

# Incidence of *Phellinus robineae* in Black Locust Plantings in Oklahoma

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## ABSTRACT

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Incidence of sporocarps of *Phellinus robineae* on living black locust (*Robinia pseudoacacia*) in Oklahoma plantings was determined by examining about 15,000 trees in 144 plantings of six ages in five major land resource areas (MLRAs) from April 1981 to May 1982. Infected trees with sporocarps were found in 44% of the plantings and in 33 of 48 counties sampled. Incidence of infected trees among the MLRAs ranged from 0 to 7% and was significantly greater in the MLRA in western Oklahoma than in central and northeastern Oklahoma. Incidence of infected 10-yr-old trees was less than 1%; incidence increased significantly after trees were 15 yr old. More than 7% of 7,350 black locust trees 20, 24, 30, and 40 yr old in Oklahoma plantings in the five MLRAs had sporocarps.

Additional key words: *Phellinus punctatus*, stem decay

Black locust (*Robinia pseudoacacia* L.) has been planted widely in the southern Great Plains for erosion control, wildlife food and cover, posts, firewood, and because of its drought resistance and adaptability to calcareous soils, for windbreaks (10). During 1975-1980, 40% of the 2.3 million broadleaf trees planted in Oklahoma were black locust, and the demand for this species is increasing.

Many windbreak plantings established throughout the Great Plains in 1935-1942 during the Prairie States Forestry Project (PSFP) have reached an age of declining vigor (12), and damage from stem diseases has become increasingly serious (4,8,11,13,14).

The principal stem decay pathogens of black locust are *Phellinus robineae* (Murr.) A. Ames (syn. *Fomes rimosus* (Berk.) Cke.) and *Polyporus robinophilus* (Murr.) Lloyd. *Phellinus robineae* has been observed on living black locust trees in PSFP windbreaks in the central and southern Great Plains since 1972 (J. W. Riffle, unpublished), and *Polyporus robinophilus* has been reported on this species in Kansas (7). A 24% incidence of *Phellinus robineae* and other factors have caused a 59% loss among 200 black locust trees in two windbreak plantings in north

central Oklahoma (4).

Because stem decay pathogens may reduce the effectiveness and longevity of trees in windbreaks (9) and because the demand for black locust planting stock and wood products is increasing in Oklahoma, the USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, and the Oklahoma Forestry Division initiated a cooperative study in 1981. Objectives were to determine incidence of trees infected with *P. robineae* in black locust plantings of six ages in five major land resource areas (MLRAs) in Oklahoma and to determine if there was a relationship between incidence of infected trees and tree age or MLRA. MLRAs consist of geographically associated land resource units and represent a natural classification of physical site characteristics including water, soil, elevation, topography, and climate (2). MLRA characteristics are used as a guide in the development of tree planting recommendations in the Great Plains.

## MATERIALS AND METHODS

The numbers of black locust trees 10, 15, 20, 24, 30, and 40 yr old in Oklahoma were obtained from nursery tree distribution records. Records of the Oklahoma Forestry Division showed that 523,600 black locust trees were planted in 608 plantings in Oklahoma during the fall to spring seasons of 1940-1941 (40 yr old), 1950-1951 (30 yr old), 1956-1957 (24 yr old), 1960-1961 (20 yr old), 1964-1965 (15 yr old), and 1970-1971 (10 yr old) on 11 MLRAs (2). No data exist on seed sources or genetic diversity of these trees. Five MLRAs (77 = Southern High Plains, 78 = Central Rolling Red Plains, 80A = Central Rolling Red Prairies, 84A = Cross Timbers, and 112 = Cherokee Prairies) in the northeastern, central, and western portions of Oklahoma (Fig. 1) contained 565 of the 608 plantings and were selected for sampling.

Some black locust plantings did not survive, and many that did were removed later for land development, farm reorganization, or other reasons. Data from a survey made by Norman Smola of the Soil Conservation Service were used to estimate that 415 plantings of the desired ages remained in 58 counties of the five sample MLRAs in 1978 (1). The 415 planting locations were visited from April 1981 to May 1982, but only 144 plantings were found.

All living black locust trees within each planting were examined for occurrence of sporocarps of *P. robineae*. Data recorded were total number of trees in each planting, number with sporocarps of *P. robineae*, and number and location of sporocarps on each tree. The number of infected trees was considered the same as

**Table 1.** Incidence of *Phellinus robineae* on black locust trees in Oklahoma plantings of six ages in five major land resource areas (MLRAs) (1981-1982)

MLRA <sup>a</sup>	Age of plantings in 1981 (yr)						All ages	
	10	15	20	24	30	40	No.	(%)
77	0/1 <sup>b</sup>	0/1	0/2	—	—	—	0/4	0
78	1/5	2/4	8/9	4/4	1/1	10/11	26/34	76
80A	0/8	3/11	5/10	7/10	6/10	4/5	25/54	46
84A	0/12	1/10	1/5	4/7	2/5	—	8/39	21
112	1/6	0/3	1/1	3/3	—	—	5/13	38
Total	2/32	6/29	15/27	18/24	9/16	14/16	64/144	...
Incidence (%)	6	21	56	75	56	88	44	...

<sup>a</sup> 77 = Southern High Plains, 78 = Central Rolling Red Plains, 80A = Central Rolling Red Prairies, 84A = Cross Timbers, and 112 = Cherokee Prairies.

<sup>b</sup> Plantings with trees with sporocarps of *P. robineae*/total plantings examined; — = no living black locust found.

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**Table 2.** Incidence of *Phellinus robineae* on black locust trees of six ages in five major land resource areas (MLRAs) in Oklahoma (1981–1982)

MLRA <sup>a</sup>	Age of trees in 1981 (yr)						All ages	
	10	15	20	24	30	40	No.	%
77	0/1 <sup>b</sup>	0/6	0/4	—	—	—	0/11	0
78	4/1,025	2/339	107/1,681	25/117	8/18	128/592	274/3,772	7
80A	0/974	17/1,319	25/1,562	32/588	125/1,253	40/60	239/5,756	4
84A	0/1,515	7/915	1/334	13/406	7/131	—	28/3,301	<1
112	2/1,452	0/61	5/236	6/368	—	—	13/2,117	<1
Total	6/4,967	26/2,640	138/3,817	76/1,479	140/1,402	168/652	554/14,957	4
Incidence (%)	<1	1	4	5	10	26	4	...

<sup>a</sup>77 = Southern High Plains, 78 = Central Rolling Red Plains, 80A = Central Rolling Red Prairies, 84A = Cross Timbers, and 112 = Cherokee Prairies.

<sup>b</sup>Trees with sporocarps of *P. robineae*/total trees examined; — = no living black locust found.

the number with sporocarps of *P. robineae*. Sporocarps and decayed wood were collected for isolation and identification of the decay fungus where identity of sporocarps was in doubt.

The percent incidence of *P. robineae* for each planting was determined by dividing the number of trees with sporocarps by total trees examined. Incidence data were transformed to inverse sine and analyzed by MLRA and tree age using Gabriel's analysis of variance of proportions with unequal frequencies (5). Statistical comparisons were considered significant if  $P \leq 0.05$ .

## RESULTS

*P. robineae* was the predominant stem decay fungus found. Nearly half of all plantings examined contained trees with sporocarps of *P. robineae* (Table 1). Plantings with infected trees were found in 33 of 48 counties sampled and in four of the five MLRAs examined; incidence of infected plantings in the four MLRAs ranged from 21 to 76% (Table 1). Trees with sporocarps were found in 67% of the plantings that were 20 yr and older but in only 6% of the plantings that were 10 yr old.

About 15,000 black locust trees were examined in 144 plantings, and 554 had sporocarps of *P. robineae* (Table 2). Incidence of infected trees ranged from 0 to 7% among MLRAs and increased with tree age. More than 7% of the 7,350 trees 20 yr and older and 11% of the 3,533 trees 24 yr and older were infected.

Because of the limited number of plantings and black locust trees 30 and 40 yr old available for examination (Table 2), only three comparisons could be made between incidence of infected trees and tree age and MLRA. Incidence of infected trees by tree age for MLRAs 80A and 84A showed a significant age effect, with increasing percent incidence after 20 yr (Table 3). A similar comparison by tree age for MLRAs 78, 80A, 84A, and 112 showed increased incidence after 15 yr (Table 3). For trees 10–24 yr old, MLRA 78 had significantly greater percent incidence of infected trees than MLRAs 80A, 84A, and 112 (Table 4). The comparison of MLRAs 80A, 84A, and 112 for trees 10–24 yr old was not significant and is not included in Table 4.

More than 1,600 sporocarps of *P.*

**Table 3.** Incidence of *Phellinus robineae* on black locust trees in Oklahoma plantings by tree age for three major land resource area (MLRA) comparisons

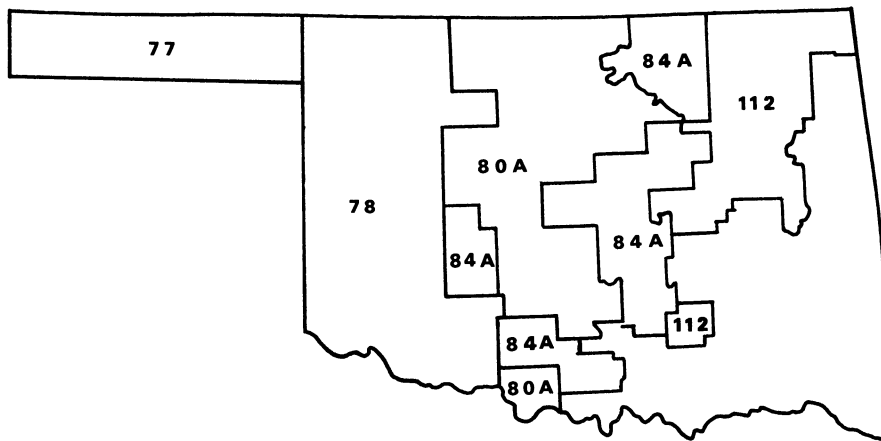
MLRA <sup>w</sup>	Variable	Age of trees in 1981 (yr)				
		10	15	20	24	30
80A, 84A	No. of trees	0/2,489 <sup>x</sup>	24/2,234	26/1,896	45/994	132/1,384
	Incidence (%)	0 a <sup>y</sup>	1.1 ab	1.4 ab	4.5 b	9.5 c
80A, 84A, 112	No. of trees	2/3,941	24/2,295	31/2,132	51/1,362	...
	Incidence (%)	0.1 a	1.0 ab	1.5 b	3.7 b	...
78, 80A, 84A, 112	No. of trees	6/4,966	26/2,634	138/3,813	76/1,479	...
	Incidence (%)	0.1 a	1.0 a	3.6 b	5.1 b	...

<sup>w</sup>78 = Central Rolling Red Plains, 80A = Central Rolling Red Prairies, 84A = Cross Timbers, and 112 = Cherokee Prairies.

<sup>x</sup>Trees with sporocarps of *P. robineae*/total trees examined.

<sup>y</sup>For rows two, four, and six, values not followed by a letter in common differ significantly from each other ( $P = 0.05$ ) according to Gabriel's analysis of variance of proportions with unequal frequencies.

<sup>z</sup>Sample size too small to include in data comparisons.

**Fig. 1.** Location of five major land resource areas in Oklahoma where incidence of infection of black locust by *Phellinus robineae* was estimated. 77 = Southern High Plains, 78 = Central Rolling Red Plains, 80A = Central Rolling Red Prairies, 84A = Cross Timbers, and 112 = Cherokee Prairies.

*robineae* were found on 554 black locust trees. The average number of sporocarps per tree ranged from one for 10-yr-old trees to four for 40-yr-old trees. The average number of sporocarps per infected tree in MLRAs 78, 80A, 84A, and 112 was 3.3, 2.6, 3.3, and 1.5, respectively. More than 75% of the sporocarps were found within 1.8 m of the ground; 53% were found within 0.9 m of the ground. About 60% of the sporocarps were associated with branch stubs, and 32% were associated with mechanical or insect wounds on the bole or major branches.

Another stem decay pathogen, *Phel-*

*linus punctatus* (Fr.) Pilat, was found on black locust trees in seven Oklahoma plantings in three MLRAs; it was associated with a canker rot on living trees. Sporocarps of this fungus were found on 2% of 1,594 trees in the seven plantings; incidence was less than 1% for 673 trees in three 20-yr-old plantings, 2.8% for 178 trees in three 24-yr-old plantings, and 3.3% for 743 trees in one 30-yr-old planting. It was not observed on any of the 652 trees examined in sixteen 40-yr-old plantings.

## DISCUSSION

*P. robineae* occurs on black locust

**Table 4.** Incidence of *Phellinus robineae* on black locust trees in Oklahoma plantings by major land resource areas (MLRAs) for two age comparisons

MLRA <sup>x</sup>	Age group in 1981 (yr)			
	10-30		10-24	
	No. of trees	Incidence (%) <sup>y</sup>	No. of trees	Incidence (%)
78	—	—	138/3,162 <sup>z</sup>	4.3 a
80A	199/5,696	3.5 a	74/4,443	1.7 b
84A	28/3,301	0.8 a	21/3,170	0.7 b
112	—	—	13/2,117	0.6 b

<sup>x</sup>78 = Central Rolling Red Plains, 80A = Central Rolling Red Prairies, 84A = Cross Timbers, and 112 = Cherokee Prairies.

<sup>y</sup>For columns three and five, values not followed by a letter in common differ significantly from each other ( $P=0.05$ ) according to Gabriel's (5) analysis of variance of proportions with unequal frequencies.

<sup>z</sup>Trees with sporocarps of *P. robineae*/total trees examined.

throughout the windbreak planting area in Oklahoma; it is the most prevalent stem decay pathogen of living black locust in four MLRAs examined. *P. punctatus* occurred on living black locust in 5% of the plantings sampled. It was reported on this host in 1936 (3) and was recently found associated with canker rot on eight tree and shrub species commonly used in windbreaks in the northern Great Plains (13). Its importance as a stem decay pathogen of black locust remains unknown.

*P. robineae* is an important factor in the deterioration of windbreak and other black locust plantings that are normally grown for more than 20 yr in Oklahoma. It should have little effect on development of energy and post lot plantings that are grown for less than 20 yr. The percentage of trees with sporocarps increases significantly after 20 yr: about 11% of trees 24 yr and older and 15% of trees 30 yr and older were infected. These percentages are conservative because they do not include infected trees that lacked sporocarps. In a recent report, nearly 60% of the dead and dying black locust trees in two windbreaks more than 40 yr old in two counties in MLRAs 78 and 80A had sporocarps of *P. robineae* (4). Our results confirm these findings. Thirty-five trees were examined in two 40-yr-old windbreaks within the same counties, and 71% of the black locust had sporocarps of *P. robineae*. Also, 652 trees were examined in sixteen 40-yr-old windbreaks within the same MLRAs,

and 88% of the plantings and 26% of the trees were infected. All trees with sporocarps were alive but had low vigor and extensive stem dieback.

Incidence of trees with sporocarps of *P. robineae* was greater in MLRA 78 than in 80A, 84A, and 112 through age 24 yr. MLRA 78 (Fig. 1) is located in the western part of the state and has greater elevation (>457 m) and lower mean annual precipitation (64.7 cm for the period 1951-1980) than the other three MLRAs (<457 m elevation and 78.5, 87.1, and 98.9 cm for 80A, 84A, and 112, respectively) (6). Thus infection of black locust trees by *P. robineae* may be greater on drier sites. Several site characteristics, including available soil moisture and soil type, are being assessed to determine if they are related to disease incidence and volume of stem decay caused by *P. robineae*.

Only one-third of the estimated number of black locust plantings in Oklahoma were located during field examinations. The limited number of black locust trees available in certain MLRA/age combinations is attributed in part to deterioration of trees by *P. robineae* (4), to land clearing for agricultural or urban development (1), and to harvesting of trees for products like firewood. During the period 1970-1975, windbreaks in Oklahoma decreased in number by 3.9%, in area by 3.1%, and in length by 4.1% (1).

Most sporocarps of *P. robineae* were found within 1.8 m of the ground on the

boles of black locust trees. The information on numbers and locations of sporocarps may be significant in estimating decay losses if a relationship between their number and decay volume is determined in a current tree dissection study.

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