CHAPTER 15.

Thousand Cankers Disease in Tennessee: For How Long?

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

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INTRODUCTION

In August 2010, the Tennessee Department of Agriculture (TDA) announced the discovery of the walnut twig beetle (WTB) (*Pityophthorus juglandis*) and associated fungus *Geosmithia morbida* in Knox County (TN.gov Newsroom 2010). This find, the first east of Colorado, incited alarm due to the potentially devastating effects on black walnut (*Juglans nigra* L.), an extremely valuable tree species that is highly susceptible to the thousand cankers disease (TCD) caused by *G. morbida*. After the initial discovery in Knox County, TCD was identified in five other Tennessee counties: Anderson, Blount, Loudon, Sevier, and Union (TN.gov Newsroom 2011). All six counties were quarantined by TDA to limit the movement of black walnut material out of the infested areas.

Symptoms of TCD include yellowing leaves and thinning foliage in the upper part of the crown. As the disease progresses, crown dieback continues with progressively larger branches dying until the tree completely succumbs to mortality, often within 2 to 4 years of the earliest visible symptoms (Hansen and others 2011, Kolařík and others 2011, Seybold and others 2010). TCD may have been present in Tennessee 10 to 20 years prior to its discovery (Haun and others 2010). If this is indeed the case, then it is possible that evidence of its presence might exist in the data collected by the Forest Inventory and Analysis (FIA) Program. Among the data collected by FIA are descriptions of individual tree crown condition and tree status (live or dead); therefore, the objectives of this project were to (1) analyze black walnut crown conditions from the past 10 years to determine if symptoms of TCD were present, (2) locate areas that have black walnut trees with poor crown conditions that might suggest the presence of TCD, and (3) evaluate the effectiveness of the FIA plot network for detecting localized forest health problems (Randolph and others 2010).

METHODS

Data included in this study were collected by the Southern FIA Program in Tennessee between 2000 and 2009. Under the current inventory, FIA has two phases of on-the-ground data collection. Traditional timber inventory variables are collected in what is known as the phase 2 (P2) inventory, and additional forest health variables are collected in the phase 3 (P3) inventory (Bechtold and Patterson 2005). FIA plots are located across the United States in such a way that each P2 plot represents about 2428 ha. P3 plots, a 1/16 subset of the P2 plots, represent about 38 850 ha each. Both P2 and P3 plots consist of four 7.32-m fixed-radius subplots spaced 36.6 m apart in a triangular arrangement.

Variables included in the analysis were tree status (live or dead), four assessments of crown condition, and cause of death. The crown assessments were crown density (the amount of crown branches, foliage, and reproductive structures that blocks light visibility through the projected crown outline), crown dieback (recent mortality of branches with fine twigs, which begins at the terminal portion of a branch and proceeds inward toward the trunk), foliage

transparency (the amount of skylight visible through the live, normally foliated portion of the crown, excluding dieback, dead branches, and large gaps in the crown), and hardwood dieback incidence (hereafter, "SRS dieback;" recorded as present if 10 percent or more of the crown area is affected with dieback that has occurred from the branch tips inward or as absent if otherwise) (Schomaker and others 2007, USDA Forest Service 2008). Possible causes of death were insect, disease, fire, animal, weather, vegetation (includes suppression, competition, and vines; e.g., kudzu), silvicultural or land clearing activity, or unknown (USDA Forest Service 2008). Tree status was recorded for all trees and SRS dieback for all hardwood trees measured on both P2 and P3 plots. Cause of death was recorded for all dead trees on both P2 and P3 plots. Crown density, crown dieback, and foliage transparency were assessed for all live trees on all P3 plots, and crown density and crown dieback additionally on all P2 plots included in the Tennessee urban FIA pilot study (Nowak and others 2012). Trees were categorized as "recent mortality" if the status was "live" at the previous inventory but "dead" at the most recent inventory, between 2005 and 2009. Only trees ≥ 12.7 cm diameter at breast height (d.b.h.) were included.

Black walnut crown density, crown dieback, and foliage transparency were averaged for the entire State and by plot for the years 2005–09. Frequency of SRS dieback was summarized by year, 2000–09, for black walnut individually and for all other hardwood species combined. Plot maps of the crown condition averages and occurrences of SRS dieback, recent black walnut mortality, and mortality causes between 2005 and 2009 were examined visually for spatial correlation.

RESULTS

Between 2005 and 2009, 23 black walnut trees were assessed for crown condition on 17 P3 plots across Tennessee. During this time, crown conditions averaged 44.3 percent crown density, 0.4 percent crown dieback, and 21.7 percent foliage transparency. The percentage of trees with SRS dieback fluctuated annually between 0.0 percent in 2000, 2006, and 2008 and 10.2 percent in 2002. This annual variation was greater than that observed for all other hardwoods, which ranged from 0.0 percent in 2000 to 2.7 percent in 2003. There were 31 live black walnut trees assessed for crown condition across 20 P2 urban plots. Crown conditions for those trees averaged 36.0 percent crown density and 16.3 percent crown dieback. At the plot level, most crown density and foliage transparency averages were generally "normal and healthy" (fig. 15.1). The plots that were marginally healthy in terms of crown density (i.e., ≤ 35 percent crown density) were scattered throughout the State. Only one plot had a crown dieback average at the marginal health level, and that was a P2 urban plot observed in Knox County (fig. 15.1B).

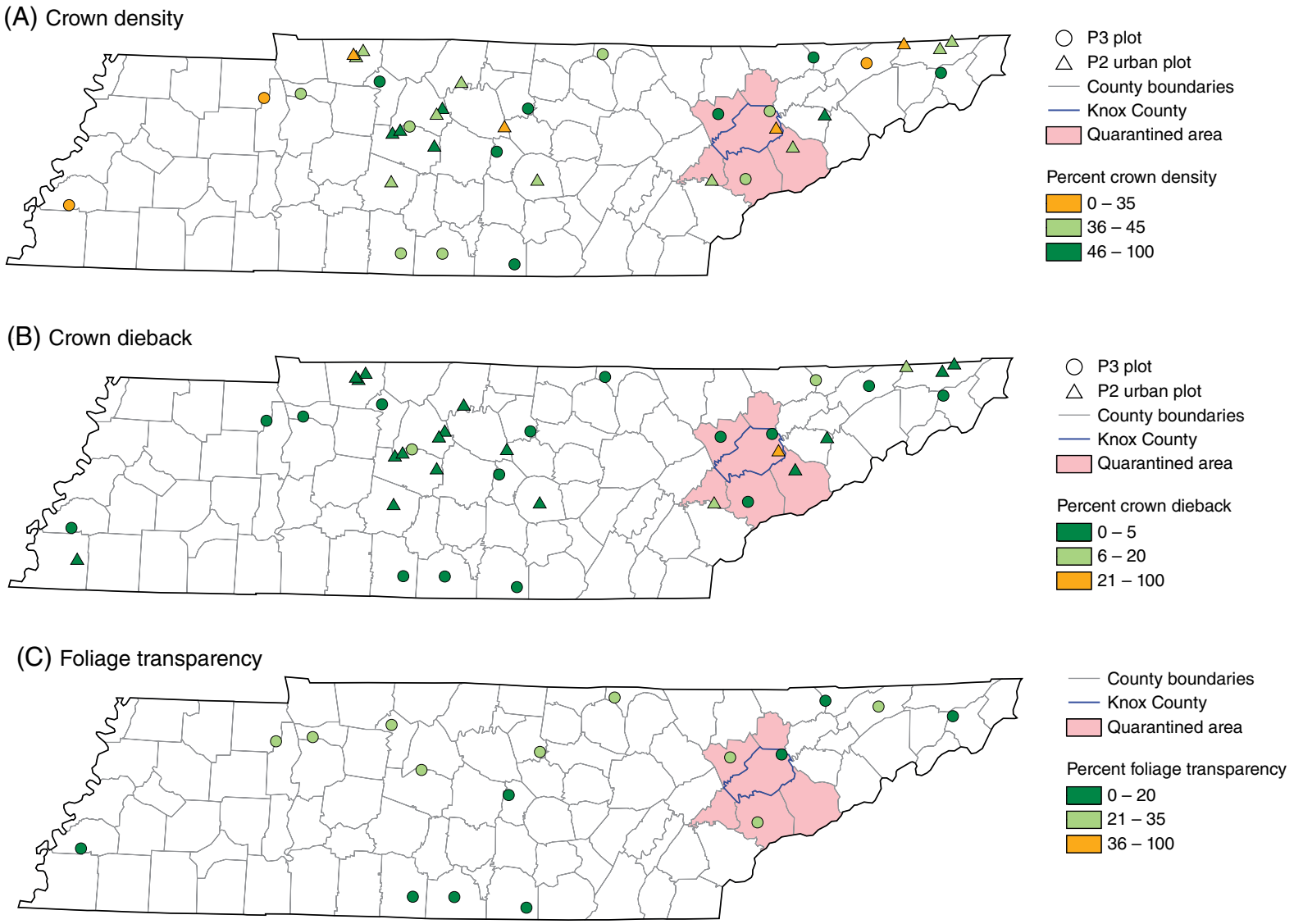

Figure 15.1—Thousand cankers disease quarantined counties and mean crown conditions by plot for black walnut trees in Tennessee between 2005 and 2009: (A) crown density, (B) crown dieback, and (C) foliage transparency. Plot locations are approximate.

Recent mortality was scattered throughout Tennessee but occurred most often in middle Tennessee. Vegetation was the most frequently recorded cause of death for black walnut (fig. 15.2). In the six quarantined counties in particular, 35 live and 12 dead black walnut trees (d.b.h. ≥ 12.7 cm) were observed on 23 of the 161 forested P2 plots between 2005 and 2009. The dead trees were observed in Blount (1 tree), Knox (5 trees), and Sevier (6 trees) Counties. Cause of death was recorded for 9 of these 12 dead walnuts as vegetation (4 trees), disease (2 trees), silviculture/land clearing (2 trees), or weather (1 tree). Only 4 of these trees, 2 killed by disease and 2 by vegetation and both in Knox County, were classified as recent mortality. All of the dead walnuts observed in Sevier County were dead upon their first encounter in 2000 or 2001, as was the one dead walnut in Blount County, first observed in 1999.

DISCUSSION

Williams (1990) noted that black walnut typically occurs as individual trees or small clusters scattered throughout the mixed hardwood forest. This pattern was supported by the plot data collected in Tennessee. When occurring on a plot, the number of live black walnut trees ranged between 1 and 7, with an average of 1.4 live trees per P3 plot. This infrequent occurrence across the landscape in conjunction with the P3 sampling intensity makes it difficult to capture an adequate sample for rigorous estimation of black walnut crown conditions in Tennessee. Indeed, the number of plots with black walnut trees in the P3 sample falls short of the number of plots recommended by Bechtold and others (2009) for estimating changes over time. Nevertheless, some general observations about black walnut and the possible extent of TCD in Tennessee can be gleaned from

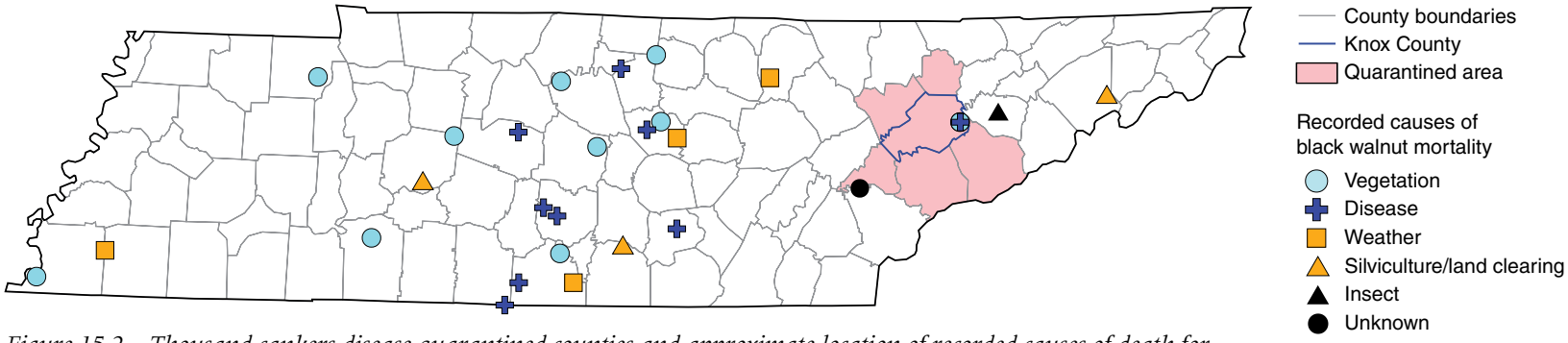

Figure 15.2—Thousand cankers disease quarantined counties and approximate location of recorded causes of death for recent black walnut mortality in Tennessee, 2005 to 2009.

the FIA data. Most notably is that within the six quarantined counties, recent mortality and extremely poor crown conditions were confined to the same one plot in Knox County. Further, Nowak and others (2012) noted that 14 percent of the black walnut urban sample was standing dead, all of which occurred on this same P2 urban plot in Knox County. Crown conditions on the remaining plots in the quarantined counties, and for the State overall, were within the range of what is typically considered normal and healthy for hardwood trees. This seems to suggest that the WTB may not have invaded the forest at large or has not progressed far enough to be detected.

During the course of this project, WTB and TCD were discovered in Virginia and Pennsylvania, and the investigation was expanded to include the entire native range of black walnut in the Eastern United States. A comprehensive treatment of the findings for the expanded investigation is given by Randolph and others.[1] The same general conclusions found in this Tennessee-specific investigation were concluded in the expanded project. That is, overall crown conditions were generally within the normal range for hardwood trees and were relatively stable between 2000 and 2010, with no obvious clustering of poor crown conditions or recent mortality due to unknown causes.

[1]Randolph, K.C.; Rose, A.K.; Oswalt, C.M.; Brown, M.J. Manuscript in preparation. Status of black walnut (*Juglans nigra* L.) in the Eastern United States. Authors can be reached at Southern Research Station, Forest Inventory and Analysis, 4700 Old Kingston Pike, Knoxville, TN 37919.

CONCLUSION

Across Tennessee, black walnut crown conditions were within the range of what is typically considered normal and healthy for hardwood trees. Overall, little in the FIA data suggested the presence of WTB and TCD in the forested landscape of Tennessee. This could be due to the actual absence of WTB or perhaps an insufficient inventory and monitoring system to detect its presence. Given the distribution of recent mortality, middle Tennessee may be an area for special WTB and TCD surveys.

CONTACT INFORMATION

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LITERATURE CITED

Bechtold, W.; Randolph, K.; Zarnoch, S. 2009. The power of FIA phase 3 crown-indicator variables to detect change. In: McWilliams, W.; Moisen, G.; Czaplewski, R., comps. Forest Inventory and Analysis (FIA) symposium 2008. Proc. RMRS–P–56CD. Fort Collins, CO: U.S. Department of Agriculture Forest Service, Rocky Mountain Research Station: 21 p.

Bechtold, W.A.; Patterson, P.L., eds. 2005. The enhanced Forest Inventory and Analysis Program—national sampling design and estimation procedures. Gen. Tech. Rep. SRS-80. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 85 p.

Hansen, M.A.; Bush, E.; Day, E. [and others]. 2011. Walnut thousand cankers disease alert. Virginia Cooperative Extension. http://www.ppws.vt.edu/~clinic/alerts/07-22-11_TCD_alert.pdf. [Date accessed: September 19].

Haun G.; Powell, S.; Strohmeier, C.; Kirksey, J. 2010. State of Tennessee thousand cankers disease action plan. http://www.tn.gov/agriculture/publications/regulatory/TN_TCD_ActionPlan.pdf. [Date accessed: October 25].

Kolařík, M.; Freeland, E.; Utley, C.; Tisserat, N. 2011. *Geosmithia morbida* sp. nov., a new phytopathogenic species living in symbiosis with the walnut twig beetle (*Pityophthorus juglandis*) on *Juglans* in USA. Mycologia. 103(2): 325–332.

Nowak, D.J.; Cumming, A.B.; Twardus, D.T. [and others]. 2012. Urban forests of Tennessee, 2009. Gen. Tech. Rep. SRS-149. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 52 p.

Randolph, K.; Oswalt, C.; Rose, A.; Brown, M. 2010. Thousand cankers disease in Tennessee: for how long? (project proposal). http://fhm.fs.fed.us/em/funded/11/SO-EM-B-11-01.pdf. [Date accessed: February 15, 2012].

Schomaker, M.E.; Zarnoch, S.J.; Bechtold, W.A. [and others]. 2007. Crown-condition classification: a guide to data collection and analysis. Gen. Tech. Rep. SRS-102. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 78 p.

Seybold, S.; Haugen, D.; O'Brien, J.; Graves, A. 2010. Pest alert: thousand cankers disease. NA–PR–02–10. Newtown Square, PA: U.S. Department of Agriculture Forest Service, Northeastern Area State and Private Forestry. 2 p.

TN.gov Newsroom. 2010. Thousand cankers disease discovered in East Tennessee. Press release. August 5, 2010. Nashville, TN: State of Tennessee Government. http://news.tn.gov/node/5684. [Date accessed: September 13, 2011].

TN.gov Newsroom. 2011. Walnut tree quarantine expanded due to thousand cankers disease. Press release. August 29, 2011. Nashville, TN: State of Tennessee Government. http://news.nt.gov/node/7691. [Date accessed: September 12].

U.S. Department of Agriculture (USDA) Forest Service. 2008. Forest Inventory and Analysis national core field guide: field data collection procedures for phase 2 plots, version 4.0. Vol.: SRS MIDAS version, updated October 1, 2008. Knoxville, TN: U.S. Department of Agriculture Forest Service, Forest Inventory and Analysis Program, Southern Research Station. [Pages unknown].

Williams, R.D. 1990. Black walnut. In: Burns, R.M.; Honkala, B.H., tech. cords. Silvics of North America. Vol. 2: hardwoods. Agric. Handb. 654. Washington, DC: U.S. Department of Agriculture Forest Service. [Pages unknown].