Nectria cinnabarina: The Cause of a Canker Disease of Honey Locust in Minnesota

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ABSTRACT

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Nectria cinnabarina was determined to be the causal organism of a canker disease of honey locust (*Gleditsia triacanthos*) in Minnesota by using field pathogenicity tests. Surveys were made throughout the Minneapolis-St. Paul area. The highest incidence of the disease was observed in a tree nursery. Cankers were especially important on clones derived from *G. triacanthos* var. *inermis*, which is commonly planted in Minnesota.

A canker disease of honey locust (*Gleditsia triacanthos* L.) has been observed in Minnesota for many years. Cankers on the main stem can disfigure a tree, provide an entrance for decay fungi, and lead to premature death of the tree. *Nectria cinnabarina* Tode ex Fr. was the only fungus found associated with the early development of the cankers. The disease received only passing attention, and pathogenicity of *N. cinnabarina* was never confirmed. Increased attention has been given to this disease in recent years, partly because of the increased number of honey locusts being planted to replace American elms (*Ulmus americana*) lost to Dutch elm disease.

In the past 4 yr, nearly 17,000 honey locusts have been planted in Minnesota's public areas (11). Honey locusts have been favored for their rapid growth, ease of transplanting, and attractive foliage. The clones used, derived from *G. triacanthos* var. *inermis* (Pursh) Schneid., are desirable because they have no objectionable thorns and seed pods. The purpose of this study was to determine the cause of the cankers and the severity of the disease.

N. cinnabarina is known as a common saprophyte and parasite. In 1883, Mayr reported *N. cinnabarina* to be pathogenic on *Acer, Aesculus, Prunus, Robinia, Spiraea, Tilia*, and *Ulmus* (10). In the early 1930s the Christine Buisman elm, which is resistant to Dutch elm disease, was developed in Holland (7). *N. cinnabarina* became such a severe problem with this elm that it had to be abandoned as a suitable tree for planting (H. M. Heybroek, Dorschkamp Research Inst., Wageningen, Netherlands *personal communication*); thus, the usefulness of different elm clones developed in Europe is in part determined by their susceptibility to *N. cinnabarina*. More recently, *N. cinnabarina* has been reported as a pathogen on black locust (*Robinia pseudoacacia*), Japanese Keaki (*Zelkova serrata*), and winged spindle tree (*Euonymus alatus*) (6,13,15).

Several canker-causing fungi have been reported as pathogens of honey locust (2,12,14). Seeler (14) first identified *Thyronectria austro-americana* as the causal organism of a canker disease of honey locust on Nantucket Island, MA, in 1940. In 1942, the same fungus was reported to cause cankers on honey locusts in Tennessee, Mississippi, and Alabama (3). More recently, *T. austro-americana* was reported as the cause of a canker disease and honey locusts in Colorado (8) and Kansas (4). Cankers of *T. austro-americana* are macroscopically similar to those of *N. cinnabarina*. Microscopically, the causal agent can easily be differentiated.

MATERIALS AND METHODS

The incidence of cankers was determined by surveying 13 randomly selected areas distributed throughout the city of Minneapolis, all of the honey locusts on the Minnesota State Fairgrounds in St. Paul, the St. Paul campus of the University of Minnesota, and a windbreak of honey locusts planted in Beaver Falls Township of Renville County, MN. All of the honey locusts in a tree nursery located west of Minneapolis were also surveyed for the incidence of cankers. The trees planted at the Beaver Falls site were common honey locusts, and all the other sites contained various cultivars of the seedless, thornless variety of honey locust (*G. triacanthos* var. *inermis*).

Pathogenicity of *N. cinnabarina* was based on the results of inoculating eight honey locusts, 5–8 cm in diameter, at 1.4 m above the ground in the city of Minneapolis tree nursery. Each of the eight honey locusts was wounded in eight places on the main stem on 8 August 1981. Wounds, 3 cm circumferentially and 1 cm longitudinally, were made with a sterile scalpel through the bark and phloem. Two isolates of *N. cinnabarina* were selected from more than 300 isolates obtained from cankered honey locusts and were grown on sterile oats for 4 wk before inoculation. One infected oat kernel was placed in each of four wounds on each tree. A sterile oat kernel was placed in each of the remaining four wounds on each tree. All of the wounds were covered with Parafilm.

RESULTS

Incidence of cankers on 361 honey locusts in Minneapolis ranged from 0 to 48%, averaging 12.2% for the 13 randomly selected areas, with a mean of 2.4 cankers per tree. Incidence of cankers on 88 honey locusts on the Minnesota State Fairgrounds and 80 honey locusts on the St. Paul campus was 9.1% and

Table 1. The incidence of *Nectria* canker on honey locusts in several different areas

Location	Total no. of trees observed	No. of trees with cankers	Percent infection	Avg no. of cankers per tree
St. Paul campus	80	17	21.3	3.4
Minnesota State Fairgrounds	88	8	9.1	2.4
Minneapolis, MN	361	44	12.2	2.4
Beaver Falls, MN	78	3	3.8	1.3
A Minnesota nursery	1,113	266	23.9	2.0

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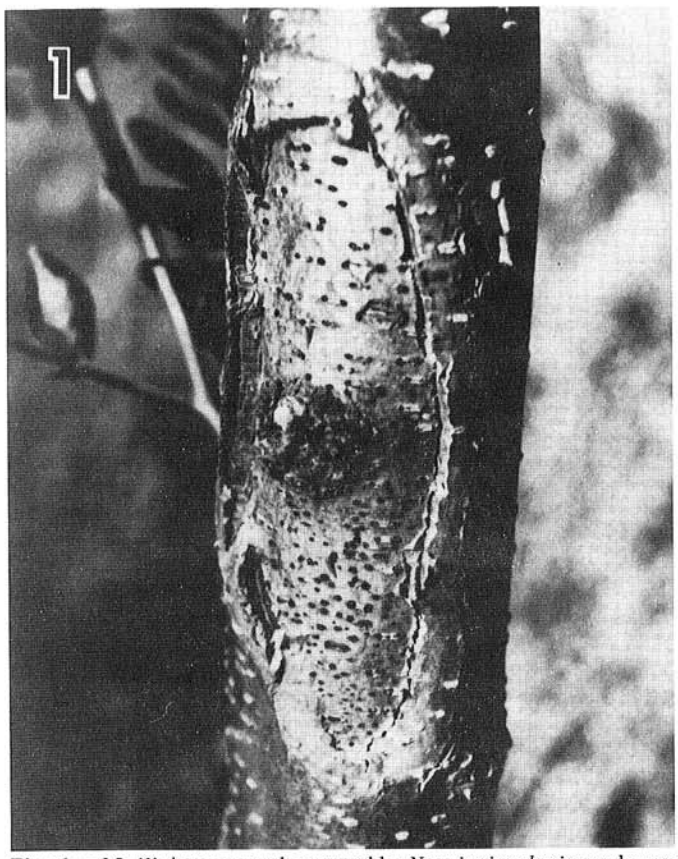
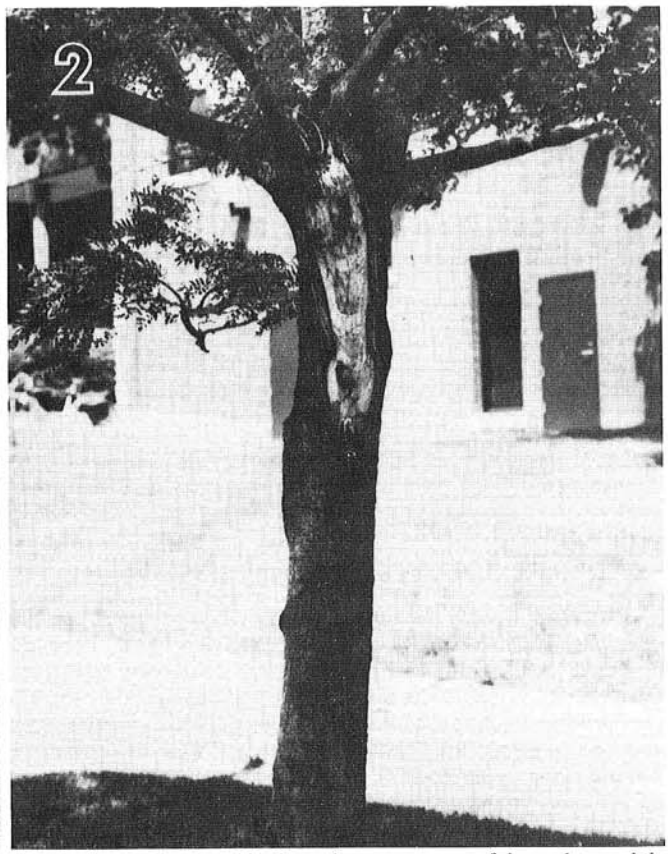
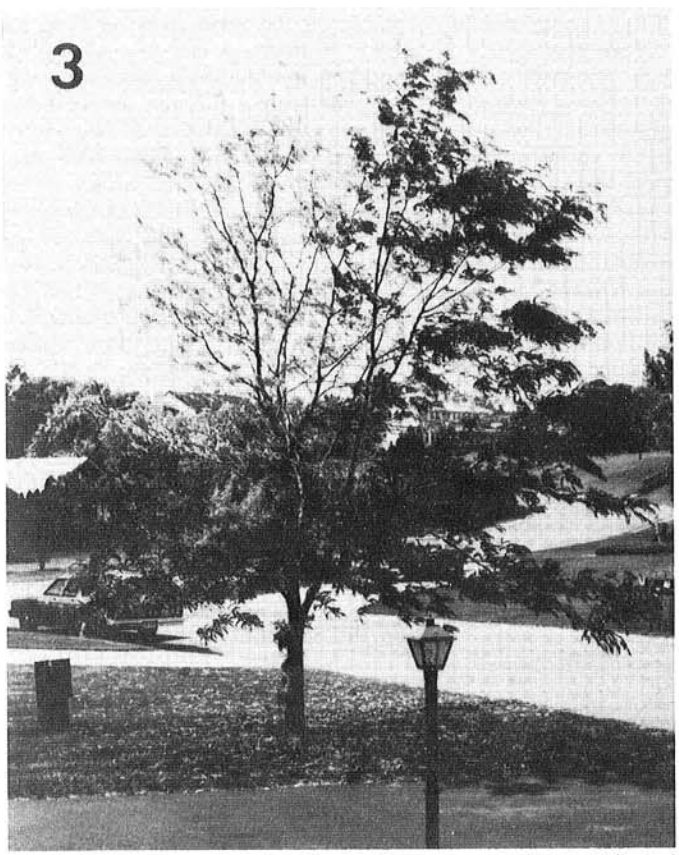
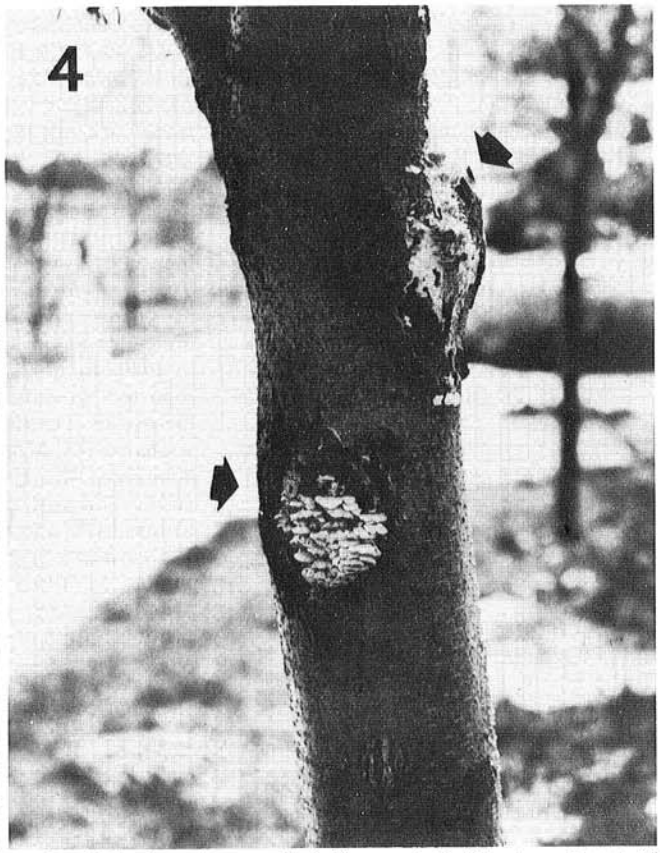




Figs. 1 and 2. (1) A young canker caused by *Nectria cinnabarina* on honey locust. Note the discolored bark, sunken appearance of the canker, and the black sporodochia protruding from the lenticels. **(2)** A canker on honey locust caused by *Nectria cinnabarina*, exposing a large area of wood.





Figs. 3 and 4. (3) A canker caused by *Nectria cinnabarina* is located in the branch axil 3 ft above the ground, girdling one half of the honey locust. **(4)** Cankers serve as sites for colonization of decay fungi. Sporophores of *Schizophyllum commune* and *Polyporus tulipiferus* are fruiting on the exposed xylem (arrows).

21.3%, respectively (Table 1). Incidence of cankers was lowest at the windbreak planting near Beaver Falls and highest at the tree nursery west of Minneapolis.

Cankers first appeared as sunken, slightly discolored (brown to reddish brown) zones in the bark (Fig. 1). As the fungus developed, areas of necrosis resulted (Fig. 2), which in some cases girdled and killed the tree above that point; this occurred in some trees in less than 1 yr (Fig. 3). More often, the fungus did not girdle the tree, and the host began to callus over the necrotic areas. It could take several years for the host to callus over these areas completely, which would provide ample time for the exposed tissue to become colonized by decay fungi (eg, *Schizophyllum commune* and *Polyporus tulipiferus*) (Fig. 4).

Sporodochia of *Tubercularia vulgaris* Tode ex Fr. (the anamorph of *N. cinnabarina*) usually protruded from lenticels in the cankered bark (Figs. 1 and 5a, b). The sporodochia ranged in color from coral pink when young to dark brown or black when old. Sporodochia were present throughout the year but were especially prominent during wet weather. A key microscopic characteristic of *T. vulgaris* was the presence of curled conidiophores (Fig. 5c). The conidia were about 2–3 × 5–7 μm (1) (Fig. 5d). They are produced in a sticky, gelatinous matrix that swells in wet weather.

The teleomorph of *N. cinnabarina* consisted of clusters of round red perithecia (Fig. 5a). The perithecium, with a definite ostiole, contained asci and

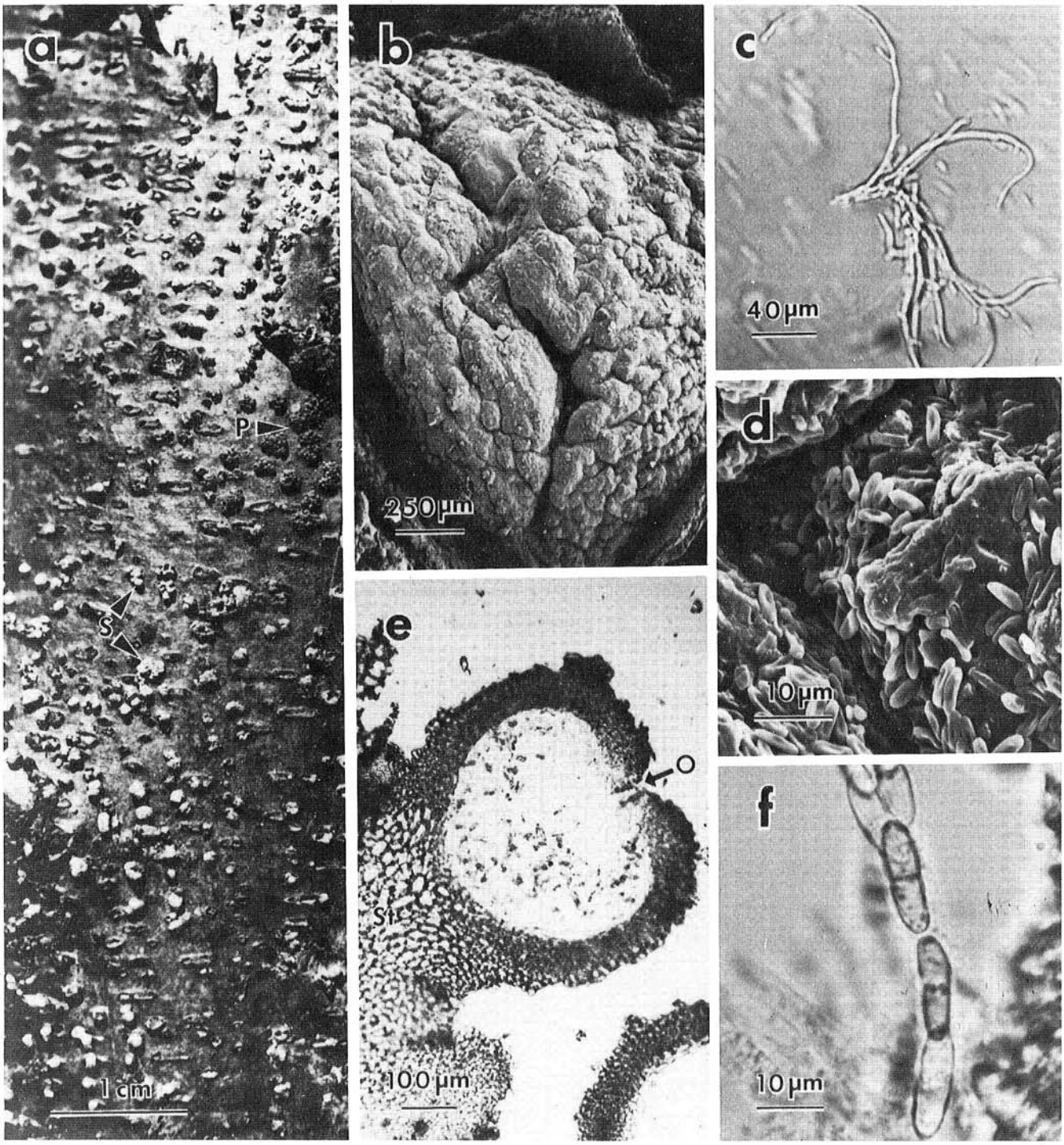


Fig. 5. Morphological characteristics of *Nectria cinnabarina*: **(a)** sporodochia (S) and perithecia (P) on surface canker; **(b)** sporodochium erupting through lenticel; **(c)** characteristic curling of conidiophores from a sporodochium; **(d)** surface of sporodochium showing conidia held in sticky matrix; **(e)** cross section through perithecium, stroma (St), and ostiole (O); **(f)** an ascus containing two-celled ascospores. Figures 5b and d are scanning electron micrographs; 5c, e, and f are light micrographs.

ascospores (Fig. 5e). There usually were eight ascospores per ascus (Fig. 5f) and ascospores, 12–20 × 4.6–6.5 μm (1), are bicellular.

Eleven weeks after healthy honey locusts were inoculated, cankers had formed around all 32 wounds inoculated with *N. cinnabarina*. The length of the cankers ranged from 2.5 to 8.1 cm, with a mean of 3.9 ± 1.2 cm. No cankers were observed around the 32 wounds inoculated with sterile oat kernels. *N. cinnabarina* was reisolated from all cankers.

DISCUSSION

From these studies it is evident that *N. cinnabarina* is a serious pathogen of honey locusts in Minnesota. The high frequency of cankers in a nursery (Table 1) may be due to cultural practices; in nurseries, trees are planted close to one another and are frequently wounded. Grant and Spaulding (5) and others (9,15) state that wounds are needed for infection by *N. cinnabarina*. Spores of *N. cinnabarina* may be spread from tree to tree on pruning tools (9). Investigations by the authors (*unpublished*) also indicate that pruning may be extremely important in the spread of this canker disease in Minnesota. The close spacing of nursery trees could possibly aid in the transmission of this disease. The planting at Beaver Falls, with the lowest incidence of the disease, consisted of common honey locusts that were not pruned frequently. The lower incidence of cankers could be attributed either to the lack of infection sites (ie, pruning wounds) or to greater natural resistance of the species compared with commercial cultivars. Another explanation is that the seed source of the common honey locust used is hardier in Minnesota climate than the commercial cultivars. A less hardy plant may be naturally predisposed to infection by *N. cinnabarina* (12,15). Further research is essential to determine resistant species or cultivars.

Because multiple infections tend to occur on a tree (Table 1), problems associated with a single canker are compounded. The fungus can girdle a tree or part of it in one season or less (Fig. 3); multiple cankers can coalesce, causing a greater possibility of girdling. Cankers provide more avenues for decay fungi to enter a tree. In Figure 4, sporophores of two different decay fungi can be observed, each colonizing a different canker. Colonization of cankers on honey locusts by these wood-destroying fungi result in a hazardous and unsightly tree.

Although honey locusts have many desirable characteristics as urban shade trees, their use may be limited because of the severity of *Nectria* canker. If reliable control measures were developed, honey locusts could be planted without drastic consequences. From our observations and previous investigations (9), the incidence of cankers may possibly be reduced by some or all of the following methods: i) avoid excessive pruning wounds or other injuries; ii) do not prune honey locusts during wet, damp weather; and iii) avoid stress because vigorously growing trees are generally less susceptible to disease.

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