Longevity of untreated wood in use above ground

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Abstract

Test crosses constructed from 12 different softwoods and 9 different hardwoods were exposed on a test fence for 9 to 12 years in both southern Mississippi and Wisconsin. Objectives of the test were to determine the aboveground longevity of these woods under varying climatic conditions and to identify the fungi associated with their deterioration. The woods tested in Mississippi were classified into aboveground decay resistance groups. The sapwood of lodgepole pine, basswood, balsam poplar, red alder, and sweetgum and the interior wood of sugar maple, yellow birch, and basswood decayed within an average of 7 years and were classified as nonresistant. Woods estimated to last over 20 years above ground, and thus classified as most resistant, included heartwood of Douglas-fir, redwood, western white pine, red and white oak, and sapwood of red oak. The remaining woods fell in between these classes. In Wisconsin most woods decayed too slowly for estimates to be made of their longevity. *Gloeophyllum saepiarium,* the white-rot fungus "Unknown T," *Schizophyllum commune,* the brown-rot fungus "Unknown U," and a *Xylaria* sp. were predominant in the Mississippi test units. *Peniophora cinerea, Phanerochaete chrysosporium, Meruliopsis corium, Irpex lacteus,* and *Peniophora violaceo-livida* predominated in Wisconsin.

Numerous field studies have dealt with durability of untreated Wood in contact with soil (4,7-10,17-19). However, information is lacking on the comparative durability of American woods in aboveground exterior use. Recently, the relative decay resistance of the sapwood of 15 different American woods was determined, in the laboratory, using a test designed to simulate aboveground conditions (3). As a result of these tests, the woods were tentatively placed into sapwood decay-resistance groups.

The present study was established to estimate, through actual field tests, the service life to be expected of these woods, also the heartwood of some, when exposed above ground in the form of cross-brace joints in high- and moderate-decay hazard locales. In addition, we wished to determine the fungi associated with the decay.

Materials and methods

Test units were constructed of boards, 1.9 by 7.62 by 15.24 cm long (3/4 by 3 by 6 in.), nailed together at their centers to form a cross (Fig. 1). The intersection of the

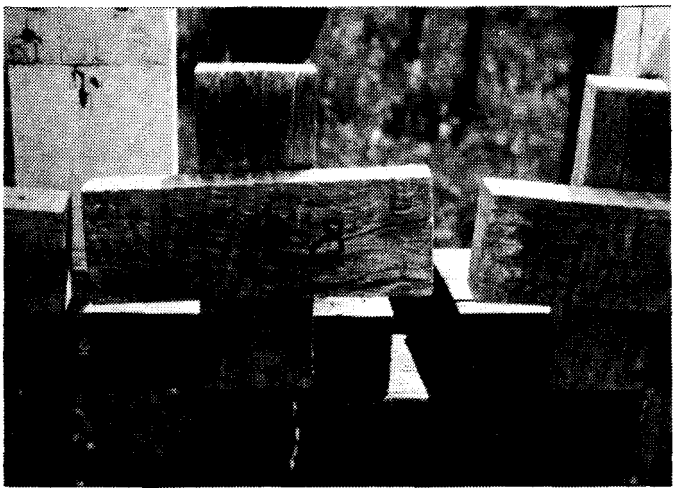

Figure 1. - Test crosses installed on fence.

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boards provided a water catchment area similar to joints where decay often originates in wood structures. Twenty units were constructed of wood from each tree species. Where both sapwood and heartwood were available from a given species an additional 20 units were constructed. Each series of units was then installed on test fences (Fig. 1) located near Gulfport, Miss., and near Madison, Wis., when sufficient number of units was available. The Gulfport climate promotes rapid decay in wood, while Madison's climate is only moderately favorable for promotion of decay (11).

The test units (crosses) were constructed from sapwood (unless otherwise noted) of the following tree species:

A. Coniferous woods

Douglas-fir - *Pseudotsuga menziesii* (Mirb.) Franco

2. Douglas-fir heartwood
3. Engelmann spruce — *Picea engelmannii* Parry
4. Engelmann spruce heartwood
5. Sitka spruce — *Picea sitchensis* (Bong.) Carr.
6. White spruce - *Picea glauca* (Moench) Voss
7. Western hemlock — *Tsuga heterophylla* (Raf.) Sarg.
8. Western redcedar — *Thuja plicata* Donn.
9. Western redcedar heartwood
10. Redwood - *Sequoia sempervirens* (D. Don) Endl.
11. Redwood heartwood
12. Lodgepole pine - *Pinus contorta* Dougl. ex Loud.
13. Lodgepole pine heartwood
14. Ponderosa pine - *Pinus ponderosa* Dougl. ex Laws.
15. Ponderosa pine heartwood
16. Western white pine – *Pinus monticola* Dougl. ex D. Don
17. Western white pine heartwood
18. Red pine – *Pinus resinosa* Ait.
19. Southern yellow pine – *Pinus* sp.

B. Hardwoods

1. Balsam poplar — *Populus balsamifera* L.
2. Basswood — *Tilia americana* L.
3. Basswood heartwood
4. Eucalyptus — *Eucalyptus* sp.
5. Eucalyptus heartwood
6. Red alder — *Alnus rubra* Bong.
7. Sugar maple – *Acer saccharum* Marsh.
8. Sugar maple interior wood — true heartwood is not formed in this species (15), hence the term "interior" wood is used
9. Sweetgum — *Liquidambar styraciflua* L.
10. Red oak – *Quercus* sp.
11. Red oak heartwood
12. White oak - *Quercus* sp.
13. White oak heartwood
14. Yellow birch interior wood - *Betula alleghaniensis* Britton — see note under 8 above.

Each summer the test units were examined for decay and fungal fruiting structures and isolations were attempted usually from two of the units within each group of tree species. In addition, units that had failed were brought back to the laboratory for dissection and intensive isolation work. Malt agar and Taylor's agar (16) were used for all isolations. Only the basidiomycetous isolates are discussed in this work. We considered separation of the cross components due to decay a failure of the unit.

All Mississippi test units were removed to the laboratory for dissection, isolation, and decay rating in 1983, because decay was generally well established in most of the units. The decay ratings were No. 1, sound; No. 2, sound-appearing but infected with a Basidiomycete or a *Xylaria* spp.; No. 3, up to 25 percent decayed; No. 4, 26 to 50 percent decayed; and No. 5, 50 + percent decayed. The remaining units in the Wisconsin test were left for an indefinite period because little failure was evident. The condition of these units was assessed externally.

Results and discussion

Longevity of test units in Mississippi

The time required for more than half of the test units of a given wood species to fail was termed the "average service life" (Table 1). In those cases in which failure of six or more units of one species occurred prior to final inspection, the average service life was readily discernible. For example, six of the southern pine units failed in 10 years, so the average service life of this pine was 10 years (Table 1). However, determination of the longevity of those wood species in which less than half of the test units had failed required extrapolation from data on related woods in this test and from the condition of the surviving units. The estimate of 20 + years service life for Douglas-fir heartwood was based upon the longevity reported by Scheffer and Eslyn (13,14) for untreated Douglas-fir cross braces and flooring boards stored above ground in Mississippi.

Based upon their determined or estimated service life, the Mississippi-stored woods were rated as to aboveground decay resistance (Table 2.) Heartwood of Douglas-fir, western white pine, redwood, white and red oak, and red oak sapwood, each with an expected average service life of at least 20 years, were classified as "most resistant." The sapwood of lodgepole pine, red alder, basswood, balsam poplar, and sweetgum and the heartwood or interior wood of basswood, yellow birch, and sugar maple, which could be expected to last 7 or fewer years, were classified as "nonresistant." The remaining woods were "moderately resistant" or "resistant" based upon expected average service lives of 8 to 13 and 14 to 19 years, respectively.

While the preceding resistance groupings may remain unaffected, the longevity spans now included within each group are likely to be determined by both board size and kind of structural joint. For example, 4-inch-thick planks of untreated Douglas-fir were estimated to have a service life of only 12 years (6), con-

TABLE 1. - *Decay evaluation and longevity of test units composed of different woods and exposed above ground in Mississippi.*

Species	Type of wood	Failed units		Condition of remaining test units			Avg. service life[b] (years)
		No.	Years in test	No.	Years in test	Category[a]	
Douglas-fir	Sap	1	10	2	11	1	16E
				7	11	2	
	Heart	0	10	10	10	1	>20E
Hemlock, western	Sap	3	10	2	11	3	11
		3	11	2	11	5	
Pine, lodgepole	Sap	1	4	2	10	5	7
		2	6				
		5	7				
	Heart	1	9	8	10	1	16E
				1	10	2	
Pine, ponderosa	Sap	3	9	1	11	5	10
		5	10				
		1	11				
	Heart	1	9	5	10	1	14E
				1	10	2	
				3	10	4	
Pine, red	Sap	1	4	2	11	5	8
		1	5				
		4	8				
		1	9				
		1	10				
Pine, southern yellow	Sap	1	9	0	—	—	10
		6	10				
		3	11				
Pine, western white	Sap	2	5	0	—	—	9
		2	7				
		4	9				
		2	10				
	Heart	0	10	9	10	1	>20E
				1	10	2	
Redwood	Sap	1	11	9	11	3	15E
	Heart	0	10	9	10	1	>20E
				1		2	
Spruce, Engelmann	Sap	2	7	8	10	3	14E
	Heart	1	9	6	10	1	14E
				2	10	2	
				1	10	3	
Spruce, Sitka	Sap	2	8	1	11	3	13E
				2	11	4	
				5	11	5	
Spruce, western white	Sap	1	5	0	—	—	10
		2	8				
		2	9				
		4	10				
		1	11				
Western redcedar	Sap	1	6	3	10	5	9
		1	7				
		5	9				
Alder, red	Sap	2	4	0	—	—	5
		5	5				
		3	6				
Basswood	Sap	3	3	0	—	—	4
		6	4				
		1	5				
	Heart	2	3	0	—	—	4
		6	4				
		2	5				
Birch, yellow	Interior	2	6	0	—	—	7
		8	7				
Eucalyptus sp.	Sap	1	5	3	11	3	10
		1	6				
		1	8				
		1	9				
		3	10				
	Heart	0	10	3	10	1	16E
				7	10	3	
Maple, sugar	Interior	1	3	0	—	—	6
		1	4				
		2	5				
		4	6				
		2	7				

Table continued on next page.

TABLE 1. — *Continued.*

Species	Type of wood	Failed units: No.	Failed units: Years in test	Condition of remaining test units: No.	Condition of remaining test units: Years in test	Condition of remaining test units: Category[a]	Avg. service life[b] (years)
Oak, red	Sap	0	10	10	10	1	>20E
	Heart	0	8	9	8	1	>20E
				1		2	
Oak, white	Heart	0	10	10	10	1	>20E
Poplar, balsam	Sap	1	5	0	—	—	7
		3	6				
		3	7				
		3	8				
Sweetgum	Sap	4	3	0	—	—	4
		6	4				

[a]Category 1 = sound; 2 = appearing sound but infected with a Basidiomycete or *Xylaria* spp.; 3 = up to 25% decayed; 4 = 26% to 50% decayed; 5 = 50 + % decayed.
[b]Time required for failure of six or more test units to occur. An E following this figure indicates the time period is estimated.

TABLE 2. - *Grouping of test woods for aboveground decay resistance and service life in a climate such as that of southern Mississippi.*

Most resistant (≥20 years)[a]	Resistant (14 to 19 years)[a]	Moderately resistant (8 to 13 years)[a]	Nonresistant (≤7 years)[a]
Douglas-fir, heart	Douglas-fir, sap	Western hemlock, sap	Lodgepole pine, sap
Western white pine, heart	Lodgepole pine, heart	Ponderosa pine, sap	Red alder, sap
Redwood, heart	Ponderosa pine, heart	Red pine, sap	Basswood, sap
Red oak, sap	Redwood, sap	Southern yellow pine, sap	Basswood, heart
Red oak, heart	Engelmann spruce, sap	Western white pine, sap	Yellow birch, interior
White oak, heart	Engelmann spruce, heart	Sitka spruce, sap	Sugar maple, interior
	Eucalyptus sp., heart	Western white spruce, sap	Balsam poplar, sap
		Western redcedar, sap	Sweetgum, sap
		Eucalyptus sp., sap	

[a]Based on years to failure of cross-brace joints in the Mississippi test.

siderably less than the 20 + life determined for the thin test crosses of the same species used in the present test. The shorter longevity of the larger units may be due to longer moisture retention, particularly if checking is involved, increasing the period during which invading fungi can grow and deteriorate the wood. Similar planks of southern pine were heavily decayed after 5 years in aboveground tests (5). Hence, longevity spans derived herein will apply only to structural components similar in cross-sectional size to the test units used in this study. Millwork and fencing components may fit into this category.

Longevity span will also be affected by variability within species. For example, Scheffer et al. (12) concluded that use of white oak will provide superior decay resistance in general, but some individual trees of this species may have only moderate resistance. Furthermore, they report variability in decay resistance with locality, tree size, and position of the wood in the tree.

Longevity of test units in Wisconsin

The average service life was determinable for only five of the woods stored in Wisconsin (Table 3). These woods, whose longevity ranged from 8 to 11 years, are sapwood of lodgepole pine, red pine, sweetgum, basswood, and basswood heartwood. All except red pine were in the nonresistant group (≤ 7 years) in the Mississippi test (Table 2). We did not attempt to estimate the longevity of the woods remaining in test in Wisconsin (Table 3) because of the few failures. These estimates will be made in the future.

Fungi associated with decay of test units in Mississippi

Over 22 species of Hymenomycetes and wood-decaying members of the *Xylariaceae* were isolated from or found fruiting on test units exposed in Mississippi (Table 4). *Gloeophyllum saepiarium,* Unknown T, *Schizophyllum commune,* Unknown U, and *Xylaria* spp. predominated, in that order. The other fungi we found were each isolated from fewer than five test units (Table 4). The hyphae of both Unknown T and Unknown U contain clamp connections and are considered to be Basidiomycetes. The positive Bavendamm reaction (1) of Unknown T indicates it is a white-rot fungus while the negative reaction of Unknown U indicates it is a brown-rot fungus.

Gloeophyllum saepiarium was found fruiting on southern pine units as early as 1 year after installation in Mississippi (Table 4), but first failure of these units did not occur until the 9th year of test (Table 1). Interestingly, at time of failure or conclusion of the test, we could not isolate *G. saepiarium* from the units on which it had fruited years earlier. Apparently this fungus, or specific strains of this fungus, were dying out or not successfully competing with other wood-inhabiting

TABLE 3. - *Decay evaluation and longevity of test units composed of different woods and exposed above ground in Wisconsin.*

Species	Type of wood	Failed units		Condition of remaining test units			Avg. service life[b] (years)
		No.	Years in test	No.	Years in test	Category[a]	
Douglas-fir	Sap	1	11	9	11	3	—
	Heart	0	10	9	10	1	—
				1	10	2	
Hemlock, western	Sap	2	9	7	11	4	—
		1	10				
Pine, lodgepole	Sap	6	9	—	—	—	9
		4	10				
	Heart	1	10	9	10	1	—
Pine, ponderosa	Heart	0	10	6	10	1	—
				1		2	
				3		3	
Pine, red	Sap	6	10	2	11	5	10
		2	11				
Pine, southern yellow	Sap	2	9	6	11	5	—
		2	11				
Pine, western white	Heart	0	10	10	10	1	—
Redwood	Sap	0	11	10	11	3	—
	Heart	0	10	10	10	1	—
Spruce, Engelmann	Sap	0	10	10	10	3	—
	Heart	0	10	9	10	1	—
Western redcedar	Sap	1	8	5	10	5	—
		2	9				
		2	10				
	Heart	0	10	10	10	1	—
Alder, red	Sap	1	9	5	11	5	—
		1	10				
		3	11				
Basswood	Sap	5	9	0	—	—	10
		5	10				
	Heart	6	8	0	—	—	8
		3	9				
		1	10				
Birch, yellow	Interior	0	8	10	8	3	—
Eucalyptus sp.	Sap	0	11	10	11	4	—
	Heart	0	10	10	10	1	—
Maple, sugar	Interior	0	8	10	8	5	—
Oak, red	Sap	0	10	10	10	1	—
	Heart	0	8	10	8	1	—
Oak, white	Heart	0	10	10	10	1	—
Poplar, balsam	Sap	1	9	9	11	3	—
Sweetgum	Sap	1	8	2	10	5	9
		6	9				
		1	10				

[a]Category 1 = sound; 2 = appearing sound but infected with a Basidiomycete or *Xylaria* spp.; 3 = up to 25% decayed; 4 = 26% to 50% decayed; 5 = 50+% decayed.
[b]Time required for failure of six or more test units to occur.

fungi in some of the test units. We also found *S. commune,* the *Peniophora* spp., *Phanerochaete sordida,* and *Corticium* 'C' fruiting on, or isolated them from, test units shortly after installation only (Table 4). These early colonizers may be poor wood decayers, e.g. *S. commune* is, and unable to compete with later, more vigorous fungal competitors.

Fungi associated with decay of test units in Wisconsin

Half the number of species of Hymenomycetes encountered in test units in Mississippi (Table 4) were found in Wisconsin (Table 5). Only *Phanerochaete chrysosporium* and *Phlebia subserialis* were found in common. In the Wisconsin test units *Peniophora cinerea, Phanerochaete chrysosporium, Meruliopsis corium, Irpex lacteus,* and *Peniophora violaceo-livida* predominated (Table 5). Surprisingly, *Gloeophyllum trabeum* most often associated with decay in aboveground building components (2), was expected to be strongly represented in these isolations but was not obtained.

Conclusions

In the aboveground test in Mississippi, the longevity of both the sapwood and heartwood of different wood species varied significantly. The variance encountered in sapwood decay susceptibility supported earlier laboratory findings (3) and, together with the heartwood test data, formed the basis for establishment of both aboveground decay resistance classes and length of service estimates for the woods in test. Unlike a decay-resistance class, however, length of service of a given wood is influenced by its cross-sectional size and by its surrounding climatic conditions. For example,

TABLE 4. - *Hymenomycetes and Xylariaceae associated with test units constructed of different woods and exposed above ground in Mississippi.*

Fungus species	Type of decay[a]	Wood species	Type of wood	No. of units from which fungus obtained	Time lapse to isolation or fruiting (years)
Antrodia albida (Fr.) Donk	BR	*Eucalyptus* sp.	Sap	1	6
A. malicola (Berk. et Curt.) Donk	BR	Basswood	Sap	1	4
		Maple, sugar	Interior	1	3
A. serialis (Fr.) Donk	BR	Basswood	Sap	1(F)	3
Corticium 'C'	WR	Maple, sugar	Interior	1	1,2,3[b]
		Maple, sugar	Interior	1	3
		Sweetgum	Sap	1	3
"Chain Chlamydospore"	BR	Pine, southern yellow	Sap	1	9
Crustoderma dryinum (Berk. et Curt.) Parm.	BR	Maple, sugar	Interior	1	4
Gloeophyllum saepiarium (Wulf.:Fr.) Karst.	BR	Douglas-fir	Sap	1(F,I)[c]	7(F)9(I)
		Douglas-fir	Sap	1(F,I)	5(F)11(I)
		Douglas-fir	Sap	1(F)	5
		Douglas-fir	Sap	2	11
		Hemlock, western	Sap	1	5
		Hemlock, western	Sap	1(F)	8
		Hemlock, western	Sap	1	9
		Hemlock, western	Sap	1	10
		Pine, lodgepole	Sap	4	2
		Pine, lodgepole	Sap	1(F,I)	3(F)4,6(I)
		Pine, lodgepole	Heart	1	4
		Pine, ponderosa	Heart	1(F)	2
		Pine, red	Sap	1	2
		Pine, southern yellow	Sap	1(F)	1
		Pine, southern yellow	Sap	3(F)	2
		Pine, southern yellow	Sap	1(F)	3
		Spruce, Engelmann	Sap	1(F)	5
		Spruce, Sitka	Sap	3	11
		Spruce, western white	Sap	1	2,5
		Spruce, western white	Sap	1	10
		Birch, yellow	Sap	1	5
		Eucalyptus sp.	Sap	1	10
Hyphoderma mutatum (Pk.) Donk	WR	Pine, lodgepole	Sap	1(F)	3
H. radula (Fr.) Donk	WR	Sweetgum	Sap	1	4
Phanerochaete crassa (Lév.) Burds.	WR	Alder, red	Sap	1(F)	2
Phanerochaete flavido-alba (Cke.) Rattan	WR	Maple, sugar	Interior	1	2
Peniophora spp. sensu stricto	WR	Pine, lodgepole	Sap	1	1
		Basswood	Heart	1	1
		Eucalyptus sp.	Heart	1(F,I)	1(F)2(I)
Phanerochaete chrysosporium Burds.	WR	Redwood	Heart	1	10
P. sordida (Karst.) Erikss, et Ryv.	WR	Pine, ponderosa	Sap	1(F)	3
		Poplar, balsam	Sap	1(F)	3
		Poplar, balsam	Sap	1	7
		Sweetgum	Sap	1(F)	2
Phlebia Brevispora Donk	WR	Pine, southern yellow	Sap	2	10
		Birch, yellow	Interior	2	7
P. subserialis (Bourd. et Galz.) Donk.	WR	Douglas-fir	Sap	1	10
Resinicium bicolor (Alb. et Schw.:Fr.) Parm.	WR	Sweetgum	Sap	1	3
		Sweetgum	Sap	1	4
Schizophyllum commune Fr.	WR	Pine, southern yellow	Sap	1(F)	2
		Basswood	Sap	1(F)	1
		Basswood	Sap	4(F)	2
		Basswood	Heart	1(F)	2
		Maple, sugar	Interior	1	1
		Poplar, balsam	Sap	1(F,I)	2(F)2(I)
Xylaria spp.	WR	Douglas-fir	Sap	1	10
		Pine, lodgepole	Sap	1	4
		Pine, lodgepole	Sap	1	6
		Pine, ponderosa	Sap	1	4
		Basswood	Sap	1	3
Unknown T	WR	Douglas-fir	Sap	2	10
		Douglas-fir	Sap	2	11
		Hemlock, western	Sap	1	10
		Pine, lodgepole	Sap	1	11
		Pine, lodgepole	Heart	1	9
		Pine, ponderosa	Sap	1	10
		Pine, southern yellow	Sap	1	10

Table continued on next page.

TABLE 4. - *Continued.*

Fungus species	Type of decay[a]	Wood species	Type of wood	No. of units from which fungus obtained	Time lapse to isolation or fruiting (years)
		Spruce, Engelmann	Heart	1	9
		Spruce, Sitka	Sap	1	11
		Redwood	Sap	1	10
		Redwood	Sap	2	11
		Western redcedar	Sap	1	9
		Basswood	Heart	1	8
		Birch, yellow	Interior	6	7
		Poplar, balsam	Sap	1	6
Unknown U	WR	Douglas-fir	Heart	1	10
		Pine, lodgepole	Sap	1	11
		Pine, red	Sap	1	6
		Pine, southern yellow	Sap	1	9
		Pine, southern yellow	Sap	2	10
		Pine, western white	Sap	1	10
		Basswood	Heart	1	5
		Poplar, balsam	Sap	1	6
Unidentified	—	Douglas-fir	Sap	1	10
		Douglas-fir	Sap	3	11
		Hemlock, western	Sap	1	11
		Pine, lodgepole	Sap	2	11
		Pine, lodgepole	Heart	1	9
		Redwood	Sap	3	11
		Spruce, Sitka	Sap	2	11
		Spruce, western white	Sap	1	10
		Alder, red	Sap	1	5
		Alder, red	Sap	1	6
		Birch, yellow	Interior	2	7
		Oak, red	Heart	1	8

[a]BR = brown-rot fungus.
WR = white-rot fungus.
[b]The presence of more than one number indicates that the fungus involved was isolated at different exposure periods from the same test unit.
[c]The fungi were isolated from the test units or, where denoted by the letter F, were found fruiting on them. The letters F and I indicate that the fungus fruited on and was isolated from the same unit.

TABLE 5. - *Hymenomycetes associated with test units constructed of different woods and exposed above ground in Wisconsin.*

Fungus species	Type of decay[a]	Wood species	Type of wood	No. of units from which fungus obtained	Time lapse to isolation or fruiting (years)
Aleurodiscus livido-coeruleus[b] (Karst.) Lemke	WR	Hemlock, western	Sap	1	9
Athelia sp.		Basswood	Heart	1	10
"Chain chlamydospore"	BR	Sweetgum	Sap	1	8
Irpex lacteus (Fr.:Fr.) Fr.	WR	Basswood	Sap	1	3,9[c]
		Basswood	Sap	1	4
		Basswood	Sap	1	10
		Basswood	Heart	1	4,5
		Maple, sugar	Interior	1	1
		Maple, sugar		1	3
Meruliopsis corium (Fr.) Ginns	WR	Basswood	Heart	2(F)[d]	5
		Basswood	Heart	1	8
		Basswood	Heart	1(F)	9
		Sweetgum	Sap	4(F)	5
Peniophora cinerea (Fr.) Cke.	WR	Douglas-fir	Sap	1	4
		Pine, southern yellow	Sap	2	3
		Pine, southern yellow	Sap	2	4
		Eucalyptus sp.	Sap	1	4
		Alder, red	Sap	1	3
		Alder, red	Sap	1	4
		Sweetgum	Sap	1	2
Peniophora violaceo-livida (Sommerf.) Mass.	WR	Sweetgum	Sap	1	8
		Sweetgum	Sap	1	9
		Maple, sugar	Interior	2	6
		Birch, yellow	Interior	1	6
Peniophora spp. sensu stricto	—	Alder, red	Sap	1	6
		Alder, red	Sap	1	9
		Maple, sugar	Heart	3	6
Phanerochaete chrysosporium Burds.	WR	Pine, lodgepole	Sap	1	9
		Pine, red	Sap	2	10

Table continued on next page.

TABLE 5. - *Continued.*

Fungus species	Type of decay[a]	Wood species	Type of wood	No. of units from which fungus obtained	Time lapse to isolation or fruiting (years)
		Basswood	Sap	3	9
		Sweetgum	Sap	2	8
		Oak, red	Sap	1	10
Phlebia subserialis (Bourd. et Galz.) Donk	WR	Sweetgum	Sap	1	9
Unknown	—	Douglas-fir	Sap	1	10
		Pine, lodgepole	Sap	1	3
		Pine, lodgepole	Sap	3	9
		Pine, lodgepole	Sap	1	10
		Pine, ponderosa	Heart	1	8
		Pine, southern yellow	Sap	1	9
		Pine, southern yellow	Sap	2	11
		Recedar, western	Sap	1	10
		Basswood	Sap	3	8
		Basswood	Heart	4	8
		Maple, sugar	Interior	1	8
		Sweetgum	Sap	1	5
		Sweetgum	Sap	1	10

[a]BR = brown-rot fungus.
WR = white-rot fungus.
[b]Based on oxidase test.
[c]The presence of more than one number indicates that the fungus involved was isolated more than once from the same test unit.
[d]The fungi were isolated from the test units or, where denoted by the letter F, were found fruiting on them.

large wood pieces subject to extensive splitting, and thus to increased water retention, may fail sooner than thinner pieces in aboveground use. Also, wood in test in northern, moderate-decay hazard climates (11) may be expected to outlast similar wood installed in southern, high-decay hazard zones. This has proven true in the present test where far fewer wood failures occurred in Wisconsin than in Mississippi; the paucity of failures in the former prevents the assemblage of wood species into service life groupings for that area.

Climate appeared to exert great influence upon the fungi associated with test units in Mississippi and Wisconsin as only 2 of the more than 23 Basidiomycetes identified in this study were obtained from both areas.

Literature cited

1. Davidson, R.W., W.A. Campbell, and D.J. Blaisdell. 1938. Differentiation of wood-decaying fungi by their reactions on gallic or tannic acid medium. J. Agric. Res. (U.S.) 57:683-695.
2. Duncan, C.G., and F.F. Lombard. 1965. Fungi associated with principal decays in wood products in the United States. USDA Forest Serv. Res. Pap. WO-4, 33 pp.
3. Eslyn, W.E., and T.L. Highley. 1976. Decay resistance and susceptibility of sapwood of fifteen tree species. Phytopathology 66:1010-1017.
4. Gjovik, L.R., and H.L. Davidson. 1975. Service records on treated and untreated fenceposts. USDA Forest Serv. Res. Note FPL-068. 45 pp. Forest Prod. Lab., Madison, Wis.
5. Highley, T.L., and T.C. Scheffer. 1975. In-place treatments of simulated waterfront structures for decay control. Mater. und Org. 10:57-66.
6. _____ and _____. 1978. Controlling decay in above-water parts of waterfront structures. Forest Prod. J. 28(2):40-43.
7. Krzyzewski, J., and B.G. Spicer. 1974. 34 years of field testing of fence posts—results of final inspection. Can. Dept. Forestry, East. Forest Prod. Lab. Rept. OPX95E, 17 pp.
8. Meagher, G. 1951. Service record of wood posts in the southwest—a progress report. USDA Forest Serv., SW Forest and Range Expt. Sta. Res. Note 120, 6 pp.
9. Miller, D.J., and R.D. Graham. 1977. Service life of treated and untreated fence posts—1976 progress report on the post farm. Oregon State Univ. Res. Pap. 37, 18 pp., Corvallis, Oreg.
10. Purslow, D.F. 1976. Results of field tests on the natural durability of timber (1932-1975). Princes Risborough Lab., Bldg. Res. Estab. Current Pap. 6/76, 17 pp.
11. Scheffer, T.C. 1971. A climate index for estimating potential for decay in wood structures above ground. Forest Prod. J. 21(10):25-31.
12. _____, G.H. Englerth, and C.G. Duncan. 1949. Decay resistance of seven native oaks. J. of Agric. Res. 78(5&6):129-152.
13. _____ and W.E. Eslyn. 1982. Twenty-year test of onsite preservative treatments to control decay in exterior wood of buildings. Mater. und Org. 17:181-198.
14. _____ and _____. 1978. Residual pentachlorophenol still limits decay in woodwork 22 years after dip-treating. Forest Prod. J. 28(1):25-30.
15. Shigo, A.L. 1967. The early stages of discoloration and decay in living hardwoods in northeastern United States: a consideration of wound-initiated discoloration and heartwood. XIV IUFRO Congress, International Union of Forestry Research Organizations, Vol. IX, Section 41, pp. 117-133, Munich, Germany.
16. Taylor, J.B. 1971. A selective medium for the isolation of Basidiomycetes from diseased roots, mycorrhizas, and soil. Trans. Br. Mycol. Soc. 56:313-314.
17. Westbrook, R.F. 1973. State-wide service test of fence posts. Twenty-four-year progress report. Texas Forest Serv. Publ. 110.
18. White, W.E. 1954. Comparative durability of posts from trees grown in Pennsylvania woodlands. Pennsylvania State Univ. Agric. Expt. Sta. Prog. Rept. 123, 6 pp.
19. Whitney, C.U. 1946. Results to date of studies of the durability of native woods treated and untreated. USDA Forest Serv., North. Rocky Mt. Forest and Range Expt. Sta. Pap. 5, 54 pp.