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Taxonomy, host range and distribution of some powdery mildew fungi (Erysiphales)

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Abstract: Ale-Agha, N., Boyle, H., Braun, U., Butin, H., Jage, H., Kummer, V. & Shin, H.-D. 2008: Taxonomy, host range and distribution of some powdery mildew fungi (Erysiphales). Schlechtendalia **17**: 39–54.

Oidium pedaliacearum sp. nov. (≡ *O. sesami*, nom. inval.) and *Podosphaera macrospora* comb. et stat. nov. (≡ *Sphaerotheca alpina* f. *macrospora*) are introduced, and the taxonomy and distribution of *Erysiphe celosiae* is discussed. New host species and new collections of *Erysiphe cruciferarum* (on *Cleome hassleriana*), *E. flexuosa* (on *Aesculus hippocastanum*), *E. hedwigii* (on *Viburnum carlesii*), *E. heraclei* (on *Tinguarra montana*), *E.* cf. *macleayae* (on *Macleaya cordata*), *E. prunastri* (on *Prunus cerasifera*), *E. sedi* (on *Sedum* aff. *spectabilis*), *E. trifolii* (on *Trigonella caerulea*), *Golovinomyces cichoracearum* (on *Argyranthemum pinnatifidum* subsp. *succulentum*), *G.* cf. *hydrophyllacearum* (on *Nemophila menziesii*), *G. orontii* (on *Nolana* spp.), *G.* cf. *orontii* (on *Tiarella cordifolia*), *Neoerysiphe cumminsiana* (on *Bidens* cf. *ferulifolia*), *Oidium clitoriae* (on *Clitoria ternatea*), *O.* cf. *hortensiae* (on *Philadelphus coronarius*), *O. pedilanthi* (on *Pedilanthus tithymaloides*), *Oidium* (*Pseudoidium*) sp. (on *Utricularia alpina*), *Podosphaera* sp. (on *Bergia capensis*), *Sawadaea bicornis* (on *Acer platanoides*) and *S. tulasnei* (on *Acer ginnala* and *A. tatatica*) are recorded from France, Germany, Greece and Mexico.

Zusammenfassung: Ale-Agha, N., Boyle, H., Braun, U., Butin, H., Jage, H., Kummer, V. & Shin, H.-D. 2008: Taxonomie, Wirtsspektrum und Verbreitung einiger Mehltaupilze (Erysiphales). Schlechtendalia **17**: 39–54.

Oidium pedaliacearum sp. nov. (≡ *O. sesami*, nom. inval.) und *Podosphaera macrospora* comb. et stat. nov. (≡ *Sphaerotheca alpina* f. *macrospora*) werden eingeführt. Die Taxonomie und Verbreitung von *Erysiphe celosiae* wird diskutiert. Neue Wirte und Neunachweise von *Erysiphe cruciferarum* (auf *Cleome hassleriana*), *E. flexuosa* (auf *Aesculus hippocastanum*), *E. hedwigii* (auf *Viburnum carlesii*), *E. heraclei* (auf *Tinguarra montana*), *E.* cf. *macleayae* (auf *Macleaya cordata*), *E. prunastri* (auf *Prunus cerasifera*), *E. sedi* (auf *Sedum* aff. *spectabilis*), *E. trifolii* (auf *Trigonella caerulea*), *Golovinomyces cichoracearum* (auf *Argyranthemum pinnatifidum* subsp. *succulentum*), *G.* cf. *hydrophyllacearum* (auf *Nemophila menziesii*), *G. orontii* (auf *Nolana* spp.), *G.* cf. *orontii* (auf *Tiarella cordifolia*), *Neoerysiphe cumminsiana* (auf *Bidens* cf. *ferulifolia*), *Oidium clitoriae* (auf *Clitoria ternatea*), *O.* cf. *hortensiae* (auf *Philadelphus coronarius*), *O. pedilanthi* (auf *Pedilanthus tithymaloides*), *Oidium* (*Pseudoidium*) sp. (auf *Utricularia alpina*), *Podosphaera* sp. (auf *Bergia capensis*), *Sawadaea bicornis* (auf *Acer platanoides*) und *S. tulasnei* (auf *Acer ginnala* und *A. tatatica*) aus Frankreich, Deutschland, Griechenland und Mexiko werden mitgeteilt.

Key words: Erysiphaceae, new hosts, new records, *Oidium pedaliacearum*, *Podosphaera macrospora*.

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Powdery mildew fungi belong to the most common, widespread plant pathogenic fungi worldwide. They occur on a wide range of herbs and woody plants in all kinds of temperate, arid, but also subarctic and tropical habitats. Although comprehensive data on host range and distribution (e.g., Amano 1986) and a taxonomic monograph are available (Braun 1987), the knowledge of this fungal group is still fragmentary, even in Europe. Introductions of exotic powdery mildew diseases are not uncommon. Various spectacular cases have recently been reported from Europe, e.g., the introductions of the Asian powdery mildew species *Erysiphe deutziae* (Bunkina) U. Braun & S. Takam. on *Deutzia* spp. (Bolay et al. 2005) and *E. syringae-japonicae* (U. Braun) U. Braun & S. Takam. (Braun 1998, Piątek 2005) as well as the North American *E. flexuosa* (Peck) U. Braun & S. Takam. on *Aesculus* spp. (Butin & Kehr 2002, Zimmermannová-Pastirčáková et al. 2002), *E. elevata* (Burrill) U. Braun & S. Takam. on *Catalpa* spp. (Ale-Agha et al. 2004), *E. symphoricarpi* (Howe) U. Braun & S. Takam. on *Symphoricarpos* spp. (Kiss et al. 2002) and *Podosphaera pruinosa* (Cooke & Peck) U. Braun & S. Takam. on *Rhus hirta* (L.) Sudw. (reported in this volume).

Most powdery mildew species are said to be host specific, i.e. with limited host ranges. There are, however, various species of this fungal group with much wider, plurivorous host ranges, as recently demonstrated for *Erysiphe quercicola* S. Takam. et al., which may attack oaks as well as a wide range of species of tropical trees (Takamatsu et al. 2007).

Records of powdery mildews on new host plants, often as anamorphic states, are not rare. This paper is a further contribution reporting about various new hosts of powdery mildew species as well as taxonomic notes on some species of the Erysiphales.

(1) ***Erysiphe celosiae*** S. Tanda, Mycoscience 41: 155, 2000.

Material examined: On *Celosia argentea* L. (Amaranthaceae), Germany, Saxony, eastern Oberlausitz, Görlitz-Rauschwalde, Kopernikus Street, MTB 4855/4.1, 11 Oct. 2007, S. Hoeflich & H. Boyle (GLM F080834, HAL 2128 F), anamorph and teleomorph; *Celosia argentea* var. *cristata* (L) Kuntze [C. *plumosa* Burv.], Germany, Hessen, Cappel, Nov. 1994, comm. Dalchow (HAL 1679 F), anamorph and teleomorph; *Celosia* sp., Ukraine, Kiev, Shcherbakova Street, 4 Oct. 1983, P. Marczenko (HAL 2127 F, ex herb. KW), anamorph and teleomorph.

Braun (1998) recorded, described and illustrated a first German powdery mildew collection on *Celosia* sp. and, based on the strong morphological similarity of the anamorphs and chasmothecia as well as the affinity of the host plant families, assigned it to *Erysiphe betae* (Vaňha) Weltzien. Tanda (2000) introduced *E. celosiae*, based on a Japanese collection on *Celosia argentea*. The taxonomy of this species is, however, not yet settled, i.e., inoculation experiments or molecular sequence analyses proving that *E. celosiae* and *E. betae* are distinct species have not yet been carried out. Tanda's (2000: 157, Tab. 1) comparison of *E. celosiae* with different morphologically similar species, including *E. betae*, shows that the two fungi on *Beta* and *Celosia* spp. are morphologically barely distinguishable. Records of *E. communis* auct. on *Celosia argentea* from Italy (Amano 1986) seem to belong to *E. celosiae*. *Oidium* sp. was recorded from Russia on *Celosia* sp. (Amano 1986).

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(2) ***Erysiphe cruciferarum*** Opiz ex L. Junell, Svensk Bot. Tidskr. 61: 217, 1967.

Material examined: On *Cleome hassleriana* Chodat [= *C. spinosa* hort.] (Capparaceae), France, Region Central de Loire, Département Touraine, Tour, flower pot, 6 Sep. 2006, U. Braun (HAL 2129 F), anamorph.

Host new to France. Due to the agreeing morphology and the affinity of the host families, Braun (1987) assigned powdery mildew collections on *Cleome* spp. to *E. cruciferarum*. Previously, this host was usually called *Cleome spinosa*. Various records from Germany are known (Brandenburger & Hagedorn 2006), in some cases even the teleomorph (Jage et al. 2007).

(3) ***Erysiphe flexuosa*** (Peck) U. Braun & S. Takam., Schlechtendalia 4: 19, 2000.

Material examined: On *Aesculus hippocastanum* L. (Hippocastanaceae), Belgium, Brussel, Brussel-Etterbeek, Pater-Deken-Straat, 18 Jun. 2005, H. Boyle (GLM F062375, HAL 2210 F), anamorph and teleomorph; France, Region Central de Loire, Département Touraine, Blois, park in the centre, 7 Sep. 2006, U. Braun (HAL 2130 F), anamorph and teleomorph.

Zimmermannová-Pastirčáková et al. (2002) discussed the introduction of *E. flexuosa* in Europe in detail and listed collections from Austria, Croatia, England, France, Germany, Poland, Slovakia and Switzerland. The record from Belgium is new. All French collections listed were from the eastern part of this country. The new collection shows that *E. flexuosa* is distributed at least up to central France.

(4) ***Erysiphe hedwigii*** (Lév.) U. Braun & S. Takam., Schlechtendalia 4: 9, 2000.

Material examined: On *Viburnum carlesii* Hemsl. (Caprifoliaceae), Germany, Saxony, Görlitz, historical centre of the city, Nikolaizwinger, MTB 4855/2.4, 15 Oct. 2007, S. Hoeflich (GLM F081204, HAL 2215 F).

New host species (determined by H. Boyle).

(5) ***Erysiphe heraclei*** DC., Fl. franç. 6: 107, 1815.

Material examined: On *Todaroa montana* Webb ex Benth. & Hook. f. (Apiaceae), Germany, North Rhine-Westphalia, Essen, botanical garden, MTB 4588/3.1, 8 Jan. 2007, N. Ale-Agha (HAL 2131 F), anamorph and teleomorph; on *Pimpinella anisum* L. (Apiaceae), Saxony, Königshain, park of the castle, MTB 4855/1.2, 12 Oct. 2006, H. Boyle (GLM F078529), anamorph.

This is the first record of *E. heraclei* on a host of the genus *Todaroa*. *T. montana*, native on the Canary Islands, is a new host species. The features of the anamorph and the chasmothecia with frequently branched appendages perfectly coincide with *E. heraclei*. *Pimpinella anisum* is a new host for Germany.

(6) ***Erysiphe*** cf. ***macleayae*** R.Y. Zheng & G.Q. Chen, Sydowia 34: 290, 1981.

Material examined: On *Macleaya cordata* (Papaveraceae), Germany, Brandenburg, Teltow, Lenau Street, MTB 3545/4.3, 18 Sep. 2004, V. Kummer (HAL 2133 F, herb. Kummer), anamorph; Glindow, Mühlen Street, MTB 3643/1.4, 11 Sep. 2004, V. Kummer (herb. Kummer), anamorph; Eiche, Kuhfortdamm near railway crossing, MTB 3643/2.2, 15 Oct. 2004, V. Kummer (herb. Kummer), anamorph; Potsdam, botanical garden, MTB 3544/3.3, 7 Nov. 2005, V. Kummer (herb. Kummer), anamorph; Saxony, Görlitz, centre, Sonnen Street, Museum, garden, MTB 4855/2.4, 25 Oct. 2005, H. Boyle (GLM F070246, HAL 2209 F).

This species is new to Germany. The anamorph agrees well with the original description of *E. macleayae* (mycelium amphigenous and on petioles, forming greyish white patches or being effuse, thin; appressoria lobed; conidia solitary, subcylindrical, 30–40×14–17 µm). Chasmothecia have not yet been found.

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(7) ***Erysiphe prunastri*** DC., Fl. franç. 6: 108, 1815.

Material examined: On *Prunus cerasifera* Ehrh. (Rosaceae), Germany, North Rhine-Westphalia, Köln, Neustadt-Süd, 4 Sep. 2003, N. Ale-Agha & Linke (HAL 2134 F), anamorph and teleomorph; Sachsen-Anhalt, Magdeburg-Herrenkrug, MTB 3836/1.3, 13 Oct. 2004, W. Lehmann (herb. Lehmann 478/04, det. H. Jage), anamorph and teleomorph.

Prunus cerasifera is a new host of this powdery mildew species in Germany. This host is not listed in Brandenburger & Hagedorn (2006). Braun (1995) recorded *E. prunastri* on *P. cerasifera* from Bulgaria, the Czech Republic and Romania.

(8) ***Erysiphe sedi*** U. Braun, Feddes Repert. 92: 502, 1981.

Material examined: On *Sedum* aff. *spectabile* Boreau (Crassulaceae), Germany, Brandenburg, Geltow: Garden Centre near Baumgartenbrück, MTB 3643/4.4, 1 Dec. 2006, leg. & det. V. Kummer, conf. U. Braun (herb. Kummer), anamorph.

First record of *E. sedi* from Germany. The fungus has been introduced from Asia to Europe. Braun (1987, 1995) listed general information about the occurrence of *E. sedi* in Asia and records of this species on *Aeonium decorum* Webb ex Bolle, *Bryophyllum calycinum* Salisb. and some *Sedum* species from Romania and the former Soviet Union. Two additional reports about the occurrence of *E. sedi* in Central Europe were recently published [on *Sedum alboroseum* Baker in Hungary (Jankovicz & Szentiványi 2006), on *Chiastophyllum oppositifolium* (Ledeb. ex Nordm.) A. Berger, *Rhodiola rosea* L. and some *Sedum* species in Switzerland (Bolay 2005)]. Kiss & Daughtrey (2001) discussed the first record of this species in North America, also on *S. spectabile*.

S. spectabile is a species native in Eastern Asia (NE-China, Korea), and the other hosts of the Crassulaceae infected by *E. sedi* are important ornamental plants produced in garden nurseries. Therefore, the spreading of this fungus in Germany deserves special attention.

In Europe, *E. sedi* and *G. orontii* were reported as pathogens of *Sedum* species (Braun 1995). However, the anamorphs of the two species are easily distinguishable. *E. sedi* produces the conidia singly, whereas *G. orontii* is characterised by conidia formed in chains. Only one record of *G. orontii* on a *Sedum* species from Germany is listed in Brandenburger & Hagedorn (2006).

(9) ***Erysiphe trifolii*** Grev., Fl. Edin.: 459, 1824.

Material examined: On *Trigonella caerulea* (L.) Sér. (Fabaceae), Germany, Brandenburg, Potsdam, Botanical Garden, MTB 3544/3.3, 29 Sep. 2003, V. Kummer (HAL 2135 F; herb. Kummer), anamorph and teleomorph.

Trigonella caerulea is a new host species for *E. trifolii*. Braun (1995) only cited *Trigonella* spp. as hosts of *E. pisi* DC.

(10) ***Golovinomyces cichoracearum*** (DC.) V.P. Heluta, Ukrayins´k. Bot. Zhurn. 45: 62, 1988.

Material examined: On *Argyranthemum pinnatifidum* (L. f.) Lowe subsp. *succulentum* (Lowe) Humphries (Asteraceae), Germany, North Rhine-Westphalia, Essen, botanical garden, MTB 4508/3.1, 12 Dec. 2007, N. Ale-Agha (HAL 2113 F), anamorph.

New host.

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(11) ***Golovinomyces* cf. *hydrophyllacearum*** (U. Braun) V. P. Heluta, Ukrayins'k. Bot. Zhurn. 45(5): 62, 1988

Material examined: On *Nemophila menziesii* Hook. & Arn. (Hydrophyllaceae), Germany, Brandenburg, Potsdam-Bornim, garden colony Gr. Herzberg, garden, MTB 3543/4.4, 26 Oct. 1996, leg. V. Kummer, det. U. Braun (HAL 639 F, herb. Kummer), anamorph.

N. menziesii is a North American annual species introduced in Europe as ornamental plant. The pathogen *G. hydrophyllacearum* is distributed in Northern America, infecting in addition to *N. menziesii* numerous other species of different genera of the Hydrophyllaceae (Amano 1986, Braun 1987). Amano (1986) and Farr et al. (1995) also listed *Podosphaera fuliginea* (Schltdl. : Fr.) U. Braun & S. Takam., *P. macularis* (Wallr. : Fr.) U. Braun & S. Takam. and *Erysiphe polygoni* DC. as agents of powdery mildew diseases on a few species of *Hydrophyllum* and *Nemophila*, respectively. These records are doubtful since the first species is confined to hosts of the genera *Veronica* and *Veronicastrum* (Plantaginaceae, previously placed in the Scrophulariaceae), the second species to *Humulus* spp. (Cannabaceae), and the third species to different genera of the Polygonaceae (Braun 1987). The anamorph found on the *N. menziesii* plants is characterised by having ellipsoid conidia without fibrosin bodies, arranged in chains (Euoidium). The teleomorph was unfortunately not found. Therefore, a detailed comparison and differentiation in relation to the closely related species *G. cichoracearum* and *G. orontii* was not possible. Braun (1983) separated *G. hydrophyllacearum* from the *G. cichoracearum* complex by the teleomorph. Thus, the identification of this powdery mildew can only be considered to be tentative. Unfortunately the powdery mildew on *N. menzisii* could not be recollected. This is the first report of a powdery mildew infection on a hosts belonging to the Hydrophyllaceae in Europe.

(12) ***Golovinomyces orontii*** (Castagne) V.P. Heluta, Ukrayins´k. Bot. Zhurn. 45: 63, 1988

Material examined: On *Nolana humifusa* (Gouan) M. Johnst. (Nolanaceae), Germany, Brandenburg, Potsdam, botanical garden, MTB 3544/3.3, 8 Sep. 1999, leg. V. Kummer, det. U. Braun (HAL 445 F, herb. V. Kummer), anamorph and teleomorph; on *Nolana napiformis* Phil. (Nolanaceae), Germany, Brandenburg, Potsdam, botanical garden, MTB 3544/3.3, 8 Sep. 1999, leg. V. Kummer, det. U. Braun (HAL 446 F, herb. V. Kummer), anamorph and teleomorph.

New host species. Both plant species were cultivated as ornamental plants side by side near the so called "Seitenhaus" in the botanical garden. Buhr (1958) reported about the infection of *N. prostrata* L. f. (= *N. humifusa*) by *Oidium* sp. in the botanical garden Rostock. This is the only record of a member of the Erysiphaceae on a host belonging to the Nolanaceae (Amano 1986, Braun 1987). The two host species are native in the loma regions of Chile and Peru.

(13) ***Golovinomyces*** cf. ***orontii*** (Castagne) V.P. Heluta, Ukrayins´k. Bot. Zhurn. 45: 63, 1988.

Material examined: On *Tiarella cordifolia* L. (Saxifragaceae), Germany, Hessen, Wiesbaden, 10 Oct. 2002, R. Ullrich (HAL 2136 F), anamorph.

The anamorph found on *Tiarella cordifolia* agrees morphologically well with *Golovinomyces orontii* (appressoria nipple-shaped, conidia catenate, without fibrosin

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bodies), suggesting that a plurivorous race of the *G. cichoracearum* (DC.) V.P. Heluta complex switched onto this host.

(14) ***Neoerysiphe cumminsiana*** (U. Braun) U. Braun, Schlechtendalia 3: 50, 1999.

Material examined: On *Bidens* cf. *ferulifolia* (Jacq.) DC. [cult.] (Asteraceae), Germany, Saxony, Freiberg (West), Obergasse, nursery Bimberg, 2007, collector unknown (HAL 2137 F), anamorph.

New host. *Bidens pilosa* L. has been recorded as a host of *Neoerysiphe* cf. *galeopsidis* (DC.) U. Braun from Cuba (Amano 1986). This record belongs possibly to *N. cumminsiana*. The conidial state of *N. cumminsiana* is well-characterised by having catenate conidia without fibrosin bodies and lobed appressoria, a combination that easily distinguishes this anamorph from other powdery mildews on *Bidens* with conidia formed in chains, viz. *Golovinomyces cichoracearum* and *Podosphaera xanthii* (Castagne) U. Braun & Shishkoff. Voytyuk et al. (2006) and Voytyuk (2007) demonstrated that *N. cumminsiana* is a rather common and widespread species in Israel and the Ukraine, often confused with *G. cichoracearum*, suggesting that this species is also not rare in other parts of Europe. Jage et al. (2007) reported *Oidium* sp. on *Bidens ferulifolia* (wrongly as '*ferulifera*') from Baden-Württemberg, Brandenburg, Sachsen-Anhalt and Saxony since 1999. Lehmann & Jage (2005) published it as *Golovinomyces cichoracearum*. All specimens concerned have to be proven, since they may belong to *N. cumminsiana*.

(15) ***Oidium clitoriae*** Narayanas. & K. Ramakr., J. Madras Univ. 37–38: 89, '1967–1968' 1969.

Material examined: On *Clitoria ternatea* L. (Fabaceae), Mexico, Oaxaca, Puerto Escondido, Universidad del Mar, 11 Oct. 2007, S. Eilmus & S. Kautz (HAL 2211 F), anamorph.

New to Mexico. The collection from Mexico is characterised as follows: Hyphae branched, septate, hyaline, thin-walled, 2–8 µm wide; appressoria lobed, 3–10 µm diam.; conidiophores erect, 40–70 µm long, foot-cells cylindrical, 25–40×7–10 µm, followed by 1–3 shorter cells; conidia solitary, ellipsoid-doliiform to cylindrical, 25–40×10–20 µm.

(16) ***Oidium*** cf. ***hortensiae*** Jørst., Skr. Norske Vidensk.-Akad. Oslo, Mat.-Naturvidensk. Kl. 1925, 10: 106, 1926. **Fig. 1**

Material examined: On *Philadelphus coronarius* L. (Hydrangeaceae), Germany, North Rhine-Westphalia, Essen, university campus, MTB 4508/1.3, 20 Oct. 2003, G.B. Feige & N. Ale-Agha (HAL 2138 F), anamorph.

The morphological features of this anamorph found on *Philadelphus coronarius* agree well with those of *Oidium hortensiae* on *Hydrangea* spp.: Hyphae sparingly branched, 3–7 µm wide, septate, hyaline, smooth; appressoria lobed, solitary or in opposite pairs, 3–10 µm diam.; conidiophores erect, straight to slightly curved, cylindrical or subcylindrical, width slightly increasing towards the apex, foot-cells cylindrical, (20–)25–35(–40)×8–12 µm; conidia solitary, occasionally in very short chains, primary conidia (first conidia formed) obovoid, apex rounded, base subtruncate, secondary conidia ellipsoid-doliiform, subcylindrical, both ends subtruncate, (20–)25–35×13–20 µm. Therefore, this powdery mildew is tentatively assigned to *O. hortensiae*.

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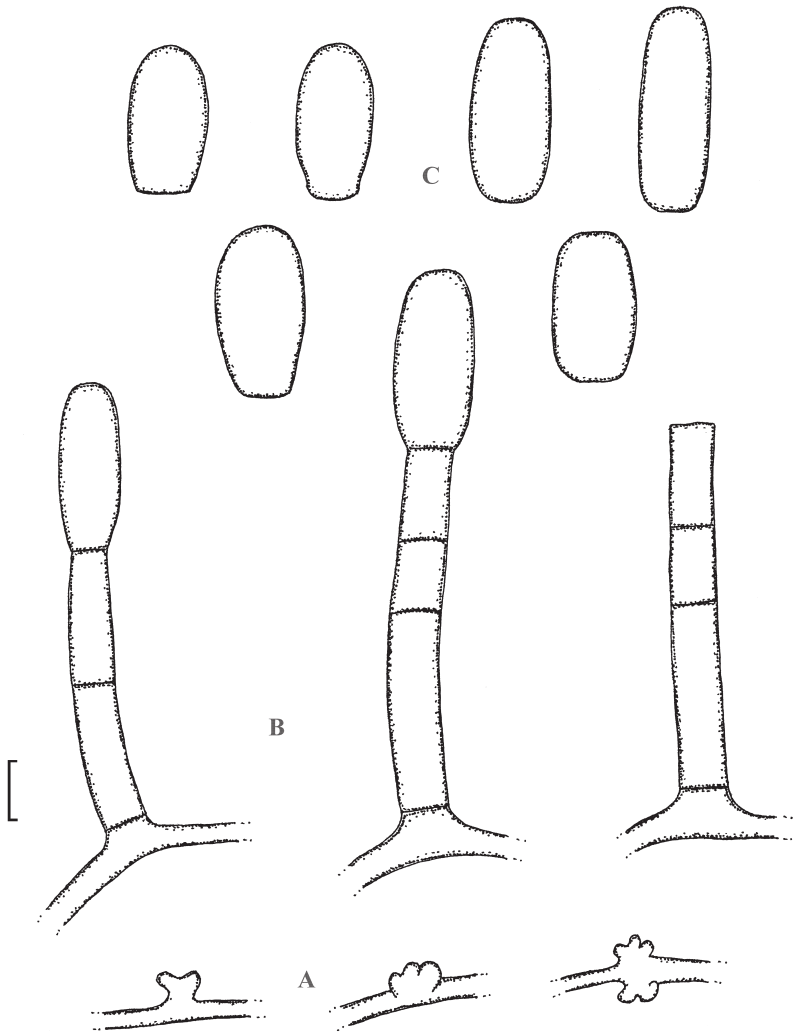

Fig. 1: *Oidium* cf. *hortensiae* on *Philadelphus coronarius*, **A** – appressoria, **B** – conidiophores, **C** – conidia. Bar = 10 µm (U. Braun del.).

(16) ***Oidium pedaliacearum*** H.D. Shin, **sp. nov.** **Fig. 2**

MycoBank, MB 511424

Latin description: Shin (1990: 9–10, sub *Oidium sesami* H.D. Shin, nom. inval.).

Holotype: on *Sesamum indicum* L. (Pedaliaceae), Korea, Kangnung, 16 Sep. 1991, H.D. Shin (KUS-F 11074).

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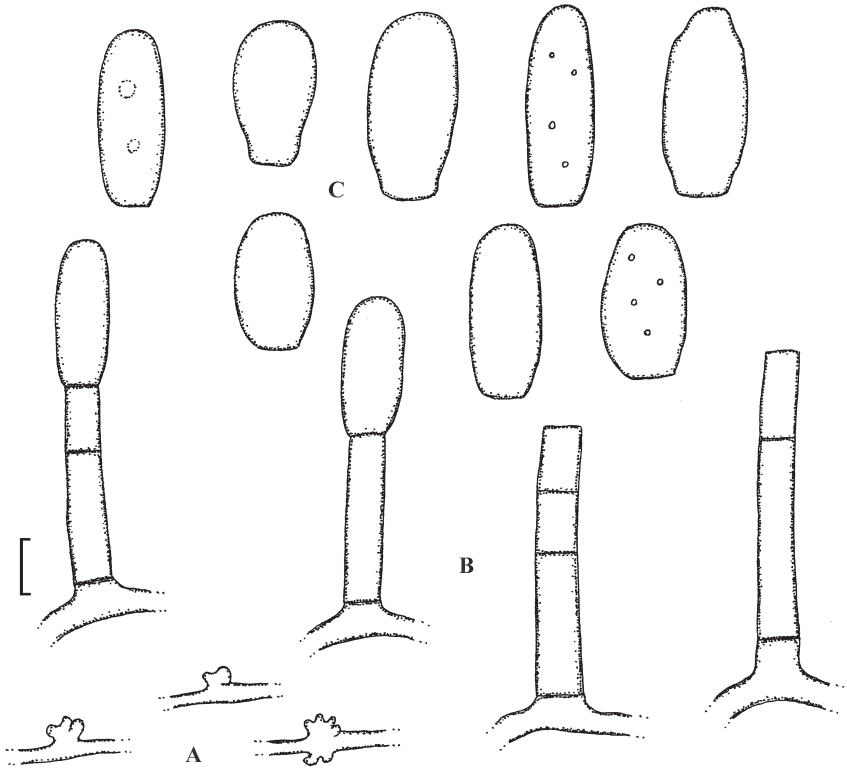

Fig. 2: *Oidium pedaliacearum* on *Ibicella lutea*, **A** – appressoria, **B** – conidiophores, **C** – conidia. Bar = 10 µm (U. Braun del.).

Syn.: *Oidium sesami* H.D. Shin, Korean J. Pl. Pathol. 6(1): 9, 1990, nom. inval. (ICBN, Art. 37.6), non *O. sesami* (Y.S. Paul & J.N. Kapoor) Hosag., Vijay., Udaiyan & Manian, 1993.

Material examined: On *Ibicella lutea* (Lindl.) Van Eselt. [≡ *Martynia lutea* Lindl.] (Pedaliaceae), Germany, North Rhine-Westphalia, Essen, botanical garden, MTB 4508/3.1, 5 Nov. 2007, N. Ale-Aga (HAL 2139 F).

The conidial state (*Pseudoidium*) on *Ibicella lutea* found in a botanical garden is morphologically barely distinguishable from *Oidium sesami* H.D. Shin and thus tentatively referred to the latter species. The anamorph on *Ibicella lutea* is characterised as follows (Fig. 2): Mycelium amphigenous, thin, effuse, greyish white; hyphae sparingly branched, 2.5–6 µm wide, thin-walled, hyaline, smooth; appressoria solitary or in opposite pairs, lobed to multilobed, 3–10 µm diam.; conidiophores arising from superficial hyphae, position more or less central between two septa, erect, (30–)60–90

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µm long, basal septum at the branching point of the hyphae or occasionally somewhat away, foot-cells cylindrical, straight to slightly curved, 25–50×6–10 µm, followed by (0–)1–2(–3) shorter cells or a single cell of about the same length; conidia formed singly, primary conidia (first conidia formed) more or less obovoid, with rounded apex and subtruncate base, secondary conidia broadly ellipsoid-ovoid to doliiform-limoniform, both ends subtruncate, (25–)30–49(–45)×14–22 µm, length/width ratio (1.25–)1.4–2.5(–3).

The name *Oidium sesami* H.D. Shin (Shin 1990) is unfortunately invalid (ICBN, Art. 37.6). Due to the validly published combination *Oidium sesami* (Y.L. Paul & J.N. Kapoor) Hosag. et al. (Hosagoudar et al. 1993), based on *Euoidium sesami* Y.L. Paul & J.N. Kapoor (Paul & Kapoor 1987), which is an anamorphic powdery mildew species belonging to the euoidium type [conidia in chains, according to Bappammal et al. (1995) conidia with fibrosin bodies], Shin´s name cannot be simply validated. In order to avoid the introduction of a homonym, it is necessary to use a new name for the pseudoidium state on *Sesamum*. *Oidium sesami* U. Srinivas., Bagyan. & M. Raju (Srinivasulu et al. 2003) is an illegitimate name (homonym of *O. sesami* (Y.L. Paul & J.N. Kapoor) Hosag. et al., 1993). Morphologically, the latter species is also characterised by having catenate conidia.

(18) ***Oidium pedilanthi*** J.M. Yen, Cahiers du Pacifique 11: 104, 1967.

Material examined: On *Pedilanthus tithymaloides* (L.) Poit. (Euphorbiaceae), Germany, North Rhine-Westphalia, Essen, campus, MTB 4508/1.3, 1 Oct. 2007, N. Ale-Agha (HAL 2140 F).

This is the first record of this Asian species from Germany. Braun (1987) considered this species the anamorph of *Podosphaera euphorbiae-hirtae* (U. Braun & S. Somani) U. Braun & S. Takam. (≡ *Sphaerotheca euphorbiae-hirtae* U. Braun & S. Somani), which is, however, unproven.

(19) ***Oidium*** sp. **Fig. 3**

Material examined: On *Utricularia alpina* Jacq. (Lentibulariaceae), Germany, North Rhine-Westphalia, Essen, botanical garden, MTB 4508/3.1, Mar. 2007, N. Ale-Agha (HAL 2141 F).

The conidial state found on *Utricularia alpina* in a botanical garden is characterised as follows: Mycelium hypophyllous, effuse, thin, whitish, causing greenish to purplish discolorations; hyphae sparingly branched, 2–7 µm wide, septate, thin-walled, smooth; appressoria solitary or in opposite pairs, lobed, 3–8 µm diam.; conidiophores arising from hyphae, position between two septa more or less central, erect, straight, 40–70 µm long (without conidia), foot-cells cylindrical, straight, rarely slightly curved, 20–30×7–11 µm, followed by 1–2 shorter cells; conidia formed singly, subcylindrical to ellipsoid-doliiform, (25–)30–45(–50)×(12–)14–20 µm, length/width ratio (1.6–)1.9–2.8(–2.9), without fibrosin bodies.

This is the first record of a pseudoidium anamorph on a species of *Utricularia*, but the identity of this powdery mildew is quite unclear. Lebeda et al. (2001) recorded powdery mildew anamorphs on 15 *Utricularia* spp. in a glasshouse in the Czech Republic, which were, however, characterised by having catenate conidia with fibrosin bodies (*Oidium* subgen. *Fibroidium*, i.e., anamorphs of *Podosphaera*).

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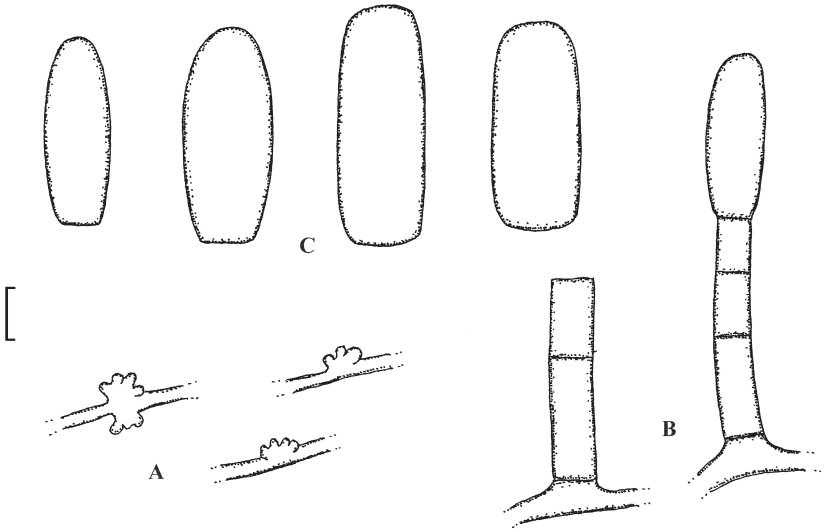

Fig. 3: *Oidium* sp. on *Utricularia alpina*, **A** – appressoria, **B** – conidiophores, **C** – conidia. Bar = 10 µm (U. Braun del.).

(20) ***Podosphaera macrospora*** (U. Braun) U. Braun & V. Kumm., **comb. et stat. nov.** **Figs 4–5**

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Bas.: *Sphaerotheca alpina* S. Blumer f. *macrospora* U. Braun, Zbl. Mikrobiol. 140: 164, 1985.

Syn.: *Podosphaera alpina* (S. Blumer) U. Braun & S. Takam. f. *macrospora* (U. Braun) U. Braun & S. Takam., Schlechtendalia 4: 26, 2000.

Mycelium amphigenous, forming persistent greyish white patches or sometimes it is effuse; hyphae branched, 3–8 µm wide, hyaline, finally sometimes pigmented, smooth, wall thin to slightly thickened; appressoria rather indistinct; conidiophores arising from superficial hyphae, erect, straight, mostly 80–200 µm long, foot-cells subcylindrical, straight, 40–80(–100)×10–15 µm, followed by 1–3 shorter cells; conidia catenate, primary conidia (first conidia formed) broadly obovoid-ellipsoid, apex rounded, base subtruncate, secondary conidia broadly ellipsoid, doliiform to limoniform, 25–40×(12–)15–20 µm, length/width ratio 1.5–2.2. Chasmothecia scattered to gregarious, 65–90 µm diam., peridial cells irregularly shaped, 20–60 µm diam., walls in front view thick, 2–4 µm, appendages few to moderately rich, usually arising from the lower half of the chasmothecium, 0.25–3 times as long as the chasmothecial diam., mycelioid, mostly unbranched, continuous to pluriseptate, brown throughout or brown below and paler towards the apex, sometimes subhyaline, wall thin to somewhat thickened, up to 1.5 µm, smooth; ascus saccate, subsessile to short-stalked,

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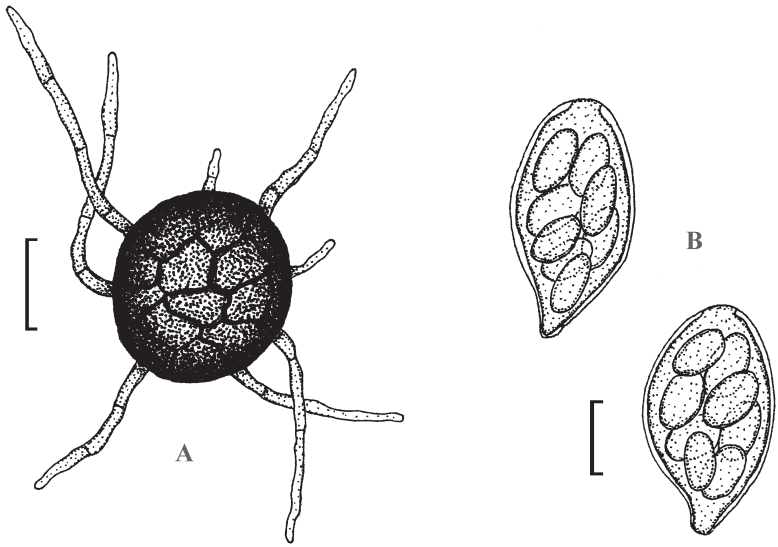

Fig. 4: *Podosphaera macrospora*, teleomorph, **A** – chasmothecium, **B** – asci. Bar = 50 µm [chasmothecium], 20 µm [asci] (U. Braun del.).

55–80(–90)×40–65 µm, lateral wall 1.5–3 µm wide, terminal oculus small, 10–15 µm diam., (6–)8-spored; ascospores broadly ellipsoid-ovoid, colourless, 20–37×12–18 µm.

Material examined: On *Tellima grandiflora* (Pursh) Dougl. ex Lindl. (Saxifragaceae), Germany, Brandenburg, Groß Pinnow, Landhof Arche, MTB 2851/2.1, 25 June 2007, V. Kummer (HAL 2142 F; herb. Kummer), with chasmothecia. On *Tiarella wherryi* Lakela (Saxifragaceae), Switzerland, Genève, Jardin botanique, 28 Oct. 1996, A. Bolay (HAL 2143 F; herb. Bolay), with chasmothecia. On *Tolmiea menziesii* (Pursh) Torr. et A. Gray (Saxifragaceae), Switzerland, Genève, Jardin botanique, 22 June 1998, A. Bolay (HAL 2144 F; herb. Bolay), anamorph.

Braun (1985) described *Sphaerotheca alpina* f. *macrospora* from North America on *Saxifraga tricuspidata* Rottb. Braun (1987) assigned Asian, European and North American collections on *Heuchera*, *Saxifraga*, *Tellima* and *Tiarella* spp. to *S. alpina*, but without any differentiation between f. *alpina* and f. *macrospora*. The latter fungus is undoubtedly a true North American powdery mildew occurring on various hosts of the Saxifragaceae indigenous in North America. In Europe it has been introduced and is, however, confined to various cultivated North American host species, usually found in gardens and parks. *Podosphaera alpina* (S. Blumer) U. Braun & S. Takam. (≡ *Sphaerotheca alpina* S. Blumer) is a European species, confined to *Saxifraga rotundifolia* L. and *S. nivalis* L. The North American f. *macrospora* is morphologically easily distinguishable from the European fungus by much larger ascospores, which are early developed and visible in the asci, and thin-walled asci (*P. alpina* is characterised by thick-walled asci, lateral wall (2–)3–5 µm, with a late development of ascospores,

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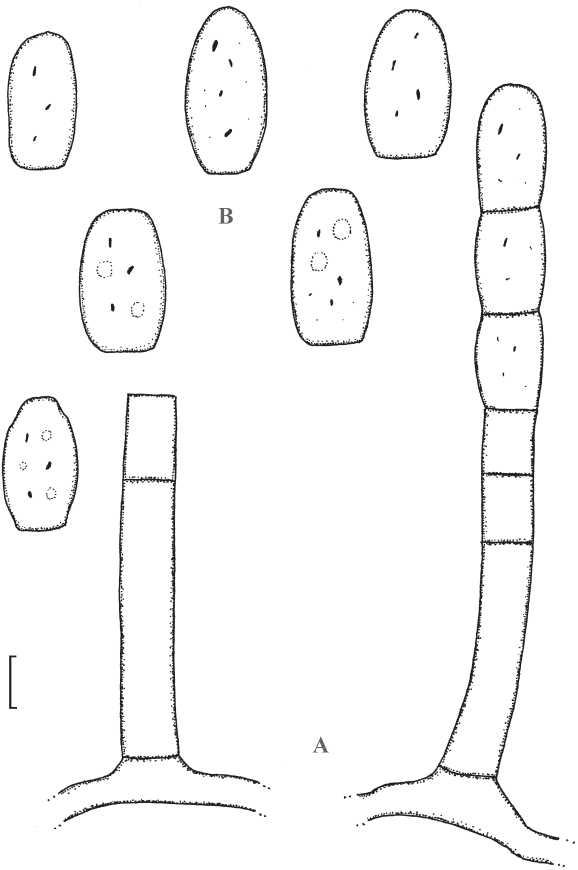

Fig. 5: *Podosphaera macrospora*, anamorph, **A** – conidiophores, **B** – conidia. **Bar = 10 µm** (U. Braun del.).

which are much smaller, < 20 µm in length). The mycelium in *P. macrospora* is also persistent, and some hyphae turn yellowish to brown. But well-developed, pigmented, secondary mycelium, often forming brown patches, as in *P. alpina*, is not formed, i.e., the persistent mycelial patches remain greyish white. The European fungus and the North American taxon are morphologically distinct and probably not closely related, i.e., the treatment of the North American fungus on various hosts of the Saxifragaceae as forma of *P. alpina* is not justified. We prefer to consider f. *macrospore* a separate species. The Asian *Podosphaera astilbicola* (Z.Y. Zhao) U. Braun & S. Takam. (≡ *Sphaerotheca astilbicola* Z.Y. Zhao) on *Astilbe* spp. is quite distinct from *P. macrospora* by small peridial cells, i.e., it belongs in *Podosphaera* sect. *Sphaerotheca* (Lév.) U. Braun & Shishkoff subsect. *Sphaerotheca* (Braun 1987).

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(21) ***Podosphaera*** sp. [*P.* cf. *xanthii* (Castagne) U. Braun & Shishkoff]

Material examined: On *Bergia capensis* L. (Elatinaceae), Greece, Peleponnes, between Kalamata and Messini, rice fields, 3 Oct. 2001, U. Raabe [Jage 2791/03] (HAL 2148 F; herb. Jage).

Bergia capensis is a new host for powdery mildew, belonging to a family hitherto unknown as host of any powdery mildew. *B. capensis* is a glabrous weed of palaeotropical origin, introduced in Greece (see report of Raabe in Greuter & Raus 2001: 323). The conidial state found on this host belongs in *Oidium* subgen. *Fibroidium*, the anamorph of *Podosphaera* (conidiophores cylindrical, foot-cells 40–60×9–15 µm, followed by 1–3 shorter cells; conidia catenate, short cylindrical to doliiform, 22–30×12–20 µm, with fibrosin bodies). The exotic *Bergia capensis* has undoubtedly been attacked by a plurivorous powdery mildew, possibly *P. xanthii*, which is characterised by having a wide host range.

(22) ***Sawadaea bicornis*** (Wallr. : Fr.) Homma, J. Fac. Agric. Hokkaido Imp. Univ. 38: 371, 1937. **Pl. 1**

Material examined: On *Acer platanoides* L. (Aceraceae), Germany, Lower Saxony, Wolfenbüttel, 3 Nov. 2007, H. Butin (HAL 2149 F); Saxony, Görlitz, centre of the city, Otto-Müller-Street, MTB 4855/2.4, 13 Oct. 2007, S. Hoeflich, det. H. Boyle (GLM F081206, HAL 2214 F); Saxony, Görlitz-Südstadt, Inselweg, Obermühle MTB 4855/4.2, S. Hoeflich, det. H. Boyle (GLM F081230, HAL 2218 F).

Braun (1987, 1995) emphasised that *Sawadaea tulasnei* (Fuckel) Homma has to be considered the principal agent of powdery mildew on *Acer platanoides*, although *S. bicornis* had been recorded on this host several times (Amano 1986). These records were considered to be doubtful and probably based on confusions between *S. bicornis* and *S. tulasnei*. Bolay (2005) recently published a record of *S. bicornis* on *A. platanoides* from Switzerland. Based on new collections on *A. platanoides* from Germany (see 'material examined'), it could be confirmed that *S. bicornis* may, indeed, occur on the latter host plant. Almost all appendages of the chasmothecia were dichotomously to trichotomously branched. The infections of *S. bicornis* on *A. platanoides* are very characteristic by being strictly hypophyllous, forming whitish mycelial patches on the lower leaf surface and greenish patches (discolorations of the host tissue) on the corresponding upper leaf surface of senescent yellowish leaves (Pl. 1). This peculiarity agrees well with descriptions of *S. bicornis* and *S. tulasnei* by Shin (2000), who classified the latter species to be mainly epiphyllous, whereas *S. bicornis* was distinguished by its mainly hypophyllous habit. The occurrence of *S. bicornis* on *A. platanoides* has recently been confirmed by Hirose et al. (2005), based on molecular sequence analyses. *Sawadaea* collections from *A. platanoides* formed a *S. tulasnei* clade, but a second group of samples from Europe clustered together with other *S. bicornis* samples on *A. campestre*, indicating that *S. bicornis* races from *A. campestre* are possibly responsible as causal agent of infection of this species on *A. platanoides*.

(23) ***Sawadaea tulasnei*** (Fuckel) Homma, J. Fac. Agric. Hokkaido Imp. Univ. 38: 374, 1937.

Material examined: On *Acer ginnala* Maxim. (Aceraceae), Germany, Brandenburg, Potsdam-West, Kiewitt Street near the so called "Neustädter Havelbucht", MTB 3644/1.2, 6 Oct. 2004, leg. & det. V. Kummer, conf. M. Scholler (herb. Kummer), teleomorph; Potsdam-Waldstadt, Devils Sea Street, MTB 3644/2.3, 7 Oct. 2004, leg. & det. V. Kummer, conf. M. Scholler (herb. Kummer), teleomorph. On *Acer tataricum* L. (Aceraceae), Germany, Brandenburg, Cottbus, Juri Gagarin Street (area of the Brandenburg Technical University), MTB 4251/2, 28. Oct. 2001, leg. E. Sitka, det. V. Kummer, conf. M. Scholler (herb. Kummer), anamorph and teleomorph.

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Plate 1: *Sawadaea bicornis* on *Acer platanoides*, habit. **A** – epiphyllous symptoms, **B** – hypophylleous symptoms. Photo (above): H. Butin.

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The mycelium was only developed on the upper leaf surface. The appendages of the chasmothecia in all three collections were mostly simple, only rarely branched, with uncinate to circinate apices. Because of the morphological leaf plasticity the matrix determination was difficult, especially with regard to shoots from stumps. *A. ginnala* is classified by Roloff & Bärtels (1996) only as a subspecies of *A. tataricum* Some additional observations of *Sawadaea* anamorphs on such matrices have been made in the Potsdam area.

Braun (1995) listed *S. tulasnei* on *A. ginnala* only from the former Soviet Union and the Ukraine, and on *A. tataricum* only from the formerly Soviet Union. Brandenburger & Hagedorn (2006) reported only *S. tulasnei* on *A. platanoides* from Germany.

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