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**102. © Natural and experimental host range of *Sirococcus clavigignenti-juglandacearum*.** Ostry, M. E. and Moore, M. Plant Disease 91:581-584. 2007.

# Natural and Experimental Host Range of *Sirococcus clavigignenti-juglandacearum*

M. E. Ostry and M. Moore, Northern Research Station, 1561 Lindig Avenue, St. Paul, MN 55108

## ABSTRACT

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The fungus *Sirococcus clavigignenti-juglandacearum* causes butternut canker in North America and is not known to kill or seriously affect tree species other than butternut (*Juglans cinerea*). However, this putative exotic pathogen has been found on branches of black walnut (*J. nigra*) and heartnut (*J. ailantifolia* var. *cordiformis*), raising questions regarding the potential host range of the pathogen and its spread to new areas on tree hosts other than butternut. Results of artificial inoculations of several hardwood species indicated that the pathogen, although not causing lethal cankers, has the ability to colonize and survive in the wood of several genera, including *Quercus*, *Carya*, *Corylus*, *Prunus*, and *Castanea*. Several commercially important Persian walnut (*J. regia*) cultivars tested were moderately or highly susceptible, underscoring the importance of preventing the movement of the pathogen into commercial *Juglans* plantations in California, where its ability to cause disease and damage trees is unknown. Evidence for the presence of variation in aggressiveness among isolates of *S. clavigignenti-juglandacearum* was detected based on differences in canker lengths resulting from inoculations with two isolates of the pathogen. In a field test of several previously named butternut cultivars, all were found to be highly susceptible to the disease, calling into question the value of these selections for nut production or future restoration uses.

Butternut (*Juglans cinerea*) is dying throughout its native range in North America due to infection by the fungus *Sirococcus clavigignenti-juglandacearum*, described as a new species in 1979 (8). There are no reports of this fungus outside of North America; however, it is believed to be an exotic pathogen (3). Evidence supporting the hypothesis that the origin of the fungus was outside of North America includes the relatively recent first reports of the occurrence of the disease and its documented rapid expansion in North America. The symptoms of the disease are obvious, diagnostic (8), and most likely were not overlooked in the past. In addition, the fungus is easily isolated from active cankers and sporulates profusely, aiding in its identification (8). Similar to the impacts of other introduced pathogens, trees free of the disease or expressing resistance are relatively rare within affected populations of native butternut (14).

The pathogen may have been introduced into the United States by inadvertently moving the fungus on seed of Asian *Juglans* spp. (14). Japanese walnut (*J. ailantifolia*) was widely planted from imported

seed in the southeastern United States in the early 1900s (2), where butternut survival is now at risk because of past high mortality rates from this canker disease. The fungus can be seedborne on eastern black walnut (*J. nigra*) and butternut (5). Dissemination of the fungus by insects (4,6) and, presumably, by birds also may contribute to the widespread distribution of the disease among widely dispersed populations of butternut throughout its range in North America.

The most recent United States Department of Agriculture, Forest Service survey data revealed that, overall, in seven Midwestern states, the number of butternut trees in all size classes has decreased by 23% since 1989, with decreases in the larger classes ranging from 13 to 100% (14). Minnesota was the first state to enact measures to conserve butternut with a moratorium on the harvest of healthy butternut in 1992 on state lands (12). Butternut remains a "species of concern" or a "sensitive species" in many states and is a Regional Forester Sensitive Species in the Eastern Region on 13 of the 16 National Forests (15). Butternut was recommended for endangered species status by the Committee on the Status of Endangered Wildlife in Canada in 2003. In Canada, butternut was officially listed as endangered under the Species at Risk Act in 2005 (Species at risk—butternut, online publication through Environment Canada).

Butternut is the only species that has been reported killed by this pathogen. However, other *Juglans* spp. and hybrids can be affected by *S. clavigignenti-*

*juglandacearum* to varying degrees. Eastern black walnut and heartnut (*J. ailantifolia* var. *cordiformis*) have been found infected naturally in the field (10,11). Orchard et al. (9) inoculated 10- to 20-year-old trees of several *Juglans* spp. They found that Japanese walnut, heartnut, and hybrids between them and butternut expressed greater resistance than either eastern black walnut or Persian walnut, with the latter species developing the most severe disease.

Nearly the entire U.S. Persian walnut (*J. regia*) crop is produced in California (1). *S. clavigignenti-juglandacearum* is not known to be present in California. The potential for *S. clavigignenti-juglandacearum* being introduced into California and its impact on commercially grown *Juglans* spp. is unknown. However, an existing quarantine on moving *Juglans* spp. from the eastern United States is in place to avoid the introduction of bunch disease caused by a phytoplasma in the *Prunus* X-disease group that can affect *Juglans* spp.

The objective of this study was to determine the susceptibility of *Juglans* spp. and various other hardwood species, to *S. clavigignenti-juglandacearum* in order to identify potential hosts of the pathogen in forest stands and nurseries that could serve as pathways for the movement of the pathogen on planting stock.

## MATERIALS AND METHODS

**Field assessment of butternut cultivars.** Several butternut cultivars have been described and some are available as scionwood from collectors and germ plasm repositories (13). From two to four trees of each of 6- to 12-year-old *J. cinerea* cvs. Bear Creek, Beckwith, Booth, Buckley, Bulman, Chreighton, George Elmer, VanderPoppen, Johnson, Kineyglan, and Painter that were field grafted onto young, wild eastern black walnut saplings in a woodlot near Des Moines, IA were evaluated for symptoms of butternut canker in 2003 and 2006. Numerous severely diseased wild butternut trees were growing among the grafted cultivars. Trees were scored during the dormant season for the presence or absence of stem and branch cankers caused by *S. clavigignenti-juglandacearum*.

**Propagation of grafted *Juglans* spp.** Details of grafting butternut and other *Juglans* spp. have been summarized (7). Briefly, bare-root 1-year-old eastern black walnut nursery stock was potted in February 2001 and 2002 with a commercial

Corresponding author: M. E. Ostry  
E-mail: mostry@fs.fed.us

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