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NEW DISEASE REPORT

First record of *Sawadaea polyfida* causing powdery mildew on *Acer palmatum* and *A. japonicum* in Switzerland and Europe

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The Japanese maples, *Acer japonicum* and *A. palmatum*, and their cultivars are popular ornamental trees in Europe. The powdery mildew, *Sawadaea polyfida*, occurs natively on these and some other Asian maple species in China, Japan, and Korea (Hirose et al., 2005; Braun & Cook, 2012; Wan et al., 2022), and was introduced into Australia on *A. palmatum* in 2018 (Kiss et al., 2020). The pathogen was previously unknown in Europe, but *Sawadaea tulasnei* has been reported on *A. japonicum* and *A. palmatum* (Braun & Cook, 2012; Ing, 1990; author's observation in Geneva in 2015). In October 2022, *S. polyfida* was identified for the first time on *A. palmatum* in a cemetery in Zurich. After this first finding, further randomly selected sites in Switzerland were monitored. In total, *S. polyfida* was detected on two *A. japonicum* and 38 *A. palmatum* trees. The records were registered at the Swissfungi online distribution atlas (https://swissfungi.wsl.ch/en/distribution-data/distribution-atlas.html.)

FIGURE 1 *Sawadaea polyfida*: mycelium patches on cultivars of *Acer palmatum*: a, b 'Atropurpureum' group, c 'Dissectum' group.

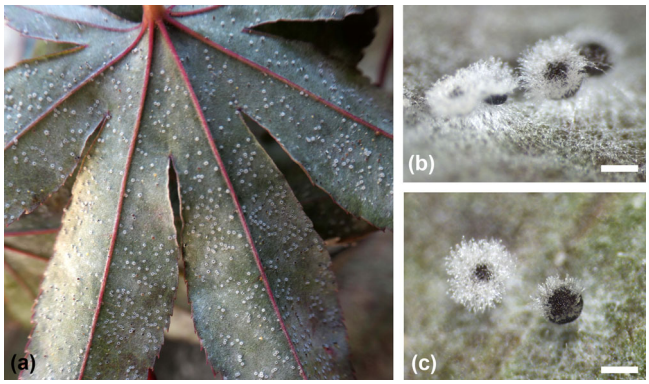

FIGURE 2 *Sawadaea polyfida*: black chasmothecia with white wreaths of appendages on the underside of *Acer palmatum* leaf (b & c, Bar = 200 μm)

The morphology of our samples (Figures. 1–3) fitted well with the description of Braun & Cook (2012): white mycelium on leaves, amphigenous, in patches or effuse. Conidiophores erect, 70–150 μm long, septate; macroconidia doliiform, 20–30×10–15 μm, with fibrosin bodies; microconidia broadly ellipsoid 7–13.5 × 5–9 μm, with fibrosin

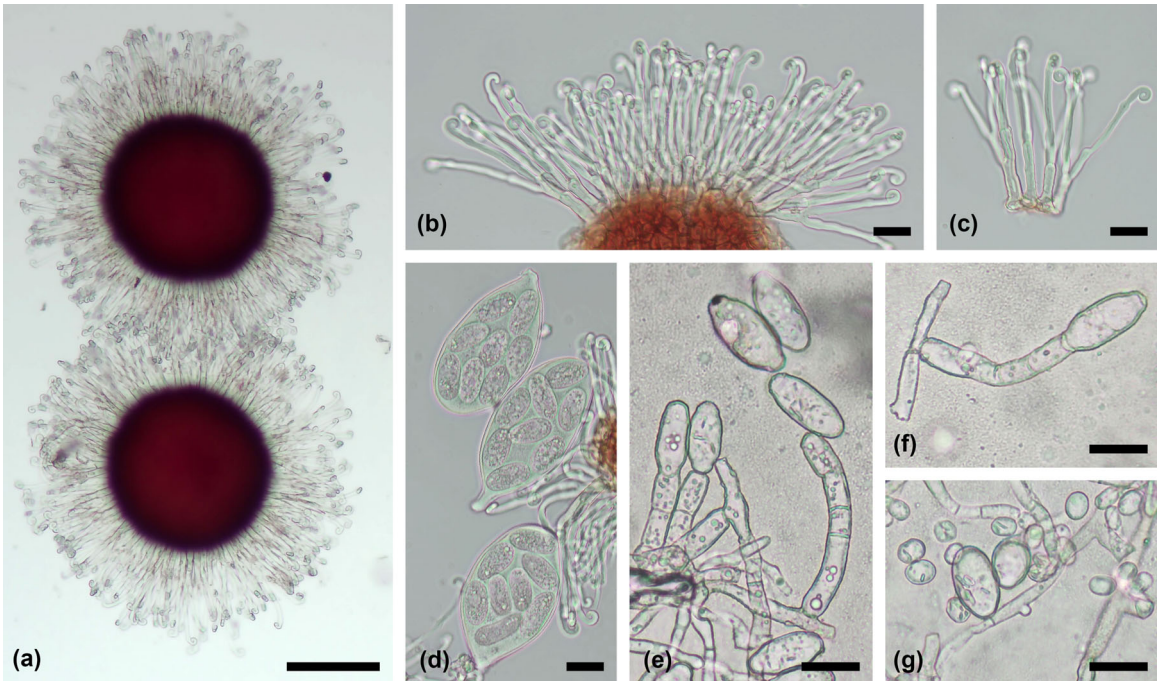

FIGURE 3 *Sawadaea polyfida*: a two chasmothecia; b, c multi branched appendices; d asci; e, f macroconidiophores with macroconidia; g micro- and macroconidia containing fibrosin bodies (a, Bar = 100 μm; b–g Bar = 20 μm)

FIGURE 4 Maximum likelihood analysis based on ITS1-5.8S-ITS2 sequences performed by RAxML v. 8.2.11 as implemented in Geneious prime 2021.1.1 (https://www.geneious.com). Bootstrap values > 80 (1,000 replications) are indicated at nodes. GenBank accession number, host tree and country of origin are given for each sequence. Swiss samples with canton of origin are printed in bold; additional collection data available in GenBank.

bodies. Chasmothecia dark brown, globose, 170–240 μm in diameter, with a white wreath of many densely standing appendages in the upper half; appendages up to 110 μm long, multiple branched, with uncinate tips; asci numerous 80–100 × 40–50 μm, ascospores (6–)8, up to 25 × 15 μm.

The main difference compared to *S. bicornis* and *S. tulasnei* is the much higher number of appendages (Braun & Cook, 2012). Collections without or with poorly developed chasmothecia could therefore be misidentified. We confirmed the identification molecularly from a collection subset, including the record on *A. palmatum* from Geneva, which had been determined morphologically as *S. tulasnei* in 2015 (L. Beenken, unpublished). Powdery mildews on *A. campestre*, *A. platanoides*, and *A. pseudoplatanus* trees in close vicinity to infected Japanese maples were also sampled. Vouchers were deposited in the herbarium of ETH Zurich (ZT Myc 66412–ZT Myc 66430).

DNA was extracted from infected leaves. PCR and sequencing of the ITS region were performed using the PMITS1/PMITS2 primer pair (Cunnington et al., 2003). Sequences were checked by Blast and deposited in GenBank (OQ309157–OQ309175). They were aligned to ITS sequences of *S. bicornis*, *S. polyfida*, and *S. tulasnei* from GenBank to perform a Maximum Likelihood analysis (Figure 4). The results show that all powdery mildews sampled from Japanese maples belong to *S. polyfida*. In contrast, *S. polyfida* could not be found on the three European maple species, these trees were infected with *S. bicornis* or *S. tulasnei*.

The point of first introduction of *S. polyfida* into Europe is difficult to determine due to possible misidentifications in the past. Therefore, older powdery mildew findings on Japanese maples should be re-determined (e.g., Ing, 1990). The 2015 collection from the Botanical Garden of Geneva was such a misidentification as *S. tulasnei*, this has now turned out to be the oldest known record of *S. polyfida* for Switzerland and Europe. The species is unlikely to have occurred much earlier in Switzerland, as Japanese maples have not previously been reported as hosts of powdery mildew from Switzerland (Bolay, 2005; Swissfungi online distribution atlas), not even from the very well-studied Botanical Garden of Geneva (Bolay, 2013). *Sawadaea polyfida* is probably much more widespread in Europe and can be expected wherever Japanese maples are planted.

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REFERENCES

Bolay, A. (2005) Les Oidiums de Suisse (Erysiphacées). *Cryptogamica Helvetica*, 20, 1–174.

Bolay, A. (2013) Les champignons parasites des plantes vasculaires des Conservatoire et Jardin botaniques de la Ville de Genève. *Boissiera*, 66, 1–147.

Braun, U. & Cook, R.T.A. (2012) Taxonomic manual of the *Erysiphales* (powdery mildews), CBS Biodiversity Series. Utrecht, The Netherlands: Centraalbureau voor Schimmelcultures.

Cunnington, J.H., Takamatsu, S., Lawrie, A.C. & Pascoe, I.G. (2003) Molecular identification of anamorphic powdery mildews (Erysiphales). *Australasian Plant Pathology*, 32, 421–428. https://doi.org/10.1071/AP03045

Hirose, S., Tanda, S., Kiss, L., Grigaliunaite, B., Havrylenko, M. & Takamatsu, S. (2005) Molecular phylogeny and evolution of the maple powdery mildew (*Sawadaea*, *Erysiphaceae*) inferred from nuclear rDNA sequences. *Mycological Research*, 109, 912–922. https://doi.org/10.1017/S0953756205003527

Ing, B. (1990) An introduction to British powdery mildews - 2. *The Mycologist*, 4, 88–90. https://doi.org/10.1016/S0269-915X(09)80543-0

Kiss, L., Vaghefi, N., Bransgrove, K., Dearnaley, J.D.W., Takamatsu, S., Tan, Y.P. et al. (2020) Australia: a continent without native powdery mildews? The first comprehensive catalog indicates recent introductions and multiple host range expansion events, and leads to the re-discovery of *Salmonomyces* as a new lineage of the Erysiphales. *Frontiers in Microbiology*, 11, 1571. https://doi.org/10.3389/fmicb.2020.01571

Wan, Y., Si, Y.-Z., Liao, Y.-C.-Z. and Zhu, L.-H. (2022) First report of *Sawadaea polyfida* causing powdery mildew of *Acer palmatum* in China. *Plant Disease*, 106, 1302. https://doi.org/10.1094/PDIS-07-21-1566-PDN

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