

## Additions to the knowledge of the genus *Cladosporium* in Iran

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**Abstract:** During an investigation on *Cladosporium* species associated with numerous substrates of various localities in Iran during 2011-13, eight species including *C. delicatulum*, *C. echinulatum*, *C. exile*, *C. macrocarpum*, *C. neriicola*, *C. pannosum*, *C. scabrellum* and *C. uredinicola* were identified based on the morphological characters. All these species are new records for the Iranian mycobiota, except for *C. echinulatum*, *C. macrocarpum* and *C. uredinicola*. Furthermore, *C. echinulatum* and *C. neriicola* are reported as plant pathogens, causing lesion and leaf spot of *Dianthus* sp. and *Nerium oleander*, respectively.

**Key words:** biodiversity, biotrophs, hyperparasite, hyphomycetes.

### INTRODUCTION

*Cladosporium* species are saprobes in soil or on decaying plant material, pathogenic on plants or hyperparasitic on other fungi (Ellis 1971, 1976; Mullins 2001; Heuchert et al. 2005; Bensch et al. 2012). Members of this genus have worldwide distribution. However, the exact geographical distribution and species composition of the genus is not known for many regions. The first reports of *Cladosporium* species in Iran dates back to Petrak (1939) who reported *C. herbarum* on *Dianthus orientalis* from Kurdistan (Ershad 2009). Other four species of this genus were later reported by Scharif & Ershad (1966). Since then, there have been several sporadic reports of *Cladosporium* species from various substrates in Iran (Zad 1979; Bujari & Ershad 1993; Soleimany et al. 1993; Rouhibakhsh & Ershad 1997; Saremi 1989; Taherzadeh et al. 1998; Doulaty-Baneh et al. 2000; Gooya et al. 2000; Asgari et al.

2004; Ahmadi & Sadravi 2008). In the recent years, based on the new taxonomic concept of this genus, Jam-Ashkezari et al. (2012) reported some endophytic species of *Cladosporium* from common yew (*Taxus baccata*). Amirmijani et al. (2013, 2014) also reported six species of *Cladosporium* as new records from Iran based on the morphological characters and ITS sequences data. The present study constitutes five new records of *Cladosporium* to the mycobiota of Iran.

### MATERIALS AND METHODS

Eighteen isolates were collected from different substrates such as air, living leaves of plants, decaying structures of plants, dead insects and contaminated rust or powdery mildew fungi from some regions including Guilan, Hamedan, Mazandaran and Markazi provinces in Iran, during 2011–13. Cultural characteristics were recorded from cultures grown on 2 % malt-extract agar (MA, Merck, Germany) and synthetic nutrient-poor agar (SNA) incubated at 24 °C in the dark for one week (Crous et al. 2009; Bensch et al. 2010, 2012). Preparations of all collections were provided in 50% Lactic acid and their morphological characteristics were studied using light microscopy (Olympus BH2, Japan) based on the natural substrates or living cultures. Measurements were made using 10-30 conidiophores and 50 conidia. Photographs were taken for each specimen using a BH2 Olympus microscope equipped with a Sony Digital Camera. All specimens examined are deposited at Mycological Herbarium and Culture Collection of the University of Guilan (GUM), Rasht, Iran.

### RESULT AND DISCUSSION

In the present study, eight species of *Cladosporium* including *C. delicatulum*, *C. echinulatum*, *C. exile*, *C. macrocarpum*, *C. neriicola*, *C. pannosum*, *C. scabrellum* and *C. uredinicola* were identified that are all illustrated and briefly described here.

*Cladosporium delicatulum* Cooke, Grevillea 5(33): 17. (1876).

Colonies on SNA with immersed, rarely superficial mycelium, hyphae unbranched or rarely branched, (1–)2–4(–4.5) µm wide, septate, subhyaline to pale brown, smooth. Conidiophores solitary, arising terminally and laterally from hyphae, erect,

cylindrical-oblong, not swollen, unbranched, occasionally with short branches, (63–)75–90(–100)  $\times$  2.5–3  $\mu\text{m}$ , 1–3-septate, pale brown to brown, smooth, sometimes minutely verruculose at the base, walls unthickened. Conidiogenous cells integrated, often terminal, 12–35  $\mu\text{m}$  long, with 2–3(4) hila crowded at the apex, sometimes denticulate, 1.5–2  $\mu\text{m}$  diam. Ramoconidia cylindrical-oblong, 19–30  $\times$  2.5–3.5(–4)  $\mu\text{m}$ , 0–1-septate, base 2–3  $\mu\text{m}$  wide. Conidia numerous and catenate, up to four conidia in the terminal unbranched part of the chain, small terminal conidia obovoid or slightly subglobose, 3.5–4.5(–5)  $\times$  (2–)2.5–3  $\mu\text{m}$ , aseptate; intercalary conidia ellipsoid to ovoid, 5–10 (–12)  $\times$  (2.5–)3–4  $\mu\text{m}$ , 0(–1)-septate, up to 4 distal hila; secondary ramoconidia subcylindrical or cylindrical, (8–)12–24(–30)  $\times$  3–4(–4.5)  $\mu\text{m}$ , 0–1(–2) septate, not constricted at septa, pale brown, smooth, walls unthickened, with up to 4(–5) distal hila; hila conspicuous, 1–1.5(–2)  $\mu\text{m}$  diam, thickened and darkened. Microcyclic conidiogenesis not observed (Fig. 1).

Cultural characteristics — Colonies on MEA reaching 4–4.6 cm diam after 7-days, flat with radial furrows in the center, olive-green, margins white,

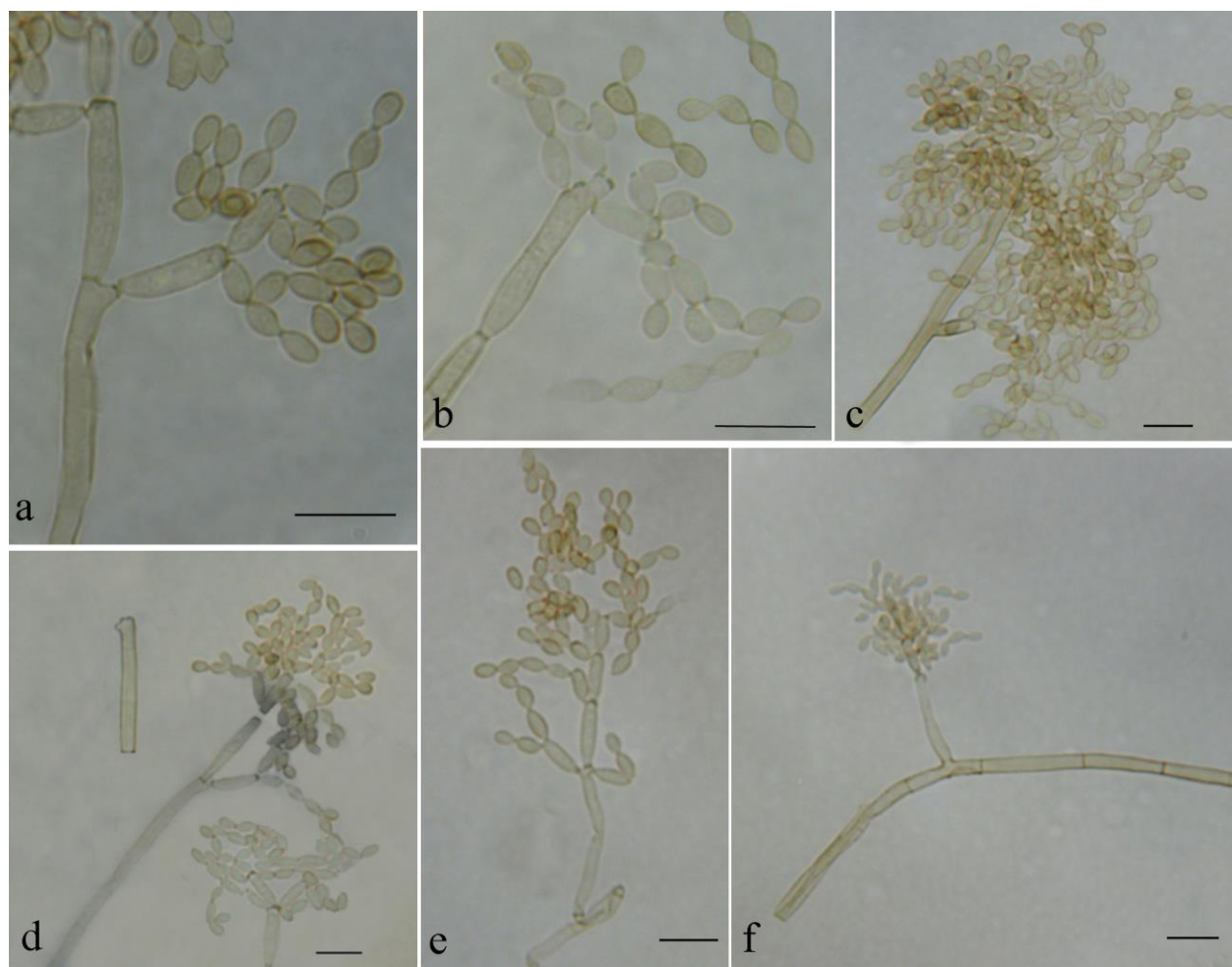
reverse dark-green, aerial mycelium not crowded; sporulation few to abundant.

*Specimens examined.* IRAN, Hamedan Province, Hamedan, saprobic on dead *Thrips* sp., 5 Nov. 2013, *H. Amanellahi*, GUM 146C.

The specimen examined in this study had the same characters of *C. delicatulum* described by Bensch et al. (2012), except its intercalary (vs. 17.5  $\mu\text{m}$ ) and terminal conidia (vs. 6  $\mu\text{m}$ ) were shorter. *Cladosporium delicatulum* belongs to *Cladosporium cladosporioides* species complex and is differentiated from the closest species *C. cladosporioides* by having 0–1-septate intercalary conidia and secondary ramoconidia, and also the conidia in the terminal unbranched part of conidial chains (Bensch et al. 2012). This is the first report of this species from Iran.

*Cladosporium echinulatum* (Berk.) G.A. de Vries, Contr. Knowl. Genus *Cladosporium*: 49. (1952).

On living leaves and calyxes of *Dianthus* sp., leaf spots amphigenous, circular to irregular, up to 18 mm diam, center white to gray, surrounded by a purple or purple-red margin. Colonies amphigenous, scattered to caespitose, brown, mycelium immersed.



**Fig. 1.** *Cladosporium delicatulum*. **a.** Conidiogenous cell; **b.** Conidia; **c.** Short branches of conidiophore; **d.** Ramoconidium; **e.** Conidiophore and conidia; **f.** Semi-macronematous conidiophores. — Scale bars = 10  $\mu\text{m}$ .

Conidiophores loosely fasciculate, arising from stromata, more or less flexuous and geniculate, unilaterally and bilaterally swollen, unbranched, up to  $150 \times 7.5\text{--}9\text{--}(11) \mu\text{m}$ , swellings up to  $(10\text{--})12\text{--}14 \mu\text{m}$  wide, septate, not constricted at septa, brown, smooth, walls thickened. Conidiogenous cells integrated, terminal and intercalary, sympodial, up to  $45\text{--}(65) \mu\text{m}$ , conidiogenous loci more or less protuberant,  $(1.5\text{--})2\text{--}2.5 \mu\text{m}$  wide, somewhat darkened. Conidia solitary or in short and unbranched chains, mostly of two types: small conidia ellipsoid to subcylindrical,  $8\text{--}10\text{--}(14) \times 6.5\text{--}8 \mu\text{m}$ , 0(–1)-septate, smooth to minutely verruculose, pale brown; large conidia ellipsoid to cylindrical, often soleiform,  $18\text{--}43\text{--}(53) \times (9\text{--})11\text{--}13\text{--}(15) \mu\text{m}$ , up to six septa, somewhat septa appearing curved and sinuous, brown, distinctly verrucose, walls thickened, often appearing two-layered, conidial hila up to  $2.5\text{--}(3) \mu\text{m}$  wide, thickened and darkened. Microcyclic conidiogenesis not observed (Fig. 2).

*Specimens examined.* IRAN, Guilan Province, Siahkal, on living leaves and calyxes of *Dianthus* sp., 19 June 2011, M. Salimi, GUM 1353; Guilan Province, Rasht, on living leaves and calyxes of *Dianthus* sp., 7 Aug. 2011, A. R. Amirmijani, GUM 1351; Markazi Province, Mahalat, on living leaves and calyxes of *Dianthus* sp., 6 Feb. 2013, J. Bagheri, GUM 1352.

The specimens examined in this study had the same characters of *C. echinulatum* as described by David (1997) and Bensch et al. (2012). However, the specimens examined by David (1997) and Bensch et al. (2012) had smooth to distinctly verruculose conidiophores, often swollen at the base and microcyclic conidiogenesis occurred. In the meanwhile, the small, 0(–1)-septate conidia  $8\text{--}10 \times (6.5\text{--}8 \mu\text{m})$  observed in our specimens have not been previously reported.



**Fig. 2.** *Cladosporium echinulatum*. a. Conidiophores; b. Small Conidia and soleiform conidia; c. leaf spots on *Dianthus* sp. — Scale bars =  $10 \mu\text{m}$ .

*Cladosporium exile* Bensch, Glawe, Crous & U. Braun, Stud. Mycol. 67: 43. (2010).

Colonies on SNA with immersed and slightly superficial mycelium, hyphae often unbranched or scarcely branched, 2–3.5(–4)  $\mu\text{m}$  wide, septate, sometimes constricted at septa and slightly swollen, 4–5  $\mu\text{m}$  wide, subhyaline to pale brown, especially where conidiophores are formed, smooth, walls unthickened. Conidiophores arising terminally and laterally from hyphae, solitary, straight to slightly geniculate, unbranched, rarely with one branch below a septum, 23–133(–150)  $\times$  (2.5–)3–4  $\mu\text{m}$ , somewhat slightly wider at the base, up to 6(–7)  $\mu\text{m}$  wide, mostly 1–4-septate, brown, sometimes paler towards the apex, smooth to minutely verruculose at the base, walls thickened. Conidiogenous cells integrated, terminal, cylindrical-oblong, sometimes geniculate, up to 40  $\mu\text{m}$  long, with up to five loci, loci crowded at the apex, 1–1.5  $\mu\text{m}$  diam, slightly darkened. Ramoconidia cylindrical-oblong, 12–32(–38)  $\times$  2.5–3.5(–4)  $\mu\text{m}$ , 0–1-septate, base 2.5–3  $\mu\text{m}$  wide, unthickened. Conidia numerous and catenate, up to four or five conidia in the unbranched terminal part of the chain, small terminal conidia mostly obovoid, (2.5–)3.5–4(–5)  $\times$  2–2.5(–3)  $\mu\text{m}$ ; intercalary conidia ovoid to ellipsoid, (5–)7–9  $\times$  2.5–3(–3.5)  $\mu\text{m}$ , aseptate, with up to 2(–3) distal hila; secondary ramoconidia ellipsoid to subcylindrical or cylindrical, with up to three apical hila, (9–)10–29(–33)  $\times$  (2.5–)3–4  $\mu\text{m}$ , 0–1-septate, not constricted at septa, subhyaline to pale brown, smooth, walls unthickened, hila 1–1.5(–2)  $\mu\text{m}$  diam., somewhat darkened. Microcyclic conidiogenesis sometimes occurring (Fig. 3).

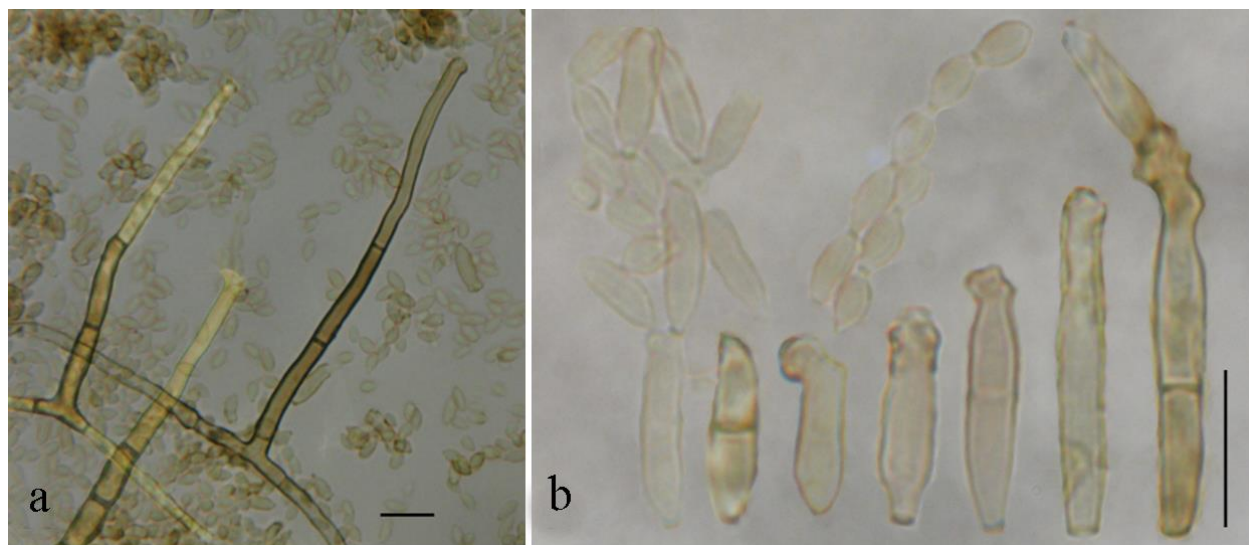
Cultural characteristics — Colonies on MEA, 4.5–5 cm diam. after one week, sometimes with radial furrows in the center, olive green, margins white, reverse dark olive green, aerial mycelium low; sporulation abundant.

*Specimens examined.* IRAN, Guilan Province, Somesara, on dead *Aphis* sp., 18 June 2012, S.A. Khodaparast, GUM 1355.

*Cladosporium exile*, belonging to *C. cladosporioides* s. l., morphologically resembles *C. cladosporioides* s. s. The latter species has smooth, longer and wider conidiophores and conidia (Bensch et al. 2010, 2012). Morphology of the specimen examined in this study was concordant with the description provided by Bensch et al. (2010, 2012). However, long conidiophores (up to 305  $\mu\text{m}$ ) were absent in the Iranian specimens. This is the first report of this species from Iran.

*Cladosporium macrocarpum* Preuss, in Sturm, Deutsch. Fl. 3(26): 27. (1848).

Colonies on SNA with immersed and superficial mycelium, unbranched or rarely branched, 2–5  $\mu\text{m}$  wide, septate, sometimes slightly constricted at septa, pale brown, smooth, walls unthickened. Conidiophores mostly arising terminally and sometimes laterally from hyphae, solitary (*in vivo* fasciculate), straight to distinctly geniculate, with several uni- and bilateral swellings in short and irregular distances, unbranched, up to 300  $\mu\text{m}$  long and 4–5.5(–6)  $\mu\text{m}$  wide, swellings 6–10(–11)  $\mu\text{m}$  wide, with several septa, brown, smooth to minutely verruculose, walls somewhat thickened, sometimes appearing two-layered. Conidiogenous cells integrated, terminally or intercalary, geniculate-sinuous, conidiogenous loci confined to swellings, up to 49  $\mu\text{m}$  long, with up to 10(–11) loci per cell, (1–)1.5–2  $\mu\text{m}$  diam, somewhat darkened. Ramoconidia not observed. Conidia numerous and catenate, up to 4 conidia in the unbranched terminal part of the chain, small terminal conidia subglobose, obovoid or ellipsoid, 5–7(–9)  $\times$  4–6  $\mu\text{m}$ , aseptate, intercalary conidia ellipsoid,



**Fig. 3.** *Cladosporium exile*. **a.** Conidiophores; **b.** Small terminal and intercalary conidia, secondary ramoconidia and ramoconidia. — Scale bars = 10  $\mu\text{m}$ .

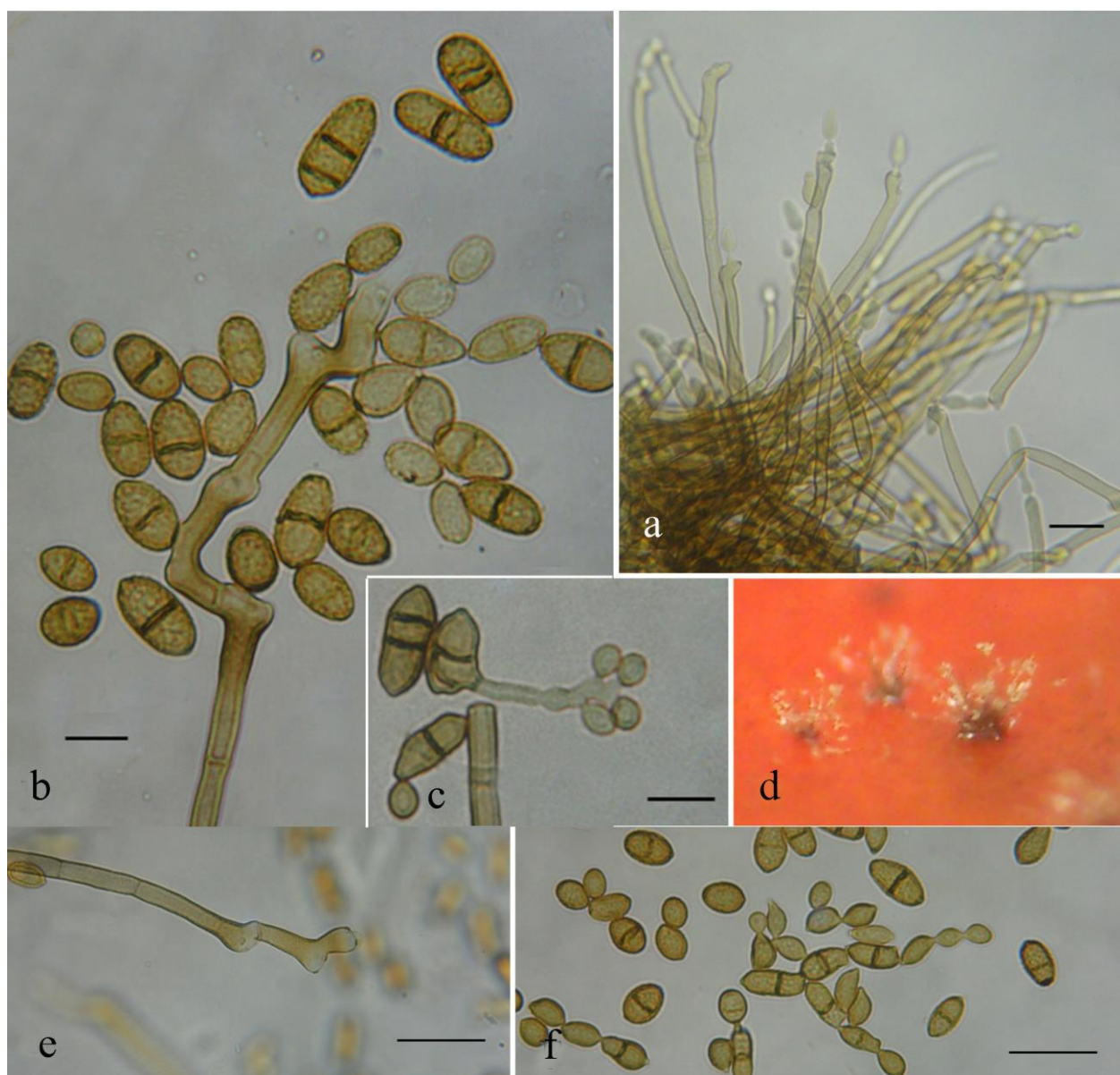
fusiform, 10–16(–18) × (–5)6–9 μm, 0–1(–2)-septate; secondary ramoconidia ellipsoid, subcylindrical to cylindrical, 14–25(–27) × (5–)6–8(–9) μm, 0–3-septate, septa somewhat appearing two-layered and slightly sinuous, brown, distinctly verruculose, walls thickened, with 2–3 apical hila, hila protuberant, 1–2 μm diam, somewhat thickened and darkened. Microcyclic conidiogenesis occurring (Fig. 4).

Cultural characteristics — Colonies on MEA, up to 3 cm diam. after one week, dark olive green, margins white, reverse black, aerial mycelium low; sporulation abundant.

*Specimens examined.* IRAN, Guilan Province, Rasht, saprobic on fruit of tomato (*Lycopersicon esculentum*), 25 Oct. 2012, A.R. Amirmijani, GUM 147C; Guilan Province, Rasht, saprobic on fallen dead leaves, 21 May 2012, A.R. Amirmijani, GUM

148C; Guilan Province, Parash-kooch, saprobic on wilted leaves of *Citrus sinensis*, 18 Aug. 2012, A.R. Amirmijani, GUM 149C; Guilan Province, Ziabar, saprobic on fruit of apple (*Malus domestica*), 25 Dec. 2012, A. Heidari, GUM 150C.

*Cladosporium macrocarpum* is a very common and widespread saprobic species (Bensch et al. 2010, 2012), already reported from Iran (Ershad, 2009). This species is morphologically close to *C. herbarum*, but is finely distinguished by having wider swellings of conidiophores (5–10 μm) and broader, more frequently septate conidia. Morphology of the specimens examined in this study agreed with the specimen examined by Bensch et al. (2010, 2012). However, the conidiogenous cells of the Iranian specimens were longer (vs. 12–37 μm long).



**Fig. 4.** *Cladosporium macrocarpum*. **a.** Conidiophores *in vivo*; **b.** Conidiophores *in vitro*; **c.** Microcyclic conidiogenesis; **d.** Colony on fruit of *Solanum lycopersicum*; **e.** Protuberant hila of conidiogenous cell; **f.** Branched chains of conidia. — Scale bars = 10 μm.

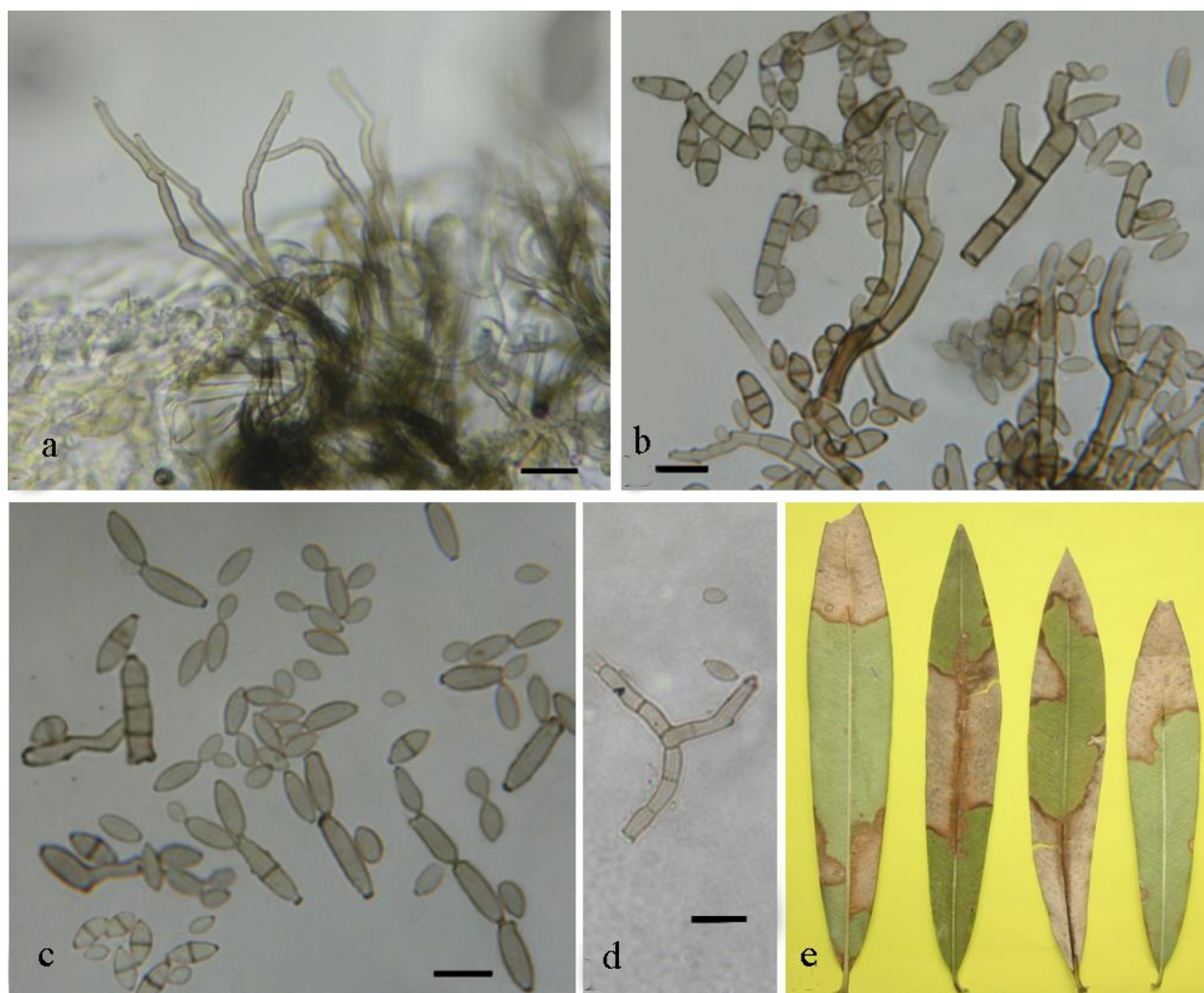
*Cladosporium neriiicola* S.A. Khan & M.A. Kamal, Mycopathol. Mycol. Appl. 52(1): 33. (1974).

On tips and margins of living leaves of *Nerium oleander*, center gray to pale brown, surrounded by a brown margin, colonies growing on the underside of leaves, punctiform and scattered, dark brown to dark brown-black. Mycelium internal, somewhat external, hyphae branched, 2.5–3.5  $\mu\text{m}$  wide, septate, slightly constricted at septa, pale brown, smooth, walls slightly thickened. Stromata well-developed, up to 40  $\mu\text{m}$  diam., dark brown to black. Conidiophores of two types: solitary, arising laterally from external hyphae, or mostly in loose groups arising from stromata, straight or slightly flexuous to distinctly geniculate, sometimes branched, (11–)14–95(–120)  $\times$  (2.5–)3–4.5(–5)  $\mu\text{m}$ , up to 10 septa, mostly 4–7-septate, pale to brown, somewhat slightly paler towards the apex, smooth, walls thickened. Conidiogenous cells integrated, terminal or intercalary, up to 26(–30)  $\mu\text{m}$  long, with 1–2 to several conidiogenous loci, 1–2(–2.5)  $\mu\text{m}$

diam., somewhat thickened and darkened. Ramoconidia not observed. Conidia numerous and catenate, up to 3(–4) conidia in the unbranched terminal part of the chain, small conidia obovoid, up to 3–6(–7)  $\times$  2.5–4  $\mu\text{m}$ , aseptate, rarely 1-septate, smooth, gray. Intercalary conidia ellipsoid, cylindrical-oblong, (6–)7–11(–13)  $\times$  (–3)4–4.5  $\mu\text{m}$ , with 1–2 septa, pale gray to brown, smooth to faintly verruculose. Secondary ramoconidia cylindrical, 15–26(–28)  $\times$  (–3.5)4–5(–5.5)  $\mu\text{m}$ , mostly with 3–4 conspicuous and denticulate hila; hila measuring 1–2(–2.5)  $\mu\text{m}$  diam, thickened and darkened. Microcyclic conidiogenesis occurring (Fig. 5).

*Specimens examined.* IRAN, Guilan Province, Rasht, on living leaves of *Nerium oleander*. 21 Apr. 2012, A.R. Amirmijani, GUM 1354.

Conidiophores and conidiogenous cells of the Iranian specimens were slightly longer than those reported by Schubert (2005) and Bensch et al. (2012) (vs. up to 100 and 25  $\mu\text{m}$  long, respectively), with microcyclic conidiogenesis occurring. This is the first report of this fungus from Iran.



**Fig. 5.** *Cladosporium neriiicola*. **a.** Conidiophores in stromata; **b.** Branches of conidiophore and secondary ramoconidia; **c.** Conidia; **d.** Solitary conidiophore arising from creeping hyphae; **e.** Leaf spots on *Nerium oleander*. — Scale bars = 10  $\mu\text{m}$ .

*Cladosporium pannosum* Cooke, Grevillea 12(61): 24. (1883).

Colonies on SNA with immersed and superficial mycelium; hyphae unbranched or rarely branched, (2–)2.5–4(–4.5)  $\mu\text{m}$  wide, septate, constricted at septa, subhyaline to brown, smooth. Conidiophores solitary, occasionally arising laterally from swollen hyphal cells, straight to slightly geniculate, unbranched, up to  $120 \times (2\text{--}3\text{--}4\text{--}5) \mu\text{m}$ , 0–3(–5)-septate, brown, somewhat paler towards the apex, smooth, walls slightly thickened; conidiogenous cells integrated, terminally and intercalary, up to 35  $\mu\text{m}$  long, sympodial, loci 1–1.5  $\mu\text{m}$  wide. Conidia numerous and catenate, up to 4 conidia at terminal unbranched part of the chain; small terminal conidia obovoid,  $4\text{--}5 \times 2\text{--}2.5\text{--}3) \mu\text{m}$ , aseptate; intercalary conidia ellipsoid, limoniform,  $6\text{--}10\text{--}11) \times (2.5\text{--}3\text{--}4\text{--}4.5) \mu\text{m}$ , aseptate; secondary ramoconidia ellipsoid-ovoid to cylindrical,  $(10\text{--})12\text{--}28 \times 3\text{--}4\text{--}5) \mu\text{m}$ , 0 (–1) septa, non-constricted at septa, pale brown, smooth, with up to 7 hila, crowded at the

apex, hila 1–1.5(–2)  $\mu\text{m}$  diam. Microcyclic conidiogenesis occurring (Fig. 6).

Cultural characteristics — Colonies on MEA, 5.5 cm diam. after one week, olive-green, margins narrow, white, reverse dark-green to black, aerial mycelium absent; sporulation abundant.

*Specimens examined.* IRAN, Guilan Province, Rasht, from air, 14 May 2013, A.R. Amirmijani, GUM 151C; Mazandaran province, Noshahr, saprobic on dead leaves, 26 Aug. 2012, A.R. Amirmijani, GUM 152C.

The specimens examined in this study slightly deviated from *Cladosporium pannosum* (Heuchert et al. 2005, Bensch et al., 2012) by possessing shorter conidiogenous cells (vs. 35  $\mu\text{m}$  long) and more slender conidia (vs. 4 (–5)  $\mu\text{m}$  wide). *Cladosporium pannosum* is close to *C. cladosporioides* (Bensch et al. 2012). However, it is finely distinguished by having intercalary conidiogenous cells, often with numerous hila and geniculate conidiophores. This fungus is new to the Iranian mycobiota.



**Fig. 6.** *Cladosporium pannosum*. **a.** Conidiophores and microcyclic conidiogenesis (arrow); **b.** Conidia; **c.** Secondary ramoconidia with several hila. — Scale bars = 10  $\mu\text{m}$ .

*Cladosporium scabrellum* Bensch, Schroers, Crous & U. Braun, Stud. Mycol. 67: 75. (2010).

Colonies on SNA with immersed mycelium, hyphae unbranched, up to 4(–5)  $\mu\text{m}$  wide, septate, sometimes slightly constricted at septa, subhyaline to pale brown, smooth, walls unthickened. Conidiophores often arising laterally from hyphae, solitary, erect, straight, cylindrical-oblong, unbranched, 40–70(–95)  $\times$  3–4  $\mu\text{m}$ , somewhat swollen at the base, 4–5  $\mu\text{m}$  wide, septate, not constricted at septa, pale brown to brown, smooth, walls slightly thickened. Conidiogenous cells integrated, mainly terminal, cylindrical-oblong, up to 34  $\mu\text{m}$  long, with 3–4 loci at the apex, conspicuous, slightly denticulate, 1–1.5  $\mu\text{m}$  diam., more or less thickened and darkened. Ramoconidia cylindrical-oblong, 19–30  $\times$  3–4, base 2–2.5  $\mu\text{m}$  wide, brown, smooth. Conidia numerous and catenate, up to 4 conidia (rarely 5 or 6 conidia) in the unbranched terminal part; small terminal conidia subglobose to obovoid, 3.5–4.5  $\times$  2–2.5(–3)  $\mu\text{m}$ , aseptate; intercalary conidia limoniform, fusiform, ellipsoid, (6–)7–9(–11)  $\times$  (2–)3–3.5  $\mu\text{m}$ , 0–1-septate, mostly 2–3 distal hila, secondary ramoconidia ellipsoid to cylindrical, 9–20(–22)  $\times$  3–4  $\mu\text{m}$ , 0–1-septate, with up to 4 distal hila, pale brown, smooth, walls unthickened, hila conspicuous, 1–1.5  $\mu\text{m}$  diam., somewhat thickened and darkened. Microcyclic conidiogenesis not observed (Fig. 7).

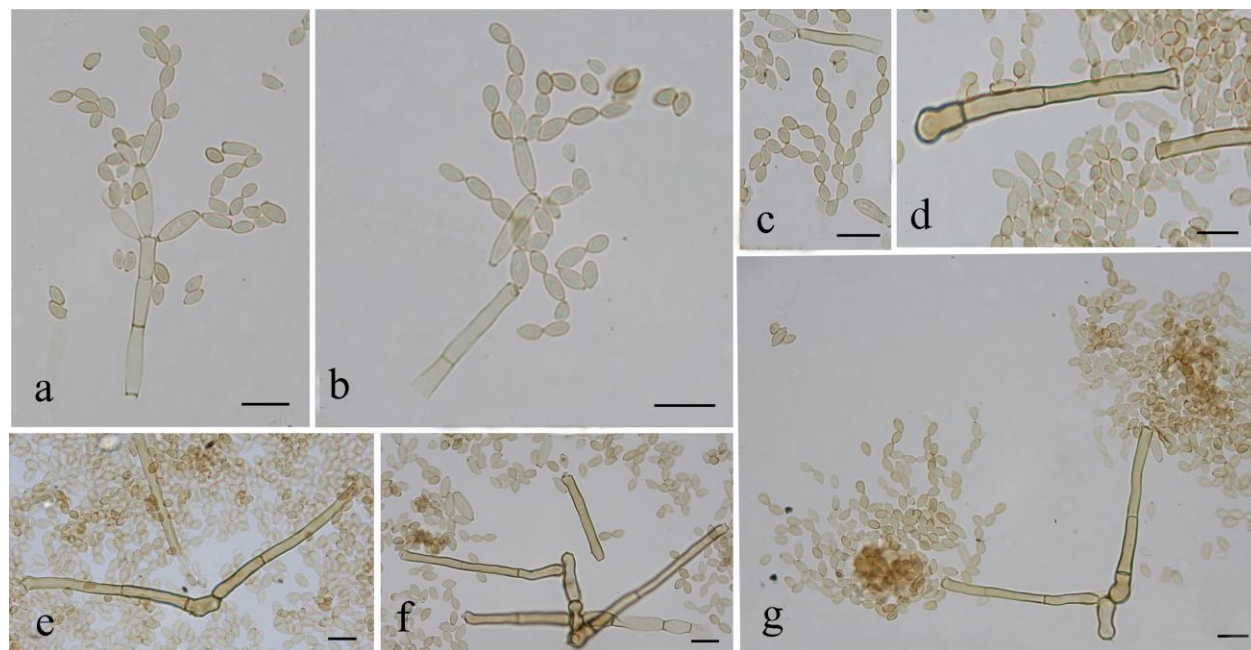
Cultural characteristics — Colonies on MEA, 5 cm diam. after one week, brown, with radial furrows in the center, margins slightly irregular, white, reverse dark brown to black, aerial mycelium low; sporulation abundant.

*Specimens examined.* IRAN, Guilan Province, Masal, on fallen dead leaves, 18 Oct. 2011, A.R. Amirmijani, GUM 153C; Hamedan Province, Hamedan, on leafhopper, 5 Nov. 2013, H. Amanellahi, GUM 154C.

*Cladosporium scabrellum* belongs to *C. cladosporioides* s. l. and morphologically resembles *C. cladosporioides* s. str. Nevertheless, Bensch et al. (2010) showed that these two species are phylogenetically quite distinct. *Cladosporium scabrellum* is well-differentiated from *C. cladosporioides* by forming long dense hyphal ropes, and having shorter conidiophores and numerous smooth or mostly indistinctly asperulate conidia (Bensch et al. 2010, 2012). The Iranian specimens had shorter conidiophores (vs. 185  $\mu\text{m}$ ), ramoconidia (34  $\mu\text{m}$ ) and secondary ramoconidia (vs. 25  $\mu\text{m}$ ) compared to those examined by Bensch et al. (2010, 2012). In the meanwhile, no dense rope and asperulate conidia were observed in our specimens. This is the first report of this species from Iran.

*Cladosporium uredinicola* Speg., Anales Mus. Nac. Hist. Nat. Buenos Aires 23: 122–123. (1912).

Colony on the rust fungi and powdery mildews fungi, dark olive green, loose to dense, mycelium often immersed, somewhat partly superficial and interweaving between rust teliospores, hyphae branched, up to 4.5(–5)  $\mu\text{m}$  wide, septate, faintly constricted at septa, pale brown, smooth, walls unthickened, particularly when growing on teliospores, producing to the inflated, thick-walled, brown, chlamydospore-like cells. Conidiophores



**Fig. 7.** *Cladosporium scabrellum*. **a, b.** Conidiogenous cell and conidia; **c.** Branched chains of conidia; **d., g.** Conidiophore with swollen at the base; **e.** Conidiophores without swollen base; **f.** Ramoconidia. — Scale bars = 10  $\mu\text{m}$ .



solitary, often arising laterally from hyphae or inflated, chlamyospore-like cells, or somewhat aggregated in loose groups, straight to slightly flexuous, unilaterally branched,  $(10-20-200 \times 2.5-4(-5) \mu\text{m})$ , mostly up to  $100 \mu\text{m}$  long, septate, not constricted at septa, medium brown or brown, smooth to minutely verruculose, walls slightly thickened. Conidiogenous cells integrated, terminal and less often intercalary, cylindrical, up to  $48 \mu\text{m}$  long, slightly sympodial, with 3-4 protuberant loci,  $1-1.5(-2) \mu\text{m}$  diam. Ramoconidia not observed. Conidia usually in short branched chains, small terminal conidia mostly subglobose to obovoid,  $4-5 \times 3-4 \mu\text{m}$ , aseptate, smooth, intercalary conidia ellipsoid to somewhat limoniform,  $6-13(-18) \times 3-4.5(-5) \mu\text{m}$ , 0-1-septate, medium brown, smooth, walls slightly thickened, secondary ramoconidia cylindrical,  $10-38 \times 3-5(-6.5) \mu\text{m}$ , 0-2(-3)-septate, without any constriction, brown, occasionally somewhat wider at the apex, with up to 4 distal hila; hila protuberant, denticulate,  $1-1.5 \mu\text{m}$  diam., darkened and more or less thickened. Microcyclic conidiogenesis occasionally occurring (Fig. 8).

*Specimens examined.* IRAN, Guilan Province, Siahkal road, hyperparasitic on telium of *Puccinia buxi*, 16 May 2013, A.R. Amirmijani, GUM 1358; Guilan Province, Siahkal, Shemshad garden, hyperparasitic, on telium of *Puccinia buxi*, 16 May 2013, A.R. Amirmijani, GUM 1356; Guilan Province, Rasht, hyperparasitic on telium of *Phragmidium* sp. on *Rubus caesius*, 25 Dec. 2013, A.R. Amirmijani, GUM 1357; Guilan Province, Rasht, hyperparasitic on *Oidium* sp. on *Euonymus japonica*, 25 July 2004, S. A. Khodaparast, GUM 1032.

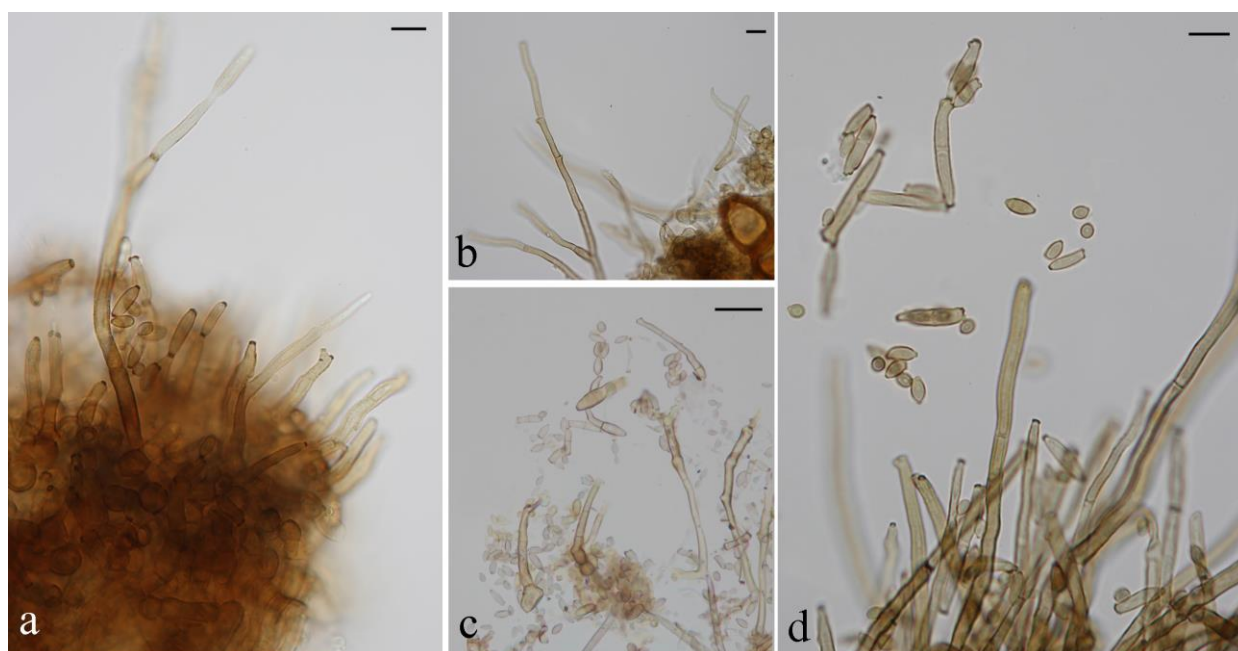
*Cladosporium uredinicola* belongs to *C. cladosporioides* s. l. phylogenetically, and is similar to *C. pseudocladosporioides* (Bensch et al. 2010). However, it is well-differentiated from the latter species in having longer conidiophores and the wider and more frequently septate conidia (Morgan-Jones & McKemy, 1990). Morphology of the specimens examined in this study agreed with the description provided by Morgan-Jones & McKemy (1990); although, there were some differences with the description provided by Heuchert et al. (2005) and Bensch et al. (2012). Indeed, the Iranian specimens had shorter conidiophores (vs.  $300 \mu\text{m}$ ) and conidiogenous cells (vs.  $75 \mu\text{m}$ ). In addition, the inflated chlamyospore-like cells have not been reported by Heuchert et al. (2005) and Bensch et al. (2012).

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**Fig. 8.** *Cladosporium uredinicola*. **a.** Conidiophore arising from inflated, chlamyospore-like cells (on *Puccinia buxi*); **b.** Unilateral branches of conidiophore; **c.** Microcyclic conidiogenesis on powdery mildews; **d.** Conidiophores and secondary ramoconidia on *Puccinia buxi*. — Scale bars a,b,c =  $10 \mu\text{m}$  and c =  $20 \mu\text{m}$ .

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## اطلاعات جدید از جنس کلادوسپوریوم در ایران

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**چکیده:** طی انجام تحقیقی در مورد وضعیت گونه‌های *Cladosporium* مرتبط با سوبستراهای مختلف در ایران، تعداد هشت گونه شامل گونه‌های *C. delicatulum*، *C. echinulatum*، *C. exile*، *C. macrocarpum*، *C. neriicola*، *C. pannosum* و *C. uredinicola* با استفاده از ویژگی‌های ریخت شناسی شناسایی شد. تمامی این گونه‌ها به غیر از *C. macrocarpum*، *C. echinulatum* و *C. uredinicola* برای فلور قارچ‌های ایران جدید می‌باشند. علاوه بر این، دو گونه *C. echinulatum* و *C. neriicola* به ترتیب به عنوان قارچ‌های بیماری‌زا روی گل میخک (*Dianthus* sp.) و خرزهره (*Nerium oleander*) گزارش می‌شوند که از طریق آلودگی بافت‌های زنده گیاهی سبب ایجاد لکه برگگی و زخم می‌شوند.

**واژه‌های کلیدی:** بیوتروف، تنوع زیستی، هایپرپارازیت، هیفومیست