Erysiphe paradoxa: A Newly Reported Powdery Mildew on Acer monspessulanum in Turkey

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Abstract
Aim of the study: The current study aims to contribute Turkish powdery mildews by adding newly recorded fungus.

Area of study: The northern slopes of Derebağ waterfall was the study area located within the borders of Derebağ Town (Yahyalı/Kayseri/Turkey) district in the northeast of Aladağlar.

Material and methods: Infected maple specimens were collected from the field on October 14, 2015 and brought the laboratory for identification studies. Morphological structures were examined using both simple light microscope and scanning electron microscope (SEM). The identified samples were deposited in Inonu University Herbarium (INU).

Main results: Erysiphe paradoxa was recorded for the first time from Turkey.

Highlights: Erysiphe paradoxa was reported on Acer monspessulanum. E. paradoxa was a new record for Turkish powdery mildews. E. paradoxa samples collected from Turkey were the third report in the World.

Keywords: Acer, Powdery Mildews, New Record, Turkey

Erysiphe paradoxa: Türkiye’de Acer monspessulanum Üzerinde Tespit Edilen Yeni Bir Külleme Kaydı

Öz
Çalışmanın amacı: Mevcut çalışma, Türkiye küllemelerine yeni bir kayıt ilave ederek katkıda bulunmayı amaçlamıştır.
Çalışma alanı: Çalışma alanı olan Derebağ şelalesinin kuzey yamaçları, Aladağların kuzeydoğusunda Derebağ Kasabası (Yahyalı/Kayseri/Türkiye) sınırları içerisinde yer almıştır.
Materiały ve yöntem: Enfekte akçaağaç örnekleri 14 Ekim 2016 tarihinde toplanmıştır ve teşhis çalışmalari için laboratuvara getirilmiştir. Morfolojik yapılar hım basit ışık mikroskobu hem de taramalı elektron mikroskobu (SEM) kullanılarak incelenmiştir. Teşhis edilen örnekler İnönü Üniversitesi Herbariyumunda (INU) saklanmaktadır.
Temel sonuçlar: Erysiphe paradoxa Türkiye için yeni kayıt olarak verilmiştir.
 Araştırma vurguları: Erysiphe paradoxa, Acer monspessulanum üzerinden rapor edilmiştir. E. paradoxa Türkiye için yeni kayıt olarak kaydedilmiştir. Türkiye’den toplanan E. paradoxa örnekleri, dünyadan üçüncü rapor olarak bildirilmiştir.
Anahtar Kelimeler: Acer, Külleme, Yeni Kayıt, Türkiye

Introduction

Erysiphales, also known as powdery mildews, is a widely distributed order, which includes 873 species belonging to 16 genera within the family Erysiphaceae. Its members are plant pathogens infecting approximately 10.000 Angiosperms species worldwide and causing fungal diseases on various cultivated and wild plants. Although they are cosmopolitan and distributed from tropics to the polar areas, powdery mildews are mainly distributed in the north temperate zone (Braun, 1987; Kabaktepe et al., 2015).

Erysiphe is the largest genus of the family Erysiphaceae and it contains roughly 450 species. Chasmotheca including multiple asci
and mycelioid appendages are the main characteristics of the genus, whose definition and the members have been dramatically revised based on morphological and molecular phylogenetic data. Currently, members of the genus consist of five morphological sections (Erysiphe, Microsphaera, Uncinula, Typhulochaeta, Californiomycetes) that are separated from each other by different morphologies of their sexual structures (Braun & Takamatsu, 2000; Abasova et al., 2018).

Erysiphe paradoxa (Simonyan) U. Braun & S. Takam. collected in Armenia on Acer monspessulanum subsp. ibericum (M.Bieb. ex Willd.) Yalt. was identified by Simonyan (1959) as Uncinula paradoxa. In 2000, U. paradoxa was reported from Iran on Acer hyrcanum Fisch. & C.A.Mey. and A. monspessulanum L. (Tavaneaei et al., 2000; Khodaparast & Abbasi, 2009). Later, Uncinula was considered as one of the five sections of the genus Erysiphe DC, and the new and current name Erysiphe paradoxa was published as a new combination (Braun & Takamatsu, 2000).

According to literature on Turkish powdery mildews (Akata & Heluta, 2015; Kabaktepe et al., 2015; Kabaktepe & Akata 2016; Heluta et al., 2017; Churakov et al., 2018; Akata et. al., 2019; Kabaktepe & Akata, 2019; Akdeniz & Sert, 2019), 146 species has been recorded so far. Among them, 48 species belong to the genus Erysiphe, but there was not any report of E. paradoxa in Turkey. The aim of the present research is to make a contribution to the Turkish powdery mildews.

Materials and Methods

The specimens were collected on A. monspessulanum (Montpellier maple) in the northern slopes of Derebağ waterfall within the borders of Derebağ Town (Kayseri/Turkey) on October 14, 2015. While infected host surfaces were photographed under stereomicroscope (Euromex BioBlue BB. 1153-PL trinocular stereo microscope with the camera Euromex CMEX-5f DC. 5000F), morphological structures were examined and photographed under a light microscope Zeiss Primo Star binocular microscope with the camera Canon A 300 and the software AxioVision 4.7). Approximately, 30 measurements were taken for each microscopic structure and the compiled data were statistically processed. For SEM analysis, dried pieces of infected Montpelier maple leaves were fixed on stubs using double-sided sticky tape, coated with gold particles, and visualized with an EVO 40XVP (LEO Ltd., Cambridge, UK) scanning electron microscope by using an accelerating voltage of 20 kV. The identified samples were kept at the herbarium of Inonu University (INU).

Results

Systematic overview
Fungi
Ascomycota
Erysiphales
Erysiphaceae
Erysiphe paradoxa (Simonyan) U. Braun & S. Takam. (Figure 1-2).

Mycelium amphigenous, persistent, thin, effuse. Chasmothecia scattered to gregarious, 100–155(–165) μm diam, peridium cells are irregularly polygonal to rounded, 5–15 μm, appendages 30–80, equatorial, flexuous-curved, on aggregated chasmothecia often densely interwoven with each other, widely and loosely curved, sinuous or twisted, length variable, 2–8 times as long as the chasmothecial diam, 3–8 μm wide, aseptate, hyaline, walls thin, somewhat thicker at the base, smooth to rough, apices very widely and loosely uncinate or forming very irregular and loose spirals. Ascii 5–12, easily visible in mature still closed chasmothecia, ellipsoid to ovoid, sessile or short-stalked, 50–80 × 30–50 μm, 5–8-spored. Ascospores broadly ellipsoid, ellipsoid to elongate, curved or subcylindrical 20–30 × 12–18 μm, Q= (1.3-) 1.4–1.6 (-1.7), colorless. Anamorph was not found.
Figure 1. *Erysiphe paradoxa* on *A. monspessulanum*: A. the host plant affected by the fungus; B. chasmothecia as viewed under the stereo microscope, C. chasmothecia as viewed under the light microscope, D. asci and ascospores as viewed under the light microscope.
Figure 2. *Erysiphe paradoxa* on *A. monspessulanum* as viewed by a scanning electron microscope: **A-B** chasmothecia, **C.** peridial surface of the chasmothecia, **D.** appendages of chasmothecia

**Material Examined**

TURKEY—Kayseri: Yahyalı, Northern Slopes of Derebağ waterfall, on *Acer monspessulanum* L. (*Sapindanaceae*), 1400 m, 14.10.2015, Kabaktepe & Akata 8326.

**Discussion**

Although numerous powdery mildews are known to grow on maple (*Acer*) species, only two *Erysiphe* species, *E. ljubarskii* (Golovin) U. Braun & S. Takam. and *E. paradoxa* prefer maples as host species. These species can easily be distinguished from each other by mycelium, different peridium cells and appendages. While *E. paradoxa* is an amphigenous species and possesses thin mycelium, irregularly polygonal to rounded, peridium cells (up to 15 μm), appendages (up to 80 μm) with very widely apices which is irregular and loose spiral, *E. ljubarskii* is mostly epiphyllous, and has polygonal peridium cells (up to 25 μm), appendages (up to 50 μm) with non-enlarged apices which are densely circinate and almost helicoid (Braun and Cook, 2012).

Although morphological features of our Turkish samples match up with the Iranian and Armenian samples of *E. paradoxa*, our samples have a distinctive characteristics. While peridium cells of Iranian and Armenian samples are obscure, they are conspicuous (irregularly polygonal to rounded, 5-15 μm) in Turkish samples. (Braun & Cook, 2012).

With the current study, *E. paradoxa* on *A. monspessulanum* was reported for the first time from Turkey and this is the third report (After Armenia and Iran reports) in the World. The species will be the 147th and 49th members of the Turkish powdery mildews and *Erysiphe* respectively.

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