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NEW DISEASE REPORT

First report of powdery mildew caused by *Leveillula taurica* on *Opsicarpium insignis*

K. Sepahvand[1] | **M. Darvishnia**[1] | **S.A. Khodaparast**[2] | **E. Bazgir**[1]

[1] Plant Protection Department, Faculty of Agriculture and Natural Resources, University of Lorestan, Iran

[2] Plant Protection Department, Faculty of Agricultural Sciences, University of Guilan, Iran

Correspondence
M. Darvishnia, Plant Protection Department, Faculty of Agriculture and Natural Resources, University of Lorestan, Iran.
E-mail: mdarvishnia44@yahoo.com

Species of fungi in the order Erysiphales cause disease referred to as powdery mildew which affect more than 10,000 angiosperm species (Glawe, 2008). These fungi are obligate pathogens with a global distribution especially in temperate regions of the northern hemisphere (Braun & Cook, 2012). Iran possesses one of the richest apiaceous floras in the world (Valiejo-Roman et al., 2006) and some of these species are susceptible to powdery mildew, including *Opsicarpium insignis*. This species is a perennial, endemic plant that grows to 150 cm high.

A powdery mildew fungus on leaves of *Opsicarpium insignis* was collected in October 2013, June 2018 and October 2020, in the Zagros Mountain, Oshtorankouh, western Iran (voucher specimen GUM 1735 deposited in the fungarium of the University of Guilan). Disease symptoms appeared as irregular white/grey patches on upper and lower leaf surfaces, and usually extended to the whole leaf (Figures 1–3). Microscopic examination showed primary conidia were lanceolate, in the



FIGURE 2 Upper (a) and lower (b) surface of infected leaf of *Opsicarpium insignis* (bar = 10 mm)

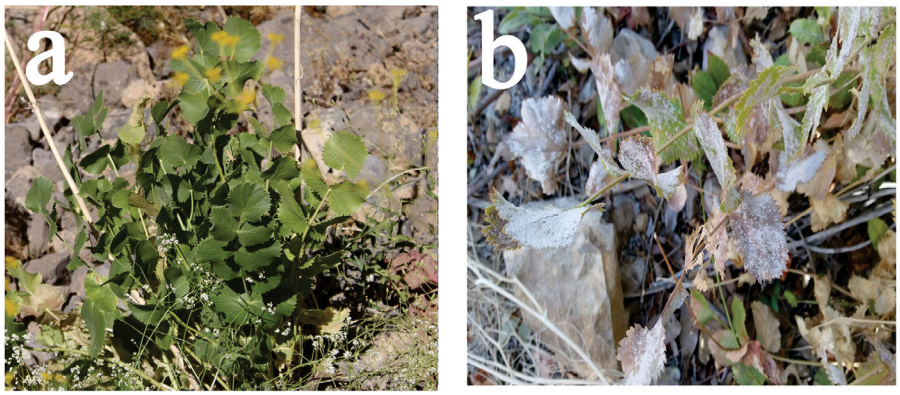


FIGURE 1 A healthy young plant of *Opsicarpium insignis* (a) and powdery mildew-infected plant (b), in the middle of June

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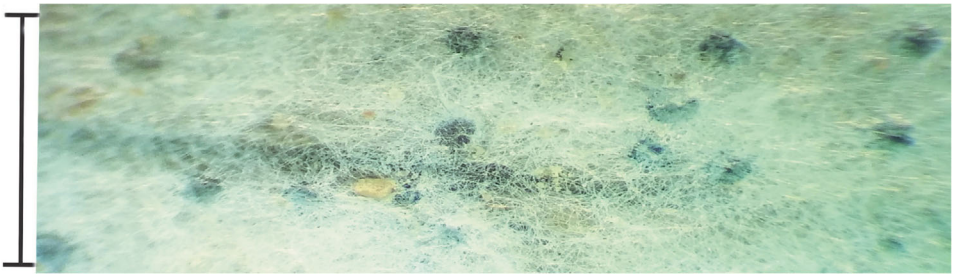


FIGURE 3 Chasmothecia and mycelia of *Leveillula taurica* on infected leaf of *Opsicarpium insignis* (bar = 1 mm)

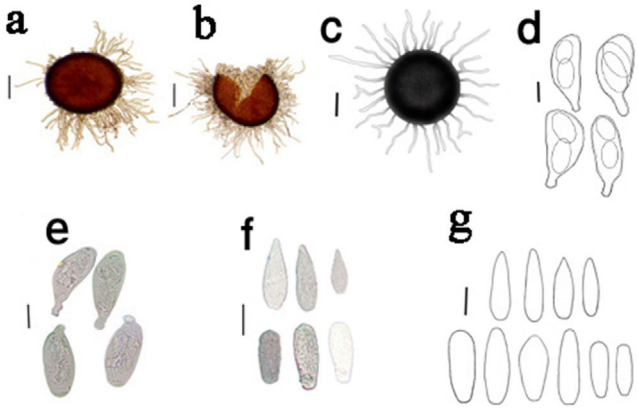


FIGURE 4 *Leviellula taurica*: Chasmothecia (a & c), opened chasmothecia and asci (b), asci and ascospores (d & e), and Conidia (f & g) (bar: a-c = 60 μm, d-g = 20 μm)

upper half narrowing towards the apex, and measured 14–18 × 42–54 μm, length/width ratio was 2.9-3, widest in the lower half or sometimes in the middle of conidia. Secondary conidia were cylindrical, sub cylindrical or somewhat clavate, and approximately as long as the primary conidia (12-24 × 37–54 μm). Chasmothecia were scattered to gregarious, (146-246 μm diameter). Appendages usually well developed, arose from the lower half of the chasmothecia and branched infrequently. Asci were numerous, about 22–27 per chasmocarp, elongate-ovoid to sub cylindrical, and measured 20–38 × 75–92 μm. Asci were stalked and two-spored. Ascospores were ovoid to ellipsoid, (12-18 × 42–54 μm) (Figure 4). Morphological characteristics were similar to that of *Leveillula taurica*, as described by Braun & Cook (2012).

To confirm the morphological identification, total DNA was extracted from mycelia using the Chelex method (Hirata & Takamatsu, 1996). The ITS1/ITS4 primer pair was used to amplify the ITS region (Cunnington et al., 2003) and the nucleotide sequences of resulting amplicons were obtained using direct sequencing. The sequence was edited using MEGA 7 (Edgar, 2004; Kumar et al., 2016) and deposited in GenBank (Accession No. KT221623). Sequences were compared with those in GenBank using BLASTN which confirmed the identification of *L. taurica* and showed >99% identity to sequences of *L. taurica* from *Capsicum annuum* in USA (GQ167201), and from *Coronilla varia* and *Lotus corniculata* in Iran. Nineteen GenBank sequences were selected for phylogenetic analyses based on their identity, along with three *Phylactinina guttata*, four *Podosphaera pannosa* and two *Sawadaea tulasnei* accessions as outgroups. The sequences were aligned using MUSCLE in MEGA 7 (Edgar, 2004) and a phylogenetic tree was obtained using the neighbour-joining method (Kumar et al., 2016) which confirmed the BLASTN results (Figure 5). To our knowledge this is the first record of powdery mildew on *Opsicarpium* globally.

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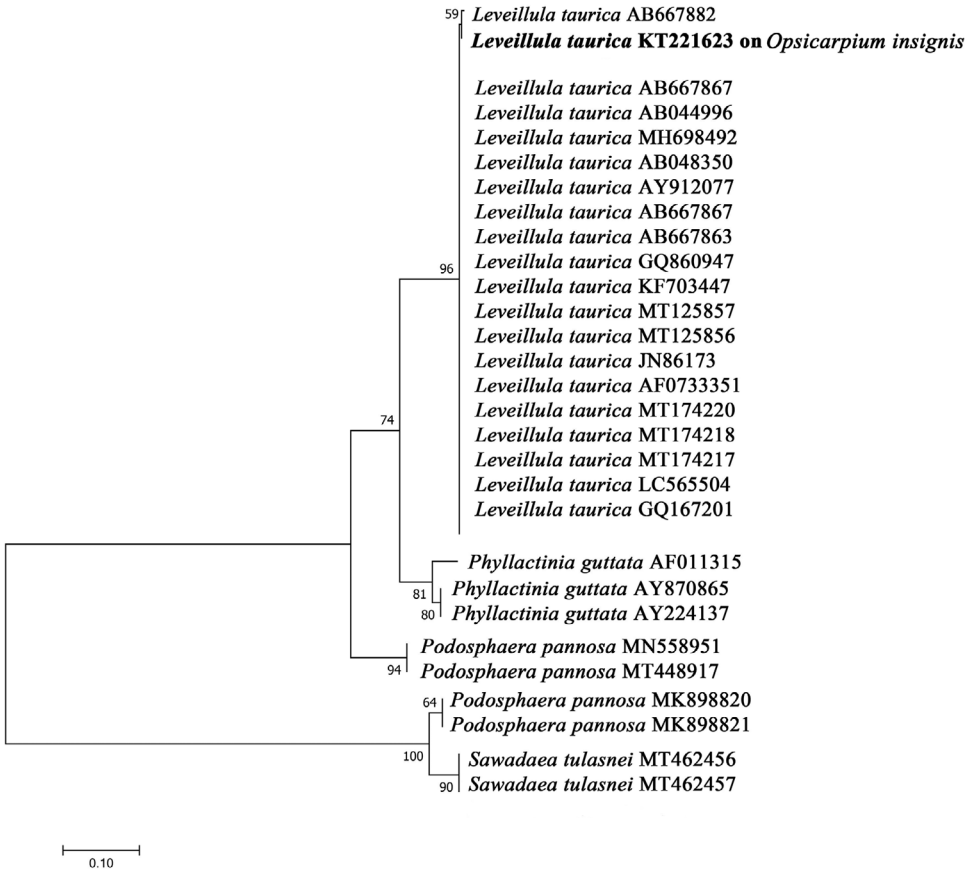


FIGURE 5 Phylogenetic tree based on the ITS sequences by neighbour-joining method for *Leviellula taurica* identified from *Opsicarpium insignis* in Zagros Mountain, Iran, and 28 ITS sequences of fungi causing powdery mildew in different plants published in GenBank

ORCID

M. Darvishnia https://orcid.org/0000-0002-5860-1330

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