

SIX-YEAR RESULTS OF HYBRID POPLAR CLONAL TESTS
IN PENNSYLVANIA AND MARYLAND

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ABSTRACT.--Six-year height and diameter growth were measured and analyzed for 199 hybrid poplar clones at Ephrata, Pennsylvania, and Hampstead, Maryland. Six-year heights differed significantly between and within locations. Six-year diameter at breast height differed significantly within locations. Hybrid poplar clones can be selected for use in Pennsylvania and Maryland at 6 years with predictable performance to about age 12.

IN 1784 THE LOMBARDY POPLAR, *Populus nigra* L. cv. 'Italica', was introduced in the United States (Rehder 1954). Artificial hybridization with poplars in the United States was initiated in the spring of 1924 by the Oxford Paper Company, now Boise Cascade Paper Group, Rumford, Maine, in cooperation with the New York Botanical Garden (Stout et al. 1927, Stout and Schreiner 1933). The USDA Forest Service, Northeastern Forest Experiment Station, acquired the project in 1936 when Dr. Ernst J. Schreiner left the Oxford Paper Company and joined the Forest Service. Currently the Forest Service is testing 199 poplar clones--158 clones from the Oxford Paper Company and 41 from Canadian and European selections. The 158 clones originally from the Oxford Paper Company represent selections within 42 full-sib families; 106 selections are from 10 families, and 74 of these 106 are from only 5 families. Twenty-four of the selections are from the full-sib cross *P. deltoides* x *P. trichocarpa*, and 17 from the full-sib cross *P. deltoides* x *P. nigra* cv. 'Caudina'.

This report evaluates the 6-year height and diameter growth of these 199 clones planted on two sites, one in Pennsylvania and the other in Maryland.

METHODS AND MATERIALS

The Ephrata, Pennsylvania, and Hampstead, Maryland, clonal tests were established with 10-inch dormant cuttings on agricultural sites in the spring of 1974. The experimental design at each planting location consisted of five blocks of 200 clonal four-tree plots; each plot consisted of two rows of two trees at a 6- x 6-foot spacing. Additional information on plantation establishment and care

was reported by Demeritt (1981). All trees were measured for total height to the nearest foot and for diameter at breast height (dbh) to the nearest one-tenth of an inch. The data was analyzed using a randomized complete block statistical computer program with plot means as the variable.

RESULTS AND DISCUSSION

Average 6-year height of the 199 clones ranged from 9 to 33 feet (2.7 to 10.1 m) in Pennsylvania and 3.5 to 27.5 feet (1.1 to 8.4 m) in Maryland. Average dbh at 6 years ranged from 0.70 to 5.86 inches (1.8 to 9.1 cm) in Pennsylvania and 0.60 to 3.58 inches (1.5 to 9.1 cm) in Maryland. Six-year clonal heights differed significantly between and within locations. Also, the clone by location interaction for 6-year height was significant. The top 50 clones for height and diameter at each location are listed in Tables 1 and 2, respectively. These plantings at 4 years of age grew 4 to 6 feet per year (Demeritt 1981). The top clones at each location are still growing 4 to 6 feet per year. Hybrid poplars growing on a reclaimed strip mine in Pennsylvania have maintained an average growth rate of 4 feet per year and have reached 65 feet in height after 16 growing seasons (Davidson 1979).

Duncan's multiple range test was used to compare each clonal mean with every other clonal mean. The top 23 clones were not significantly different for 6-year height in Pennsylvania, and the top 35 clones were not significantly different for 6-year height in Maryland. The top 44 clones were not significantly different for 6-year height in the combined location analysis. For dbh, the top four clones were not significantly different in Pennsylvania and the top 83 clones were not significantly different in Maryland. Within clone variability is evident by the range of within clone heights and diameters at each location (Tables 1 and 2). Variability within clones is greater at the Maryland location probably because of less than optimum weed control the first two growing seasons.

The 12 tallest hybrid poplar clones in both the Pennsylvania and Maryland clonal tests at 4 years (Demeritt 1981) are within the 25 tallest clones at 6 years of age (Table 1). Three clones--AK-30 (P. alba x P. glandulosa), NE-353 (P. deltoides x P. nigra cv 'Caudina'), and NE-51 (P. maximowiczii x P. nigra cv 'Plantierensis')--have moved into positions in the top 10 clones for 6-year height in the combined analysis. In Table 1, AK-30 is listed twice because it was inadvertently planted twice at each location. AK-30 shows the good repeatability of growth results at least for this clone--ranked first and third in the combined analysis for 6-year height. The ranking of clones may be better than Duncan's multiple range test to indicate the superiority of height and diameter growth.

Although early measurements of height are of limited value in predicting future performance of hybrid poplar (Wilkinson 1973), 6-year performance data should predict performance of clones up to about age 12.

LITERATURE CITED

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Table 1.--The best 50 hybrid poplar clones in Maryland and Pennsylvania clonal tests by rank and height (in feet) at 6 years

Rank	Clone If	Pennsylvania		Maryland			Combined (PA & MD)	
		Height	Range	Clone #	Height	Range	Clone #	Height
		al						
1	NE-51	33.0 ^{ab}	28-37	AK-30	27.5a	27-28	AK-30	28.5a
2	GA-88*	31.7 ^{abc}	27-36	NE-14	26.4a	18-32	NE-14	27.2ab
3	NE-20	29.8 ^{a-d}	26-34	AK-30	25.0ab	24-26	AK-30	26.3abc
4	NE-248	29.5 ^{a-d}	27-3	1-45/51	23.5abc	18-26	NE-41	25.5abc
5	AK-30	29.5 ^{a-d}	27-32	NE-308	23.2abc	9-35	NE-353	25.1abc
6	NE-308	29.5 ^{a-d}	21-38	NE-37	22.4abc	9-31	NE-308	25.0abc
7	DN-22	29.3 ^{a-e}	25-32	NE-353	22.4abc	9-29	1-45/51	24.5a-d
8	AK-30	29.0 ^{a-e}	29	NE-41	22.3abc	12-28	NE-51	24.4a-d
9	NE-22	29.0 ^{a-e}	29	NE-19	22.3abc	5-38	DN-22	24.3a-d
10	NE-41	28.8	25-31	NE-310	22.0abc	6-34	NE-17	24.2a-d
11	NE-313	28.6 ^{a-e}	15-41	NE-21	21.9abc	5-36	NE-310	23.8a-d
12	NE-14	28.5 ^{a-e}	26-31	NE-284	21.4 ^{abc}	9-27	NE-263	23.7a-e
13	NE-388	28.5 ^{a-e}	21-33	NE-381	21.3abc	9-27	NE-19	23.3a-e
14	NE-47	28.3 ^{a-e}	27-31	NE-228	21.2abc	7-25	NE-47	23.0a-e
15	NE-353	27.8 ^{a-e}	23-32	NE-286	21.0a-d	20-22	NE-381	22.8a-e
16	NE-17	27.8 ^{a-e}	18-40	1-214	20.9a-d	9-32	NE-316	22.8a-e
17	NE-225	27.6 ^{a-e}	21-37	NE-17	20.7a-d	9-32	NE-248	22.5a-f
18	NE-359	27.5 ^{a-e}	20-33	NE-316	20.6a-d	8-31	NE-225	22.4a- ^f
19	NE-318	27.4 ^{a-e}	22-40	NE-318	20.6a-d	5-28	NE-228	22.4a-f

(continued)

Table 1 (cont.)

Rank	Pennsylvania			Maryland			Combined (PA & MD)	
	Clone #	Height	Range	Clone #	Height	Range	Clone #	Height
20	NE-357	27.3a-e	24-32	NE-351	19.8a-d	9-24	NE-359	22.3a-f
21	GA-87*	27.0a-f	27	DN-19	19.3a-d	7-25	NE-37	22.3a-f
22	NE-314	27.0a-f	20-32	DN-22	19.2a-d	5-27	NE-20	22.2a-f
23	NE-310	26.7a-f	22-29	NE-278	19.1a-d	5-26	DN-19	22.2a-f
24	NE-43	26.6b-f	17-35	NE-376	18.8a-d	4-32	NE-388	22.1a-f
25	NE-263	26.5b-f	25-28	NE-16*	18.6a-d	5-27	1-65A	22.1a-f
26	NE-19	26.0b-f	26	DN-55	18.6a-d	9-26	NE-43	22.0a-f
27	NE-376	26.0b-f	26	NE-224	18.5a-d	3-29	NE-313	22.0a-f
28	NE-389	25.7b-f	24-27	NE-359	18.1a-d	3-34	NE-222	21.8a-f
29	NE-222	25.6b-f	21-30	NE-389	18.1a-d	6-34	NE-314	21.7a-f
30	1-45/51	25.5b-f	25-26	NE-263	18.0a-e	18	DN-55	21.5a-f
31	NE-381	25.3b-f	19-31	NE-38*	18.0a-e	4-25	NE-357	21.4a-f
32	DN-31	25.3b-f	22-31	NE-222	18.0a-e	5-29	NE-376	21.2a-g
33	DN-19	25.0c-f	19-29	NE-357	17.8a-e	4-35	NE-226	21.2a-g
34	NE-316	25.0c-f	13-30	NE-226	17.7a-e	5-30	NE-21	21.2a-g
35	DN-16	24.8c-f	15-31	NE-47	17.7a-e	6-26	NE-351	21.2a-g
36	NE-348	24.8c-f	20-38	NE-355	17.7a-e	6-25	NE-389	20.9a-g
37	DN-55	24.5c-f	18-30	J-4	17.6b-e	3-25	DN-31	20.9a-g
38	NE-288	24.5c-g	24-25	DN-30	17.6b-e	4-27	1-214	20.9a-g
39	DN-30	24.2c-g	18-32	NE-314	17.5b-e	5-30	DN-30	20.9a-g

(continued)

Table 1 (cont.)

Rank	Pennsylvania			Maryland			Combined (PA & MD)	
	Clone #	Height	Range	Clone #	Height	Range	Clone #	Height
40	I-78B	24.0c-h	24	DN-31	17.4b-e	7-24	NE-318	20.6a-h
41	NE-226	24.0c-h	21-2	NE-43	17.4b-e	10-27	DN-16	20.5a-h
42	NE-53	23.8c-h	18-31	NE-225	17.2b-e	5-29	NE-355	20.4a-h
43	NE-228	23.6c-h	18-3	NE-6*	17.2b-e	6-26	NE-278	20.1a-h
44	NE-218	23.5c-h	19-28	NE-388	17.0b-e	5-31	NE-286	20.0a-i
45	NE-375	23.5c-h	17-3	NE-238	16.9b-e	6-25	NE-284	19.9b-i
46	DJ-17	23.0d-h	15-3	NE-321	16.9b-e	5-29	NE-224	19.4c-i
47	DN-15SRS	23.0d-i	2	DN-25	16.8b-e	5-23	NE-348	19.1c-i
48	NE-202	23.0d-i	2	NE-322	16.6b-e	4-20	NE-206	19.0c-i
49	NE-309	23.0d-i	2	NE-309	16.5b-e	5-28	NE-366	18.8c-i
50	NE-33	23.0d-i	23	NE-252	16.3b-e	3-18	NE-236	18.1c-i

*
Clone not represented at other location.

'Means with same letter are not significantly different.

Table 2.--The best 50 hybrid poplar clones in Maryland and Pennsylvania clonal tests by rank and diameter at breast height (in inches) at 6 years

Rank	Pennsylvania			Maryland		
	Clone If	Diameter	Range	Clone #	Diameter	Range
1	NE-51	5.86a ¹	4.8-6.7	DN-22	3.58a	2.6-4.7
2	GA-88*	5.50 ab	4.3-6.5	AK-30	3.55ab	3.2-3.9
3	NE-41	5.44ab	4.1-6.4	NE-376	3.43abc	0.7-5.4
4	NE-248	5.10abc	4.7-5.5	NE-37	3.33abc	0.6-5.7
5	NE-47	4.85bc	3.7-5.4	AK-30	3.20a-d	2.8-3.6
6	NE-388	4.65bcd	3.3-6.0	NE-310	3.12a-d	0.6-4.5
7	NE-43	4.62bcd	2.2-6.0	NE-21	3.09a-d	0.9-4.8
8	NE-376	4.60b-e	4.6	1-45/51	3.00a-e	2.5-3.6
9	AK-30	4.40b-f	4.4	NE-19	2.92a-e	0.5-5.1
10	NE-308	4.40b-f	3.2-5.6	NE-228	2.89a-e	0.6-4.0
11	NE-19	4.35b-f	3.9-4.8	NE-389	2.88a-e	2.1-4.8
12	AK-30	4.35b-f	4.1-4.6	NE-14	2.87a-f	1.2-4.0
13	DN-31	4.33b-f	3.1-3.8	NE-381	2.86a-f	0.6-4.3
14	NE-381	4.20b-f	2.4-5.4	NE-353	2.85a-f	0.5-4.6
15	DN-22	4.13c-f	3.8-4.7	NE-8	2.82a-f	1.4-4.5
16	NE-353	4.04c-f	3.0-5.1	NE-41	2.79a-f	0.7-4.3
17	NE-22	4.00c-g	4.0	DN-19	2.78a-f	1.0-4.0
18	NE-225	3.96c-g	2.8-5.6	NE-309	2.73a-f	0.8-3.5
19	NE-348	3.96c-g	3.0-5.1	NE-388	2.70a-f	0.7-5.4
20	NE-17	3.95c-g	2.8-5.5	NE-318	2.69a-f	0.7-4.5
21	NE-359	3.93c-g	2.9-4.5	NE-359	2.64a-f	1.0-4.1
22	1-45/51	3.90c-g	3.7-4.1	NE-284	2.63a-f	1.9-3.6
23	NE-314	3.90c-g	2.2-5.1	NE-308	2.61a-f	0.6-5.0
24	NE-20	3.85c-g	3.4-4.3	DN-23	2.59a-f	0.6-4.1
25	NE-334	3.85c-g	3.6-4.0	DN-16	2.51a-g	0.7-3.7
26	NE-14	3.80c-g	3.7-3.9	NE-320	2.49a-h	0.9-4.3
27	NE-313	3.76c-g	1.7-5.8	DN-30	2.49a-h	0.6-3.7
28	CAG-77	3.70c-g	3.4-4.0	NE-225	2.47a-h	0.7-4.0
29	NE-310	3.70c-g	2.3-4.6	NE-16*	2.47a-h	1.1-4.7

Table 2 (cont.)

Rank	Pennsylvania			Clone #	Maryland	
	Clone If	Diameter	Range		Diameter	Range
30	I-65A	3.66d-g	2.9-5.0	NE-238	2.46a-h	1.9-3.4
31	NE-218	3.65d- g	2.7-4.2	1-214	2.46a-h	0.8-4.0
32	DN-19	3.64d-g	2.3-4.3	NE-17	2.43a-h	1.5-4.6
33	DN-30	3.62d-g	1.9-5.0	NE-50*	2.40a-h	1.0-3.6
34	NE-222	3.60d-g	2.7-4.7	NE-374	2.38a-i	0.5-3.5
35	DN-16	3.54d-g	2.2-4.3	NE-47	2.35a-i	0.2-3.7
36	NE-236	3.52efg	2.9-4.1	NE-222	2.31a-i	0.6-4.3
37	CAG-23	3.50e-h	3.4-3.6	NE-321	2.29a-i	0.6-3.5
38	DN-55	3.50e-h	3.1-3.8	NE-357	2.27a-j	0.6-4.5
39	NE-357	3.50e-h	3.4-3.7	NE-367	2.27a-j	2.0-2.6
40	NE-366	3.46e-h	3.0-4.0	NE-252	2.26a-j	0.7-3.6
41	NE-373	3.42e-h	2.0-4.5	NE-346	2.23a-j	0.8-2.8
42	NE-228	3.36e-h	2.1-4.2	NE-350	2.22a-j	1.0-2.9
43	NE-263	3.25e-i	2.9-3.6	NE-11	2.22a-j	1.2-3.6
44	GA-87*	3.20e-j	3.2	NE-242*	2.20a-k	1.0-3.3
45	NE-318	3.20e-j	2.9-3.4	DN-17	2.20a-k	1.3-2.7
46	NE-254	3.20e-j	2.9-3.6	NE-43	2.18a-k	0.6-4.1
47	NE-206	3.16f-j	2.2-3.9	NE-343*	2.18a-k	0.5-3.8
48	NE-213	3.14f-j	2.3-3.7	NE-51	2.17a-k	0.5-5.5
49	NE-320	3.14f-j	2.7-3.7	DN-31	2.15a-k	0.6-2.8
50	DJ-17	3.12f-j	1.9-3.9	NE-6*	2.13a-k	1.0-3.4

* Clone not represented at other location.

¹Means with same letter are not significantly different.