Thousand Cankers Disease is Widespread in Black Walnut in the Western United States

Ned Tisserat and **Whitney Cranshaw**, Professors, Department of Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins, CO 80523-1177; **Melodie L. Putnam**, Director, Plant Disease Diagnostic Lab, Botany and Plant Pathology, Oregon State University, Corvallis, OR 97331; **Jay Pscheidt**, Professor, Botany and Plant Pathology, Oregon State University, Corvallis, OR 97331; **Charles A. Leslie**, Director, Walnut Improvement Program, Department of Plant Sciences, University of California, Davis, CA 95616; **Marion Murray**, IPM Extension Associate, Department of Biology, Utah State University, Logan, UT 84322; **James Hoffman**, Plant Pathologist, USDA Forest Service, Boise, ID 83709-1663; **Yvonne Barkley**, Associate Extension Specialist, Idaho Extension Forestry, University of Idaho, Moscow, ID 83844-1140; **Kathleen Alexander**, City Forester, City of Boulder Forestry, 5200 Pearl Street, Boulder, CO 80301-2437; and **Steven J. Seybold**, Research Entomologist, USDA Forest Service, Pacific Southwest Research Station, Davis, CA 95616

Corresponding author: Ned Tisserat. ned.tisserat@colostate.edu

Tisserat, N., Cranshaw, W., Putnam, M. L., Pscheidt, J., Leslie, C. A., Murray, M., Hoffman, J., Barkley, Y., Alexander, K., and Seybold, S. J. 2011. Thousand cankers disease is widespread in black walnut in the western United States. Online. Plant Health Progress doi: 10.1094/PHP-2011-0630-01-BR.

Black walnut (*Juglans nigra* L.) is native to eastern North America, and is distributed from New England and the Appalachian Mountains west to the Great Plains, and from the Canadian border south into Texas and the Florida panhandle (3). It has been widely planted west of its native range as an ornamental and nut tree. In the early 1990s black walnut mortality was observed along the front range of the Wasatch Mountains in Utah (Diane Alston, Utah State University, *personal communication*) as well as at sites in the Willamette Valley in Oregon (5). Mortality was not linked to a specific biotic cause at the time. Death of black walnut was associated with feeding by the walnut twig beetle (WTB), *Pityophthorus juglandis* Blackman, in Utah Co., UT, in 1997 (2) and in the Espanola Valley in New Mexico in 2001 (7). These observations were significant because black walnut is not a native host of the WTB; the beetle was originally collected in 1896 from a "black" walnut in Grant Co., NM (1). The host of this collection for the type specimen was most likely Arizona walnut, *J. major* (Torr.) A. Heller, based on geographic ranges of native walnut species. The WTB subsequently has been collected from naturally senescing or damaged twigs, branches, and stems of otherwise healthy Arizona walnut at many sites in Arizona and New Mexico.

The WTB was associated with black walnut mortality in Boulder and El Paso counties in Colorado in 2003 and in Oregon in 2007 (Fig. 1), although upon further inspection of museum collections, the WTB had been present in the latter state at least since 1997 (2). In 2008 black walnut death in Colorado was determined to be the result of aggressive feeding by the WTB on large branches and even the trunk, and subsequent canker development around beetle galleries caused by a newly described fungal symbiont of the beetle, *Geosmithia morbida*, (4,6). The disease was given the common name of thousand cankers disease (TCD) because of the enormous number of coalescing cankers that are formed in the bark of severely affected trees (6).

Fig. 1. Thousand cankers disease was identified in black walnut (*Juglans nigra*) or hybrids (Oregon only) of black walnut with northern California black walnut (*J. hindsii*), in (A) Colorado in 2008 and (B) Oregon in 2009, although walnut decline had been noted in Oregon since the early 1990s. Thousand cankers distribution in the western United States has expanded with confirmations in (C) Washington in 2009 and (D) Idaho in 2010.

Symptoms of TCD in black walnut, including progressive crown thinning, bark cankers, branch dieback, and eventually mortality, have now been observed in a number of western states. To confirm the presence of *G. morbida*, branch and trunk samples with WTB galleries and cankers were collected from many of these locations and fungal isolations were attempted in a manner previously described (6). *G. morbida* was initially identified by morphological characteristics of the conidiophores and conidia, and colony shape and color on half-strength potato dextrose agar (4). DNA was extracted from single spore isolates and the ITS1, 5.8s, and ITS2 regions of the rDNA were amplified by using the ITS1 and ITS4 universal primers. All putative *G. morbida* isolates identified by morphological characteristics had ITS sequences with > 98% similarities to the type isolate (CBS124663). Koch's postulates were successfully completed with two Utah isolates (1222 and 1223) by using inoculation methods previously described (6). We have now isolated *G. morbida* from black walnut or hybrids of black walnut with northern California black walnut [*J. hindsii* (Jeps.) Jeps. ex R.E. Sm.] with TCD in California, Colorado, Idaho, New Mexico, Oregon, Utah, and Washington (Fig. 2).

Fig. 3. Percentage of the total number of black walnuts that were removed in Boulder (black line) and Denver (gray line), Colorado, 2001-2010. Percentages are based on total black walnut inventories determined by detailed visual surveys in both cities.

Acknowledgments

We thank the USDA NIFA Western Region IPM Center and Critical Issues-Emerging and New Plant and Animal Pests and Diseases grant programs and the USDA Forest Service Forest Health Monitoring Program (Detection Monitoring Grant No. INT-DM-09-01) for their financial support of this work. We thank B. Cassel, T. Tompkins, M. Zerillo, E. Freeland, C. Utley, and D. Leatherman for help with collecting and processing samples and data.

Literature Cited

1. Blackman, M. W. 1928. The genus *Pityophthorus* Eichh. in North America: A revisional study of the *Pityophthori*, with descriptions of two new genera and seventy-one new species. Bulletin 1(3-6), Tech. Publ. 25. College of Environmental Sci. and Forestry, State Univ. of New York, Syracuse, NY.
2. Cranshaw, W. 2011. Recently recognized range extensions of the walnut twig beetle, *Pityophthorus juglandis* Blackman (Coleoptera: Curculionidae: Scolytinae), in the Western United States. The Coleopterist's Bull. 65:48-49.
3. Harlow, W., and Harrar, E. 1969. Textbook of Dendrology, 5th Edn. McGraw-Hill, New York, NY.
4. Kolařík, M., Freeland, E., Utley, C., and Tisserat, N. 2011. *Geosmithia morbida* sp. nov., a new phytopathogenic species living in symbiosis with the walnut twig beetle (*Pityophthorus juglandis*) on *Juglans* in the USA. Mycologia 103:325-332.
5. Pscheidt, J. W., and Ocamb, C. M., senior eds. 2010. Pacific Northwest Plant Disease Management Handbook. Oregon State Extension Service, Corvallis, OR.
6. Tisserat, N., Cranshaw, W., Leatherman, D., Utley, C., and Alexander, K. 2009. Black walnut mortality in Colorado caused by the walnut twig beetle and thousand cankers disease. Online. Plant Health Progress doi:10.1094/PHP-2009-0811-01-RS.
7. USDA Forest Service. 2002. Forest Insect and Disease Conditions of the Southwestern Region, 2001. Forestry and Forest Health Publication R3-02-01. Southwestern Region, USDA Forest Service, Albuquerque, NM.