A Report on Cone and Seed Yield in Georgia Forestry Commission Seed Orchards

SANFORD DARBY [1/]

The question of prime interest to tree improvement workers is, what cone and seed yields will seed orchards produce? Do grafted trees have the fecundity of other forest trees? Are they more productive?

I wish it were possible for me to give you the answers to these questions. I feel I am safe in saying that large acreages of grafted seed orchard trees have not been established a sufficient length of time to give us yield data on which to base an answer. I was asked to report on cone and seed yields in the Georgia Forestry Commission seed orchards. To expedite our subject I am going to present orchard yield data in tabular form. The material is presented in Tables 1 through 7.

To acquaint those individuals who may not be familiar with the Georgia Forestry Commission's tree improvement activities, we will briefly review the program. Work was commenced on two orchards in 1954. The orchards are located near Glenwood and Cochran, Georgia, approximately forty miles apart. One hundred seventy-nine slash and 129 loblolly phenotypes were selected for use. Grafting was commenced in 1955. Initial ramets were planted in the orchards in 1956. Today, ten years later, we are still propagating ramets for the orchards. Currently, 26,333 slash (Pinus elliottii Engelm.) and 11,974 loblolly (Pinus taeda L.) ramets are living. The orchards are uneven aged and over 80 percent of the ramets are five years or less in age. Forty-one slash clones have produced no wind-pollinated cones. Only thirteen loblolly clones have been non-productive.

Orchard cone production records are maintained on IBM cards. Seed yield records were kept on the weight of seed per cone in grams.

In an attempt to obtain preliminary information on seed yield, a small amount of data was collected during

Table 1. Cone and seed yield data for 1960 comparing yields of various type slash cones.

ITEM	TYPE CONE: Select phenotypes	Seed orchard open-pollinated	Seed orchard controlled pollinated
Number of cones	740	56	347
Number of seed	28,009	2,120	10,060
Avg. seed per cone	38	38	30

Table 2. Typical sample of cone collection data for Georgia Forestry Commission Seed Orchards showing average number of cones produced per tree by production year, species, and orchard.

SPECIES	YEAR	ORCHARD	NUMBER TREES	NUMBER CONES	AVERAGE CONES/TREE
SLASH	1962	HORSESHOE	2,455	12,224	5
		ARROWHEAD	1,137	1,916	2
		TOTAL	3,592	14,140	4
	1963	HORSESHOE	1,061	9,068	9
		ARROWHEAD	381	1,123	3
		TOTAL	1,442	10,191	7
	1964	HORSESHOE	897	23,449	26
		ARROWHEAD	915	13,624	15
		TOTAL	1,812	37,073	20
LOBLOLLY	1962	HORSESHOE	783	4,766	6
		ARROWHEAD	821	4,311	5
		TOTAL	1,604	9,077	6
	1963	HORSESHOE	1,060	7,763	7
		ARROWHEAD	1,101	14,601	13
		TOTAL	2,161	22,364	10
	1964	HORSESHOE	1,620	28,312	17
		ARROWHEAD	1,245	68,796	55
		TOTAL	2,865	97,108	34

Table 3. Typical sample cone yield data for years 1962 through 1964. Showing average number slash and loblolly cones produced per tree and range in yield - Georgia Forestry Commission Seed Orchards.

SPECIES	YEAR	HORSESHOE ORCHARD: LOW	AVG.	HIGH	ARROWHEAD ORCHARD: LOW	AVG.	HIGH
SLASH	1962	1	5	17	1	2	4
	1963	1	9	39	1	3	13
	1964	3	26	92	2	15	55
LOBLOLLY	1962	1	6	13	1	5	23
	1963	1	7	20	1	13	70
	1964	1	17	44	4	55	146

1/ Chief of Reforestation, Georgia Forestry Commission, Macon, Georgia

Table 4. Comparison of slash and loblolly cone yields by clones for period 1962 through 1964 Georgia Forestry Commission Seed Orchards.

Species	Clone	HORSESHOE ORCHARD Number Trees	Number Cones	Average Cones/Tree	ARROWHEAD ORCHARD Number Trees	Number Cones	Average Cones/Tree
Slash	5	21	124	6	1	4	4
	18	1	2	2	9	83	9
	45	72	666	9	2	7	3
	46	1	17	17* 1/	69	118	2*
	80	1	1	1*	30	242	8
	85	81	179	2	4	17	4
	86	86	902	11	17	228	13
	87	4	15	4	3	8	3
	106	1	1	1	3	28	9
	119	3	8	3	6	63	10
	136	1	2	2	5	403	81*
	157	17	28	2	1	27	27
	174	78	1151	15	2	71	35
TOTAL		367	3096	8**	152	1299	9**
Loblolly	500	2	81	41*	78	1406	18
	513	36	285	8	6	87	15
	514	1	15	15	73	1655	23
	516	26	155	6	4	128	32
	527	29	156	5	2	117	59*
	531	19	147	8	2	12	6*
	538	39	148	4*	78	1630	21
	546	28	229	8	1	26	26
	570	0	0	0	10	165	17
	577	65	424	7	41	1030	25
	617	77	506	7	56	2086	37
	618	44	268	6	26	659	25
TOTAL		366	2414	7**	377	9001	24**

1/ * Indicates range in cone yield per tree.

Table 5. Sample seed yield data for Georgia Forestry Commission open pollinated slash and loblolly cones by production year.

Species	Year	Number Cones	Total Seed Yield Grams	Pounds	Average Seed Yield/Cone Grams	Ounces
Slash	1962	14,128	7,202.4	15.88	.510	.018
	1963	10,157	19,144.0	42.21	1.885	.066
	1964	33,361	58,668.0	129.34	1.759	.062
	Total	57,646	85,014.4	187.43	1.475	.052
Loblolly	1962	9,270	8,954.7	19.74	.966	.034
	1963	22,189	17,292.5	38.12	.779	.027
	1964	97,108	119,750.4	264.01	1.233	.043
	Total	128,567	145,997.6	321.87	1.136	.040

Table 6. Typical seed yield data for years 1962 through 1964, showing in grams range in yield per cone for slash and loblolly pine. Georgia Forestry Commission Seed Orchards.

Species	Year	Low	Average	High
Slash	1962	.03	.510	2.71
	1963	.16	1.885	5.72
	1964	.11	1.759	5.95
Loblolly	1962	.10	.966	4.31
	1963	.10	.779	3.11
	1964	---	1.233	---

1960. The interesting thing shown in this particular sample (Table 1) is that open-pollinated slash seed orchard cones produce seed equal in number to wind-pollinated cones from selected pheno types. Controlled pollinated cones yield 21 percent less seed per cone than either of the other two types. Similar clones were not used in the comparison as clones were selected on basis of availability of cones. All clones, however, are used in the Georgia program and were originally selected using similar standards.

The important point illustrated in Table 2 is the constant annual increase in the average number of cones per tree. Annual average cone production for slash ranged from a low of two cones per tree in 1962 to a high of 26 during 1964. The average annual loblolly cone yield ranged from five in 1962 to 55 per tree in 1964. Age of ramets in sample is varied, with oldest being nine years old.

Average cone yields for slash pine shown in Table 4 are almost identical for the two orchards. One would expect this result since trees involved are similar in age. Loblolly cone yields for the two orchards are.more variable. This may be explained by a difference in age as the Arrowhead Orchard loblolly trees are on an average, several years older than Horseshoe Bend trees.

Information shown in Table 5 can be used to calculate the potential yield of seed per bushel of cones.

SLASH PINE - Assuming 185.?,/ cones per bushel and that the average seed yield per cone is .052 ounces, cone produced have a yield of .60 pounds of seed per bushel.

LOBLOLLY PINE - Using 309Z/ cones per bushel and an average seed yield per cone of .040 ounces, the seed yield is .77 pounds per bushel of cones.

Table 7. Georgia Forestry Commission 1964 seed data for open-pollinated seed orchard seed, showing total orchard yields and seed test results.

Species	Seed Size	Pounds Seed Cleaned	Germ. Percent	Purity Percent	Full Seed Percent	Seed Per Pound
Slash	Large 3/	277	84	99	92	11,139
	Medium 4/	100	84	100	97	14,153
	Small	31	75	84	91	19,560
	Total	408				
Loblolly	Large	151	65	98	94	13,337
	Medium	45	62	100	89	13,601
	Small	68	72	100	99	16,074
	Total	264				

3/ Top screen size - 11/64"
4/ Bottom screen size - 7/64" x 3/4"

It is interesting to note the variation in seed per pound for both species. Loblolly appears to be lacking in medium size seed, thus indicating lar-

1/ Indicates range in cone yield per tree.

2/ Darby, S. P. Unpublished data collected from 1957 through 1965.

ger seed and a smaller number of seed per pound.

SUMMARY AND CONCLUSION

In summary we can say that the yield of cones per tree from Georgia orchard trees is currently considerably below that normally produced by the same species occurring in other type stands. To illustrate this point, one worker reported that an average yield of 1.85 bushels of cones per tree was collected from a loblolly seed producing area. This amounts to several hundred cones per tree compared to an average of 34 loblolly cones per tree produced in the Georgia orchards during 1964.

In regard to the number of sound seed per cone produced in the Georgia orchards, they compare favorably to that reported by other workers for Georgia. Squillace, his study of the geographic variation in slash pine, reported that the mean sound seed yield for the whole species was 51 seed per cone. Slash cones collected during 1964 from the Georgia orchards averaged 57 seed each. The seed yield per cone for slash pine averaged 1.475 grams, a potential yield of .60 pounds of seed per bushel of cones. In regard to the yield for loblolly, the average yield per cone for this specie was 1.136 grams. This is a possible yield of .77 pounds of seed per bushel of cones.

In conclusion we can safely say, based on what we now know of seed per cone, that the Georgia orchards produce seed at this time that at least equal in quantity, seed produced by the same species growing in other environments in Georgia. Additional time will be needed before trees reach maximum productivity and before we can answer the question of what cone and seed yields will grafted seed orchards produce?

5/ Squillace, A. E., 1964. Geographic Variation in. Slash Pine. Unpublished Thesis - University of Florida Graduate School.