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A NEW SPECIES, *PHLEBIA BREVISPORA*, A CAUSE OF INTERNAL DECAY IN UTILITY POLES

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SUMMARY

A new species, *Phlebia brevispora* (Corticaceae, Aphyllophordles), is proposed for the fungus previously identified on the basis of cultural traits only as *Peniophora* A. Basidiocarp and culture descriptions of the fungus are provided. The fungus causes a white rot, and is shown, by soil-block testing, to be capable of causing substantial decay in southern pine wood. This capability, coupled with its past isolation from internally decayed utility poles and posts, shows *P. brevispora* to be important in the decay of these structures.

The Hymenomycetes associated with decay of wood products within various geographic regions of North America were reported by Duncan and Lombard (1965) and by Esllyn (1970). On the basis of their frequency of isolation, *Lentinus lepideus* Fr. and a second fungus designated as *Peniophora* A (Esllyn, 1970), appeared to be of major importance in the decay of pine poles in southeastern United States. Cultures of *Peniophora* A did not have the combination of characters present in the species included in Davidson *et al.* (1942),

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Nobles (1948, 1965) or Stalpers (1978). They were believed, however, by the late Dr. H. H. McKay, Forest Disease Laboratory, Laurel, Maryland, to represent a species of *Peniophora* and were given the name *Peniophora* A. Because of its probable involvement in pine pole decay, it was important to know the identity of this fungus.

Cultures of *Peniophora* A were subsequently compared with those obtained by Dr. H. H. Burdsall, Jr., Forest Products Laboratory, from basidiocarps of an unknown fungus collected on slash pine in southern Florida. Based on cultural studies and on dikaryotic-monokaryotic pairings, the two fungi were identical. Studies of the basidiocarps showed them to represent an undescribed species of *Phlebia*. Basidiocarp and cultural descriptions of this new species are provided. The wood-decay capabilities of the fungus are also evaluated.

MATERIALS AND METHODS

Microscopic examination of basidiocarps was made from freehand sections mounted in 2% KOH and 1% aqueous phloxine. Other sections were mounted in Melzer's reagent and lactophenol with cotton blue (Ainsworth, 1971). Capitalized color names are from Ridgway (1912). Specimens and cultures are deposited at the Center for Forest Mycology Research (CFMR), Madison, Wisconsin. Common and scientific names of plant hosts are from Little (1979). Cultures were grown on 1.5% malt extract agar (MEA) at 25 C and checked at weekly intervals. Gallic acid agar (GAA) and tannic acid agar (TAA) were used as described by Davidson *et al.* (1938). Gum guaiac solution was applied as specified by Nobles (1959). Key patterns are based on the system of Davidson *et al.* (1942), whereas the species code is from Nobles (1965).

To test decay capability, sapwood blocks, each $3.17 \times 2.68 \times 0.48$ cm (with the 0.48 cm in the grain direction), were cut from southern yellow pine (*Pinus* sp.). The blocks were conditioned at 27 C and 70% RH, weighed, then steamed for 20 min. They were subjected to the standard soil-block method of testing decay resistance of wood (American Society for Testing and Materials, D-2017-71, 1980) except the incubation period was decreased from 12 to 7 wk. At the end of the incubation period the blocks were reconditioned, reweighed, and their weight losses calculated. The amount of weight loss attributed to a given isolate provided a measure of its decay capability. Five isolates of *Phlebia brevispora*, all of which were obtained from utility poles,

were tested. The standard wood-decay test fungus, *Poria placenta* (Fr.) Cke. (Mad-698), was included in the test as a reference.

DESCRIPTION OF SPECIES

Phlebia brevispora Nakas., sp. nov.

FIGS. 1, 2

Similiter a *Phlebia subserialis* et *Hyphoderma ludoviciana* sed differt cum cystidiis cylindraceis, attenuatis, glabratibus, $65-75 \times 5-6.5 \mu\text{m}$; basidiosporis $4-4.5 \times 2-2.5 \mu\text{m}$, ellipsoideis, glabratibus. In culture conidiis globosis, hyalinis, conidiophoris fibulatis.

Holotypus: in ligno *Pinus elliottii* Engelm. var. *densa* Little et Dorman (south Florida slash pine), Long Pine Key, Everglades National Park, Dade County, Florida, leg. H. H. Burdsall, Jr., No. 7090, August 8, 1972; in herbarium CFMR.

Etymology: From *brevis* (L., adj.) = short + *spora* (L., n.) = spore, to describe the short basidiospores.

Basidiocarp resupinate, effused, up to $10 \times 4.5 \text{ cm}$, adnate, tuberculate, tubercles $200-350 \mu\text{m}$ high, but smooth near margins, cracking when dried, when fresh membranous to waxy, Light Drab to Light Brownish Olive with the warts lighter in color, darkening to Deep Olive Buff, Buffy Brown, or Snuff Brown when dry, ceraceous; margin very narrow, white. *Subiculum* compact and agglutinated, usually collapsed when dried, $70-110 \mu\text{m}$ thick; subicular hyphae distinct in margin, $5-10 \mu\text{m}$ diam, hyaline, with gelatinized walls, $3-4 \mu\text{m}$ thick, nodose septate with scattered simple septa. *Hymenium* thickening, $10-20 \mu\text{m}$ thick; *cystidia* arising from subhymenium, at first clavate, often with an apical protuberance, $23-40 \times 8-11 \mu\text{m}$, thin-walled, with a basal clamp, covered with a thick layer of resinous material, then elongating into a matured structure, obclavate, $65-75 \times 5-6.5 \mu\text{m}$, protruding about $40 \mu\text{m}$. hyaline, thin-walled, smooth or lightly encrusted with resinous material, abundant on tubercles; *basidia* clavate, $16-23 \times 4-5 \mu\text{m}$, thin-walled, with a basal clamp, 4-sterigmate, sterigmata $3-4 \mu\text{m}$ long; *basidiospores* ellipsoid to short cylindrical, adaxially flattened, $4-4.5 \times 2-2.5 \mu\text{m}$, hyaline, smooth, acyanophilous, negative in Melzer's reagent.

Specimens examined. — HHB-7018, HHB-7030 (holotype), and HHB-7099, on south Florida slash pine, Everglades National Park, Dade County, Florida.

Remarks — *Phlebia brevispora* is associated with a white rot of conifer and hardwood slash. It is similar to *Phlebia subserialis* (Bourd. et Galz.) Donk and *Hyphoderma ludovicianum* (Burt) K. J. Martin et Gilbn. However, the short, cylindrical spores of *P. brevispora*, always

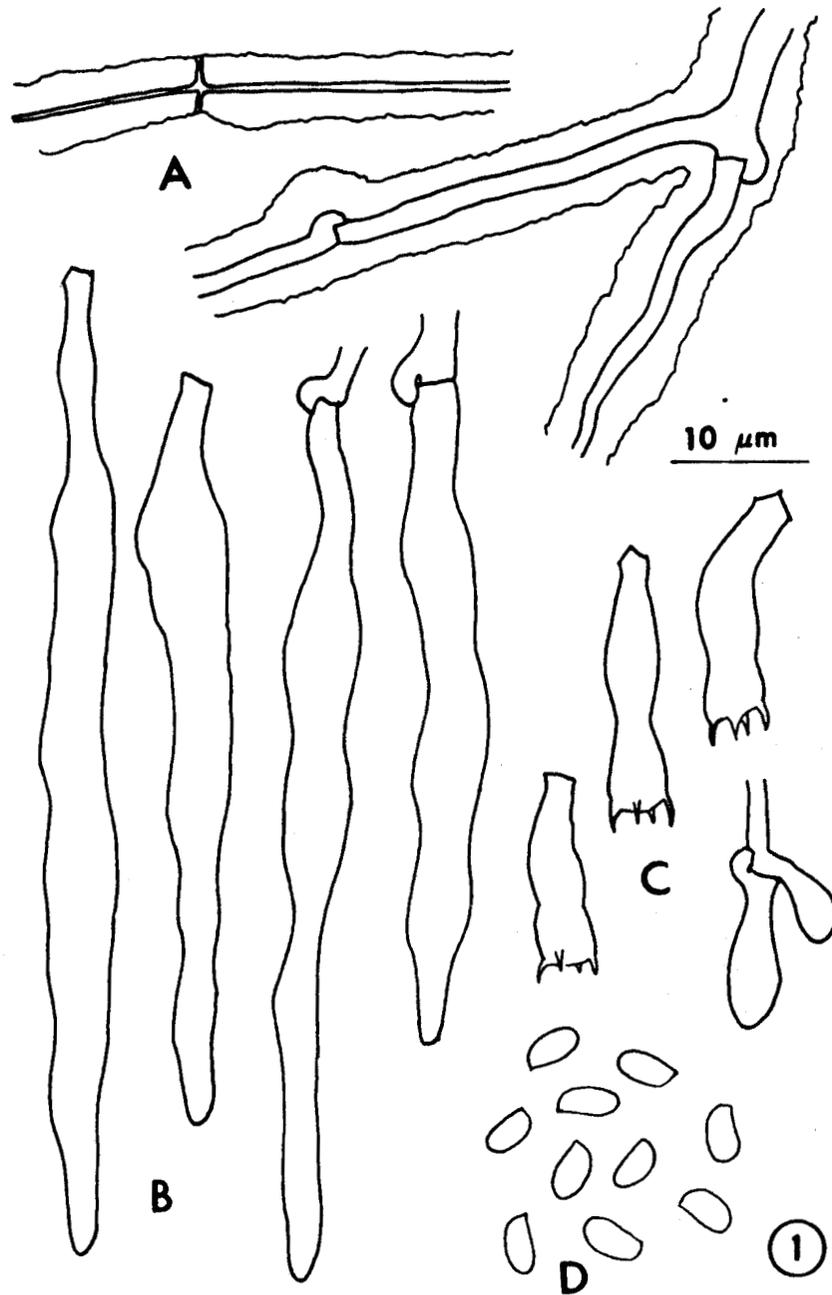


FIG. 1. *Phlebia brevispora* (HHB 7030) basidiocarp characters: A, subicular hyphae; B, cystidia; C, basidia; D, basidiospores.

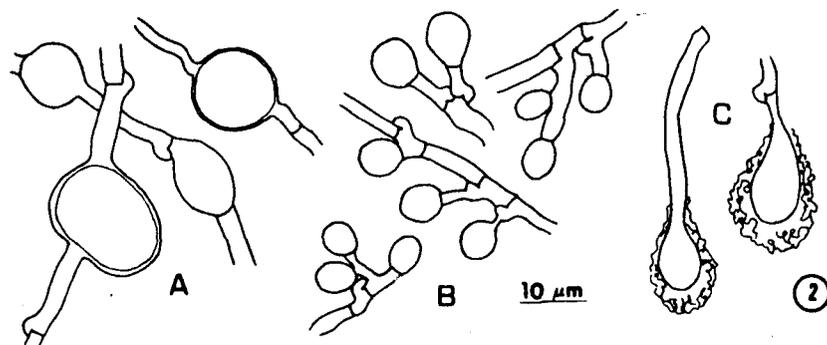


FIG. 2. *Phlebia brevispora* (HHB 7030) 2-wk-old culture characters: A, chlamydospores; B, holoblastic conidia; C, vesicles.

less than 5 μm long, distinguish it from *P. subserialis*, with allantoid spores (5–7 \times 1.5–2 μm), and *H. ludovicianum*, with larger spores (5.5–6.5 \times 2–2.5 μm) (Nakasone *et al.*, 1981). *Hyphoderma ludovicianum* also possesses well-developed encrusted cystidia. *Phlebia brevispora* is known only from the southeastern United States. Both *P. subserialis* and *H. ludovicianum* are found throughout North America.

The development of cystidia from a short, clavate structure to a mature, elongated one is best observed in the marginal zone of specimen HHB 7099 or of fruiting patches developing in spore culture. The immature cystidium, called vesicle in culture description, develops a small, blunt, apical protuberance which enlarges; and the entire structure gradually elongates. Initially heavily encrusted with resinous material, the cystidium is smooth or only lightly encrusted at maturity.

DESCRIPTION OF CULTURES

Cultural characters. —Growth on MEA rapid, plates covered in 1 wk; at 2 wk inoculum usually light brown, mats white, appressed, sub-felty, sometimes woolly, often powdery or mealy; at 5 wk mats unchanged but with scattered Ivory Yellow, Deep Colonial Buff, Cham-
 ois, or Olive Brown fruiting areas, especially around plate edges; margin even, indistinct, appressed; odor none; reverse bleached by 2 wk. Oxidase reactions at 1 wk on GAA moderate, mat 68–90 mm diam, on tannic acid agar reactions strong, mat 31–38 mm diam. Reaction with gum guaiac milky or rarely Capri Blue in 3 min.

Microscopic characters.—Hyphae from advancing zone 7–11.5 μ m diam, simple-septate, thin-walled or walls up to 3.5 μ m thick, later giving rise to smaller, nodose septate hyphae. Submerged and aerial hyphae 3–4.5 μ m diam, thin-walled, with clamp connections, branched. Chlamydospores abundant at 2 wk, intercalary, globose to subglobose, 11–17 \times 13–22 μ m, walls up to 1 μ m thick, hyaline; holoblastic conidia abundant to scattered at 2 to 3 wk, terminal, globose to subglobose, 6–9 \times 7–9 μ m, hyaline, thin-walled; vesicles rare to abundant at 2 wk, 9–10 μ m diam, clamped at base, hyaline, thin-walled, usually densely covered with resinous material that dissolves in 2% KOH; heavily encrusted hyphae from aerial mat scattered at 2 wk. Fruiting areas composed of basidia, cystidia, and basidiospores as found in basidiocarps.

Incompatibility system.—Seven single spore isolates of HHB-7030 lacking clamp connections were paired in all combinations. After 7 da the pairings were examined and two mating types were obtained. Mating type A₁ was represented by isolates numbers 1, 6, and 13 and mating type A₂ by numbers 8, 14, 19, and 20. *Phlebia brevispora* appears heterothallic and bipolar.

Interfertility studies.—Two monosporous isolates lacking clamp connections of ME 425, numbers 1 and 3, were mated with 17 dikaryon isolates of *P. brevispora* listed below. After 2 wk the monosporous isolates were examined for clamp connections. All matings resulted in clamp formation indicating that all the isolates were conspecific.

Key patterns: A-P-F-1-2-3-10-14-16; A-P-F-1-2-10-16; A-P-F-1-2-10:
A-P-F-1-2-10-14.

Speciescode:2.4.(13).21.33.34.36.40.41.48.54.55.59.

Temperature relationship: Five isolates were incubated at eight temperatures, and their radial growth rates were measured after 4 da. Average growth rates are given: 16 C, 6 mm; 20 C, 21 mm; 24 C, 41 mm; 28 C, 56 mm; 32 C, 67 mm; 36 C, 64 mm; 40 C, 10 mm; 44 C, 1 mm. Optimum temperature 32 C to 36 C.

Cultures examined: Florida: HHB-7018, HHB-7030, and HHB-7099, polysporous isolates from specimens cited; Illinois: CS66-106-B-A on *Quercus* sp.; Louisiana: MD-192 and MD-193 on southern yellow pine telephone poles; Maryland: ME-128 and ME-131 on southern yellow pine telephone poles; Mississippi: Mad 4703 on southern yellow pine posts, MD-245 and MD-247 on *Pinus resinosa* Ait. (red pine) posts, ERT-72-R on *Quercus nuttallii* Palmer, ERT-637 on *Quercus lyrata* Walt.; Oklahoma: ME-134 on *Pseudotsuga menziesii* (Mirb.)

Franco (Douglas-fir) telephone pole; Virginia: ME-422, ME-425, and ME-430 on southern yellow pine telephone poles.

Remarks.— In addition to producing vesicles in culture, *P. brevispora* possesses holoblastic conidia and chlamydospores. This combination of characters distinguishes *P. brevispora* from similar species of *Phlebia* in culture.

DECAY CAPABILITY

Data on weight losses incurred in southern pine wood blocks from decay by utility pole isolates of *P. brevispora* are listed in TABLE I. Average weight loss varied from 15 to 24% for the individual isolates following a 7-wk exposure of test blocks to fungal decay. Overall average weight loss for the five isolates was 19%. In comparison the average weight loss determined for the reference fungus, *Poria placenta* (MAD-698), was 49%.

DISCUSSION

Poria placenta causes more overall weight loss in decay susceptible wood than eight major wood products decay fungi tested (Eslin and Highley, 1976). All isolates of *P. brevispora* decayed pine wood in pure culture. Their rate of decay in terms of wood weight loss was about 40% of the weight loss produced by *Poria placenta*. Thus, the decay capability of *P. brevispora* can be judged substantial.

TABLE I
WEIGHT LOSSES CAUSED BY *Phlebia brevispora* IN
SOUTHERN PINE SAPWOOD AFTER 7-WK INCUBATION

Fungus	Isolates	Weight loss ^a
<i>P. brevispora</i>	ME-131	20
	ME-134	15
	ME-422	22
	ME-425	24
	ME-430	16
	Average	19
<i>Poria placenta</i>	Mad-698	49

^a Each figure is average of four replicates.

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