VARIATIONS IN HEIGHT GROWTH AND CONELET SET IN TWO-YEAR-OLD F2 SEEDLINGS OF LOBLOLLY PINES

James T. Greene 1/

Without selection, natural or artificial, there can be little genetic change of the forest. To determine if and how a particular characteristic is inherited, the tree improver must exert selection pressure on a specific characteristic. The ultimate goal is to incorporate the desired characteristics, whatever they may be, into a particular genetic strain. Breeding better forest trees, with attention to a particular characteristic, begins with a close look at what nature has already produced. Natural and planted populations often present the breeder with trees which show outstanding and desirable differences.

Variation in the vigor of progeny from individual trees is of great interest to workers engaged in forest tree improvement and forest genetics. research. Trees that produce fast-growing offspring may provide the basis for a superior strain. Such trees may produce superior seed. in sufficient volume for large scale nursery planting. They would also be valuable breeding stock for intra-and inter-specific hybridization.

The early production of strobili is essential in seed orchards and especially in *a* controlled-pollination program. In the establishment of breeding programs, distinct from vegetative propagation, it is apparent that any means which will hasten the onset of sexual maturity and increases the amount of seed produced will be of great importance. Most loblolly pine (Pinus taeda L.) trees begin to produce strobili at an age of about 8 to 10 years. By selection and controlled pollination, it should be possible to reduce "flowering"' age. This will *save* valuable years in a genetics program as well as insure early seed production in a grafted or seedling seed orchard.

Seed source studies of loblolly pines established in 1935 on the properties of the School of Forest Resources, University of Georgia offer a wide genetic base for the selection of phenotypes. These seed sources represent a **single** county from each of the following states: Alabama, Arkansas, Florida, Georgia, Louisiana, Maryland, Mississippi, North Carolina, South Carolina, Texas and Virginia. By intensive scouting in these plantations, individual trees that have twice the wood volume of the average tree in the same stand at the same age have been located. Furthermore, some of these loblolly pines are bearing seeds which produce seedlings that have mature cones at three and four years from seed.

1/ Associate Professor of Forest Genetics, School of Forest Resources, University of Georgia. This research was conducted in cooperation with the Georgia Forest Research Council and the College Experiment Station.

Approximately 800 **trees** were selected in these plantations for superior and inferior phenotypic characteristics. Some of the superior characteristics were: outstanding diameter and height growth, narrow crowns, straight stems, small limb size, seed production, long tracheid length, high specific gravity and apparent resistance to disease.

The inferior characteristics were: poor diameter and height growth, wide crowns, crooked and forked stems, large limbs, short tracheids, low specific gravity and susceptibility to disease. Some of these selected trees have been and are being crossed in all possible combinations to learn if and how the particular selected characteristics are inherited.

Progenies from some of these controlled crosses now offer excellent opportunities to make additional selections for desired characteristics. Approximately 100 possible combinations of crosses of loblolly pine trees are growing in the field in a randomized complete-block design with six replications. Each cross is represented in each block by one square plot of 25 seedlings spaced 10 X 10 feet.

This report will illustrate the effects of selection, controlled-pollinations and progeny testing of selected loblolly pine parents and their F_1 and F_2 progenies relative to their fecundity rate and height growth for the populations studied.

Results And Discussion

Flower Production

Greene (1966) reported on the seed yield and plantable seedlings from controlled and open-pollinated four and five-year-old seedlings of loblolly and shortleaf pines. These young "parents"' were three and four years from seed when the pollinations were made. In these studies, seventy-seven per cent of the controlled-pollinations made in 1963 on four-year-old loblolly pines were successful. These crosses were F_2 and backcrosses.

The F_2 seedlings have been in the field for two years and represent 30 controlled loblolly pine progeny groups of approximately two-thousand seedlings from three and four-year-old parents. Nineteen per cent of the progeny groups were producing female strobili at one year in the field or two years from seed. Fourty-eight per cent of the progeny groups were producing female strobili at two-years in the field or three-years from seed. Crosses were made this year on the two-year-old trees.

Growth Rate

Some F_1 crosses are yielding approximately five cords per acre per year in seven years from seeds. At six years in the field, the best F1 cross *was* averaging 8.2 inches approximately 4.5 feet above the ground, 32.0 feet in height and *was* producing approximately 30.08 cords of wood per acre.

As one might suspect, the poorest specific cross was producing

considerably less than one cord per acre per year.

The best loblolly F_1 cross relative to height growth and yield also produced the fastest growing F_2 progeny todate. The mean of the best F2 cross in two years was 9.1 feet and the tallest individual within the group was 12.2 feet (Table 1).

The range in average height growth among the two-year-old F_2 progeny groups was from 6.6 feet to 9.1 feet for a difference of 2.5 feet. This is' a 38 per cent increase in height growth between the poorest and the best F^2 cross.

The average height growth for Coastal Plain and Piedmont loblolly pines is approximately 1.50 feet per year (Zobel 1968). On this basis, the poorest F_2 progeny are making 100 per cent better height growth than the average Piedmont and Coastal Plain loblolly pines at two years. The best F_2 progeny is growing 200 per cent better than the average Piedmont and Coastal Plain loblolly pines at two years (Table 1).

The F_2 generation, in our studies are characterized by a high **degree of** diversity. This is evident by variations of height growth within and among the progeny groups (Table 1). Variations in height growth within progeny groups varied as much as 7.7 feet with a range of 4.0 feet to 11.7 feet.

Variations of height growth among the individual trees that make up the entire progeny groups varied from a low of 4.2 feet to a high of 12.2 feet, a difference of 8.0 feet in two years.

These data clearly illustrate the importance of selection, controlled-pollination and progeny testing for height growth and early "flower"' production. It is within and among these known progeny groups that selection pressure can best be exerted on height growth and "flower" production for the next generation. The tree improver can either select the individuals within the 14.0 feet class or the individuals that are within the 12.0 feet class for his parental stock and future generations. This possibility has great promise in programs of tree improvement and especially from the practical aspect of producing commercial quantities of improved seed from "Seedling" orchards.

Table 1. Height Growth in Feet of Two-Year-Old F_2 Seedlings of Loblolly Pines From 3-and 4-Year-Old Parents

Cross	Average Height	Height Range Within Progeny Groups	Variations Within Progeny Groups
8	6.6	4.2 - 8.9	4.7
1	6.8	5.9 - 8.4	2.5
3	6.8	4.3 - 8.4	4.1
20	6.9	5.2 - 9.3	4.1
9	7.0	4.9 - 8.4	3.5
2	7.4	3.4 - 9.3	5.9
18	7.4	4.9 - 9.6	5.3
30	7.6	4.8 - 11.4	6.6
6	7.8	5.7 - 10.1	4.4
21	7.9	4.6 - 10.5	5.9
26	7.9	4.0 - 11.7	7.7
11	7.9	3.6 - 9.6	6.0
12	8.0	5.2 - 10.1	4.9
29	8.0	4.7 - 10.0	5.3
27	8.0	5.6 - 10.1	4.5
25	8.0	5.4 - 10.0	4.6
7	8.0	5.6 - 9.4	3.8
4	8.1	5.2 - 10.0	4.8
10	8.1	6.9 - 9.5	2.6
14	8.1	7.1 - 9.3	2.2
15	8.1	5.7 - 9.9	4.2
16	8.1	3.4 - 10.9	7.5
23	8.3	6.2 - 10.7	4.5
5	8.6	6.4 - 10.7	4.3
19	8.6	7.5 - 10.1	2.6
17	8.8	6.4 - 10.6	4.2
22	8.9	5.9 - 11.9	6.0
28	9.0	6.7 - 11.5	4.8
13	9.0	7.1 - 11.4	4.3
24	9.1	7.1 - 12.2	5.1

Summary

A study of variation, selection, controlled-pollinations and progeny testing of selected parents and their F_1 and F_2 progenies relative to height growth and strobili production *was* conducted with the following results.

1. These data prove that F_2 seedlings of loblolly pines can be successfully grown in five to **six** years from seed involving three-and four-year-old parents for the populations studied°

2. Nineteen per cent of the F_2 loblolly pine progeny groups produced female strobili at one year in the field or two years from seed.

3. Forty-eight per cent of the progeny groups produced female strobili at two years in the field or three years from seed.

4. Some F_1 crosses of loblolly pines yielded approximately five cords per acre per year in seven-years from seeds.

5. The best loblolly F_1 cross relative to height growth and yield also produced the fastest growing F_2 progeny todate. The mean of this cross in two-years was 9.1 feet and the tallest individual within the cross *was* 12.2 feet.

6. The range in average height growth among the two-year-old F2 progeny groups was from 6.6 feet to 901 feet for a difference of 2.5 feet. This is a 38 per cent increase in height growth between the poorest and the best F2 cross.

7. The average growth rate in height for Coastal Plain and Piedmont loblolly pines is approximately 1.50 feet per year. On this basis, the poorest $F_?$ progeny are making 100 per cent better height growth than the average Piedmont and Coastal Plain loblolly pines at two years, whereas the best F_2 progeny are making 200 per cent better height growth.

8. Data indicate that age of "flowering", fecundity rate, height growth and yield in loblolly pines for the populations studied can be altered by selection, controlled-crossing and progeny testing.

Literature Cited

Greene, James T. -- 1966. Seed yield and plantable seedlings from controlled- and open-pollinated four- and five-year-old seedlings of loblolly and shortleaf pines. Eight South. Conf. on Forest Tree Impr. Proc. pp. 155-157.

North Carolina State University -- 1968. Twelfth Annual Report N. C. State--Industry Cooperative Tree Improvement Program. School of Forestry, N. C. State Univ. pp. 23