https://doi.org/10.17221/38/2025-HORTSCI

Powdery mildew (Erysiphales) on ornamental plants in the Czech Republic

Markéta Michutová, Mária Neoralová, Barbora Jílková, Jana Víchová, Helena Pluháčková, Ivana Šafránková*

Department of Crop Science, Breeding and Plant Medicine, Faculty of AgriSciences, Mendel University in Brno, Brno, Czech Republic

**Corresponding author: marketa.michutova@mendelu.cz*

Citation: Michutová M., Neoralová M., Jílková B., Víchová J., Pluháčková H., Šafránková I. (2026): Powdery mildew (Erysiphales) on ornamental plants in the Czech Republic. Hort. Sci. (Prague): 53: 1–14.

Abstract: Ornamental perennials are highly popular and irreplaceable plants commonly used for enhancing public spaces and private gardens. One of the most frequently occurring pathogens is powdery mildew, a parasitic fungus that covers leaves, stems, and flowers with a whitish to light grey mycelium and reproductive structures. It significantly reduces not only the lifespan of plants but also their aesthetic value. A field survey of ornamental plants infected with powdery mildew was conducted during the growing seasons of 2021–2023 in the Czech Republic. Thirty-nine species and cultivars of infected plants from 17 families were collected from botanical gardens, private gardens, and city parks, and 26 species of powdery mildew were identified. Species identification was based on a combination of morphological and PCR-based molecular analyses. The most frequently represented genus was *Golovinomyces* (13 species and varieties of powdery mildew on 21 plant samples from eight families), followed by five species of the genus *Erysiphe* on seven plant species from five families, and seven species of the genus *Podosphaera* on ten plant species from five families. The species *Neoërysiphe galeopsidis* was identified on a single plant sample. Two new powdery mildew species (*Golovinomyces savulescui*, *Erysiphe knautie*) were identified in the Czech Republic, and the host range of several species was clarified. *Golovinomyces bolayi* was confirmed on *Campanula lactiflora* and *Veronica longifolia*, *Erysiphe macleaye* on *Dicentra spectabilis,* and *Podosphaera xantii* on *Calendula officinalis*, *Chrysanthemum* sp., *Dahlia pinnata*, and *Gerbera* × *hybrida*.

Keywords: *Erysiphe*; *Golovinomyces*; morphology; *Neoërysiphe*; PCR; perennials; *Podosphaera*

Ornamental plants play a crucial role in enhancing the aesthetic and environmental quality of public spaces and private gardens. In 2021, the Czech flower industry reached a value of 2.75 billion CZK (108 million EUR), marking a 19% increase from the previous year. While the COVID-19 pandemic in 2020 slowed flower consumption, it rebounded in 2021 with nearly a 12% rise in per capita consumption, reaching 1 360 CZK (53 EUR). The spectrum of ornamental plants is constantly expanding to include new species and cultivars of originally medicinal plants, culinary herbs and vegetables. However, the aesthetic appearance of these plants is often threatened by pathogens such as powdery mildew, which diminishes their visual appeal and affects their overall health (Buchtová, Czetmayer

Supported by the Internal Grant Agency of the Faculty of AgriSciences Mendel University in Brno (AF-IGA2023-IP-068).

https://doi.org/10.17221/38/2025-HORTSCI

Ehrlichová 2022). Understanding the taxonomy of powdery mildews is essential for interpreting their diversity, host associations, and ecological impact.

Powdery mildew (Erysiphales) is a highly specialised group of pathogens. It reduces the aesthetic value of plants by producing a white, powdery coating on their surfaces. This extensive and significant group of pathogenic fungi, belonging to the kingdom Fungi and the division Ascomycota, has a nearly global distribution (Braun et al. 2010) and affects over 10 000 species of angiosperms (Braun, Cook 2012).

The taxonomy of powdery mildew has a long history and continues to be refined through ongoing research. Braun and Takamatsu (2000), using molecular phylogenetic analyses, reclassified the largest genus *Erysiphe* into three genera: *Erysiphe*, *Golovinomyces*, and *Neoërysiphe*. Both *Golovinomyces* and *Neoërysiphe* were identified as monophyletic groups. However, since the redefined genus *Erysiphe* remained a genetically diverse group with multiple ancestral origins.

Braun and Takamatsu (2000) combined *Microsphaera*, *Uncinula*, and *Erysiphe* into *Erysiphe* sensu lato and redefined them as sections. The genus *Erysiphe* sensu lato is distinguished by diverse appendage morphology, conidiophores generally of the Pseudoidium type, and lobed appressoria. The phylogenetic importance of appendage morphology is supported by the separation of the sections *Microsphaera* and *Uncinula* into distinct phylogenetic groups. Nevertheless, members of the section *Erysiphe* are also interspersed within the sections *Microsphaera* and *Uncinula*, forming numerous smaller clades (Lebeda et al. 2017; Takamatsu 2018). These findings suggest that the simple, myceloid appendages in section *Erysiphe* are the result of convergent evolution. Braun and Takamatsu (2000) also unified the genera *Sphaerotheca* and *Podosphaera* into a single genus, *Sphaerotheca* sensu lato, following a similar approach (Takamatsu 2018).

Recent discoveries have prompted revisions to the original taxonomic framework (Braun 1987), by Braun and Cook (2012). This updated work classifies 16 genera and 873 species, including anamorphic forms. Further phylogenetic studies have since identified additional species, with the current estimate reaching approximately 900 (Marmolejo et al. 2018; Takamatsu 2018).

While powdery mildew can still be identified based on morphological traits – a method commonly applied in practice – the complexity of its taxonomy renders this approach exceedingly difficult. Accurate identification requires knowledge of the host plant or its family, as well as the geographic distribution of the specific species, without which reliable determination is nearly impossible. The research focused on identifying and describing the species diversity of powdery mildew in the Czech Republic.

MATERIAL AND METHOD

Field survey. During the growing seasons of 2021–2023, ornamental plants exhibiting symptoms of powdery mildew were surveyed in botanical gardens and parks in Moravia (Czech Republic). Out of a total of 39 collected samples of ornamental perennial plants showing symptoms of powdery mildew, the presence of the pathogen was laboratory-confirmed in 25 cases. Plants were selected based on visible disease symptoms, such as white to grey patches or a continuous layer of mycelium on green tissues or covering the entire leaf surface. Green plant parts, including stems, leaves, and the green portions of flowering shoots, were collected. Host plants were taxonomically identified and included representatives of the following families: Acanthaceae (*Acanthus hungaricus*); Asteraceae (*Coreopsis grandiflora* 'Heliot', *Dahlia pinnata*, *Centaurea dealbata* 'Steenbergii', *Centaurea montana* 'Rosea', *Echinops sphaerocephalus*, *Helianthus decapetalus* 'Lemon Queen', *Helianthus salicifolius*, *Rudbeckia hirta* 'Amarillo Gold', *Rudbeckia laciniata* 'Goldquelle', *Rudbeckia nitida* 'Herbstsonne', *Tanacetum vulgare*, *Aster dumosus* 'Kristina', *Symphyotrichum lateriforum*, *Chrysanthemum* sp., *Gerbera* × *hybrida*); Campanulaceae (*Campanula lactiflora*); Caprifoliaceae (*Knautia macedonica*, *Scabiosa columbaria*); Caryophyllaceae (*Dianthus chinensis*); Euphorbiaceae (*Euphorbia epithymoides*, *Euphorbia seguieriana*); Geraniaceae (*Geranium* × *cantabrigiense* 'Cambridge'); Lamiaceae (*Salvia lavandulifolia*); Papaveraceae (*Dicentra spectabilis* 'Valentine', *Macleaya cordata*); Plantaginaceae (*Veronica longifolia* 'Charlotte', *Veronica porphyriana*); Polemoniaceae (*Phlox paniculata* 'Blue Paradise', *Phlox paniculata* 'Fujiyama'); Ranunculaceae (*Thalictrum aquilegiifolium* 'Purpureum', *Pulsatilla vulgaris* 'Perlen Glocke', *Delphinium elatum* 'Morning Lights'); Rosaceae (*Agrimonia eupatoria*, *Spiraea japonica*); Scrophu-

https://doi.org/10.17221/38/2025-HORTSCI

lariaceae (*Verbascum chaixii* 'Wedding Candles'); Verbenaceae (*Verbena bonariensis*); and Violaceae (*Viola* × *wittrockiana*).

Photo documentation of the symptoms was made using a Samsung Galaxy A52 camera, samples were collected, catalogued, and stored as herbarium specimens at the Department of Crop Science, Breeding and Plant Protection, Faculty of AgriSciences, Mendel University in Brno. The samples were then processed according to the method described by Shin (2000).

For each sample, morphological characteristics were microscopically analysed using an Olympus BX41 microscope (Olympus, Japan). In the anamorph stage, measurements were taken for: length of the conidiophore, the length of the foot cell, the number and size of distal cells, the length and width of conidia, the type of conidiophore, and the shape of the appressorium (20–30 measurements per each). In the teleomorph stage, the following measurements were made: diameter of the chasmothecium, the number and shape of appendages, as well as the number, length, and width of asci, and the number and size of ascospores within the ascus. Microphotographs of both the sexual and asexual stages were taken using Quick Photo Pro software (version 3.1, 2014), Canon EOS 1000D camera, magnification 400× (Canon Inc., Japan).

For each measurement, the mean, standard deviation, maximum, and minimum values were determined using Microsoft Excel. The obtained data were compared with published data from Braun and Cook (2012), Scholler et al. (2016), Braun et al. (2019), and Qiu et al. (2021).

DNA isolation and sequencing. DNA was isolated from dry herbarium samples of ornamental perennials using the DNeasy Plant Pro Kit (Qiagen, Germany). The isolation was performed at room temperature according to the manufacturer's recommendations. The concentration of the isolated DNA was measured using the Life Science Analyzer: BioMate 3 Spectrophotometer (Thermo Fisher Scientific Inc., USA). The samples were stored at –20 °C.

PCR reactions were carried out using *Taq* PCR Master Mix (Qiagen, Germany) on the Thermocycler XT96 XTender96 (VWR, Germany). The reaction conditions were based on the *Taq* PCR Master Mix Kit and adjusted according to the annealing temperature of the primers used. For ITS4/ITS5, the following conditions were used: 3 min at 95 °C; 39 cycles of 30 s at 94 °C, 30 s at 53 °C, and 20 s at 72 °C, followed by a final 10-min cycle at 72 °C. For PMITS1/PMITS2: 3 min at 94 °C; 35 cycles of 1 min at 94 °C, 1 min at 65 °C, and 2 min at 72 °C, followed by a final 10-min cycle at 72 °C. For PM5G/ITS4, the conditions were as follows: 3 min at 95 °C; 35 cycles of 15 s at 95 °C, 15 s at 54 °C, and 50 s at 72 °C, followed by a final 10-min cycle at 72 °C.

The resulting product of the corresponding size was purified using the QIAquick PCR Purification Kit (Qiagen, Germany) according to the standard procedure and sequenced with the Sanger sequencing (Seqme, Czech Republic). The assembled forward and reverse primers were then used for sequencing analysis performed on Geneious Prime software (version 2.1, 2023), and the sequences were compared with available fnces using BLASTN and submitted to GenBank.

RESULTS

A total of 25 species of powdery mildew were identified on 39 samples of ornamental perennial plants belonging to 16 families, collected between 2021 and 2023. Detailed data on the microscopic structures of all samples are presented in Table 1.

Erysiphe aquilegiae was observed on *Thalictrum aquilegifolium* 'Purpureum' in its anamorphic stage. The fungus exhibited lobed appressoria and Pseudoidium-type conidiophores. The absence of the sexual stage prevented differentiation between var. *aquilegiae* and var. *ranunculi*, which are distinguished by the ratio of appendage size to chasmothecium diameter.

Erysiphe buhrii was detected on *Dianthus chinensis* in its anamorphic stage. Nipple-shaped appressoria and Pseudoidium-type conidiophores with a distinctly elongated cell attached to the basal cell, as described for this species, were observed. The identification was confirmed through PCR analysis with primers PMITS1 and PMITS2, resulting in a 607 bp contig (*Erysiphe buhrii*, host *Dianthus chinensis*, GenBank: PP577761). This contig comprised 565 bp, Percent Identity (Per. Ident.) 100–97.70% identical to the first 10 hits of 18S rRNA, 219 bp of ITS1, 154 bp of 5.8S rRNA, 185 bp of ITS2, and 7 bp of 28S rRNA.

Erysiphe geraniacearum was identified on *Geranium* × *cantabrigiense* 'Cambridge' (Figure 1) in its anamorphic stage, displaying lobed appres-

Horticultural Science (Prague), 53, 2026 (1): 1–14

https://doi.org/10.17221/38/2025-HORTSCI

Table 1. Morphological characteristics of powdery mildews samples collected on hosts of ornamental plants [mean ± SD (min–max)]

Host species	Collection place, date	Conidia length (µm)	Conidia width (µm)	L/W ratio conidia	Foot-cell length (µm)	Conidiophore length (µm)	No. of distal cells	Chasmotecium length (µm)	No. of appendices	L/W ratio chasmothecium/ apendixs
Acanthus hungaricus	Brno, 06/2021	24.2 ± 2.7 (17–28)	13.7 ± 1.9 (12–19)	1.8 ± 3.0 (1–2)	130.3 ± 23.15 (92–172)	48.1 ± 10.9 (35–69)	1.3 ± 1 (1–2)	–	–	–
Coreopsis grandiflora 'Heliot'	Brno, 07/2021	25 ±4.6 (16–32)	14.5 ±3.3 (10–21)	1.7 ±0.4 (1.2–2.5)	114.9 ±31.1 (69–183)	46 ± 15.2 (29–88)	1–3	–	–	–
Dahlia pinnata	Olomouc, 10/2021	22.3±3.6 (18–28)	14.0±2.6 (10–17)	1.6±0.2 (1.4–2.0)	88.8 ± 9.4 (76–106)	35.9 ±6.4 (28–48)	1–3	–	–	–
Centaurea dealbata 'Steenbergii'	Brno, 07/2021	23.7 ± 1.67 (10–26)	15.3 ± 2.71 (13–20)	1.6 ± 0.28 (1.2–2.1)	106.50 ± 26.2 (61–130)	54.7 ± 16.21 (34–85)	1.4 ± 0.7 (0–2)	121 ± 8.1 (106–129)	> 10	0.8 ± 1.1 (0.7–1.1)
Centaurea montana 'Rosea'	Lednice, 7 /2021	29.1 ± 3.5 (36–22)	18.4 ± 2.16 (21–13)	1.6 ± 0.22 (2.1–1.2)	275.3 ± 72.4 (450–189)	151.5 ± 28.8 (206–107)	2.7 ± 0.8 (3–1)	–	–	–
Echinops sphaerocephalus	Brno, 07/2021	24.9 ± 3.1 (18–30)	17.2 ± 2.5 (11–21)	1.4 ± 2.49 (1.2–2.3)	151.38 ± 50.7 (102–308)	78.6 ± 18.6 (49–115)	2.2 ± 1.0 (1–4)	–	–	–
Helianthus decapetalus 'Lemon Queen'	Lednice, 6/2021	24.6 ± 2.8 (20–28)	15.6 ± 1.1 (14–18)	1.6 ± 0.15 (1.4–1.8)	132.2 ± 7.6 (99–168)	49.2 ± 7.6 (34–60)	1.3 ± 0.24 (1–2)	–	–	–
Helianthus salicifolius	Brno, 10/2021	28.5 ±16 (25–33)	17 ±1.8 (14–21)	1.7 ±0.17 (1.4–2.0)	171.7 ±35.2 (130–237)	91.3 ±26.2 (47–139)	2–3	142.1 ±18.9 (107–172)	> 10	0.9 ±0.4 (0.6–1.3)
Rudbeckia hirta 'Amarillo Gold'	Brno, 7/2021	23.5 ± 3.4 (18–27)	15.7 ± 1.5 (12–17)	1.35 ± 0.3 (0.9–2.1)	86.9 ± 13.3 (66–107)	39.1 ± 7.8 (28–53)	2 ± 0.7 (1–3)	–	–	–
Rudbeckia laciniata 'Goldquelle'	Brno, 9/2022	22.9 ± 3.1 (17–27)	14.5 ± 1.8 (11–18)	1.6 ± 0.3 (1.1–2.1)	129.7 ± 21.58 (83–160)	53.4 ± 11.5 (35–78)	2.5 ± 1.1 (1–4)	–	–	–
Rudbeckia nitida 'Herbstsonne'	Brno, 9/2021	28.7 ±2.4 (26–34)	16.2 ±1,7 (13–19)	1.8 ±0.2 (1.4–2.1)	138.9 ±19.2 (102–169)	49.6 ±7.1 (40–63)	1–2	–	–	–
Tanacetum vulgare	Brno, 10/2021	25±16 (20–33)	13.7±2.7 (11–22)	1.9±0.4 (1.0–2.4)	107.7 ±17.63 (74–142)	42.4±8.2 (29–55)	1–3	–	–	–
Aster dumosus 'Kristina'	Brno, 10/2021	27.5±16 (23–34)	13.9±1.7 (10–16)	2±0.2 (1.6–2.4)	131.9±25.5 (97–178)	57.7±16.8 (35–85)	2–4	–	–	–
Symphyotrichum lateriforum	Lednice, 10/2021	26.8±3.2 (20–29)	15.7±1.6 (13–18)	1.7±0.1 (1.5–1.9)	103±18.6 (72–124)	32.17±14.7 (20–61)	1–3	–	–	–
Chrysanthema sp.	Olomouc, 10/2021	28.2 ± 4.2 (21–35)	16.7 ± 1.6 (15–20)	1.6 ± 0.2 (1.4–2.1)	165.8 ± 22.4 (128–192)	61.3 ± 14.1 (36–86)	2.7 ± 0.5 (2–3)	–	–	–
Dahlia pinnata	Olomouc, 10/2021	22.3±3.6 (18–28)	14.0±2.6 (10–17)	1.6±0.2 (1.4–2.0)	88.8 ± 9.4 (76–106)	35.9 ±6.4 (28–48)	1–3	–	–	–

https://doi.org/10.17221/38/2025-HORTSCI

Table 1 to be contunued

Host species	Collection place, date	Conidia length (µm)	Conidia width (µm)	L/W ratio conidia	Foot-cell length (µm)	Conidiophore length (µm)	No. of distal cells	Chasmotecium length (µm)	No. of appendices	L/W ratio chasmothecium/ apendixs
Gerbera × *hybrida*	Plandry, 07/2023	22.2 ± 2.5 (18–26)	15.2 ± 2.7 (10–21)	1.5 ± 0.2 (1.0–1.5)	98.2 ± 29.3 (52–151)	34.2 ± 15.1 (23–69)	1–2	–	–	–
Campanula lactiflora	Rajhrad, 10/2023	23.8 ± 2.04 (19–26)	14.8 ± 1.9 (12–18)	1.6 ± 0.2 (1.1–1.9)	128.3 ± 22.2 (89–164)	55.3 ± 10.3 (36–75)	1.6 ± 0.6 (1–3)	–	–	–
Knautia macedonica	Lednice, 7/2021	20.5 ± 3.04 (16–24)	12.8 ± 2.0 (11–17)	1.6 ± 0.23 (1.4–2)	57.5 ± 6.3 (48–65)	33.5 ± 7.6 (21–42)	0.3 ± 0.5 (1–0)	–	–	–
Scabiosa columbaria	Rajhrad, 10/2023	30.3 ± 2.9 (25–36)	16.8 ± 2.2 (13–22)	1.8 ± 0.2 (1.4–2.2)	116.5 ± 19.1 (86–149)	44.6 ± 9.9 (23–64)	2 ± 0.7 (1–3)	–	–	–
Dianthus chinensis	Lednice, 10/2021	29.9 ± 3.7 (23–35)	12.4 ± 1.3 (10–14)	2.6 ± 0.2 (2.3–2.9)	98.2 ± 17.1 (65–123)	36.0 ± 7.8 (25–55)	1 ± 0 (0–1)	–	–	–
Euphorbia epithymoides	Lednice, 7/2021	21.2 ± 2.8 (17–27)	10.5 ± 1.4 (9–13)	2.03 ± 0.2 (1.7–2.4)	122.6 ± 18.7 (91–158)	51.8 ± 15.7 (30–80)	2.9 ±1.1 (1–3)	–	–	–
Euphorbia seguieriana	Brno, 7/2021	21.0 ± 1.4 (19–23)	11.3 ± 0.8 (10–12)	1.9 ± 0.6 (171–2.1)	100.0 ± 19.03 (91–136)	39.0 ± 4.2 (33–43)	3 ± 0.7 (2–4)	–	–	–
Geranium × *cantabrigiense* 'Cambridge'	Lednice, 7/2021	24.3 ± 4.2 (19–36)	12.1 ± 1.4 (11–16)	1.9 ± 0.4 (0.9–2.7)	58.1 ± 10.7 (40–77)	19.1 ± 2.9 (16–29)	1.1 ±0.7 (0–2)	–	–	–
Salvia lavandulifolia	Rajhrad, 10/2023	23.7 ± 2.4 (20–29)	15.4 ± 1.6 (12–17)	1.5 ± 0.15 (1.4–1.8)	108.0 ± 15.2 (89–137)	47.8 ± 5.9 (38–57)	1.6 ± 0.5 (1–2)	–	–	–
Dicentra spectabilis 'Valentine'	Brno, 7/2021	26.3 ±4.1 (18–33)	9.4 ± 1.4 (8–13)	2.8 ±0.6 (1.6–3.7)	95.3 ±15.2 (67–120)	39.9 ±6.6 (27–49)	1–2	–	–	–
Macleaya cordata	Lednice, 8/2021	23.7 ± 3.5 (18–27)	10.4 ± 1.9 (9–13)	2.2 ± 0.1 (2.1–2.4)	78.8 ± 17.1 (55–103)	36.0 ± 8.9 (22–46)	1± 0 (1–1)	–	–	–
Veronica longifolia 'Charlotte'	Praha, 10/2022	23.8 ± 2.4 (19–29)	13.4 ± 1.5 (11–18)	1.8 ± 0.6 (1.5–2.4)	125.4 ± 19.9 (106–172)	40.2 ± 13.8 (31–68)	2.5± 0.6 (1–3)	–	–	–
Veronica porphyriana	Brno, 10/2021	24.9 ± 2.4 (21–30)	14.4 ± 1.9 (11–17)	1.7 ± 0.3 (1.4–2.4)	129.4 ± 14.6 (108–166)	48.8 ± 12.8 (34–71)	2.1± 0.8 (1–3)	–	–	–
Phlox paniculata 'Blue Paradise'	Kroměříž, 9/2019	22.8 ±2.6 (17–26)	15.0 ± 1.4 (13–18)	1.5 ±0.1 (1.3–1.7)	133.8 ±26.8 (92–178)	52.3 ±10.4 (35–70)	2–4 (0.7–3.1)	–	–	–
Phlox paniculata 'Fujiyama'	Rajhrad, 10/2023	–	–	–	–	–	–	121.4–19.6 (89–161)	15–2.1 (10–15)	1–0.9 (0.9–3.7)
Thalictrum aquilegiifolium 'Purpureum'	Lednice, 7/2021	23.7 ±5.8 (17–37)	12.2 ± 1.9 (10–17)	1.9 ±0.6 (1.4–3.7)	67.9 ±13.9 (40–93)	31.7 ±9.1 (25–60)	0–2	–	–	–

Horticultural Science (Prague), 53, 2026 (1): 1–14

https://doi.org/10.17221/38/2025-HORTSCI

Table 1 to be contunued

Host species	Collection place, date	Conidia length (µm)	Conidia width (µm)	L/W ratio conidia	Foot-cell length (µm)	Conidiophore length (µm)	No. of distal cells	Chasmotecium length (µm)	No. of appendices	L/W ratio chasmothecium/ apendixs
Pulsatilla vulgaris 'Perlen Glocke'	Lednice, 10/2021	24.8 ± 3.4 (21–31)	14.2 ± 1.3 (13–17)	1.8 ± 0.3 (1.5–2.4)	122.5 ± 10.8 (106–139)	55.7 ± 19.8 (36–89)	1.7± 0.3 (1.5–2.4)	87.1±6.2 (78–94)	>10	1.6± 0.4 (1.1–2.5)
Delphinium elatum 'Morning Lights'	Lednice, 8/2021	25.0 ± 2.8 (20–31)	14.7 ± 2.4 (10–18)	1.7 ± 0.2 (1.4–2.1)	119.5 ± 21.2 (86–161)	45.9 ± 15.5 (25–74)	2.2± 0.7 (1–3)	89.7±4.2 (85–93)	5	2.1
Agrimonia eupatoria	Lednice, 7/2021	21.3 ±2.2 (17–24)	14.9 ± 1.3 (12–17)	1.4 ±0.1 (1.2–1.6)	172.8 ±38.1 (103–257)	83.4 ±17.4 (61–129)	1–4	–	–	–
Spiraea j aponica	Prostějov, 7/2021	22.0 ± 1.7 (19–26)	11.6 ± 1.1 (10–13)	1.9 ± 0.2 (1.6–2.2)	149.8 ± 41.6 (81–227)	66.8 ± 26.3 (32–113)	3.1± 1.1 (1–4)	–	–	–
Verbascum chaixii 'Wedding Candles'	Brno, 8/2021	21.3 ±2.2 (17–24)	14.9 ± 1.3 (12–17)	1.4 ±0.1 (1.2–1.6)	172.8 ±38.1 (103–257)	83.4 ±17.4 (61–129)	1–4	–	–	–
Verbena bonariensis	Rajhrad, 10/2023	24.4 ±2.5 (21–30)	14.7 ± 1.7 (13–19)	1.7 ±0.2 (1.4–1.8)	145.7 ±16.4 (116–171)	56.9 ±11.01 (43–77)	1–3	–	–	–
Viola × *wittrockiana*	Praha, 6/2023	23.3 ± 2.3 (18–28)	14.6 ± 1.5 (13–17)	1.6 ±0.2 (1.1–2.0)	128.0 ±19.27 (88–157)	51.8 ±11.2 (31–68)	1–2	–	–	–

L/W ratio – lenght/width ratio

https://doi.org/10.17221/38/2025-HORTSCI

soria and Pseudoidium-type conidiophores. Due to observed deviations, particularly in the length of the basal cell, PCR analysis was conducted to confirm the identification. While the analysis verified the presence of the genus *Erysiphe*, precise identification as *Erysiphe geraniacearum* could not be confirmed because no reference sequence for this species is currently available in the GenBank database. However, as *Erysiphe geraniacearum* is a commonly occurring species on *Geranium* in the Czech Republic, and no other species of *Erysiphe* is known to infect *Geranium* in this region, it is highly probable that the fungus is correctly identified as *Erysiphe geraniacearum*. The obtained sequence was submitted to GenBank as a new accession. Using primers PMITS1 and PMITS2, a 741 bp contig was generated (*Erysiphe geraniacearum*, host *Geranium* × *cantabrigiense*, GenBank: PP764328), comprising 106 bp of 18S rRNA, 219 bp of ITS1, 153 bp of 5.8S rRNA, 180 bp of ITS2, and 83 bp of 28S rRNA.

Erysiphe knautiae was observed on *Knautia macedonica*, *Scabiosa caucasica* 'Alba', and *Scabiosa columbaria* (Figure 2) in its anamorphic stage, characterised by lobed appressoria and straight, upright Pseudoidium-type conidiophores. Despite considerable variability in the size of both conidia and conidiophores, the powdery mildew was identified as *Erysiphe knautiae*. In *Scabiosa columbaria*, a case was observed where the cell attached to the foot cell was equal in length to the foot cell itself. Conidia from all samples were elliptical to slightly oval, and no germination was observed.

Erysiphe macleayae was identified on *Macleaya cordata* and *Dicentra spectabilis* using the primer combination PMITS1 and PMITS2, with the following results: For *Macleaya cordata* (GenBank: PP577764), a 660 bp contig was obtained, Per. Ident. 100–99.85% identical to the first 10 hits, consisting of 59 bp of 18S rRNA, 278 bp of ITS1, 154 bp of 5.8S rRNA, 180 bp of ITS2, and 48 bp of 28S rRNA. For *Dicentra spectabilis* (PP665599), a 648 bp contig was obtained, Per. Ident. 100–99.84% identical to the first 10 hits, comprising 58 bp of 18S rRNA, 276 bp of ITS1, 154 bp of 5.8S rRNA, 180 bp of ITS2, and 38 bp of 28S rRNA.

Golovinomyces ambrosiae was identified on *Coreopsis grandiflora* 'Heliot' and *Dahlia pinnata* from dry material. The fungus was present in its anamorphic stage, with nipple-shaped appressoria and Euoidium-type conidiophores. The conidia were oval, sometimes with a doliform shape.

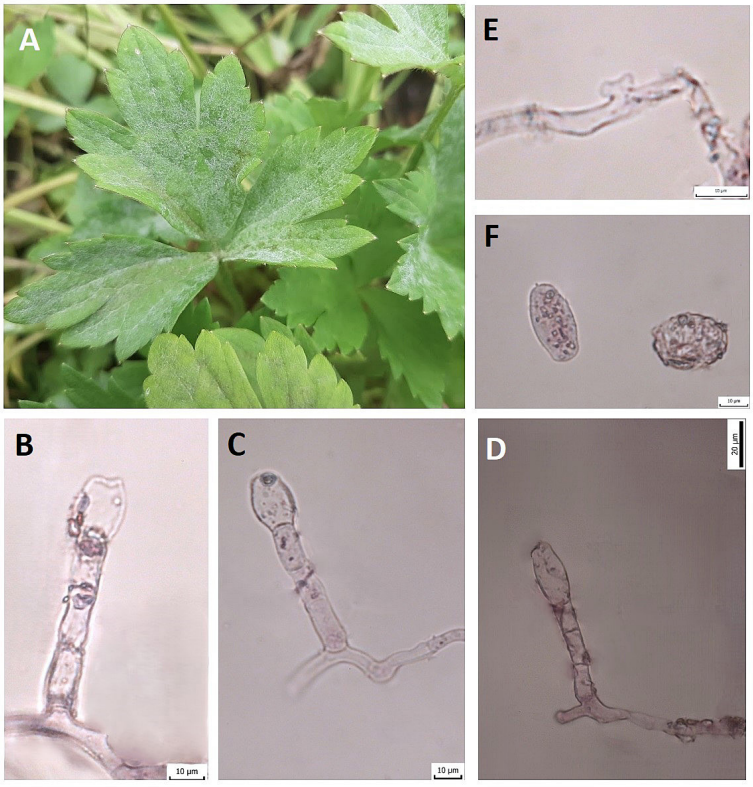

Figure 1. *Erysiphe geraniacearum*: (A) macroscopic symptoms of *Erysiphe geraniacearum* infection on *Geranium* × *cantabrigiense*; (B), (C), (D) conidiophores of *Erysiphe geraniacearum*; (E) appressoria of *Erysiphe geraniacearum*; (F) – conidia of *Erysiphe geraniacearum* (photo: M. Michutová)

https://doi.org/10.17221/38/2025-HORTSCI

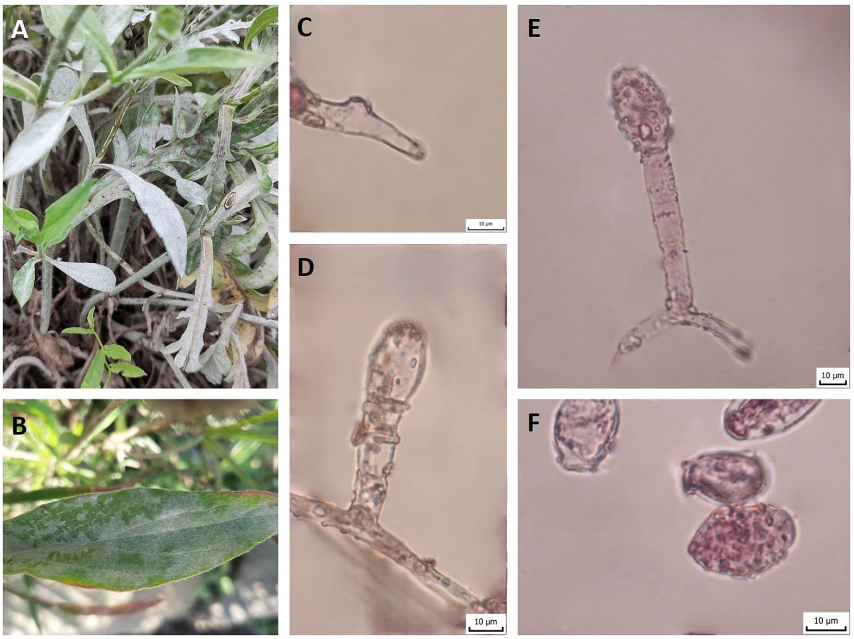

Figure 2. *Erysiphe knautiae*: (A), (B) macroscopic symptoms of *Erysiphe knautiae* infection on *Knautia macedonica* (A) and *Scabiosa caucasica* 'Alba' (B); (C) appressorium of *Erysiphe knautiae*; (D), (E) – conidiophores of *Erysiphe knautiae*; (F) conidia of *Erysiphe knautiae* (photo: M. Michutová)

Golovinomyces asterum var. *asterum* was identified on *Aster dumosus* 'Kristina' and *Symphyotrichum lateriforum* in its anamorphic stage. The fungus exhibited nipple-shaped appressoria and a longer, straight foot cell.

Golovinomyces bolayi was observed on *Campanula lactiflora* and *Veronica longifolia* 'Charlotte' in its anamorphic stage. The fungus exhibited nipple-shaped appressoria and Euoidium-type conidiophores. The conidia were oval to slightly cylindrical in shape, without fibrous bodies.

Golovinomyces depressus was observed on *Centaurea dealbata* 'Steenbergii' and *C. montana* 'Rosea' in its anamorphic stage. The fungus displayed nipple-shaped appressoria and Euoidium-type conidiophores, with a distinctly elevated basal septum in the conidiophores. The teleomorph was present on *C. dealbata* 'Steenbergii', with appendages lacking a pronounced basal termination, measuring 10–20 µm in length and 97–163 µm (80–128 µm) long. The asci were five ellipsoid-ovoid in shape, measuring 43–12.6 µm (20–57 µm) × 25–7.3 µm (12–34 µm), each containing 3 to 5 ascospores.

Golovinomyces echinopis was observed on *Echinops sphaerocephalus* in its anamorphic stage. The fungus displayed nipple-shaped appressoria and Euoidium-type conidiophores. On some conidiophores, a significantly larger cell was observed attaching to the basal cell, larger than the basal cell itself. The conidia were distinctly lemon-shaped.

Golovinomyces latisporus was observed on *Helianthus decapetalus* 'Lemon Queen', *H. salicifolius*, *Rudbeckia hirta* 'Amarillo Gold', *R. laciniata* 'Goldquelle', and *R. nitida* 'Herbstsonne' in its anamorphic stage. The fungus displayed nipple-shaped appressoria, Euoidium-type conidiophores, and conidia that were oval, or occasionally doliform to slightly lemon-shaped. The teleomorph was found only on *Helianthus salicifolius*, with identification further confirmed by PCR using the primer combination PMITS1 and PMITS2, resulting in the following data: *Golovinomyces latisporus* (host *Helianthus salicifolius*, GenBank: PP577762) produced a 620 bp contig, Per. Ident. 100–99.02% identical to the first 10 hits, consisting of 54 bp of 18S rRNA, 245 bp of ITS1, 154 bp of 5.8S rRNA, 168 bp of ITS2, and 54 bp of 28S rRNA.

Golovinomyces macrocarpus was identified on *Tanacetum vulgare* in its anamorphic stage, characterized by nipple-shaped appressoria and Euoidium-type conidiophores. The conidia were arranged in short, straight chains.

Golovinomyces magnicellulatus was identified on *Phlox paniculata* 'Blue Paradise' in its anamorphic stage, featuring Euoidium-type conidiophores. *Golovinomyces magnicellulatus* var. *magnicellulatus* was identified on *Phlox paniculata* 'Fujiyama', with the presence of telomorph chasmothecia. The variety was determined based on the absence of characteristics typical of *G. m.* var. *robustus*, which includes larger peridial cells (10–14 µm) and

https://doi.org/10.17221/38/2025-HORTSCI

notably thicker appendages (4–6–13(–18) µm), neither of which were present in the sample.

Golovinomyces orontii was observed on *Viola* × *wittrockiana* in its anamorphic stage, characterised by nipple-shaped appressoria, Euoidium-type conidiophores, and conidia without fibrosin bodies.

Golovinomyces salviae was identified on *Salvia lavandulifolia* in its anamorphic stage, with nipple-shaped appressoria and Euoidium-type conidiophores, which were shorter than 140 µm.

Golovinomyces verbasci was found on *Verbascum chaixii* 'Wedding Candles', exhibiting nipple-shaped appressoria, Euoidium-type conidiophores, and conidia that germinated laterally. The conidia were slightly smaller than those reported in the literature.

Golovinomyces verbenae was observed on *Verbena bonariensis* in its anamorphic stage, with nipple-shaped appressoria and Euoidium-type conidiophores, frequently featuring a bent foot cell.

Neoërysiphe galeopsidis was observed on *Acanthus hungaricus* in its anamorphic stage, exhibiting lobed appressoria and Euoidium-type conidiophores. The size of the conidiophores, the foot cell, and the number of distal cells matched the characteristics typical of *N. galeopsidis*.

Podosphaera aphanis var. *aphanis* was observed on *Agrimonia eupatoria* in its anamorphic stage, featuring relatively long Euoidium-type conidiophores with a notably long foot cell. The conidia contained fibrosin bodies. *Podosphaera aphanis* occurs in two varieties: var. *aphanis* and var. *hyalina*. Since *P. aphanis* var. *hyalina* is characterised by large conidia (28–33 × 19–23 µm), the observed sample corresponds to *P. aphanis* var. *aphanis*.

Podosphaera clandestina var. *clandestina* was identified on *Spiraea japonica* in its anamorphic stage, with upright conidiophores exhibiting variable lengths and foot cell sizes, often with a relatively long foot cell. Germinating conidia were of the fibroid type. As *P. clandestina* var. *cydoniae*, var. *luxurians*, and var. *perlonga* have been recorded only in North America, the observed sample is likely *Podosphaera clandestina* var. *clandestina*.

Podosphaera delphinii was observed on *Delphinium elatum* 'Morning Lights', exhibiting both anamorph and telomorph stages. The appressoria were slightly nipple-shaped, and the conidiophores were of the Euoidium type. The morphological traits were consistent with those described for this species. The chasmothecia measured 85–93 µm, with larger and more distinct peridial cells.

Podosphaera euphorbiae was observed on *Euphorbia epithymoides* and *E. seguieriana*, showing the anamorphic stage with Euoidium-type conidiophores. Based on the measurements, the possibility of *Fibroidium euphorbiicola*, which closely resembles *P. euphorbiae* but has larger conidia (35–45 × 10–15 µm), was excluded.

Podosphaera fuliginea was identified on *Veronica porphyriana*, with Euoidium-type conidiophores and conidia containing fibrosin bodies.

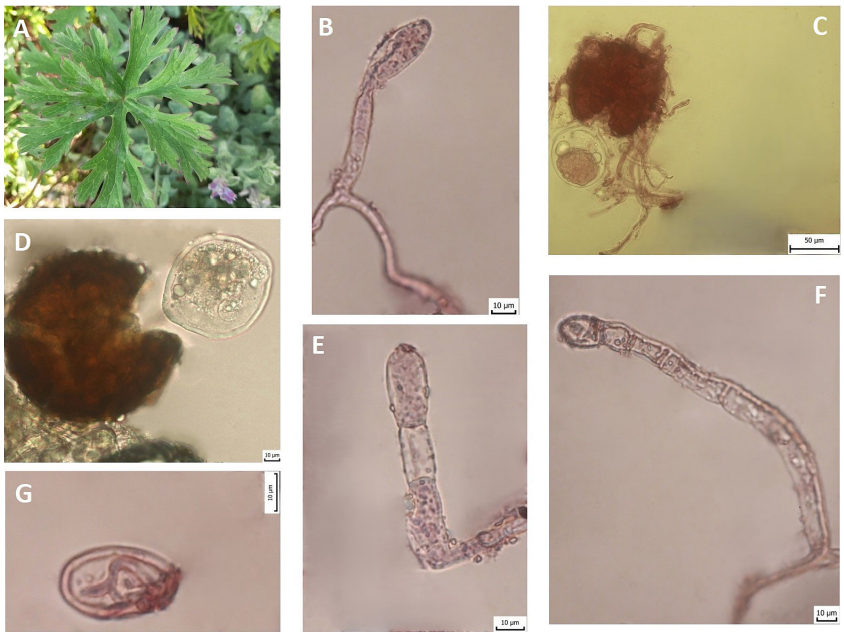

Figure 3. *Podosphaera savulescui*: (A) macroscopic symptoms of *Podosphaera savulescui* infection on *Pulsatilla vulgaris* 'Perlen Glocke'; (B), (E), (F) conidiophore of *Podosphaera savulescui*; (D), (C) chasmothecia of *Podosphaera savulescui*; (G) conidia of *Podosphaera savulescui* (photo: M. Michutová)

https://doi.org/10.17221/38/2025-HORTSCI

Podosphaera savulescui was observed on *Pulsatilla vulgaris* 'Perlen Glocke' (Figure 3), with both anamorph and telomorph stages present. The conidiophores were of the Euoidium type. The chasmothecia measured between 78–94 µm, and the peridial cells ranged from 10–16 µm. The identification of the powdery mildew was based on the morphological characteristics of both the anamorph and telomorph stages.

Podosphaera xanthii was observed on *Chrysanthemum* sp., *Dahlia pinnata*, and *Gerbera* × *hybrida*. Due to the poor quality of the material, the powdery mildew could not be reliably identified based solely on morphological characteristics. Consequently, PCR was used for confirmation. A combination of primers PM5G and ITS4 was used, yielding the following results: *Podosphaera xanthii* (host: *Chrysanthemum* sp., GenBank: PP577763) – 423 bp contig, Per. Ident. 100% identical to the first 10 hits, 125 bp ITS1, 155 bp 5.8S rRNA, and 143 bp ITS2. *Podosphaera xanthii* (host: *Dahlia pinnata*, GenBank: PP577760) – 465 bp contig, Per. Ident. 100% identical to the first 10 hits, 121 bp ITS1, 155 bp 5.8S rRNA, 146 bp ITS2, and 43 bp 28S rRNA. *Podosphaera xanthii* (host: *Gerbera* × *hybrida*, PP967964) – 534 bp contig, 207 bp ITS1, 155 bp 5.8S rRNA, 144 bp ITS2, and 28 bp 28S rRNA.

DISCUSSION

Ornamental plants belonging to diverse families, with an ever-growing number of species and cultivars, constitute a significant element of public green spaces and private gardens. This extensive variety of host plants reflects the high species diversity of powdery mildew fungi. The sample collection was carried out during the growing season of 2021–2023 in botanical gardens and parks in southern and central Moravia (Czech Republic), and therefore the results are specific to this region and may not correspond to the entire Czech Republic. A total of 25 powdery mildew species were identified in 39 samples of ornamental perennial plants representing 17 families. The most prevalent genus was *Golovinomyces* (12 species), followed by *Podosphaera* (seven species), *Erysiphe* (five species), and a single species belonging to the genus *Neoërysiphe*.

Beyond confirming the occurrence of powdery mildew species previously documented in the Czech Republic, two new species (*Golovinomyces savulescui, Erysiphe knautie*) were identified, and the host range of certain powdery mildew species was more precisely clarified. *Golovinomyces bolayi* was newly confirmed on *Campanula lactiflora* and *Veronica longifolia*, *Erysiphe macleaye* was confirmed on *Dicentra spectabilis*, *Podosphaera xantii* was confirmed on *Calendula officinalis*, *Chrysanthemum* sp., *Dahlia pinnata*, and *Gerbera*× *hybrida*.

Powdery mildew with lobed appressoria observed on the leaves of *Geranium* × *cantabrigiense* initially pointed to *Neoërysiphe geranii*. However, the conidiophores did not correspond to the Euoidium type. According to Braun and Cook (2012), *Podosphaera fugax* is characterised by inconspicuous appressoria and Euoidium-type conidiophores, which also led to its exclusion. Based on the presence of distinct appressoria and conidiophores not conforming to the Euoidium type, the powdery mildew on the leaves of *Geranium* × *cantabrigiense* was identified as *Erysiphe geraniacearum*.

Although the characteristics observed were consistent with those typically seen in *Erysiphe geraniacearum*, variations, particularly in the length of the basal cell and the size of the conidia, required verification of identification by PCR (PP764328). The results confirmed its affiliation with the genus *Erysiphe*, although sequences for *Erysiphe geraniacearum* are not available in the GenBank database. The presence of *E. geraniacearum* in the Czech Republic has been documented by Braun and Cook (2012), Petřeková (2018), Vrbovská (2020), and Ondryáš (2021) on *Geranium pratense*. Given that no other species of *Erysiphe* is known to occur on *Geranium* in this region, it is reasonable to identify the observed powdery mildew as this species. In Europe, *E. geraniacearum* has been recorded in Germany (Allescher 1875), Estonia (Karis 1956), Sweden (Gross et al. 2023), and Switzerland (Liljeblad 2024). However, the absence of reference sequences in GenBank prevented unequivocal molecular confirmation. This case demonstrates the limitations of relying on either morphological traits or incomplete molecular data alone. To overcome such obstacles, it is crucial to expand and maintain high-quality reference databases, such as MycoBank, which will facilitate more accurate identification of powdery mildew species in the future.

https://doi.org/10.17221/38/2025-HORTSCI

According to the information provided by Braun and Cook (2012), it is likely that the following powdery mildew species occur on the Caprifoliaceae family in the Czech Republic: *Podosphaera diclipterae*, *Leveillula durieui*, *L. taurica*, and *Erysiphe knautiae*. The conidiophores of *Podosphaera diclipterae* are of the Euoidium type, and the species of the genus *Leveillula* are morphologically distinct, allowing for their exclusion. *Erysiphe knautiae* was described by Paulech (1995) in Slovakia, and Braun and Cook (2012) report its presence throughout Europe. Based on morphological characteristics and conidiophores of the Pseudoidium type, *Erysiphe knautiae* was identified in all powdery mildew samples from ornamental plants of the Caprifoliaceae family (*Knautia macedonica*, *Scabiosa caucasica* 'Alba', *S. c.* 'Perfecta', and *S. columbaria*), confirming its presence in the Czech Republic as previously anticipated (Petřeková 2018).

Haňáčková et al. (2023) describe *Erysiphe macleayae* as an introduced species from the temperate regions of Asia, which has been recorded in the Czech Republic on *Macleaya microcarpa* and *M. cordata* by Pastirčáková et al. (2016), Kitner et al. (2017), and Petřeková (2018). In both samples from the Papaveraceae family, *Dicentra spectabilis* and *Macleaya cordata*, the powdery mildew was identified as *Erysiphe macleayae* through PCR analysis. The powdery mildew on *Macleaya cordata* matched the occurrence reported by Petřeková (2018), while the finding on *Dicentra spectabilis* marks the first detection of *Erysiphe macleayae* on this species.

Based on the morphological characteristics of *Golovinomyces bolayi*, its presence was confirmed on *Campanula lactiflora* (Campanulaceae) and *Veronica longifolia* and *V. l.* 'Charlotte' (Plantaginaceae). Braun and Cook (2012) reported *Golovinomyces orontii* on plants of the genera *Campanula* and *Veronica*, and later, Braun et al. (2019) identified *Golovinomyces bolayi*. The key distinguishing factor was the length of the conidiophores, which substantially exceeded 130 µm (with some reaching over 200 µm), suggesting *G. bolayi*. This identification is further supported by recent findings of this species on *Veronica* in China (Cai et al. 2023), Iran (Golmohammadi et al. 2019), and on nine *Veronica* species in Korea (Park et al. 2024).

Golovinomyces latisporus is a nearly cosmopolitan species occurring on various species of *Helianthus* and *Rudbeckia* (Bradshaw et al. 2021). According to Qiu et al. (2020), molecular methods have revealed additional hosts, *Zinnia angustifolia* and *Z. elegans*. In the Czech Republic, it has been confirmed on *Helianthus* and *Rudbeckia* (Mieslerova et al. 2020). Morphological assessment revealed variation mainly in conidial size and, to a lesser extent, in conidiophore morphology. Nevertheless, all samples fell within the diagnostic range reported by Qiu et al. (2020), with conidial length-to-width ratios below 2. The observed variability may be attributed to several factors, including environmental conditions of the host plant (Mielserova et al. 2020), host defence responses to powdery mildew infection (Kallamadi et al. 2022), or methodological aspects related to handling dried plant material (Lebeda et al. 2017).

Several species and varieties of powdery mildew have been described on the genus *Phlox*, including *Podosphaera xanthii*, *Leveillula guilanensis*, *Leveillula taurica*, *Golovinomyces magnicellulatus* var. *magnicellulatus*, and *G. magnicellulatus* var. *robustus* (Braun, Cook 2012). In the Czech Republic, Dvořáková (2016) reports *Golovinomyces magnicellulatus* on *Phlox* sp. This species of powdery mildew is now found almost worldwide, including in Europe. With the importation of *Phlox* species cultivated as ornamental plants, powdery mildew has spread to Australia, Fiji, Egypt, and parts of Africa (Braun, Cook 2012).

Golovinomyces magnicellulatus var. *magnicellulatus* has been identified on *Phlox paniculata* and *P. p.* 'Fujiyama' (Polemoniaceae). *G. magnicellulatus* var. *robustus* differs from *G. magnicellulatus* var. *magnicellulatus* in having larger peridium cells (10–14 µm) and significantly thicker appendices (4–)6–13(–18), features that were not present in the observed sample. The powdery mildew on *Phlox paniculata* 'Blue Paradise' identify as *G. magnicellulatus*. Closer identification of the variety was not possible due to the absence of the teleomorphic stage. The occurrence of this species in the Czech Republic is reported by Dvořáková (2016).

Neoërysiphe galeopsidis was identified on *Acanthus hungaricus* (Acanthaceae) based on the morphological characteristics of its asexual stage. The conidiophore type was Euoidium, and the key feature was the presence of lobed appressoria, typical for the genus *Neoërysiphe* (*Golovinomyces orontii* forms knobbed appressoria). *N. galeopsidis* was first described in 1815 as *Erysiphe galeopsidis*. Klika (1923) recorded this powdery mildew on the genus

https://doi.org/10.17221/38/2025-HORTSCI

Stachys and described it as a species with distinctly lobed appressoria, which corresponds to the current species *Neoërysiphe galeopsidis*. The species has been confirmed on several species of *Stachys* in the Czech Republic and Slovakia (Pastirčáková et al. 2008), on the genus *Catapa* (Lebeda et al. 2017), and *Betonica officinalis* (Petřeková 2018). However, to date, *N. galeopsidis* has not been recorded on *Acanthus hungaricus* or other genera of the *Acanthaceae* family in the Czech Republic.

Blumer (1933) initially described *Podosphaera fuliginea* as a species affecting plants from 35 genera across 10 families. Following its division into several smaller units (Junell 1967), *P. fuliginea* was later phylogenetically classified using the ITS region as a species occurring exclusively on *Veronica* species (Liu, Braun 2022). Lebeda et al. (2017) report this powdery mildew on weed plants of the *Plantaginaceae* family in Central Europe. On *Veronica*, powdery mildew species such as *Golovinomyces orontii* (now *G. bolayi*) and *Podosphaera fuliginea* have been identified. *P. fuliginea* was confirmed on a sample of *Veronica porphyriana* (Plantaginaceae) based on the presence of fibrosin bodies, which excluded *Golovinomyces bolayi*. Braun and Cook (2012) mention *Podosphaera fuliginea* on this plant species, and despite slight differences in conidial size, its morphological characteristics corresponded. It can be concluded that this species occurs not only on wild-growing *Veronica* species (Lebeda et al. 2017) but also on ornamental species and their cultivars.

Podosphaera savulescui is morphologically similar to other species of the genus *Podosphaera* on *Ranunculaceae*, but it differs in the size of its relatively subtle peridium cells, which measure 8–20(–25) µm. In the other two powdery mildew species, the peridium cells are larger and more pronounced: *Podosphaera delphinii* has cells measuring 15–40 µm, and *Podosphaera thalictri* has cells ranging from (10–)15–35 µm (Braun, Cook 2012).

Braun and Cook (2012) report the occurrence of *Podosphaera savulescui* in Ukraine, and Georgescu et al. (2021) in Romania. As of now, there are no records of its occurrence in the Czech Republic. Although Romaszewska-Sałata and Sałata (1978) and Romaszewska-Sałata (1981) mention its occurrence in Poland on *Adonis vernalis*, Braun and Cook (2012) believe that, due to the large peridium cells, it is more likely to be *P. delphinii*. Braun (2006) also reports the same on this plant species in Poland.

Podosphaera savulescui was identified on *Pulsatilla vulgaris* 'Perlen Glocke' (Ranunculaceae). The peridium cells ranged in size from 10 to 16 µm, and the chasmothecia size corresponded to that of *P. savulescui*. This allowed for the exclusion of *P. thalictri*, which has smaller chasmothecia (diameter 55–70 µm). Both *P. delphinii* and *P. savulescui* have similarly sized chasmothecia (Braun, Cook 2012).

Although this species has been recorded in countries neighbouring the Czech Republic, it has not yet been identified within the country. Considering the size of the peridium cells, which align with those of *Podosphaera savulescui*, there is no reason to consider it could be *P. delphinii*, a species much more commonly found in the Czech Republic, and which was also identified in this study on a sample of *Delphinium elatum* 'Morning Lights'.

Podosphaera xanthii is a highly complex species that forms races capable of infecting a wide variety of hosts. Braun and Cook (2012), based on its broad host range, global distribution, and genetic variations (Hirata et al. 2000; Ito, Takamatsu 2010), concluded that it should be treated as a species complex. However, due to the lack of significant morphological, molecular, and inoculation data, this approach has not been adopted, and the name *P. xanthii* s. lat. remains in use. This powdery mildew species is relatively common in the Czech Republic, primarily observed on species of the *Cucurbitaceae* family (Lebeda 1983; Lebeda et al. 2004, 2011), as well as on various other cultivated, wild, ornamental, and medicinal plants, such as *Calendula officinalis* (Mieslerova et al. 2020).

Powdery mildew *Podosphaera xanthii* was identified on ornamental plants of the *Asteraceae* family (*Chrysanthemum* sp., *Dahlia pinnata*, *Gerbera* × *hybrida*) in the Czech Republic. Due to the poor quality of the plant material examined, it was not possible to reliably determine the mildew based on its morphological features. Some conidia exhibited only faint fibrosin bodies, prompting the use of PCR for identification. The results confirmed the presence of Podosphaera *xanthii*. This study extends the host range of *P. xanthii* to ornamental plants *Chrysanthemum* sp., *Dahlia pinnata*, and *Gerbera* × *hybrida*.

CONCLUSION

This study confirms the expected species diversity of powdery mildew on ornamental plants

https://doi.org/10.17221/38/2025-HORTSCI

in the Czech Republic. To preserve the aesthetic value of ornamental plants, which is significantly diminished by powdery mildew, it is recommended to prioritize species and cultivars that are resistant to this disease in gardens and parks. The work describes the species and varieties of powdery mildew found on ornamental plants, updates the species spectrum of powdery mildew in the Czech Republic, and provides a more precise identification of host plant species, and reports new species in the Czech Republic.

REFERENCES

Allescher A. (1875): Staatliche Naturwissenschaftliche Sammlungen Bayerns. The Erysiphales Collection at the Botanische Staatssammlung München. Occurrence Dataset. Available at: https://www.gbif.org/occurrence/1098994752

Blumer S. (1933): Die Erysiphaceen Mitteleuropas unter besonderer Berücksichtigung der Schweiz. Beiträge zur Kryptogamenflora der Schweiz. Vol. 7, Zurich, Gebr. Fretz AG.

Bradshaw M., Braun U., Götz M., Takamatsu S., Brand T., Cabrera M.G., Dirchwolf P., Kummer V., Medina R., Moparthi S., Salcedo-Sarmiento S. (2021): Contributions to the phylogeny and taxonomy of the Erysiphaceae (powdery mildews) – Part 1. Sydowia, 73: 89–112.

Braun U. (1987): A Monograph of the Erysiphales (Powdery Mildews). Beiheft zur Nova Hedwigia, Vol. 89. Berlin, Stuttgart, J. Cramer.

Braun U. (2006): Fungi selecti exsiccati ex Herbario Universitatis Halensis – nos. 31–70. Schlechtendalia, 14: 3347.

Braun U., Cook R.T.A. (2012): Taxonomic Manual of the Erysiphales (Powdery Mildews). CBS Biodiversity Series, Vol. 11, Utrecht, CBS-KNAW Fungal Biodiversity Centre.

Braun U., Takamatsu S. (2000): Phylogeny of *Erysiphe, Microsphaera, Uncinula* (Erysipheae) and *Cystotheca, Podosphaera, Sphaerotheca* (Cystotheceae) inferred from rDNA ITS sequences – Some taxonomic consequences. Schlechtendalia, 4: 1–33.

Braun U., Kruse J., Wolcan S.M., Murace M. (2010): Three new species of the genus *Erysiphe* (Ascomycota, Erysiphales) on legumes and some new combinations. Mycotaxon, 112: 173–187.

Braun U., Shin H.D., Takamatsu S., Meeboon J., Kiss L., Lebeda A., Kitner M., Götz M. (2019): Phylogeny and taxonomy of *Golovinomyces orontii* revisited. Mycological Progress, 18: 335–357.

Buchtová I., Czetmayer Ehrlichová M. (2022): Situation and Outlook Report. Prague, Ministry of Agriculture. (in Czech)

Cai P., Zhang W., Duan X., Gong S., Qiu Z., Zhu M. (2023): First report of powdery mildew caused by *Golovinomyces bolayi* on *Veronica persica* in Central China. Plant Disease, 107: 2867.

Dvořáková J. (2016): Study of the occurrence of representatives of the family Erysiphaceae (powdery mildews) on ornamental plants. [Master's Thesis.] Olomouc, Palacký University Olomouc. (in Czech)

Georgescu M.I., Săvulescu V.I., Popa V., Luchian E., Moisescu Miloș G.C. (2021): Some observations on the ecology and morphological features of a *Humulus scandens* (Lour.) Merr. (*H. japonicus* Siebold & Zucc.) populations found on the Dâmbovița river banks. Scientific Papers. Series B, Horticulture, 65: 631–636.

Golmohammadi H., Torbati M., Arzanlou M. (2019): *Golovinomyces bolayi* causes powdery mildew on Persian speedwell (*Veronica persica*) in Iran. Australasian Plant Disease Notes, 14: 1–4.

Gross A., Blaser S., Senn-Irlet B. (2023): Swiss National Fungi Databank. Version 1.2. Swiss National Biodiversity Data and Information Centres – infospecies.ch. Occurrence dDataset. Available at: https://www.gbif.org/occurrence/3120395069

Haňáčková Z., Hrabětová M., Zíbarová L., Šafránková I., Sedlářová M., Černý K. (2023*):* List of Non-Native Fungi and Fungal Organisms of the Czech Republic. Centre for Landscape and Biodiversity. Divland. Available at: https://divland.cz/wp-content/uploads/2024/02/SS02030018-V66.pdf. (in Czech)

Hirata T., Cunnington J.H., Paksiri U., Limkaisang S., Shishkoff N. (2000): Evolutionary analysis of subsection *Magnicellulatae* of *Podosphaera* section *Sphaerotheca* (Erysiphales) based on the rDNA internal transcribed spacer sequences with special reference to host plants. Canadian Journal of Botany, 78: 1521–1530.

Ito M., Takamatsu S. (2010): Molecular phylogeny and evolution of subsection Magnicellulatae (Erysiphaceae: Podosphaera) with special reference to host plants. Mycoscience, 51: 34–43.

Junell L. (1967): Erysiphaceae of Sweden. Symbolae Botanicae Upsaliensis, 9: 117.

Kallamadi P.R., Yadav P., Dandu K., Soni P.K., Sankaraneni C.R., Bharawaja K.P., Mulpuri S. (2022): Host defense responses during powdery mildew (*Golovinomyces latisporus* comb. nov.) infection in sunflower (*Helianthus annuus* L.). Tropical Plant Pathology, 47: 495–508.

Karis H. (1956): *Erysiphe geraniacearum* U. Braun & Simonyan. Occurrence Dataset GBIF. Available at: https://www.gbif.org/occurrence/1148615039

https://doi.org/10.17221/38/2025-HORTSCI

Kitner M., Mieslerová B., Petřeková V., Lebeda A. (2017): First report of powdery mildew caused by *Erysiphe macleayae* on leaves of *Macleaya microcarpa* in the Czech Republic. Plant Disease, 101: 1544.

Klika J. (1923): Morphology of Czech powdery mildews. Masarykova akademie práce, 23: 1–80. (in Czech)

Lebeda A. (1983): The genera and species spectrum of cucumber powdery mildew in Czechoslovakia. Phytopathology, 108: 71–79.

Lebeda A., Křístková E., Sedláková B. (2004): Distribution, harmfulness and pathogenic variability of cucurbit powdery mildew in the Czech Republic. Acta Fytotechnica et Zootechnica, 7: 174–176.

Lebeda A., Křístková E., Sedláková B., Coffey M.D., McGreight J.D. (2011): Gaps and perspectives of pathotype and race determination in *Golovinomyces cichoracearum* and *Podosphaera xanthii*. Mycoscience, 52: 159–164.

Lebeda A., Mieslerová B., Huszár J., Sedláková B. (2017): Powdery mildews of cultivated and wild-growing plants: Taxonomy, biology, ecology and epidemiology, resistance mechanisms, breeding for resistance, methods of experimental work, diagnostics and plant protection. Olomouc, Agriprint. (in Czech)

Liljeblad J. (2024): Artportalen (Swedish Species Observation System). Version 92.371. SLU Artdatabanken. Occurrence dataset. Available at: https://www.gbif.org/occurrence/4435038083

Liu M., Braun U. (2022): Powdery mildews on crops and ornamentals in Canada: A summary of the phylogeny and taxonomy from 2000–2019. Canadian Journal of Plant Pathology, 44: 191–218.

Marmolejo J., Siahaan S.A.S., Takamatsu S., Braun U. (2018): Three new records of powdery mildews found in Mexico with one genus and one new species proposed. Mycoscience, 59: 1–7.

Mieslerová B., Kitner M., Křístková E., Majeský L., Lebeda A. (2020): Powdery mildews on *Lactuca* species – A complex view of host-pathogen interactions: I. Erysiphe sect. Erysiphe. Critical Reviews in Plant Sciences, 39: 44–71.

Ondryáš S. (2021): Plant mycoses in the Losový Nature Reserve and surrounding areas. [Bachelor's Thesis.] Olomouc, Palacký University Olomouc. (in Czech)

Park J.H., Choi Y.-J., Shin H.-D. (2024): Taxonomy, phylogeny, and host expansion of powdery mildew fungi parasitic to *Veronica* species. Mycobiology, 52: 135–143.

Pastirčáková K., Takamatsu S., Shiroya Y., Pastirčák M. (2008): European hornbeam powdery mildew *Erysiphe arcuata* in Slovakia. Journal of Phytopathology, 156: 597–601.

Pastirčáková K., Jankovics T., Komáromi J., Pintye A., Pastirčák M. (2016): Genetic diversity and host range of powdery mildews on *Papaveraceae*. Mycological Progress, 15: 1–18.

Paulech C. (1995): Flora of Slovakia. X/1 Fungi: Powdery Mildews (Erysiphales). Bratislava, Slovak Academy of Sciences Publishing House (Veda).

Petřeková V. (2018): Atlas of Selected Species of Powdery Mildews (Order Erysiphales) in the Czech Republic. Prague, Academia. (in Czech)

Qiu L., Liu N., Wang H., Shi X., Li F., Zhang Q., Wang W., Guo W., Hu Z., Li H., Ma J., Sun Q., Xie C. (2020): Fine mapping of a powdery mildew resistance gene MlIW39 derived from wild emmer wheat (*Triticum turgidum* ssp. *dicoccoides*). Theoretical and Applied Genetics, 134: 2469–2479.

Romaszewska-Sałata J.(1981): Two parasitic fungal species new to Poland. Annales Universitatis Mariae Curie-Skłodowska, Sectio C, 31: 109–111.

Romaszewska-Sałata J., Sałata S. (1978): New localities of interesting powdery mildew species (Erysiphales) in south-eastern Poland. Folia Societatis Scientiarum Lublinensis, 20: 93–97.

Shin H.D. (2000): Erysiphaceae of Korea. Suwon, National Institute of Agricultural Science and Technology.

Scholler M., Schmidt A., Siahaan S.A.S., Takamatsu S., Braun U. (2016): A taxonomic and phylogenetic study of the *Golovinomyces biocellatus* complex (Erysiphales, Ascomycota) using asexual state morphology and rDNA sequence data. Mycological Progress, 15: 1–13.

Takamatsu S. (2018): Studies on the evolution and systematics of powdery mildew fungi. Journal of General Plant Pathology, 84: 422–426.

Vrbovská A. (2020): Occurrence of powdery mildews (order Erysiphales) on medicinal and aromatic plants in the Czech Republic. [Master's Thesis.] Olomouc, Palacký University Olomouc. (in Czech)

Received: March 14, 2025
Accepted: September 4, 2025
Published online: March 23, 2026