

## *Sirococcus clavigignenti-juglandacearum*

**System:** Terrestrial

Kingdom	Phylum	Class	Order	Family
Fungi	Ascomycota	Sordariomycetes	Diaporthales	

**Common name** butternut canker (English)

**Synonym**

**Similar species**

**Summary** *Sirococcus clavigignenti-juglandacearum* is the cause of butternut canker, which is a lethal stem disease. It causes multiple cankers on the main stem, branches and twigs of butternut, *Juglans cinerea*. Cankers commonly occur at the base of trees and on exposed buttress roots and can survive and sporulate on dead trees for many years. The fungus may be threatening the viability of butternut as a species.



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## Species Description

Diagnostic Systems include elliptical to fusiform cankers formed on the main stem and branches. Young cankers originate at leaf scars lenticells bark wounds and buds, often with an inky black center and whitish margin. Peeling the bark away reveals the brown to black elliptical areas of killed cambium. Older branch and stem cankers are perennial, found in bark fissures or covered by shredded bark, and bordered by successive callus layers. Cankers commonly occur at the base of trees and on exposed buttress roots. Branch cankers usually occur first in the lower crown and stem cankers develop later from spores washing down from branch cankers. The fungus can survive and sporulate on dead trees for at least 13 years (Nair, V.M.G, 1999). Authors of a study report that cankers develop first on branches in the lower crown. This is followed by branch mortality and sporulation by the fungus. Trunk cankers develop 1-3 yr after initial branch mortality. The authors report that trees with tops killed by coalescing basal cankers did not resprout at the root collar (Tisserat and Kuntz, 1984; Nair, V.M.G, 1999).

## Notes

Anderson and LaMadeleine (1978) states that, "Butternut (*J. cinerea*) is a small to medium size tree that matures around 75 years of age, is shade intolerant and reproduces by sprouting or seed germination. It grows on rich loamy soils, as well as, drier rocky soils. Butternut typically is mixed with other hardwoods such as black walnut. The species is found in New England, south to Northern Georgia, in the United States from west to central Missouri and north to the Lake State ([distribution map](#)). It hybridizes with other species of *Juglans* such as heartnut, Japanese walnut, English walnut, little walnut, and manchurian walnut." Ostry *et al.* (1996) state that, "*J. cinerea*, Butternut, produces nuts for wildlife and is important for commercial nut production. In addition, butternut contributes significantly to forest biodiversity, especially in the northern part of its range where the closely related black walnut (*J. nigra*) does not grow."

Schlarbaum *et al.* (1999) states that, "Butternuts were often planted on farmsteads, close to the house. Nut kernels were used in baking, and cultivars have been selected for orchard production (Millikan and Stefan, 1989). The husk surrounding the nut was often used to dye fabrics. In the American Civil War, the colour of Confederate uniforms was created using butternut husks as a source of dye." Paterson (1993) states that, "Deer love to rub their newly formed antlers on the smooth bark of young *J. cinerea* trees in autumn. Large bark wounds result, and canker seems to quickly enter."

## Lifecycle Stages

*S. clavigignenti-juglandacearum* is named based on the only known asexual stage. To date, the perfect stage of the fungus has not been reported.

The fungus can be readily isolated in pure culture from both infected wood and bark. In culture, the fungus forms both hyphal pegs and pycnidia in the central part of the colony, or in concentric circles as the colony develops (Nair *et al.* 1979). Pycnidia also develop at the tip of the hyphal pegs (Kuntz and Nair, 1982). In diseased tissue, the fungus forms dark brown to black stroma of abundant, septate, branched mycelium below the outermost layer of bark from which arise prominent hyphal pegs made up of interwoven mycelium. These pegs lift and rupture the bark. Pycnidia which arise from eustroma are glabrous, non-rostrate, innate to erumpent, without a clypeus, globose to flatten. The pycnidial cavity is simple, convoluted or multilocular; uni or multiostiolate. Conidiophores are simple or branched, septate with momphyletic conidiogenous cells which produce fusiform, hyaline, two-celled median septate conidia, 1-17 x 1.0-1.5  $\mu$ m. Conidia are single or contenate, extruded through the ostiole in a glutinous beige to tan matrix. During germination the germ tubes arise from the swollen cells terminally or laterally. (Nair *et al.* 1979).

**Host Parasite Interactions:** Artificial inoculations of eight-week-old seedling and 10 year-old field planting of butternut and black walnut with spore suspensions in distilled water have reveals that the spores can germinate and penetrate through lenticell, fresh wounds and fresh leaf scars. Mycelial development from germinated spores was observed on the surface of fresh leaf scars and hyphae penetrated the host cells at the leaf scars. Hyphae advanced penetrating the phloemparenchyma intracellularly and between the phloem fibre elements intercellularly. Hyphae also penetrated intracellularly and uni and multi-seriate xylem ray cells and parenchyma cells. For the first time globose pycnidia were observed in inoculated black walnut seedlings. Samples from natural infections of butternut clearly showed that hyphal pegs originated from a stroma formed below the outermost layer of bark. The stroma was composed of interwoven mycelium phellogen, phloem parenchyma and cambial cells.

## Uses

Butternut, is valued for its wood for furniture, paneling interior trim, gunstock speciality products, carving and nut production. Nut kernels were used in baking, and cultivars have been selected for orchard production (Millikan and Stefan, 1989). The husk surrounding the nut was often used to dye fabrics. In the American Civil War, the colour of Confederate uniforms was created using butternut husks as a source of dye.

Native Americans boiling the tree sap to make syrup beverages. Sugar may be produced from the sap of this species as in sugar maple (Van Dersal, 1938). The boiled nuts are used to produce buttery-flavoured liquid in order to make a mush for baby food. Nuts were used in breads, cakes, soups, and relishes. The inner bark of the root is the best for medicinal use which should be collected in May or June. It has a mild cathartic property and may be used as a habitual laxative, as well as for dysentery and hepatic congestions. The expressed oil of the fruit removes tapeworm. The fruit when half-grown is made into pickles (Grieve, 1998).

## Habitat Description

Butternut (*Juglans cinerea* L.) the primary host of *S. clavigignenti-juglandacearum* is a widespread, but rare tree. Also known as white walnut, it commonly grows on rich loamy soils in mixed hardwood forests (Ostry *et al.* undated). Its natural range extends from New Brunswick Canada, south to North Carolina, then west to Minnesota and south to Missouri. Additionally, small pockets of butternut occur in Arkansas, Mississippi, Alabama, Georgia, and South Carolina (Morin *et al.* 2003). Halik (1999) states that, "The following four species of beetles were collected in greatest abundance and were most frequently found infested with *S. clavigignenti-juglandacearum*: *Acoptus suturalis* (Curculionidae), *Astylopsis macula* (Cerambycidae), *Eubulus parochus* (Curculionidae), and *Hyperplatys maculata* (Cerambycidae)."

**Host Range:** Recent research studies using artificial inoculations have revealed that the pathogen can attack other highly valuable species of the family Juglandaceae; such as black walnut, Japanese walnut, Persian walnut, and heartnut as well as various hybrids of these species. This wide host range of the pathogen has attracted international concern. Both seedlings (Feberspiel and Nair, 1982) and 10 to 20 year old field planted trees of all species mentioned proved to be susceptible (Orchard *et al.* 1982, Gabka 1986). In addition, black walnuts growing in a mixed stand of severely diseased butternuts have been found infected naturally. However, heartnut, Japanese walnut and hybrids between them and butternut exhibited greater resistance to the pathogen, developing smaller cankers, than the highly valuable black walnut and Persian walnut. (Nair, V.M.G. 1999)

## General Impacts

Butternut, *J. cinerea*, is being killed throughout its native range in North America by the fungus *S. clavigignenti-juglandacearum*. The fungus may be threatening the viability of butternut as a species (Katovich and Ostry, 1998). It is second in value only to black walnut. Innes and Rainville (1996) state that, "Although the *Sirococcus* canker of butternut, caused by *S. clavigignenti-juglandacearum*, has caused damage only to butternut, *J. cinerea*, black walnut, *J. nigra*, and hybrids of walnut are also susceptible to a certain degree. In 1995, this disease was isolated for the first time from seedlings in two forest nurseries in Quebec. This constitutes the first report of the disease on butternut and black walnut seedlings in forest nurseries." Tisserat and Kuntz (1984) state that, "The incidence of butternut canker, incited by *S. clavigignenti-juglandacearum*, increased exponentially from 5% in 1978 to 76% in 1983 within an isolated butternut plantation." Anderson (1996) states that, "*S. clavigignenti-juglandacearum* kills trees of all ages. Branches and young saplings may be killed by a single canker, however, older trees are killed by multiple, coalescing cankers that either progressively kill the crown or eventually girdle the stem. Sprouts, if they develop, also become infected and are killed usually within the first few years. The nut husk can also become infected. USDA Forest Service Inventory and Analysis forest inventory data show a dramatic decrease in the number of live butternut trees in the United States. Live butternut decreased by 58 percent in Wisconsin and 84 percent in Michigan in the last 15 years. A recent Wisconsin Department of Natural Resources survey revealed that 91 percent of the live butternut throughout Wisconsin were diseased (Cummings and Carlson, 1993). Surveys in the southeast United States revealed that 77 percent of the butternut have been killed in North Carolina and Virginia, and infected trees continue to be found in new counties in most of the United States. (U.S.D.A. Forest Service, 1995 a and 1995 b.).

## Management Info

For details on management of this species including preventative, biological and chemical control download our pdf file on [management information](#).

## Principal source: Anderson, 1996. Butternut Canker

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**Publication date:** 2005-03-18

## ALIEN RANGE

[4] CANADA

[8] UNITED STATES

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# GLOBAL INVASIVE SPECIES DATABASE

FULL ACCOUNT FOR: *Sirococcus clavigignenti-juglandacearum*

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