THE DISTRIBUTION OF SURVIVING AMERICAN CHESTNUTS IN MICHIGAN

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ABSTRACT.--Two-hundred-twenty-four locations of American chestnuts were examined in Michigan between 1975 and 1981. Eighty-four of these locations were diseased while 140 sites were disease-free. Of the 1094 trees recorded with diameters greater than 15 cm d.b.h., a total of 645 were diseased or occurred at diseased sites whereas 349 were located at sites where blight was not observed. Most trees at locations where blight occurs suffered extreme damage during the first few years of infection. However, 24 locations in southwestern Michigan and 5 locations in the Northeast contain trees where superficial cankers are common 10 to 20 years after the disease was first observed.

In 1975, I began a study on the American chestnut in Michigan. The native range of *Castanea dentata* extended into southeastern Michigan (Saucier 1973), but early settlers planted the tree beyond the native range. The objective of my research was to locate planted or native American chestnuts and record number of trees, heights, circumferences, and condition with respect to chestnut blight. When possible an estimate of the time blight was first observed in the area was obtained from nearby residents.

Over the last 6 years locations from herbarium specimens were gathered and letters sent to botanists, foresters, county agents, and other knowledgeable individuals. When there was doubt as to whether a tree was an American chestnut, Graves (1961) was used for species identification. Voucher specimens from each location were placed in the Clarence Hanes Herbarium at Western Michigan University. Slides taken at each site are in the author's possession.

Results

Two hundred twenty-four locations were examined during the study (Figure 1). Eighty-four of these locations were in various states of disease while 140 were disease-free. Of all the trees with diameters 15 cm or greater, 645 were diseased or occurred at diseased sites, whereas 349 were found at sites where blight was not observed. Several locations in the upper part of the lower Peninsula have 15 or more large blight-free trees. One of the most impressive sites is in Missaukee County where there are 27 blight-free trees 25 cm d.b.h. or greater with 2,500 naturally produced saplings or small trees 15 cm d.b.h. or less. Only 42 blight-free trees were found

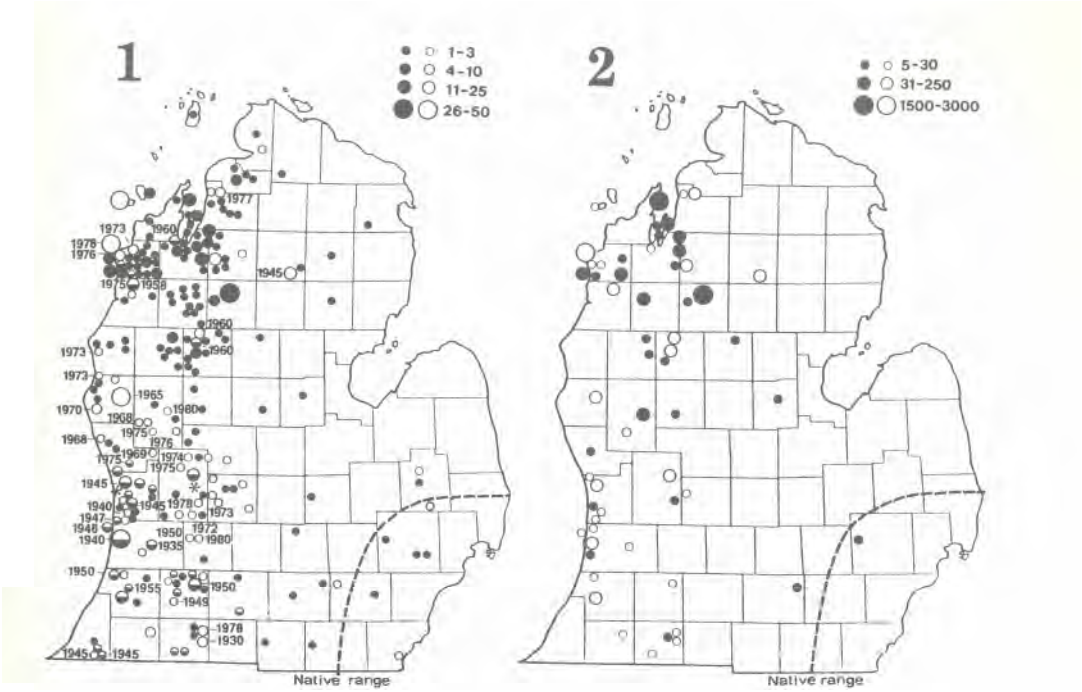

Figure 1. Distribution and number of American chestnuts in Michigan greater than 15 cm d.b.h. Completely dark circles indicate blight-free locations while the open circles represent diseased sites. The half dark circles are diseased locations that show signs of surviving the blight. The two sites with asterisks have confirmed hypovirulent strains. The dates are the approximate times when the blight entered specific locations as conveyed by nearby residents. The size of circles indicate average stand diameter,d.b.h., in inches.

Figure 2. Distribution and number of naturally reproduced American chestnuts in Michigan. Dark circles indicate blight-free locations; open circles represent diseased sites. The size of circles indicate relative numbers of trees at each site.

in the lower half of the Lower Peninsula; no blight-free groves were found. Only two American chestnut locations were reported from the Upper Peninsula.

The distribution of many of these chestnuts appears to be correlated with old homesteads and orchards. With the exception of the Manistee National Forest, the fruit belt along the western portion of the Lower Peninsula provided the greatest concentration of trees.

In this study, few American chestnuts were found in the native range. This was due partly to the development around the Detroit area and partly because the tree was never very abundant in its Michigan native range. An examination of the original land surveys of 80 townships in southeastern Michigan revealed only five American chestnuts recorded as witness trees. This suggests to me that the tree composed less than 1 percent of the original forest in its native range in Michigan. However, Davis (1976) has pointed out through pollen studies that *Castanea dentata* moved into Michigan less than 1,000 years ago and that at the time of the blight the chestnut was still migrating. Data from this study supports the idea that the American chestnut

was migrating northward and would have done well in other parts of Michigan. Figure 2 shows the locations of small trees and saplings under 15 cm d.b.h. which have reproduced naturally. In addition to the Missaukee County site mentioned above, one location in Leelanaw County also has 1500 impressive small trees and saplings. If these two populations are not infected in the next 50 years, they should become small chestnut forests. The stand described by Thompson (1967) had an estimated 3000 naturally produced chestnuts 15 cm d.b.h. or less in 1978 when the blight was first thought to have entered.

How far north the American chestnut would have migrated in Michigan is debatable. When planted, the tree is able to grow and reproduce naturally throughout the lower peninsula. However, the fact that damage was done to trees in the cold northeastern part of the Lower Peninsula during the winters of 1977-78 and 1978-79 indicates that the American chestnut probably would not have done well in that part of the state. The two locations reported from the upper peninsula (not visited) are probably sheltered from extreme cold or great fluctuation in temperature because of their proximity to Lake Superior.

The examination of the diseased trees proved to be the most interesting aspect of this study. The earliest record of blight in Michigan was a grove in St. Joseph County in which blight was described in 1930. Although these trees have been stripped of their bark for over 50 years, some of them are still standing. Most of the trees in the native range were probably blighted in the 1930's and 40's also. As a result many of these trees have been removed. Most of the large groves in southwestern Michigan were diseased in the 1940's and early 50's. The majority of the diseased locations in the northwestern part of Michigan were infected in the last 10 years.

From the start it was obvious that some trees in Michigan were more damaged by blight than others (Figures 3 and 4). However, it was not known whether some trees were more resistant or certain strains of the fungus more deadly. In 1977, after reading the article by Van Alfen et al. (1975) and talking with the individuals from the Connecticut Agricultural Experimental Station, it became obvious that the situation in Michigan was in some ways similar to that in Europe where Michigan American chestnut trees have cankers that have callused (healed) naturally.

Figure 3. A. A large blight-free American chestnut (168 cm d.b.h.) in Lake County, B. This American chestnut tree was from Kalkaska County.

Figure 4. A. Mary Reinoldt reported American chestnuts near Grand Haven in 1975; trees have had the blight for over 35 years and possess hypovirulent strains of *Endothia parasitica.* B. Chestnut trees were reported by Thomas Reuschal and have had the blight for over 23 years (middle photo). C. Richard Pippen reported this tree (bottom photo) near Bangor in 1975; this tree has had the blight for over 25 years and has many superficial cankers.

The first record of hypovirulence in Michigan and America came from a grove near Rockford, Michigan, in 1976 when Priscilla Johnson sent bark samples to the Connecticut Agricultural Experimental Station. They proved to have double-stranded RNA characteristics of hypovirulent strains and were able to cure cankers incited by virulent strains (Anagnostakis 1978). In 1978 hypovirulent strains were also confirmed from a site near Grand Haven, Michigan by Peter Day. The Grand Haven location was reported to me by Mary Reinoldt in 1975. According to George Unger, who has lived on the Grand

Haven site more than 70 years, the blight entered the site about 1945 at which time the trees began to die rapidly. However, after about 10 to 15 years the death rate slowed so that new growth began to equal the amount of dieback. In recent years only small branches have died (Figure 4). Cores taken from a number of larger trees show that most trees have maintained a slow rate of growth in the last 30 years with one tree showing a dramatic increase in growth during the period. The smaller 25- to 35-year-old trees that never suffered damage from the virulent strains have maintained a diameter growth of about 1.25 cm per year. Because of its potential value to science, this Grand Haven site is being purchased by the Michigan Nature Conservancy.

Although only the Grand Haven and Rockford sites have confirmed hypovirulence at this point, I have observed significant numbers of superficial cankers at 24 localities in southwestern and five in northwestern Michigan (Figure 1). These superficial cankers which persist for many years are nearly always swollen and show signs of continuous growth whereas the virulent cankers are nearly always flush with little or no swelling to surrounding bark, and without noticeable callusing tissue. The superficial cankers vary in shape and form from one location to another. In a couple of sites in the northwestern part of the Lower Peninsula the superficial cankers are less swollen and lack the yellowish-orange color. These cankers tend to have a callus layer on the outer portion of the bark (Figure 5).

Figure 5. A. A typical virulent or killing canker taken in Allegan County. B. A swollen superficial canker from the Grand Haven location. C. A superficial canker from the Benzie-Manistee County line site. This canker is less swollen, lacks the yellowish-orange color, and has a callus layer on the outer portion of the bark.

The important fact about the Michigan trees is that in certain groves the superficial cankers have spread throughout the population and the trees have survived even though infected. The ability of trees with these cankers to survive for extended periods of time is evident from the dates in which the blight first entered, the present stem sizes, the lack of dieback, and tree cores taken at specific sites. To what extent hypovirulent strains suppress virulent strains in Michigan is not known. The fact that hypovirulent strains are not spread by wind-dispersed ascospores makes it hard to believe that they are capable of keeping the virulent strains in check. However, as Mittempergher (1978) pointed out, a possible explanation for the spread of hypovirulent strains is that they may be more adaptable in the saprophytic phase than virulent strains. If this is so, we may have areas in Michigan saturated with hypovirulent strains with very few virulent strains remaining. It may be necessary to have a reservoir of hypovirulent strains in a stand before it can be sufficiently protected from virulent strains. I have noticed that in one location near Holland, Michigan where the majority of the larger trees with superficial cankers were removed, the remaining trees have since become badly blighted. In addition, the smaller trees and saplings 0.25 mile (0.40 km) south of the larger trees at the Grand Haven location are in much worse condition than those in the middle of the grove. More research should be done to determine what density of hypovirulence is needed to protect a stand. Also, Michigan's environment may be more favorable than other states for hypovirulent strains. Consequently, further research should determine the environmental factors important for survival of hypovirulent and virulent strains.

Understanding how hypovirulent strains have been dispersed in Michigan may have significance in determining whether or not the strains can be used in biological control. The question of whether hypovirulent strains are being dispersed between groves miles apart or have arisen at various locations should be answered. Of the over 80 different blighted locations which I have observed, nearly every location has had extensive initial dieback indicating that the first strains to enter a site are virulent. It is only after the virulent strains have come in and caused considerable damage to the trees do we see signs of the swollen superficial cankers. In most cases there has been a 10 to 20 year period before the superficial cankers appear. This, I think, adds support to the idea that hypovirulence is being developed simultaneously at different sites around Michigan.

Conclusion

Although the American chestnut is very close to extinction in its Michigan native range, there are numerous locations where blight-free trees survive outside the native range. How long these trees will remain isolated from the blight will probably depend on the ability of the fungus to disperse and live on various substrates. In the last three years over 150,000 American chestnut seeds collected by James R. Comp, Sr., and others in the Cadillac area have been planted by the Soil Conservation Department. Although these trees may provide new host material for the blight, they will probably assure the existence of at least some blight-free trees.

Since blight-free trees will always be susceptible to virulent strains of the blight the most impressive American chestnuts in Michigan are not the large blight-free trees but those which are surviving with the blight. The

fact that there are groves which suffered extensive damage earlier but are now improving and reaching mature tree size again is encouraging. The Michigan trees provide an interesting opportunity for further study. The fact that different groves of chestnuts in Michigan are separated provides for isolated populations of *Endothia.* These populations should be studied before the newly planted saplings become new host material and eliminate the barriers between them.

Whether problems such as vegetative incompatibility and dispersal can be worked out remains to be seen. However, the present status of the American chestnut in Michigan provides new hope for its survival as a tree species.

Literature Cited

Anagnostakis, S. L. The American chestnut: New hope for a fallen giant. Conn. Agr. Exp. Stn.; 1978; Bull. 777. 9 p.

Davis, M. B. Pleistocene biogeography of temperate deciduous forests. Geosci. and Man 8:13-26; 1976.

Graves, A. H. Keys to chestnut species. 52nd Ann. Rep. Northern Nut Growers Assoc., 1961. p. 78-90.

Mittempergher, L. The present status of chestnut blight in Italy. MacDonald, William L.; Cech, Franklin C.; Luchok, John; Smith, Clay, eds. Proceedings of the American chestnut symposium; 1978 January 4-5; Morgantown, WV. Morgantown: West Virginia University Books; 1978: 34-37.

Saucier, J. R. American chestnut...an American wood. *(Castanea dentata)* (Marsh) Borkh.). USDA, FS-230; 1973. 6 p.

Thompson, P. W. A unique American chestnut grove. Mich. Academician 1:175-178; 1969.

Van Alf en, N. K.; Jaynes, R. A.; Anagnostakis, S. L.; Day, P. R. Chestnut blight: Biological control by transmissible hypovirulence in *Endothia parasitica.* Science 189:890-891; 1975.