reflect the selective action of lower summer and autumn rainfall to the west.

In "Physiological Aspects of Racial Variation," Thomas O. Perry said that the results of past research reveal racial variation in the following physiological responses: photoperiod requirement, duration of growing season, drought resistance, upland versus lowland and maritime versus inland habitats, altitude, winter chilling requirements, nutrient requirements, and soil requirements. He gave several instances of racial variation in southern pines and red maple in response to photoperiod, light intensity, and day and night temperature. For example, northern sources of red maple had lower optima of both day and night temperature than southern sources. In loblolly pine, Maryland sources grew poorly in Florida unless given extended daylength to simulate that of their home in Maryland.

Doctor Perry concludes that genetic strains can be developed that will give superior (but perhaps not optimal) performance over a fairly large geographic province. Experience from agronomic crops indicates that two or three improved genetic strains will adequately serve the needs of a fairly large state.

In his philosophical paper "Selection as a Method of Tree Improvement" Keith Dorman makes a good case for a more careful selection of priorities to guarantee rapid progress toward genetic improvement. He stresses the gains that can be made through simple roguing of stands, through seed-production areas, through better knowledge of individual and racial variation, through concentrating more effort on the most important species and the most significant traits, and through performing selection under the most favorable conditions of stand and site uniformity. He asks practicing foresters to keep the pressure on geneticists to give them useful techniques as well as estimates of costs and benefits of tree improvement. Researchers must realize that their job is to make complicated things simple, not to make simple things complicated.

In their paper on "Statistical Aspects of Progeny Testing," Evans, Barber, and Squillace reap a considerable harvest of lessons from progeny tests established in the past decade. Their first plea is that anyone making a progeny test establish in his mind a minimum level of difference which he will consider meaningful. Only then can an appropriate test be designed and interpreted. In fact the authors ask the Tree Improvement Committee to prepare guides to the least meaningful differences in respect to traits that are important in progeny testing.

Their second main point is that it is futile to install progeny tests in randomized block designs if the blocks are too big. Their evidence is that blocks 1 acre in size are entirely too big for areas of patchy soil variation such as the Georgia Piedmont. This means that the number of trees per plot or the number of progenies or both must somehow be kept down.

The authors deny the appropriateness of the single-tree plot for ordinary use in progeny test, first, because it leads into the statistical complications of missing-value techniques; second, because it fails to show how the progenies develop in a group of their own kind; and third, because recognized statistical tests which presume normal distribution of error may fail to apply to data from single-tree plots.

They recommend a 25-tree plot because the coefficient of variation for many individual traits such as height tends to level off at about 20 surviving trees per plot. Where there are more different progenies than can be gotten into the allowable block size with 25-tree plots the authors suggest a 2-stage process of a screening test with all progeny, followed by a more rigid test of the most promising ones. Incomplete block designs are another alternative, though a risky one.

The authors plead for the release of file data which will contribute to our knowledge of the variability encountered in previous progeny tests. Their final plea is that all second-stage progeny tests be repeated in both time and space to take account of the influence of year-to-year and place-to-place variations that affect growth and survival .

Concerning "Inheritance of Vigor in Slash Pine," Peters and Goddard reported that both open- and control-pollinated progenies of slash pine parents selected for high vigor exceeded average progenies in this trait. Heritability of vigor in their study was very roughly estimated at 15 percent. They confirmed other reports of reduced vigor from self-pollination. Among the controlled pollinated progenies there were definite indications of variation in specific combining ability.

Squillace and Bengtson, in "Inheritance of Gum Yield and Other Characteristics of Slash Pine," give some specific inheritance information from the plantations of rooted cuttings and control-pollinated and wind-pollinated progeny tests at Lake City. They conclude that heritability is very strong for gum yield (45 to 90 percent) moderately strong for bark thickness, diameter, and volume growth (5 to 67 percent), weak for total height at 10 to 15 years (5 to 16 percent) and weak to moderately strong for crown width (12 to 48 percent) . The average heritability of perhaps 55 percent for gum yield indicates very good promise for genetic improvement in this trait.

" Growth, Crown Form, and Fusiform Rust Resistance in Open-Pollinated Slash Pine Progenies" were reported by David VanHaverbeke for John C. Barber, This work was initiated by Keith Dorman at the Ida Cason Callaway Foundation in the early 1950's. Barber's paper assesses both the biological results and the validity of progeny testing methods. As for methods of progeny testing, he found consistently that the block X progeny-group interaction was significant. This means that the progeny groups are more sensitive to site variations than had been expected, and that sensitive tests will require using several relatively uniform test sites. He also found, when he attempted to correct growth rate for stand density, that the progenies that survived best grew fastest in diameter and height, even though the number of competing trees on each plot was greater. It was impossible to tell what portion of this relationship is attributable to inherent vigor and what portion to site variation. If it is vigor, then mortality and vigor are confounded, and any adjustment of progeny test growth data for differences between progenies in stand density will be very difficult.

A significant though not unexpected finding is that branch length and branch diameter are negatively correlated with branch angle. Thus we can select trees with which have more nearly horizontal branches and expect that these branches will tend to be shorter in length and smaller in diameter.

In these studies the greatest degree of crook was found in progeny from crooked parents. Progenies from open-pollinated seed collected in different years gave similar estimates of the parent trees in such traits as rust resistance. There was a weak tendency for the faster-growing progeny groups to be less resistant to fusiform rust, but the correlation is low enough to be negligible in its bearing on selection work. Even under severe field conditions, some of the faster growing progenies remain free of rust infection. Rust cankers inhibit growth, so cankered trees must not be used in estimating the inherent vigor of progenies. The author feels he was successful in estimating greneral crown characteristics from measurements of single whorls on progenies 7 or 8 years old. The most variable characteristics studied were height and diameter, which is no doubt a reflection of their greater sensitivity to variation in site.

F. F. Jewell's paper covered "Results of Artificially Testing Intra- and Interspecies Southern Pine Hybrids for Rust Resistance." Some crosses of pairs of rust-free slash pine parents produced progeny with increased resistance, and other crosses did not. Hybrids of the resistant species shortleaf pine with susceptible species have shown no galled individuals in limited field trials. However, under intensive artificial inoculation, the different progeny groups from four slash X shortleaf crosses resulted in a full range from 4 to 92 percent of galled individuals. Apparently rust resistance in interspecies shortleaf hybrids is more complicated than the simple dominance for resistance in shortleaf assumed earlier, In order to produce relatively resistant progeny it is probably necessary to use parent trees that have shown the ability to transmit resistance in earlier trials.

Carl Maisenhelder's "Selection of Populus Clones for Southern Bottom Lands" describes the program of selection in cottonwood at the Stoneville (Mississippi) southern hardwood research project of the Southern Forest Experiment Station. In view of the tremendous growth potential of cottonwood in our southern bottom lands, and the ease with which it can be propagated vegetatively, I view this as one of the very best opportunities for tree improvement in the United States, and perhaps the best of all for the development of highly intensive culture in combination with genetic improvement. Early results indicate that of Euramerican hybrids, I 214 (a spontaneous cross between cottonwood and European black poplar) grows best at Stoneville. But selections of native cottonwood with such fine rustic names as Catfish No. 8 have outstripped the most famous hybrids from Europe, and one native cottonwood is 30 feet tall and 4.8 inches d.b.h. at 2 years of age from the cutting. Future research will be concentrated on the development of elite types with superior growth, quality, pest resistance, and site adaptability.

"Advances in Tools and Techniques of Tree Improvement" were discussed and illustrated by Franklin C. Cech. He described present tree-climbing devices, with particular emphasis on the evolution of truck- and trailer-mounted ladders. He also described the latest equipment for pollination and for removal of wood samples from living trees, including a reversible 1-inch electric drill for extracting large increment cores.

Campbell and Wakeley presented specific suggestions concerning "Possible Refinements in Controlled Pollination of Southern Pines." First, put on bags before buds enlarge to avoid contamination. Second, bagged flowers can be pollinated at any stage from 2 (buds large) to 5 (Flowers at maximum receptivity) inclusive, though yields from pollination at stages 4 (Flowers partly open) and 5 are the most certain and abundant. Third, it is far more difficult than has been realized to tell when flowers have in fact ceased to be receptive. If contamination is intolerable, flowers must not be debagged until far into or past the conventional stage 6 (flowers closed). The authors also found that pollen germinating as low as 65 percent in laboratory tests may be well worth using in attempts to make certain greatly desired crosses. High laboratory germination is not essential for success in crossing.

Francois Mergen's paper on "Natural and Induced Flowering in Young Pine Trees" makes several new contributions to our knowledge of early flowering. Among these are the observations that Mugo pine seedlings have flowered when less than 1 year old, that there are precocious ecotypes in jack pine, that interspecific hybrids may flower earlier than the parent species, and that flowering could be induced in 2-year-old white pine hybrids and Scotch pine by various manipulations of temperature, humidity, and nutrition. The manner in which these factors go about producing their effect on cell differentiation is still a challenging mystery for future research.

Merkel and Ebel's report "Cone and Seed Insects and their Control" identifies the main culprits on southern pines in Florida as coneworms, seedworms, and a species of pine thrips which attacks the succulent flowers of slash pine. Tentative spray schedules for the control of these insects are given. Another possibility for control of the pine seedworm, particularly in isolated seed orchards, is to collect the entire cone crop, infested and sound, This reduces the population to zero, but the researchers do not yet know how soon the moths (Laspeyresia anaranjada) would reinvade the seed orchard,

The paper on "Interrelationship of Wood Properties in Loblolly Pine" by Zobel, McElwee, and Browne substantiates the general correlation in wood properties between the younger and older wood laid down by the same tree, except for width of tracheids. The magnitude and genetic importance of anatomical differences between trees was emphasized. These tree-to-tree differences in such properties as tracheid length can amount to as much as 100 percent.

The most significant part of this paper examines the interrelationships among the various wood properties in loblolly pine. The strongest relationships were between specific gravity and cell wall thickness (positive). Among the cell dimensions, tracheid width, length, and wall thickness were only weakly related to each other. Cellulose characteristics were only weakly related to cell dimensions. Faster growth rate tended to be associated with lower specific gravity and shorter tracheids, but this relationship was very weak and was overshadowed by the large differences among trees.

No correlations of more than two wood characteristics were calculated, but the authors found that almost all possible combinations of characteristics occurred in different trees. From this they conclude that we can expect to be able to produce strains of trees with almost any specified wood quality without having to accept undesired characteristics as a bonus.

McKnight and Bonner in "Potentials and Problems of Hardwood Tree Improvement" summarize the important information available on flowering, seeding characteristics, and cytogenetic data for twenty selected species of southern hardwoods, such as cottonwood, willow, sweetgum, oaks, and yellow-poplar, and others.

All in all, this sample of recent progress indicates that we have gone a long way in forest genetics research and tree improvement programs since that time 10 years ago when plans were made for an expected attendance of 25 or 30 people at the First Southern Forest Tree Improvement Conference. Now there are 48 professional workers in this field in the South. Perhaps the most impressive thing about the accomplishments of the past decade has been the cooperation of all forestry agencies, particularly through the Southern Forest Tree Improvement Committee., The massive South-wide seed-source study is a fine example of this cooperation.

Where do we go from here? I feel that the southern pine and hardwood forest region should have a tree improvement program second to none in the world. This area is the largest body of really good-quality timber-producing land north of the Tropic of Cancer, where most of the world's markets lie. It has a half-billion dollar pulpwood crop annually, plants narly 2 billion trees a year, and has some sites which, with the best plant materials and most intensive culture, should produce up to 500 cubic feet per acre per year. Its level topography and broad areas of uniform climate mean that a reasonably small number of improved strains will serve the region. This is far from true in the mountains that dot most of our timber-growing areas.

You folks are largely the ones who will determine how fast the genetic improvement of timber trees will move ahead in this ideal setting. It is your efforts that will determine how much progress we will be able to record when we meet for our twentieth anniversary in 1971.

Publications and Reports Prepared in Cooperation
With the Committee on Southern Forest Tree Improvement:

Report of the first southern conference on forest tree improvement. Atlanta, Georgia, January 9-10, 1951. U. S. Forest Serv., Atlanta, Ga. (Mimeo)*

Proposal for a cooperative study of geographic sources of southern pine seed. Subcommittee on Geographic Source of Seed, Philip C. Wakeley, Chairman. Southern Forest Expt. Sta. 1951. (Mimeo.)*

Standardized working plan for local tests of seed source. Subcommittee on Geographic Source of Seed, Philip C. Wakeley, Chairman. Southern Forest Expt. Sta. 1951. (Mimeo)

Hereditary variation as the basis for selecting superior forest trees. Subcommittee on Tree Selection and Breeding. Keith W. Dorman, Chairman, Southeastern Forest Expt. Sta. Paper 4 15. 1952.

Directory of forest genetic activities in the South. Subcommittee on Tree Selection and Breeding, Keith W. Dorman, Chairman. Southeastern Forest Expt. Sta. Paper 17. 1952.

Suggested projects in genetic improvement of southern forest trees. Committee on Southern Forest Tree Improvement. Southeastern Forest Expt. Sta. Paper 20. 1952.

Testing tree progeny. A guide prepared by the Subcommittee on Progeny Testing, E. G. Wiesehuegel, Chairman. Tennessee Valley Authority, Technical Note No. 14. 1952.

Report of the second southern conference on forest tree improvement. U. S. Forest Serv., Atlanta, Ga. 1953. (Mimeo)*

Progress in study of pine races. Philip C. Wakeley. Southern Lumberman 187(2345): 137-140. December 15, 1953.

The role of genetics in southern forest management. Special subcommittee of the Committee on Southern Forest Tree Improvement. Bruce Zobel, Chairman. Pt. 1, Forest Farmer 14(1): 4-6, 14-15. Pt. 2, Forest Farmer 14(2):8, 14-19. Pt. 3, Forest Farmer 14(3):8-9, 14-15. (Reprint, 11 pp. 1954).

Proceedings of third southern conference on forest tree improvement.
Southern Forest Expt. Sta. 1955.

Better seed for better southern forests. Subcommittee on Genetic Control of Seed, T. E. Maki, Chairman. N, C. State College School of Forestry Tech. Rpt. 9. 1955.

Forest tree improvement for the South. Committee on Southern Forest Tree Improvement, T. E. Bercaw, Chairman. 1955.

Supplement No. 1 to the original working plan of September 12, 1952, for the southwide pine seed source study. Subcommittee on Geographic Source of Seed, Philip C. Wakeley, Chairman.

Time of flowering and seed ripening in southern pines. Subcommittee on Tree Selection and Breeding, Keith W. Dorman, Chairman, and John C. Barber, Southeastern Forest Expt. Sta. Paper 72. 1956.

Proceedings of the fourth southern conference on forest tree improvement, University of Georgia. 1957.

Pest occurances in 35 of the southwide pine seed source study plantations during the first three years, Southern Forest Expt. Sta. 1957.

Proceedings of the fifth southern conference on forest tree improvement,. North Carolina State College, Raleigh. 1959.

Minimum standards for progeny-testing southern forest trees for seed certification purposes. Subcommittee on Progeny Testing for Seed Certification Purposes. Philip C. Wakeley, Chairman. Southern Forest Expt. Sta., 20 pp. 1960.

* These reports are out of print.