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Study on species of *Phylloporus* I: Neotropics and North America

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Abstract: Seventeen out of the 24 taxa of *Phylloporus* (Boletaceae) known from the Neotropics are presented here. Complete descriptions, illustrations and a key to the 17 species are provided. *Phylloporus alborufus* is newly described, and an unnamed species is also described from Costa Rican oak forests. *Phylloporus colligatus* was recently described from a *Dicymbe* forest in Guyana. A table of the 24 known New World *Phylloporus* taxa, their distribution and possible hosts also is presented.

Key words: boletes, distribution, ectomycorrhizae, new species, systematics

INTRODUCTION

Most members of the Boletaceae form conspicuous basidiomes and are recognized for their importance in the forest ecosystems and for their role as symbiotic organisms. Despite this importance there are still large gaps in Central and South America, where members of this family have not been thoroughly inventoried. Mycologists working in these areas have recently reported new taxa and records of Boletaceae for the Neotropics, for example *Leccinum* from Belize (Ortiz-Santana and Halling 2009), *Leccinum* and *Phylloporus* from Costa Rica (Halling 1999, Halling et al. 1999), *Boletellus* and *Tylopilus* from Guyana (Fulgenzi et al. 2007, Fulgenzi et al. 2008), *Phlebopus* and *Phylloporus* from Mexico (Guzmán et al. 2007, Montoya and Bandala 1991) and *Boletus* and *Bothia* from USA (Halling et al. 2007, Ortiz-Santana et al. 2009). The ecological roles of members of the Boletaceae as ectomycorrhizal fungi have not been well studied in Neotropical forests. The mutualistic interactions have been studied for some of these forests. The host-fungus associations are known for boletes growing with *Pinus* and *Quercus* at high elevation in Costa Rica, Mexico and Colombia, where the forests have characteristics of temperate regions (Halling 1989, Orijel-Garibay et al. 2008, Osmundson et al. 2007). In Belize these forests occur at lower elevation, where members of the Boletaceae also are present and associated with these hosts (Ortiz-Santana et al. 2007). In Guyana species of Boletaceae have been associated with *Dicymbe* species (Henkel et al. 2002). Some of the areas that need more attention are the lowlands of central Amazonia, where Singer et al. (1983) reported the presence of ectomycorrhizal boletes, but no further studies have been done to investigate the fungus-host relationships.

Phylloporus Quél. is a diverse genus in the Boletaceae that is predominantly lamellate instead of poroid. The type species, *P. pelletieri* (Lév.) Quél., was described from temperate Europe, and approximately 70 species have been described from other regions of the world. This number is expected to increase as new collections are made from tropical regions that have not been thoroughly inventoried (Halling et al. 1999, Montoya and Bandala 1991, Neves 2007, Singer and Gómez 1984, Singer et al. 1990).

Twenty-two species of *Phylloporus* previously were reported from the Neotropics and North America, 10 of which have been reported from South America, although Watling (2008), who works primarily in the paleotropics, recognized only one species from South America. Three species of the genus have been collected in Colombia (Halling 1989, Singer et al. 1990), three in Belize (Ortiz-Santana et al. 2007) and four species are known from Mexico (Montoya and Bandala 1991, Singer and Gómez 1984). Five poorly known species of *Phylloporus* were found by Singer et al. (1983) in Amazonia. Five species are known from North America, mostly distributed in the United States; four are from eastern USA and one rarely collected species is from the western coastal states (Singer 1945, Smith and Trappe 1972). Costa Rica, one of the most explored Neotropical regions in terms of macrofungi, has 10 known species of *Phylloporus* (Halling 1999, Singer and Gómez 1984), including one new species and one unnamed species described below.

In this paper 17 taxa are described from the Americas; one is a new species from Costa Rica, and one is a distinct species from Costa Rica that remains incompletely described and unnamed due to the lack of adequate material. The results also include an identification key to the species from the Neotropics and North America, color photographs of the described species, line drawings, SEM photographs of the spores and a table with all the known species

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from these regions, their known distribution and their possible hosts.

MATERIALS AND METHODS

The collections were studied macro- and microscopically following traditional mycological methods (Largent 1986, Largent et al. 1977). The basidiomes were exposed to NH_4 to observe the presence or absence of the blue reaction on the pileus, stipe or the hymenophore surface. Imler's reaction is described by Watling and Gregory (1991) and also is called the fleeting amyloid reaction (Ladurner and Simonini 2003). To test for Imler's reaction a small piece of lamella (slice 3 mm broad) is mounted in Melzer's reagent and carefully squeezed between the slide and cover slip. This reaction is visible to the naked eye when the mounted slide is placed on white paper. The lamella will turn blue when the reaction is positive. The reaction can vary from a light, inconspicuous blue to a deep blue, and it always will vanish within a few minutes. When observed under the microscope the reaction appears to be located in the trama hyphae, but due to the thickness of the piece used it is hard to determine the exact location.

Color terms and codes (e.g. 5D3) are those of Kornerup and Wanscher (1978) and were noted only for species that were observed when fresh. The structure dimensions are based on 15 or more structures. In the descriptions of the basidiospores Q is the mean length/width quotient. Line drawings were made with a drawing tube.

To perform the scanning electron microscopy (SEM) studies of spores fragments of the hymenophore were removed from dried basidiomata, mounted on aluminum stubs (EMS#75610) with carbon adhesive tabs (EMS#77825-12), and coated with 10 nm of gold with a Hummer II sputter coater. The basidiospores were examined with a Hitachi S-2700 scanning electron microscope operating at 10 keV.

The descriptions were generated from a Delta database (Dallwitz 1980, Dallwitz et al. 1993 onward). Herbarium acronyms are from Holmgren et al. (1990).

RESULTS AND DISCUSSION

Among the 24 taxa known from the western hemisphere (TABLE I) 17 are described below. Some species were omitted from the key and the discussion because the collections have not been adequately studied due to their poor preservation or because the collections were not located in the referenced herbaria.

KEY TO SOME *PHYLLOPORUS* SPECIES FROM THE NEOTROPICS AND NORTH AMERICA

1. Basal mycelium white.
   2. Pileus red-brown, 2.5–3.5 cm diam, becoming blue or blue-green when exposed to NH_4.
      3. Flesh unchanging when exposed; cystidia lanceolate 62.3–84 × 7–11.2 µm, sometimes encrusted .... *P. alborufus*
      3′. Flesh cyanescent when exposed; cystidia ampullaceous, 50–71 × 11–12 µm, never encrusted .... *P. leucomycelinus*
   2. Pileus dull brown, NH_4 reaction positive or negative.
      4. Hymenophore alveolate ..... *P. boletinoides*
      4′. Hymenophore lamellate.
         5. Flesh unchanging when exposed; commonly found growing with *Alnus* ..... *P. caballeroi*
         5′. Flesh usually changing; commonly found growing with *Quercus*, *Magnolia*, *Chusquea*, or *Castanopsis*.
            6. Reaction of NH_4 on pileus blue; cystidia thick-walled ..... *P. centroamericanus*
            6′. Reaction of NH_4 on pileus blue-lilac; cystidia thin-walled ..... *P. bellus*
1. Basal mycelium yellow.
   7. Flesh unchanging when exposed; NH_4 reaction on pileus positive or if negative then spores ovoid.
      8. Pileus orange; spores ovoid ..... *P. aurantiacus*
      8′. Pileus colored otherwise; spores fusoid.
         9. Lamellae unchanging when bruised.
            10. Pileus olive; commonly found growing with *Pinus* (on sandy soil) ..... *P. arenicola*
            10′. Pileus brown; commonly growing with *Quercus* or *Fagus*, never in sandy soil.
               11. Cystidia nonencrusted; basidiospores dextrinoid ..... *P. phaeoxanthus* var. *simplex*
               11′. Cystidia encrusted; basidiospores inamyloid.
                  12. Stipitipellis composed of cells in chains ..... *P. phaeoxanthus* var. *phaeoxanthus*
                  12′. Stipitipellis composed of cylindrical hyphae ..... *P. rhodoxanthus*
         9. Lamellae bluing when bruised.
            13. Stipe finely subscabrous; clamp connections absent ..... *P. scabripes*
            13′. Stipe glabrous; clamp connections present at the base of the basidia, but not abundant ..... *P. colligatus*
   7. Flesh staining blue; NH_4 reaction on pileus negative.
      14. Spores ovoid ..... *P. guzmanii*
      14′. Spores fusoid.
         15. Clamp connections abundant in all tissues ..... *P. fibulatus*
         15′. Clamp connections absent or rare.
            16. Pileus red with yellowish stipe; cystidia melleous at the apex ..... *P. foliiporus*
            16′. Pileus vinaceous brown with brown stipe; cystidia hyaline ..... *Phylloporus* sp.1

TABLE I. Neotropical species of *Phylloporus*, their distribution and possible hosts

Species	Distribution	Possible hosts
P. alborufus Neves & Halling sp. nov.	Costa Rica	*Quercus*
P. arenicola A.H. Sm. & Trappe	USA	*Pinus* L.
P. aurantiacus Halling & G.M. Muell.	Costa Rica	*Quercus*
P. bellus (Massee) Corner	Costa Rica, Mexico	*Quercus, Castanopsis* (D. Don) Spach
P. boletinoides A.H. Sm. & Thiers	Belize, United States	*Pinus, Quercus*
P. caballeroi Singer	Argentina, Bolivia, Costa Rica, Panama	*Alnus jorullensis* Kunth, *A. acuminata* Kunth
P. centroamericanus Singer & L.D. Gómez	Costa Rica, Mexico	*Quercus*
P. colligatus Neves & Henkel	Guyana	*Dicymbe*
P. fibulatus Singer, Ovrebo & Halling	Colombia	*Quercus humboldtii* Bonpl.
P. flavipes Rick	Brazil	?
P. foliiporus (Murrill) Singer	United States	*Pinus, Quercus*
P. guanacastensis L.D. Gómez	Costa Rica	?
P. guzmanii Montoya & Band.-Muñoz	Mexico	*Pinus, Quercus*
P. gymnocystis Singer	Brazil	Leguminoseae
P. leucomycelinus Singer	United States	*Fagus* L., *Quercus*
P. manausensis Singer	Brazil	*Neea*, Euphorbiaceae
P. phaeoxanthus Singer & L.D. Gómez	Colombia, Costa Rica, Mexico	*Quercus*
P. phaeoxanthus var. *simplex* Singer & L.D. Gómez	Costa Rica	*Quercus*
P. pratensis Rick	Brazil	*?*
P. purpurellus Singer	Colombia, Costa Rica	*Quercus*
P. rhodoxanthus (Schwein.) Bres.	United States	*Fagus, Quercus*
P. scabripes Ortiz-Santana & Neves	Belize	*Pinus, Quercus*
P. viridis (Berk.) Singer	Brazil	*?*
Phylloporus sp.1	Costa Rica	*Quercus*

TAXONOMY

Phylloporus alborufus M.A. Neves & Halling, sp. nov. FIGS. 1, 18

MycoBank MB515395

Etymology: albo (white) + rufus (red), referring to the white basal mycelium and the red pileus

Pileo plano-depresso, brunneo-rufo, sicco, tomentoso, 2.5–3.5 cm lato, cum NH_4 caerulescent. Contextus flavus, immutatus. Lamellis decurrentis, flavis, intervenosis, ubi contusi caeruleus. Stipes aequalus, albidus, rufo versum adapicem. Contextus albo-flavus, cum NH_4 caerulescent. Mycelio basali albo. Sporis 9.8–11.2 × 3.5–4.2 μm. Hyphis defibulatis.

Pileus 2.5–3.5 cm broad, at first plane, with age plano-depressed, dry, entire, becoming even; disk even, at first dark reddish brown (8E7, 8E8), then brownish red; margin inrolled (slightly when young), when young deep red-brown; surface matted tomentose, becoming subtomentose, with NH_4 blue. *Flesh* 3–4 mm thick, yellow, staining absent; odor and flavor mild. *Hymenophore* lamellate, decurrent. *Lamellae* subdistant, 3–4.5 mm wide, not anastomosing, intervenose, when young bright yellow (2A7), with age yellow, staining blue; edges even. *Stipe* 2.3–5.1 cm long, 6 mm wide, equal, sinuate, dry; upper half when young fibrillose, white with a red-brown line next to the hymenophore, with age fibrillose or subfibrillose; lower half when young subfibrillose, brownish red (7C5), with age slightly roughened-fibrillose or subfibrillose, red or buff tan; fibrils on upper half when young brown or reddish (8E8); base yellow, not staining; interior solid; flesh above when young whitish yellow, with NH_4 blue. *Basal mycelium* white. *Fleeting-amyloid reaction* positive.

Basidiospores 9.8–11.2 μm long, 3.5–4.2 μm wide, mean Q = 2.72, subfusoid, smooth, with SEM smooth to finely rugulose, slightly amyloid, in KOH ochraceous. *Basidia* 24.5–32.2 μm long, 7–7.7 μm wide, clavate, hyaline, four-sterigmate. *Hymenial cystidia* 62.3–84 μm long, 7–11.2 μm wide, numerous on sides and edges of lamellae, thin-walled, hyaline, lanceolate, encrusting pigment present (in some). *Hymenophoral trama* bilateral, with age divergent; hyphae cylindrical, hyaline, amyloid. *Pileipellis hyphae* a trichodermium, in KOH pale yellow or hyaline, inamyloid; cylindrical, smooth, thin-walled, granular content present (some). *Pileus trama* hyphae hyaline, smooth, thin-walled. *Stipitipellis hyphae* vertically oriented, parallel, giving rise to clusters of caulocystidia, cylindrical or clavate, hyaline. *Stipe trama* hyphae parallel, cylindrical. *Clamp connections* absent.

Mycorrhizal host: *Quercus*.

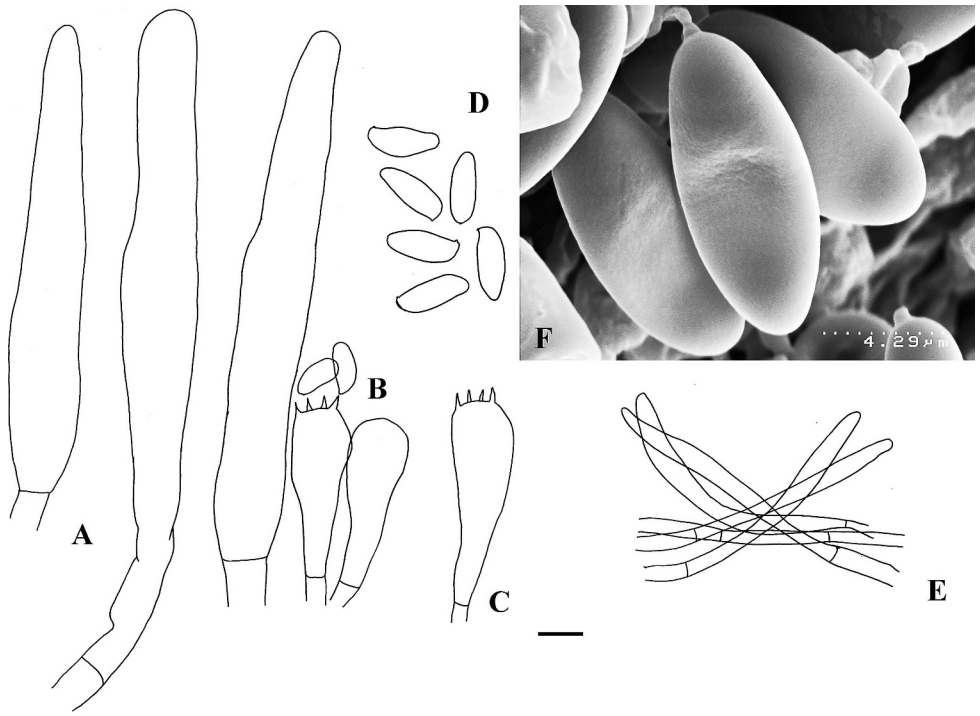

FIG. 1. *Phylloporus alborufus*. A. Pleurocystidia. B. Basidium and basidiole. C. Basidium. D. Basidiospores. E. Stipitipellis hyphae. F. Scanning electron microscopy of basidiospores. Bar: A–E = 10 µm.

Distribution: This species is currently known only from the type locality in Costa Rica, but it eventually might be found in other Neotropical *Quercus* forests.

While *P. alborufus* occurs in *Quercus* forest, *P. leucomycelinus* normally is associated with *Fagus* but may be found with *Quercus*. Compared to *P. leucomycelinus*, *P. alborufus* is brighter red, the spores are slightly shorter and some cystidia have encrusting pigment.

Specimens examined: COSTA RICA. San José. San Gerardo de Dota, ± 5 km southwest of Cerro de la Muerte, Albergue de la Montaña, Savegre, 9°33′N, 83°48′28″W, 2200 m, 11 Jun 2004, *Neves 22* (HOLOTYPE: USJ, ISOTYPE: NY).

Phylloporus arenicola A.H. Sm. & Trappe, Mycologia 64:1138–1153. 1972. FIGS. 2, 19

Pileus 1.5–4.5 cm broad, at first plane, with age convex or depressed, dry, even; disk subtomentose, at first olive, then olive-ocher; margin when young olive, then olive-brown or olive-ocher; surface velutinous, becoming subtomentose or tomentose, with NH_4 red or purple. *Flesh* pale yellow, staining absent; odor absent; flavor mild; with $FeSO_4$ olivaceous. *Hymenophore* lamellate, adnexed. *Lamellae* subdistant, simple, when young bright yellow, with age mustard yellow, staining absent; edges even. *Stipe* 4–6 cm long, 6–8 mm wide, tapering downward, curved or sinuate, dry; upper half when young pruinose, with age subpruinose; lower half when young pruinose, dull yellow; pruina on upper half when young brown; base bright yellow, not staining; interior solid; yellow, flesh at base when young bright yellow, not staining. *Basal mycelium* yellow. *Fleeting-amyloid reaction* weakly positive.

Basidiospores 9–12 µm long, 4–5 µm wide, mean Q = 2.3, ovoid or lacrymoid, smooth, weakly dextrinoid, in KOH olive-hyaline. *Basidia* 38–60 µm long, 9–13 µm wide, clavate, hyaline, four-sterigmate. *Hymenial cystidia* 52–86 µm long, 9–16 µm wide, numerous on sides and edges of lamellae, thin-walled, hyaline, subfusoid or fusoid-ventricose, encrusting pigment absent. *Hymenophoral trama* bilateral; hyphae cylin-

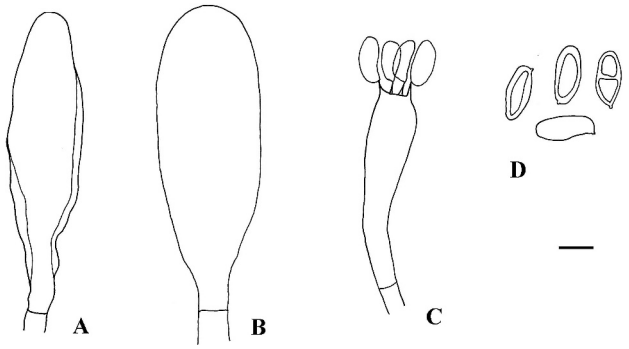

FIG. 2. *Phylloporus arenicola*. A. Pleurocystidium. B. Caulocystidium. C. Basidium. D. Basidiospores. Bar = 10 µm.

drical, 9–13 μm wide, hyaline. *Pileipellis hyphae* a trichodermium, in KOH pale yellow or hyaline, inamyloid; cylindrical or elongated, encrusted with pigment (in Melzer's), thin-walled, granular content absent. *Pileus trama* hyphae hyaline, smooth. *Stipitipellis hyphae* vertically oriented, parallel, giving rise to versiform caulocystidia (rare), 44.8–45.5 μm long, 15.4–16.1 μm wide, cylindrical, hyaline. *Stipe trama* hyphae parallel, cylindrical, hyaline, somewhat dextrinoid. *Clamp connections* absent.

Mycorrhizal host: *Pinus*.

Distribution: Collections of *P. arenicola* are from Washington, Oregon and northern California, USA.

This olive-colored *Phylloporus* is known from sandy soils in western USA and is not as common as *P. rhodoxanthus* is in the east. *Phylloporus arenicola* does not turn blue when injured; its pileus cuticle turns violet-fuscous or reddish when exposed to NH_4, and the basidiome dimensions are generally smaller than those observed for *P. rhodoxanthus*. The forests with which each taxon is associated also differ. *Phylloporus arenicola* is associated with *Pinus* (*Pinus contorta* in the type location, Tillamook County, Oregon), while the hosts for *P. rhodoxanthus* are species of *Quercus*.

Specimens examined: UNITED STATES. California. Marin County, Bolinas Ridge Road, 37°52′7″N, 122°30′29″W, 3 Jan 1992, *Desjardin 5447* (SFSU). Mendocino County, Jackson State Forest, Highway 409, 38°20′56N, 120°46′23W, 21 Nov 1992, *Halling 6951* (NY). Sierra County, Chapman Creek Campground, 37°55′8N, 122°30′57W, 5 Jun 1997, *Desjardin 6622* (SFSU).Washington. Clallam County, Olympic National Forest, Boulder Creek Drainage, 48°15′17″N, 124°15′30″W, 19 Oct 1991, *Desjardin 5373* (SFSU).

Phylloporus aurantiacus Halling & G.M. Muell., Mycotaxon 73:64. 1999. FIGS. 3, 20

Pileus 1–3 cm broad, at first plane, with age depressed, dry; disk even, orange; margin even, when young orange to yellow orange, then yellow orange; surface matted tomentose to tomentose, becoming matted subtomentose, maculose color spots absent or sometimes present, yellow, with NH_4 no reaction. *Flesh* 2–5 mm thick, yellow, staining absent; odor and flavor mild. *Hymenophore* lamellate, decurrent. *Lamellae* close, 1–3 mm wide, not anastomosing, rarely somewhat intervenose, orange to orangish brown, staining green; edges even. *Stipe* 3–5 cm long, 4–5 mm wide, equal, strict, dry; floccose to fibrillose, red to orange (with yellow undertones); base yellow, not staining or green; interior solid; flesh above yellow, not staining, flesh at base yellow, not staining. *Basal mycelium* bright yellow. *Fleeting-amyloid reaction* positive.

Basidiospores 5.6–7.7 μm long, 3.5–5 μm wide, mean Q = 1.6, oblong to ovoid, smooth, weakly dextrinoid, in KOH straw yellow. *Basidia* 35–42 μm long, 8–10.5 μm wide, cylindrical to clavate, hyaline, four-sterigmate. *Hymenial cystidia* 60–90 μm long, 7–10 μm wide, more common on sides of lamellae, thin-walled, hyaline, subfusoid to subcylindrical, encrusting pigment absent. *Hymenophoral trama* bilateral; yellow-brown in the central stratum. *Pileipellis hyphae* a trichodermium (tangled), in KOH orange to yellow ochraceous, inamyloid; elements 3.5–7 μm wide, cylindrical to elongated, smooth, thin-walled, granular content absent. *Pileus trama* interwoven, hyphae hyaline, inamyloid, with elements 3.5–10 μm wide, smooth, thin-walled. *Stipitipellis hyphae* vertically oriented, parallel, giving rise to clusters of caulocystidia, 35–90 μm long, 7–10 μm wide, clavate to subfusoid, hyaline to orange. *Stipe trama* hyphae parallel, cylindrical, hyaline, inamyloid. *Clamp connections* absent.

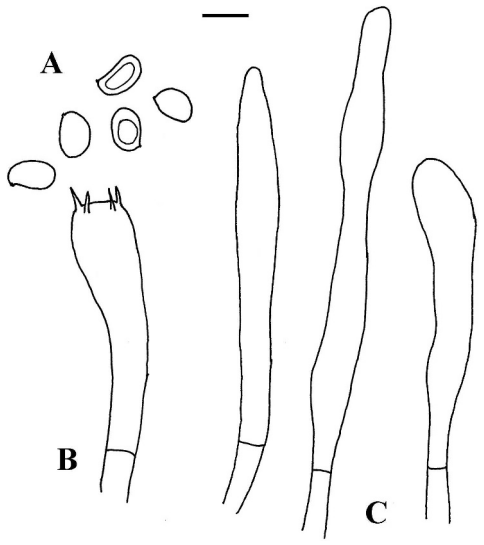

FIG. 3. *Phylloporus aurantiacus*. A. Basidiospores. B. Basidium. C. Pleurocystidia. Bar = 10 μm.

Mycorrhizal host: *Quercus*.

Distribution: This species is known only from one site in Cartago Province in the northern Talamancas, Costa Rica.

When Halling et al. (1999) described this species from Costa Rica they considered it to be phenetically closest to *P. coccineus*, described by Corner (1970) from Singapore. Both species possess yellow basal mycelium and ovoid spores, an uncommon shape in the genus. However Corner's fungus has cyanescent, yellow flesh and larger spores. The flesh of *P. aurantiacus* is not cyanescent. The color of the basidiome and the yellow flesh are distinctive field characters.

Material examined: COSTA RICA. Cartago: near town of Palo Verde, ± 4.5 km E of km 31 of Interamericana

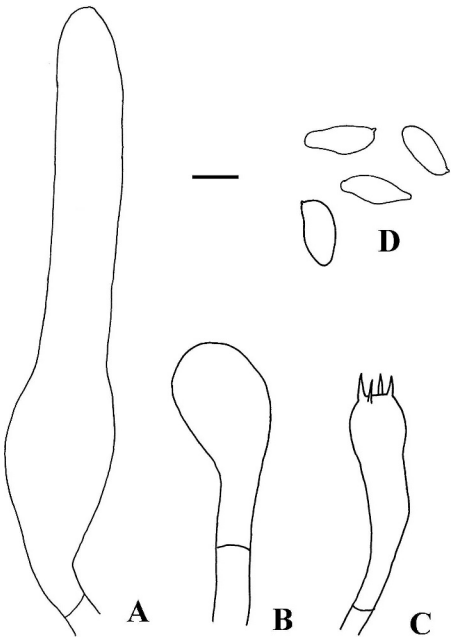

FIG. 4. *Phylloporus bellus*. A. Pleurocystidium. B. Caulocystidium. C. Basidium. D. Basidiospores. Bar = 10 μm.

Highway, 9°46′34″N, 83°56′42″W, 1600 m, 11 Jun 1994, *Halling 7271* (ISOTYPE: NY).

Phylloporus bellus (Massee) Corner, Nova Hedwigia 20:798. 1970. FIGS. 4, 21

Flammula bella Massee, Kew Bull. 74. 1914.

Pileus 1–3.3(–6) cm broad, at first convex, with age plane or depressed or eventually concave, dry; dark brown to yellow orange; surface subtomentose to subvelutinous, becoming granular-fibrillose or subsquamulose, with NH_4 blue to purple (sometimes fading to latter color). *Flesh* white to pale yellow (with age), staining absent or blue. *Hymenophore* lamellate, decurrent. *Lamellae* subclose to distant, not anastomosing, somewhat intervenose, a few forked, sulfur to primrose yellow, staining absent or blue to slightly green. *Stipe* 1–4.4 cm long, 1.3–7.5(–9.5) mm wide, mostly equal or subequal or occasionally clavate, dry; upper half when young glabrous to subglabrous, yellow to light cinnamon; lower half when young subglabrous to glabrous, sordid yellow to light cinnamon, with age finely pustulate; base white; interior solid; flesh above white to whitish yellow or pale cinnamon, not staining or staining blue; flesh at base whitish yellow or pale cinnamon, not staining or staining blue. *Basal mycelium* white. *Fleeting-amyloid reaction* positive.

Basidiospores olive in mass, (8–)9–10 μm long, (2.7–)3.5–4.5(–5.5) μm wide (11.2–14 μm long, 2.8–3.5 μm wide in collection REH7733), mean Q = 2 (without longer spores from REH7733), lacrymoid to subfusoid, smooth, inamyloid, in KOH golden yellow to light brown melleous. *Basidia* 29–38 μm long, 6.5–10 μm wide, clavate, hyaline, four-sterigmate. *Hymenial cystidia* 32–81 μm long, 7.5–18 μm wide, numerous on sides and edges of lamellae, thin-walled, ampullaceous or clavate-ventricose to ventricose to utriform to obtuse to mucronate, encrusting pigment sometimes present. *Hymenophoral trama* bilateral. *Pileipellis hyphae* a trichodermium or forming a palisade, in KOH pale yellow; elongated or short (e.g. 11–16 × 10 μm, but mostly 20–28 × 6–7 μm), smooth, thin-walled. *Stipitipellis hyphae* vertically oriented, parallel, giving rise to dermatocystidia, 30–55(–87) μm long, 5–20 μm wide, with encrusting pigment present. *Clamp connections* absent.

Mycorrhizal hosts: *Quercus* and *Castanopsis*.

Distribution: First described from Singapore, Singer and Gómez (1984) cite collections from Japan, Mexico and Costa Rica.

The diagnostic features are the white basal mycelium, the cyanescent lamellae and thin-walled nonencrusted hymenial cystidia. Collection REH7733 (Costa Rica) has spores of two sizes and agrees with Singer's description for Costa Rican collections. Collection REH8710 (USA) agrees with REH7733 but has only the smaller spores.

Material examined: COSTA RICA. Guanacaste: Santa Rosa, Guanacaste Conservation Area, 10°51′4″N, 85°36′26″W, 330 m, 22 Jun 1997, *Halling 7733* (NY). UNITED STATES. Bronx: New York Botanical Garden, 40°67N, 73°94W, 13 Jul 2005, *Halling 8710* (NY). JAPAN. Tottori Prefecture: Tottori, near Tottori Mycological Institute, 7 Sep 1983, *A4021* (F).

Phylloporus boletinoides A.H. Sm. & Thiers, Contr. N. Amer. Sp. *Suillus*. 105. 1964. FIGS. 5, 22

Pileus 2–4 cm broad, at first convex, with age planoconvex, dry, even; disk subtomentose or velutinous, at first cinnamon brown or dark vinaceous brown, then cocoa brown or cinnamon brown; margin inrolled, brown; surface tomentose, becoming glabrous or matted tomentose, with NH_4 violet purple with an ocher-orange circle around the drop. *Flesh* white, staining absent; odor and flavor mild; with NH_4 purple, with $FeSO_4$ grayish green (slightly). *Hymenophore* lamellate or subporoid (more poroid near the stipe), decurrent. Tubes 2–5 mm long, light yellow (with olive-buff tinges), becoming olive, unchanging when injured; pores 2–3 mm wide, pallid yellow or olive-buff, then deep olive-buff, unchanging when injured. *Stipe* 3–5 cm long, 0.5–1 mm wide, equal or tapering downward, strict or curved, dry; upper half when young glabrous, yellow, with age longitudinally ribbed (ribs sometimes anastomosing); lower half when young glabrous, light cinnamon, buff tan; base

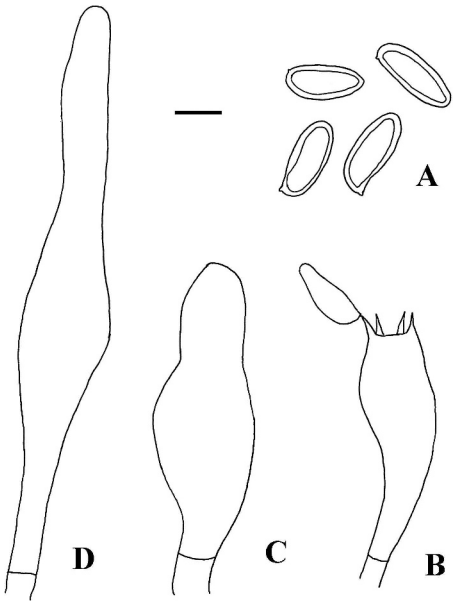

FIG. 5. *Phylloporus boletinoides*. A. Basidiospores. B. Basidium. C. Caulocystidium. D. Pleurocystidium. Bar = 10 μm.

pallid, not staining; interior solid, or hollow (at the base, with age); flesh yellow, not staining. *Basal mycelium* white. *Fleeting-amyloid reaction* weakly positive.

Basidiospores 10.5–11.9 μm long, 4.2–4.9 μm wide, mean Q = 2.46, subfusoid or oblong fusoid or cylindrical (rarely), smooth, dextrinoid, in KOH ochraceous. *Basidia* 25.9–31.5 μm long, 7–8.4 μm wide, clavate, hyaline, four-sterigmate. *Hymenial cystidia* 60.2–81.9 μm long, 7–10.5 μm wide, more common toward the edge of lamellae, thin-walled, hyaline (often with brownish content when at the edge of the lamellae), fusoid or fusoid-ventricose, encrusting pigment absent. *Hymenophoral trama* divergent; hyphae cylindrical, 1.5–5 μm wide, hyaline or melleous hyaline, subgelatinous in KOH. *Pileipellis hyphae* a trichodermium, in KOH yellow ochraceous, inamyloid; elements 7–11 μm wide, cystidioid or cylindrical, thin-walled. *Pileus trama* interwoven, hyphae hyaline. *Stipitipellis hyphae* vertically oriented, giving rise to a caulohymenium. *Stipe trama* hyphae hyaline. *Clamp connections* absent.

Mycorrhizal hosts: *Pinus*, *Quercus*.

Distribution: The type was found in Florida, and the species also has been collected in Alabama and Texas (Singer et al. 1990). A collection from Belize was examined (Baroni 9681) and was the first record of *P. boletinoides* outside USA (Ortiz-Santana et al. 2007).

Phylloporus boletinoides can be distinguished from other *Phylloporus* due to its hymenophore characteristics; the configuration is alveolate to subporoid,

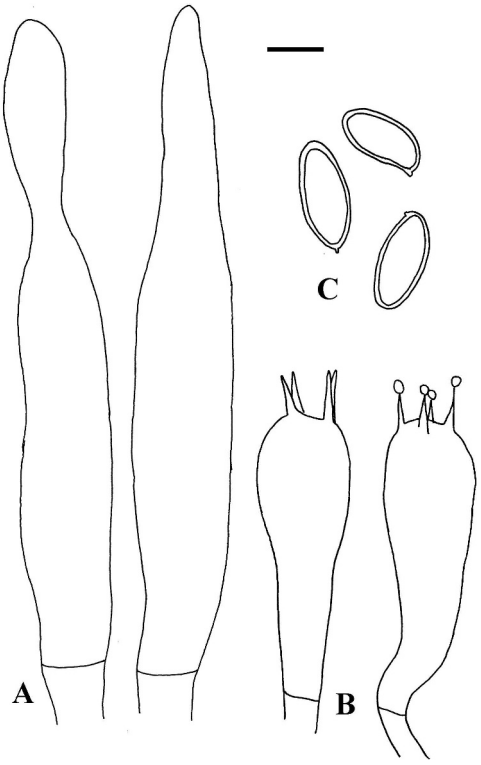

FIG. 6. *Phylloporus caballeroi*. A. Pleurocystidia. B. Basidia. C. Basidiospores. Bar = 10 μm.

more anastomosed than other species, and the color is not bright yellow as in most species but has a yellowish tone with olive tints. When dried the hymenophore loses much of its color and becomes dull brownish ochraceous.

Material examined: UNITED STATES. Florida: Alachua County, east of Gainesville, 31 Jul 1958, *Thiers 4960* (HOLOTYPE: MICH); 16 Aug 1996, *Baroni 8047* (CORT); Sarasota, Myakka Valley Ranches, 12 Jan 1991, *F3912* (F). Texas: Tyler County, Big Thicket National Preserve, Turkey Creek, 6 Sep 1996, *Baroni 8172* (CORT). New Jersey: Burlington County: Penn State Forest, Oswego Lake, 17 Aug 1984, *Halling 3811* (NY). Alabama: Baldwin County, Orange Beach, 1982, *Lewis 3196* (F). BELIZE. Cayo District: Douglas D'Silva Forest Station, 16°58′18.6″N, 88°59′29.4″W, 458 m, 6 Oct 2003, *Baroni 9681* (CORT).

Phylloporus caballeroi Singer, Beih. Sydowia 7:101. 1973. FIG. 6

Pileus 1.7–4.5 cm broad, at first pulvinate to planoconvex, with age frequently subumbonate to umbonate, dry; disk uneven or smooth, at first brown to dark brown, then brown to dark reddish brown; margin smooth, cinnamon brown; surface tomentose to velutinous (often fracturing into small brown fibrils on yellowish ground), often becoming glabrous or tomentose to velutinous, with NH_4 strongly blue. *Flesh* white or yellowish white, staining absent; odor absent

or fruity. *Hymenophore* lamellate, subdecurrent to sinuate to adnate. *Lamellae* subdistant to close, not anastomosing, sometimes intervenose, when young yellow, staining absent or light blue green. *Stipe* 2.4–4.6 cm long, 2.5–7 mm wide, equal or tapering downward, dry; upper half when young glabrous to subglabrous, pallid, with age yellow pruinose to fibrillose or subreticulate, ground-yellow; lower half when young subglabrous to glabrous, pallid, with age fibrillose to punctate, brown to yellow; interior solid; flesh white or whitish yellow, not staining or staining rusty ochraceous. *Basal mycelium* white. *Fleeting-amyloid reaction* positive.

Basidiospores brownish olive in mass, (9–)10–12 (–12.7) µm long, 4–5(–6) µm wide, mean Q = 2.21, mostly subfusoid or subellipsoid to subglobose (few), smooth, dextrinoid. *Basidia* (30.5–)32–37(–40) µm long, (7.5–)8.5–9.5(–11) µm wide, clavate, hyaline, (2–)4-sterigmate. *Hymenial cystidia* 40–105 µm long, 7.5–14 µm wide, thin-walled, hyaline, ampullaceous or fusoid (with obtuse tip but often with constrictions) or utriform, encrusting pigment absent. *Hymenophoral trama* bilateral. *Pileipellis hyphae* a trichodermium and forming a palisade, in KOH yellow or brownish; elements 6–18.5 µm wide, elongated, smooth, thin-walled, granular content absent. Intercalary cells subisodiametric, 10–14 µm long, 8.5–10 µm wide. *Pileus trama* interwoven, hyphae hyaline, inamyloid, smooth, thin-walled. *Stipitipellis hyphae* vertically oriented, parallel or interwoven, giving rise to dermatocystidia, 25–42 µm long, 5–10 µm wide, mostly clavate, hyaline, with encrusting pigment present (pale melleous and granular). *Clamp connections* absent.

Mycorrhizal host: *Alnus acuminata*.

Distribution: First described from collections gathered in northern Argentina, the species is widespread under montane Neotropical alder, *A. acuminata*, from that country north to at least Costa Rica. Collections examined in this work are from Argentina, Bolivia and Panama.

The ectomycorrhizal association along with the white basal mycelium are good field characters to identify this taxon. Singer and Gómez (1984) compared the Argentinean specimen to collections from Costa Rica and suggested that the latter were larger, older collections, with tomentose stipes and that the basidiomes collected in Argentina were still young and therefore glabrous. The collection from Panama agrees with the Costa Rican specimen described as possessing a larger basidiome with a tomentose stipe. The question posed by Singer on whether the collections from Costa Rica and Panama are a different species or a Central American race of *P. caballeroi* cannot be answered until more material is studied. The Bolivian material also agrees with the description from the Costa Rican specimen. The type specimen at F has been annotated with the correct number cited in the protolog (T5150).

Material examined: ARGENTINA. Jujuy: Lagunas de Yala, 2400 m, 14 Feb 1966, *Singer T5051* (HOLOTYPE: F), *T4062* (PARATYPE: F). BOLIVIA. Departamento de La Paz: Province of Sud Yungas, 18–25 km from Unduavi on road to Chulumani, 16°19′S, 67°54′W, 22 Mar 1990, *Halling 6360* (NY). COSTA RICA. Cartago: Empalme, 2300 m, 17 Jun 1983, *Singer B14336* (F). PANAMA. Chiriqui: Bugaba, Cerro Punta, Parque Internacional La Amistad, Sendero Retoño, 8°51′N, 82°34′W, 2280 m, 20 Oct 1999, *Halling 7906* (NY).

Phylloporus centroamericanus Singer & L.D. Gómez, Brenesia 22:169. 1984. FIGS. 7, 23

Pileus 2–3 cm broad, at first convex, with age plane, dry, even, becoming cracked; disk even, at first brown (7F6), then tan (6D7, 6C6); margin even, when young brown (6E7, 6E8), then tan (6D7); surface subtomentose, becoming finely areolate, with NH_4 blue or blue-green. *Flesh* 5–9 mm thick, white or light yellow (2A4), staining absent or blue-green (rare); odor and flavor mild. *Hymenophore* lamellate, decurrent. *Lamellae* subdistant, 1–5.5 mm wide, not anastomosing, later strongly intervenose, when young yellow (3A7) or sulfur yellow (2A7), with age yellowish brown, staining blue; edges even. *Stipe* 3.5–4 cm long, 5–8 mm wide, tapering downward, sometimes eccentric or curved, dry; upper half when young coarsely subpruinose to finely subscabrous, yellowish (4A2); lower half when young finely subscabrous to subpruinose (coarse), white or yellow (near the base), with age coarsely subpruinose to finely subscabrous; pruina on upper half brown, on lower half brown (6D7); base white, not staining; interior solid; flesh above white slightly pinkish brown in midportion, not staining, flesh at base white, not staining. *Basal mycelium* white. *Fleeting-amyloid reaction* positive.

Basidiospores olive-brown in mass, 8–16 µm long, 3.5–5.5 µm wide, mean Q = 2.7, subfusoid, smooth, with SEM finely rugulose, dextrinoid, in KOH light brown melleous. *Basidia* 28–38 µm long, 6.2–8 µm wide, clavate, hyaline, four-sterigmate. *Hymenial cystidia* 35–138 µm long, 10–25 µm wide, more common toward the edge of lamellae, thick-walled (2–4 µm) hyaline, often clavate to ventricose to fusoid to fusoid mucronate to utriform, encrusting pigment present. *Hymenophoral trama* bilateral; hyphae cylindrical, hyaline, in KOH yellow. *Pileipellis hyphae* hymeniform and forming a palisade, in KOH yellow (exuding a yellow pigment on KOH), inamyloid; elements 5–24 µm wide, elongated or subisodiametric or cellular, encrusted with pigment, thin-walled,

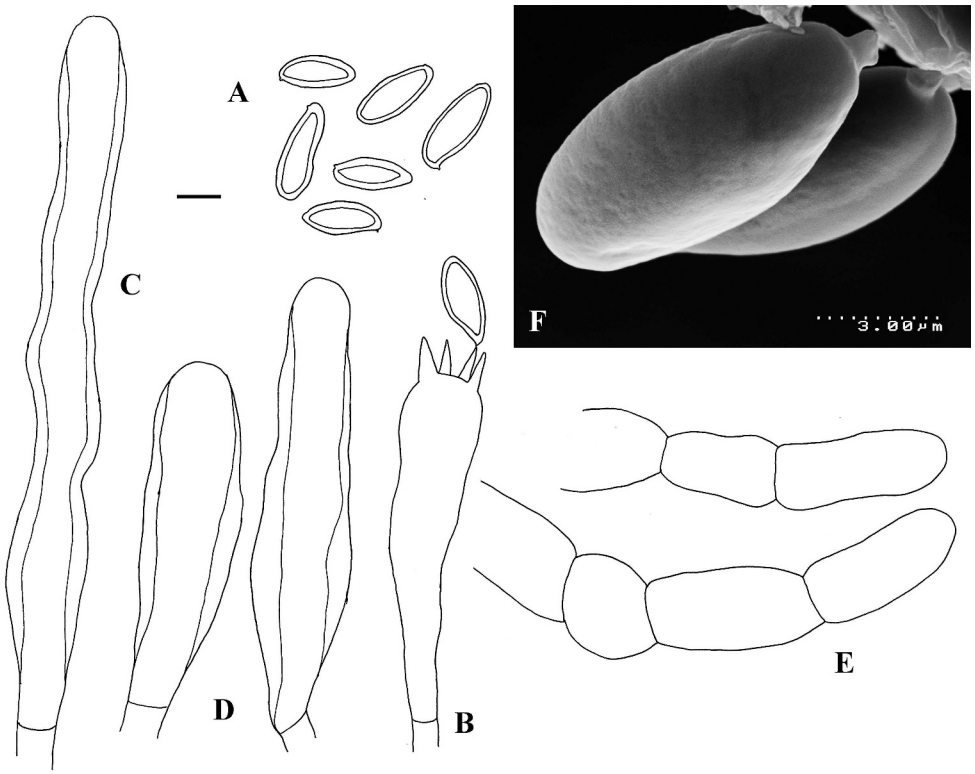

FIG. 7. *Phylloporus centroamericanus*. A. Basidiospores. B. Basidium. C, D. Pleurocystidia. E. Pileipellis hyphae. F. Scanning electron microscopy of basidiospores. Bar: A–E = 10 µm.

granular content absent. Intercalary cells isodiametric to subisodiametric, 15–32 µm long, 12–24 µm wide. *Pileus trama* interwoven, hyphae hyaline, inamyloid, smooth, thin-walled. *Stipitipellis hyphae* vertically oriented, parallel, giving rise to versiform caulocystidia or clusters of caulocystidia, 40–80 µm long, 10–20 µm wide, clavate to ventricose or fusoid, with encrusting pigment present (hyaline to melleous). *Stipe trama* hyphae parallel to subparallel, cylindrical, hyaline, inamyloid. *Clamp connections* absent.

Mycorrhizal host: *Quercus*.

Distribution: *Phylloporus centroamericanus* originally was described from Costa Rica and recently was found in Mexico (Montoya and Bandala 1991).

This species is characterized by the red-brown pileus, white mycelium at the stipe base, and conspicuous encrusted hymenial cystidia with thick walls, not seen in other species. It is one of the most common species in oak forests of Costa Rica's Cordillera Talamanca.

Material examined: COSTA RICA. Cartago: La Chonta, 2800 m, Sep 1982, Gómez 18413 (TYPE: F). Puntarenas: Coto Brus, Zona Protectora Las Tablas, Sitio Tiñieblas, 8°54′N, 82°46′W, 1450 m, 11 Jun 2004, *Neves 47*; Coto Brus, Zona Protectora Las Tablas, Finca La Cafrosa, Camino El Portones por El Tajo, 8°55′34″N, 82°46′W, 1500 m, 12 Jun 2004, *Neves 51* (NY). San Jose de Dota: La Chonta, south of Interamericana Highway toward Cerro Chonta, 9°41′56″N, 83°56′31″W, 2340 m, 14 Jun 2004, *Neves 57*, *Neves 58*, *Neves 59* (NY). San Jose: San Gerardo de Dota, ± 500 km SW Cerro de La Muerte, Albergue de la Montaña, Savegre, 9°33′N, 83°48′28″W, 2200 m, 3 Jun 2004, *Neves 16*, *Neves 18*, 6 Jun 2004, *Neves 30*, 7 Jun 2004, *Neves 37*, 8 Jun 2004, *Neves 41* (NY).

Phylloporus colligatus M.A. Neves & T.W. Henkel, Mycotaxon (In press). FIGS. 8, 24

Pileus 1–1.7 cm broad, at first plano-convex, dry,

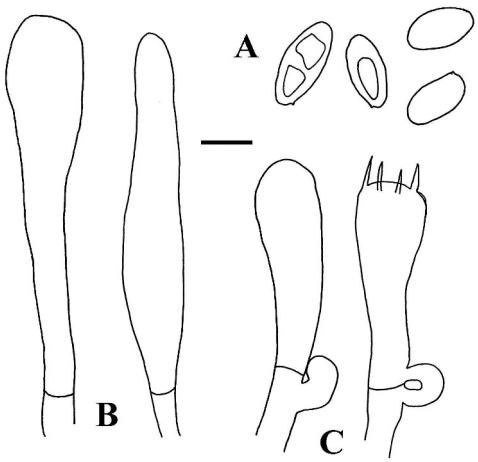

FIG. 8. *Phylloporus colligatus*. A. Basidiospores. B. Pleurocystidia. C. Basidia. Bar = 10 µm.

even, becoming matted subtomentose; reddish brown (with orangish overtones); with NH_4 blue (instantly, but rapidly changing to dull burgundy-brown). *Flesh* 1–5 mm thick, off-white, staining absent; odor not distinctive. *Hymenophore* lamellate, decurrent or adnate. *Lamellae* subdistant, forked, when young light yellow, with age yellow, staining brighter yellow; edges even. *Stipe* 3–4.5 cm long, 2–4 mm wide, equal, curved, dry; upper half when young glabrous, dull orangish; lower half orangish yellow; interior solid; flesh above when young off-white (sometimes yellowing on exposure). *Basal mycelium* pale yellow. *Fleeting-amyloid reaction* positive (weakly).

Basidiospores 8.4–9.8 µm long, 3.5–4.2 µm wide, mean Q = 2.36, subfusoid, smooth, inamyloid, in KOH pale yellow. *Basidia* 34.3–37.8 µm long, 6.3–8.4 µm wide, clavate, pale yellow, four-sterigmate (rarely five). *Hymenial cystidia* 42–45.5 µm long, 7–7.7 µm wide, more common on sides of lamellae, thin-walled, hyaline, clavate to fusoid or lanceolate, encrusting pigment absent. *Hymenophoral trama* bilateral; hyphae cylindrical, 4.9–7 µm wide, yellowish. *Pileipellis hyphae* an ixotrichodermium, in KOH pale yellow; hyphae cylindrical, thin-walled. *Pileus trama* interwoven; hyphae hyaline. *Stipitipellis hyphae* vertically oriented, parallel, subcylindrical or cylindrical, yellow. *Stipe trama* hyphae parallel, cylindrical, pale yellow, 6.3–10.5 µm wide. *Clamp connections* present (not observed in all septa, rare to infrequent at the base of some basidia and on hymenophoral trama hyphae).

Mycorrhizal host: *Dicymbe*.

Distribution: This species is known only from Guyana.

This taxon has similarities to *P. phaeoxanthus*, but the cystidia are not encrusted. It could be confused with *P. phaeoxanthus* var. *simplex* from which it differs in the fusoid cystidia and the presence of clamp connections at the base of the basidia. Other *Phylloporus* species have been found to be associated with Caesalpinioideae trees in Africa (Heinemann and Rammeloo 1987). The only clamped species described from Africa, by Heinemann and Rammeloo (1987), is *P. pseudopaxillus* Heinem. & Rammeloo. However the African species is larger, has longer spores and the clamp connections are seen in all parts of the basidiome. (See comments under *P. fibulatus* and *P. foliiporus*, the other two clamped species presented here.)

Material examined: GUYANA. Region 8 (Potaro-Siparuni), Pakaraima Mountains: Upper Potaro River Basin, 15 km east of Ayanganna Mountain, 3 km southwest of base camp, 5 May 2001, *Henkel 8026* (BRG, HOLOTYPE; HSU, ISOTYPE).

Phylloporus fibulatus Singer, Ovrebo & Halling, Mycologia 82:452. 1990. FIGS. 9, 25

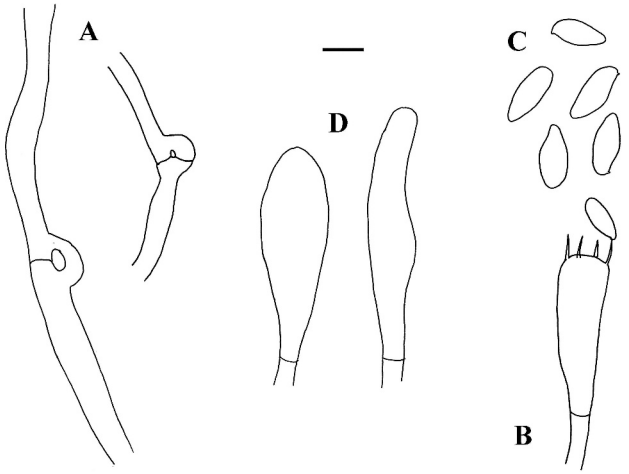

FIG. 9. *Phylloporus fibulatus*. A. Clamp connections. B. Basidium. C. Basidiospores. D. Pleurocystidia. Bar = 10 µm.

Pileus 1.1–3.5 cm broad, at first convex, with age plane or plano-depressed, dry; disk even, at first yellow, then dull yellow; margin even to uneven, when young yellow, then brown; surface woolly, with KOH ocher, with NH_4 brown (deep purple-brown at junction of pileus surface and trama). *Flesh* 4–5 mm thick, yellow, staining absent or slightly blue; odor fragrant; flavor mild; with $FeSO_4$ olivaceous, with KOH ocher. *Hymenophore* lamellate to subporoid, decurrent. *Lamellae* subdistant, 2–3 mm wide, anastomosing (at half height or when young), shallowly intervenose, boletinoid (not distinctly), when young yellow, with age yellowish green to yellowish gray, staining absent; with $FeSO_4$ olivaceous, with KOH ocher. *Stipe* 1.5–4.5 cm long, 2.5–9 mm wide, equal or tapering downward, sometimes eccentric or curved, dry; upper half slightly roughened-fibrillose, yellow (with reddish zone near apex); lower half slightly roughened-fibrillose, yellow; base pale yellow to yellow, not staining; interior solid; flesh yellow, not staining, with $FeSO_4$ olivaceous, with KOH ocher. *Basal mycelium* yellow to pale yellow. *Fleeting-amyloid reaction* positive.

Basidiospores brownish olive in mass, (8–)8.5–10 (–11) µm long, 3–4(–4.5) µm wide, mean Q = 2.7, subfusoid, smooth, inamyloid, in KOH ochraceous. *Basidia* 23–41 µm long, 6–8.5 µm wide, narrowly clavate, hyaline to pale yellow, four-sterigmate. *Hymenial cystidia* (29–)50–104 µm long, 6–10.4 µm wide, thin-walled, hyaline, cylindrical with the mid-portion swollen to narrowly fusiform ventricose, with the apex sometimes subcapitate. *Hymenophoral trama* divergent, with age interwoven; hyphae cylindrical, 3.5–14 µm wide, hyaline, in KOH yellow; subhymenial hyphae 2.8–3 µm wide. *Pileipellis hyphae* interwoven or a trichodermium, in KOH yellow; elements 3.5–9.2 µm

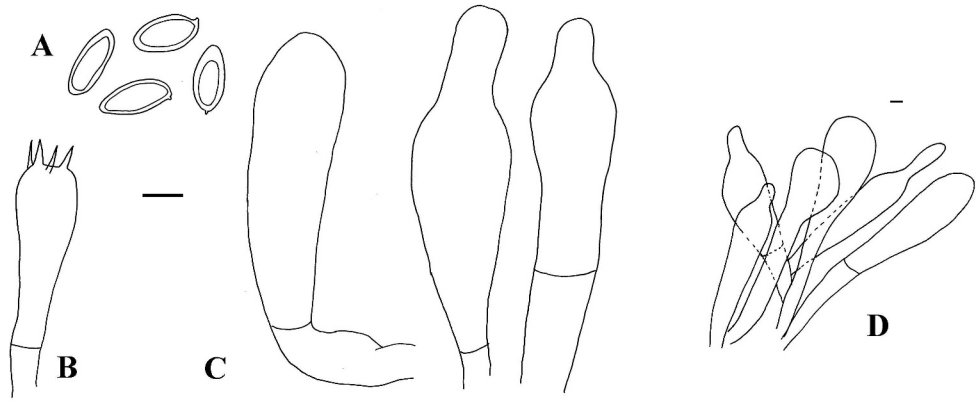

FIG. 10. *Phylloporus foliiporus*. A. Basidiospores. B. Basidium. C. Pleurocystidia. D. Stipitipellis with caulocystidia. Bar = 10 μm.

wide, cylindrical and elongated, thin-walled, granular content absent or present. *Pileus trama* interwoven, hyphae hyaline to light yellow, inamyloid, with elements 3.5–17 μm wide, thin-walled. *Stipitipellis hyphae* vertically oriented, interwoven, 3.5–5.8 μm wide, cylindrical. *Stipe trama* hyphae parallel, cylindrical, pale yellow, inamyloid, 4.6–17 μm wide. *Clamp connections* numerous.

Mycorrhizal host: *Quercus*.

Distribution: This species first was described from Colombia, and more collections have been found there since. It has not been found in other Neotropical forests, although it might occur outside Colombia because of similar forest types in the montane Neotropics.

The yellow basidiome is a distinctive field character. Other diagnostic features include the abundance of clamp connections, the absence of a blue reaction to ammonia and the subporoid hymenophore. *Phylloporus fibulatus* is distinguished from *Phylloporus colligatus*, described above, by the pileus color, abundance of clamp connections and reaction of NH_4 in the pileus. In addition *P. fibulatus* has cylindrical to fusiform cystidia and a more subporoid hymenophore compared to the ventricose to subcapitate cystidia and lamellate hymenophore of *P. colligatus*. (See comments under *P. foliiporus*, also a clamped species, to distinguish the two taxa.) Another species with an obvious subporoid hymenophore is *P. pumilus* Neves & Halling ined. from Indonesia, which is much smaller and lacks clamp connections. Singer et al. (1990) created section *Fibulati* to accommodate *P. fibulatus*, however a section with the same name had been erected by Heinemann and Rammeloo (1987) to include *P. pseudopaxillus*, a clamped species from central Africa. The section erected by Singer et al. (1990) therefore is invalid. *Phylloporus paxillus* differs from *P. fibulatus* by the simple lamellae and larger spores.

Material examined: COLOMBIA. Departamento de Antioquia: along road from Santa Rosa de Osos to San José de la Montaña, 25 Sep 1986, *Ovrebo 2546* (ISOTYPE: NY); Municipio Santa Rosa de Osos, ± 11 km north of Santa Rosa de Osos, road to Aragon, near Llanos de Cuivá, 6°45′N, 75°3′W, 2500 m, 5 Sep 1986, *Halling 4983* (NY); on road to Aragon, El Chaquiro, 8 Nov 1988, *Halling 6068* (NY). Departamento de Nariño: Municipio Pasto, 11 km east of Chachagüi, bosque ''El Común'', 22 Sep 1988, *Halling 6132* (NY); km 17, road from Pasto to Chachagüi, vereda ''La Josefina'', 23 Sep 1988, *Halling 6153* (PARATYPE: NY). Departamento del Tolima: Municipio de Murillo, Cabecera Municipal, Sector El Infierno, 2900 m, 19 Apr 2005, *Palacio 04* (HUA).

Phylloporus foliiporus (Murrill) Singer, Persoonia 9:424. 1978. FIGS. 10, 26

Gomphidius foliiporus Murrill, Mycologia 35:432. 1943.

Phylloporus rhodoxanthus ssp. *foliiporus* (Murrill) Singer, Farlowia 2:280. 1945.

Phylloporus foliiporus (Murrill) Phillips & Kibby, Mushrooms of North America, p 216. 1991. superfluous

Pileus 1.8–14.5 cm broad, at first convex, with age plane or plano-depressed, dry, even; disk subtomentose; margin even, when young dark reddish brown or maroon, then tan or ochraceous brown; surface subtomentose, becoming glabrous, with NH_4 blue green. *Flesh* white, staining blue (when fresh and young); odor and flavor mild; with NH_4 no reaction. *Hymenophore* lamellate, decurrent. *Lamellae* subdistant, not anastomosing, intervenose, forked, when young bright yellow, with age yellowish brown, staining blue; edges even. *Stipe* 1.6–5.5 cm long, 2–40 mm wide, equal or tapering downward, strict, dry; upper half when young finely subpruinose ridged, yellow, with age finely subpruinose ridged, grayish yellow; lower half when young floccose, olivaceous, grayish green; fibrils on upper half when young red-brown, with age light brown, on lower half when young gray-brown; base yellow, staining absent;

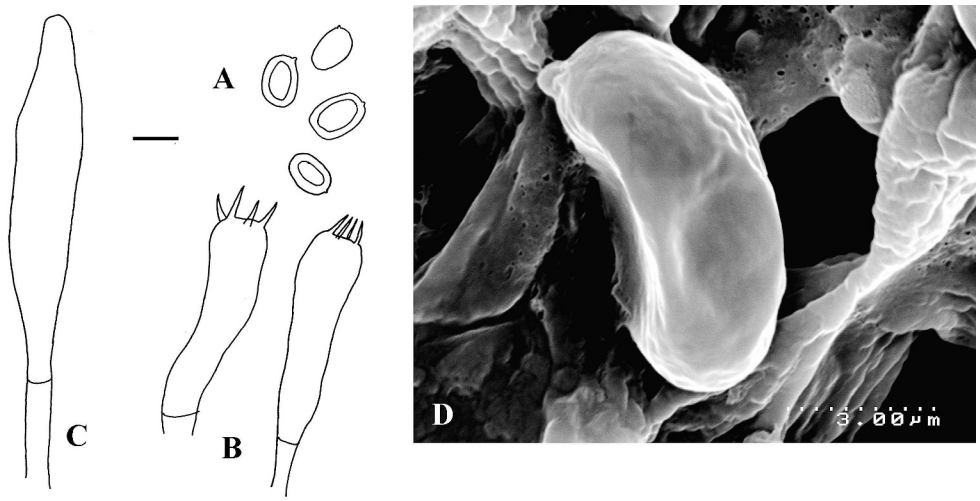

FIG. 11. *Phylloporus guzmanii*. A. Basidiospores. B. Basidia. C. Pleurocystidium. D. Scanning electron microscopy of basidiospore. Bar: A–C = 10 µm.

interior solid; flesh when young whitish yellow, staining blue. *Basal mycelium* yellow, or pale yellow. *Fleeting-amyloid reaction* positive.

Basidiospores brownish olive, 10.5–12.6 µm long, 4.2–4.9 µm wide, mean Q = 2.54, subfusoid, smooth, amyloid, in KOH ochraceous. *Basidia* 32.2–35 µm long, 5.6–6.3 µm wide, clavate, hyaline, four-sterigmate. *Hymenial cystidia* 38.5–50.4 µm long, 11.9–14 µm wide, more common on sides of lamellae, thin-walled, hyaline or honey-colored contents (at the apex), fusoid or clavate, encrusting pigment present (at the apex). *Hymenophoral trama* bilateral; hyphae cylindrical, 7–8.4 µm wide, hyaline, amyloid. *Pileipellis hyphae* a trichodermium (with appressed hyphae), in KOH pale yellow or hyaline, inamyloid; inflated, encrusted with pigment (brownish cytoplasmic content), thin-walled, granular content absent. *Pileus trama* hyphae hyaline, inamyloid, thin-walled. *Stipitipellis hyphae* vertically oriented, parallel, giving rise to clusters of caulocystidia, 42.7–44.1 µm long, 12.6–13.3 µm wide, clavate, yellow. *Stipe trama* hyphae parallel, cylindrical, hyaline, inamyloid. *Clamp connections* present (rare, in the hymenophoral trama).

Mycorrhizal hosts: *Pinus*, *Quercus*.

Distribution: The species is known from Japan and from southern USA; it has been collected in Florida and recently was found in Alabama.

One of the most diagnostic characteristics of this taxon is the presence of hymenial cystidia with a melleous-colored apex, sometimes constricted. Although Murrill (1943) did not mention the presence of cystidia, they are present in the type material. Singer (1945) described the presence of the cystidia, noting the colored apex but without emphasizing it as a diagnostic character. Additional collections deposited by Singer at FH also possess these diagnostic cystidia.

This is the third of the clamped species included in this work. *Phylloporus fibulatus* has more abundant clamp connections and lacks the melleous cystidia. *Phylloporus fibulatus* has smaller spores and the surface of the pileus turns brown when exposed to NH_4, in contrast to *P. foliiporus* that turns blue-green when exposed to NH_4. *Phylloporus colligatus* spores also are smaller than those of *P. foliiporus*; the NH_4 reaction is blue at first but turns burgundy, and the cystidia lack the melleous apex. The African *P. pseudopaxillus* has more abundant clamp connections that are seen throughout the basidiome.

Singer (1978) included *P. cyanescens* (Corner) Neves & Halling ined. as a synonym of *P. foliiporus*. However *P. cyanescens* has longer cystidia and the melleous contents are mostly seen in the cheilocystidia but not in the pleurocystidia. Watling and Gregory (1991) reported *P. foliiporus* from Queensland, Australia, however never mentioned the diagnostic cystidia or the presence of clamp connections.

Material examined: UNITED STATES. Florida: Alachua County, Gainsville, 31 May 1943, *Singer F 2183*, 8 Jul 1943, *Singer F 2629*; Sugarfoot Hammock, 11 Jul 1938, *West, Arnold & Murrill F17747* (ISOTYPE: FH); Highlands County, Highlands Hammock State Park, 15 Aug 1942, *Singer F 223/I, 223/I*; Sebring, Aug 194_, *Singer F 439* (FH). Alabama: Baldwin County, Meaher State Park, 22 Jul 2005, *Mata 1677* (NY). JAPAN. Nara: Nara Park, 5 Jul 1975, *Trappe 4289* (SFSC).

Phylloporus guzmanii Montoya & Band.-Muñoz, Mycotaxon 41:473. 1991. FIG. 11

Pileus 1.5–4.5 cm broad, at first convex, with age convex or plano-convex, dry; disk velutinous, at first

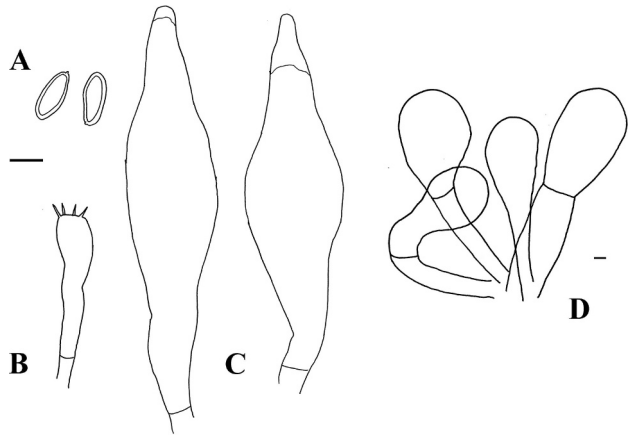

FIG. 12. *Phylloporus leucomycelinus*. A. Basidiospores. B. Basidium. C. Pleurocystidia. D. Stipitipellis with caulocystidia. Bar = 10 μm.

vinaceous red or dark purple, then dark reddish brown (with yellowish tinges); margin undulated, yellowish brown; surface velutinous, becoming tomentose. *Flesh* pale yellow, staining blue; odor and flavor mild. *Hymenophore* lamellate, decurrent. *Lamellae* close or subdistant, not anastomosing, intervenose, when young bright yellow, with age mustard yellow, staining blue or reddish brown; edges even. *Stipe* 25–50 cm long (65), 4–8 mm wide, equal, strict, dry; upper half subfibrillose, purplish, brown; lower half subfibrillose, brown; base brown, not staining; interior solid; flesh above when young pale yellow; flesh at base when young mustard yellow. *Basal mycelium* yellow. *Fleeting-amyloid reaction* positive (weakly).

Basidiospores (6.4–)7.2–8.8(–10.4) μm long, (3.2–)4–4.8(–5.6) μm wide, mean Q = 1.8, globose or ovoid, smooth, with SEM finely scrobiculate or bumpy inamyloid, in KOH pale yellow or greenish. *Basidia* 47–65.6 μm long, (5.6–)7.2–8 μm wide, clavate, hyaline, four-sterigmate. *Hymenial cystidia* (41.6–)45–105.6(–116.8) μm long, 5.6–11(–12) μm wide, moderately abundant, thin-walled, hyaline, subfusoid or sublageniform. *Hymenophoral trama* bilateral; hyphae cylindrical, (3.2–)4.8–10 μm wide, hyaline or yellowish. Subhymenial hyphae 2.4–3.2 μm wide. *Pileipellis hyphae* a trichodermium, in KOH yellowish, inamyloid; elements (20–)22–78(–80) μm wide, subclavate, smooth, thin-walled. *Pileus trama* hyphae hyaline, smooth, thin-walled. *Stipitipellis hyphae* vertically oriented, parallel, cylindrical, yellow. *Stipe trama* hyphae parallel, cylindrical, hyaline, inamyloid. *Clamp connections* absent.

Mycorrhizal hosts: *Pinus*, *Quercus*.

Distribution: This species is known only from northwestern Mexico.

This is another rare *Phylloporus* species with subglobose or ovoid spores. The collections originally were identified as *P. coccineus* Corner by Pérez-Ramirez et al. (1986); however the latter has broader pleurocystidia, larger cheilocystidia and shorter epicutis elements.

Material examined: MEXICO. Guerrero: Municipio de Chilpancingo, Omiltemi, 21 Aug 1985, *Pérez-Ramirez 565* (ISOTYPE: XAL).

Phylloporus leucomycelinus Singer, Persoonia 9:426. 1978. FIGS. 12, 27

Phylloporus leucomycelinus Singer & Gómez, Brenesia 22:176. 1984. *superfluous*

Phylloporus rhodoxanthus ssp. *albomycelinus* Snell & Dick, Boleti of Northeastern North America p 47. 1970. *nom. nud.*

Phylloporus rhodoxanthus ssp. *leucomycelinus* Singer, Röhrlinge p 91. 1965. *nom. nud.*

Pileus 2.8–3.4 cm broad, at first pulvinate, with age convex, dry, becoming rivulose cracked; when young pale red-brown; then deep red-brown; surface subvelutinous, with NH_4 blue green. *Flesh* yellowish white, staining blue and bright yellow (in the lower part of the pileus) or cinnamon (immediately underneath the cuticle); odor and flavor mild. *Hymenophore* lamellate, decurrent. *Lamellae* subclose or close, not anastomosing, intervenose, when young brownish yellow, with age yellowish brown, staining blue; edges even. *Stipe* 2.7–4.5 cm long, 3–5 mm wide, tapering downward, strict or curved, dry; upper half when young punctate, red-brown, with age punctate, pale brown; lower half when young punctate, pale brownish red; pruina on upper half when young red-brown; base pallid, not staining; interior solid; flesh above when young whitish yellow, staining bright yellow, flesh at base when young whitish yellow, not staining. *Basal mycelium* white. *Fleeting-amyloid reaction* positive.

Basidiospores olive-brown in mass, 10–12.5(–13.5) μm long, 3.3–4.5(–4.8) μm wide, mean Q = 2.88, subfusoid, smooth, dextrinoid, in KOH pale yellow. *Basidia* 20–25 μm long, 6–7 μm wide, ventricose, hyaline, four-sterigmate. *Hymenial cystidia* 50–71 μm long, (6–)11–12 μm wide, moderately abundant, thin-walled, hyaline, ampullaceous, encrusting pigment absent. *Hymenophoral trama* bilateral; hyphae cylindrical, melleous hyaline. *Pileipellis hyphae* a trichodermium, in KOH pale yellow or hyaline, inamyloid; elements 18–50 μm wide, cylindrical, smooth, thin-walled. *Pileus trama* hyphae hyaline, inamyloid, smooth, thin-walled. *Stipitipellis hyphae* vertically oriented, parallel, giving rise to dermatocystidia or clusters of caulocystidia, 49.7–53.9 μm long, 8.4–11.2 μm wide, clavate, hyaline. *Stipe trama* hyphae parallel, cylindrical, hyaline, inamyloid. *Clamp connections* absent.

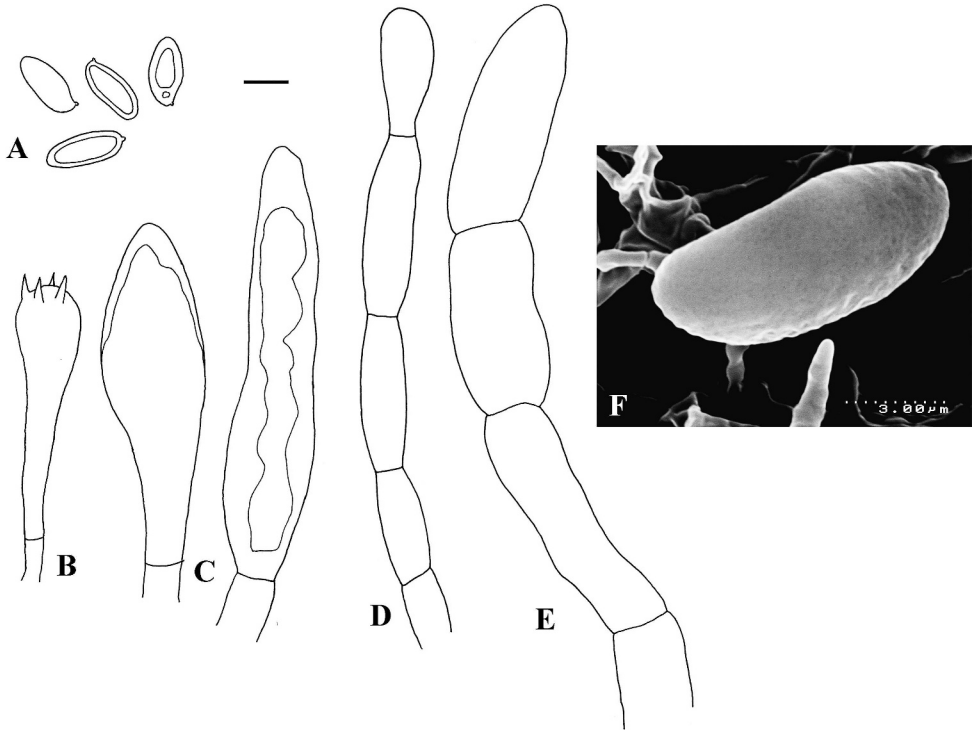

FIG. 13. *Phylloporus phaeoxanthus* var. *phaeoxanthus*. A. Basidiospores. B. Basidium. C. Cystidia. D. Stipitipellis hyphae. E. Pileipellis hyphae. F. Scanning electron microscopy of basidiospore. Bar: A–E = 10 µm.

Mycorrhizal hosts: *Fagus* and possibly *Quercus*.

Distribution: This taxon has been reported from eastern USA. Although Singer (1986) noted a collection from Canada that might be *P. leucomycelinus*, he omitted the collection number and the specimen was not found at FH or F.

This species is sympatric with *P. rhodoxanthus* in eastern USA and has been confused with it, even though the two species can be distinguished easily by the white versus yellow basal mycelium. Because *P. rhodoxanthus* was the only known species in USA until Singer validly published *P. leucomycelinus*, many collections had been identified as a ''white basal mycelium form'' of *P. rhodoxanthus*. Diagnostic characteristics of this taxon include cyanescent flesh and white basal mycelium.

Phylloporus leucomycelinus is cited mostly as occurring in fagaceous forests. It is possible that it is associated with *Quercus* because it has been collected around *Quercus* trees. Watling and Gregory (1991) collected in Australia what they considered to be *P.* aff. *leucomycelinus* in a *Eucalyptus* forest, however it is likely that the Australian collection belongs to a different taxon.

This taxon was mentioned for the first time by Singer (1945) as a variety of *P. rhodoxanthus* ssp. *americanus* with white basal mycelium. Singer (1965) used the name *P. rhodoxanthus* spp. *leucomycelinus* for the first time in a key, but no Latin diagnosis and no type were included. Snell and Dick (1970) published *P. rhodoxanthus* ssp. *albomycelinus* based on Singer's (1945) notes, but this also is considered *nomen nudum* because no type or Latin diagnosis were included.

Material examined: UNITED STATES. Michigan: Warren Woods, 23 Jul 1973, Ponce de León & Nash; *Singer N4674* (HOLOTYPE: F). New York: Bronx. New York Botanical Garden, 40°67′N, 73°94′W, 14 Sep 2003, *Halling 6279*, *Halling 6649*, *Halling 7055*, *Halling 8705*, *Halling 8452* (NY). Massachusetts: Upton, 12 Aug 2003, *Binder 03-038* (NY); Worcester, Rutland State Park, 27 Aug 2000, *Binder 00-043* (NY); Lancaster, Devens Reserve Forces Training Area, Slate Quarry, 70 m, 2 Sep 1998, *D-112* (FH).

Phylloporus phaeoxanthus var. *phaeoxanthus* Singer & L.D. Gómez, Brenesia 22:171. 1984. FIGS. 13, 28

Pileus 2.5–4 cm broad, at first plano-convex, with age plane, dry; disk even, vinaceous brown (8F5); margin even, brown (6D7, 6D6); surface tomentose, with NH_4 blue green or dull lilac (eventually). *Flesh* 4–10 mm thick, white, staining absent; odor and flavor mild; with NH_4 blue green or dull lilac. *Hymenophore* lamellate, decurrent. *Lamellae* close, 1–8 mm wide, anastomosing to subporoid, yellow (3A7), staining absent; edges even. *Stipe* 2–3 cm long, 6–8 mm wide, equal to tapering downward, curved, dry; upper half

when young finely pruinose, pale brown (6D6) to brown (7E7); lower half when young finely pruinose, pale brown to brown; base pale yellow to yellow, not staining; interior solid; flesh above white to whitish yellow to yellow, not staining, flesh at base white to yellow, not staining. *Basal mycelium* yellow. *Fleeting-amyloid reaction* weakly positive.

Basidiospores (6.5–)8.5–12.3(–14) μm long, (3.3–)4.3–4.8 μm wide, mean Q = 2.84, subfusoid, smooth, with SEM finely bacillate or bumpy, inamyloid, in KOH light brown melleous. *Basidia* 23–40 μm long, 6–9 μm wide, clavate, hyaline, four-sterigmate. *Hymenial cystidia* 35–90 μm long, 9–20 μm wide, moderately abundant, thin-walled, hyaline, ventricose to fusoid to utriform, encrusting pigment present. *Hymenophoral trama* bilateral; up to 15 μm wide, hyaline, in KOH finely melleous ocher. *Pileipellis hyphae* a trichodermium and forming a palisade, in KOH yellow, inamyloid; elements 6–12 μm wide, elongated, smooth, thick-walled. Intercalary cells subisodiametric to isodiametric, 10–12 μm long, 8–10 μm wide. *Pileus trama* interwoven, hyphae hyaline, inamyloid. *Stipitipellis hyphae* palisade-like, with short cells arranged in chains, vertically oriented, parallel to interwoven, giving rise to clusters of caulocystidia, 15–45 μm long, 7–13 μm wide, ventricose to fusoid, with encrusting pigment sometimes present. *Stipe trama* hyphae parallel to subparallel, cylindrical, hyaline, inamyloid. *Clamp connections* absent.

Mycorrhizal host: *Quercus*.

Distribution: This species is known from Costa Rica, Colombia and Mexico.

The yellow mycelium at the stipe base, brown pileus, unchanging context, palisade-like arrangement of hyphal elements in the pileipellis, the cells arranged in chains in the stipitipellis, and blue ammonia reaction are diagnostic for *P. phaeoxanthus*. (See comments under *P. phaeoxanthus* var. *simplex* for comparison.)

Material examined: COSTA RICA. San José: Jardín de Dota, Route 2, 6 km west of Empalme, 2000 m, 2 Jul 1983, *Singer 20583* (HOLOTYPE: F). COLOMBIA. Departamento de Boyacá: near border with Departamento de Cudinamarca, Municipio San Miguel de Sema, road from Simijacta to San Miguel de Sema, 9 May 1987, *Halling 5248* (NY). Departamento de Cauca: Municipio de Popayan, vereda Rio Blanco, Hacienda Cantaclaro, 1800 m, 9 May 1990, *Franco-Molano 423* (NY).

Phylloporus phaeoxanthus var. *simplex* Singer & L.D. Gómez, Brenesia 22:172. 1984. FIGS. 14, 29

Pileus 2–6.5 cm broad, at first plano-convex, with age plane, dry; vinaceous brown (8F5) to light brown; margin even, brown (6D7, 6D6); surface finely scaly, scales dark brown, with NH_4 blue green. *Flesh* white, staining absent; odor and flavor mild; with NH_4 blue.

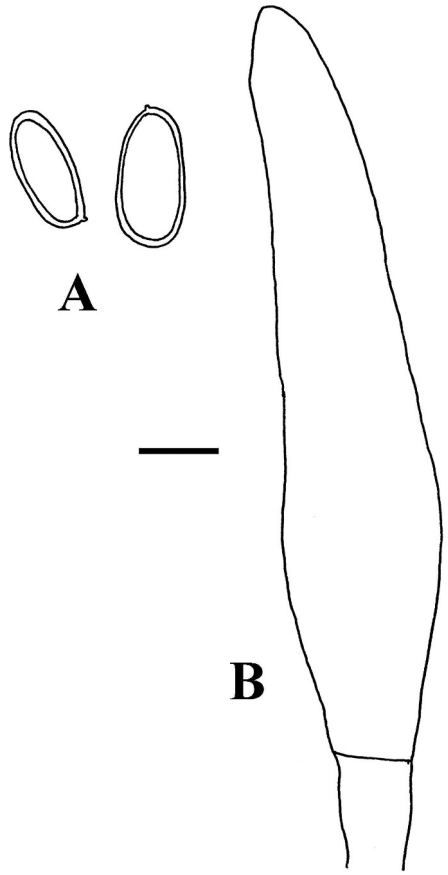

FIG. 14. *Phylloporus phaeoxanthus* var. *simplex*. A. Basidiospores. B. Pleurocystidium. Bar = 10 μm.

Hymenophore lamellate, decurrent. *Lamellae* close, with venations, bright yellow (3A8), staining absent; edges even. *Stipe* 3–4.5 cm long, 5–8 mm wide, equal to tapering downward, dry; upper half when young finely pruinose, pale brown (6D6); lower half when young finely pruinose, pale brown to brown; base pale yellow to yellow, not staining; interior solid; flesh above white to whitish yellow to yellow, not staining, flesh at base white to yellow, not staining. *Basal mycelium* yellow. *Fleeting-amyloid reaction* weakly positive.

Basidiospores 8.5–12.3(–14) μm long, 4.3–4.8 μm wide, mean Q = 2.84, subfusoid, smooth, with SEM finely bacillate or bumpy, dextrinoid, in KOH light brown melleous. *Basidia* 23–40 μm long, 6–9 μm wide, clavate, hyaline, four-sterigmate. *Hymenial cystidia* 30–101.5 μm long, 9–28 μm wide, moderately abundant, thin-walled, hyaline, versiform, encrusting pigment absent. *Hymenophoral trama* bilateral; hyaline, in KOH finely melleous ocher. *Pileipellis hyphae* a trichodermium and forming a palisade, in KOH yellow, inamyloid. *Pileus trama* interwoven, hyphae hyaline, inamyloid. *Stipitipellis hyphae* palisade-like, with short cells arranged in chains, vertically oriented,

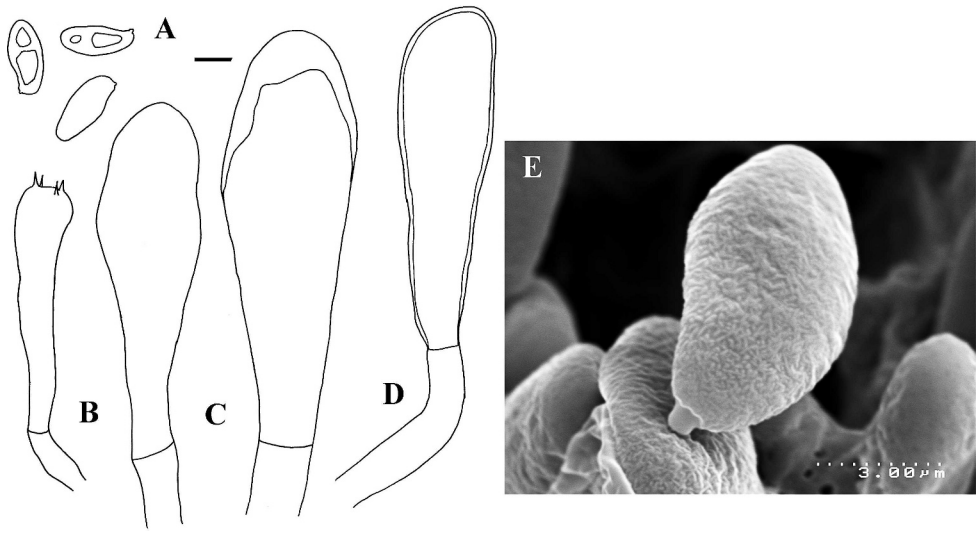

FIG. 15. *Phylloporus rhodoxanthus*. A. Basidiospores. B. Basidium. C. Pleurocystidia. D. Caulocystidium. E. Scanning electron microscopy of basidiospore. Bar: A–D = 10 µm.

parallel to interwoven, giving rise to clusters of caulocystidia, 15–45 µm long, 7–13 µm wide, ventricose to fusoid. *Stipe trama* hyphae parallel to subparallel, cylindrical, hyaline, inamyloid. *Clamp connections* absent.

Mycorrhizal host: *Quercus*.

Distribution: Variety *simplex* is only known from Costa Rica, where it is more common than var. *phaeoxanthus*. Variety *simplex* differs from var. *phaeoxanthus* in having dextrinoid basidiospores, hymenial cystidia that are unencrusted, more variable in size and shape, and thin- instead of thick-walled.

Material examined: COSTA RICA. San José: Empalme, 1.1 km east of La Perla Restaurant, 2000 m, Jul 1983, *Singer 20623* (HOLOTYPE: F); San Gerardo de Dota, Albergue de La Montaña, Savegre, 5 km southwest Cerro de La Muerte, 9°33′2″N, 83°48′27″W, 2350 m, 19 Oct 1994, *Halling 7388*, 3 Jun 2005, *Neves 17*, 6 Jun 2005, *Neves 31*, 7 Jun 2005, *Neves 38*, 8 Jun 2005, *Neves 42*, 13 Jun 2005, *Neves 55*, 15 Jun 2005, *Neves 64*, *65*, *66* (NY).

Phylloporus rhodoxanthus (Schwein.) Bres., Fungi Tridentini 2(14):95. 1900. FIGS. 15, 30

Agaricus rhodoxanthus Schwein., Schr. Naturf. Ges. Leipzig 1:83. 1822.

Paxillus flavidus Berk, London J. Bot. 6:315. 1847.

Gomphidius rhodoxanthus (Schwein.) Sacc., Syll. Fung. 5:1887.

Phylloporus rhodoxanthus ssp. *americanus* Singer, Rev. Mycol. (Paris) 3:171. 1938.

Pileus (2.5–)6–7.5 cm broad, at first obtusely convex or convex or subumbonate, with age subdepressed, dry, even; disk even, at first tawny olivaceous; when young cinnamon brown; surface subtomentose or tomentose, becoming fibrillose tomentose, with NH_4 blue. *Flesh* buff, staining absent; odor and flavor mild. *Hymenophore* lamellate, decurrent. *Lamellae* subclose or close, not anastomosing, intervenose, when young deep yellow, with age yellowish brown, staining absent; edges even. *Stipe* 3.3–4.1 cm long, 5–8 mm wide, equal, strict, dry; upper half when young pustulate, yellow, with age longitudinally ridged, yellow; base pale yellow or yellow, not staining; interior solid, or soon hollow; flesh above when young buff, flesh at base when young buff, staining cinnamon. *Basal mycelium* yellow. *Fleeting-amyloid reaction* positive.

Basidiospores 10–12(–14.5) µm long, 3.5–4.5 (–5.5) µm wide, mean Q = 2.7, subfusoid, smooth, with SEM bacillate, inamyloid, in KOH melleous. *Basidia* 28–37 µm long, (6–)6.8–9 µm wide, clavate, hyaline, four-sterigmate. *Hymenial cystidia* 40–95 µm long, 9–27 µm wide, numerous on sides and edges of tubes, thin-walled, hyaline, ventricose or clavate-ventricose, encrusting pigment present (scarcely in a few). *Hymenophoral trama* bilateral; hyphae cylindrical, hyaline, inamyloid. *Pileipellis hyphae* a trichodermium, inamyloid; elongated, encrusted with pigment, thin-walled, granular content absent. Intercalary cells subisodiametric, 16 µm long, 14 µm wide. *Stipitipellis hyphae* vertically oriented, parallel, giving rise to dermatocystidia (clavate to ventricose), cylindrical. *Stipe trama* hyphae parallel, cylindrical, hyaline, inamyloid. *Clamp connections* absent.

Mycorrhizal hosts: *Quercus*, *Fagus*, *Pinus*.

Distribution: This species is found widely in oak and beech forests in USA and also has been reported from Belize (Ortiz-Santana et al. 2007).

The species originally was described from a collec-

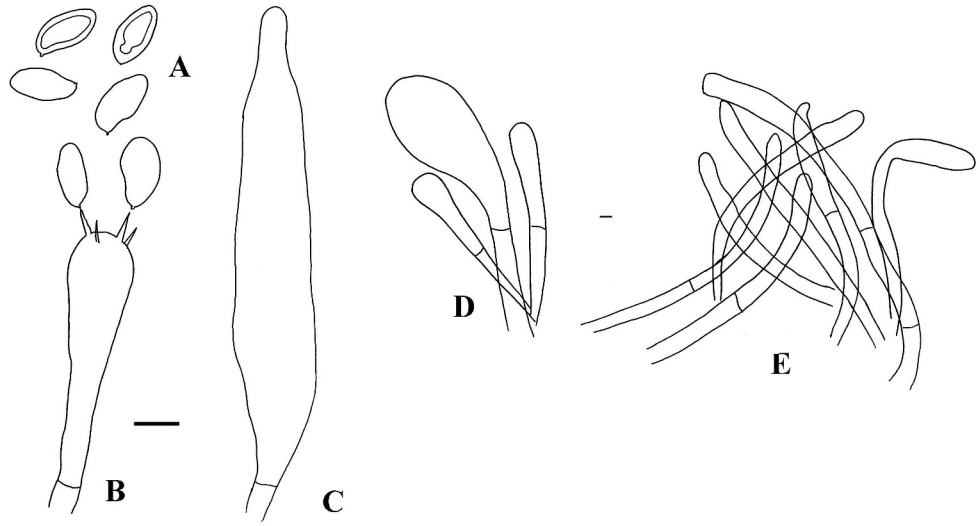

FIG. 16. *Phylloporus scabripes*. A. Basidiospores. B. Basidium. C. Pleurocystidium. D. Stipitipellis with caulocystidia. E. Pileipellis hyphae. Bar = 10 μm.

tion in North Carolina, but there is no information about the location of the type specimen. Representative material deposited in FH as *Phylloporus rhodoxanthus* ssp. *americanus* is designated here as the neotype: Singer, 22 Jul–25 Aug 1946, near Mountain Lake, Giles County, Virginia, under pines (*Pinus rigida*), no collection number (as *P. rhodoxanthus* [Schwein.] Bres. ssp *americanus* Sing. [type ssp.]).

This is the most widely used name in *Phylloporus*. The taxon as it was interpreted by Singer, and is now recognized, occurs in eastern USA to possibly Belize along with other species of *Phylloporus* (*P. boletinoides*, *P. foliiporus*, *P. leucomycelinus*). The species has yellow basal mycelium; the flesh and other parts of the basidiome do not stain blue, and the application of NH_4 to the pileus surface produces an immediate blue reaction. The species concept has a complicated history, including the synonymy with *P. pelletieri* and the creation of a complex that included a number of subspecies: *americanus*, *bogoriensis*, *europeaus*, *foliiporus*, *leucomycelinus* and *sulcatus*. Among those *P. bogoriensis*, *P. foliiporus*, *P. leucomycelinus*,

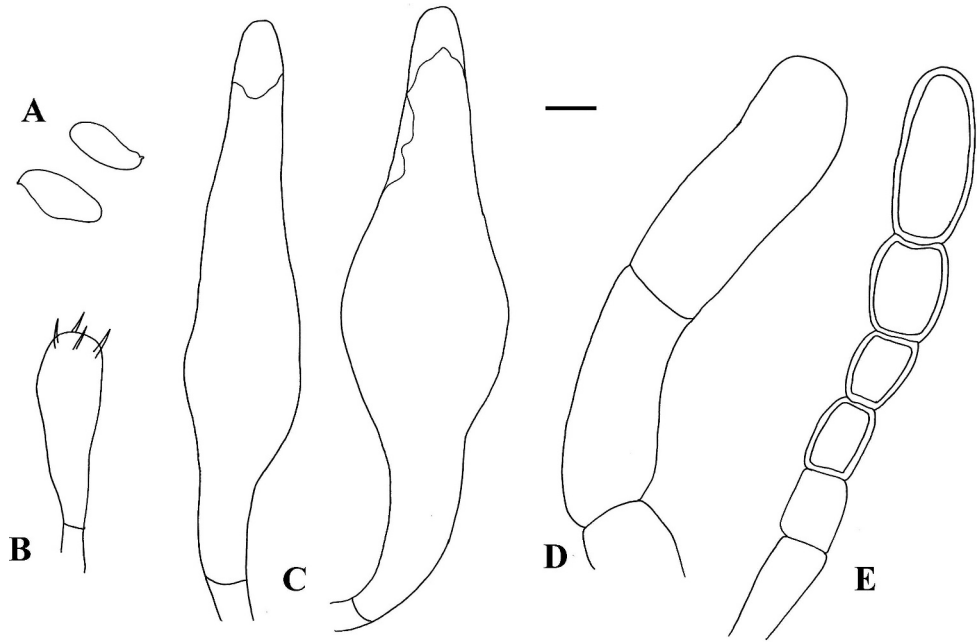

FIG. 17. *Phylloporus* sp2. A. Basidiospores. B. Basidium. C. Pleurocystidia. D. Pileipellis hyphae. E. Stipitipellis hyphae. Bar = 10 μm.

FIGS. 18–24. 18. *Phylloporus alborufus*. 19. *Phylloporus arenicola*. 20. *Phylloporus aurantiacus*. 21. *Phylloporus bellus*. 22. *Phylloporus boletinoides*. 23. *Phylloporus centroamericanus*. 24. *Phylloporus colligatus*; photo courtesy T. Henkel.

and *P. sulcatus* have been elevated and are recognized at the species level.

Material examined: UNITED STATES. Virginia: Giles County, Near Mountain Lake, 22 Jul–25 Aug 1946, *Singer* (no collection number, type ssp. *americanus*) (NEOTYPE: FH). North Carolina: Asheville, 17 Jul 2004, *Neves 75* (NY); Pennsylvania: Mont Alto, 12 Aug 2005, *Neves 97* plus two collections (NY). Alabama: Mobile County, 22 May 2005, *Mata 1808* (NY). New York: Cornwall, Black Rock Forest, *Halling 8714* (NY); 19 Jul 1933, *Singer 667* (FH). Illinois: Cook County, Palos Park Cook County Forest Preserve, Sag Valley Division, Swallow Cliff Woods, 41°40′34″N, 87°51′52″W, 215 m, 19 Aug 1997, *Campbell 159*; 23 Aug 2003, *Leacock 5805* (F). Texas: Jasper County, Black Brunch

FIGS. 25–31. 25. *Phylloporus fibulatus*. 26. *Phylloporus foliiporus*. 27. *Phylloporus leucomycelinus*. 28. *Phylloporus phaeoxanthus* var. *phaeoxanthus*. 29. *Phylloporus phaeoxanthus* var. *simplex*. 30. *Phylloporus rhodoxanthus*. 31. *Phylloporus scabripes*.

Hunting Club, Roads 2 and 6, 8 Jun 1990, *Lewis 4378* (F). North Carolina: Macon County, Horse Cove Drive, Bull Pen Road, 1000 m, 20 Jul 1997, *Quist 42* (F).

Phylloporus scabripes Ortiz & Neves, Fungal Diversity 27:247–416. 2007. FIGS. 16, 31

Pileus 2.8–6.5(–7.5) cm broad, convex, dry, even, becoming tomentose; at first pale red-brown, then tan; margin inrolled; surface tomentose, with NH_4 bright green (then slowly vinaceous lilac). *Flesh* 10 mm thick, yellowish white or yellow, staining absent; odor not distinctive; flavor mild; with NH_4 lilac just under the pileipellis. *Hymenophore* lamellate, decurrent. *Lamellae* close, 7 mm wide, simple, when young

yellow, with age olive, staining reddish brown in a few seconds; edges even. *Stipe* 3–5(–6) cm long, 7–15 mm wide, equal, strict, dry; upper half when young squamulose, pale yellow, light cinnamon or red-brown; lower half pale yellow, with age squamulose; scabers on upper half when young red-brown; base pale yellow, not staining; interior solid; flesh whitish yellow, not staining. *Basal mycelium* bright yellow. *Fleeting-amyloid reaction* positive.

Basidiospores 9.8–12.6 µm long, 3.5–4.9 µm wide, mean Q = 2.67, subfusoid, smooth, slightly dextrinoid, in KOH straw yellow or olive-hyaline. *Basidia* 33.6–38.5 µm long, 8.4–9.8 µm wide, cylindrical, hyaline, four-sterigmate. *Hymenial cystidia* 42.7–79.1 µm long, 12.6–14.7 µm wide, more common toward the edge of lamellae, thin-walled, hyaline, cylindrical or clavate, encrusting pigment absent. *Hymenophoral trama* bilateral; hyphae cylindrical, hyaline, amyloid. *Pileipellis hyphae* a trichodermium, in KOH yellow ochraceous, inamyloid; smooth, thin-walled. *Pileus trama* interwoven, hyphae ochraceous (pigment dissolving in KOH), inamyloid, thin-walled. *Stipitipellis hyphae* vertically oriented, parallel, giving rise to versiform caulocystidia, 16.1–80.5 µm long, 7–18.9 µm wide, fusoid or clavate or ventricose, hyaline. *Stipe trama* hyphae parallel, cylindrical, inamyloid. *Clamp connections* absent.

Mycorrhizal hosts: *Pinus*, *Quercus*.

Distribution: This is a species described from Belize and so far known only from that country.

This species is distinctive because of the orangish pileus surface that becomes greenish blue when exposed to NH_4, and the reddish scabers on the upper surface of the yellow stipe. No other known *Phylloporus* species has a scabrous stipe.

Material examined: BELIZE. Belize District: Western Highway, Foster property, near Belize Zoo, 17°22′25″N, 88°33′42″W, 50 m, 15 Oct 2003, *Halling 8558* (NY); Cayo District: Mountain Pine Ridge Reserve, 17°2′5.1″N, 88°56′53.3″W, 450 m, 7 Oct 2003, *Halling 8531* (NY).

Phylloporus sp. 1. FIG. 17

Pileus 2–2.25 cm broad, at first convex, with age plano-convex or plane, dry, entire; disk finely scaly, at first dark vinaceous brown, then violet-brown (10F4); margin inrolled, when young violet-brown; surface scaly, becoming crenate, with NH_4 no reaction. *Flesh* yellowish white, staining blue; odor and flavor mild; with NH_4 light pink (under pileipellis). *Hymenophore* lamellate, decurrent. *Lamellae* subdistant, simple, when young bright yellow (3A6), with age yellowish green, staining light blue; edges even. *Stipe* 1.5–2.5 cm long, 4 mm wide, equal, curved, dry; brown (7E4), with age finely squamulose, pale brown; base yellow, not staining; interior solid; flesh when young whitish yellow (2A2), with NH_4 blue. *Basal mycelium* yellow. *Fleeting-amyloid reaction* positive.

Basidiospores 9.1–10.5 µm long, 2.8–3.5 µm wide, mean Q = 3.1, subfusoid or cylindrical, smooth, slightly amyloid, in KOH light brown melleous. *Basidia* 23.1–25.2 µm long, 5.6–7 µm wide, clavate, hyaline, 2–4-sterigmate. *Hymenial cystidia* 63.7–70 µm long, (8.4–)10.5–18.2 µm wide, more common toward the edge of lamellae, thin-walled, hyaline, subfusoid or fusoid or ventricose, encrusting pigment present. *Hymenophoral trama* bilateral; hyphae cylindrical, 6.3–7.7 µm wide, hyaline, inamyloid. *Pileipellis hyphae* a trichodermium, in KOH yellow ochraceous or brownish, inamyloid; elements 6.3–14 µm wide, inflated or cylindrical, smooth, thick-walled, granular content absent. *Pileus trama* interwoven, hyphae hyaline, inamyloid, smooth, thin-walled. *Stipitipellis hyphae* vertically oriented, parallel, giving rise to chains of short cells (thick-walled), 9.8–20.3 µm long, 8.4–9.1 µm wide, subcylindrical, yellow-brown contents. *Stipe trama* hyphae parallel, cylindrical, hyaline, inamyloid. *Clamp connections* absent.

Mycorrhizal host: *Quercus*.

Distribution: This collection was found in Costa Rica in Puntarenas Province and so far is the only one known.

The collection is composed of only one basidiome. The stipitipellis with chains of cells is similar to those observed in *P. phaeoxanthus* but with thicker walls. It is included as a distinct taxon and keyed separately because of this distinctive feature and the absence of a NH_4 reaction on the pileus.

Material examined: COSTA RICA. Puntarenas: Coto Brus, Zona Protectora Las Tablas, Finca La Cafrosa, Camino El Portones por el Tajo, 8°55′34″N, 82°46′W, 1500 m, 12 Jun 2004, *Neves 50* (NY).

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