50 YEARS OF HYBRID POPLAR RESEARCH IN THE NORTHEAST

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POPLAR CULTURE was initiated in the Northeast in 1925 by Drs. A. B. Stout and E. J. Schreiner. An intensive hybridization and breeding program was undertaken during the years 1925 and 1926 at the New York Botanical Gardens and at Highland Park, Rochester, New York, under the control of the Oxford Paper Company, Rumford, Maine. The objective of the hybridization and breeding program was to produce hybrids or strains of poplar that would be faster growing than existing types, that would be resistant to disease, possess good forest form, and could be cheaply propagated from cuttings. Since such poplar were to be used for pulpwood purposes, the type selected must, in addition to the growing requirements mentioned above, possess the desirable wood properties of poplar pulpwood. Approximately 13,000 to 14,000 seedlings were produced from 99 full-sib crosses among 34 different poplar species and cultivars. The hybrid seed was sown in greenhouses at the New York Botanical Gardens and the resulting seedlings were grown there for one year and subsequently planted at Strathglass Farm as one-year-old seedlings. Seedlings from seed produced in 1925 and 1926 were transplanted to the Oxford Nursery, Frye, Maine, in 1926 and 1928, respectively.

The hybrids were carefully and individually studied during their year at Strathglass Farm and selections of the best individuals were made at the end of the second season. The selected hybrids were cut back to the ground and the original root, together with stem cuttingsfrom each seedling were planted at the Oxford Nursery in a plot designated as N-5. The remaining thousands of hybrid seedlings were transplanted at a six by six foot spacing in so-called reserve plantations on cut-over forest land at the Oxford Nursery. These reserve hybrids were not cut back, but were planted as individual trees.

Approximately 780 selected individuals were originally planted in plot N-5. These were all hybrids that appeared to be outstanding in vigor and habit of growth. From 1927 to 1932 annual selections were made, first in Plot N-5 and later in other nursery plots derived from the stock that had been

originally selected and tested in Plot N-5. Between 1929 and 1931 approximately 115 hybrids were selected from Plot N-5 and planted in two other plots designated as N-7 and N-7A in the spring of 1931. Between 1931 and 1933 approximately 60 selections were made in Plots N-7 and N-7A. As a result of these three selection cycles, i.e., 780 trees from 13,000 at Strathglass Nursery, 115 from 780 from Plot N-5, and 58 from 115 from Plots N-7 and N-7A, approximately one out of 200 seedlings was selected as having special value for forestation purposes. These 58 seedlings selected are Northeastern hybrid poplar clones NE-1 through NE-58.

In 1927 and 1928 one reserve plantation consisting of 8,103 trees was planted on cut-over forest land. Hybrids NE-200 through NE-344 were selected in this plantation during 1945 and 1946. Hybrids NE-345 through 388, except 367, 369, 378, and 388 were selected in 1949 and NE-389 and 390 in 1968. Hybrids NE-369 and 388 were selected in Plot N-7A. NE-367 and 378 were selected in plots designated as H-8 and H-8A that were planted in 1932 and 1933, respectively, using 20 rooted trees of each of 46 different hybrids which were originally established in the Oxford Nursery.

There are 78 selected hybrid poplars surviving at the hillside planting as well as an approximately equal number that were not selected. No cultural treatment was used after the first couple of years following planting. By 1935 the area was rather densely covered with volunteer growth. These conditions have provided a rather rigorous natural test of the various groups of hybrids.

Height, diameter breast high (d.b.h.) and cubic foot volume were tabulated over the life of the planting (Table 1). There was very little mortality of the selections in the planting until 1959 when the trees had been growing for over 30 years Each selection averaged 16 cubic feet of wood at 25 years. If 300 trees/acre at 25 years and 90 cubic feet of wood per cord are assumed, then volume growth per acre/year =

$$\frac{300 \times 16}{90 \times 25} = \frac{4800}{2250} = 2.1$$

This is approximately the same yield/acre/year that has been reported by Walter Davidson in Northeastern Forest Experiment Station Research Note NE-282 for hybrid poplars on strip mines in Pennsylvania at 16 years.

DISTRIBUTION OF HYBRID POPLARS

Between 1931 and 1936 the Oxford Paper Company distributed cuttings of the 58 selected hybrids to many American and foreign organizations and individuals. In 1936 the

Oxford Paper Company transferred all of the poplar hybrids to the U.S. Forest Service, Northeastern Forest Experiment Station. In 1938 and 1939 the U.S. Forest Service furnished cuttings of the 58 selected clones for uniform cooperative tests with 35 agencies engaged in reforestation in the United States. The distribution of hybrid poplar cuttings to organizations and individuals has continued to date with distribution to the 48 contiguous states in the United States and to at least 40 foreign countries. It is difficult to determine just how many foreign countries have distributed cuttings to other countries. Also, a total of 3,469 people received 8 cuttings, 2 cuttings each of 4 hybrids, as a result of Mr. Richard C. David's article, "Hybrid Poplars Make News", in the October 1954 issue of the Farm Journal. These people or cooperators furnished 1,659 first year evaluations:. The majority of the poplar hybrids distributed are from 70 clones representing 23 different parentages.

WHAT WE KNOW ABOUT GROWING HYBRID POPLARS

We know how to plant hybrid poplars either by dormant or rooted cuttings and the cultural operations necessary to establish the planting. Also, we have information that juvenile-mature correlations are low. This necessitates growing clonal tests until at least half rotation age to be able to predict later performance. We also are aware of the many insects and diseases associated with growing Populus in general.

WHAT WE DON'T KNOW ABOUT GROWING HYBRID POPLARS

We do not know which clones will do best on any particular site. More study of clone-site relationships are necessary. Genotype by environment interactions appear to be important. Likewise there is evidence that clone by year of planting interactions are also important. We also know very little about intergenotypic competition among hybrid poplars, except that the effects have been demonstrated in greenhouse experiments.

WHAT STUDIES ARE UNDERWAY BY THE USFS

The Forest Service has clonal evaluations underway on strip mine sites in Pennsylvania, Virginia, and West Virginia and on agricultural sites in Massachusetts, Maryland, and Pennsylvania. An intergenotypic competition study expanded from the greenhouse to the field has also been established in southern Maine,

WHAT IS PLANNED FOR THE FUTURE

More crosses are planned among the Populus species used initially by Stout and Schreiner. This has two purposes: 1) to expand the genetic base and 2) to evaluate the worth of particular interspecific crosses. Also breeding work is planned among the existing clonal selections and between the selections and other Populus individuals. Open-pollinated progeny have been collected and will continue to be collected from within an existing clone bank. These progeny will be grown and evaluated. Genetic variation studies will continue with Populus deltodes. Demonstration areas, about three acres each, are to be planted with 10 clones of hybrid poplar and managed for home firewood production.

The author wishes to express his sincere gratitude to John Hartranft, Sumner Burgess, and Paul Perkins, Woodlands Department, Boise-Cascade Corporation, Rumford Mill, for their continued support and interest in the original hybrid poplar planting on corporation lands.

Table 1.--Total height, diameter breast high, and volume in cubic feet for some of the original Northeastern hybrid poplar trees planted at Frye, Maine

Clone No.	Year planted	Height[1/]			DBH						Volume[2/]		
		1946	1951	1954	1946	1951	1954	1959	1968	1979	1946	1951	1954
200	1927	cut	--	--	--	--	--	--	--	--	--	--	--
201	1927	34	47	47	7.9	10.5	11.9	13.8	16.0	17.8	5.9	12.9	17.5
202	1927	29	43	49	8.2	11.2	12.8	14.4	15.6	16.4	5.3	13.1	20.6
203	1927	29	(19)	19	7.9	11.0	(10.9)	12.1	D[3/]	--	5.0	5.6	6.2
204	1927	31	47	49	8.0	10.3	11.8	13.4	14.0	D	5.5	12.5	18.0
205	1927	44	47	(46)	11.0	12.6	13.1	14.1	15.5	17.6	13.0	17.6	20.1
206	1927	39	41	51	9.7	10.7	11.1	12.2	13.2	14.1	9.4	11.6	17.0
207	1927	39	51	56	11.5	13.9	15.4	17.2	20.7	25.0	12.5	22.6	32.1
208	1927	35	35	44	8.7	9.9	10.4	11.1	D	--	7.0	8.7	13.3
209	1927	34	35	38	8.5	9.5	10.0	10.8	D	--	6.6	8.1	10.8
210	1927	40	47	47	12.1	13.9	14.6	16.0	18.0	20.2	13.9	20.8	24.6
211	1927	34	35	37	7.9	8.7	9.5	10.1	D	--	5.9	7.0	9.7
212	1927	43	51	51	12.7	15.1	15.6	16.5	18.1	20.8	16.3	26.2	29.8

Clone No.	Year planted	Height[1]			DBH						Volume[2]		
		1946	1951	1954	1946	1951	1954	1959	1968	1979	1946	1951	1954
213	1927	37	(35)	44	10.3	11.6	12.8	14.5	16.1	D	9.8	11.3	18.5
214	1927	41	47	53	10.6	12.7	13.3	20.9[4]	12.5	23.5[4]	11.4	17.8	23.7
215	1927	34	39	50	8.2	11.7	13.9	16.0	D	--	6.2	12.8	24.1
216	1927	39	51	53	13.1	15.8	16.7	18.4	21.0	23.5	15.6	28.4	34.9
217	1928	30	39	39	8.9	10.4	11.2	11.6	D	--	6.3	10.5	13.2
218	1928	34	43	(41)	8.2	10.4	10.9	11.5	12.0	D	6.2	11.6	13.3
219	1928	43	43	ND[5]	10.5	12.6	ND	13.2	D	--	11.8	16.1	ND
220	1928	37	47	51	11.7	14.5	15.3	17.1	19.2	D	12.2	22.4	28.9
221	1927	39	51	59	13.0	15.6	17.2	18.2	19.2	21.6	15.4	27.7	40.8
222	1927	41	51	55	10.6	12.6	14.3	15.7	17.5	18.0	11.4	19.1	27.6
223	1927	44	51	65	11.2	13.6	15.3	17.0	19.5	22.5	13.4	21.8	36.8
224	1927	47	55	61	12.7	15.8	17.5	19.6	22.5	25.5	17.8	30.6	43.5
225	1927	49	(47)	63	10.3	12.2	13.1	14.2	16.1	18.8	13.0	16.6	27.5
226	1927	54	(47)	55	9.5	10.8	11.1	D	--	--	12.5	13.5	18.4

Clone No.	Year planted	Height[1/]			DBH						Volume[2/]		
		1946	1951	1954	1946	1951	1954	1959	1968	1979	1946	1951	1954
227	1927	41	51	55	9.2	10.1	11.3	12.8	14.6	16.0	9.0	13.1	18.9
228	1927	49	59	58	12.0	14.5	16.0	17.9	20.6	23.4	16.8	28.2	35.4
229	1927	39	39	47	13.1	14.9	15.8	15.2	D	--	15.6	19.5	28.1
230	1927	33	(23)	D	7.7	8.0	D	--	--	--	5.5	(4.1)	D
231	1927	29	35	37	8.3	9.7	10.4	10.6	D	--	5.4	8.4	11.2
232	1928	22	35	36	7.2	9.2	10.0	10.6	10.8	D	3.3	7.7	10.2
233	1928	27	39	42	7.9	9.8	10.8	11.6	D	--	4.7	9.5	13.4
234	1928	24	31	37	8.3	9.9	10.3	10.6	D	--	4.5	7.7	11.0
235	1928	34	39	43	9.9	11.8	12.8	12.9	D	--	8.4	13.0	18.1
236	1928	27	31	39	9.1	11.1	11.6	12.0	D	--	5.8	9.3	14.0
237	1928	31	39	47	8.6	10.2	10.8	11.5	12.2	13.0	6.1	10.2	15.0
238	1928	35	39	48	8.5	9.7	10.1	10.5	10.8	D	6.8	9.4	13.8
239	1928	33	39	45	6.8	8.9	9.5	10.6	12.2	15.1	4.5	8.1	11.8
240	1928	34	39	49	7.4	10.2	11.8	13.5	17.1	18.8	5.3	10.2	18.0

Clone No.	Year planted	Height[1/]			DBH						Volume[2/]		
		1946	1951	1954	1946	1951	1954	1959	1968	1979	1946	1951	1954
241	1928	34	39	43	8.6	11.5	12.7	13.5	D	--	6.7	12.5	17.8
242	1928	34	39	46	7.8	10.0	11.4	12.5	14.0	16.8	5.8	9.9	16.0
243	1928	27	39	39	7.0	9.3	10.2	D	--	--	3.9	8.7	11.4
244	1927	23	39	49	8.2	11.5	13.7	15.9	19.5	22.4	4.2	12.5	23.0
245	1927	19	35	41	7.2	10.0	11.6	12.5	(12.2)	--	2.8	8.8	14.7
246	1927	19	43	53	7.8	12.3	15.3	17.7	21.6	24.0	3.2	15.4	30.0
247	1927	11	27	34	6.2	8.6	9.9	11.2	12.6	14.3	1.3	5.3	9.5
248	1927	11	17	22	4.9	6.3	7.5	9.0	12.1	14.1	1.0	2.1	4.1
249	1927	25	39	39	8.3	10.4	11.1	12.3	13.9	15.4	4.7	10.5	13.0
250	1927	27	43	47	9.2	11.9	13.1	15.2	17.9	20.9	6.0	14.6	20.5
251	1927	37	47	53	11.4	14.0	15.0	15.5	D	--	11.6	21.1	29.0
252	1927	23	31	44	7.7	9.8	11.4	13.3	16.2	19.3	3.8	7.6	15.3
253	1928	33	39	45	8.0	9.9	10.8	12.2	14.6	17.2	5.8	9.7	14.4
254	1928	29	39	46	8.5	10.6	11.7	13.2	16.2	18.4	5.6	10.9	16.7

Clone No.	Year planted	Height[1/]			DBH						Volume[2/]		
		1946	1951	1954	1946	1951	1954	1959	1968	1979	1946	1951	1954
255	1928	26	35	44	8.8	10.8	11.6	13.2	15.3	18.4	5.3	10.1	15.8
256	1928	41	43	53	12.6	14.5	15.4	16.4	17.4	D	15.3	20.5	30.3
257	1928	31	39	43	9.2	11.7	12.6	13.7	15.5	17.2	6.8	12.8	17.6
258	1928	34	39	44	8.3	9.4	10.2	11.5	13.4	14.2	6.4	8.9	12.8
259	1928	17	19	D	6.5	8.2	D	--	--	--	2.2	3.5	--
260	1928	29	35	44	8.3	9.9	10.7	11.0	D	--	5.4	8.7	13.9
261	1928	35	43	52	9.6	12.3	12.9	13.4	14.8	16.3	8.3	15.4	22.1
262	1928	31	39	43	7.2	9.0	9.9	10.9	12.1	13.0	4.6	8.3	12.0
263	1928	21	39	45	7.7	9.4	10.2	11.0	12.6	13.7	3.5	8.9	13.1
264	1928	44	51	57	10.3	13.1	14.2	15.6	17.6	19.1	11.7	20.4	28.4
265	1928	34	43	47	8.6	10.7	11.8	12.8	14.2	15.6	6.7	12.2	17.3
266	1928	31	43	46	9.3	11.1	12.4	13.4	15.3	16.1	7.0	12.9	18.3
267	1928	36	43	52	7.7	9.4	ND	10.7	11.4	12.0	6.0	9.8	ND
268	1928	15	27	33	5.2	7.0	7.4	7.5	D	--	1.4	3.9	6.0

Clone No.	Year planted	Height[1/]			DBH						Volume[2/]		
		1946	1951	1954	1946	1951	1954	1959	1968	1979	1946	1951	1954
269	1928	32	39	39	9.1	11.6	12.1	12.7	13.0	D	6.9	12.6	15.0
270	1928	24	31	34	7.2	9.4	10.3	D	--	--	3.6	7.1	10.1
271	1928	24	31	43	5.9	7.8	8.6	10.0	11.6	12.5	2.7	5.3	9.7
272	1927	25	D	--	5.9	D	--	--	--	--	2.8	D	--
273	1927	27	32	36	6.6	8.1	8.9	9.6	10.4	D	3.6	5.8	8.6
274	1927	14	19	23	5.5	6.6	6.4	6.7	D	--	1.4	2.5	3.5
275	1928	19	35	(30)	5.7	7.5	8.2	9.0	D	--	2.0	5.6	6.3
276	1927	27	27	31	6.4	7.6	7.8	8.7	D	--	3.4	4.4	6.0
277	1927	29	31	38	8.1	9.6	10.2	10.9	11.8	D	5.2	7.3	11.1
278	1927	31	39	44	9.9	11.0	11.6	D	--	--	7.7	11.6	15.2
279	1927	34	(19)	(17)	8.5	9.2	9.3	9.4	D	--	6.6	(4.2)	4.3
280	1927	37	39	(37)	9.2	10.4	10.7	11.1	D	--	8.2	10.5	11.7
281	1927	34	39	47	10.1	11.9	12.5	13.5	14.3	14.8	8.7	13.2	19.0
282	1927	35	39	48	9.4	10.6	11.0	11.3	D	--	8.0	10.9	15.8

Clone No.	Year planted	Height[1/]			DBH						Volume[2/]		
		1946	1951	1954	1946	1951	1954	1959	1968	1979	1946	1951	1954
283	1927	37	(35)	ND	11.7	12.7	ND	13.0	D	--	12.2	13.3	ND
284	1928	29	39	39	8.5	10.8	11.7	12.3	D	--	5.6	11.2	14.2
285	1928	44	47	37	13.4	15.2	15.9	16.8	17.2	D	18.3	24.4	22.4
286	1927	17	17	29	4.8	5.6	5.9	6.0	D	--	1.4	1.8	3.9
287	1928	37	39	44	9.1	10.3	10.6	D	--	--	8.0	10.4	13.7
288	1928	31	31	38	7.5	9.0	9.9	10.2	10.5	D	4.9	6.6	10.6
289	1928	19	35	35	6.2	8.1	(8.0)	D	--	--	2.3	6.3	7.1
290	1928	29	35	(33)	7.6	8.3	8.7	9.0	10.0	D	4.7	6.5	7.6
291	1928	46	47	D	9.8	11.5	D	--	--	--	11.2	15.0	D
292	1928	27	31	36	7.8	8.5	9.3	10.4	11.3	12.3	4.6	6.0	9.1
293	1928	31	35	42	7.8	8.9	9.3	9.5	D	--	5.3	7.3	10.7
294	1928	29	35	37	6.9	8.0	8.3	8.3	D	--	4.1	6.2	7.9
295	1928	39	39	39	11.1	12.0	12.5	12.8	D	--	11.7	13.4	15.8
296	1928	37	47	57	11.0	15.0	16.6	18.7	21.0	23.1	11.0	23.8	37.1

Clone No.	Year planted	Height[1/]			DBH						Volume[2/]		
		1946	1951	1954	1946	1951	1954	1959	1968	1979	1946	1951	1954
297	1928	cut	--	--	--	--	--	--	--	--	--	--	--
298	1928	41	47	47	11.9	13.4	13.5	D	--	--	13.9	19.5	21.6
299	1928	34	43	(41)	8.0	9.7	10.3	10.8	D	--	6.0	10.3	12.2
300	1928	35	39	40	7.5	9.5	11.0	12.8	13.8	16.1	5.6	9.1	13.2
301	1928	37	39	(37)	6.6	8.5	9.0	9.7	10.0	D	4.9	7.6	9.0
302	1928	34	(23)	27	9.8	12.0	12.0	D	--	--	8.3	(7.9)	10.2
303	1927	29	(27)	D	7.1	8.1	D	--	--	--	4.3	4.9	D
304	1927	31	31	31	6.4	7.4	7.6	7.9	D	--	3.9	4.8	5.9
305	1927	27	27	31	7.1	7.3	7.3	D	--	--	4.0	4.1	5.6
306	1927	27	27	29	4.8	6.3	6.9	D	--	--	2.3	3.3	4.8
307	1928	35	(19)	D	7.7	8.4	D	--	--	--	5.8	(3.6)	D
308	1927	35	39	47	9.3	10.3	10.5	10.8	D	--	7.9	10.3	14.4
309	1927	39	39	47	9.5	10.9	11.6	12.8	14.4	15.5	9.1	11.4	16.8
310	1927	41	(39)	52	10.0	11.4	11.9	12.6	13.0	D	10.4	12.3	19.4

Clone No.	Year planted	Height[1/]			DBH						Volume[2/]		
		1946	1951	1954	1946	1951	1954	1959	1968	1979	1946	1951	1954
311	1927	49	(47)	53	10.0	11.5	12.0	13.1	14.6	15.9	12.4	15.0	20.0
312	1927	31	35	42	7.0	7.9	8.5	9.3	9.9	D	4.5	6.1	9.3
313	1927	41	(39)	46	8.1	8.8	9.2	9.8	10.9	11.2	7.4	8.0	11.5
314	1927	39	39	47	9.8	10.5	11.2	11.5	11.9	12.7	9.5	10.7	15.9
315	1927	37	39	49	9.9	12.0	12.5	13.5	15.0	16.8	9.2	13.4	19.8
316	1927	37	43	44	8.7	10.0	10.3	11.2	12.0	12.4	7.5	10.9	13.1
317	1927	46	D	--	10.8	D	--	--	--	--	13.2	D	--
318	1927	37	39	44	9.0	10.7	11.5	12.8	14.2	15.4	7.9	11.0	15.5
319	1927	35	39	41	8.1	9.5	9.7	10.3	D	--	6.3	9.1	11.1
320	1928	34	35	D	8.8	8.9	D	--	--	--	7.0	7.3	--
321	1928	39	43	47	9.7	11.7	12.0	D	--	--	9.4	14.1	17.8
322	1928	23	35	35	7.2	9.9	10.4	10.4	D	--	3.4	8.7	10.6
323	1928	29	35	41	7.7	9.5	10.4	11.2	D	--	4.8	8.1	12.4
324	1928	36	43	(42)	9.5	11.2	12.2	12.3	D	--	8.4	13.1	16.3

Clone No.	Year planted	Height[1/]			DBH						Volume[2/]		
		1946	1951	1954	1946	1951	1954	1959	1968	1979	1946	1951	1954
325	1928	35	43	45	7.8	9.4	10.3	11.0	11.6	D	5.9	9.8	13.4
326	1928	37	43	47	10.4	12.5	13.2	14.2	D	--	10.0	15.8	20.8
327	1928	39	47	47	11.2	14.6	15.1	16.8	18.3	18.9	11.8	22.7	26.0
328	1928	33	43	(33)	8.8	11.5	12.3	13.0	14.1	D	6.8	13.7	(13.0)
329	1928	39	43	45	10.2	12.2	12.8	D	--	--	10.2	15.2	18.9
330	1928	34	43	44	10.4	12.4	13.2	14.5	16.5	17.7	9.2	15.6	19.4
331	1927	27	(23)	D	6.9	7.2	D	--	--	--	3.8	(3.4)	D
332	1927	35	39	39	7.8	9.4	9.9	10.4	10.6	D	5.9	8.9	10.9
333	1927	35	(19)	D	8.2	8.9	D	--	--	--	6.4	(4.0)	D
334	1927	27	27	37	8.0	9.7	10.5	11.2	D	--	4.8	6.5	11.3
335	1927	28	35	43	7.0	9.0	9.7	10.8	11.9	D	4.0	7.4	11.6
336	1927	36	35	39	7.3	8.4	8.8	D	--	--	5.5	6.7	9.1
337	1927	23	35	(34)	6.1	7.6	8.2	8.8	D	--	2.7	5.7	7.2
338	1927	34	39	43	8.0	10.2	11.2	12.0	D	--	6.0	10.2	14.6

Clone No.	Year planted	Height[1]			DBH						Volume[2]		
		1946	1951	1954	1946	1951	1954	1959	1968	1979	1946	1951	1954
339	1928	25	35	37	7.0	9.0	10.0	10.9	12.3	D	3.6	7.4	10.5
340	1928	37	(35)	ND	11.0	11.4	ND	12.9	D	--	11.0	11.0	ND
341	1928	37	51	53	10.6	14.2	15.8	18.0	20.5	21.3	10.3	23.5	31.7
342	1928	27	31	35	8.0	11.0	12.3	12.8	D	--	4.8	9.2	13.8
343	1927	ND	19	D	ND	8.7	ND	D	--	--	ND	3.8	D
344	1928	17	31	31	7.3	9.2	10.5	12.7	14.5	15.5	2.6	6.8	9.5
345	1927	ND	39	49	ND	10.9	11.6	D	--	--	ND	11.4	17.8
346	1927	ND	47	51	ND	12.1	13.9	24.4[4]	30.3[4]	36.1[4]	ND	16.4	24.6
347	1927	D	--	--	D	--	--	--	--	--	D	--	--
348	1927	ND	43	(39)	ND	12.1	12.5	13.5	14.6	16.6	ND	15.0	15.8
349	1928	ND	39	43	ND	13.3	14.3	15.6	D	--	ND	16.0	21.7
350	1928	ND	47	47	ND	12.7	13.4	14.1	16.2	19.5	ND	17.8	21.3
351	1927	ND	43	57	ND	12.0	12.8	14.1	16.2	17.9	ND	14.8	23.9
352	1927	ND	43	55	ND	12.9	13.9	15.5	17.0	18.4	ND	16.7	26.5

Clone No.	Year planted	Height[1/]			DBH						Volume[2/]		
		1946	1951	1954	1946	1951	1954	1959	1968	1979	1946	1951	1954
353	1927	ND	43	49	ND	10.1	11.1	11.7	12.1	D	ND	11.0	16.4
354	1927	ND	39	46	ND	10.5	11.1	11.9	12.0	D	ND	10.7	15.4
355	1927	ND	39	54	ND	9.9	10.8	ND	13.5	15.7	ND	9.7	17.3
356	1927	ND	51	(31)	ND	12.0	13.0	13.1	D	--	ND	17.5	(13.4)
357	1927	ND	47	54	ND	11.6	12.4	13.4	14.7	16.3	ND	15.2	21.5
358	1927	ND	39	54	ND	10.4	11.6	13.1	13.8	15.4	ND	10.5	19.3
359	1927	ND	39	51	ND	9.0	10.1	11.8	D	--	ND	8.3	14.7
360	1927	ND	47	56	ND	14.4	15.8	16.6	17.5	18.5	ND	22.2	33.5
361	1927	ND	39	53	ND	10.9	12.2	12.4	D	--	ND	11.4	20.6
362	1927	ND	35	48	ND	8.5	9.5	10.3	13.6	19.0	ND	6.8	12.6
363	1927	ND	39	50	ND	9.0	9.6	10.1	10.3	D	ND	8.3	13.3
364	1927	ND	43	52	ND	11.0	12.0	12.8	14.8	D	ND	12.7	19.7
365	1927	ND	39	51	ND	10.3	11.0	12.5	13.7	14.6	ND	10.4	16.8
366	1927	ND	39	ND	ND	9.4	ND	(9.3)	D	--	ND	8.9	ND

Clone No.	Year planted	Height[1/]			DBH						Volume[2/]		
		1946	1951	1954	1946	1951	1954	1959	1968	1979	1946	1951	1954
367	1932	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
368	1928	ND	31	(30)	ND	9.3	9.5	9.5	D	--	ND	7.0	7.9
369	1931	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
370	1928	ND	39	43	ND	9.5	9.8	10.3	10.5	D	ND	9.1	11.8
371	1928	ND	35	35	ND	8.6	9.9	11.3	13.1	15.9	ND	6.9	9.8
372	1927	ND	35	42	ND	8.7	9.5	10.6	12.0	13.0	ND	7.0	11.0
373	1928	ND	35	35	ND	10.1	10.4	11.4	13.1	15.0	ND	9.0	10.6
374	1928	ND	43	50	ND	12.1	14.6	16.8	19.5	22.4	ND	15.0	26.1
375	1928	ND	35	37	ND	8.0	8.8	9.2	10.3	11.2	ND	6.2	8.7
376	1927	ND	35	D	ND	9.1	D	--	--	--	ND	7.6	D
377	1927	ND	47	51	ND	12.6	13.3	14.3	D	--	ND	17.6	22.8
378	1933	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
379	1927	ND	43	48	ND	10.3	11.1	12.0	13.0	14.2	ND	11.4	16.0
380	1927	ND	39	49	ND	11.9	12.7	14.3	16.3	18.9	ND	13.2	20.3

Clone No.	Year planted	Height[1/]			DBH						Volume[2/]		
		1946	1951	1954	1946	1951	1954	1959	1968	1979	1946	1951	1954
381	1927	ND	43	47	ND	10.2	11.3	12.8	14.0	14.6	ND	11.2	16.1
382	1927	ND	43	(42)	ND	9.6	9.8	9.9	D	--	ND	10.2	11.8
383	1928	ND	43	44	ND	13.1	13.8	15.7	16.5	17.3	ND	17.2	20.9
384	1928	ND	39	41	ND	10.7	11.6	12.2	D	--	ND	11.0	14.7
385	1927	ND	35	39	ND	7.6	8.2	9.0	10.0	11.0	ND	5.7	8.2
386	1928	ND	39	41	ND	10.7	11.4	12.3	12.7	D	ND	11.0	14.3
387	1928	ND	39	43	ND	13.1	13.7	13.8	D	--	ND	15.6	20.2
388	1931	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
389	1927	ND	ND	ND	ND	ND	ND	ND	16.6	19.0	ND	ND	ND
390	1927	ND	ND	ND	ND	ND	ND	ND	15.0	18.8	ND	ND	ND

[1/] Merchantable height estimated to 3" dia. (i.b.) less 1 ft. for 1946 and 1951 and 4" dia. (i.b.) less 1 ft. for 1954.

[2/] Volume (cubic feet) = height (1/) x 0.001818 x $[(dbh)^2 + (3)^2 + (dbh)]$ for 1946 and 1951 and height (1/) x 0.00.8.8 x $[(dbh)^2 + (4)^2 + 4\ (dbh)]$ for 1954.

[3/] Dead.

[4/] Forked trunk approximately at dbh.

[5/] No data.