

FULL PAPER

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Three new species of the genus *Leveillula* from Iran

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Abstract Based on molecular and morphological studies, *Leveillula guilanensis* sp. nov. on *Chondrilla juncea*, *L. lactucae-serriolae* sp. nov. on *Lactuca serriola*, and *L. mindii* sp. nov. on *Mindium laevigatum* are described from Iran.

Key words *Chondrilla* · *Lactuca* · *Leveillula* spp. · *Mindium* · Powdery mildew

Introduction

Comprehensive molecular examinations of *Leveillula* G. Arnaud collections have recently been carried out by Khodaparast et al. (2001), based on internal transcribed spacers (ITS) of the ribosomal DNA. These studies confirmed previous findings suggested by Golovin (1956) and Braun (1987), in which the anamorphic features of the fungus, especially the shape and size of primary conidia, are useful for the discrimination of species.

In this study, some of the taxa examined appeared to be genetically divergent from *Leveillula taurica* (Lév.) G. Arnaud and other species of this genus. Examinations of the holomorphs showed that collections on *Chondrilla juncea* L. and *Lactuca serriola* L., both in the family Asteraceae, and *Mindium laevigatum* (Vent.) Rech. f. &

Schiman-Czeika, in the Campanulaceae, represent three new species that are morphologically distinguishable from allied taxa.

Materials and methods

Powdery mildews belonging to genus *Leveillula* were collected in Iran during 1997 to 2000. The following taxonomic characteristics of the fungi have been observed: mycelial appearance and development on the surface of the infected host plants, conidial shape and size, cleistothecial shape and size, and number, size, and shape of appendages, asci, and ascospores. The measurements are based on microscopic examinations of 100 of each element mounted in lactic acid.

Results and discussion

Leveillula mindii Khodaparast & Hedjaroude, sp. nov.

Fig. 1

Mycelium ectogenum amphigenum in foliis vivis, densum, persistens, ex hyphis sparse ramosis 2–4 μm latis septatis hyalinis levibus compositum. Conidia primaria sparsa, cylindrica, apicem versus attenuata, 52–62 × 14–20 μm. Conidia secundaria cylindrica, utrinque rotundata, (45–)50–65 × 12–19 μm. Ascomata in mycelio immersa, globosa, 175–225 μm diameter. Appendices ex ascomate oriundae, infraequatoriales, saepe bene evolutae, ad 225 μm longae vel breviores, hyalinae vel dilute brunneae, 4–7(–8) μm latae, tenuitunicatae, leves, non vel modice ramosae. Asci numerosi, 14–41, stipitati, cylindrici vel ellipsoidei, 80–110 × 30–36 μm, 2-spori. Ascosporae ellipsoideo-cylindricae vel ovoideae, 30–38 × 16–20 μm, hyalinae.

Mycelium on living leaves, dense, amphigenous, persistent. Hyphae sparingly branched, 2–4 μm diameter, septate, hyaline, smooth. Primary conidia cylindrical, attenuated toward the apex, 52–62 × 14–20 μm, not abundant. Secondary conidia cylindrical, ends rounded, (45–)50–65 × 12–19 μm.

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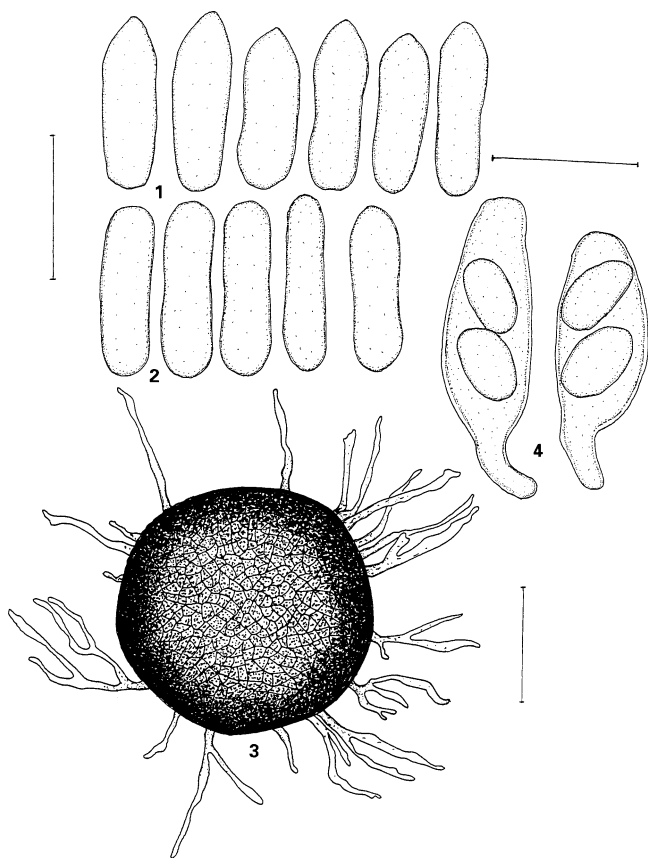


Fig. 1. *Leveillula mindii*. 1 Primary conidia. 2 Secondary conidia. 3 Ascoma. 4 Asci. Bars 1, 2, 4 50 μm ; 3 100 μm

Ascomata immersed in the dense mycelium, globose, 175–225 μm diameter. Appendages arising from the lower half of ascomata, usually well developed, about as long as the ascoma diameter or shorter, mycelioid, hyaline or faintly pigmented, 4–7(–8) μm diameter, thin walled, smooth, unbranched to moderately branched, aseptate. Asci numerous, 14–41 per ascoma, cylindrical to ellipsoid, stalked, 80–110 \times 30–36 μm , 2-spored. Ascospores ellipsoid-cylindrical or ovoid, 30–38 \times 16–20 μm , hyaline.

Holotype. On *Mindium laevigatum* (Vent.) Rech. f. & Schiman-Czeika (Campanulaceae), Iran, Karadj, June 26, 1974, M. Moosavi (IRAN 10909F).

Leveillula mindii is morphologically as well as genetically closely related to *L. rubiae* Khodaparast et al. on *Rubia tinctorum* L. (Khodaparast et al. 2000), but differs in having longer, simple to moderately branched, hyaline to faintly pigmented appendages, smaller ascospores, and an unrelated host plant family. Moreover, *L. rubiae* possesses an insertion site in its ITS rDNA region (Khodaparast et al. 2001). Durrieu and Rostam (1984) have recorded a *Leveillula* collection on *Campanula* sp. that is morphologically close to, and possibly identical with, *L. mindii*.

Leveillula guilanensis Khodaparast & Hedjaroude, sp. nov.

Mycelium ectogenum amphigenum in foliis vivis, album, in maculis densis, ex hyphis sparse ramosis septatis hyalinis 2–5 μm latis compositum. Conidia uniformia, cylindrica,

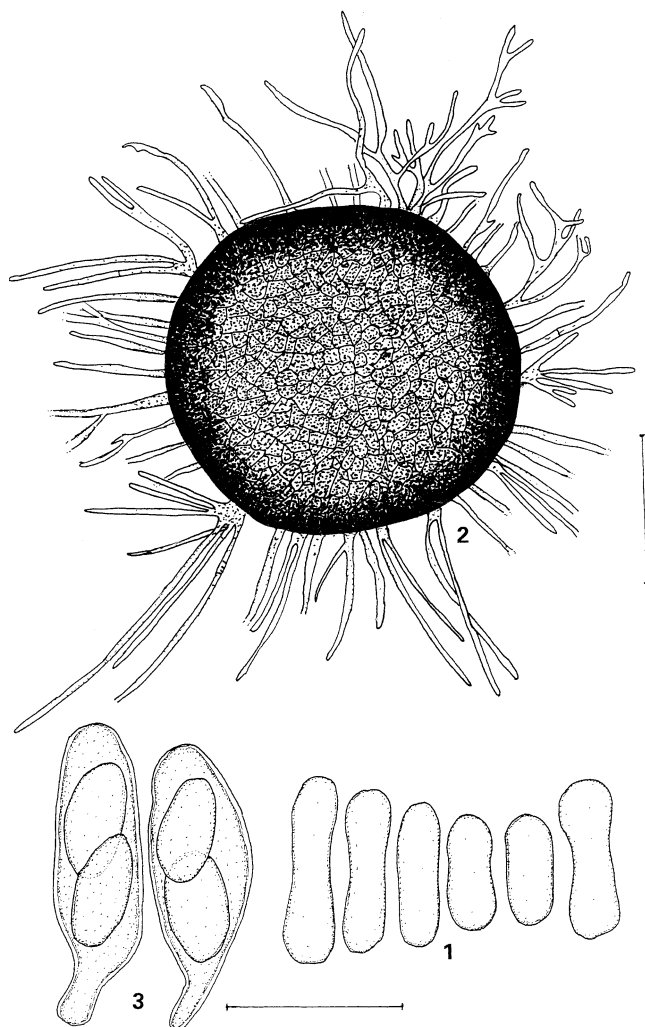


Fig. 2. *Leveillula guilanensis*. 1 Conidia. 2 Ascoma. 3 Asci. Bars 1, 3 50 μm ; 2 100 μm

utrinque rotundata, in medio saepe constricta, 43–57 \times 12–17 μm . Ascomata globosa, gregaria, in mycelio immersa, (150–)200–270(–290) μm diameter. Appendices numerosae, ex ascomate oriundae, infraequatoriales, saepe 200–270 μm longae, interdum longiores, 4–6 mm latae, mycelioides, hyalinae vel ad basim brunneae, tenuitunicatae, continuae vel septatae, leves, saepe ad basim pluriseptatae. Asci numerosi, 30–70, ellipsoidei vel ovoidei, stipitati, (60–)72–95 \times 24–35 μm , 2-sporei. Ascosporae ellipsoideae, ovoideae, 28–35(–37) \times 13–18 μm , hyalinae.

Mycelium on living leaves and stems, amphigenous, whitish, persistent, forming dense patches. Hyphae sparingly branched, septate, hyaline, 2–5 μm diameter. Only with a single type of conidia, cylindrical, ends rounded, and usually somewhat constricted in the middle, 43–57 \times 12–17 μm . Ascomata globose, gregarious, immersed in the dense mycelial tomentum, (150–)200–270(–290) μm diameter. Appendages numerous, in the lower half of the ascomata, about as long as the ascoma diameter or occasionally longer, 4–6 μm wide, mycelioid, hyaline or brownish at base, thin walled, with or without septa, smooth, usually strongly branched at the base. Asci numerous, 30–70

per ascoma, ellipsoid to ovoid, stalked, (60–)72–95 × 24–35 μm, 2-spored. Ascospores ellipsoid, ovoid, 28–35(–37) × 13–18 μm, hyaline.

Holotype. On *Chondrilla juncea* L. (Asteraceae), Iran, Guilan province, Rudbar, November 8, 1999, S.A. Khodaparast (IRAN 11443F).

In molecular examinations recently carried out by Khodaparast et al. (2001), the present *L. guilanensis* on *C. juncea* was included in a basal group together with *Leveillula* on *Acroptilon repens* (L.) DC. and *Artemisia annua* L. These taxa occurred at the base of the phylogenetic tree but did not form a clade. Durrieu and Rostam (1984) described *L. lactucarum* on *Lactuca* spp. as well as *Chondrilla juncea*. Heluta and Taran (1989) recorded *L. lactucarum* on *Artemisia* spp. as well as some additional composites. *Leveillula lactucarum* is well characterized by having subcylindrical primary conidia narrowed toward a pointed apex. The *L. guilanensis* from Iran differs from *L. lactucarum* in forming a single type of cylindrical conidia, not attenuated toward the apex, and ascomata with very numerous asci.

Leveillula lactucaae-serriolae Khodaparast & Hedjaroude, sp. nov.

Fig. 3 Mycelium ectogenum amphigenum in foliis vivis, album, densum, persistens, ex hyphis sparse ramosis 2–5 μm latis hyalinis levibus compositum. Conidia primaria lanceolata, apice acuta, 53–75 × 13–17(–18) μm, in ratione longitudinis/latitudinis 3.1–5 vel saepe 4.0–4.5. Conidia secundaria subcylindrica vel subclavata, apicem versus latiora, 49–75(–82) × 13–18 μm. Ascumata subgregaria vel dispersa, 187–225 μm diameter, in mycelio immersa. Appendices bene evolutae, numerosae, ex ascumate oriundae, infraequatoriales, irregulariter ramosae, ad 225 μm longae, 5–11 μm latae, non septatae, dilute brunneae, apicem versus pallidiorae, tenuitunicatae, leves. Asci numerosi, saepe 30–55, 85–103(–117) × 28–35 μm, stipitati, 2-sporei. Ascosporeae ellipsoideae, 30–40 × 15–20(–23) μm, hyalinae.

Mycelium on living leaves, amphigenous, whitish, dense, persistent. Hyphae sparingly branched, 2–5 μm diameter, septate, hyaline, smooth. Primary conidia lanceolate, apically pointed, 53–75 × 13–17(–18) μm, length/width ratio 3.1–5, mostly 4.0–4.5. Secondary conidia subcylindrical to subclavate, usually maximum width near the apex, long, 49–75(–82) × 13–18 μm. Ascumata subgregarious to scattered, globose, 187–225 μm diameter, immersed in the dense mycelial tomentum. Appendages well developed, numerous, on the lower half of the ascumata, irregularly branched, up to as long as ascum diameter or less, 5–11 μm in width, aseptate, light brown, paler toward the tips, thin walled, smooth. Asci numerous, usually 30–55 per ascumata, 85–103(–117) × 28–35 μm, stalked, 2-spored. Ascospores ellipsoid, 30–40 × 15–20(–23) μm, hyaline.

Holotype. On *Lactuca serriola* L. (Asteraceae), Iran, Karadj, October 14, 1999, S.A. Khodaparast (IRAN 11144F).

Leveillula lactucaae-serriolae is distinguished from *L. lactucarum*, previously described on *Lactuca* spp., by fairly long, lanceolate primary conidia and more or less subclavate secondary conidia. The primary conidia of *L.*

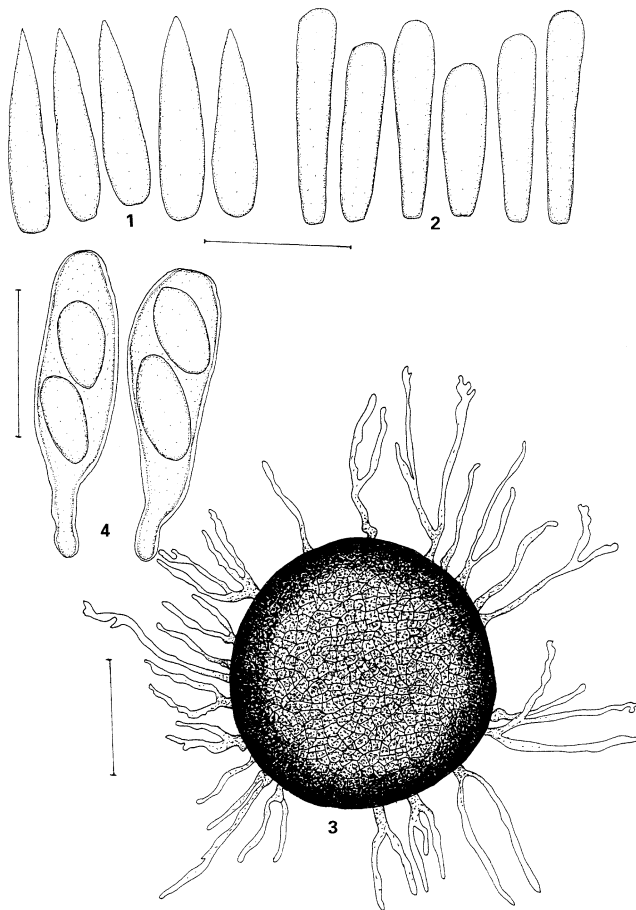


Fig. 3. *Leveillula lactucaae-serriolae*. 1 Primary conidia. 2 Secondary conidia. 3 Ascoma. 4 Asci. Bars 1, 2, 4 50 μm; 3 100 μm

taurica are morphologically similar to those of *L. lactucaae-serriolae*, but the latter species differs in having subclavate secondary conidia. In molecular examinations of *Leveillula* spp. recently carried out by Khodaparast et al. (2001), the present new taxon formed a separate clade together with *L. taurica* on *Cirsium arvense* (L.) Scop., which is, however, morphologically distinct from *L. lactucaae-serriolae*.

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