CHAPTER 10.

Multi-State Beech Bark Disease Survey and Beech Scale Resistance

(Project NE-EM-B-11-01)

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INTRODUCTION

Beech bark disease (BBD) remains the most serious threat to American beech (*Fagus grandifolia*) in its native range. Pathologists have historically described BBD as a predictable interaction between the *Cryptococcus fagisuga* scale insect and a *Neonectria* canker-forming fungus. It is well known that beech trees infested by *C. fagisuga* become predisposed to *Neonectria* colonization (Houston and O'Brien 1983).

This cooperative effort involved Delaware, New Jersey, Maryland, and West Virginia. The purposes of this study were (1) to identify potentially BBD-resistant beech trees in areas with BBD-associated decline and mortality, and (2) to establish permanent plots containing beech trees in four States where trees will be monitored for general health conditions including BBD.

METHODS, RESULTS, AND DISCUSSION

In Delaware, BBD had never been recorded, although no formal surveys had yet been carried out. Therefore, the primary goal was to identify suitable survey sites and to initiate a BBD survey. During the 2011 field season, four permanent survey sites were established. Three were in New Castle County, the county closest to the known range of BBD. The fourth site was in Kent County. At each site, a starting point was chosen in the interior of the stand, away from edge influence. The closest tree with diameter at breast height (d.b.h.) of ≥10 inches was selected as the first study tree. Subsequent trees were selected based on closest proximity to the previous study tree. A total of 116 beech trees were surveyed at the four sites. For each tree, the d.b.h. was recorded and visual estimates were made for crown transparency, percent crown dieback, percent of crown with foliar discoloration, and trunk decay. GPS coordinates were recorded for each survey tree, and each was photographed with a digital camera to facilitate follow-up work in coming years. Stand information was also recorded, including slope, aspect, elevation, soil type, and overstory and understory vegetation types at each site.

The 2011 surveys in Delaware did not detect *Cryptococcus fagisuga* or decline due to *Neonectria*. The obvious conclusion based on this first survey is that BBD is not yet established in Delaware. Follow-up surveys using the same methodology were conducted in 2012 at the same four sites, and again no scale or mortality was observed. All 116 trees in the 2011 survey were alive during the 2012 survey, and overall condition of study trees remained the same.

Study sites will continue to be revisited annually to continue gathering baseline data in anticipation of possible introduction of BBD in the future. Should BBD be identified at these sites in coming years, this study will be of value in two ways. First, the exact year of first appearance will be well documented, assisting in rate-of-spread analysis. Second, the effects of this disease on growth rate will be easily

quantifiable given multiple years of baseline data. At that time, the study would be able to enter a second phase in which putatively resistant trees are identified.

In West Virginia, BBD has been monitored for more than 30 years and has been well documented as a cause of mortality. Efforts in this State have (1) focused on locating scale-resistant beech in areas where both scale and BBD-induced mortality are known to be present, and (2) determined the etiology and extent of scale infestation and fungal colonization. In 2012, 10 locations were selected as potential survey sites for identification of putatively resistant beech. Nine of these sites were ultimately included as actual survey sites. The sites were located in Tucker, Randolph, and Pocahontas Counties where beech mortality and scale presence were previously documented. Each stand contained up to 20 potentially resistant trees >9 inches in d.b.h. Each of these trees was rated for scale presence and measured for d.b.h.

In addition to these beech resistance monitoring plots, another 10 plots were established throughout the State in 2013 as permanent survey sites. Each survey site consisted of a minimum of 20 mature beech trees > 9 inches in diameter. Each tree was examined for *Cryptococcus fagisuga* presence and quantity, *Neonectria* colonization, and presence of decay-associated fungi. Tree canopy conditions were measured and photographed for dieback, foliar discoloration, and crown transparency. Survey trees also were measured for d.b.h. and located using GPS coordinates.

In Maryland, as in West Virginia, BBD was known to be well established in some areas. For this study, sites in Garrett County were scouted with the goal of locating stands with moderate scale pressure. It was believed that these sites would provide the best opportunity to identify putatively BBD-resistant beech. No sites with moderate scale pressure were located. All sites examined were either very heavily infested, with "whitewashing" of all beech trunks due to scale abundance, or very minimally infested with low scale, and *Neonectria* populations were observed. Foresters, to date, were unable to locate a site in Garrett County that had a moderate scale population.

In 2013, staff established several permanent sites in western and central areas of the State to survey the incidence of scale and fungal populations. Some of these sites might be more appropriate for identification of putatively resistant beech trees.

In New Jersey, the disease was well established for at least 20 years within the Stokes State Forest in northern New Jersey. This State forest and the surrounding county contain the greatest basal area of American beech in New Jersey. It was assumed that scale and disease would spread southward as time passed.

In 2012, surveys to determine BBD incidence and spread were carried out in several northern and central locations. A total of 293 beech trees were examined for scale and fungal colonization.

The survey did not show any evidence of scale or disease spread from north to south. In fact, even within the northern areas of the State, population levels of *Cryptococcus fagisuga* were very low and *Neonectria* fruiting bodies were difficult to find. For the most part, beech trees appeared healthy. With only slight disease pressure, resistant beech could not be identified. It is highly doubtful that the numerous trees examined in areas previously affected by BBD were resistant. Survivors were younger and might have been more disease tolerant than older trees, or may have simply escaped disease exposure.

A novel approach during this survey examined bark integrity based on suggestions that the fungus could form lethal sapwood cankers without necessarily fruiting. Sapwood in this case would be clearly discolored. An effort was made during the New Jersey survey to examine bark for weakness and/or discoloration due to fungal colonization. However, bark even on scale-infested trees appeared intact tightly appressed to sapwood without evidence of fungal colonization. Surveys for BBD often are limited to examinations made of the lower stem. This survey, however, provided a unique opportunity to examine upper-stem sections and branches of mature trees. Beech trees blown over during Hurricane Sandy made possible the examination of upper stems and canopy branches not visible from ground level. Even though only a limited number of fallen beech trees could be examined, it was apparent that bark integrity remained good throughout the entire tree. There was also no incidence of scale or *Neonectria* on upper canopy branches.

CONCLUSIONS

Permanent plots established in Delaware in 2011 as well as those scheduled for installation in West Virginia, New Jersey, and Maryland in 2013 provided baseline data that will most accurately describe scale and disease progression as well as general beech health conditions. This study clearly demonstrates the need for additional research in coming years. Permanent BBD plots will facilitate future research and provide an excellent opportunity to continually monitor and survey for this disease.

CONTACT INFORMATION

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LITERATURE CITED

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