

HYBRID CHESTNUTS AT THE LESESNE FOREST, VIRGINIA

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ABSTRACT.--Approximately 12,000 hybrid chestnut seedlings were planted at the Lesesne State Forest, Nelson County, Virginia, between 1969 and 1975. Most of the trees were grown from open-pollinated seed of the best hybrid chestnut trees available based on tree form and apparent blight resistance. Seed was collected from 46 different trees or tree collections at several locations, with much of it derived from selections of breeding efforts at the Connecticut Agricultural Experiment Station. Outstanding individual trees in the Lesesne planting were selected in the spring of 1972, 1975, and 1980. Form, vigor, and blight resistance of several selections have been impressive to date. Efforts to propagate selections and future plans for seed orchards and controlled pollinations were discussed.

A classical approach to counteracting a serious plant pathogen of crops is to breed a resistant variety. Resistant species of chestnut exist and breeding for a blight-resistant, American-like chestnut has proceeded for some 60 years with varying degrees of intensity (Jaynes 1972; 1978). However, it has not been a massive effort, at least from the perspective of growing large segregating populations of several thousand individuals and carrying the process through several generations of trees. Chestnut breeders had assumed their goals could be reached with relatively small populations, something which in hindsight we can now question. To date, no single hybrid has been selected which appears to be fully comparable in growth characteristics to the American chestnut and is also highly resistant to the blight. Progress has been made, but the apparent combination of multi-genic control and/or linkage of good form and susceptibility, versus poor form and resistance, indicate that larger populations and more generations of selection are needed to attain the goal.

The Lesesne Planting

The encouragement and financial support of Arthur and Anne Valk has resulted in a substantial planting of hybrid chestnut on land donated to the State of Virginia and now called the Lesesne State Forest in Nelson County. R. A. Jaynes and associates at the Connecticut Agricultural Experiment Station

supplied the seed or seedlings and T. A. Dierauf and associates with the Virginia Division of Forestry planted and cared for the trees (Dierauf 1977; Jaynes 1971).

During 1969 to 1976, approximately 11,500 chestnut seedlings from 46 different seed sources were planted at the Lesesne Forest (Table 1). Most were field planted as 1-year-old seedlings, although some just-germinated seed in tubes and 2-year-old trees were also planted. Open pollinated seed was the rule, but a few controlled crosses were included. Most of the seed parents were hybrids selected for good form, vigor, and blight resistance. Some American and Chinese sources, as well as hybrid nut-tree selections, were also included for comparative purposes.

Over half of the seed parent trees were located in six different Connecticut Agricultural Experiment Station plantings. Many of these trees, such as those labeled WdsL (Table 1), were in situations where the pollen parent would also have been a tree selected for improved form, vigor, and blight resistance, the poorer trees having been culled. Five of the seed sources were trees in cooperative test plots established by J. D. Diller between 1947 and 1955 (Berry 1980). The 'Clapper' chestnut, a hybrid by R. B. Clapper grown in the Carbondale, Illinois plot was the best known of these trees.

Cultural Notes

The Lesesne planting site was an abandoned farm that, prior to planting, was cleared of brush and boulders and then fenced to keep cattle out. In 1969, the first 1,100 trees were planted at 1.2 x 4.9 m; subsequent spacing of all trees was 1.2 x 2.4 m. There has been no thinning. The weaker and blight susceptible trees will be suppressed by the more vigorous hybrids.

Combinations of contact and residual herbicides were spot sprayed around newly planted trees and annually reapplied for 2 to 3 years until the trees were well established. Annual mowing was also done the first few years after planting to control competing vegetation. Woody invaders such as *Robinia*, *Ailanthus*, and *Vitis* were periodically killed with treatments of a phenoxy herbicide. Fertilizer (0.11 to 0.23 kg 10-10-10) was applied to all newly planted trees and reapplied annually for up to 3 years.

Survival of trees has been good. However, on at least three occasions, 1971, 1972, 1978, and to a lesser degree 1974, trees were injured by what appeared to have been an early hard freeze in the fall. Although the planting site is high with good air drainage, there is a mountain to the north that rises another 305 m. Cold air on clear, still nights drains down the slope. Bark on the lower portion of the main stem of young trees was killed. Affected trees occur in irregular patches with the pattern more related to topography than to tree genotype.

Seasonal fluctuations in rainfall have affected growth. For instance, in 1980 and 1981 the growing seasons were very dry and growth was less. A notable event, but one that had little effect on the trees, was 51 to 69 cm rainfall that occurred August 19 to 20, 1969, when Hurricane Camille went through.

Table 1. Pedigree, number, and characteristics of seed parents for chestnut seedlings planted at the Lesesne State Forest between 1969 and 1976

Seed source		Seed parent characteristics		Number planted trees
Identification	Pedigree ¹	Blight resistance	Tree form	
'Sleeping Giant'	C•JA	Good	Good	1029
C3	(JP•J)C	Good	Good	126
C4	C•JA	Good	Good	54
C9	C•JA	Good	Good	1188
C13	C•hybrid	Good	Excellent	959
C14	C•JA	Good	Good	1101
'Clapper'	CA•A	Fair	Excellent	129
WdsL R11T7	C•JAxA	Fair	Excellent	550
WdsL R11T8	C•JAxA	Fair	Excellent	302
WdsL R12T10	C•JAxA	Fair	Excellent	931
WdsL Misc.	C•JA's	Variable	Excellent	320
1-71 Controlled Cross	C3•Clapper	Good	Excellent	51
3-70 Controlled Cross	Sleeping GiantxClapper			62
OTR7T8	J•AC	Good	Good	259
Broker, Cheshire	C•JAxC•JA	Good	Good	179
Easton, Bridgeport	C•JAxC•JA	Fair-good	Good	309
#40 Norfolk	JA•hybrid	Fair	Excellent	131
NH R9T6	JA•C	Good	Good	27
NHB (4 trees)	C•JA's	Good	Good	1245
NHB	(J•JA)C	Good	Good	180
R9T12	AC•C	Good	Excellent	126
R10T10	CA	Poor	Excellent	
R4T10	JA	Poor	Excellent	23
R10T12	CA	Poor	Excellent	563
IL-Mix	CA's	Variable	Good	28
B-71	C	Good	Good	7
B-70	C	Good	Good	14
B-1	C	Good	Good	5
IL-Chin	C	Good	Good	15
'Eaton'	C•hybrid	Good	Orchard	267
RR R8T5	CJ	Good	Good	72
Grassman	AC	Poor	Excellent	32
Grassman	JA	Fair	Good	79
Grassman	A	Poor	Excellent	32
Siebentritt	A	Poor	Excellent	17
Sauber	A	Poor	Excellent	62
Inshi	C	Good	Orchard	25
Red Win	C	Good	Orchard	25
Hemming C	C	Good	Orchard	40
Quin. C orig.	C	Good	Orchard	41
Quin. C reg.	C	Good	Orchard	25
V188 Baldwin NH	C	Good	Good	405
NHB 58602	C	Good	Good	379
OxC	OC	Fair	Orchard	60
R23T12	CS•C	Good	Orchard	44
1-70 Controlled Cross	CS•CSxC	Good	Orchard	24
Total				11,542

¹ C=*Castanea mollissima*; J=*C. crenata*; A=*C. dentata*; P=*C. pumila*; S=*C. sequinii*

Selection

Our first attempt to select trees was in the spring of 1972, Approximately 1,000 3-year-old trees were evaluated and 15 selected as superior for form and vigor. Three years later five of the selected trees had been killed back by cold, four had lost vigor and form, and six maintained desirable form and vigor. We knew it was premature to select for blight resistance, but we also learned that 3-year-old chestnut trees are too young to select for form and vigor.

In March 1975, we examined the 1969 to 1971 hybrid plantings of about 4,700 trees and selected 106 trees for blight resistance with desirable growth and form. These trees were reevaluated in March 1976. Only 43 of the original 106 trees met the standard of the year before. Loss of apical dominance was the biggest problem. In March 1980, only 18 of the original 106 trees were still as promising as they had been in 1975. We then selected 18 additional trees of merit. When the same planting was evaluated again, two growing seasons later in the fall of 1981, only three of the original trees selected in 1975 and five of the 18 trees selected in 1980 were still rated as good when first selected.

Loss of apical dominance (narrow forks and multiple leaders) continued to be a big problem. Selected trees have been eliminated because their terminal growth has not been sufficient to keep them in the dominant crown canopy. The major cause, however, has been chestnut blight. Many of the original selections were girdled and many more have severe cankers which eliminate them from consideration for future breeding. Practically all of the remaining selected trees have been challenged by chestnut blight; that is, they have at least superficial cankers.

Although all the progeny at Lesesne have not been evaluated, it is clear that offspring of blight susceptible trees such as 'Clapper' and WdsL selections (Table 1) are, in general, highly susceptible to the blight even when the seed parent was crossed by neighboring trees that were blight resistant. The original Clapper tree was girdled and killed by the blight in 1977. It had obtained a height of 21 m and d.b.h. of 36 cm in 25 years. One of its offspring was the most impressive tree in the Lesesne planting in 1980. This seedling had a straight central leader and was 11 m tall at 10 years, but now in its 12th year is severely blighted.

One of the most promising seed parents for production of seedlings with good form, vigor, and blight resistance is C13. It is a Chinese chestnut cross of unknown parentage growing in a small mixed hybrid planting at Redding Ridge, Connecticut. Of 16 new selections made in the fall of 1981, one-half were C13 seedlings whereas only 20 percent of the population examined were of the C13 source.

We are encouraged by the possibilities of selecting blight resistant hybrid chestnuts that would compete satisfactorily in forest tree plantings. However, as previously stated, no selection appears fully comparable in growth characteristics to the American chestnut and is also highly resistant to the blight. Burham (1981) has recently proposed that there is still hope for breeding a blight resistant American chestnut by recurrent backcrossing from the resistant species to the American chestnut.

However, our experience at Lesesne and some 25 years experience in breeding and growing chestnut hybrids suggests that adequate field resistance may never be recovered by relying on crosses with pedigrees that are predominantly *Castanea dentata*. Finite inheritance data are not available so the point is not conclusive. Because so few resistant progeny results from a cross of one susceptible and one resistant parent (e.g. Clapper x Sleeping Giant), we prefer to work with the best of the blight resistant trees.

Future Plans--Seed Orchards

In March of 1980, scions from eleven of the most promising selections at Lesesne were propagated by grafting dormant buds on germinating nuts (Jaynes 1980). Our intentions are to vegetatively propagate the best hybrids and establish two seed orchards, one in Virginia and one in Connecticut. Two kinds of nuts will be obtained from these seed orchards, one will be from controlled crosses and the other from open-pollinated nuts. The orchards will be isolated so open-pollinated seed would result from natural crossing among the grafted selections. To the extent that labor and resources allow, controlled crosses will be made, but even without controlled crosses the open-pollinated seed should be genetically better than what we have available now.

Obviously, if adequate field control of chestnut blight on American chestnut is obtained in the United States, then the effort to breed a blight resistant hybrid will have been redundant. However, the lack of demonstrated natural spread of hypovirulent strains in the field to date suggests that hybrids may yet play a role if a higher level of host resistance is required than that in pure *C. dentata*.

The long-term goal is to develop a true-breeding strain of chestnut with favorable growth characteristics and resistance to the chestnut blight fungus. It was not anticipated that hybrid trees now growing at Lesesne would meet the final goal, but these trees give us an opportunity to select improved individuals of a family and thus move closer to the ultimate goal.

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