Marchandiobasidium aurantiacum gen. sp. nov., the teleomorph of Marchandiomyces aurantiacus (Basidiomycota, Ceratobasidiales)

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Received 2 April 2002; accepted 20 February 2003.

The name Marchandiobasidium aurantiacum gen. sp. nov. is introduced for the teleomorph of Marchandiomyces aurantiacus. Dolipore septa and septal pore caps of the closely related Marchandiomyces corallinus are typical of the Ceratobasidiales, and the basidiomatal characters of Marchandiobasidium aurantiacum are reminiscent of those of the monotypic genus Waitea. Morphological, ultrastructural and molecular data suggest that Marchandiobasidium should not be included in Waitea, but should be treated as a distinct genus.

INTRODUCTION

Lichenicolous fungi that produce sclerotia are rare, although one widespread and common, lichenicolous and algicolous species, Athelia arachnoidea, is known. Another fungus, Leucogyrophana lichenicola, confined to Cladonia and Stereocaulon thalli in boreal regions of Europe and America, has been described as producing conspicuous sclerotia (Thorn, Malloch & Ginns 1998). The form-genus Marchandiomyces Diederich & D. Hawksw. 1990, of which only the sclerotial morph was known, includes at least two widespread lichenicolous species, M. aurantiacus (Lasch) Diederich & Etayo 1996 and M. corallinus (Roberge) Diederich & D. Hawksw. 1990; an additional lignicolous species has recently been discovered (DePriest et al., unpubl.). Molecular studies by Sikaroodi et al. (2001) suggested that these three Marchandiomyces species form a clade, but the phylogenetic relationships with other basidiomycetes, especially members of the Ceratobasidiales, were not clear. Although M. aurantiacus has much been studied in the field by P.D. during the past 15 yr, no basidiomata have been recognized until recently. The discovery of the teleomorph of M. aurantiacus, and ultrastructural information on the dolipore septum and septal pore cap of M. corallinus allow comparison of Marchandiomyces with similar or related genera. As the generic name Marchandiomyces clearly refers to the sclerotial morph (see below), the Code requires the description of a new genus, Marchandiobasidium, for the teleomorph.

MATERIAL AND METHODS

Material and light microscopy

Material and light microscopy

Fresh material, deposited in LG and in the private collection of P.D., has been studied macroscopically and microscopically, mounted in water or in a mixture of KOH, Congo Red and Phloxin. Dolipore septa are best observed with phase contrast at ×2000. Drawings were prepared with a drawing tube.

Ultrastructure

A culture of Marchandiomyces corallinus was examined using TEM (USA: New York: Essex Co., on Rhizoplaca chrysoleuca, 1983, R. C. Harris 16642, NY; culture IMI 290746). The culture was fixed with 2% glutaraldehyde in 0.05 M cacodylate buffer on the agar surface overnight at 4 °C. Small pieces (about 5 x 5 x 5 mm) of agar were cut out, placed in vials, and postfixed in 2% osmium tetroxide. Dehydration in a graded alcohol series and embedding in low viscosity plastic (Spurr 1969) over a week at 4 °C before hardening in an oven at 70 °C. Sections were cut with a diamond knife, and
the sections were post-fixed on copper grids in uranyl acetate and lead citrate.

**TAXONOMY**

**Marchandiobasidium** Diederich & Schultheis, gen. nov.

A *Waitea* basidiis longioribus, aliquando probasidio basali laterali vesicario ellipsoideo, et sclerotis siccis, non gelatinosis differt.


Differing from *Waitea* in the longer basidia, the occasional presence of a basal, lateral probasidial bladder, and dry, non-gelatinous sclerotia.

**Sclerotial morph**: *Marchandiomyces* Diederich & D. Hawksw. 1990. *Marchandiobasidium aurantiacum* Diederich & Schultheis, sp. nov. (Figs 1–5)

Basidiomata pallide aurantiaca, effusa, tenuia, adnata, granulosa, floccosa, margin indeterminata, ad 1 cm diam. Hymenium basidiis primum elongato-cylindricis, aliquando probasidio basali laterali vesicario ellipsoideo, ad 57 × 11 μm, maturitate clavatis ad suburniformibus, 25–40 × 12–15 μm, efibulatis, 4 sterigmatibus curvatis, ad 6.5 μm longis, basim ad 3 μm latis. Basidiosporae hyalinae, leves, non-amyloideae, non repetite germinantes, pyriformes vel lacriformes, uno latere saepe complanatae vel concave, apiculo 1.5–3 μm diam, aseptatae, raro 1-aseptatae, 13–17.5–18.5 × 8–11.5–13.5 μm, pariete 0.5–1 μm crasso. Hyphidia et cystidia nulla. Hyphae basales hyalinae, aliquando contortae, 3.5–6 μm crassae, cellulis 7–25 μm longis, crassitunicatis. Hyphae superiores hyalinae, tenuiunicatae, efibulatae, 2–4 μm crassae. Conidia ignota.


Basidiomata light orange (same colour as sclerotia of *Marchandiomyces aurantiacus*), effused, thin, adnate, granulose, floccose, margin indeterminate, reaching 1 cm diam. Hymenium comprising one or several layers of basidia on vertically branching, thin-walled hyphae. Basidia initially elongate cylindrical, sometimes with a basal, lateral, ellipsoid probasidial bladder, to 57 × 11 μm; when mature, generally becoming clavate to suburniform, exceptionally with one thin, transverse septum in the upper third, 25–40 × 12–15 μm, distinctly wider than the supporting hyphae; wall 0.6–0.8 μm thick; basal clamps lacking; basal septum with dolipore visible by light microscopy. Sterigmatula 4 per basidium, to 6.5 μm long and 3 μm wide at the base, curved. Basidiospores hyaline, smooth, usually aseptate, non-amyloid, not repetitive, pyriform or lacriform, one side frequently flattened or slightly concave, with a prominent truncate apiculus of 1.5–3 μm diam, 13–17.5–18.5 × 8–11.5–13.5 μm; pariete 0.5–1 μm thick; exceptionally with one thin, transverse septum, and then wall distinctly constricted at this septum; dolipore of septum visible by light microscopy. *Hyphidia*, *cystidia* and

Figs 1–3. *Marchandiobasidium aurantiacum* (holotype). **Fig. 1**. Dead thallus of *Physcia tenella* with sclerotia (young basidiomata were present on the same thallus). **Fig. 2**. Dead thallus of *P. tenella* with developing basidioma. **Fig. 3**. Mature basidioma. Bar = 250 μm.
other sterile hymenial elements lacking. Basal hyphae hyaline, occasionally contorted, 3.5–6 µm thick, cells 7–25 µm long, wall 0.5–1 µm thick; dolipores (observed in phase contrast) 0.5–1 µm wide, 0.5–1 µm thick. Superior hyphae hyaline, thin-walled, lacking clamps, septate, 2–4 µm thick. Conidial morph unknown.

Sclerotial morph: Marchandiomyces aurantiacus.

Distribution and ecology: Basidiomata of Marchandiobasidium aurantiacum are rare and have hitherto been recognized only in two specimens from Belgium and Luxembourg. The anamorph Marchandiomyces aurantiacus is relatively common and widespread in Europe. It has not yet been collected in North America, although its occurrence there is likely. The species is a virulent parasite of corticolous Physcia spp., occasionally also attacking neighbouring thalli of other lichens, such as Xanthoria spp. The parasite develops mainly in autumn and is able to kill Physcia thalli over larger areas within several weeks. Infection results in the thalli shrinking in thickness, leaving at the end the decoloured, film-like, cortical remnants of the hosts.

Observations: Marchandiobasidium aurantiacum is an unusual basidiomycete, which produces basidiomata only very rarely, but can easily be recognized in the field by its pale orange colour, parasitic behaviour on corticolous lichens (mostly Physcia spp.), and concolourous, but much smaller (50–150 µm diam), subspherical sclerotia that are almost always present.

When describing the new genus Marchandiomyces (Diederich 1990), the authors concluded that colonies (of specimens belonging to M. aurantiacus!) are formed of sclerotia of 50–150 µm and of sporodochia of 100–500 µm diam. Inside the ‘sporodochia’ of the specimen P. Diederich 8526, elongated cells were considered to be ‘conidiophores’, and single, detached, obpyriform cells 11–15 × 7–10 µm with a truncate base to be ‘conidia’. The discovery of the teleomorph of M. aurantiacus revealed the true nature of all these elements: the ‘sporodochia’ are basidiomata, and the ‘conidiophores’ and ‘conidia’ immature basidia and basidiospores. Nevertheless, the type species of Marchandiomyces is M. corallinus, the type specimen of which entirely consists of sclerotia, and does not include any basidiomata (Desmazières, Pl. crypt. Fr., edn 1, fasc. 32, no. 1551, K–isotype!); thus, the name Marchandiomyces refers to the sclerotial morph of these fungi, and as such represents an anamorph name.

According to the original description, the name Aegerita physciae Vouaux 1914 (Vouaux 1912–14) might represent an earlier synonym of Marchandiobasidium aurantiacum. The conidiophores were said to be straight, aspetate, hyaline, 25–35 × 4–7 µm, corresponding with immature basidia, and the conidia were described as hyaline, aspetate, smooth, thin-walled, perfectly spherical, 10–15 µm diam, suggesting basidiospores. However, the description of conidiogenesis does not entirely correspond to basidiospore formation in M. aurantiacum: Vouaux stated that the conidia were formed by budding at the apex of the conidiophores followed by separation by a septum and detachment; furthermore,
phylogenetic relationships of the entire group. Three Ceratobasidium sporum D. P. Rogers 1935, has continuous parentheso-
cies of enc¸ on 1990, Mu¨ ller cap, as shown in most species of that order that have

Roberts (1999), including the discontinuous septal pore
to those in the complexes observed in this species (Fig. 5) were similar
ago, but the results never published. The septal pore

Marchandiomyces corallinus

However, the structure of the closely related Marchandiomyces aurantiacus, like those of M. corallinus and the undescribed lignonicolous species, are never gelatinous in appearance. Despite these differences, inclusion of Marchandiobasidium aurantiacum in Waitea might be conceivable.

Sikaroodi et al. (2001) studied the phylogenetic rela-
tionships of Marchandiomyces aurantiacus, M. corallinus and the undescribed species (as AF289659),
based on parsimony analysis of SSU rDNA sequences of 124 fungal species. The taxa included the type of Thanatephorus, T. cucumeris (syn. T. praticola), and the anamorph of the type of Waitea, Rhizoctonia zeae. Their results suggested that Waitea and Thanatephorus belong to distinct lineages and are not closely related. Thus Waitea should not be included in Thanatephorus, as suggested by Roberts (1999). Furthermore, the phylogenetic tree (Sikaroodi et al. 2001) suggested that the three species of Marchandiomyces form a clade, closely related to R. zeae, but nevertheless different. We conclude that the description of a new genus Marchandiobasidium is the best solution.

discussion

The basidiomatal characters of the new fungus are
reminiscent of the monotypic genus Waitea Warcup
& P. H. B. Talbot 1962. The type species, W. circinata
Warcup & P. H. B. Talbot 1962 (syn. W. muda Clé-
mençon 1990), has similar subcylindrical to suburniform
basidia; four short, curved sterigmata; ellipsoid, basally
truncate, rarely transeptate basidiospores, which are
usually wider close to the distal end, and are often
slightly asymetrical; dolipore septa and septal pore caps
are visible by light microscopy; superior hyphae, which
are similar in width or slightly narrower than the base
of the basidia; contorted basal hyphae; the absence
of clamps; the absence of hyphidia, cystidia and other
sterile hymenial elements; and pinkish to orange or
brownish sclerotia.

The ultrastructure of the septal pore complex of Marchandiobasidium aurantiacum has not been studied.
However, the structure of the closely related Marchandiomyces corallinus was studied by M.B. many years
ago, but the results never published. The septal pore
complexes observed in this species (Fig. 5) were similar
to those in the Ceratobasidiales, as circumscribed by

(Ceratobasidium, Thanatephorus and Waitea) were included by Roberts (1999) within the Cerato-
basidiales, and the new genus Marchandiobasidium has
to be compared with all of them.

Ceratobasidium differs from M. aurantiacum by a
hymenium of laterally branching hyphae and much
shorter and generally wider, often ellipsoid to sub-
globose basidia. Species of Thanatephorus Donk 1956
are distinguished primarily by their ellipsoid to cylin-
drical basidia that are never suburniform; sterigmata
longer than 6 μm; self-replicating basidiospores, which
are aseptate in most species; and basal hyphae that
are not contorted (e.g. Talbot 1965). However, in some
species of Thanatephorus, especially those with orna-
mented basidiospores, the sterigmata are relatively
short, 4.5–10 μm long; in two species, T. helbolomato-
sporus (Boidin & Gilles) P. Roberts 1998 and T. terri-
genus (Bres.) G. Langer 1994, the basidiospores are
not self-replicating; and in T. terrigenus, the basidiospores
become 1-septate; sclerotia are known from at least
two Thanatephorus species, viz. T. cucumeris (A. B.
Frank) Donk 1956 and T. ochraceus (Massee) P.
Roberts 1998 (Roberts 1999). These morphological
observations indicate that the generic limits between
Thanatephorus and Waitea are unclear, and Roberts
(1999) suggested that the two genera can hardly be
retained as distinct.

W. circinata is similar to M. aurantiacum, but differs
by its much smaller basidia, 10–18 × 5.5–6.5 μm in
culture, 19–29 × 5–8 μm in nature, which never have
a basal probasidial bladder; smaller basidiospores,
8–12 × 3.5–5 μm in culture, 8.5–13 × 4–5.5 μm in nature
(Warcup & Talbot 1962); a different ecology (patho-
genic on cereals, turf grass and legumes, causal agent of
’sheath spot’ of rice, or saprobic in soil); and especially
by the larger sclerotia, 0.5–3 mm diam (Roberts 1999),
which are covered with a gelatinous substance, giving
them a glistening appearance (Andersen 1996). Scler-
otia of Marchandiomyces aurantiacus, like those of
M. corallinus and the undescribed lignonicolous species,
are never gelatinous in appearance. Despite these dif-
ferences, inclusion of Marchandiobasidium aurantiacum
in Waitea might be conceivable.
For the time being, we include *Marchandiobasidium* in the *Ceratobasidiales sensu* Roberts (1999), although we are aware that this order is heterogeneous. The phylogenetic relationships of *Marchandiomyces* with some groups of *Corticiaceae*, based on molecular studies using parsimony, likelihood and bayesian analyses of complete sequences of the nuclear small subunit and internal transcribed spacers ribosomal DNA, and a portion of the nuclear large subunit, will be discussed in a separate paper.

**ACKNOWLEDGEMENTS**

We wish to thank warmly Daniel Thoen for discovering the fertile population of *Marchandiobasidium aurantiacum* in his garden, Rosa-lind Lowen for putting at our disposal a culture of *Marchandiomyces corallinus*, and James Lawrey and Paula DePriest for fruitful discussions on the phylogenetic position of the new genus.

**REFERENCES**


