

Relationship of Stem Tissue Age to Frequency of Nectria Canker

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ABSTRACT

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The relationship between cumulative frequency of cankers caused by *Nectria galligena* and the age of the tissue when the canker became established on the main stem was sigmoidal in *Betula lenta*, *B. papyrifera*, *Juglans nigra*, and *Sassafras albidum*. The point of change in the curve from exponential to logistic was at 3 yr for *J. nigra*, 5 yr for *B. papyrifera*, and 7 yr for *B. lenta* and *S. albidum*.

Stem canker, caused by *Nectria galligena* Bres., is an important disease of northern hardwoods. All hardwood species are susceptible, although susceptibility varies among species. Some important economic species, such as black walnut (*Juglans nigra*), are particularly susceptible. Indeed, Nectria canker is the limiting disease problem on black walnut in Pennsylvania; cankers low on the bole render the butt log unfit for lumber or veneer.

The association of Nectria cankers with branch stubs is well documented (3). Grand and Spaulding (3) examined 3,161 cankers on various New England hardwoods and found 71% associated with branches, and 8% with wounds. Infection courts for 21% of the cankers could not be determined. On the basis of field observations and inoculations, they concluded that infection occurred through living or dying branches but not through dead branches. Also, branches larger than 1.3 cm in diameter were seldom infected except very close to their axils and then were rarely girdled and killed. Most infection occurred in branches between 0.3 and 1.3 cm in

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diameter.

Although on many tree species, cankers occur primarily on the lower 5 m of the stem, on some species, such as sassafras (*Sassafras albidum*), cankers

occur at all heights on the stem and on the branches. Casual examination of cankers on sassafras suggested that cankers low on the bole were older than those higher on the bole, ie, they had more annual rings of callus.

In a brief unpublished preliminary study, L. W. Kress and F. A. Wood, of this institution, found an apparent relationship between canker frequency and the age of the stem tissue at the time the canker became established on the bole. The following study was done to confirm the findings of Kress and Wood and to determine if this relationship existed for other tree species. A

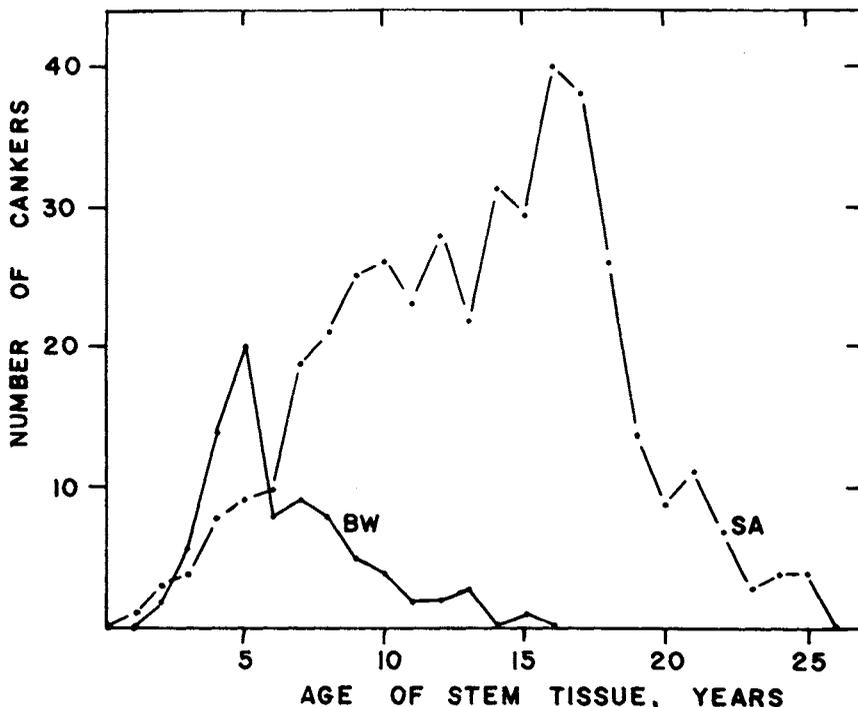


Fig. 1. Frequency of Nectria canker on black walnut (BW) and sassafras (SA) in relation to age of the stem tissue at the time and point of infection.

preliminary report has been published (1).

MATERIALS AND METHODS

Cankered sassafras stems were collected at three sites at varying altitudes in Perry County, PA. All 415 cankers were associated with branch stubs. Each canker was sectioned with a handsaw through the center of the branch stub. Annual rings were counted from the pith outward to the annual ring just preceding the first layer of callus tissue; this gave the age of the stem tissue when first infected by the pathogen.

Sassafras was selected to confirm the preliminary work of Kress and Wood and also because abundant cankered trees were readily available. After a relationship was established between canker frequency and age of the stem tissue when first infected, the study was extended to two other less available species, black and paper birch (*Betula lenta* and *B. papyrifera*, respectively), and finally to black walnut. We examined 75 cankers on black birch, 43 on paper birch, and 84 on black walnut. In addition, we measured the heights above ground of the cankers on black walnut.

RESULTS AND DISCUSSION

When canker incidence was plotted against age of the stem tissue at the time the canker was initiated, the curves for sassafras and black walnut were more or less bell-shaped (Fig. 1), indicating a nonrandom relationship between age and infection. The small sample size did not give clear relationships for the birches; indeed, the relationship for black walnut is questionable because of the small sample size. However, when cumulative percentage of total number of cankers was plotted against stem tissue age at the time the cankers were initiated, well-defined sigmoidal relationships were evident for all four species (Fig. 2).

The 10% canker incidence occurred at 3 yr for black walnut, 5 yr for black birch, and 7 yr for paper birch and sassafras. Note that this was the age of the tissue at the height that the canker was initiated, not the age of the stem. Tree age would be somewhat greater, depending on the height at which the canker occurred and how fast the young sapling grew. The relationship between cumulative canker incidence on black walnut and height of the canker above ground also was sigmoidal; 50% of the cankers occurred below 5 ft, 85% below 7 ft, and 95% below 10 ft.

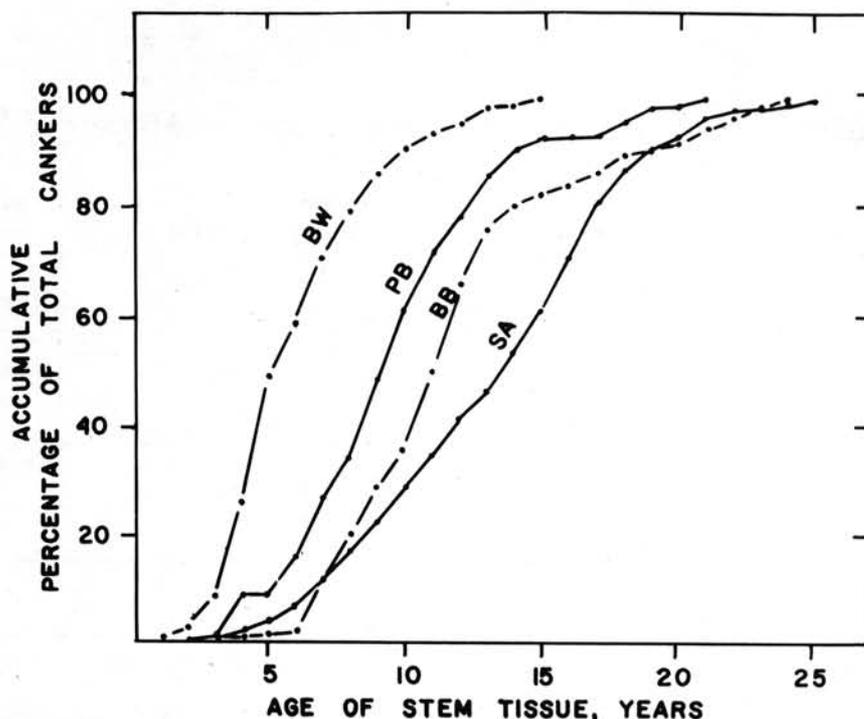


Fig. 2. Cumulative percentage of total number of *Nectria* cankers examined on black walnut (BW), paper birch (PB), black birch (BB), and sassafras (SA) in relation to age of the stem tissue at the time and point of infection.

There is an apparent relationship between age of stem tissue when infected and the shade tolerance of the tree. Black walnut and paper birch are shade intolerant (4). Black birch is classed between shade intolerant and intermediate (2,4). Although sassafras seedlings are shade intolerant (2), root sprouts appear to be of intermediate tolerance; such root sprouts are common, very slow growing, understory shrubs in Pennsylvania oak forests. Based on these studies, the curves for shade tolerant species, such as sugar maple (*Acer saccharum*) and American beech (*Fagus grandifolia*), would be expected to be displaced to the right considerably; ie, cankers would be initiated in somewhat older stem tissues.

These data and the literature (3) support the hypothesis that senescing branches serve as infection courts. As the canopy closes in a stand of young saplings or sprouts, the lower branches begin to die from lack of sunlight. The more shade intolerant the species, the younger the age at which this occurs. As this occurs, the fungus invades these branches and moves from them into the main stem. In species such as the birches and sassafras, where cankers may occur at any height on the

stem, these senescing branches occur at progressively greater heights on the stem with increasing time. Cankers occur at progressively greater heights also, but always in stem tissue of a certain age range.

These findings are significant from the standpoint of management of young stands of valuable species such as black walnut. In young stands of black walnut saplings, branches should be pruned to a height of 10 ft before they begin to die from shading out or before the branches are 3 yr old. This should result in a stand relatively free of stem cankers.

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