

Fomes fraxinophilus on Green Ash in Nebraska Windbreaks

J. W. RIFFLE, Plant Pathologist, USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Forestry Sciences Laboratory, University of Nebraska, Lincoln 68583; W. D. OSTROFSKY, Forest Pest Specialist, Department of Forestry, Fisheries, and Wildlife, University of Nebraska; and R. L. JAMES, Plant Pathologist, USDA Forest Service, State and Private Forestry, Forest Pest Management, Lakewood, CO 80215

ABSTRACT

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Visible incidence of *Fomes fraxinophilus* stem decay on 35- to 42-year-old *Fraxinus pennsylvanica* trees in Nebraska Prairie States Forestry Project windbreaks was estimated by using a 2.8% random sample of windbreaks (clusters). A total of 55,155 living trees in 173 windbreaks in 41 counties was examined. Based on occurrence of sporocarps, infected trees were found in 40 counties and in 90% of the windbreaks. Mean incidence of infected trees was $5.5 \pm 0.4\%$ (0.95 confidence limit). A mean of six sporocarps was found per infected live tree, and more than 98% of the sporocarps were associated with branch stubs on the bole or major lateral branches within 3.6 m of the ground. About 110,000 trees of an estimated 2 million living *Fraxinus pennsylvanica* in Nebraska have sporocarps; an even greater number are infected with *F. fraxinophilus*.

Additional key words: shelterbelts, white mottled rot

From 1935 to 1942 during the Prairie States Forestry Project (PSFP), more than 217 million trees and shrubs representing 56 species were planted in 30,223 windbreak strips totaling 29,932 km. The planting area extended from the northern border of North Dakota into the Texas panhandle (13). Green ash (*Fraxinus pennsylvanica* Marsh.), the most widely distributed of all American ashes (6), was commonly used in these plantings.

Read (13) reported that green ash was one of the best medium- to slow-growing windbreak species in the Great Plains, based on survival and adaptation to harsh sites after 12 to 19 yr of growth. Average survival of green ash, based on examination of 1,046 rows in 569 windbreaks from North Dakota to northern Texas, dropped only slightly (from 85 to 77%) from 1944 to 1954. Tree heights during the same period averaged 5.8 m on all sites and ranged from 6.4 m in deep, permeable, well-drained loams to 4.0 m on shallow, sandy or silty soils underlain by claypan or gravel.

Some of the PSFP windbreak plantings

have now reached an age (36–42 yr) where tree vigor is declining and damage caused by diseases and insects is increasing (12). A cursory examination of several windbreaks in the early 1970s revealed that *Fomes fraxinophilus* (Peck) Cooke, a cause of stem decay of six ash and 14 other broadleaf species, was widely distributed on green ash throughout the central and northern Great Plains (Riffle, unpublished data).

Although *F. fraxinophilus* occurs on at least 20 tree species over a large geographical area (10,11), little information is available on its distribution, incidence, and the damage it causes to green ash in Great Plains windbreak plantings. This study was conducted from November 1977 to May 1978 to determine distribution and visible incidence of *F. fraxinophilus* on green ash in Nebraska PSFP windbreaks.

MATERIALS AND METHODS

Windbreaks totaling 6,709 km were planted in 63 Nebraska counties during the PSFP. Because many of these windbreaks have since been removed (4,7), it was necessary to determine the percentage of remaining windbreaks as a prerequisite to determining sample size. We compared original planting records with 1973–1977 high-altitude, infrared photographs of 10 Nebraska counties and found that 9–25% of the windbreaks had been removed. By applying removal estimates from these 10 counties to the remaining 53 counties in which PSFP windbreaks were planted, we determined that windbreaks totaling 5,789 km (86%) were present in Nebraska when this study was initiated.

Cluster sampling for proportions was used, whereby windbreaks were treated as clusters and all trees in each cluster were examined (3). Based on a preliminary survey that suggested a 3% incidence of trees with sporocarps, on a precision of 10% of the mean (0.95 confidence limit), and on basic windbreak resource information, we randomly selected 176 windbreaks in 41 counties from a Nebraska windbreak atlas for examination.

Within each windbreak, all living green ash trees were examined and the following information recorded: number and position in row of all trees with *F. fraxinophilus* sporocarps, diameter breast height and total height of each tree with sporocarps, and number and position of sporocarps on each tree. In addition, sporocarps and samples of

Table 1. Green ash trees infected with *Fomes fraxinophilus* by tree age in 173 Nebraska windbreaks examined November 1977–May 1978

Age (yr)	Windbreaks		Trees	
	No. examined	% with <i>F. fraxinophilus</i>	No. examined	% with <i>F. fraxinophilus</i>
35	13	100	2,913	4.2
36	23	100	5,270	4.5
37	33	97	9,479	6.2
38	26	100	8,200	5.4
39	54	78	17,983	4.4
40	13	62	3,517	4.4
41	8	100	4,454	7.8
42	3 ^a	100	3,339	11.1
35–42	173	90	55,155	5.5

^aThe low number of 42-year-old windbreaks examined reflects the fact that few plantings were made in Nebraska during the first year of the PSFP. Many of these windbreaks contained 20 rows with 2 to 6 rows of green ash.

Second author is now a graduate student at the University of New Hampshire, Durham.

Third author is now with the USDA Forest Service, State and Private Forestry, Forest Pest Management at Missoula, MT 59807.

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decayed wood were collected randomly from one or two living green ash trees in each windbreak. Isolations were made on malt agar on the collection day or within 96 hr after collection to recover the fungus. The cultures were compared macroscopically and microscopically with known cultures of *F. fraxinophilus* to verify identity of the fungus (2,8,9). Sporocarps were also identified to species.

RESULTS

F. fraxinophilus was found on living green ash trees in 40 of the 41 counties visited during windbreak examinations (Fig. 1). The fungus was not found on the 55 trees examined in Banner County. These results, as well as previous observations on distribution of the fungus, indicate that it occurs in at least 57 of the 93 counties in the state.

Based on occurrence of sporocarps, infected green ash trees were found in nearly all windbreaks examined. The mean incidence (0.95 confidence limit) was $5.5 \pm 0.4\%$ for all trees examined (Fig. 1). Some 19,069 *F. fraxinophilus* sporocarps were observed on 3,052 infected green ash trees examined in the windbreaks. Nearly all sporocarps observed (98.5%) were associated with branch stubs on the bole or major lateral branches within 3.6 m of the ground.

F. fraxinophilus was isolated from 80% of the sporocarps and decayed wood collected from living green ash trees from 156 windbreaks. Bacteria and other

fungi, principally species of *Trichoderma*, *Alternaria*, and *Penicillium*, were obtained from the remaining isolations.

Other stem decay fungi observed on the trees included *Polyporus meliae* Underw., *P. gilvus* (Schw.) Fr., *Ganoderma applanatum* (Pers. ex Wallr.) Pat., and *Irpex* sp. Very few of these fungi were found on living trees; most occurred on dead trees or on dead branches of live trees.

Although *F. fraxinophilus* was found most often in the oldest trees examined, no consistent trend emerged between incidence and tree age for the 8-yr planting period (Table 1). Similarly, no consistent trend emerged between incidence of infection and tree diameter, which varied considerably within individual windbreaks.

We observed insect damage, attributed to carpenterworms or borers, on living green ash trees in some PSFP windbreaks. This damage was extensive in windbreaks in the western region of the state but was not associated specifically with *F. fraxinophilus*-infected trees.

DISCUSSION

F. fraxinophilus was the principal stem decay fungus found on living green ash in Nebraska PSFP windbreaks. It was widely distributed, and we estimate that at least 110,000 of nearly 2 million living green ash trees in Nebraska PSFP windbreaks are infected. This estimate is based on a sporocarp incidence of 5.5%, the average number of living green ash

trees in windbreaks sampled, and the total number of PSFP windbreaks in the state.

Although the incidence of *F. fraxinophilus* on 35- to 42-year-old green ash appears low, it does not include recently infected trees that lack sporocarps. The fungus produces many sporocarps in infected green ash trees, but the time interval between infection and initial sporocarp development remains unknown. An early investigation on *F. fraxinophilus* stem decay of white ash (*Fraxinus americana* L.) indicated that sporocarp development closely follows the progress of decay (14). First sporocarps develop at branch stubs of white ash when the wood has decayed for a distance of only 10 cm on either side of the base of a branch. However, the time interval required for development of the initial sporocarp was not specified.

We have observed *F. fraxinophilus* sporocarps only on green ash trees in Nebraska, even though some hosts commonly grow adjacent to infected green ash in windbreak plantings (11). Our observations confirm those of Duff (5), who identified the fungus only from ash trees in four eastern Nebraska counties in 1924. We suggest that *F. fraxinophilus* inoculum for infection of windbreak trees originated from native green ash trees commonly found on flood plains along rivers and streams in Nebraska (1). The fungus was originally found in Nebraska along the Dismal River in Thomas County and at Anselmo

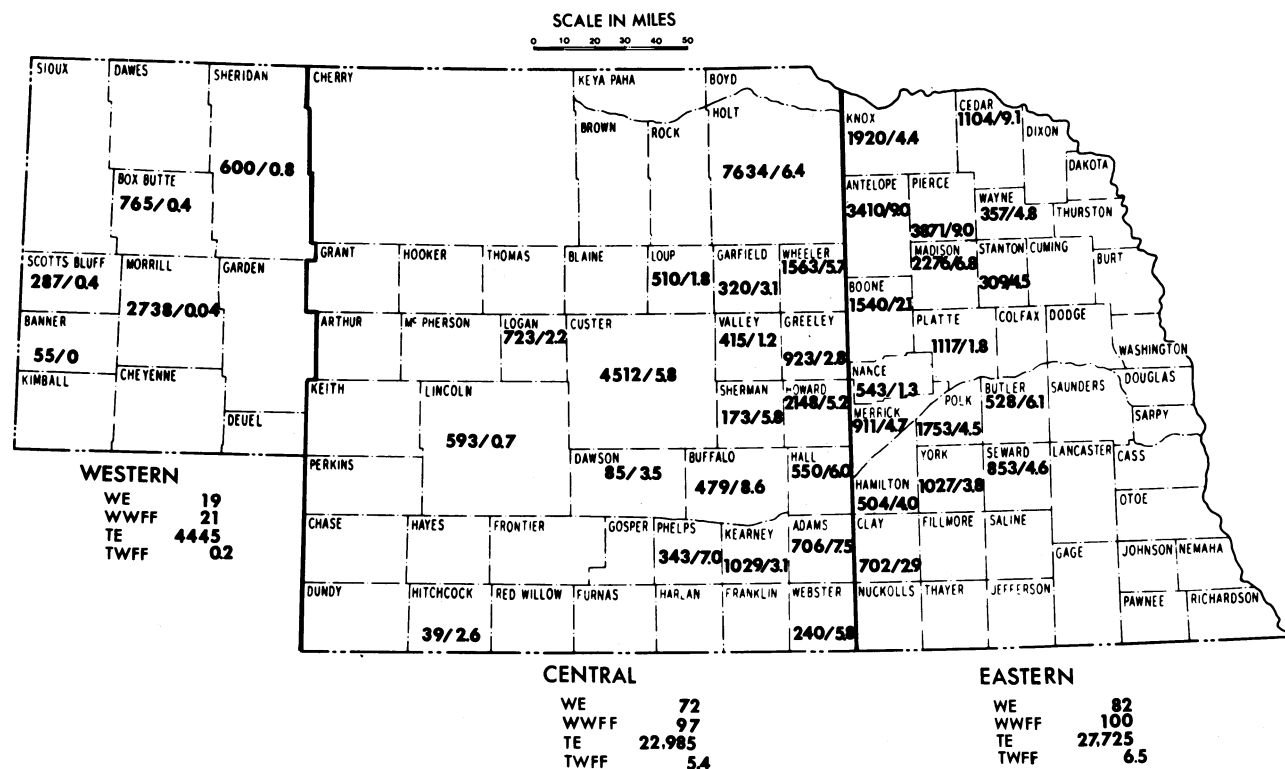


Fig. 1. Incidence in 1978 of *Fomes fraxinophilus* on green ash in windbreaks in three regions of Nebraska. Data given by county as number of trees examined/percentage of trees infected. For each region WE = number of windbreaks examined, WWFF = percentage of windbreaks with *F. fraxinophilus*, TE = number of trees examined, and TWFF = percentage of trees with *F. fraxinophilus*.

in Custer County 45 years before the PSFP was initiated (15).

Reasons for the low incidence of *F. fraxinophilus* in windbreaks and green ash trees in the western region of the state are not known. It may be related to the generally drier climate, the greater number of young trees, and the scattered distribution pattern of green ash plantings in the west. Low annual precipitation in the west (35-41 cm vs. 63-86 cm in the eastern region) may be less favorable for sporocarp development on infected trees. Sporocarps on green ash trees in the western region were very small compared with those on trees in the eastern region of the state. Further, many of the trees in western Nebraska were sprouts and may have fewer infection courts than the originally planted trees. The widely scattered distribution of green ash could also affect densities of *F. fraxinophilus* inoculum. The incidence of *F. fraxinophilus* in each region of the state was proportional to the size of windbreaks in the region.

Information about the incidence and distribution of *F. fraxinophilus* on green ash can be used to monitor future changes

in this disease in Nebraska PSFP windbreaks and will be useful in determining when management practices such as thinning, pruning, and replanting should be undertaken.

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LITERATURE CITED

1. Aikman, J. M. 1926. Distribution and structure of the forests of eastern Nebraska. Univ. Nebr. Stud. 26(1-2):1-75.
2. Campbell, W. A. 1938. The cultural characteristics of the species of *Fomes*. Bull. Torrey Bot. Club 65:31-69.
3. Cochran, W. G. 1963. Sampling techniques. John Wiley & Sons, New York. 413 pp.
4. Davis, R. M. 1976. Great Plains windbreak history; an overview. Pages 8-11 in: Shelterbelts on the Great Plains. Proc. Symp., Denver, CO, April 1976. Great Plains Agric. Council. Publ. 78. 218 pp.
5. Duff, D. 1924. The Polyporaceae and Merulieae of Nebraska exclusive of the genus *Poria*. Master's thesis. University of Nebraska, Lincoln. 113 pp.
6. Fowells, H. A. 1965. Silvics of Forest Trees of the United States. USDA For. Serv. Agric. Handb. 271. 762 pp.

7. Goldsmith, L. 1976. Action needed to discourage removal of trees that shelter cropland in the Great Plains. Pages 12-18 in: Shelterbelts on the Great Plains. Proc. Symp., Denver, CO, April 1976. Great Plains Agric. Council. Publ. 78. 218 pp.
8. Nobles, M. K. 1948. Studies in forest pathology. VI. Identification of cultures of wood-rotting fungi. Can. J. Res. 26:281-431.
9. Nobles, M. K. 1965. Identification of cultures of wood-inhabiting hymenomycetes. Can. J. Bot. 43:1097-1139.
10. Overholts, L. O. 1953. The Polyporaceae of the United States, Alaska and Canada. University of Michigan Press, Ann Arbor. 466 pp.
11. Pandila, M. M. 1965. Cultural studies of *Fomes fraxinophilus* (Peck) Cooke and *Fomes ellisianus* Anderson. Ph.D. thesis. State University of New York, College of Forestry, Syracuse. 194 pp.
12. Peterson, G. W., and Riffle, J. W. 1976. Protection of windbreaks from diseases. Pages 172-180 in: Shelterbelts on the Great Plains. Proc. Symp., Denver, CO, April 1976. Great Plains Agric. Council. Publ. 78. 218 pp.
13. Read, R. A. 1958. The Great Plains shelterbelt in 1954. U.S. For. Serv. Rocky Mount. For. Range Exp. Stn. Bull. 441. 123 pp. (Great Plains Agric. Council. Publ. 16.)
14. Von Schrenk, H. 1903. A disease of the white ash caused by *Polyporus fraxinophilus*. U.S. Dep. Agric. Plant Ind. Bull. 32:1-20.
15. Webber, H. J. 1889. A catalogue of the flora of Nebraska, Pteridophyta, Gymnosperms, Angiosperms. Pages 175-302 in: R. W. Furnas Annual Report, Nebraska State Board of Agriculture for the Year 1889. State J. Co., Printers, Lincoln. 390 pp.