Seed Yield and Plantable Seedlings from Controlled- and Open-Pollinated Four- and Five-Year-Old Seedlings of Loblolly and Shortleaf Pine

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The early production of strobili is highly desirable in seed orchards and especially in a program of tree breeding where early flowering of progeny and the production of viable seed are of much importance. Most loblolly pine (Pinus taeda L.) and the shortleaf pine (Pinus echinata Mill.) trees begin to produce strobili at an age of about 8 to 10 years. By selection and breeding, it should be possible to reduce "flowering" age considerably. This would save valuable years in a genetics program as well as insure early seed production in a grafted or seedling seed orchard.

Greene and Porterfield (1962) located loblolly pine trees ranging from 21 to 30 years of age on the property of the University of Georgia that produced seedlings bearing female strobili at ages of three and four years. One three-year-old loblolly pine seedling (L-81A) produced female strobili in 1959, after two years in the field. This seedling was back-crossed to one of the early cone-producing parents. Two cones from this cross were collected in late 1960 which yielded 102 seeds. These seeds produced 44 seedlings, and after three years in the field, 40 of these are making normal growth and appear exceedingly vigorous. The original parent seedling has produced female strobili during the five successive years.

RESULTS AND DISCUSSION

The following data illustrate that "flowering" age can be reduced through selection and breeding and that four-year-old parents will yield seed that will produce plantable seedlings. The term "plantable" seedling refers to a number one grade seedling with no apparent defects.

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Table 1. Open-pollinated loblolly pine cones collected in 1963 from 4-year-old seedlings.

Female	Number of cones	Number of Seeds Per Seedling	Number of Seeds Per Cone	No. and Percent of plantable seedlings	
				No.	Percent
L-72xL-78	3	119	40	71	60.0
L-72xL-78	2	111	56	6	5.0
L-79 (A)	1	62	62	20	32.0
L-65xL-64	2	129	65	6	5.0
L-65xL-64	2	64	32	11	17.0
L-65	3	98	33	11	11.0
L-65	2	78	39	5	6.0
L-64	2	139	70	94	68.0
L-64	7	208	29	7	3.0
L-64	1	62	62	19	31.0
L-64	1	107	107	2	2.0
L-64	2	109	55	11	10.0
L-78	1	66	66	16	24.0
L-64xL-78	1	77	77	1	1.0
L-64xL-78	1	78	78	27	35.0
L-64xL-78	1	83	83	12	14.0
L-64xL-78	2	140	70	52	37.0
L-64xL-78	1	62	62	44	71.0
L-64xL-78	1	92	92	43	47.0
L-64xL-78	1	24	24	11	46.0
L-64xL-78	1	53	53	35	66.0
L-64xL-78	2	120	60	36	30.0
L-78xL-77	2	73	37	40	55.0
L-72xL-64	1	109	109	56	51.0
L-72xL-72	1	69	69	36	52.0
L-64xL-64	1	47	47	1	2.0
L-69xL-64	2	111	56	3	3.0
L-69xL-64	1	25	25	2	8.0
L-69xL-64	1	78	78	43	55.0
L-69xL-64	1	47	47	17	36.0
L-69xL-65	1	97	97	44	45.0

Table 2. Open-pollinated shortleaf pine cones collected in 1963 from 4-year-old seedlings.

Female	Number of cones	Number of Seeds Per Seedling	Number of Seeds Per Cone	No. and Percent of plantable seedlings	
				No.	Percent
SH-10xSH-5	1	21	21	5	24.0
SH-10xSH-5	1	31	31	6	19.0
SH-6xSH-8	1	47	47	10	21.0
SH-5xSH-6	1	9	9	5	56.0
SH-8xSH-10	5	145	29	31	21.0
SH-8xSH-10	4	106	27	14	13.0
SH-8xSH-5	7	131	19	20	15.0

Table 3. Control and open-pollinated loblolly pine cones collected in 1964 from 5-year-old control pollinated seedlings.

Female	Male	Type of Cross	Number of Cones	Number of Seeds Per Seedling	Number of Seeds Per Cone
L-64xL-78	L-64xL-78	F_2	4	184	46
L-64xL-78	L-64xL-78	F_2	1	52	52
L-64xL-78	L-64xL-78	F_2	2	109	55
L-64xL-78	L-64	Back-cross	4	24	6
L-64xL-78	L-78	Back-cross	2	63	32
L-64xL-78	L-78	Back-cross	1	4	4
L-64xL-78	L-64xL-78	F_2	4	225	57
L-64xL-78	Wind	Open	1	62	62
L-64xL-78	Wind	Open	2	120	60
L-64	L-64xL-78	F_2	1	22	22
L-64	Wind	Open	2	151	75
L-65xL-78	L-64xL-78	F_2	1	42	42
L-65xL-78	L-65	Back-cross	2	99	49
L-65xL-78	Wind	Open	4	136	34
L-65xL-78	Wind	Open	1	32	32
L-65xL-65	L-65	Back-cross	2	19	10
L-65xL-64	L-65	Back-cross	2	12	6
L-65xL-64	Wind	Open	2	52	26
L-65	L-65	Back-cross	1	23	23
L-65	Wind	Open	5	389	78
L-72xL-78	Wind	Open	1	133	133
L-72xL-78	Wind	Open	1	102	102
L-69xL-77	L-69	Back-cross	1	22	22
L-69xL-77	L-77	Back-cross	1	14	14
L-69xL-72	L-69	Back-cross	2	102	51
L-69xL-65	Wind	Open	3	280	93
L-69xL-65	Wind	Open	1	55	55
L-79	L-79	F_2	1	47	47
L-79	Wind	Open	3	172	58
L-79xL-79	Wind	Open	1	130	130
L-78	L-78	Back-cross	1	20	20
L-78	L-78	Back-cross	1	57	57
L-69xL-64	Wind	Open	2	129	64

Tables 1 and 2 contain data relative to open-pollinated cones, seeds and plantable seedlings from young loblolly and shortleaf pine parents. The progenies had been outplanted in the field for four years when the cones were collected. This means that the progenies were producing strobili at four years from seed.

The number of open-pollinated seeds per individual seedling of loblolly pine ranged from 24 to 208. The range of plantable seedlings per individual parent was from one percent to seventy-one percent (Table 1).

Open-pollinated seeds from individual four year old shortleaf pine parents ranged from nine to 145. Range in plantable seedlings from these young parents was from thirteen to fifty-six percent (Table 2).

Tables 3 and 4 present data relative to controlled and open- pollinated cones collected in 1964 from five-year-old parents. These progenies produced female strobili in 1963 which were controlled pollinated.

Seventy-seven percent of the controlled pollinations made in 1963 on four-year-old loblolly pines were successful. These crosses were F_2 and back-crosses.

The range in number of seeds from individual F_2 crosses ranged from forty-two to 225. Backcrossing resulted in a range of seeds from four to 102 per seedling. The range in number of open-pollinated seeds for each individual parent was from 32 to 389 (Table 3).

Fifty-four percent of the controlled pollinations made in 1963 on four year old shortleaf pine parents were successful. The range of seeds resulting from the F_2 crosses for individual parents was from 14 to 762. The number of seeds for each individual parent resulting from backcrossing ranged from three to 56. One open-pollinated cone was collected which yielded 28 seeds (Table 4).

SUMMARY

These data indicate that "flowering" age can be reduced by selection and breeding. These data show that it is possible to produce F_2 seed in loblolly and shortleaf pine in five or six years from seed. In fact, we have F_2 seedlings growing in the field in a total of 5 years from seed. The next step iE,

Table 4. Controlled and open-pollinated shortleaf pine cones collected in 1964 from 5-year-old seedlings.

Female	Male	Type of Cross	Number of Cones	Number of Seeds Per Seedling	Number of Seeds Per Cone
SH-10	SH-10	Backcross	1	3	3
SH-10xSH-5	SH-10xSH-8	F_2	2	63	32
SH-10xSH-8	SH-10xSH-8	F_2	1	40	40
SH-6xSH-8	SH-10xSH-8	F_2	17	762	45
SH-6xSH-8	SH-10xSH-8	F_2	2	101	50
SH-6xSH-5	SH-10xSH-8	F_2	1	68	68
SH-8xSH-6	SH-6xSH-8	F_2	1	53	53
SH-8xSH-5	SH-8xSH-5	F_2	2	50	25
SH-8	SH-10xSH-8	F_2	1	14	14
SH-8	SH-10xSH-8	F_2	1	56	56
SH-8	SH-10xSH-8	F_2	1	48	48
SH-9	SH-10	F_2	1	31	31
SH-9	SH-10	F_2	1	38	38
SH-9	SH-9	Backcross	4	56	14
SH-9	SH-10	F_2	1	60	60
SH-5	SH-6	Backcross	1	37	37
SH-5	SH-6	Backcross	1	13	13
SH-5	Wind	Open	1	28	28

to find out how readily the early "flower-producing" trait found in these trees may be transmitted to the next generation, and the segregating progeny of the F generation will be invaluable in this respect.

An opportunity for reducing age of "flowering" in loblolly and shortleaf pines exists in the selection and progeny testing of "early-flowering" phenotypes like the ones just described. Once tested, these genotypes can be crossed with other genotypes to produce "early-flowering" strains possessing other desirable traits. This possibility has great utility in programs of tree improvement and more especially from the practical aspect of producing commercial quantities of improved seed from seedling orchards in the future.

LITERATURE CITED

Greene, J. T. and H. D. Porterfield, 1962. Early cone production in loblolly pine through selection and control-pollination. Georgia Acad. Sci. Bul. 20:6.