

New records of powdery mildew fungi (Erysiphaceae)

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Abstract: BRAUN, U., ALE-AGHA, N., BOLAY, A., BOYLE, H., BRIELMAIER-LIEBETANZ, U., EMGENBROICH, D., KRUSE, J. & KUMMER, V. 2009: New records of powdery mildew fungi (Erysiphaceae). *Schlechtendalia* **19**: 39–46.

The conidial stage and chasmothecia of *Golovinomyces orontii* have been found in Germany on cultivated *Limnanthes douglasii*. A powdery mildew anamorph found in the Netherlands on *Malva alcea* agrees morphologically with the *Oidium* of the latter species as well. *Golovinomyces* sp. (anamorph) on *Parthenium integrifolium* is described and discussed. *Erysiphe* sp. has been found in Germany on *Acer opalus*, and *E. magnifica* is recorded from Germany and Switzerland on *Magnolia* spp. *Oidium passiflorae* is new to Switzerland. An *Oidium* morphologically agreeing with the anamorph of *Podosphaera aphanis* has recently been collected on *Exacum macranthum* cultivated in a greenhouse, and conidiophores and conidia of a species of *Podosphaera* sect. *Sphaerotheca* subsect. *Magnicellulatae* (*P. fusca* complex) on *Phlox paniculata* and *Polemonium caeruleum* have been found in Germany.

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Sowohl die Anamorphe als auch Chasmothecien von *Golovinomyces orontii* sind in Deutschland auf kultivierten Pflanzen von *Limnanthes douglasii* gefunden worden. Eine in den Niederlanden auf *Malva alcea* gefundene Mehltau-Anamorphe stimmt morphologisch ebenfalls mit dieser Art überein. *Golovinomyces* sp. (Anamorphe) auf *Parthenium integrifolium* wird beschrieben und diskutiert. *Erysiphe* sp. wurde in Deutschland auf *Acer opalus* gefunden und *E. magnifica* wird aus Deutschland und der Schweiz auf *Magnolia*-Arten angegeben. *Oidium passiflorae* ist neu für die Schweiz. In einem Gewächshaus wurde ein *Oidium* auf *Exacum macranthum* gesammelt, das morphologisch völlig mit der Anamorphe von *Podosphaera aphanis* übereinstimmt. Weiterhin wurden Konidienträger und Konidien einer zu *Podosphaera* sect. *Sphaerotheca* subsect. *Magnicellulatae* (*P. fusca* Komplex) gehörenden Art auf *Phlox paniculata* und *Polemonium caeruleum* entdeckt.

Key words: Erysiphales, new hosts, Germany, the Netherlands, Switzerland.

Powdery mildew fungi cause common, widespread plant diseases on a wide range of wild and cultivated host plants. Although a monographic treatment of European taxa of this fungal group is available (BRAUN 1995), host range and distribution are still incompletely known. Several collections of powdery mildew fungi (Erysiphales) on new hosts have recently been found in Germany, the Netherlands and Switzerland. The collections concerned are described, illustrated and briefly discussed.

(1) *Erysiphe* sp.

Fig. 1

Material examined: On *Acer opalus* (Aceraceae), Germany, Nordrhein-Westfalen, Essen, University Campus, 1 Nov. 2008, N. Ale-Agha (HAL 2309 F).

Mycelium hypophyllous, external, effuse, thin, white; hyphae branched, septate, hyaline, thin-walled, smooth, 2–5 µm wide; appressoria sparingly developed, few, usually solitary, somewhat lobed, 3–6 µm diam. Chasmothecia hypophyllous, gregarious, small, 75–105 µm diam.; peridial cells irregularly polygonal, (5–)10–20(–25) µm diam.; appendages equatorial, 3–8(–11), straight to curved, about as long as the chasmothecial diam. (75–110 µm long), 6–9 µm wide below, somewhat narrowed towards the apex, stalk thick-walled throughout (–3 µm wide) or thick-walled below and thinner towards the apex, smooth to rough-walled below, hyaline, often pigmented at the base, 0–1(–2)-septate near the base, apex 3–5 times regularly dichotomously branched, compact, primary branches often slightly elongated, tips of the ultimate branchlets recurved; asci 3–7, short-stalked or sessile, 40–70 × 30–50 µm, wall thin (up to 2 µm), 4–8-spored, mature ascospores colourless, ellipsoid-ovoid, 15–28 × 8–15 µm.

Microsphaera aceris has been described by BUNKINA (1974) from the Russian Far East on *Acer barbinerve*. According to V.P. Heluta (Kiev, Ukraine, in litt.), who examined type material of this species, *M. aceris* is a synonym of *Erysiphe syringae-japonicae* (U. Braun) U. Braun & S. Takam. The German collection on *A. opalus* is morphologically barely distinguishable from the latter species. Additional examinations are necessary to prove the true identity of the German *Acer* powdery mildew.

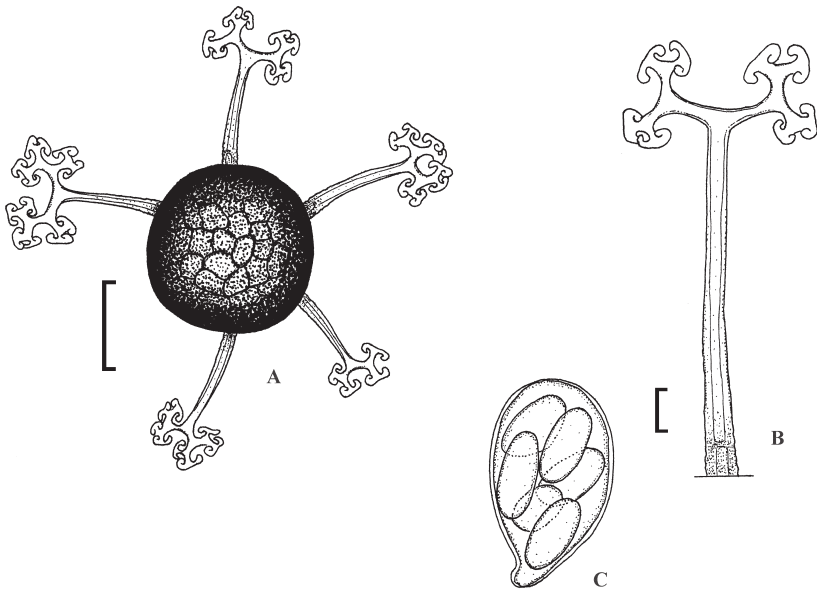


Fig. 1: *Erysiphe* sp., A – Chasmothecium, B – Appendage, C – Ascus. Bar = 50 µm (A), 10 µm (B–C) [U. Braun del]

(2) *Erysiphe magnifica* (U. Braun) U. Braun & S. Takam.

Material examined: On *Magnolia* sp. (Magnoliaceae), Switzerland, VD, Nyon, Parc de Bourg de Rive, 10 Oct. 2008, A. Bolay (HAL 2295 F), anamorph and teleomorph; Germany, Saxony, Bischofswerda, MTB 4851/3.3, 12 Aug. 2007, H. Boyle (GLM F-081250), anamorph; Germany, Niedersachsen, Hannover, Nussriede, MTB 3624/2.2, garden, Oct. 2008, J. Kruse (herb. J. Kruse).

E. magnifica is known from Asia and North America (BRAUN 1987). It is new to Germany and Switzerland. In the Botanical Garden of Genève this fungus was found on *Magnolia kobus*, *M. liliiflora* and *M. liliiflora* var. *nigra*. The chasmothecia found in Switzerland agree well with the description given by BRAUN (1987). The anamorph, which has not yet been described in detail, is characterised as follows: Hyphae branched, septate, hyaline, thin-walled, 2–6 µm wide; appressoria solitary or in opposite pairs, nipple-shaped to usually lobed, 3–7 µm diam.; conidiophores arising from superficial hyphae, erect, straight, foot-cells cylindrical, 20–30 × 6–10 µm, followed by 1–2 shorter cells; conidia solitary, ellipsoid-ovoid to doliiform, 25–38 × 10–20 µm, germ tubes terminal, tips unchanged or often swollen, with a lobed appressorium.

(3) *Golovinomyces orontii* (Castagne) Heluta

Fig. 2

Material examined: On *Limnanthes douglasii* (Limnathaceae), Germany, Schleswig-Holstein, Barkelsby, 10 June 2008, J. Kruse (HAL 2239 F), anamorph and teleomorph. On *Malva alcea* (Malvaceae), the Netherlands, Utrecht, Oorsprong Park, 23 Jul. 2008, U. Braun (HAL 2266 F), anamorph.

The collection on *L. douglasii* is morphologically characterised as follows: Hyphae colourless, branched, septate, thin-walled, smooth, 3–7 µm wide, with nipple-shaped appressoria, solitary, 3–5 µm diam.; conidiophores erect, straight, subcylindrical or slightly curved at the very base, foot-cells 40–80 × 9–11 µm, followed by 1–3 shorter cells; conidia catenate, broadly ellipsoid-ovoid to doliiform, occasionally somewhat limoniform, 25–35 × 12–19 µm, colourless, sometimes with large oil drops. Chasmothecia scattered to subgregarious, 80–100 µm diam., globoid; peridial cells 10–30 µm diam., walls undulate in outline, thick, up to 2.5 µm wide; with numerous mycelioid appendages, arising from the lower half, up to 1.5 times as long as the chasmothecial diameter, 3–8 µm wide, brown throughout or paler towards the tip, thin-walled, smooth; with 5–8 asci, ovoid-saccate, 40–60 × 30–55 µm, wall thin, up to 1 µm wide, subsessile or with a short stalk, 2–3(–4)-spored; ascospores broadly ellipsoid-ovoid, 16–28 × 10–17(–19.5) µm.

NORDELOOS & LOERAKKER (1989) described *Oidium limnanthis* Noordel. on cultivated *L. douglasii* from the Netherlands. This anamorphic powdery mildew belongs in *Oidium* subgen. *Pseudoidium* (Y.S. Paul & J.N. Kapoor) R.T.A. Cook et al., characterised by having lobed appressoria and conidia formed singly. BOLAY (2005) recorded *Oidium limnanthis* from Switzerland, but considered it, based on morphological similarities, the anamorph of *Erysiphe cruciferarum* L. Junell. This treatment seemed to be supported by the phylogenetic affinity of the host genus. The position of *Limnanthes* and the family Limnathaceae was previously quite unclear, but following recent molecular analyses it became evident that the family Limnathaceae is allied to the Brassicaceae and pertains now to the order Brassicales, including Brassicaceae, Capparidaceae,

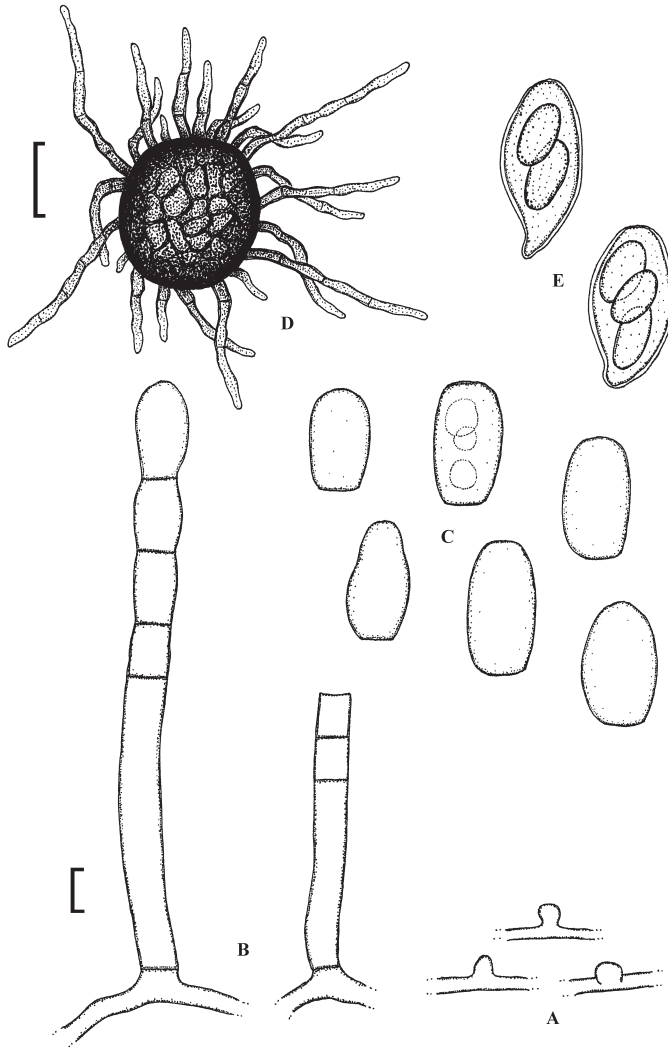


Fig. 2: *Golovinomyces orontii*, A – Appressoria, B – Conidiophores, C – Conidia, D – Chasmothecium, E – Asci. Bar = 50 μ m (D), 10 μ m (A–C, E) [U. Braun del].

Cleomaceae, Limnanthaceae and Resedaceae (STEVENS 2007). *E. cruciferarum* is also known from various hosts of the families Capparidaceae, Cleomaceae and Resedaceae (BRAUN 1987). However, PUTNAM & GLAWE (2007) found *O. limnanthis* on potted plants of *L. alba* in Oregon, USA. The anamorph was associated with some immature chasmothecia with dichotomously branched appendages, suggesting a spe-

cies of *Erysiphe* sect. *Microsphaera* (Lév.) U. Braun & Shishkoff. Hence, in spite of the morphological similarity *O. limnanthis* is undoubtedly not the anamorph of *E. cruciferarum*. The new collection from Schleswig-Holstein in Germany is, however, a member of the genus *Golovinomyces* (U. Braun) Heluta, characterised by having nipple-shaped appressoria, catenate conidia and usually 2-spored asci, which morphologically coincides with the characteristics of the plurivorous *G. orontii*. The inclusion of this sample in *G. orontii* is supported by conidiophores occasionally with somewhat curved foot-cells, less swollen conidial units and 2- to 4-spored asci. This is the first record of the latter species on a host of the Limnanthaceae.

The anamorph found in the Netherlands on *Malva alcea* agrees well with the conidial stage of the plurivorous *G. orontii* (appressoria almost indistinct to nipple-shaped, occasionally somewhat irregular, 3–5 µm diam.; conidiophores arising from superficial hyphae, 3–8 µm wide, position between two septa more or less central to somewhat non-central, foot-cells cylindrical, (30–)40–80(–100) × (8–)10–14(–17) µm, followed by 1–3 shorter cells; conidia catenate, conidial units not strongly swollen, terminal conidia obovoid, the following conidia ellipsoid-doliiform, subcylindrical, 25–38 × 15–20 µm, germ tubes terminal or subterminal, short, slightly clavate, often with a somewhat swollen terminal appressorium). *Golovinomyces cichoracearum* (DC.) Heluta s. lat. has been recorded on various species of the genus *Malva* from Asia (India, Far East of Russia), Europe and North America, including *M. alcea* in Finland (AMANO 1986). The teleomorph on *Malva* species has not yet been seen and examined, and inoculation tests as well as molecular sequence analyses are not yet available, but based on the characters of the anamorph this powdery mildew seems to pertain to the *G. orontii* complex.

(4) *Golovinomyces* sp. [*Oidium* (subgen. *Reticuloidium*) sp.]

Material examined: On *Parthenium integrifolium* (Asteraceae, Heliantheae), Germany, Brandenburg, Potsdam, botanical garden, 15 Sep. 2008, V. Kummer (HAL 2270 F).

Mycelium amphigenous, effuse or in white patches; hyphae branched, septate, 3–10 µm wide, hyaline, thin-walled, smooth; appressoria solitary, occasionally with two appressoria per cell, nipple-shaped, occasionally with slightly crenate surface, 4–8 µm diam.; conidiophores arising from superficial hyphae, position between two septa more or less central to usually non-central, erect, straight, foot-cells 60–130 × 8–13(–15) µm, subcylindrical to usually slightly increasing in breadth from base to top [8–11 µm wide at the base and 10–13(–15) µm wide above], occasionally slightly curved at the very base, foot-cells followed by 1–3 short cells; conidia in long chains, broadly ellipsoid-ovoid, doliiform, limoniform, (25–)28–40(–45) × (15–)18–24 µm, length/breadth ration 1–2, mostly 1.3–1.7, fresh conidia with large oil drops, germ tubes subterminal to somewhat lateral, some germ tubes short, tips with a slightly swollen appressorium, but most germ tubes long and narrow, up to six times as long as the conidial length after one day, tips not swollen.

The conidial shape, size and germination pattern of the anamorph on *Parthenium integrifolium*, belonging to the Heliantheae, is morphologically barely distinguishable from the anamorph of *Golovinomyces depressus* (Wallr.) Heluta, which is, however,

confined to hosts of the Cynareae. *Oidium latisporum* U. Braun, the anamorph of *Golovinomyces cichoracearum* var. *latisporus* (U. Braun) U. Braun is morphologically also very similar. The latter variety, occurring on numerous hosts of the genera *Ambrosia*, *Helianthus*, *Iva* and *Rudbeckia* (Asteraceae, Heliantheae), differs from var. *cichoracearum* in having broadly ellipsoid-ovoid, doliiform to limoniform conidia, 18–27 µm wide, with a length/breadth ration < 2, and narrow, very long, sometimes lateral germ tubes, with tips usually not swollen (BRAUN 1987, 1995). However, the *Oidium* on *Parthenium* cannot be referred to as *O. latisporum* since the foot-cells of the conidiophores are much longer, 60–130 µm, mostly somewhat increasing in width from base to top, 8–11 µm wide below and 10–13(–15) µm wide above. The conidiophores of *O. latisporum* are subcylindrical, (30–)40–70(–80) µm long. *Oidium parthenii* Satyapr. & Ushar. (SATYAPRASAD & USHARANI 1981), described from India on *Parthenium hysterophorum*, is quite distinct from the *Oidium* on *Parthenium integrifolium*. The foot-cells of the conidiophores are shorter and cylindrical, and the conidia are much narrower, 17–29.7 × 9.9–16.5 µm (SATYAPRASAD & USHARANI 1981). BAPPAMMAL et al. (1995) examined Indian material on *Parthenium hysterophorum* and reduced this *Oidium* species to synonymy with *Golovinomyces cichoracearum*.

(5) *Oidium passiflorae* Politis

Material examined: On *Passiflora caerulea* (Passifloraceae), Switzerland, VD, Rolle, Rue du Port, 16 Aug. 2008, A. Bolay (HAL 2296 F) and Morges, Rue des Tanneurs, 31 Oct. 2008, A. Bolay (HAL 2297 F).

This species, described from Greece (BRAUN 1987), is new to Switzerland. BRAUN (1998) recorded *O. passiflorae* from Germany, together with a detailed description and illustration, and LIBERATO (2006) from Australia.

(6) *Podosphaera aphanis* (Wallr.) U. Braun & S. Takam.

Material examined: On *Exacum macranthum* (Gentianaceae), Germany, Niedersachsen, Braunschweig, Julius Kühn Institute, greenhouse, 24 June 2008, U. Brielmaier-Liebetanz (HAL 2242 F), anamorph.

The anamorph found on leaves, stems and flowers of cultivated *E. macranthum* in a greenhouse is characterised by forming erect, long conidiophores with foot-cells that slightly increase in width from base to top. The basal septum is usually somewhat distant from the branching point of the supporting hypha (up to 20 µm). The foot-cells are 70–180(–200) × 7–14 µm, followed by (1–)2(–3) short cells. The conidia are formed in long chains, broadly ellipsoid-ovoid, doliiform or limoniform, (22–)25–35(–40) × 14–25 µm, guttulate, with conspicuous fibrosin bodies. These peculiar features agree perfectly with the characteristics of the anamorph of *Podosphaera aphanis*, which probably infected the new host under greenhouse conditions. *Oidium pseudolongipes* U. Braun & Gabler is another powdery mildew anamorph described on *Exacum macranthum* from a greenhouse in Germany. This species, confined to petals of the host, is also a chain-building *Oidium*, but quite distinct from the present collection by conidia with lacking fibrosin bodies and cylindrical conidiophores with a distinct arrangement of cells (GABLER & BRAUN 1995). This is the first record of the anamorph of *P. aphanis* on *E. macranthum*.

(7) *Podosphaera* sp. (*Podosphaera* sect. *Sphaerotheca* subsect. *Magnicellulatae* (U. Braun) U. Braun & Shishkoff)

Material examined: On *Phlox paniculata* (Polemoniaceae), Germany, Sachsen-Anhalt, Halle (Saale), Georg Cantor Street, garden, 8 Aug. 2008, U. Braun (HAL 2265 F); Brandenburg, Potsdam-Bornim, Flora Street, 15 Sep. 2008, V. Kummer (HAL 2267 F, herb. Kummer), anamorphs. On *Polemonium caeruleum* (Polemoniaceae), Germany, Brandenburg, Potsdam, botanical garden, 15 Sep. 2008, V. Kummer (HAL 2269 F, herb. Kummer); Brandenburg, Potsdam-Bornim, Flora Street, 15 Sep. 2008, V. Kummer (HAL 2268 F, herb. Kummer), anamorph.

The anamorph on *Phlox paniculata* is characterised as follows: Hyphae 3–10 µm wide; appressoria solitary, indistinct to slightly nipple-shaped; conidiophores erect, foot-cells cylindrical, straight to slightly curved, 30–80 × 10–12 µm, followed by 1–3 short cells, position between two septa more or less central to usually non-central; conidia in chains, ellipsoid-doliiform to subcylindrical, 25–45(–50) × 13–24 µm, with oil drops and numerous conspicuous fibrosin bodies, germ tubes lateral, short and stout, up to 25 × 9 µm, attenuated at the very base. The anamorph on *Polemonium caeruleum* is very similar (conidiophores 40–60 × 9–12 µm, conidia 25–35 × 12–20 µm), with an agreeing germination pattern. Due to the presence of fibrosin bodies in the conidia and the type of conidial germination, this powdery mildew anamorph can be classified as a species of *Podosphaera* sect. *Sphaerotheca* subsect. *Magnicellulatae*, probably belonging to the *Podosphaera fusca* (Fr.) U. Braun & Shishkoff complex (sensu BRAUN 1987). The features of the anamorph on *Phlox paniculata* agree well with the description of the conidial stage of the latter species in BRAUN (1987, 1995). Plurivorous races are, above all, known within *P. xanthii* (Castagne) U. Braun & Shishkoff (BRAUN et al. 2001). ‘*Sphaerotheca fuliginea*’ auct. on *Phlox acuminata* from France, *P. divaricata* from the USA, *P. drummondii* from Armenia and *Phlox* sp. from Great Britain were listed by AMANO (1986). NOMURA (1997: 49, Fig. 56) illustrated *Oidium* sp. on *Phlox paniculata* and *P. subulata* from Japan. The drawing based on Japanese material agrees well with the *Oidium* from Germany. Furthermore, Shin (2000) recorded *Phlox drummondii* as host of *Sphaerotheca fusca* (Fr.) S. Blumer in Korea. All of these records probably refer to the same causal agent of powdery mildew on *Phlox*, but the true identity has to be proven by collections of the teleomorph or molecular sequence analyses. HELUTA (1989) recorded *Sphaerotheca polemonii* L. Junell on *Phlox paniculata* from the Ukraine. However, the latter species belongs to *Podosphaera* sect. *Sphaerotheca* (Lév.) U. Braun & Shishkoff subsect. *Sphaerotheca*, characterised by having small peridial cells, 10–25 µm diam.

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