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First report of powdery mildew on *Platanus orientalis* caused by *Erysiphe platani* in Uzbekistan

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Abstract. As a result of mycological research on the territory of Zaamin National Nature Park, a new powdery mildew for mycobiota of Uzbekistan — *Erysiphe platani* was found. This species was collected on *Platanus orientalis*. A brief description and photographs of *Erysiphe platani* are provided.
Keywords: *Pseudoidium*, anamorphs, conidia, mycelium, Zaamin National Nature Park.

Первое сообщение о мучнистой росе *Platanus orientalis*, вызванной *Erysiphe platani*, в Узбекистане

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Резюме. В результате микологических исследований на территории Зааминского национального природного парка обнаружен новый для микобиоты Узбекистана мучнисторосяный гриб *Erysiphe platani*. Этот вид был собран на *Platanus orientalis*. Приведены краткое описание и фотографии *Erysiphe platani*.
Ключевые слова: *Pseudoidium*, анаморфы, конидии, мицелий, Зааминский национальный парк.

Powdery mildew fungi are biotrophic, highly specialized pathogens, attacking nearly 10 000 species of vascular plants. The taxonomy of this group has brought about an ever increasing number of powdery mildew species described, which in 2012 stood at 873, including 794 holomorphs, i.e., those with described asexual and sexual morphs (Braun, Cook, 2012).

Central Asia is one of the main centers of powdery mildews species diversity, especially *Leveillula* species (Braun, Cook, 2012).

The earliest data about powdery mildew fungi on the territory of the Uzbekistan is in the works of N. G. Zaprometov, who studied the mycobiota of Central Asia. Special studies of powdery mildew fungi in Central Asia were started in 1935 by P. N. Golovin. He and his students intensively studied the diversity of microfungi in the mountains of Central Asia between 1940^{s}–1970^{s}, including powdery mildew fungi on the territory of Uzbekistan (Gaponenko *et al.*, 1983).

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Thus, in Central Asia, including Uzbekistan, through the efforts of several generations of mycologists, a rich collection of fungi has been accumulated, which made it possible to publish a monograph "Fungal flora of Uzbekistan", including the first volume of this book series containing complete data on all recorded Erysiphales until 1983 (Gaponenko *et al*., 1983). According to the monograph, a total number of powdery mildew species in Uzbekistan was 88, and there are 361 forms, which were recorded on 778 plant species in the host plant index of Uzbekistan.

In recent decades, studying powdery mildew fungi has been expanded, in Uzbekistan, including new species and host records (Mustafaev, Nuraliev, 2012; Mustafaev *et al.,* 2016, 2019; Abdurazakov *et al.,* 2021; Nabieva *et al.,* 2021).

It should be noted that powdery mildew fungi are widespread in the natural areas of Uzbekistan (Mustafaev *et al.,* 2019, Abdurazakov *et al.,* 2021). Recently, invasive species of powdery mildew originating from other regions of the world have extensively spread in Uzbekistan (e.g., *Erysiphe australiana* on *Lagerstroema indica*), mostly being found on introduced trees and shrubs that are widely used for landscaping (Nabieva *et al.,* 2021).

Platanus orientalis L. is a member of the Platanaceae and constitutes one of the commonest types of plane trees in the world. Oriental planes (*P. orientalis*) are commonly planted throughout Uzbekistan on the road sides and in parks.

The goal of this paper is to report the first record of powdery mildew — *Erysiphe platani* on *Platanus orientalis* for Uzbekistan.

Materials and Methods

Leaf samples from *Platanus orientalis* with symptoms of a powdery mildew disease were collected in July, 2022, on the territory Usmonlisoy valley (39.72175°N, 68.48930°E), Zaamin National Nature Park (ZNNP). ZNNP was created in 1926 as the Guralash Nature Reserve, and it is located on the northern side of the Turkestan Ridge (Alibekov, 2013) and covers 156 km2 (60 sq mi) of protected mountain landscapes in the Zomin District of Jizzakh Region, in the east of Uzbekistan (Fig. 1).

The collected leaves of *Platanus orientalis* affected by powdery mildews were labeled, dried, and deposited at Tashkent Mycological Herbarium (TASM) in Institute of Botany of Academy of Sciences of the Republic of Uzbekistan (Tashkent) according to standard methods (Heluta, 1989).

Between July, 2022, powdery mildew symptoms were observed on leaves of oriental planes in Zaamin National Nature Park. Leaves with infection symptoms were collected and dried for examination.

The fungal species were identified by morphological examinations of anamorphs (Braun, Cook, 2012). For examinations of asexual morphs, small pieces of infected leaves were mounted in lactic acid on microscopic slides, gently heated to boiling point, then scrapped off from leaf surface. Fungal structures were investigated by light microscopy with × 100, × 200 and × 400 magnifications. Measurements of at least 10–20 conidia examined using a standard light microscope (KERN OBN 132, Germany).

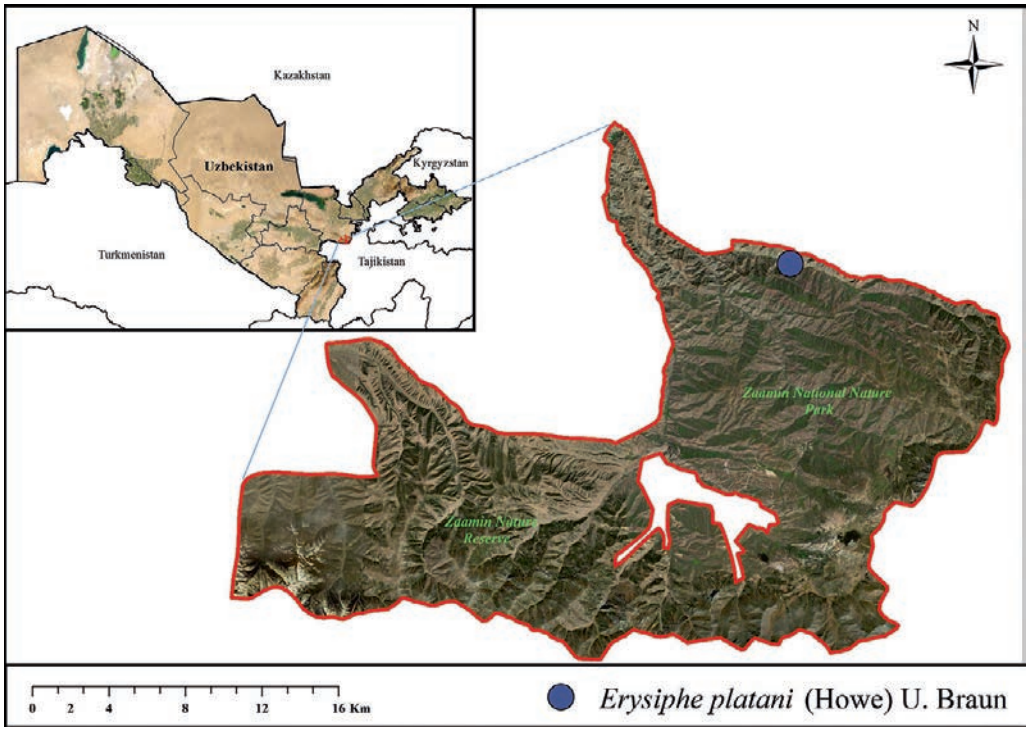


Fig. 1. The collecting locality of the *Erysiphe platani* in Uzbekistan.

Results

After thorough examination of infected leaves of *Platanus orientalis* by powdery mildews, collected from ZNNP, we found a new powdery mildew fungus species for mycobiota of Uzbekistan, *Erysiphe platani*.

Erysiphe platani (Howe) U. Braun et S. Takam., 2000, Schlechtendalia 4: 12.
≡ *Microsphaera platani* Howe, 1874, Bull. Torrey Bot. Club 5: 4.

Infected leaves had effused to dense, with white colored patches of mycelium, primarily on the adaxial surface. Leaves frequently deformed in areas supporting mycelial growth, apparently resulting from inhibition of normal leaf expansion in infected areas inhibiting the normal leaf expansion. Microscopic examination found amphigenous superficial hyphae and conidiogenous structures typical of a powdery mildew. The colonies formed generally white to dirty-yellowish conspicuous patches that often coalesced. Conidiophores erect, unbranched, 80–200 μm long, 1–3 septate, with straight to flexuous foot cells and mature conidia borne singly, *Pseudoidium* type. Conidia were very variable in shape and size, mainly elongated-ellipsoidal to ellipsoidal, often slightly vase-shaped, with minutely roughened to reticulate surface, (22)22.5–38(39) × (16)17–20(21) μm (Fig. 2).

Specimen examined: **Uzbekistan,** Turkestan Ridge, Zaamin National Nature Park, the Usmonlisoy valley, 1800–2000 m a. s. l., 39.72175°N, 68.48930°E, 15 VII 2022, *Ortiqov, Mustafaev*, IOZ309 (TASM).

Symptoms and descriptions of *Erysiphe platani* found by authors are similar to the descriptions given by Heluta and Glawe (Glawe, 2003; Heluta *et al.,* 2013). In

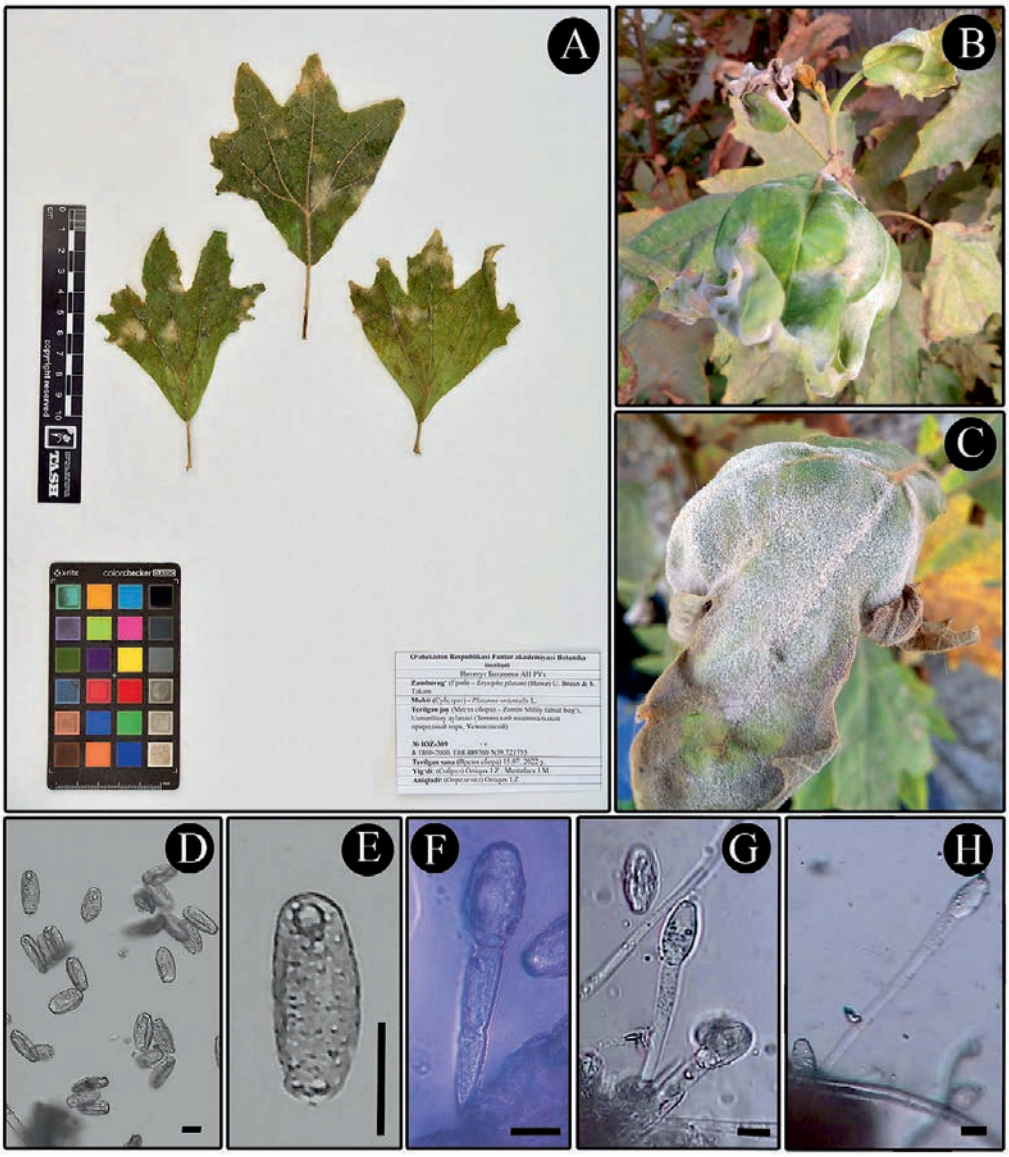


Fig. 2. The symptoms and morphological characters of *Erysiphe platani* on *Platanus orientalis* (TASM IOZ309).
A — herbarium specimen; B, C — the upper leaf surface infected by the powdery mildew fungus; D–F — conidia. Scale bars: D–F — 15 μm.

our specimen, however, the teleomorph was never observed. It should be noted that *E. platani* was mostly in its anamorphic form when first reported (Inokuti *et al*., 2008; Pastirčáková *et al*., 2014; Ligoxigakis *et al*., 2015).

Erysiphe platani has been recorded in many continents, such as North America, South America, Africa, Australia, Europe, and Asia.

The closest countries to Uzbekistan where *Erysiphe platani* was recorded are Iran (Khodaparast, 2016) and Azerbaijan (Guseinov, 1992). We did not find any information about the existence of this specimen on the territory of the Central Asia, and it may be the first record for Central Asian region.

Discussion

Erysiphe platani can be confused with some other species growing on *Platanus orientalis*, namely *Phyllactinia guttata* (Wallr.) Lév. [syn. *Phyllactinia corylea* (Pers.) P. Karst., *Phyllactinia suffulta* (Rebent.) Sacc.] (Pastirčáková *et al*., 2014).

Since the teleomorphic stage of *Erysiphe platani* was not observed, we compared it with *Phyllactinia guttata* according to anamorphic morphological characters. Conidiophores and conidia of *Erysiphe platani* are much shorter and thicker in comparison with *Phyllactinia guttata*, which has very long and filiform, 5–8 μm wide conidiophores, conidia clavate to somewhat spathulate, 57–88 × 16–28 μm (Schmidt, Braun, 2020).

Moreover, a large-scale study on the global distribution of *Erysiphe platani* was conducted by Pastirčáková *et al*. (2014). In order to re-examine *Platanus* powdery mildew fungus, 55 herbarium specimens were borrowed from BPI, GZU, KR, PDD, VPRI and W; another two specimens from BPI labeled as *Microsphaera platani* Howe (currently *Erysiphe platani*) on hosts not belonging to the Platanaceae were also examined. The specimens labeled as *Phyllactinia* (*P. corylea*, BPI 606615, BPI 859697) collected in the USA from *Platanus occidentalis* were borrowed for the re-examination. The identity of this material as *Erysiphe platani* was confirmed. The specimen BPI 859697 was also annotated by U. Braun in 2010 as *E. platani* (Pastirčáková *et al*., 2014).

According to Pastirčáková *et al*. (2014) old North American specimens labeled as *Oidium obductum* (BPI 409688, BPI 409689, BPI 409690, BPI 409691, W 7162) and *Oidium erysiphoides* Fr. (BPI 409564) on *Platanus* spp. contained the anamorph of *Pseudoidium* type belonging to *Erysiphe platani*; mature chasmothecia of *E. platani* were observed in North American specimens of *Microsphaera alni* (GZU 306255, W 1671 and 6925) and *M. platani* (BPI 605840, BPI 605841) and in a Swiss specimen (KR 26180). So, all specimens of powdery mildew on *Platanus* spp. were found to belong to *Erysiphe platani* based on morphological examinations.

Platanus is also absent as a host of *Phyllactinia* in the latest powdery mildew monograph (Braun, Cook, 2012).

According to Cooper (2013), the pattern of many powdery mildew introductions where the initial populations are represented only by the anamorphic stage, and only

much later after establishment is the sexually reproducing stage encountered. In Italy, about 90 years after the first Italian finding of *Erysiphe platani*, the fungus has formed teleomorphic reproductive structures. Menéndez Valderrey (2012) recorded the first teleomorph of the fungus in Northern Spain about 27 years after the discovery of the fungus in the country, in 1985, by Gallego and Honrubia (Pastirčáková *et al*., 2014).

Based on the discoveries above, teleomorphic stage of *Erysiphe platani* can be found in the near future, in Uzbekistan.

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