New discoveries of powdery mildew species from Austria and Italy

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Abstract: Hofbauer, W. K. & Braun, U. 2023: New discoveries of powdery mildew species from Austria and Italy. Schlechtendalia **40**: 272–277.

Erysiphe salmonii is recorded from Austria/North Tyrol on *Fraxinus excelsior* and from Italy on *F. ornus*. *Sawadaea polyfida* was collected on *Acer palmatum* in Austria. This is the first Austrian record of this species. Furthermore, *Podosphaera ampla* has been found in Austria on *Prunus cerasifera* and in Italy on *P. cerasifera* and *P. spinosa*.

Zusammenfassung: Hofbauer, W. K. & Braun, U. 2023: Neufunden von Mehltauarten aus Österreich und Italien. Schlechtendalia **40**: 272–277.

Erysiphe salmonii wird für Österreich/Nordtirol auf *Fraxinus excelsior* und Italien auf *F. ornus* angegeben. *Sawadaea polyfida* wurde auf *Acer palmatum* in Österreich gesammelt. Das ist die erste Angabe dieser Art für Österreich. Weiterhin ist *Podosphaera ampla* in Österreich auf *Prunus cerasifera* und in Italien auf *P. cerasifera* and *P. spinosa* gefunden worden.

Key words: *Erysiphaceae*, new records, Central Europe, invasive species.

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Introduction

Over the past decades, substantial progress has been made in the scientific research of powdery mildews (*Erysiphaceae*), including phylogeny, taxonomy, and geographical distribution. Powdery mildews are strongly 'mobile' fungi. Introductions of exotic species in Europe are not uncommon, such as the North American *Erysiphe flexuosa* on *Aesculus* spp. (Ale-Agha 2000), *E. arcuata* on *Carpinus betulus* in Europe, introduced from East Asia (Braun et al. 2006), and the Asian *Erysiphe corylacearum* introduced in Europe (Beenken et al. 2022). Some introductions in Central Europe happened recently, such as the discovery of the East Asian *Sawadaea polyfida* in Switzerland (Beenken et al. 2023). The identifications of powdery mildews often still rely on morphological examinations, although molecular analyses and confirmations gradually become the new standard. Sometimes, identifications solely based on morphological examinations may be unreliable, owing to overlapping morphological traits of closely allied species. The species pair *Erysiphe syringae* / *E. syringae-japonicae* is a case in point (Seko et al. 2008, 2011; Takamatsu et al. 2016). Only in clear cases, when morphology, distribution, ecological data, and host specificity allow a certain identification, molecular work may be spared. In other cases, phylogenetic revisions of traditional powdery mildew species revealed that these 'species' are complexes, including undescribed cryptic species, such as in the case of *Podosphaera tridactyla* s. lat. (Meeboon et al. 2020). Such recently published taxonomic revisions with introduced new species names require re-examinations of the species complexes concerned in the respective countries. In the following paragraphs, new discoveries of the exotic powdery mildew species *Erysiphe salmonii* (on *Fraxinus* spp.) and *Sawadaea polyfida* (on *Acer palmatum*), collected in Austria and Italy, are listed, discussed, and illustrated, and *Podosphaera ampla*, a segregation of *P. tridactyla* s. lat., is confirmed for these countries. Vouchers of the collections concerned are deposited in a publicly accessible herbarium (HAL), which offers the possibility for molecular examinations in future.

List of new records

Erysiphe salmonii (Syd.) U. Braun & S. Takam. Fig. 1

Specimens examined: **Austria**. North Tyrol, Kufstein, Maximilianstraße, on leaves of *Fraxinus excelsior* L., 5 Nov. 2022, W. K. Hofbauer, BU F 20221105005 (together with *Phyllactinia fraxini* (DC) Fuss). **Italy**. Lombardia, Brescia, Garda, Punta San Vigilio, path to Monte Luppia, on leaves of *Fraxinus ornus* L., 27 Oct. 2021, W. K. Hofbauer BU F 20211027001 (HAL 3554 F); Lombardia, Brescia, Limone sul Garda, on leaves of *Fraxinus ornus* (together with *Phyllactinia fraxini*), 28 Oct. 2022, W. K. Hofbauer BU F 20221028001 (HAL 3553 F); Lombardia, Brescia, Gardone, San Michele, Pogio die San Michele, on leaves of *Fraximus ornus* (together with *Phyllactinia fraxini*), 28 Oct. 2022, W. K. Hofbauer BU F 20221028002.

Notes: *E. salmonii* belongs to section *Uncinula* of the genus *Erysiphe* (Braun & Cook 2012) and may occur on different ash species (*Fraxinus* spp. like *F. chinensis*, *F. sieboldiana*, *F. bungeana*, *F. mandshurica*) and exceptionally also on lilac (*Syringa* sp.). *E. salmonii*, native to East Asia, was first recorded in Europe from Ukraine on *Fraxinus excelsior* and *F. pennsylvanica* in 2015 (Heluta et al. 2017, Yamaguchi et al. 2021), followed by a rapid spreading to other European countries. Beenken & Brodtbeck (2020) and Auf der Maur et al. (2022) documented the first occurrence of *E. salmonii* in Switzerland on *Fraxinus ornus* in 2020, with subsequent observations in 2021, also on *F. excelsior*. In autumn 2020, *E. salmonii* was also detected on *F. excelsior* in Romania (Chinan & Dascălu 2021). In Austria, this species was first discovered in 2021 on *F. excelsior* (Vienna) and *F. ornus* in Carinthia (Voglmayr et al. 2021). The Viennese records confirm earlier observations (Heluta et al. 2017, Chinan & Dascălu 2021) that *F. excelsior* can also be infected. Recently, Brglez et al. (2023) reported *E. salmonii* on *F. excelsior* and *F. ornus* from Slovenia.

During autumn 2022, *E. salmonii* was recorded for North Tyrol, Austria (one occurrence on *Fraxinus excelsior*), and in autumn 2021 and 2022, several specimens of this species have been collected in Italy (Lombardia, Brescia) [three samples on *Fraxinus ornus*]. These are the first documented occurrences for Italy and North Tyrol in Austria.

Characters of the investigated samples are typical, as described in Braun & Cook (2012), with mycelium mostly epiphyllous and chasmothecia with not very numerous appendages. Appendages are equatorial, stiff, and often curved with one or two septa, 1–2 times as long as the chasmothecial diameter and only slightly increasing in width towards the enrolled tip; the walls of the appendages are often rough.

As this species is currently spreading in Europe, it is likely that it may already have invaded further European countries.

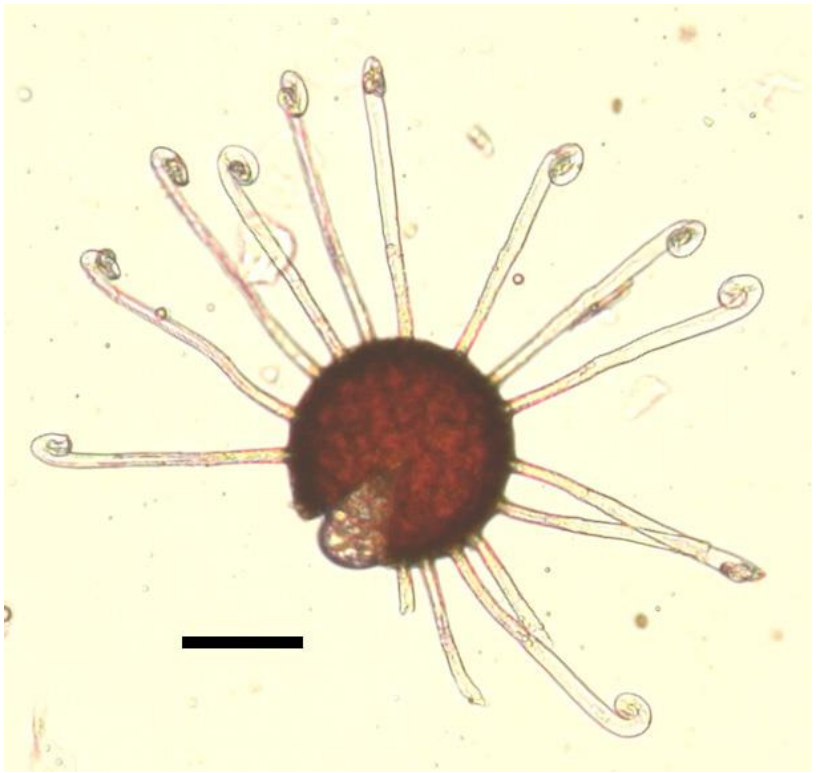

Fig. 1: *Erysiphe salmonii*. Chasmothecium from sample BU F 20221028002, with appendages slightly increasing in width towards the enrolled tip. Scale bar = 100 µm.

Podosphaera ampla Meeboon, S. Takam. & U. Braun Fig. 2

Specimens examined: **Austria**. North Tyrol: Kufstein, Kaiserbergstraße, on leaves of *Prunus cerasifera* Ehrh. 'Nigra', 21 Nov. 2022, W. K. Hofbauer BU F 20221121001; North Tyrol, Kufstein, Ekkehard Hofbauer Straße, on leaves of *Prunus cerasifera* 'Nigra', 14 Oct. 2022, W. K. Hofbauer BU F 20221014001; North Tyrol, Kufstein, Ekkehard Hofbauer Straße, on leaves of *Prunus cerasifera* 'Nigra', 16 Oct. 2022, W. K. Hofbauer BU F 20221016001 (HAL 3557 F). **Italy**. Lombardia, Brescia, Gardone Rivera, San Michele, on leaves of *Prunus spinosa* L., 30 Oct. 2022, W. K. Hofbauer BU F

20221030002 (HAL 3555 F); Lombardia, Brescia, Salo, lakeshore promenade, on leaves of *Prunus cerasifera* 'Nigra', 31 Oct. 2022, W. K. Hofbauer BU F 20221031001 (HAL 3556 F).

Notes: Based on previous results, suggesting that *Podosphaera tridactyla* s. lat. could be polyphyletic (Cunnington et al. 2005), Meeboon et al. (2020) carried out a comprehensive phylogenetic-taxonomic revision of this complex and revealed that *Po. tridactyla* constitutes a species complex. Numerous new species were described, including *Po. ampla* on *Prunus cerasifera*, *P. domestica*, and *P. spinosa*, distributed in the Caucasus region (Armenia, Georgia) and Europe (Belarus, Bulgaria, Estonia, Germany, Greece, Lithuania, Montenegro, Slovakia, Sweden, Switzerland, Ukraine). Smith et al. (2021) recently confirmed *Po. ampla* for Australia based on samples dating back to 1986 and added further hosts, viz., *Prunus armeniaca* and *P. persica*. Unfortunately, there is some divergence between presented data and information given in text.

In autumn 2022, *Po. ampla* was recorded several times in North Tyrol, Austria (occurrences on three different specimens of *Prunus cerasifera*) and Lombardia (Brescia, Italy, one sample on *Prunus spinosa* and one on *Prunus cerasifera*), which are the first documented occurrences in Austria and Italy. The morphology of the examined specimens agrees perfectly with the description given in Meeboon et al. (2020). This species is characterised by having few (up to 6) stiff appendages with variable length, formed in parallel bundles (fascicles) on the uppermost part of the chasmothecium and a typical branching pattern of the branched apex, with up to six times dichotomous branched apices, which is a combination unknown from any other *Podosphaera* species infecting *Prunus* spp. Additionally, the recorded hosts are typical for *Po. ampla*.

As *Po. ampla* was included in *Po. tridactyla* s. lat. before 2020, it is not unlikely that older voucher specimens of *Po. ampla* from many European countries may exist, hidden in herbaria under *Po. tridactyla*. Therefore, older voucher specimens of *P. tridactyla* s. lat., collected prior to 2020 in Europe, should be re-examined.

Fig. 2: *Podosphaera ampla*. From sample BU F 20221030002 (HAL 3555 F); note the stiff appendages of different lengths, running parallel to each other, with several septa, inserted in the uppermost part of the chasmothecium.

Sawadaea polyfida (Wei) Zheng & Chen Fig. 3

Specimens examined: **Austria**. North Tyrol: Kufstein, Zell, Zeller Straße, on leaves of *Acer palmatum* Thunb. 'Atropurpureum', 23 and 27 Oct. 2022, W. K. Hofbauer, BU F 20221023001, and BU F 20221027001 (HAL 3560 F).

Notes: *Acer japonicum* and *A. palmatum*, and their cultivars, are popular ornamental maple species in Europe, including Austria. *Sawadaea polyfida* was described from China, based on type material collected on *Acer amplum* ssp. *catalpifolium* in 1941 (Wei 1942), and later transferred to the genus *Sawadaea* (Zheng & Chen 1980). This species has been reported on *A. palmatum*, *A. japonicum* and some other Asian maple species from China, Japan, and Korea (Hirose et al. 2005; Lee et al. 2011, Braun & Cook 2012; Bradshaw 2020, Wan et al. 2022).

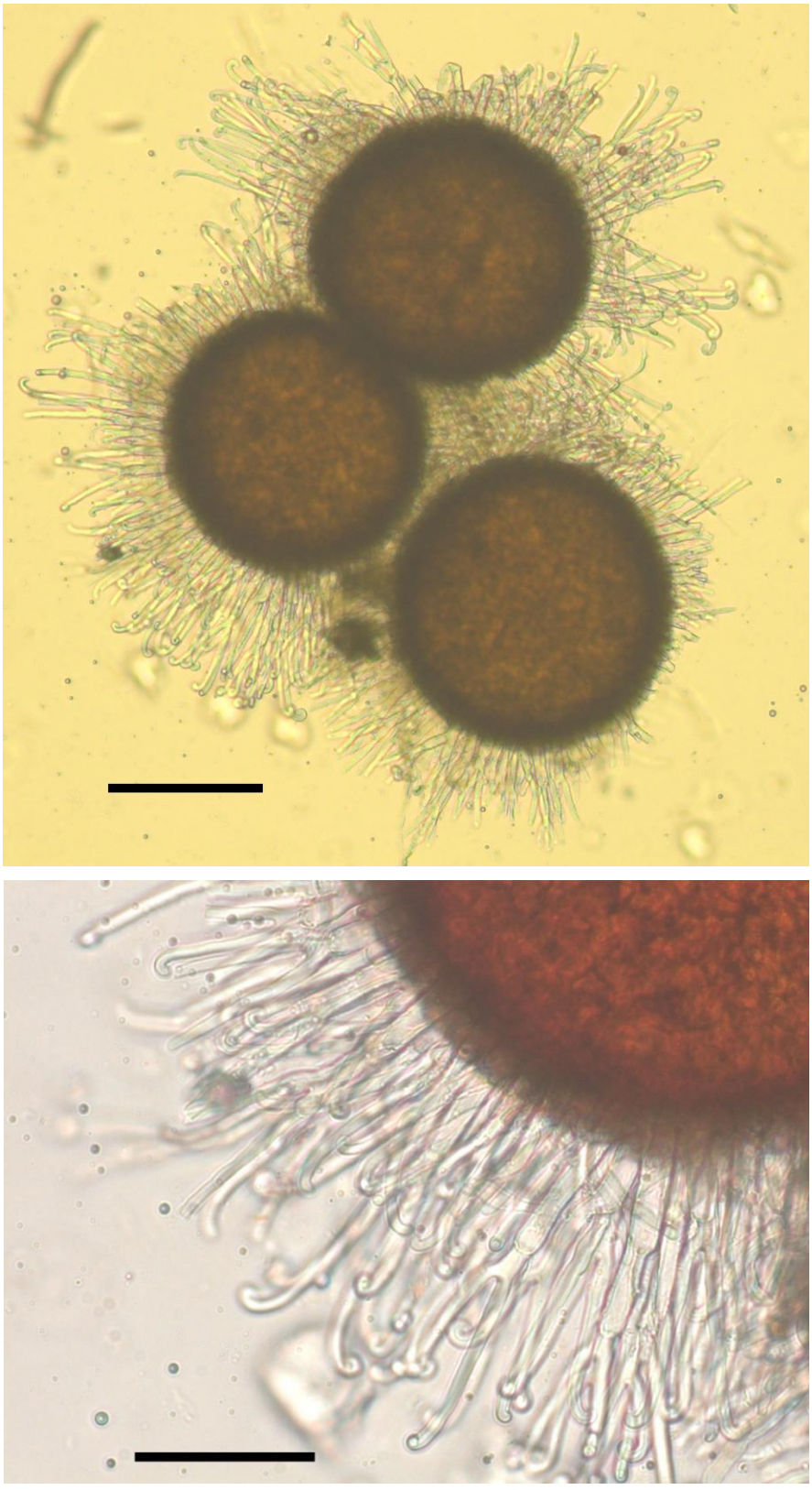

Fig. 3: *Sawadaea polyfida*. Above: Chasmothecia from sample BU F 20221027001 (HAL 3560 F). Below: Close-up of the numerous often deeply cleft appendages of a single chasmothecium.

Previously this species was endemic in the mentioned Asian countries (Hirose et al. 2005, Braun & Cook 2012, Bradshaw 2020), but recently it widened its distribution area. Already in 2004, it was debated if *S. polyfida* could be used as an agent against the unwanted invasive spread of *Acer ginnala* and other invasive Asian *Acer* species in the USA (Zheng et al. 2004), although *S. polyfida* has never been reported on *Acer ginnala*. This powdery mildew was detected on a single Japanese maple in Port Washington, New York, in 2013, but it is not yet known if this species has been established in the USA (USDA 2014). Another documentation of the occurrence of *S. polyfida* in the USA is from the Cornell University in 2014 (https://www.insectimages.org/browse/subthumb.cfm?sub=77092, assessed on June 11th, 2023). *S. polyfida* was found to be introduced into Australia on *A. palmatum* in 2018 (Kiss et al., 2020).

Until recently, this pathogen was unknown in Europe, but Beenken et al. (2023) published a first European record of *S. polyfida* from Switzerland. However, they revised a specimen collected in the Botanical Garden of Geneva, previously misidentified as *Sawadaea tulasnei*, which turned out to be *S. polyfida*, so that the first occurrence of this species in Europe seems to be from the year 2015.

In October 2022, *S. polyfida* was identified for the first time on *A. palmatum* in a private garden in Kufstein, Austria. During autumn 2022, *S. polyfida* was recorded for North Tyrol, Austria (one collection on *Acer palmatum*; two additional samples were gathered at different times). This is the first documented occurrence of this species for Austria. After this finding, further randomly selected stands of *A. palmatum* in Kufstein were inspected, but no further occurrences were encountered so far.

The morphology of our samples agrees well with the description published in Braun & Cook (2012): Patches of white mycelium on both sides of the leaves (amphigenous), or effuse. Chasmothecia dark brown to black, depressed globose, with very numerous densely arranged appendages in the upper half (more than 100 to more than 200; appendages multiply dichotomously branched (1–3 times, rarely unbranched), with uncinate tips. The appendages are often deeply cleft, with the first branching in the lower half. *S. polyfida* mainly differs from *S. bicornis* and *S. tulasnei* in having a much higher number of chasmothecial appendages, which often branch in the basal half (Braun & Cook, 2012).

The approximate time of the introduction of *S. polyfida* into Europe is still uncertain due to possible misidentifications in the past. To trace potential misidentifications from the past, when *S. polyfida* was not yet recognised in Europe, older powdery mildew vouchers on introduced Asian maples should be checked (Ing, 1990, Beenken et al. 2023). Our results show, that *Sawadaea polyfida* is already more widespread in Europe than previously documented and may be expected wherever suitable host species of maples are planted. As this species is currently spreading in Europe, it is likely that it may already have invaded other countries.

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