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EVALUATION OF CHESTNUT TEST PLANTINGS in the Eastern United States

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Abstract

Between 1947 and 1955, 15 plots were established in the Eastern United States to evaluate chestnut hybrids under forest conditions. During the 1978 field season these test plots were reassessed and all living chestnut trees critically examined. Ten percent of the 250 surviving hybrid chestnuts were blight resistant, and had the timber form and rapid growth of the American chestnut, *Castanea dentata*.

INTRODUCTION

THE DESTRUCTIVE CHESTNUT BLIGHT fungus (*Endothia parasitica*) was first reported in this country in 1904. In less than 50 years, the deadly blight reduced our native American chestnut (*Castanea dentata*) from an important timber species to an understory shrub. However, the stumps of many trees still produce sprouts from the root collar, and this persistent sprouting has allowed the species to survive, though sprouts continue to be killed by the equally persistent blight. The history of the blight, its rapid spread, and early attempts to control it were described by Beattie and Diller (1954).

In 1925, the U.S. Department of Agriculture began an extensive chestnut breeding program aimed at developing blight-resistant hybrids that would grow rapidly, be able to compete with native tree species, and have the timber form of the American species. The hybrids were from crosses among American, Chinese (*C. mollissima*), and Japanese (*C. crenata*) chestnut species (Diller et al. 1964). Several years later, a similar chestnut breeding program was initiated at the Brooklyn Botanic Garden and later transferred to the Connecticut Agricultural Experiment Station.

The Department of Agriculture also imported a large quantity of Asiatic chestnut seed. One selection of seed from Nanking, China, (Plant Introduction #58602) proved superior in blight resistance, tree form, growth rate, and nut production (Diller et al. 1964).

By the late 1940's, several thousand hybrids from controlled crosses had been produced. Between 1947 and 1955, 15 test plots were established by Dr. Jesse D. Diller, formerly of the Department of Agriculture, in cooperation with others to evaluate under forest conditions the hybrid chestnuts from the USDA and the Connecticut Agricultural Ex-

periment Station and the Chinese chestnut selection (PI-58602) (Diller et al. 1964).

METHODS

A total of 1,746 trees were planted in the 15 test plots. The USDA nursery at Glenn Dale, Maryland, contributed 500 hybrid chestnuts (MD) and 541 Chinese chestnut (PI-58602) seedlings, and the Connecticut Agricultural Experiment Station's Hamden nursery provided 705 hybrid chestnuts (CT). The Chinese chestnuts were interplanted on 14 of the 15 test plots so that the growth rate, tree form, and blight resistance of the hybrids and the Chinese introduction could be compared. The plots were established on cleared forest land of above-average hardwood site quality. All of the plots were planted in the spring except the Missouri plot, which was planted in early winter. The trees were planted randomly at a spacing of 10 x 10 feet.

The 15 plots were inspected in August and September 1963, and the height and diameter at breast height (dbh) of 20 to 25 of the most promising trees in each plot were measured. The results of this inspection have been reported (Diller et al. 1964).

Early in 1978, the author reexamined the 15 chestnut plots and assessed their current potential. Every living chestnut tree on the 15 plots was examined in the spring and early summer and data on growth, blight resistance, and tree form were recorded. The dbh was measured to the nearest tenth of an inch; height was measured with a Relaskop,¹ where

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possible, or estimated, and recorded to the nearest foot. Mean diameter and height for each of the three groups were computed from a weighted value depending on the number of trees in each class.

RESULTS AND DISCUSSION

Generally, survival of the three groups of chestnut trees was poor (Table 1). In some instances, the chestnuts were not tended properly after they were planted. Without release cutting, many chestnut trees were unable to compete with native woody sprout reproduction, and eventually died. Survival of

the Chinese chestnuts was 37 percent compared with a survival rate of 27 percent for the Connecticut hybrids and 12 percent for the Maryland hybrids.

Data on tree size were grouped into seven 2-inch diameter classes and seven 10-foot height classes. The percentage of trees in each diameter and height class, based on the total number of trees in each of the three groups, is shown in Tables 2 and 3. Mean diameter and height for each of the three groups are also shown in these tables.

Blight-susceptibility categories were determined by signs and symptoms of blight. Such evidence included the number and size of cankers present, presence of sprouts where

Table 1.—Survival of three groups of chestnut trees in 15 test plots, 1978

Plot no.	Location	Year established	Hybrid				Chinese chestnut		Total	
			CT		MD		Planted	Survival	Planted	Survival
			Planted	Survival	Planted	Survival				
			(no.)	(%)	(no.)	(%)	(no.)	(%)	(no.)	(%)
1	CT	1947	50	34	23	17	58	34	131	31
2	TN	1947	51	12	22	32	55	53	128	33
3	OH	1948	25	12	37	11	17	35	79	16
4	SC	1948	66	11	19	37	34	47	119	25
5	IL	1949	25	12	49	8	25	28	99	14
6	PA	1949	25	28	49	10	25	48	99	24
7	MI	1951	50	34	39	0	13	15	102	19
8	CT	1951	42	64	0	—	48	40	90	51
9	CT	1951	49	29	0	—	49	47	98	38
10	AR	1952	58	24	30	17	20	20	108	21
11	WV	1953	50	30	49	14	50	38	149	28
12	AL	1954	50	50	50	18	50	42	150	37
13	NY	1954	50	4	49	8	51	8	150	7
14	MO	1954	64	11	34	6	46	37	144	18
15	NH	1955	50	48	50	8	0	—	100	28
All plots			705	27	500	12	541	37	1746	26

Table 2.—Surviving trees by diameter class

Group	No. of trees	Diameter class							Means
		2	4	6	8	10	12	14	
		Percent							Inches
Chinese 58602	199	15	20	31	23	9	1	1	6.1
CT hybrids	188	24	21	22	24	8	1	—	5.5
MD hybrids	62	13	19	34	14	13	5	2	6.3
All groups	449	18	20	28	22	9	2	1	5.8

Table 3.—Surviving trees by height class

Group	No. of trees	Height class							Means
		10-19	20-29	30-39	40-49	50-59	60-69	70-79	
		<i>Percent</i>							<i>Feet</i>
Chinese 58602	199	13	11	10	22	34	9	1	43.4
CT hybrids	188	15	24	12	16	28	4	1	38.1
MD hybrids	62	3	16	18	19	34	7	3	44.7
All groups	449	13	17	12	19	31	7	1	41.4

Table 4.—Surviving trees by blight-susceptibility category, in percent

Group	Blight susceptibility				
	No blight	Light	Moderate	Heavy	Severe
Chinese 58602	57	31	8	3	1
CT hybrids	50	26	13	8	3
MD hybrids	53	27	11	7	2
All groups	54	28	10	6	2

Table 5.—Surviving trees by tree-form category, in percent

Group	Tree form				
	Excellent	Good	Average	Poor	Valueless
Chinese 58602	6	23	27	25	19
CT hybrids	3	15	36	19	27
MD hybrids	11	24	26	28	11
All groups	6	20	31	22	21

the main stem had died, and dieback of tops. The categories, though not as precise as other numerical data, are believed to be reasonable ones. It was seldom difficult to grade a tree. A surprisingly large number of the trees (54 percent) were in the blight-free category. Table 4 shows the percentage of trees in each category for the three groups of chestnuts.

The trees were rated for tree form in five categories ranging from excellent to valueless. Trees with a single, straight stem and timber form rated high; crooked, limby, multi-stemmed trees rated low. The percentage of trees in each class is shown in Table 5.

In 1964, the most promising hybrid was an

American x Chinese back-crossed with the American parent, located in the Illinois plot. This hybrid appeared to have all the fine qualities of the American species, plus the blight resistance of the Chinese species. Developed by Russell B. Clapper, it was known as the "Clapper" chestnut. The hybrid was still blight resistant after 18 years, and was 8.1 inches in dbh and 51 feet high (Clapper 1963; Little and Diller 1964). Around 1970, the "Clapper" chestnut began showing symptoms of blight infection; it was dead in 1978 when the plot was examined.

The 50 most promising trees in 1978 are shown in Table 6. At the time of examination

Table 6.—Comparison of the most promising individual trees

Plot no.	Loca- tion	Plot age (years)	MD hybrids			Chinese chestnut (PI58602)			CT hybrids				
			Tree	Parentage ^a	Dbh (inches)	Height (feet)	Tree	Dbh (inches)	Height (feet)	Tree	Parentage ^a	Dbh (inches)	Height (feet)
2	TN	31					144	6.1	60				
4	SC	30	F-31 ^b	Cx CJ	12.2	74	F-65	9.5	56				
		F-88	? ^c	6.3	56	D-80	9.2	49					
6	PA	29	44 ^b	Cx CJ	8.1	55	D-67 ^b	8.4	52	56 ^b	Cx (Jx JA)	8.8	55
7	MI	27					24	6.0	50	51 ^b	Cx (Jx JA)	8.6	60
							24	10.9	55	63	? ^c	7.1	55
8	CT	27					6-4	6.8	45	47	Cx JA	6.4	50
										56	Cx JA	6.1	55
9	CT	27					3-5 ^b	7.8	55	8-1	Cx A	7.7	40
							6-6	6.0	55	9-2	Cx A	6.0	35
										17-7	(J Ax J) x C	8.6	55
10	AR	26	90	Cx C	7.6	43				42	Cx JA	8.0	55
11	WV	25	41	Cx C	6.5	57				15	Cx JA	6.2	49
							9 ^b	10.0	60				
							6	7.8	55				
							32	7.5	55				
							38	7.3	50				
							47 ^b	6.7	60				
12	AL	24	31	Cx C ^b	13.2	73	75	11.0	55	126	(C x J A) (C x J A)	9.9	63
			23	Cx CA	10.5	59	12	10.3	61	144	(C x J A) (C x J A)	8.2	55
			94	Cx C	10.2	67	45 ^b	10.0	58	28	(C x J A) (C x J A)	7.5	51
			3	CA x CA	8.2	49	29	8.0	53	59	(C x J A) (C x J A)	6.0	55
			52	Cx C ^b	8.0	56	16	7.6	51				
							38	6.4	60				
							44	6.3	53				
13	NY	24					B-94	7.1	40				
14	MO	24					B-133	5.6	40				
							149	7.4	55				
15	NH	23					177	6.9	50	71	Cx JA	6.4	40

^aA = American Chestnut, *C. dentata*; C = Chinese chestnut, *C. mollissima*; J = Japanese chestnut, *C. crenata*; E.g. CxCJ = Chinese x Chinese-Japanese.

^bConsidered a promising tree in 1963.

^c? = Unknown, e.g., parentage lost.

Figure 1.—Tree F-31, center, a Maryland hybrid, was the best tree on the plot in South Carolina. It was free of blight, had good timber form, and was the tallest tree on the plot (74 feet).



these trees were free of blight and had good to excellent timber form. Growth rates were above average. Some are excellent specimens from a forester's viewpoint (Fig. 1). Of the 50 trees, which represent 3 percent of the original population, 10 are Maryland hybrids,

15 are Connecticut hybrids, and the remaining 25 are Chinese chestnut (PI-58602). The 25 hybrid trees represent 10 percent of the 250 surviving hybrids. These 50 trees, along with the more than 300 trees in the no blight and light disease categories, offer a good source for further genetic studies toward the development of blight-resistant chestnuts.

SUMMARY

When the plots were established it was not expected that the hybrid chestnut trees would develop into a blight-resistant forest stand. The lack of a reliable means to vegetatively propagate selected hybrids has severely restricted their distribution. If a good vegetative-propagation technique can be developed for chestnut, the very best trees on the plots should be propagated and used to establish clonal plantings or seed orchards on a limited scale. Extensive forest plantings of hybrid chestnuts with the purpose of replacing our blight-killed native American chestnuts is not feasible; however, a breeding program could provide stock for selected plantings.

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