

Identification of the Two *Nectria* Taxa Causing Bole Cankers on American Beech

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ABSTRACT

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A simple and accurate method is presented for identification of the two *Nectria* taxa associated with beech bark disease in North America. Ascospore length, in a sample of 25 ascospores, can be used to differentiate *Nectria coccinea* var. *faginata* and *N. galligena* from the boles of living American beech.

Additional key words: *Fagus grandifolia*

In his classic work on beech bark disease, Ehrlich (5) reported a *Nectria* (later named *N. coccinea* var. *faginata* Lohm. et al) that infected American beech through feeding injuries of *Cryptococcus fagisuga* Lind. Spaulding

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et al (10) reported that another *Nectria* (later identified as *N. galligena* Bres.) also caused cankers of beech boles infested with *C. fagisuga*.

In surveys for beech bark disease in North America, *Nectrias* have been assumed to be *N. coccinea* var. *faginata* simply because they were associated with *C. fagisuga* infestation of beech (7,11). This is unfortunate and obscures the role of each taxon of *Nectria* in the beech bark disease complex.

The genus *Nectria*, a member of the Hypocreaceae, is characterized by

brightly colored (often red), fleshy, superficial perithecia containing asci with usually eight hyaline one-septate ascospores (2,8,9). *N. coccinea* var. *faginata* and *N. galligena* are closely related and are both characterized by smooth perithecia that are taller than wide and reluctant to collapse. Both have *Cylindrocarpon* imperfect states producing abundant microconidia (3).

Surveys for beech bark disease are hindered by the lack of a simple way to distinguish the two fungi. A method for field identification would be ideal, but no field characters reliably separate them. The key developed by Lohman and Watson (6) demands knowledge of characteristics of the *Nectria* in question on several media.

One easily observed difference between *N. coccinea* var. *faginata* and *N. galligena* is the size of their ascospores. Lohman and Watson (6) found that ascospore dimensions coupled with cultural characteristics were useful primary characteristics in identification of *Nectria*

on eastern hardwoods. Perrin (8) used ascospore dimensions in his key to the *Nectrias* of Europe. Ashcroft (1) rejected ascospore dimensions as useful in defining taxa within *Nectria* because of the variability of this characteristic.

We evaluated the usefulness of ascospore length in separating *N. coccinea* var. *faginata* and *N. galligena*.

MATERIALS AND METHODS

Thirty-one collections of *Nectria* were obtained from bole cankers on 27

American beech trees in New Hampshire (27 collections, 21 trees), New York (three collections, three trees) and Pennsylvania (one collection, one tree). Collections were identified by morphological and cultural characteristics. All New Hampshire collections were *N. coccinea* var. *faginata*; the remaining four collections were *N. galligena*. Vouchers for 12 of the 31 collections were deposited at the New York Botanical Garden Herbarium.

The lengths and widths of 25 ascospores

from each collection were measured to the nearest micrometer ($\times 100$ oil-immersion lens). Two methods of measuring ascospores were used: Either ascospore masses on top of five or more perithecia were placed in lactophenol (12) on a slide, or five or more mature perithecia were cut in half and placed in lactophenol on a slide. All slides were heated at 35 C for 20 min before coverslips were added. Perithecia were squashed and large pieces of perithecial wall were removed. Only free ascospores

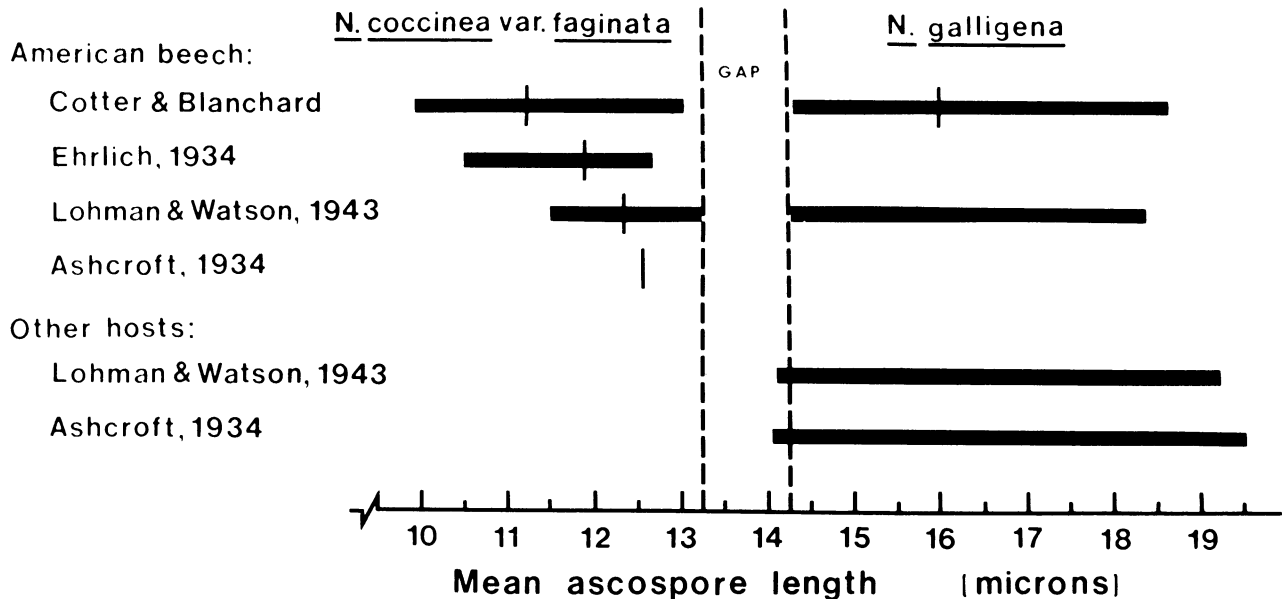


Fig. 1. Ranges of mean ascospore lengths for 27 collections of *Nectria coccinea* var. *faginata* and four collections of *N. galligena* from North America. Vertical crossbars represent overall means.

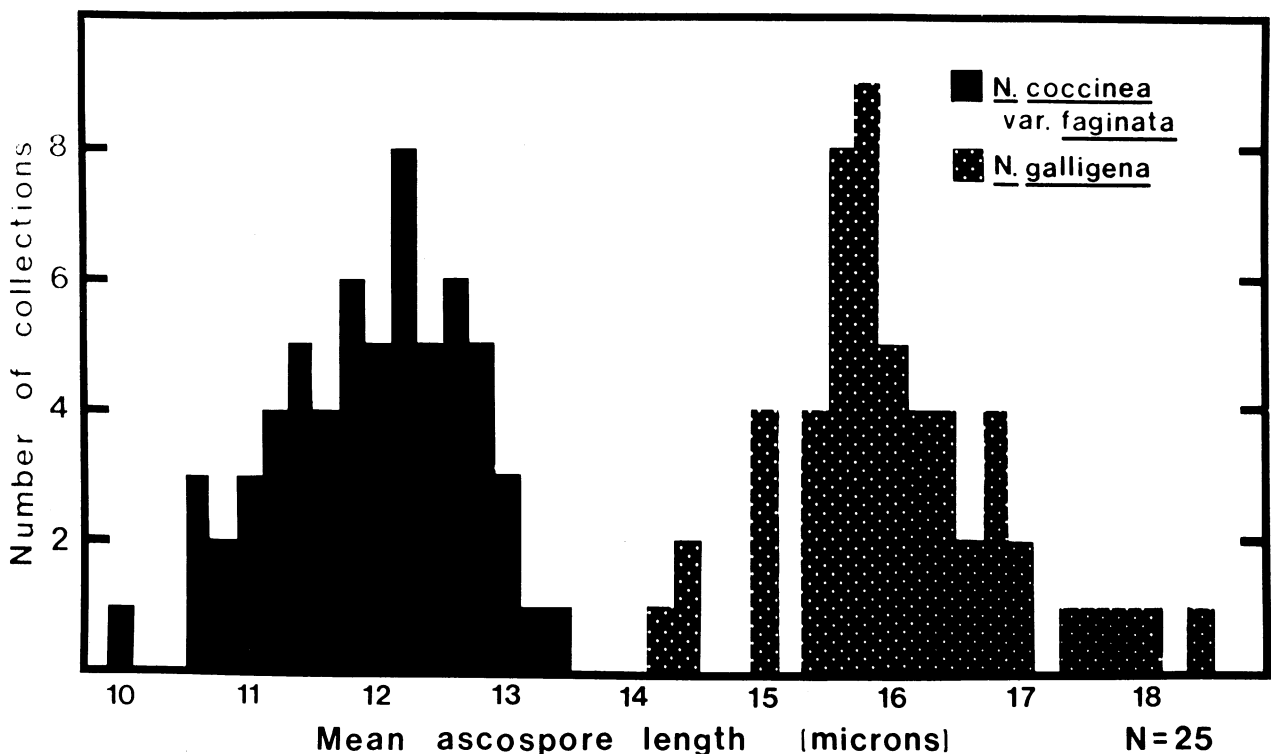


Fig. 2. Mean ascospore lengths of 62 collections of *Nectria coccinea* var. *faginata* and 54 collections of *N. galligena* from American beech. Data are those of Cotter and Blanchard, Lohman and Watson (6) and Ashcroft (1).

not in asci were measured. Two of the 31 collections were measured by both methods.

RESULTS AND DISCUSSION

The size of ascospores from the top of perithecia was not significantly different (t -test; $P=0.01$) from that of ascospores from the same collection freed by squashing perithecia. Ranges of the mean ascospore lengths for 27 collections of *N. coccinea* var. *faginata* and for four collections of *N. galligena* did not overlap (Fig. 1), suggesting a distinction useful in identification. Ranges of the mean widths for the two fungi did overlap.

We evaluated the reliability of the gap in mean ascospore lengths by combining ascospore lengths from the literature for the two *Nectria* taxa from American beech (Fig. 1) with our data (Fig. 2). The most extensive data were those of Lohman and Watson (6), who measured 25 ascospores in 34 collections of *N. coccinea* var. *faginata* and 50 collections of *N. galligena*. Ehrlich (5) did not indicate the number of collections or the sample size for his work. Ashcroft (1) measured 100 ascospores of a collection of *N. coccinea* var. *faginata*. The gap between mean ascospore lengths of the two fungi for the collections of Lohman and Watson (6) is narrower but corresponds to the difference we found. The measurements of Ehrlich (5) and

Ashcroft (1) also support this difference between the two fungi.

Although the difference in the ranges of mean ascospore lengths for the two fungi was less than $1\ \mu\text{m}$, the centers of the ranges were separated by several micrometers (Fig. 2).

Ranges of mean ascospore lengths for *N. galligena* on North American hosts other than American beech (1,6) are slightly wider than those on beech, but they do not overlap the ranges for *N. coccinea* var. *faginata* (Fig. 1).

We propose the following key for determination of *Nectria* taxa from bole cankers of American beech. Based on measurement of 25 ascospores, mean length greater than $14.3\ \mu\text{m}$ = *N. galligena*, less than $13.3\ \mu\text{m}$ = *N. coccinea* var. *faginata*, and between 13.3 and $14.3\ \mu\text{m}$ inclusive = either *N. galligena* or *N. coccinea* var. *faginata* (determine identity by examining other characteristics including cultural characteristics [3,6]).

The sample size is very important since the ranges for length of individual ascospores of the two fungi overlap. A sample size of 25 is adequate and results in accurate determinations. A statistical argument by Cotter (4) predicts that, with a sample size of 25, the key will correctly identify 97% of *Nectria* collections from American beech bole cankers, reserve judgment on 3%, and incorrectly identify 0.02% of *N. galligena* collections as *N. coccinea* var. *faginata*.

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