



## *Erysiphe azaleae*, a new powdery mildew fungus introduced into Turkey

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### Abstract

In the current study, *Erysiphe azaleae* (U. Braun) U. Braun & S. Takam. (*Erysiphales*, *Ascomycota*) is reported for the first time from Turkey. A short description, host plant, locality and illustrations related to macro and micromorphologies of the species are provided. *Erysiphe azaleae* has been found only once on *Rhododendron ponticum* L. (*Ericaceae*) in Artvin province in the Black Sea region. This is the first report of this species in Asia, because the fungus known from the Russian Far East as *E. azaleae* is actually *E. izuensis*. The fungus formed both conidia and fruiting bodies. Thus, *E. azaleae* should be considered as a potentially dangerous powdery mildew pathogen for introduced and native rhododendrons in Turkey.

**Key words:** *Erysiphales*, new record, *Rhododendron*

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### *Erysiphe azaleae*, Türkiye'ye tanıtılan yeni bir külleme mantarı

### Özet

Mevcut çalışmada, *Erysiphe azaleae* (U. Braun) U. Braun & S. Takam. (*Erysiphales*, *Ascomycota*) Türkiye'den ilk kez rapor edilmiştir. Türün kısa deskripsiyonu, konukçu bitkisi, lokalitesi ve makro ve mikro morfolojilerine ait fotoğrafları verilmiştir. *Erysiphe azaleae* Karadeniz Bölgesinde yer alan Artvin yöresinde sadece *Rhododendron ponticum* L. (*Ericaceae*) bulunmuştur. Bu tür aynı zamanda Asya kıtası için ilk rapordur çünkü Rusya uzak doğusunda daha önce *E. azaleae* olarak bilinen tür aslında *E. izuensis*'tir. Bu mantar conidium ve fruktifikasyon organı oluşturur. Bu nedenle *Erysiphe azaleae* Türkiye'de doğal yayılış gösteren orman gülleri için potansiyel tehlike arz eden bir külleme patojeni olarak düşünülmelidir.

**Anahtar kelimeler:** *Erysiphales*, yeni kayıt, *Rhododendron*

### 1. Introduction

Over recent decades, the number of powdery mildew species in Europe has increased due to the introduction of alien fungi of East Asian and North American origin. A newly introduced from America are, for example, species such as *Erysiphe azaleae* (U. Braun) U. Braun & S. Takam. (Ing, 2000; Heluta et al., 2004), *E. elevata* (Burrill) U. Braun & S. Takam. (Ale-Agha et al., 2004; Cook et al., 2004, Vajna et al., 2004; Heluta et al., 2009), *E. flexuosa* (Peck) U. Braun & S. Takam. (Ale-Agha et al., 2000; Zimmermannová-Pastirčáková et al., 2000; Piątek, 2002; Zimmermannová-Pastirčáková and Pastirčák, 2002; Heluta, Voytyuk, 2004), *E. symphoricarpi* (Kiss et al., 2002; Heluta et al., 2016), *Golovinomyces greeneanus* (U. Braun) V.P. Heluta (Heluta and Korytnyanska, 2011), *Podospaera amelanchieris* Maurizio (Braun and Cook, 2012; Heluta and Hirylovich, 2016) etc. As previously reported (Heluta et al., 2013; Akata and Heluta, 2015), at least two of introduced species, North American *E. platani* and East Asian *E. syringae-japonicae*, migrated to Turkey via Europe. This process continues, as it is evidenced by the powdery mildew on *Rhododendron ponticum* L. (Fig. 1) found recently in Turkey. We should note that before our studies, any powdery mildew on

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rhododendrons was still not registered in this country (see Kabaktepe et al., 2015). So, we had found a new species for Turkey. Therefore, the goal of this study was to identify the fungus.

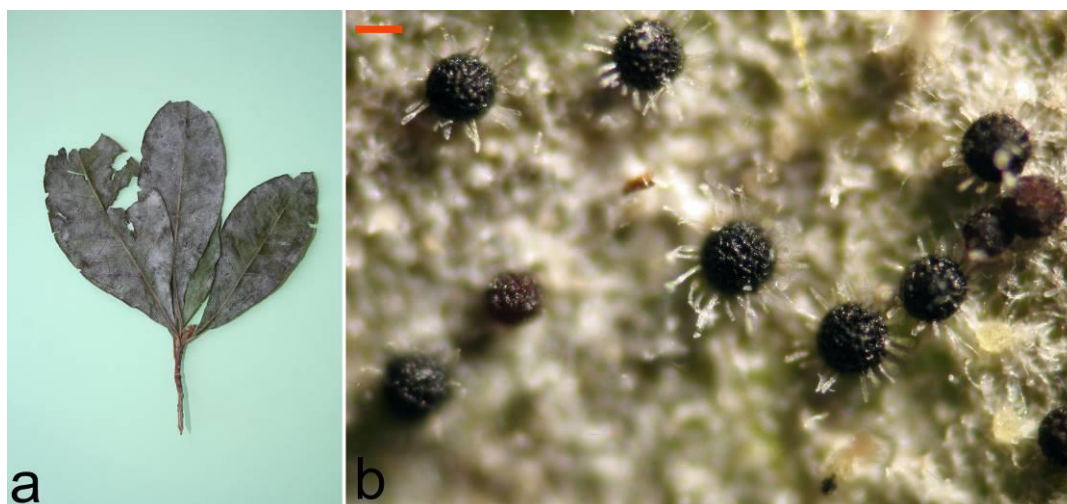


Figure 1. *Erysiphe azaleae* on *Rhododendron ponticum*: **a.** the host plant affected by the fungus; **b.** chasmothecia as viewed under the light microscope in reflected light (bar: b – 100  $\mu$ m)

## 2. Materials and methods

The powdery mildew sample was collected on *Rhododendron ponticum* in Karagöl (Şavşat, Artvin, Turkey) in 2014. The herbarium specimen is deposited at the National Herbarium of the M.G. Kholodny Institute of Botany of the National Academy of Sciences of Ukraine (KW). Morphological features were examined and photographed using a light microscope «Primo Star» (Carl Zeiss, Germany) with the camera «Canon A 300» and the software «AxioVision 4.7». The mycelium, conidiophores and conidia were removed from the surface of infected leaves by a transparent adhesive tape. To restore shape and size, a piece of tape with these fungus structures was put in a droplet of 40 % lactic acid solution on a microscope slide (sticky side up), covered with a cover glass, gently heated to boiling point, then examined under the light microscope. For each morphological feature, 30 structures were measured and the data processed statistically. For scanning electron microscopy (SEM) dried pieces of infected *Rhododendron* leaves were fixed on stubs using double-sided adhesive tape, coated with gold, and examined using an EVO 40XVP (LEO Ltd., Cambridge, UK) scanning electron microscope at an accelerating voltage of 20 kV.

## 3. Results

As a result of microscopic examination of the collected specimen, it was revealed that fungus found on *Rhododendron ponticum* in Turkey has anamorph *Pseudoidium* and immature fruiting bodies with dichotomously branched appendages (Figs 1b, 2e, g, 3a). Thus, this species belongs to the genus *Erysiphe* sect. *Microsphaera* (former genus *Microsphaera*). By all features (appearance of affected leaves, chasmothecial size, morphology and location of the appendages), our specimen is consistent with samples of *E. azaleae* collected in Europe (Ukraine). So, in Turkey we registered a new powdery mildew species of North American origin. Obviously, the fungus migrated here via Europe.

### *Erysiphe azaleae* (U. Braun) U. Braun & S. Takam., *Schlechtendalia* 4: 5. 2000

Syn.: *Oidium ericinum* Erikss., Meddn Kgl. Landbr.-Akad. Exper. 1: 47. 1885. – *Microsphaera azaleae* U. Braun, Mycotaxon 14(1): 370. 1982 (Figs 1–3).

Mycelium amphigenous, effuse, white, persistent, better developed on the upper surface of leaves, subtle on the lower surfaces of leaves. Hyphae thin, 3–4  $\mu$ m wide. Conidiophores rather short, 75–105  $\mu$ m, very rare longer, up to 180  $\mu$ m long, consisting of a mainly cylindrical, usually flexuous-sinuuous or curved foot cell 50–70  $\mu$ m long, followed by 1–2(–3) other cells. Conidia formed singly, mainly cylindrical, occasionally cylindrical-ellipsoid, (25–)27–44(–50)  $\times$  10.5–16  $\mu$ m, with a length/breadth ratio of 2.1–4.4, germinated with a single terminal germ tube. Chasmothecia immature, scattered, hemispherical, depressed in the lower part, with a distinctly meshed peridial surface, (93–)98–130(–140)  $\mu$ m diam. Peridial cells rather distinct, polygonal, irregular in shape, (8–)11–25(–30)  $\mu$ m diam. Appendages semi-matured, numerous, over 30, equatorial, short, with dichotomously branched apices. Asci immature.

**Specimen examined:** Turkey, Karagöl, Şavşat (Artvin), *Rhododendron ponticum* L., 31.08.2014, Kabaktepe & Akata (KW 70694F).

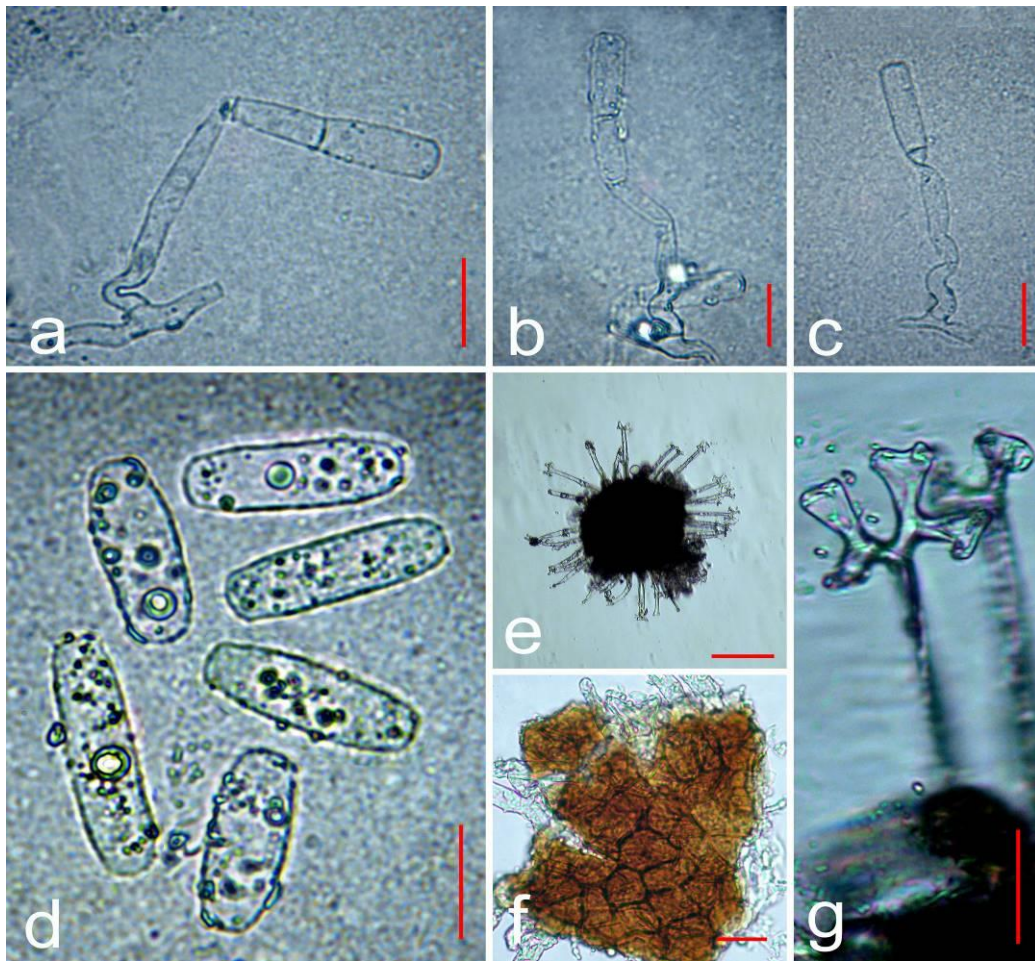


Figure 2. *Erysiphe azaleae* on *Rhododendron ponticum* as viewed by a light microscope: **a–c.** conidiophores, **d.** conidia, **e.** chasmothecium; **f.** peridial cells, **g.** appendage with dichotomously branched apex (bars: a–d, f–g – 20  $\mu\text{m}$ , e – 100  $\mu\text{m}$ )

#### 4. Conclusions and discussion

Rhododendrons are popular ornamental shrubs and they are cultivated since 18<sup>th</sup> century. More than 850 *Rhododendron* species exist in the temperate zone of the northern hemisphere. Turkish native evergreen rhododendrons are distributed in Black Sea region and they can be observed from sea level up to altitudes of 3000 m (Avcı, 2004).

Several powdery mildew fungi are known on rhododendrons, namely *Erysiphe azaleae* (U. Braun) U. Braun & S. Takam., *E. digitata* (A.J. Inman & U. Braun) A.J. Inman & U. Braun, *E. izuensis* (Y. Nomura) U. Braun & S. Takam., *E. rhododendri* J.N. Kapoor, *E. vaccinii* Schwein., and *Phyllactinia enkianthi* Z.Y. Zhao (see Braun and Cook, 2012). *Erysiphe azaleae* and *E. vaccinii* were described from North America, *E. rhododendri* from India, *E. izuensis* and *Ph. enkianthi* from East Asia. *E. digitata* is a native European species, but it is known from the type collection only (Braun and Cook, 2012). None of these species has been found before in Turkey. However, one of them, namely *E. azaleae*, was introduced into Great Britain (Watling, 1985; Ing, 2000) and then spread throughout Europe. At present, this species also is recorded in Czech Republic (Bacigálová and Marková, 2006; Lebeda et al. 2007), Germany (Dietrich, 2006), Italy (Garibaldi et al., 2002), Latvia (Apine et al., 2013), Lithuania (Grigaliūnaitė and Pribušauskaitė, 2006), Norway (Talgø et al., 2011), Poland (Piątek, 2003, Shin and Mułenko, 2004; Werner and Karolewski, 2010), Slovakia (Bacigálová and Marková, 2006), Slovenia (Hauptman and Jurc, 2008), Switzerland (Bolay, 2001), and Ukraine (Heluta et al., 2004). In the latest of these countries, the fungus parasitizes both the exotic species and the native *Rhododendron luteum* Sweet. The development of the disease is epiphytotic and observed throughout the area of *Rh. luteum*. The spreading of *E. azaleae* has invasive symptoms. Infected plants largely lose their ornamental effect. So, this fungus is a very dangerous parasite of rhododendrons.

In 2014, *E. azaleae* was recorded by us in Turkey, in the natural plant community. Hitherto, this fungus is known here only from one locality. The fungus forms both conidia and fruiting bodies. Thus, *E. azaleae* should be considered as a potentially dangerous powdery mildew pathogen for introduced and native rhododendrons in Turkey.

It should be noted that *E. azaleae* was also reported from the Russian Far East (Bunkina, 1978, 1991; Braun and Cook, 2012). However, this information is based on only one sample, which many years ago was re-identified by



the first author of the article as *E. izuensis* (unpublished data). Thus, in this paper we present a new species not only for Turkey but also for the whole of Asia.

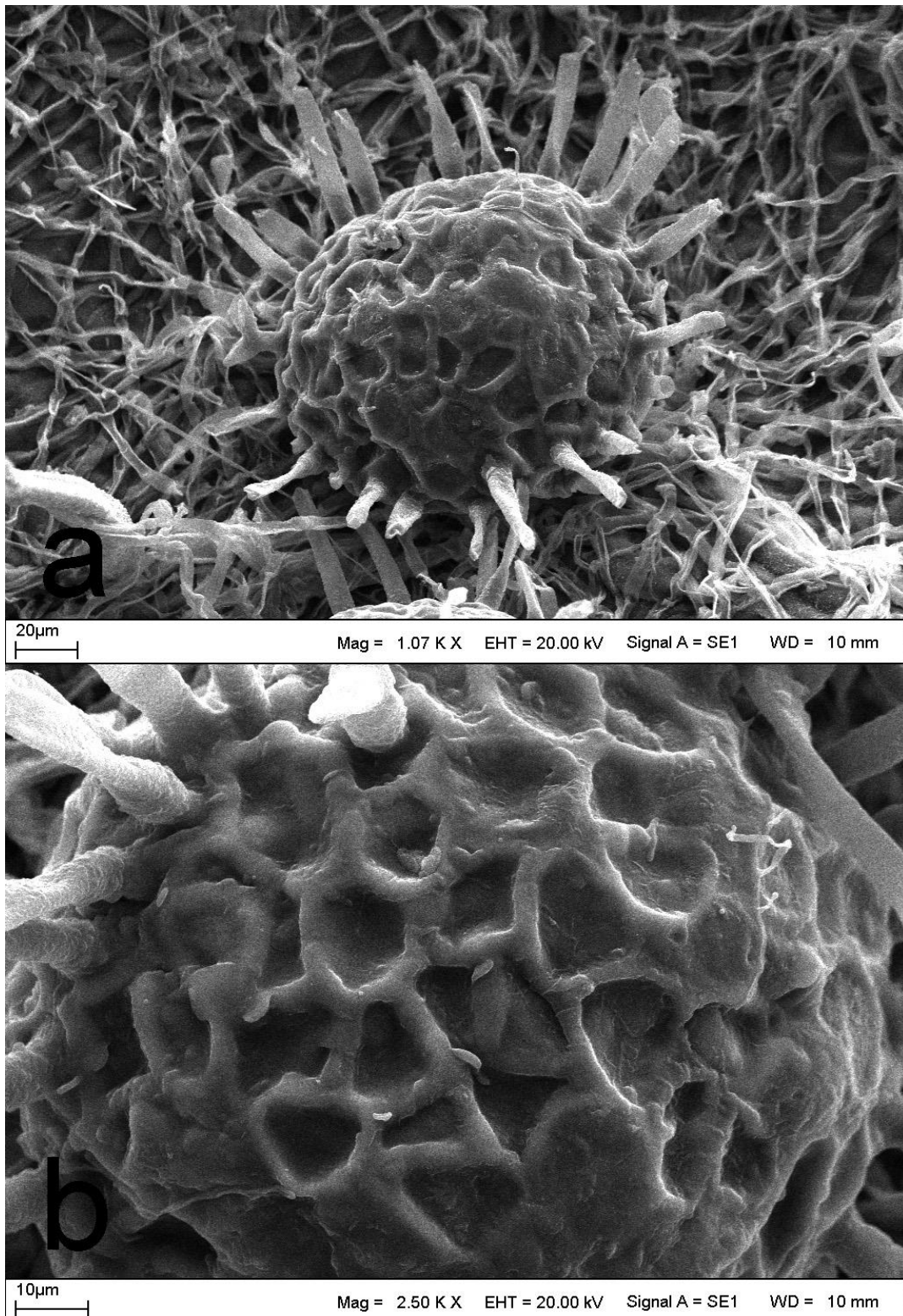


Figure 3. *Erysiphe azaleae* on *Rhododendron ponticum* as viewed by a scanning electron microscope: **a.** immature chasmothecium, **b.** peridial surface of the chasmothecium

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