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REDISPOSITION OF RADULUM CONCENTRICUM (APHYLLOPHORALES, CORTICIACEAE)

BRADLEY R. KROPP
Département des Sciences Forestières
Faculté de Foresterie et Géodésie
Université Laval, Cité Universitaire
Québec, Canada G1K 7P4

KAREN K. NAKASONE
Center for Forest Mycology Research
Forest Products Laboratory*, P.O. Box 5130
Forest Service, U.S.D.A.
Madison, Wisconsin 53705

SUMMARY

Radulum concentricum, known from British Columbia, Washington, Oregon, California and Montana, is described and illustrated. The new combination Phlebia concentrica is proposed.

During the past several years, three specimens of Radulum concentricum Cooke et Ellis were collected from decayed deciduous wood in western Oregon. Cultures obtained from these specimens were similar to unidentified cultures isolated from decayed, air-seasoned Douglas-fir (Pseudotsuga mensiesii (Mirb.) Franco) utility poles. Monokaryotic isolates obtained from fructifications produced by fungal isolates from utility poles were compatible with those from the Oregon specimens and therefore conspecific. Our studies of the basidiocarps and cultures of R. concentricum and its potential role in wood products pathology, prompted us to re-evaluate its taxonomic position. We propose the transfer of R. concentricum to Phlebia. We also include a description and illustration of Phlebia concentrica.

*Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

MATERIALS AND METHODS

The microscopic characteristics of the basidiocarps were examined by mounting sections in 5 percent KOH and 1 percent aqueous phloxine B. Additionally, a drop of 2 percent KOH was applied to basidiocarps and any color change noted. All color designations are taken from Ridgway (1912).

Cultural studies followed the methods described by Stalpers (1978) and Nobles (1948, 1965). Isolates were grown for 2 weeks on 2 percent malt extract agar (MEA), 0.5 percent gallic acid agar (GAA) and 0.5 percent tannic acid agar (TAA) in the dark at 25°C. The mycelia at the margin and center of the colonies were examined at 7 and 14 days. The production of extracellular phenoloxidases was determined by a pale purple reaction of the colonies with alpha-naphthol (Stalpers, 1978) and by a brown diffusion zone around colonies growing on GAA and TAA (Davidson *et al*., 1938).

Dikaryotic cultures were obtained by tissue explants from basidiocarps and by streaking basidiospores onto MEA plates. Monokaryotic cultures were obtained by streaking a spore suspension onto MEA plates and isolating clampless colonies. To determine the mating system, 7 monokaryons were paired in all possible combinations. Compatible matings were scored by the presence of clamp connections. Sexual compatibility between different specimens was determined by pairing monokaryons from each.

RESULTS

Phlebia concentrica (Cooke et Ellis) Kropp et Nakas., *comb. nov*.

Basionym: *Radulum concentricum* Cooke et Ellis, Grevillea 14:13. 1885.

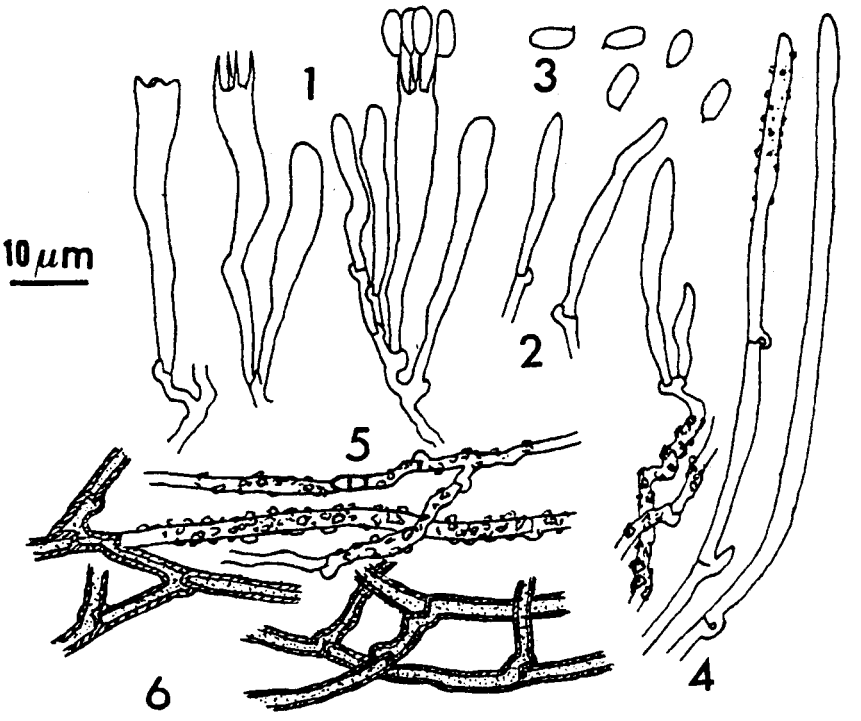
= *Irpex owensii* C. G. Lloyd, Mycol. Writ. 5, Mycol. Notes p. 616. 1916.

≡ *Radulum owensii* (C. G. Lloyd) C. G. Lloyd, Mycol. Writ. 5, The genus *Radulum* p. 10. 1917.

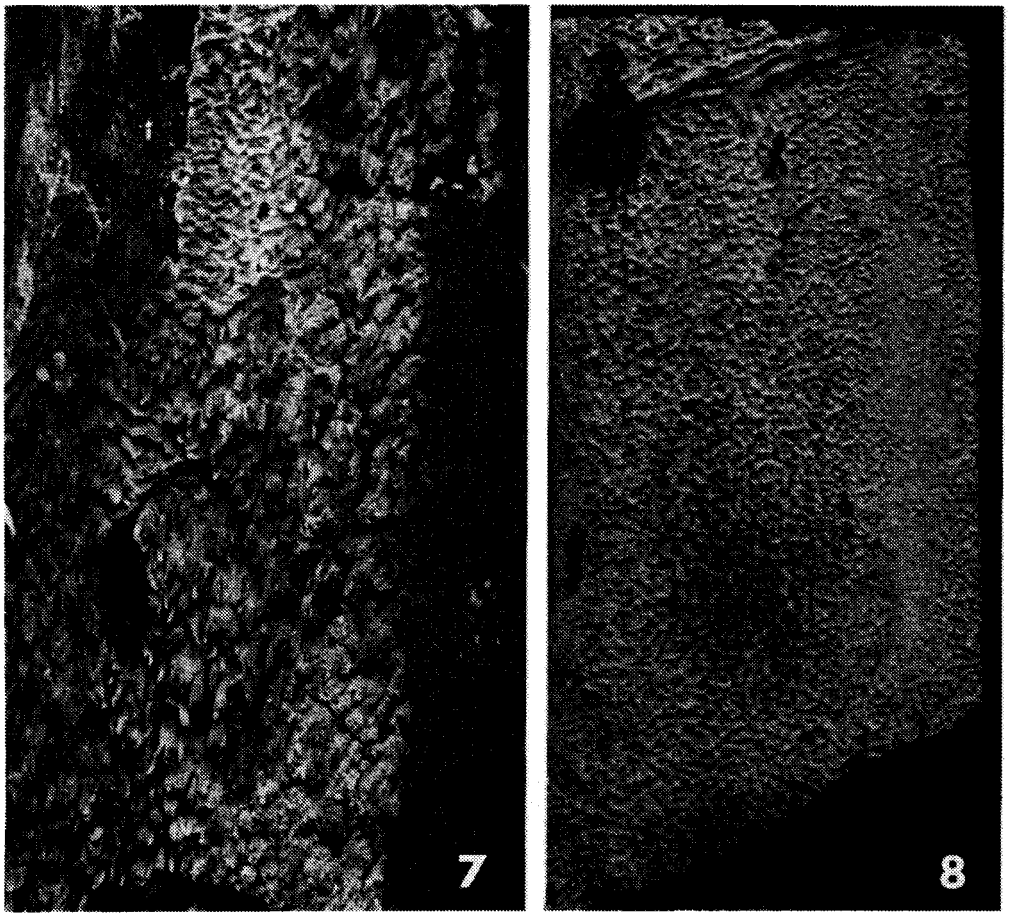
Basidiocarps annual, adnate, effuse up to 10 x 5 cm, up to 750 µm thick not including teeth; hymenophore odontoid, or merulioid (Figs. 7, 8), Ochraceous-Orange with

Warm Buff to Antimony Yellow margins, fresh specimens, bright red then black in 2 percent KOH, dried herbarium specimens Onionskin Pink to Fawn Color, darkening to Verona Brown or Chestnut-Brown, margins concolorous or Buff-Pink, black in 2 percent KOH; teeth up to 3 mm long, terete, conical to flattened, single or confluent at base, soft, smooth, apices rounded, entire; margins distinct, abrupt, smooth, occasionally with a few, small teeth, sterile or fertile; subiculum and central trama of teeth dark brown.

Hyphal system monomitic. Subiculum up to 600 µm thick, composed of densely interwoven hyphae; subicular hyphae (Fig. 6) 3-4.5 µm diam, walls dark yellowish brown, slightly thick to thick-walled, nodose-septate, frequently branched, continuous with tooth trama; subhymenium up to 100 µm thick, dense, composed of vertically arranged hyphae;



Figs. 1-6. Microscopic characters of Phlebia concentrica (OSC # 41,587). (1) mature and developing basidia; (2) cystidioles; (3) basidiospores; (4) projecting hyphal ends; (5) subhymenial hyphae; (6) brown, thick-walled subicular hyphae.



Figs. 7-8. Basidiocarps of Phlebia concentrica (approx. 2X). (7) OSC # 41,588; (8) OSC # 41,589.

subhymenial hyphae (Fig. 5) 2.5-3.5 µm diam, hyaline, thin-walled, nodose-septate, moderately branched, encrusted with yellow, resinous material; hyphal ends projecting from tooth apex present in some specimens (Fig. 4) 2.5-4 µm diam, hyaline, thin-walled, nodose-septate at base, lightly encrusted; cystidioles (Fig. 2) hyphoid, 20-33.5 x 2.5-3.5 µm, hyaline, thin-walled, nodose-septate at base, embedded, abundant to rare; basidia (Fig. 1) narrowly clavate, 27-45(-50) x 5-6 µm, hyaline, thin-walled, nodose-septate at base, 4-sterigmate, coated with yellow, resinous material; basidiospores (Fig. 3) ellipsoid to subcylindrical, (5-)6-7.5(-10) x 2.5-3.5 µm, hyaline, thin-walled, smooth, non-amyloid.

Specimens examined: OREGON-Benton County: OSC # 41,588, coll. G. Nielson, MacDonald State Forest, Oak Creek Drainage; OSC # 41,589, coll. B. Kropp, MacDonald State Forest, Soap Creek Drainage; OSC # 41,587, coll. B. Kropp, Woods Creek Road. Curray County: J. L. Lowe 10540, Gold Beach; FP 133211 and FP 133258, coll. M. J. Larsen, Siskiyou Nat. Forest, Winchuk Campground; FP 133272, coll. M. J. Larsen, Siskiyou Nat. Forest, Wheeler Creek.

Cultural description: Growth rapid, >70 mm radius in 7 da on MEA; colonies white, thin to moderately thin, appressed, subfelty to arachnoid; margins even to slightly bayed, appressed; no reverse discoloration or partially bleached at 14 da, bleached and/or Buckthorn Brown at 6 wk; oxidase reactions negative with alpha-napthol at 7 da, but weakly positive at 14 da; on TAA negative or stain, growth 0-17 mm diam at 7 da, 0-26 mm diam at 14 da; on GAA negative, growth variable, 8-12 mm or 68-90 mm diam at 7 da, 20-36 mm or 90 mm diam at 14 da, colony appressed, hyaline, with a dense submerged mat and irregular margins.

Hyphae of advancing zone 2.5-6 (-7.5) µm diam, thin-walled, simple-septate, sparingly branched, clamps forming 20-25 mm behind the margin. Submerged, surface and aerial hyphae 1.5-6 µm diam, thin-walled, nodose-septate, frequently branched, surface and aerial hyphae coated with a thin, sparse layer or crystalline or resinous material that dissolves in 2 percent KOH. Chlamydospores globose, 10-25 (-58) µm diam, hyaline, slightly thick-walled, thallic, intercalary, or terminal, numerous in surface mat, but rare in submerged mat at 2 and 6 wk. Cultures studied: OSC # 41587, OSC # 41588, and OSC # 41589. Incompatibility system: Seven single-spored isolates from OSC # 41587 were paired in all combinations. Two mating types were identified: A_1 = 1,2,3,4,7 A_2 = 5,6. Thus, P. concentrica is heterothallic and bipolar.

DISCUSSION

Phlebia concentrica is known from British Columbia, Washington, Oregon, California and Montana. It causes a white-rot decay of conifer and hardwood slash. Recently, monokaryotic cultures were isolated from non-treated, air-seasoned Douglas-fir utility poles. This suggests that

basidiospores of P. concentrica become airborne and colonize exposed wood surfaces.

For a description of the type specimens of Irpex owensii and Radulum concentricum see Gilbertson (1963 and 1964, respectively). Perhaps the most striking feature of this species is the dark brown hyphae found in the subiculum and tooth trama. The texture of P. concentrica is soft unlike most other Phlebia species which are ceraceous to corneous.

Phlebia concentrica is most similar to Phlebia centrifuga Karst. Both species produce brown subicular hyphae. In P. concentrica the subiculum and tooth trama consists of brown subicular hyphae while in P. centrifuga only a few subicular hyphae next to the substrate are brown. Both species have narrowly clavate basidia, ellipsoid to subcylindrical basidiospores, and encrustations on the subhymenial hyphae. Whereas the hymenophore of P. centrifuga is papillose to wrinkled and the subicular hyphae are arranged parallel to the substrate, P. concentrica has well developed teeth and the subicular hyphae form a dense, interwoven tissue.

Cultures of Phlebia concentrica are most similar to those of P. subserialis (Bourd. et Galz.) Donk (Nakasone et al., 1982). Both species grow rapidly on MEA, are weakly positive on GAA, grow faster on GAA than TAA, lack clamps in the marginal hyphae, and develop chlamydospores. The differences in culture are subtle. The aerial and surface hyphae of P. concentrica are thinly coated with resinous or crystalline material that dissolves in 2 percent KOH; P. subserialis lacks this character. Phlebia subserialis develops thick-walled hyphae which are absent in P. concentrica.

Phlebia concentrica has characters typical of both Phlebia and Mycoacia. These genera are similar parcicularly with regard to microscopic characters. Mycoacia species typically are hydnaceous, pale yellow in young specimens, and turn red in 2% KOH. But some species of Phlebia are ochraceous to yellow, and at least two (Phlebia centrifuga and P. chrysocrea (Berk. et Curtis in Berk.) Burds. in Lombard, Burds. et Gilbn.) turn red in KOH. The hymenophore of Phlebia species ranges from smooth to odontoid or meruloid. Phlebia queletii (Bourd. et Galz.) M. P. Chris., for example, is odontoid and ranges in color from white to

yellow ochraceous. Eriksson et al. (1981) in fact have suggested that P. queletii could easily be placed in Mycoacia.

Because Phlebia concentrica is odontoid, yellowish in color when fresh, and turns red in 2 percent KOH, it could be placed in Mycoacia. However, since the hymenophore of P. concentrica occasionally is merulioid, it seems better placed in Phlebia. Additionally, cultures of P. concentrica are similar to those of true Phlebia species (Nakasone et al. 1982).

Acknowledgments

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