Honeylocust Canker in Kansas Caused by *Thyronectria austro-americana*

F. CROWE, Assistant Professor of Plant Pathology, D. STARKEY, Area Extension Forester, and V. LENGKEEK, Assistant Professor of Plant Pathology, Kansas State University, Manhattan 66506

ABSTRACT

Crowe, F., Starkey, D., and Lengkeek, V. 1982. Honeylocust canker in Kansas caused by *Thyronectria austro-americana*. Plant Disease 66:155-158.

A survey of honeylocust (*Gleditsia triacanthos*) revealed that *Thyronectria austro-americana* commonly and abundantly fruited on dead honeylocust wood, including wood within active cankers. Perithecia were more common than pycnidia. Two disease patterns were observed: Trunk cankers and tree death associated with pruning wounds, sunburn damage, and insect borers in newly established windbreaks and open landscape sites; and cankers on shaded-out branches in well-established windbreaks and native tree stands. Branch cankers rarely killed trees, because the pathogen appeared not to spread from a cankered branch to the main trunk. Pathogenicity was confirmed by inoculating stems of seedlings with budded spores, conidia, and pycnidiospores of cultured isolates.

Thyronectria canker of honeylocust (*Gleditsia triacanthos* L.), incited by *Thyronectria austro-americana* (Spegazzini) Seeler, was first characterized by Seeler (5) in 1940 as an aggressive trunk canker disease that kills affected trees within 3–4 yr after disease symptoms appear. Cankers elongate extensively, but also eventually girdle the infected trunk. In 1942, *T. austro-americana* was active on honeylocust in Tennessee, Mississippi, and nearby states, causing small branch cankers that gradually killed the trees through multiple branch infections (1). No further reports of the disease appeared until Hudler and Oshima (2) in 1976 reported a limited outbreak of trunk cankers among city-street plantings in several Colorado communities east of the Continental Divide. Hudler and Oshima (2) confirmed pathogenicity tests reported by Seeler (5).

The pathogen was described by Lieneman (3) and Seeler (5,6) (the latter also monographed the entire genus, which contains only one other known pathogen). The fungus produces water-splashed conidia and pycnidiospores and ejected ascospores, although some ascospores bud within the perithecia (3,5,6). All spore forms are highly infectious (2,3,5). Infection courts, such as pruning or insect wounds or sunburn cracks, are apparently necessary for entry of the fungus. The fungus may sporulate profusely in its various forms on or near the surface of the dead host tissue (3,5,6), although the sexual stage commonly was not found in Colorado (2) and may not be common in Illinois (E. B. Himelick, Illinois Natural History Survey, *personal communication*). No epidemiologic information has been reported.

Honeylocust is naturally distributed with decreasing population density east and south through Kansas (Fig. 1). In eastern Kansas, honeylocust occurs in natural woodlands and along streambeds, with few in windbreaks or shelterbelts. Honeylocust has been widely planted in western and central Kansas because it tolerates extreme wind, temperatures, drought, sunlight, and soil conditions. In western and central Kansas, 5–10 million planted honeylocust comprise 10% or more of the total trees in farmstead windbreaks, field shelterbelts, and various shade-tree plantings and may become important in intensively planted energy plantations.

In 1978, we identified *T. austro-americana* from perithecia on bark from several heavily cankered honeylocust in roadside rest stops. In 1979–1980, numerous 10- to 15-yr-old honeylocust trees in western Kansas were killed by this disease. Surveys were conducted in fall 1980 and winter 1981 to determine the distribution and incidence of diseased trees in Kansas.

MATERIALS AND METHODS

Each area of the state was surveyed, but the effort was concentrated in western counties where the disease was of more concern. Surveyed sites included tree plantings in farm windbreaks, field shelterbelts, major highways, city streets, roadside rest stops, recreational camp sites, school and park grounds, naturally forested streambeds and woodlands, and naturalized stands. Naturalized stands include generally older honeylocust plantings that have reverted to a native stage through natural seeding and suckering within and away from the original planting.

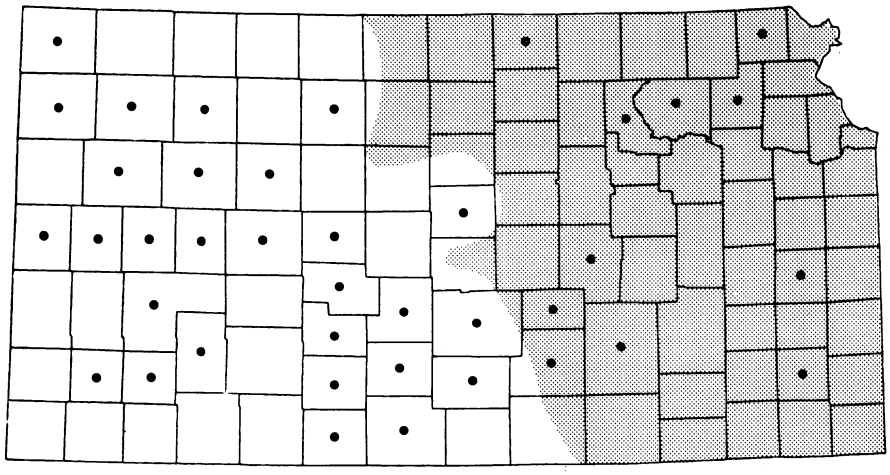

Fig. 1. Kansas counties surveyed for Thyronectria canker of honeylocust (*Gleditsia triacanthos*). Counties surveyed are marked with a dot. *Thyronectria austro-americana* was found fruiting on dead honeylocust wood in every county surveyed. Shading denotes areas where honeylocust is natively abundant (4). Native honeylocust populations gradually decrease and become more sporadic from eastern to western Kansas and are rare near the Colorado border.

Contribution 81-417-j, Departments of Plant Pathology and Forestry, Kansas Agricultural Experiment Station, Manhattan 66506.

Accepted for publication 14 October 1981.

The publication costs of this article were defrayed in part by page charge payment. This article must therefore be hereby marked "*advertisement*" in accordance with 18 U.S.C. §1734 solely to indicate this fact.

0191-2917/82/02015504/$03.00/0

The number and general condition of all honeylocust per site were noted, including presence or absence of cankers, pruning cuts, branch stubs, dead limbs, sunburn damage, and insect borer attack. Fallen branches and dead wood on honeylocust trees were inspected for fungal fruiting structures.

Descriptions by Lieneman (3) and Seeler (5,6) were used to identify *T. austro-americana*. Tentative signs of infection were dead wood with clustered perithecia or pycnidia characteristic of the pathogen. Elongated, reddish orange trunk cankers without signs of sporulation were considered potentially infected by *T. austro-americana*; in each case, however, infection was confirmed by isolating the pathogen.

Fungal cultures were obtained by plating woody tissues or fungal fruiting structures on acidified potato-dextrose agar (A-PDA) or acidified cornmeal agar (A-CMA) after 5 min or 30 sec, respectively, of surface sterilization in 0.5% sodium hypochlorite. All cultures identified as *T. austro-americana* were subcultured on PDA or CMA from single conidia.

In pathogenicity tests, thornless honeylocust seeds (*G. triacanthos* var. *inermis*) (Herbst Bros., Brewster, NY) were scarified for 1 hr in concentrated

Table 1. *Thyronectria austro-americana* (TA) canker of honeylocust trees in Kansas, 1980–1981

Tree location Age (yr)[a]	Tree spacing (m)[b]	Trees/site (no.) Range	Trees/site (no.) Mode	Sites (no.)	Tree loss (%)[c]	Sunlight	Pruning	Trees (%) with Trunk sunburn	Trees (%) with TA canker[d]	Canker location	Dead branches with fructification
Farmstead windbreaks[e]											
<20	4.6/6.1	20–100	45	15	0–100	Full	Lower branches	10–70	0–100	Main trunk	Rare
>20	1.8–3.7/ 3–4.6	20–100	50	35	0–30	Partly shaded	None	0	10–50	Branches; rare on trunk	On >80% of trees
Field shelterbelts[f]											
<20	4.6/6.1	100–500	200	5	0–100	Full	Lower branches	10–70	0–100	Main trunk	Rare
>20	1.8–3.7/ 3–4.6	200–1,000	400	35	0–30	Partly shaded	None	0	10–50	Branches; rare on trunk	On >80% of trees
Highway planting[g]											
<20	>4.6	1–150	10	25	ND	Full	None after planting	5–30	0–3	Trunk, branches	On 0–10% of trees
City street plantings[h]											
All ages[i]	Variable	1–200	45	35	ND	Variable	Lower branches, some in crown	<2	0–1	Trunk, branches	On 5–75% of trees
Roadside rest stops											
<20	>6.1	1–40	15	20	ND[j]	Full	Lower branches, some in crown	10–40	5–20	Trunk	Rare
Campsites											
<20	>6.1	1–20	7	10	ND[j]	Full	Lower branches, some in crown	10–40	5–20	Trunk	Rare
Native stands[k]											
All ages[l]	Variable	30–250	45	18	ND[m]	Partly shaded	None	0	10–50	Branches	On >80% of trees

[a] Approximate. In windbreaks and shelterbelts, honeylocust trees were planted between rows of other tree species more than 20 yr ago; they were planted on the southernmost row after that. More than one row of honeylocust was occasionally used in each time period.
[b] Spacing between trees/spacing between rows of trees.
[c] Dead or missing trees as a percentage of original number planted. ND = not determined.
[d] As determined by culture and presence of pathogen fructification.
[e] Plantings for environmental control (of wind, temperature, and sun) on farmsteads near residences, work areas, and livestock facilities.
[f] Plantings to control soil erosion along cropped acreage.
[g] Plantings along interstate highways for beautification.
[h] A site comprised all four sides of eight contiguous city blocks per community. Honeylocust trees on both sides of the street but only within easy access were included. Survey began when the first honeylocust was observed; direction of survey was random.
[i] Maximum age was about 80 yr. Within a neighborhood, trees were of similar age.
[j] Caretakers indicated high loss at some locations.
[k] Also includes naturalized stands, or older honeylocust plantings that have reverted to a native state through natural seeding and suckering within and away from the original planting. A site included all honeylocust within about 10,000 m^2.
[l] Maximum age was about 100 yr.
[m] Dynamic state of tree loss and natural replacement.

sulfuric acid and planted 1.5 cm deep in a 2:1:1 soil, peat, and perlite mixture. One-hundred plants were grown per plastic flat (30 × 60 cm) under greenhouse conditions in Manhattan, KS.

Pathogenicity was determined by placing a 1-mm-diameter agar plug of mycelium or about 1,000 conidia and budded spores directly from culture plates into a small scalpel wound on the stem of seedlings 15 cm tall. Three plants per isolate were inoculated. Controls included three each of wounded, uninoculated plants; unwounded, inoculated plants; and unwounded, uninoculated plants. Parafilm (American Can Co., Greenwich, CT 06830) was wrapped loosely around the points of wounding and inoculum placement. Stems were misted for 2 days after inoculation.

RESULTS

In each county, three to 10 sites were surveyed (Fig. 1). The kind and number of sites and survey data are listed in Table 1. Native stands were of the native thorny honeylocust. Plantings older than about 20 yr included primarily thorny honeylocust, but also some thornless plantings. Trees planted more recently were nearly all thornless types. The more important landscape sites included named cultivars, although no attempt was made to categorize these. Cankering and tree or branch deaths associated with *T. austro-americana* were found in nearly all sites visited.

In older shelterbelts and windbreaks, native tree stands, and naturalized stands, few trunk cankers were observed; however, *T. austro-americana* was common and active in branch cankers. Active cankers did not appear to extend from branch to branch or from a branch into the main trunk. At the point of attachment of branches to larger branches or to the main trunk, healthy tissues routinely grew around dead limbs, upon which the pathogen abundantly fruited. Because new tissues showed no sign of infection (Fig. 2), this suggests that the pathogen does not move from an infected branch into an adjoining branch or into the main trunk. Most dead limbs were associated with both excessive shading and *T. austro-americana* activity. Even though honeylocust trees are intolerant to shade, they were predominantly planted in the interior of the older windbreaks and shelterbelts. Actively growing branches near tree tops showed few cankers; however, active cankers high on the main stem of older trees occasionally extended downward into the larger bole of the trees and killed them.

Despite abundant branch death, honeylocust trees were usually not killed unless entirely shaded; in most established plantings of 25–45 yr, only a few trees were dead or missing. The infection courts for branch cankers were not easily determined. Pruning of any sort had rarely been performed in these sites, but some wind breakage was apparent. Insect borer damage was common on both limbs and trunks. In a few instances, extensive stand deterioration and infection courts were associated with hail damage. The above patterns were similar for both thorny and thornless trees.

Honeylocust trees in locations exposed to abundant sunlight had few branch cankers. (However, when cankers or dead branches occurred, fruiting structures of *T. austro-americana* were found.) Cankers usually were associated with pruning wounds or other injury and were on the south-southwest side of tree trunks. The thin bark of young trees is susceptible to sunburn damage and insect borers, and wounds made on southern exposures were apparently slow to heal. Cankers were not consistently associated with borers; however, for certain trees, borers may have been the primary source of wounding. For trees under no obvious soil or moisture stress, borers did not appear to be associated with trunk cankers.

Honeylocust trees were planted to the southern exterior of younger shelterbelts and windbreaks. All windbreaks and shelterbelts were planted from seedlings. Live branches have commonly been pruned to raise the canopy height, despite branch removal reducing the functional value of a windbreak. Within some young windbreaks and shelterbelts containing as many as several hundred honeylocust trees, all of those present were cankered on the trunk or were dead with abundant sporulation on the dead bark. In other young windbreaks and shelterbelts, cankers were less common.

Fig. 2. Honeylocust with dead branch upon which *Thyronectria austro-americana* perithecia are abundant. The fungus has not grown from the branch into the main tree trunk. Arrow indicates clustered perithecia. Inset shows cross section of cluster of perithecia. White bar represents 1 mm.

Shade trees along city streets had low incidences (0–1%) of branch and trunk cankers. Where cultivars could be determined, no differences in disease were obvious; however, more observations should be taken in this respect. Cankers near the base of trees were associated with wounds caused by lawn mowers or cars. Other cankers were associated with pruning or other mechanical wounding.

In contrast, honeylocust trees at roadside rest stops and reservoir campsites were frequently cankered on the main trunk (5–20%). Highway plantings were commonly free of cankers unless planting density was high, in which case branch cankers predominated, but these trees had usually not been pruned since being transplanted.

T. austro-americana stromata were routinely observed in active cankers and on dead wood. Nearly all stromata contained perithecia and about half also contained pycnidia. Stromata with pycnidia only were uncommon; however, from our observation and previous reports (3,5,6), it appears that pycnidia develop first. Perithecia are produced soon thereafter and become predominant. Frequently, as many as one perithecial or pycnidial stroma per square centimeter of surface area was present. We observed, as did Lieneman (3), that the fungus appears to remain active on dead wood for many years.

Because of observed differences in disease incidence and severity between shady and sunny locations, 15 isolates from each were compared in culture and separately tested for pathogenicity. The pathogen was easily cultured. Conidiophores, conidia, and budded spores appeared within a few days at room temperature and lighting. All isolates had similar cultural morphology and development.

Stromata and pycnidia developed on PDA after 4 wk but not on CMA, even after 3 mo. Within 8 mo, however, some isolates formed perithecia on the original PDA medium. Wounded, inoculated seedlings developed stem cankers and died within 12 days for all isolates of *T. austro-americana*. Wounding was necessary for infection, and no control plants showed disease symptoms even after 4 wk. An *Aspergillus* sp. and another fungus, either *Coniothyrium* or *Sphaeropsis,* were also commonly cultured from diseased tissue. Neither was pathogenic to seedlings.

DISCUSSION

We found cankering caused by *T. austro-americana* to be common on honeylocust in Kansas. The extent of trunk cankering in open planting sites was alarming, considering the obscurity of and inattention given to this disease. In

younger windbreaks and shelterbelts, trunk cankers were associated with pruning wounds and sunburn. Borers were involved in some cankers, but their identity and role were not clear.

The difference in incidence between plantings on city streets and those at rest stops and reservoirs may stem in part from favorable growth conditions in the former and the poorer conditions (soil, water, and care) in the latter. However, rest stop and campsite trees, even established specimens, were generally more exposed to sunlight and were much more mechanically abused and wounded than were trees in other sites.

Plantings of trees well past the seedling stage seemed particularly affected by sunburn damage, borer activity, and canker during the first few years of establishment, regardless of site conditions. Many wounds had healed without apparent infection or canker formation, especially on vigorous trees. Once trees were infected, however, trunk cankers expanded rapidly even on otherwise vigorous trees. This supports previous reports that *T. austro-americana* is an aggressive pathogen following infection (2,5).

In contrast to the observations of Crandall (1), we observed that branch cankers usually did not accumulate to kill trees directly and that the disease in natural or untended stands was not actively killing many trees. Possibly Crandall observed more highly shaded situations. Branch cankers were common in older windbreaks and shelterbelts in which little tree loss had occurred. Although the many dead branches upon which the pathogen was fruiting could have become invaded by *T. austro-americana* after the branches were already dead, we believe the pathogen's natural role may involve the recycling of unvigorous, damaged wood. This would explain our observations for both shaded and sunny conditions.

Because little is known of the epidemiology of this disease, the timing of wounding and spore production and the type and abundance of spores causing infections should be examined, as should the potential for spread with pruning implements. Where insect borers may be involved, species and relative aggressiveness with respect to tree vigor, bark integrity, and ability to transmit the fungal pathogen should be determined.

This report confirms and extends findings of Hudler and Oshima (2) that Thyronectria canker is indeed actively killing trees in the Great Plains states. Although no geographic difference was observed in the distribution pattern of the disease, eastern and western Kansas differ as to the usage and value of honeylocust and the apparent importance of the disease. Recent occurrences of Thyronectria canker in Oklahoma (K. Conway, *personal communication*) and Illinois (E. B. Himelick, *personal communication*) and the report of Crandall (1) suggest that the disease is widespread.

LITERATURE CITED

1. Crandall, B. S. 1942. Thyronectria disease of honey locust in the South. Plant Dis. Rep. 26:376.
2. Hudler, G. W., and Oshima, N. 1976. The occurrence and distribution of *Thyronectria austro-americana* on honeylocust in Colorado. Plant Dis. Rep. 60:920-922.
3. Lieneman, C. 1938. Observations on *Thyronectria denigrata*. Mycologia 30:494-511.
4. Little, E. L., Jr. 1971. Atlas of U.S. Trees. Vol. 1. U.S. For. Serv. Misc. Publ. 1146.
5. Seeler, E. V., Jr. 1940. Two diseases of *Gleditsia* caused by a species of *Thyronectria*. J. Arnold Arbor. Harv. Univ. 21:405-427.
6. Seeler, E. V., Jr. 1940. A monographic study of the genus *Thyronectria*. J. Arnold Arbor. Harv. Univ. 21:429-460.