

Incidence of *Fomes fraxinophilus* on Green Ash in Nebraska Woodlands

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ABSTRACT

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Incidence of sporocarps of *Fomes fraxinophilus* on living green ash (*Fraxinus pennsylvanica*) in Nebraska woodlands was determined by examination of 7,066 trees on 361 sample plots in 10 multicounty forest inventory units. Infected trees were found on 55% of the plots and in 55 of 64 counties sampled. A mean of nine sporocarps per tree were present on 1,019 infected trees. Incidence of *F. fraxinophilus* increased in a straight-line relationship with trunk diameter. It is estimated that $10 \pm 0.8\%$ of the more than 20 million living green ash trees in Nebraska woodlands have sporocarps.

Additional key words: *Perenniporia fraxinophila*

Green ash (*Fraxinus pennsylvanica* Marsh.) is common in woodlands in the Great Plains and is widely used in windbreaks and other plantings in this region. Survival and early growth of this species have been good (4), and serious damage from stem pathogens is seldom observed in young plantings (4,5). However, incidence of stem pathogens on green ash increases as trees mature and their vigor declines (3,5,8).

Fomes fraxinophilus (Peck) Cooke is the most common stem decay pathogen reported on green ash in the Great Plains. The taxonomic placement of this fungus has been investigated recently, and the name *Perenniporia fraxinophila* (Peck) Ryvar den comb. nov. has been proposed (6). In a 1977-1978 study of Prairie States Forestry Project windbreaks in Nebraska, incidence of living trees with sporocarps of *F. fraxinophilus* was $5.5 \pm 0.4\%$ among 55,155 green ash trees examined in 173 plantings (5). In Prairie States Forestry Project windbreaks in North Dakota, incidence was $0.29 \pm 0.07\%$ among 25,558 green ash in 30 plantings (8). *F. fraxinophilus* has also been observed on mature green ash in native woodlands in the central and northern Great Plains, but little information is available on its distribution and incidence or the extent of damage it causes.

A 1978 inventory of state and private lands by the Nebraska Forest Service (7) led to an estimate of 20 million green ash trees in Nebraska. On more than 90% of these trees, the diameter at breast height (dbh) ranged from 2.5 to 30.4 cm, and fewer than 1% had dbh of 66 cm or more.

The objective of this study was to determine the geographical distribution and incidence of green ash infected by *F. fraxinophilus* in woodlands on lands previously inventoried.

MATERIALS AND METHODS

Nebraska Forest Service personnel divided the state into 11 forest resource units (Fig. 1) and selected sample plots at random from aerial photographs for examination. Three hundred eighty-nine plots contained green ash. The total number of green ash trees in the state was estimated from data collected from these plots by the Nebraska Forest Service (7).

From April 1979 through June 1981, 361 of the 389 plots with green ash were examined for evidence of *F. fraxinophilus*. At each plot, the number of trees with sporocarps of *F. fraxinophilus*, the number and location of sporocarps on each tree, and the dbh, height, and crown class of about 20 live green ash trees closest to the plot center and at least 2.5 cm dbh were recorded. All trees examined were placed in the five diameter classes used in the Nebraska forest resources inventory (7). The number of infected trees was considered the same as the number of trees with sporocarps of *F. fraxinophilus*. When identity of the fungus was in doubt, samples of sporocarps and decayed wood were collected for isolation and identification of the decay pathogen as reported previously (5). The percentage of trees

infected (=incidence) was calculated separately for each diameter class. The relationship between dbh and incidence was assessed separately for each inventory unit, using a series of confidence intervals on pairwise differences in percentage of incidence among diameter classes. Type I error ($\alpha = 0.05$) was maintained for all comparisons within each inventory unit by using Bonferroni's probability inequality (1). Standard multiple-comparison tests were not used because variance was not constant among diameter classes within each inventory unit.

The proportion of trees infected on sample plots in each inventory unit (Table 1) was projected on the basis of inventory totals (7) to obtain an aggregate estimate of the number of green ash trees infected in Nebraska woodlands. Percentages of trees infected in the various inventory units were compared using the same technique employed to compare diameter classes within units. A regression analysis was also made to determine if the percentage of incidence of infected trees on a statewide basis was related to dbh.

RESULTS

More than 7,000 green ash trees were examined. Trees with sporocarps of *F. fraxinophilus* were found on 55% of the plots and in 86% of the counties that contained green ash (Table 1). Incidence increased with increasing dbh in seven of the nine inventory units (Table 1).

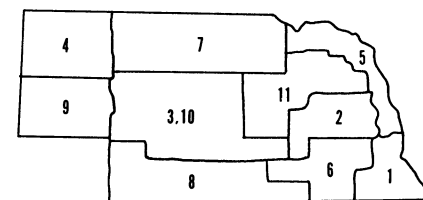


Fig. 1. Eleven multicounty units used by personnel of the Nebraska Forest Service to conduct a forest resources inventory in Nebraska. These units were also used to determine the distribution and incidence of green ash infected by *Fomes fraxinophilus* in woodlands in Nebraska. The units were 1 = Southeastern, 2 = Lower Platte, 3 and 10 = Mid-Platte and Sandhills, 4 = Pine Ridge, 5 = Upper Missouri, 6 = Capitol, 7 = Niobrara, 8 = Republican, 9 = Upper Platte (not inventoried or sampled), and 11 = Loup-Elkhorn.

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Table 1. Distribution and percent incidence of green ash trees infected by *Fomes fraxinophilus* in 361 sample plots, and estimated number of infected trees and percent incidence on a statewide basis in Nebraska woodlands

Inventory unit	Counties ^x (no.)	Plots ^x (no.)	Trees examined (no.)	Trees with sporocarps (%) ^y (diameter classes in cm)					Total trees infected statewide (in thousands)	Percent incidence ± standard error statewide
				2.5-12.6	12.7-30.4	30.5-45.6	45.7-65.9	66.0+		
(1) Southeastern	6/7	14/74	1,401	0.2 a	1.2 a	4.2 ab	27.2 b	50.0 ^z	24.6	1.6 ± 0.3 a
(2) Lower Platte (3,10) Mid-Platte and Sandhills	8/9	21/46	855	4.8 a	2.6 a	23.1 b	53.6 b	60.0 ^z	109.2	5.1 ± 1.8 ab
(4) Pine Ridge	4/5	19/30	571	2.2 a	24.3 b	31.3 b	22.6 ab	83.3 ^z	366.5	9.7 ± 2.0 b
(5) Upper Missouri	3/3	8/11	219	5.0 a	24.3 a	22.4 a	20.0 ^z	0.0	103.3	24.0 ± 6.1 b
(6) Capitol	3/7	20/40	686	15.3 a	16.8 a	19.6 a	36.4 a	57.1 ^z	377.6	16.2 ± 3.9 b
(7) Niobrara	6/6	18/26	541	3.4 a	9.1 a	30.8 b	49.1 b	44.4 ^z	101.1	9.9 ± 2.0 b
(8) Republican	5/5	42/53	1,034	2.5 a	22.9 b	44.6 c	50.0 ^z	0.0	658.6	11.3 ± 1.4 b
(11) Loup-Elkhorn	9/11	26/41	823	2.3 a	11.2 b	30.8 c	51.0 c	63.6 ^z	125.0	8.0 ± 1.1 b
(11) Loup-Elkhorn	11/11	31/40	936	4.7 a	8.3 a	29.9 b	26.2 b	28.6 ^z	127.0	9.2 ± 1.5 b
Total	55/64	199/361	7,066	4.2	15.4	28.5	37.8	56.7	1,992.8	10.0 ± 0.8

^xNumber of counties or plots with green ash infected by *F. fraxinophilus*/number of counties or plots with green ash.

^yFor each inventory unit, values in columns 4-8 and 10 not followed by the same letter are significantly different from each other according to multiple-comparison test based on Bonferroni's probability inequality.

^zInsufficient sample size to include in multiple-comparison test.

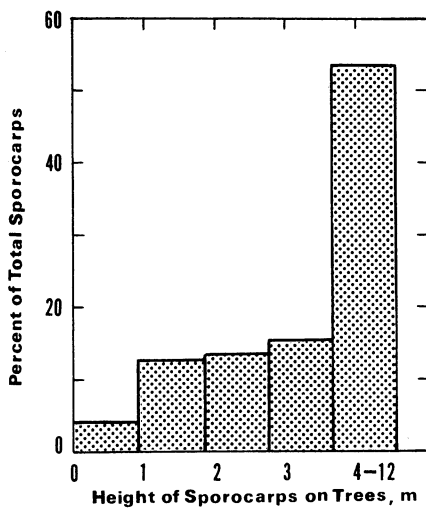


Fig. 2. Height distribution of sporocarps of *Fomes fraxinophilus* on boles and major branches of green ash in Nebraska woodlands.

More than 9,100 sporocarps of *F. fraxinophilus* were observed on live green ash trees. The average number of sporocarps per infected tree ranged from 7 in the Pine Ridge unit to nearly 16 in the Southeastern unit, and was 9 for all units combined. More than half of the sporocarps were found 3.7 m above the ground or higher (Fig. 2) on the boles or major branches of trees. Fewer than 10% of the sporocarps were within 1 m of the ground. The average percentages of sporocarps found on the boles and major branches of trees were 69.3 and 30.7, respectively. The association of sporocarps with branch stubs or wounds was not assessed because many sporocarps high above the ground could not be examined.

The number of green ash trees infected by *F. fraxinophilus* in Nebraska woodlands is estimated at nearly 2 million, or 10 ± 0.8% of the population (Table 1). Among inventory units, incidence of infected trees varied from 1.6 ± 0.3% in the Southeastern unit to 24 ± 6.1% in the Pine Ridge unit (Table 1).

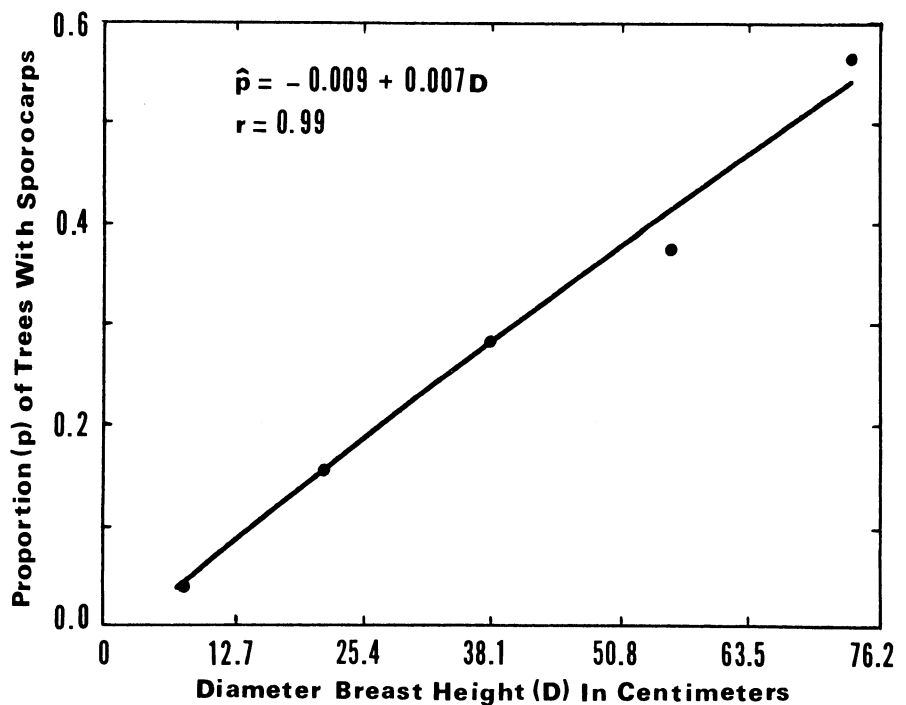


Fig. 3. Proportion of green ash trees with sporocarps of *Fomes fraxinophilus* in relation to trunk diameter 1.4 m above the ground. Scheffe's 95% confidence bands (not illustrated) are parallel to the regression line and within ±2.3% of its expected values.

Statewide incidence of infected trees progressed from 4.2% of trees in diameter class 2.5-12.6 cm to 56.7% of trees 66 cm and larger. These data approximate a straight line (incidence [\hat{p}] = -0.009 + 0.007 diameter) (Fig. 3).

DISCUSSION

F. fraxinophilus, the most common stem decay fungus on living green ash in Nebraska woodlands, was found in all survey units. An estimated 10 ± 0.8% of the 20 million living green ash trees in Nebraska woodlands are infected. This estimate is conservative because it is based on occurrence of sporocarps; it does not include infected trees that lacked sporocarps. The time interval between

infection of green ash and sporocarp development remains unknown.

A straight line best described the relationship of dbh with incidence of infection. The regression equation (Fig. 3) may be useful in predicting future levels of infection by *F. fraxinophilus* among green ash in Nebraska woodlands. A large percentage of the green ash population in Nebraska woodlands is now of small to moderate dbh (2.5-30.4 cm). When the mean dbh of this population increases to 46, 56, or 66 cm, it is expected, based on the regression relationship, that the incidence of infected trees with sporocarps of *F. fraxinophilus* will be 31, 38, and 45% respectively.

Most sporocarps of *F. fraxinophilus* were found 3.7 m or higher above the ground. Overholts (2) indicated that sporocarps of this fungus occur well above the ground on either the boles or major branches of ash and other hardwood species. In windbreaks, most sporocarps of *F. fraxinophilus* occur within 3.6 m of the ground (5). The information on numbers and locations of sporocarps may be significant in estimating decay losses if a relationship between their number or location and

decay volume is determined by a current tree-dissection study.

LITERATURE CITED

1. Miller, R. G., Jr. 1966. Simultaneous Statistical Inference. McGraw-Hill, New York. 272 pp.
2. Overholts, L. O. 1953. The Polyporaceae of the United States, Alaska and Canada. University of Michigan Press, Ann Arbor. 466 pp.
3. Peterson, G. W., and Riffle, J. W. 1976. Protection of windbreaks from diseases. Pages 172-180 in: Shelterbelts on the Great Plains. Great Plains Agric. Council. Publ. 78. 218 pp.
4. Read, R. A. 1958. The Great Plains Shelterbelt in 1954. U.S. For. Serv. Rocky Mount. For. and Range Exp. Stn. Bull. 441. 123 pp. (Great Plains Agric. Council. Publ. 16).
5. Riffle, J. W., Ostrofsky, W. D., and James, R. L. 1981. *Fomes fraxinophilus* on green ash in Nebraska windbreaks. Plant Dis. 65:667-669.
6. Ryvarden, L. 1972. Studies on the Aphyllophorales of the Canary Islands with a note on the genus *Perenniporia* Murr. Norw. J. Bot. 19:139-144.
7. Schmidt, T. L., Wardle, T. D., and Shasby, M. B. 1981. Nebraska's state and private forest resources state summary. Nebr. State For. Serv. Inst. Agric. Nat. Res. NFS 21-81. 74 pp.
8. Walla, J. A., and Riffle, J. W. 1981. *Fomes fraxinophilus* on green ash in North Dakota windbreaks. Plant Dis. 65:669-670.