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TWO INTERESTING RECORDS OF BOLETES FOUND IN COFFEE PLANTATIONS IN EASTERN MEXICO

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Fresh collections of boletes gathered in coffee plantations from the State of Veracruz (Gulf of Mexico) were investigated. They belong to species of the poroid genus *Phlebopus* (*P. portentosus*) and the lamellate genus *Phylloboletellus* (*P. chloephorus*). Basidiomata of each species grew on the ground under coffee plants near trees of *Enterolobium, Ficus, Inga*, and *Spondias*. The two species are described and illustrated.

The cultivation of coffee is an important agricultural practice in Mexico. Coffee plantations occupy areas of variable extension, and are found in regions dominated by more than one type of vegetation (Moguel & Toledo, 1999). In the Central area from the Gulf of Mexico (State of Veracruz) coffee plantations represent one of the most common agro-systems introduced amongst remnants of native woods which are transformed into managed forests or into monospecific plantations (Jiménez, 1979; Jiménez & Correa, 1980; Escamilla et al., 1995). Except for the unshaded (or sunny) system of coffee production, the management of the remaining four recognized types of coffee agro-ecosystems (Fuentes, 1979; Moguel & Toledo, 1999) involves the maintenance of trees originally established in the areas or replaced by different plant species. It offers a range of canopy levels and produces vegetationally and structurally diverse systems which still embrace an important biological diversity (Moguel & Toledo, 1999).

The documentation published on the diversity of macromycetes from the Gulf of Mexico region embraces especially information on species occurring in different forests, and data on the macrofungi inhabiting coffee plantations (under different degrees of management) are practically absent. These agro-ecosystems are currently a component of the vegetation covering the sites dedicated to the cultivation of coffee. As part of the native biological diversity of Mexico, it is of interest to document the diversity of macromycetes inhabiting these coffee systems. Compared with forest areas, the macromycetes component in coffee fields is perhaps lower in terms of original representatives (especially ectomycorrhizal). However, a high diversity of species which have found suitable habitats or even refuge in such systems under both wild or introduced trees can be expected.

As part of our fieldwork undertaken to study the macromycetes inhabiting the broad-leaved tree forests from Central Veracruz (Gulf of Mexico) (Bandala & Montoya, 2002), some visits to different coffee-producing localities have been made. We selected some sites at different altitudes and under different levels of management in order to program periodical observations. The boletes studied herein grew in two shaded coffee plantations; these latter, according to their characteristics, seem to be intermediate between the so-called traditional and commercial polycultures (Fuentes, 1979; Moguel & Toledo,

1999). Both sites are established in a warm region at 1,000 m above sea level. The forest cover, remnant of a tropical deciduous forest, comprises native elements like trees of *Enterolobium cyclocarpum* (Jacq.) Griseb. ('nacaxtle') and *Spondias mombin* L. ('jobo'), including some native or introduced trees of the genus *Inga* spp. ('jinicuil' and 'chalahuite'). Planted elements found in the sites are *Ficus calyculata* Mill. ('higuera'), and some members of *Cedrus, Citrus, Musa*, among others. The two boletes studied represent species of the poroid genus *Phlebopus* (R. Heim) Singer 1936 and the lamellate *Phylloboletellus* Singer 1951, which are scarcely documented in Mexico and typically reported from natural (uncultivated) forests (Bandala et al., 1988; Guzmán & Guzmán-Dávalos, 1984; García et al., 1986; Singer et al., 1990), although it is said that their members are not necessarily forming ectomycorrhiza (Singer, 1986; Singer et al., 1990).

MATERIAL AND METHODS

Basidiomes were recorded in fresh condition. Annotations of colours in brackets were codified following Kornerup & Wanscher (1967) (for the description of *Phylloboletellus chloephorus*), and Kornerup & Wanscher (1978) (for *Phlebopus portentosus*). Colours codified as 2.5Y 8/8; 10YR 8/4 in *Phylloboletellus chloephorus* refer to the Munsell color chart (1994). For the microscopic study hand sections of dry basidiomes were mounted in 5% KOH, 1% Congo red (aqueous solution) and Melzer's reagent. Line drawings of microscopic structures were made with the aid of a drawing tube. The designations used for the basidiospore measurements are: Rm = range of means in n collections; Qm = range of means of Q (length/width ratio). All measurements of microscopic structures were made in KOH (potassium hydroxide). The scanning electron microscope (SEM) photographs were obtained after mounting small pieces of dry hymenophore which were previously fixed in glutaraldehyde, critically point dried, and later coated with gold-palladium. Herbaria acronyms are based on Holmgren et al. (1990).

TAXONOMY

Phlebopus portentosus (Berk. & Broome) Boedijn — Fig. 1, Plate1a, 1b, Colour plate 1 (p. 445)

Phlebopus portentosus (Berk. & Broome) Boedijn, Sydowia 5 (1951) 218.

Boletus portentosus Berk. & Broome, J. Linn. Soc. (Bot.) 14 (1875) 46; *Phaeogyroporus portentosus* (Berk. & Broome) McNabb, New Z. J. Bot. 6 (1968) 142.

Pileus 58–116 mm wide, convex to plano-convex, brown or brownish-orange on the whole surface (K. & W. 7E7), gradually paler, becoming ochraceous or yellowish brown (5B5) towards the margin, with faint olivaceous tints, irregularly stained with a brownish-red (± 8F5-6) colour, pruinose at centre in younger stage, smooth, glabrous, dry, slightly viscid with a drop of water on touching; margin at first incurved, later moderately expanded but maintaining a thin band which partially covers the hymenophore around pileus; this band remains attached at margin after loss of moisture; the whole margin is moderately undulate. Hymenophore tubulate, adnate or adnate-sinuate, never decurrent, becoming depressed around the stipe, tubes yellow to yellowish or yellowish olive (± 3C7-8), slightly bluing when exposed, 6–12 mm long, gradually shorter towards the

Fig. 1. *Phlebopus portentosus*. a. Basidiospores; b. section of pileipellis; c. cheilocystidia; d. basidia; e. terminal elements of the pileipellis (*Jarvio 1150*) (bar = 10 μm; except b = 15 μm).

margin; pores greenish yellow (± 3B7), brownish red when injured, rather concolorous with the pileus stains, small (1 or 2 per mm), ± isodiametric to irregular, weakly fimbriate. Stipe 42–81 × 15–32 mm, moderately cylindric to subclavate, robust, solid, yellow or yellowish (3A4-4A4) at apex, downwards darker, rather entirely yellowish brown with olivaceous tinges (5F7-8), irregularly coloured in brown-red or vinaceous to dark vinaceous tinges from the base upwards, with yellowish olive base, smooth but with a brown pruina (observed under lens), somewhat sulcate or wrinkled longitudinally all over or at least at base; base with remnants of an olivaceous yellowish brown mycelial mass and some pale yellow rhizomorphous strands. Context pale lemon-yellow to yellow (3A3), reddish brown under the pileal surface and bluing or with greenish tints near the hymenophore, becoming ochraceous; when cut or pressed a watery (colourless) latex exudes (mainly the stipe) which stains white paper reddish-brown. Odour pleasant, more or less fruity, taste mild or slightly bitter. Spore print brown olivaceous.

Macrochemical reactions: KOH brown to pale brown or slightly pinkish on pileus, pale brown on context and brownish or amber-brown on tubes and pores. NH_4OH reddish brown on pileus and leaving a vinaceous or violaceous ring.

Basidiospores 5.6–7.2(–8.0) × 4.8–6.4 µm, Rm = 6.4–7.1 × 5.1–5.6, Qm = 1.26–1.27, ellipsoid to short ellipsoid, weakly depressed adaxially then some appearing somewhat reniform, pale yellowish brown to ochraceous brown, thick-walled (up to 1 µm thick), smooth, often containing a large oil-guttule, hilar appendix minute, inamyloid but some with a weakly greenish shade under Melzer's solution. Basidia 16–32 × (5.6–)6.4–12 µm, clavate, 4-spored, some bi- or monosporic, then sometimes with a sterigma variable in length, some appearing mucronate, hyaline, thin-walled, clamped. Pleurocystidia absent. Cheilocystidia 16–44 × 8–17 µm, broadly clavate to subglobose, hyaline, some faintly brownish (not clearly pigmented), thin-walled, numerous, not gelatinized, clamped. Pileipellis an ixotrichodermis, composed of hyaline to yellowish, thin-walled, smooth hyphae, 3.2–6.4(–7.2) µm wide, with some suberect or prostrate elements; terminal hyphae 16–54 × (4.0–)4.8–12 µm, undifferentiated or variable in shape (slender or somewhat swollen, subcylindric, clavate, subutriform or sublageniform), thin-walled, clamped, hyaline or often yellowish, then the layer more or less pigmented, loosely arranged, gelatinized (but not refringent), with scattered, curved or flexuous, oleiferous hyphae 6–9.6 µm wide which are abundant downwards. Pileus trama consisting of loosely interwoven but more or less parallel orientated, cylindric to somewhat inflated, thin-walled hyphae (4.8–)6.4–12(–14) µm wide, hyaline to yellowish in mass, clamped, tighter upwards. Hymenophoral trama bilateral, with thin-walled, smooth hyphae (4.0–)4.8–8.0(–8.8) µm wide, with a weakly gelatinized central band of hyaline to yellowish hyphae, laterostratum loosely arranged, with hyaline, gelatinized hyphae, oleiferous hyphae scattered. Stipitipellis hymeniform, composed of elements measuring 24–53 × 4.8–16 µm, clavate, clavate-mucronate, subutriform or subcylindric, some slightly swollen, yellowish in water, with an incrusting, resinous, orange-brown matter, which is more or less continuous and irregularly covers the elements; this material is dissolved in KOH and then only remaining as scattered granules; stipe context with more or less parallel, yellowish, thin-walled, slightly gelatinized hyphae, yellow to dark yellow in mass; oleiferous hyphae scattered.

Habitat — Subgregarious or solitary, on soil among dead leaves, under coffee plants near *Enterolobium cyclocarpum* trees.

Material examined. MEXICO: Veracruz, Municipio Coatepec, near Puerto Rico, 18.V.2001, *Jarvio 913*; ibidem, 23.VI.2002, *Jarvio 1150*; Ejido Las Lomas, 3.IX.1994, *Leal 415* (all at XAL).

The following set of features was found to be distinctive in our collections and relates with *P. portentosus*: pileipellis with more or less slender terminal hyphae (in a trichodermoid arrangement), presence of clamp-connections, absence of pleurocystidia, markedly swollen cheilocystidia, brown pigmented basidiomes, irregularly stained with brownish red or vinaceous to dark vinaceous colours, and minute pores (≤ 1 mm). Mexican specimens (of different sizes) shared a similar range of brown colours (not dark or blackish), with olivaceous tones mainly on the stipe. The pileipellis in all studied basidiomes is composed of somewhat slender terminal hyphae (Fig. 1b, e). However, slightly swollen terminal hyphae were detected scattered among the pileipellis, but even in younger basidiomes, no traces of a hymeniform-like arrangement is present. Singer et al. (1990) were not convinced by the characteristics used by Heinemann & Rammeloo (1982) regarding the terminal elements from the cover layer of the pileus (i.e. swollen or not). In reports of *P. portentosus* (McNabb, 1968; Corner, 1972; Pegler, 1977, 1986; Singer et al., 1983, 1990) the pileipellis is described as bearing cystidiform, clavate, acuminate or otherwise swollen terminal hyphae, with obtuse or rounded apexes. Although the monospecific subg. *Hymenophlebopus* s. Heinem. & Rammeloo was proposed for the group with pileipellis bearing swollen terminal hyphae, Heinemann & Rammeloo (1982: 397) recognized that in the type specimen of *Phlebopus beniensis* (Singer & Digilio) Heinem., "... le revêtement piléique semble formé d'hyphes cylindracées; nouns n' y avons vu aucun élément renflé mais l'état du matériel ne permet pas d'affirmer catégoriquement leur absence ...". Furthermore, the material from Martinique (*Pegler 2818*) referred to by Heinemann & Rammeloo (1982) with very characteristic swollen terminal hyphae on the pileipellis, was later published as *P. beniensis* by Pegler (1983) who described it as having erect, cylindric, lageniform or fusoid, terminal elements. We agree with Singer et al. (1990) that *P. portentosus* exhibits a pileipellis with somewhat swollen terminal hyphae but such elements do not constitute a hymeniform structure. The basidiome colours, and size and shape of both cheilocystidia and basidiospores are, therefore, the most reliable characters to distinguish *P. portentosus* from *P. beniensis*.

Pores of the Mexican specimens consistently presented broadly clavate cheilocystidia, i.e. swollen and apically rounded (Fig. 1c). In the tubes, however, we did not find any kind of sterile structure that demonstrated the presence of pleurocystidia. The hymenial cystidia of *Phlebopus portentosus* have been mentioned as scattered on the pores, and rare in the tubes, and clavate to more rarely clavate-subglobose, often basidiole-shaped (Singer et al., 1990) or they were not observed (Pegler, 1977) or were even mentioned to be absent (Boedijn, 1951; McNabb, 1968; Corner, 1972; Pegler, 1986). The description of *P. portentosus* by Singer et al. (1990) includes cheilocystidia 12–38.4 × 5.5–16 μm, at times 16 × 6 μm, more or less similar to those found in our collections. It would be interesting to analyse in future collections the consistency of the shape of the cheilocystidia, and the presence or absence of these and facial cystidia, and to correlate this data with other independent characters (micro- or macroscopic, including basidiome size) in order to verify if populations of different taxa are called *P. portentosus*. For example, Heinemann & Rammeloo (1982) underlined that some

specimens that McNabb (1968) placed under *P. portentosus* presented a net in the upper part of the stipe surface, but that most samples of this species lack such a structure.

Basidiospores of studied collections when seen under light-microscope are smooth and with a rather remarkable peripheral darker colour of the wall, hence they appear moderately thick-walled (up to 1 μm thick). Similar to the report by Pegler & Young (1981), Mexican samples show smooth walls when analysed under SEM. Perreau (1981) emphasized this character but demonstrated, using transmission electron microscopy, that the basidiospores of *P. portentosus* are partially minutely denticulate. Basidiospore measurements of our collections fit the lower limit of size dimension reported for *P. portentosus* (Boedijn, 1951; McNabb, 1968; Pegler & Young, 1981; Heinemann & Rammeloo, 1982; Pegler, 1986), although Pegler (1977) and Singer et al. (1983, 1990) reported a more or less similar size: 6–8.7 × 4.2–6.3 μm (7.7 × 5.4 μm), 6.5–8.7 × 4.2–6.3 μm or 5.5–9.5 × 4.8–6.8 μm, respectively. Three short-spored species superficially similar to *P. portentosus* are *P. colossus* (R. Heim) Singer, *P. beniensis* and *P. silvaticus* Heinem. They are, however, clearly different when compared with the former species. Basidiomes of *P. colossus* are often larger, with a very dark brown or even blackish pileus during some stages of development (Heim, 1936; Heinemann, 1954a; Heinemann & Rammeloo, 1980; Singer et al., 1983). Basidiomes of *P. beniensis* and *P. silvaticus* completely lack olivaceous tinges, the latter species has basidiomes which show brown colours but are distinctly red stained (pileus and stipe), context unchanging on exposure, apparently the cover layer of pileus bears strictly vesiculous terminal hyphae and has brownish or carmine pigments, and the basidiospores although moderately small (6.5–8.6 × 5.7–7.3 μm or 6.8–7.5 × 5.7–6.3 μm) are somewhat broader (Q = 1.18–1.28 in average) (Heinemann, 1951, 1954a; Heinemann & Rammeloo, 1980, 1982). *Phlebopus silvaticus* has, according to Pegler (1977), a pale ochraceous context which becomes green to brown on exposure, clavate to vesiculose terminal hyphae of the pileipellis, and basidiospores 8–9.5 × 5.7–7 μm (8.7 × 6.2 μm in average). Furthermore, *P. beniensis* has been described with cheilocystidia "... extremely variable, mostly fusoid-obtuse to subventricose, but some subcylindric-flexuous or clavate ..." (Singer et al., 1990), but also having an appendiculate apex (Singer & Digilio, 1960; Singer, 1964) or a narrowly mucronate or rounded tip (Singer et al., 1983), even with a resinous incrustation as illustrated by Pegler (1983, fig. 115n).

Most type material supporting the accepted species of *Phlebopus*, as emphasized by Heinemann & Rammeloo (1982), is in a poor state of conservation. The present conditions of the specimens have restricted the analysis of several microscopic features, hence at this level those authors found few characters suitable for taxonomic purposes. However, data on basidiospore dimensions as displayed by Heinemann & Rammeloo (1982), reveal some tendencies among species (at least with the number of samples measured) regarding the basidiospore size and shape. These authors state that basidiospore characteristics (size, shape) prove to be informative at infrageneric level, however, these characters alone could hardly be discriminating among related species. Diagnosis of the species provides little information on microscopic features, and in subsequent descriptions the geographic distribution and colour of basidiomes may have been overemphasized when distinguishing the populations. The microscopic variability of the basidiomes has scarcely been documented, and it is more or less well known in a limited number of species (Heinemann, 1951, 1954a & b; Heinemann &

Rammeloo, 1980; Horak, 1968; Singer & Digilio, 1957, 1960; Singer, 1964; McNabb, 1968; Miller et al., 2000; Pegler, 1977, 1983, 1986; Pegler & Young, 1981; Singer et al., 1983, 1990; Watling & Turnbull, 1992; Watling & De Meijer, 1997). It is expected, as suggested by Heinemann & Rammeloo (1982), that after the original descriptions, composiste descriptions have occurred in literature, probably in some cases involving specimens which are superficially similar but belong to different taxa.

Phylloboletellus chloephorus Singer — Figs. 2–4, Plates 1c–f, Colour plate 2 (p. 445)

Phylloboletellus chloephorus Singer, in Singer & Digilio, Lilloa 25 (1951) 438.

Pileus (8–)18–62(–72) mm wide, more or less semi-hemispherical or pulvinate when young, gradually convex, becoming plano-convex or plane, sometimes subumbonate or weakly depressed at centre, at times finally plano-concave, in wet weather more clearly viscose but during its development varying from dry to subviscose; some specimens having shiny spots; only weakly sticky when touched, hygrophanous or not, yellow when young (Mu. 2.5 Y 8/8; K. & W. 4A5-6) with yellow-orange or orange-brown (K. & W. 6BC7) tinges, gradually the whole surface becoming orange-reddish or brown orange-reddish (7DC7) or only part of the disc as such and the rest brown-yellowish (5BC6) to yellow brown-orange (6BC6), with age varying to different tones of brown-orange (6B6-6BC7; 6C6) or reddish brown (7BC7), staining reddish in some areas, glabrous in appearance but under lens decorated by minute, brownish fibrils which are variable in abundance; in fact these give the brown shades of the disc; often the fibrils more dense at centre where it looks more or less minutely fibrillose-scaly, more loosely arranged towards the marginal zone; in some stages pileus elsewhere with scattered, appressed fibrils; some areas may appear somewhat rimose or in other the fibrils are rather reticulately arranged, or even absent in most part of the disc; margin in young stages often involute and remaining so during some phases in which it is (under lens) somewhat velvety or densely minutely-fibrillose, yellowish to yellow-ochre (5B6) or orange (6A5-6), becoming more or less straight, dark vinaceous or dark reddish with age, moderately acute, at times somewhat incurved. Hymenophore lamellate; lamellae adnate to subdecurrent, moderately decurrent as pileus expands, at first somewhat distant becoming subdistant to subclose, yellowish green or pale greenish olive (3B6-7), gradually becoming olive-brown or yellow-green brown (4B6-5; 4BC6), some areas staining reddish or vinaceous, when cut exudating a watery, colourless latex, then the bruised areas immediately staining greenish blue (25C4-25D5), gradually olivaceous (± 29D4), dark green or dark greyish green (ranging 27F7-27F4), arcuate, becoming more or less segmentiform, with somewhat subventricose lamellulae, more or less membranous in consistency, moderately broad (2–12 mm); edge entire, often forked, bifurcation of each lamella varies in position with reference to its length, with short lamellulae at pileus margin but there are also longer lamellulae reaching the middle of the length, with age often interconnected with short veins. Stipe (18–)22–52(–82) × 6–10(–13) mm, more or less cylindric or with a moderately broad base, commonly narrower towards the apex or at times, on the contrary, tapering downwards and almost uniformly cylindric in the upper portion, solid, dry, yellow to mustard yellow (4A5-6), staining

(text continued on p. 374)

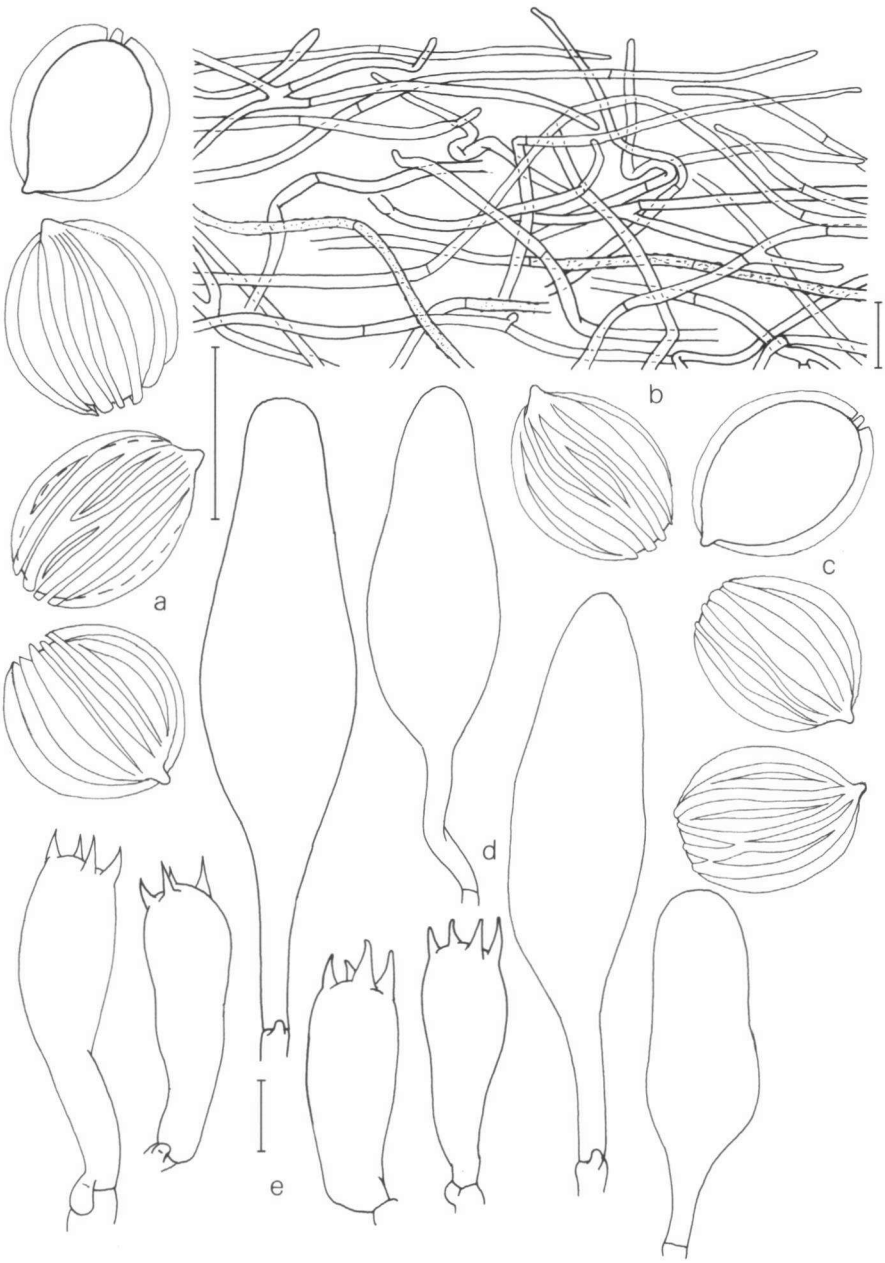

Fig. 2. *Phylloboletellus chloephorus*. a. Basidiospores (holotype); b. section of pileipellis; c. basidiospores; d. hymenial cystidia; e. basidia (*Bandala 3584*). Scale bar = 10 μm; except b = 25 μm.

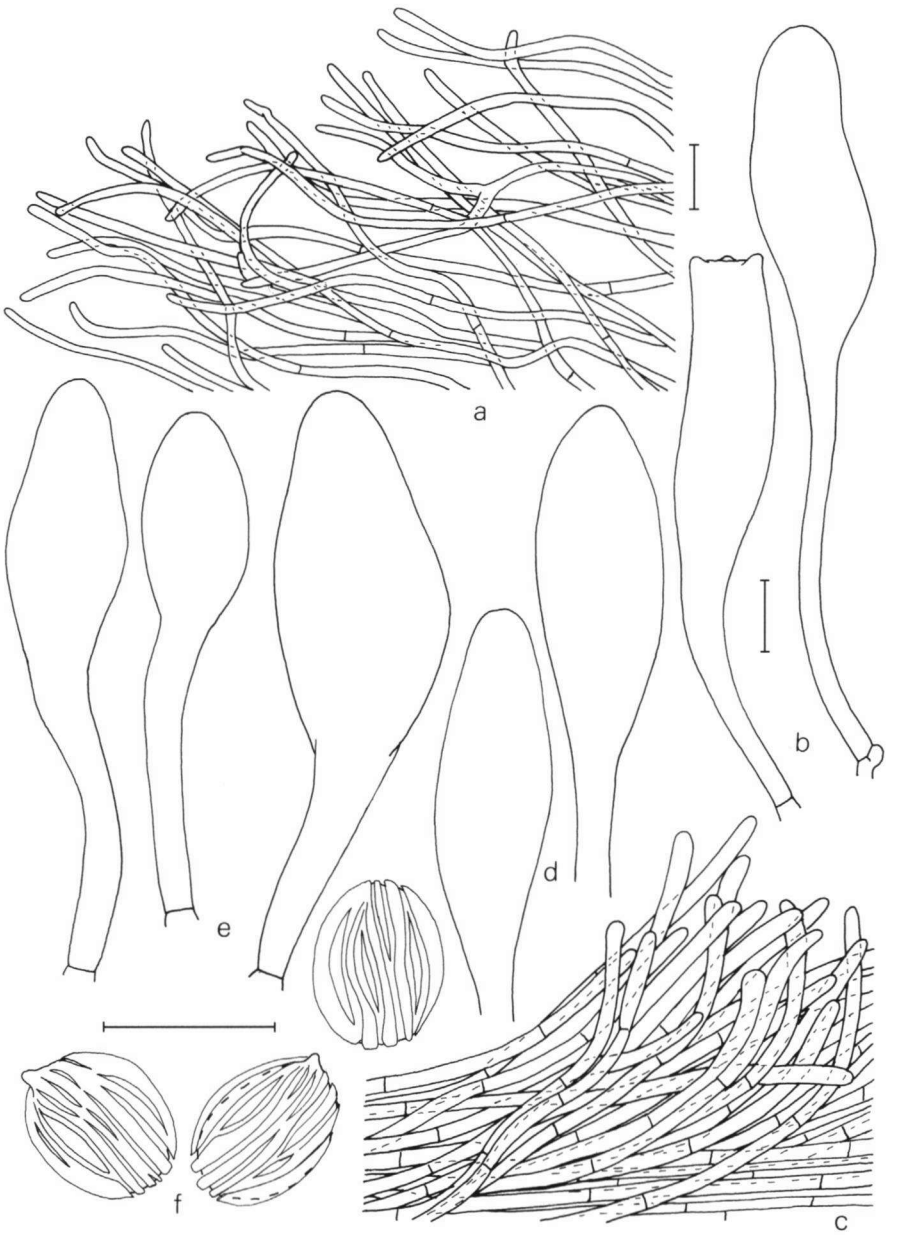

Fig. 3. *Phylloboletellus chloephorus*. a. Section of pileipellis (pileus margin); b. hymenial cystidia; c. section of stipitipellis (*Bandala 3584*); d. hymenial cystidia (*Jarvio 771*); e. hymenial cystidia; f. basidiospores (*Singer T 3580*). Scale bar = 10 μm; except a & c = 25 μm.

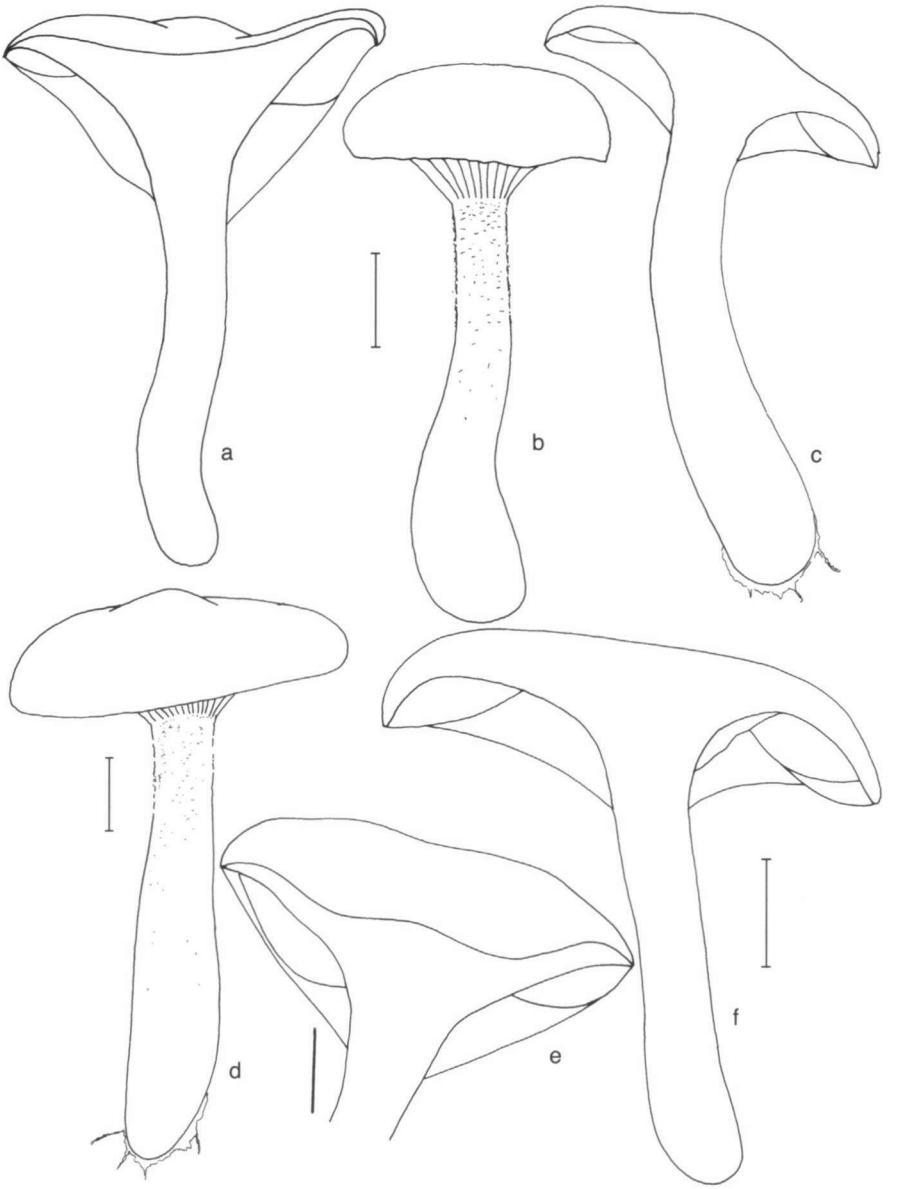

Fig. 4. *Phylloboletellus chloephorus*. Basidiomes (a, b. *Bandala 3362*; c, d. *Bandala 3584*; e. *Bandala 3388*; f. *Bandala 3505*). Scalebar = 1 cm.

reddish, red-wine or red-brown in lower part but in some specimens rather completely red-wine, near base dark red or dark red-brown, with a fine, concolorous, fibrillose or fibrillose-squamulose covering which sometimes (mainly in young specimens) may appear more dense around apex or arranged as a weakly striate rudimentary net, often with minute, brownish clumps of fibrils (granular in appearance to the naked eye), then

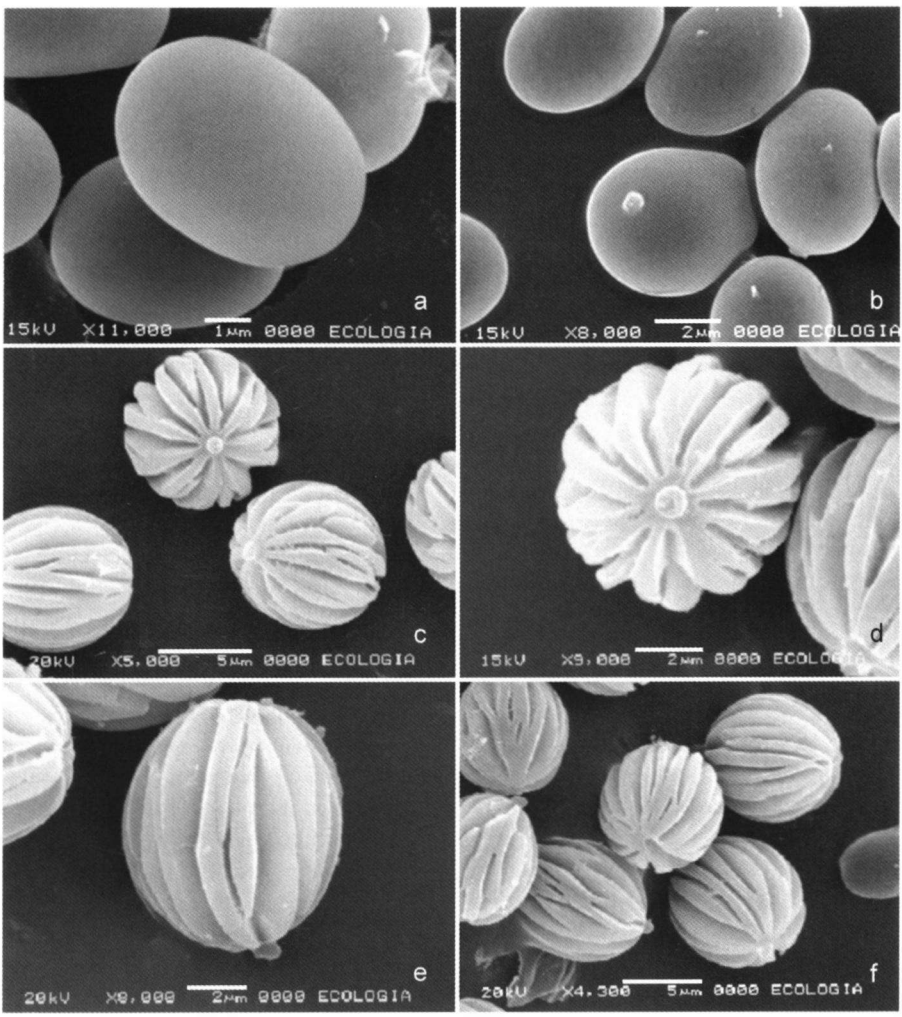

Plate 1. Basidiospores under SEM. a, b. *Phlebopus portentosus* (a. *Jarvio 913*; b. *Jarvio 1150*); c–f. *Phylloboletellus chloephorus* (c. holotype; d. *Singer T 3580*; e. *Bandala 3662*; f. *Bandala 3388*).

variably scurfy, with age this ornamentation becoming more sparsely arranged downwards, then only as scattered appressed fibrils elsewhere; veil absent; basal mycelium yellow, rather concolorous with stipe surface, some yellowish rhizomorphous strands may be present. Context yellow or yellowish ochraceous (10 YR 8/4), darkening with age, the stipe context of some specimens more or less concolorous with stipe surface, somewhat rubescent but intensifying gradually in colour during exposure, in some cases more clearly reddish under pileus cuticle or with reddish or reddish brown spots, bluing (25C4-25D5) near hymenophore and also towards the stipe base, greyish green with time; odour weak or pleasant; taste bitter, the cuticle slightly astringent.

Macrochemical reactions: KOH: pileus brown or amber and immediately dark or very dark brown, this reaction may be weak depending on the pileus expansion, perhaps correlated with the abundance of fibrils, then in some areas pale brown; only impregnating the context and appearing somewhat pale brown; stipe immediately blackish or very dark amber. NH_4OH: pileus pale olive, greenish grey or grey greenish blue, when the pileus is darker the reaction appears initially blackish green, in all cases quickly turning dark and then dark brown or amber, in young specimens immediately dark green; stipe immediately blackish or very dark amber.

Basidiospores (9.0–)9.6–12.0 × (7.2–)8.0–9.6(–10.4) µm, Rm = 10.4–11.3 × 8.5–9.3; Qm = 1.18–1.29, subglobose to short ellipsoid, with longitudinal, continuous or bifurcate ribs, 1–2 µm wide, which are somewhat anastomosed towards the apiculus; about 13–20 projections seen at the distal pole where they appear free; under oil lens showing a germ pore-like effect when observed in lateral view (but distinctive germ pore absent); without transversal veins, moderately thick-walled (up to 1 µm thick), yellowish or ochraceous to light yellowish brown, inamyloid but in water or Melzer's solution a greenish tint is observed, moreover some spores (often immature) in Melzer's solution stain at times pale orange, reddish or pinkish. Basidia 34–62(–70) × (7–)10–13(–14) µm, 4-spored, some bisporic, clavate, thin-walled, hyaline, yellowish hyaline, some of them often clearly yellow, commonly clamped. Hymenial cystidia (44–)50–154 × (10–)12–27(–29) µm, utriform to somewhat narrowly utriform, with a more or less cylindric ((2–)3–6(–10) µm wide), short or moderately long base which often extends through hymenial layer, apex commonly rounded or slightly attenuated or at times rather obtuse, (3–)6–14(–16) µm wide, often with one or two small irregular appendages that resemble amorphous sterigmata, in which case the tip is somewhat basidium-like; yellowish, yellowish hyaline or yellowish green, often with a dense, yellow golden, granular-like contents, naked but often with minute residual lumps of a resinous matter, clearly visible in water or Melzer's solution as an irregular, resinous, yellowish brown matter covering partially or entirely the cystidium, at times only as incrusting material, thin-walled, commonly clamped, solitary, rarely in groups (2 or 3), both on edges and sides of the lamellae but scattered at irregular intervals along the hymenial layer, then rare or sometimes absent on the lamella edge when it is observed on a tangential section. The hymenial layer and even lower hyphae often show a lemon-yellow pigment. Hymenophoral trama bilateral; mediostratum variable in thickness, although commonly narrow, composed of hyaline or yellowish, thin-walled, often clamped hyphae 6–10(–12) µm wide, more or less interwoven and densely arranged, yellow to lemon-yellow in mass, slightly gelatinized, differing from the laterostrata which are moderately refringent, gelatinized, consisting of hyaline to weakly yellowish, interwoven, flexuous or weakly curved, thin-walled, clamped, hyphae (2–)3–6 µm wide, somewhat more loosely arranged but in a divergent pattern, often with diffuse yellow pigmentation; oleifers (hyphae with a dense yellow content) often present, some kind of incrusting material is scattered here and there; subhymenium undifferentiated, hyphae (2–)3–5(–6) µm wide, short, hyaline, thin-walled, clamped; in Melzer's solution there is an irregular blue reaction which is more evident in some areas or varying from one specimen to another; in fact when mounting a section of the hymenophore, after adding Melzer's solution or water sometimes a bluing shade is observed. Pileus trama composed of hyphae of 6–10(–12) µm wide, hyaline to yellowish hyaline, yellow in mass, more

or less densely arranged, thin-walled, slightly gelatinized, without refringent layers, most septa clampless. Pileipellis an ixocutis or a transition between an ixocutis and an ixotrichodermis with undifferentiated terminal hyphae, consisting of sinuous, straight or slightly curved, loosely but somewhat parallel arranged, cylindric to filamentous hyphae, 3–6(–8) μm wide; this stratum is variable in thickness, sometimes poorly differentiated, weakly or decidedly gelatinized but not as a refringent, differentiated layer (as happens at hymenophore laterostratum), also varying in abundance of terminal hyphae, which are often more abundant towards pileus centre or near pileus margin; the abundance seems to be related with pileus development, in some stages the terminal hyphae are more abundant at the margin (curved margin) where they can appear more erect (as in the centre), then more trichodermoid, but also moderately prostrate, in some areas the terminal elements forming rather compact and prostrate groups; terminal hyphae undifferentiated, at times tapering towards the apex or weakly constricted at apex, hyaline to yellowish, some areas with a yellow pigmentation or the hyphae bearing incrusted, gelatinous, colourless material which may partially cover some segments; thin-walled, oleiferous hyphae often present, most septa clampless. Stipitipellis trichodermoid formed by mounds of moderately erect, cylindrical hyphae 4–10(–12) μm wide, with undifferentiated terminal hyphae, at times somewhat claviform or subutriform, not decidedly cystidiform, yellow to yellowish hyaline, deep yellow in group, thin-walled, most septa clampless, towards the trama more parallel arranged.

Habitat — Subgregarious or solitary, sometimes subcaespitose, on soil among dead leaves and woody debris, under or near coffee plants surrounding trees of *Enterolobium cyclocarpum*, *Spondias mombin*, *Ficus calyculata* or *Inga* spp.

Material examined. MEXICO: Veracruz, Municipio Coatepec, El Grande, 1.X.2000, *Jarvio 707*; 16.X.2000, *Jarvio 720*; 2.VI.2001, *Bandala 3362*; 3.VI.2001, *Jarvio 944*; 28.IX.2001, *Bandala 3505, 3506*; 13.X.2001, *Jarvio 1106*; 23.VI.2002, *Bandala 3584*; Puerto Rico, 17.XI.2000, *Jarvio 771*; 18.V.2001, *Jarvio 915*; 5.VIII.2001, *Bandala 3388*; Tres Puertas, 11.XII.2000, *Jarvio 855*; 23.VII.2001, *Jarvio 992* (all at XAL).

Other material examined. ARGENTINA: Tucumán, Los Sosas, near road to Tafi del Valle, between Playa Grande and Monumento al Indio, 27.I.1951; ad terram in silva subtropicali sub *Phoebe*, etc., solitary, *Singer & Siemseii s.n* (holotype, LIL); Tafi, Quebrada de Los Sosas, 24.I.1960, in subtropical-montane forests, on humus, under *Eugenia* and *Phoebe*, *Singer T3580* (LIL). — MEXICO: Nuevo Leon, Municipio de Santiago, El Cercado, 8.VI.1984, *Moreno s.n.* (ITCV; XAL).

Phylloboletellus chloephorus has only been found to date in two widely separated areas in the American continent, including a record from Mexico. The species was described by Singer & Digilio (1951) based on collections gathered in subtropical or tropical montane forests from Argentina. Since then, subsequent citations by Singer (1964, 1970) and Singer et al. (1992) were translations of the original description, considering the same three specimens of the first finding, plus two from the same locality collected years later by Singer (Singer, 1964, 1970). As a complement to the diagnosis, Horak (1968) and Pegler & Young (1981) provided detailed information mainly of microscopic characters, based on paratype material. The Mexican collections treated by Singer et al. (1992) were those on which García et al. (1986) previously based their record of *P. chloephorus* in Mexico. The latter authors collected their specimens in a 'matorral espinoso', a heterogeneous low forest influenced by dry weather which includes elements of dry deciduous forests and xerophylous shrubs. This area is situated

in NE Mexico (State of Nuevo Leon), so our present finding of *P. chloephorus* in the central area of the Gulf of Mexico corresponds with the second report of the species in the country and records the most southern limit of its currently known distribution in Mexico. The occurrence of *P. chloephorus* in lowland plantations, amongst remnants of a tropical deciduous forest, suggests a marked affinity for warm weather conditions.

In all publications by Singer (et al.) referred to above, the type of *P. chloephorus* is indicated as *R. Singer T 1126*, either as: "... Prov. Tucumán: Rio de Los Sosas, 27.I.1951 ..." (Singer & Digilio, 1951; Singer, 1964; Singer et al., 1992), or as: " ... Tucumán: Quebrada de Los Sosas, Playa Grande, 21.I.1951 ..." (Singer, 1970). We received from LIL the above mentioned collection *Singer & Siemseii s.n.*, dated 27.I.1951, which is labelled (in handwriting) as *typus*. According to information from the curator at LIL, the sample is kept as the type of the species. Additional data on the label (see above) agree with published information, therefore, part of our interpretation of the species is based on this specimen which we consider to be the holotype. It consists of one half of a more or less well-preserved basidiome (although with a mould on part of the hymenophore and stipe), and in fact, its macro and microscopic features agree with data in the diagnosis. Nevertheless, the present stage of preservation of the sample did not allow us to rehydrate the hymenial tissues appropriately, which made it difficult to corroborate the presence of hymenial cystidia as described by Singer & Digilio (1951). We studied one of the specimens from Nuevo Leon (*Moreno s.n.*, 8.VI.1984) treated by Singer et al. (1992), and since that specimen and our collections showed all the distinctive characters found in both the specimen *Singer T 3580* (see Singer, 1964, 1970) and *Singer & Siemseii s.n.*, we interpreted them as being conspecific. The following data are based on the type study.

Basidiospores 10–12 × (8–)9–10 μm (10.9 × 9.6 μm on average), broadly ellipsoid to short-ellipsoid, without germ pore, ochraceous to yellow-brown, longitudinally costate, with 16–18, forked or somewhat anastomose, longitudinal ribs, 1–2 μm high, extending beyond the apex and weakly attenuated towards the hilar appendix, without transversal lines (Fig. 2a; Plate 2c), inamyloid, some with a greenish tint. Hymenophoral trama bilateral, with a narrow, slightly gelatinized mediostratum of yellowish, somewhat compactly interwoven, hyphae 4–6 μm wide, thin-walled, yellowish brown when grouped; lateral stratum more clearly gelatinized, composed by flexuous or curved, loosely arranged, thin-walled, hyaline hyphae 2–4 μm wide. Pileipellis a moderately loose ixocutis in transition to an ixotrichodermium, which consists of a slightly gelatinized, variable narrow layer (not refringent) of undifferentiated, more or less parallel, cylindric to somewhat filamentous, yellowish to hyaline, thin-walled hyphae (3–)4–6 μm wide, in some zones the terminal hyphae are moderately erect and irregularly arranged, and more abundant in some areas than in other.

Singer et al. (1992) argued, after studying the collections from Nuevo Leon and comparing Argentinean specimens, that the former may represent a subspecific taxon which they provisionally named 'var. *mexicanus*'. Critically comparing the combination of characters pointed out in the different descriptions of *P. chloephorus* (Singer, 1964, 1970; García et al., 1986; Singer et al., 1992), these specimens appear to be intermediate between the type and other Argentinean materials. Our collections consist of basidiomes which exhibit differences in their development, and were collected under

different conditions (drawings of Fig. 4 show part of the elements of some specimens examined). These materials allowed a more detailed analysis of their morphologic features. The set of characters stated by Singer et al. seems not to be of taxonomic help for distinguishing more than one population. Among the examined samples we found a consistent macro- and microscopic variation which embraces that of the Argentinean specimens and that points to 'var. *mexicanus*': a) pileus surface with relative abundance of fibrils in the centre and margin, less abundant towards the latter after pileus expansion, so the pileipellis appears more markedly trichodermoid in young stages or even at pileus margin whereas more cutis-like with erect terminal hyphae in most part of the disc in certain stages of pileus development; b) an intermediate variation of pileus shape (convex to moderately umbonate or even plane); c) lamellae partially or almost entirely stained reddish brown (especially in advanced stages or on very bruised areas); d) flesh with a different degree of bitter flavour; and e) the pileipellis hyphae consistently gelatinized (with a variable degree of gelatinization). We interpret the morphologic differences shown by the examined samples as being those to be expected as part of the variation of members of a single species. Although the specimens currently known of *P. chloephorus* come from two distant areas, in the absence of any correlated character that supports robust differences among the samples, we fail to distinguish distinct subspecific taxa. Singer et al., in fact, were not completely convinced about the taxonomic validity of the 'var. *mexicanus*'.

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