

New records of citrus sooty mold fungi from North of Iran

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Abstract: Sooty molds are a group of fungi with dark-coloured hyphae, which grow saprophytically on various living plant organs and sometimes on non-living substrates and produce brown to black superficial colonies, black pellicles or pseudoparenchymatous crust. In north of Iran including Guilan and Mazandaran provinces, sooty molds are common on living leaves of a great variety of plants especially *Citrus* spp. There are a few sporadic reports of sooty mold fungi from Iran in the literature. In continuation of an earlier investigation, sooty molds from different citrus species collected from western parts of Mazandaran province and specimens obtained from fungal collection at University of Guilan were studied. As a result, five mitosporic species viz., *Chaetobolisia falcata*, *Cylindroxiphium virginianum*, *Fumiglobus citrinus*, *Fumiglobus foedus* and *Polychaeton tenellum*, and one ascomyceteous species *Phaeosaccardinula epicarpa*, were identified as causal agents of sooty mold on citrus plants in this region. According to the literature, all of the above mentioned taxa are new to Iran mycobiota.

Keyword: *Cylindroxiphium*, *Fumiglobus*, *Chaetobolisia*, *Phaeosaccardinula*, *Polychaeton*, taxonomy

Introduction

Sooty molds represent different fungi belonging to the anamorphic and teleomorphic ascomycetes, living on plant surfaces as saprobes (Kwee 1988). These fungi are common on the leaves, stems, twigs and sometimes fruits of many crops in regions with tropical, humid subtropical or temperate climate such as occur in Guilan and Mazandaran, north of Iran. This region is characterized by high rainfalls and rich fungal diversity. Sooty mold fungi are often associated with honeydew which insects secrete while feeding on the plant, but they can also occur without them (Hughes 1976). Scale insects and aphids are abundant on citrus trees which provide a good habitat for sooty molds. There is considerable evidence

that most sooty molds display no host preference, however some evidences show that particular species may be restricted to certain or a few related hosts (Hughes 1976).

The monographic literature on these fungi extends back to over 50 years ago (Batista 1959, Batista and Ciferri 1962; 1963a, b), however, taxonomy of the sooty mold fungi is much complicated for which there are several reasons that are discussed by Hughes (1976) and Reynolds and Gilbert (2005, 2006).

In north of Iran including Guilan and Mazandaran provinces, sooty molds are common on living leaves of a great variety of plants especially *Citrus* spp. There are a few brief reports of sooty mold fungi from Iran in the literature (Ershad 2009). The only comprehensive study of sooty mold fungi in Iran has been by Khodaparast (2006). He reported nine species of these fungi just from Guilan province viz. *Trichomerium grandisporum*, *Polychaeton artocarpi*, *Aithaloderma ferrugineum*, *Conidiocarpus penzigi*, *C. caucasicus*,

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Tripospermum roupalae, *Leptoxyphium* sp., *Chaetasbolisia microglobulosa* and *Polychaeton* sp. all on citrus. The objective of this study was to investigate the species diversity of sooty mold fungi in a wider area of citrus orchards in north of Iran. This paper reports only part of results that relate to our findings on this group of molds on citrus species.

Materials and Methods

Infected plant materials were initially examined visually using stereomicroscope for mycelial appearance and development. Fungal structures were mounted in 50% lactic acid and examined using a BH2 Olympus light microscope equipped with a Sony digital Camera (DSC-HX1). Measurements were taken in lactic acid (50%) mounts, based on at least 25-30 conidiophores, conidia, etc. Morphological characters of fungal structures including hyphal type, conidia and conidiomata, ascoma, asci and ascospores, when and if present were studied.

Identifications of the taxa were based on the keys and descriptions available in several sources including Kwee (1988), Hughes (1976) Batista, and Ciferri (1962; 1963a, b), Reynolds (1999, 2000, 2010), Reynolds and Gilbert (2005, 2006), Von Arx and Muller (1975) and some other related papers cited in the references. Species descriptions, photographs of the conidiophores and conidia, ascoma, asci and etc. are provided. All collected specimens were deposited in the fungal collection of the Department of Plant Protection, College of Agriculture, University of Guilan. Reference numbers are presented in parentheses after collector name.

Result and discussion

In this study, six species were determined. Brief descriptions of identified taxa are presented.

Chaetasbolisia falcata V. A. M. Mill. & Bonar, University of Calif. Publ. Bot. 19: 413 (1941)

Colonies composed of a network of pale brown hyphae. Hyphae are composed of subcylindrical to cylindrical cells which vary in size. Pycnidia globose, sessile, superficial or

partially immersed, ostiole rounded, up to 20-35 (-50) μm in diam., with rigid, brown-black setae around ostioles, setae right to curved, continuous, 4-14 in number, 20-40 \times 4-7 μm , pycnidiospores hyaline, subcylindric to bacillar, non septate, 3.5-6 \times 1.5-2 μm (Fig. 1 A-D)

Specimen examined: On *Citrus sinensis*, Langroud, Guilan province, S. A. Khodaparast, 14 Aug. 2012 (942).

Cylindroxylum virginianum Bat. & Cif., **Quad. Lab. crittogam., Pavia 31: 77 (1963)**

Mycelium epiphyllous, superficial, made of brown hyphae irregularly branched, septate, constricted, composed of cylindrical cells. Pycnidia superficial on the mycelium, 80-130 μm high with a more or less cylindrical, short or long stalk, the stalk expands into an ellipsoidal or obovoid conidiogenous zone. Pycnidial wall pseudoparenchymatous, composed of several cell layers. Some scattered cells of the wall around the ostiole have developed dark brown to almost black thick-walled, nonseptate, subulate, straight, setae which are 13-30 μm long and 2.5-5 μm wide (Fig 2A). Conidia are hyaline, ellipsoid to bacillar, 2.5-4.5 \times 1.5-2.5 μm .

Specimen examined: On *Citrus sinensis*, Nashtarood, Mazandaran province, F. Byrami, 16 June. 2012 (937).

Fumiglobus citrinus (Bat. & Cif.) D. R. Reynolds & G. S. Gilbert, **Cryptogamie Mycologie, 27 (3): 254 (2006)**

Mycelium epiphyllous, blackish, hyphae brown, composed of an irregular network. Pycnidia pyriform to globoid, superficial on the mycelium, gregarious, brown, 25-91 \times 22-75 μm , wall composed of polygonal cells (Fig. 2B). Pycnidiospores cylindrical, continuous, hyaline, 2.5-5 \times 1.2-2.5 μm (Fig. 2C).

Hughes (1976) considered the name *Asbolisia* as dubious. Reynolds and Gilbert (2006) created the name *Fumiglobus* to accommodate this ambiguity and recognized the concept for the genus as defined by Batista and Ciferri (1963b) for *Asbolisia*.

Specimen examined: On *Citrus sinensis*, Ramsar, Mazandaran province, S. A. Khodaparast, 22 Jun. 2003 (951).

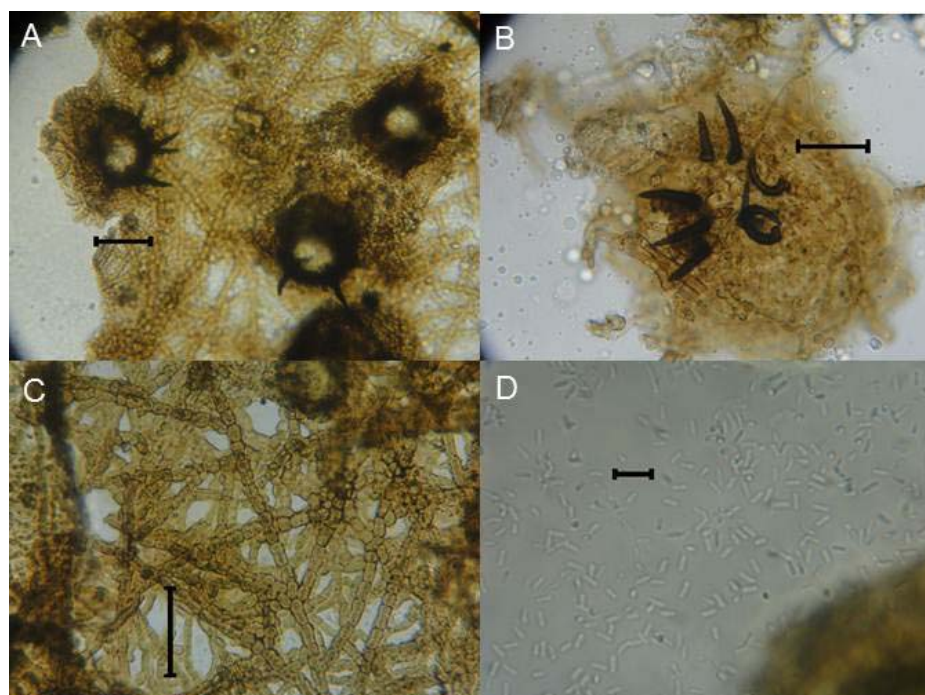


Figure 1 *Chaetabolisia falcata*: Pycnidia, with conspicuous ostiole (A), scale bar = 50 µm, Pycnidium with rigid, curved setae (B), scale bar = 20 µm Hyphal network (C), scale bar = 50 µm Conidia (D), scale bar = 10 µm.

***Fumiglobus foedus* (Sacc.) D. R. Reynolds & G. S. Gilbert, Cryptogamie Mycologie, 27 (3): 254 (2006)**

Mycelium superficial, brownish, hyphae septate, constricted, composed of cells $7.5-15 \times 3-6$ µm. Pycnidia subglobose, sessile, gregarious, 35-79 µm in height, 51-70 µm wide, with walls made up of polygonal cells. Pycnidiospores globose, hyaline, 2.5-3 µm (Fig. 3 A and B).

Specimen examined: On *Citrus sinensis*, Ramsar, Mazandaran province, H. Pedramfar, 27 Mar. 2011 (944).

***Polychaeton tenellum* (Sacc.) D. R. Reynolds, Gdns' Bull., Singapore 61 (2): 422 (2010)**

Mycelium epiphyllous, superficial, formed by irregularly branched, septate brown hyphae, hyphae composed of cylindrical or oblong cells. The short stalk varies from broad cylindrical to ellipsoid. Pycnidia superficial, 70-150 µm long, 13-60 µm wide at the base and 20-60 µm wide at the top, 35-50 µm cylindrical swelling. Pycnidiospores hyaline, ellipsoid to bacillar, $2.5-4.5 \times 1.2-2$ µm (Fig. 4)

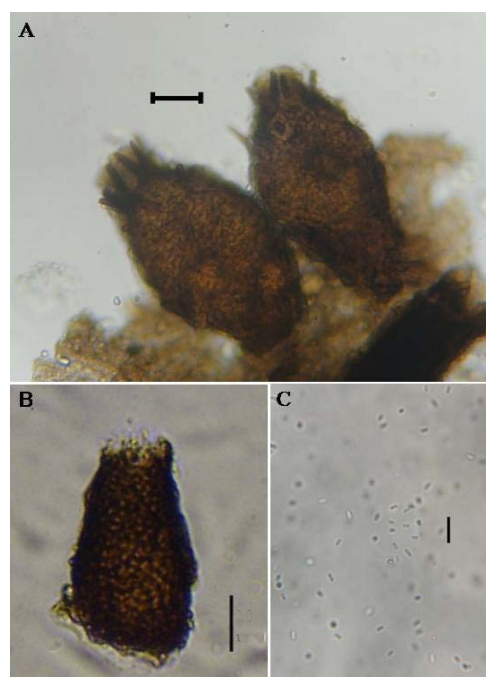


Figure 2 *Cylindroxiphium virginianum*: Pycnidia, scale bar = 20 µm (A), *Fumiglobus citrinus*, pycnidium (B) Conidia (C), scale bar for B and C = 10 µm.

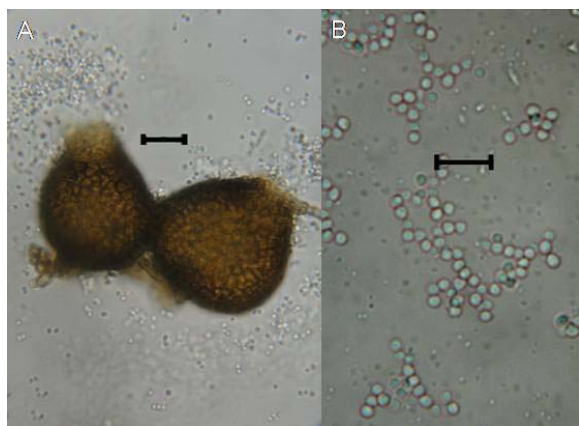


Figure 3 *Fumiglobus foedus*: Pycnidia, scale bar = 20 µm (A), Conidia, scale bar = 10 µm (B).

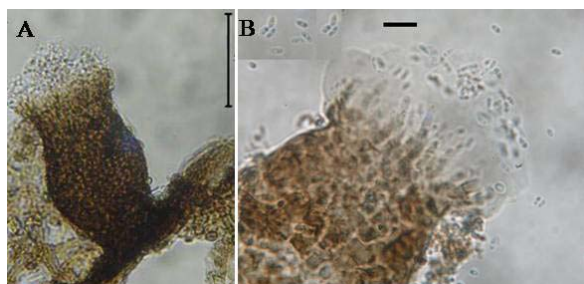


Figure 4 *Polychaeton tenellum*: Pycnidium, scale bar = 50µm (A), Terminal part of pycnidium and conidia, scale bar =10 µm (B).

According to Batista and Ciferri (1963b) this fungus was identified as *Microxiphium atmosphaericum*. Several species have been described as *Microxiphium* (= *Microxyphium*) in Batista and Ciferri (1963b), most of them are synonyms of *Polychaeton* (Reynolds 2010).

Specimens examined: On *Citrus sinensis*, Nashtarood, 16 June 2011 (945), Ramsar 20 Nov. 2011 (949), Tonekabon, 20 Nov. 2010 (948); on *Rubus* sp., Ramsar 20 Nov. 2011 (946), on *Phytolacca americana*, Ramsar 20 Nov. 2011 (947), F. Byrami.

***Phaeosaccardinula epicarpa* Bat., Nasc. & Cif. (1962)**

Mycelium superficial, blackish brown, pelliculose, composed of cylindric hyphae with subglobose cells, constricted, nonsetose. Perithecia developed beneath the mycelial pellicle. Perithecia globose to subglobose, 160-230 µm diam, with pseudo-ostiole, glabrous, blackish brown, nonsetose. Asci ellipsoid, 6-8

spores, sessile, 50-74 × 24-36 µm, aparaphysate. Ascospores ellipsoid, muriform, transversely with 5-7 and 1-4 longitudinal septa, at first hyaline, then yellowish- brown, 25-45 µm long and 6-15 µm wide (Fig. 5).

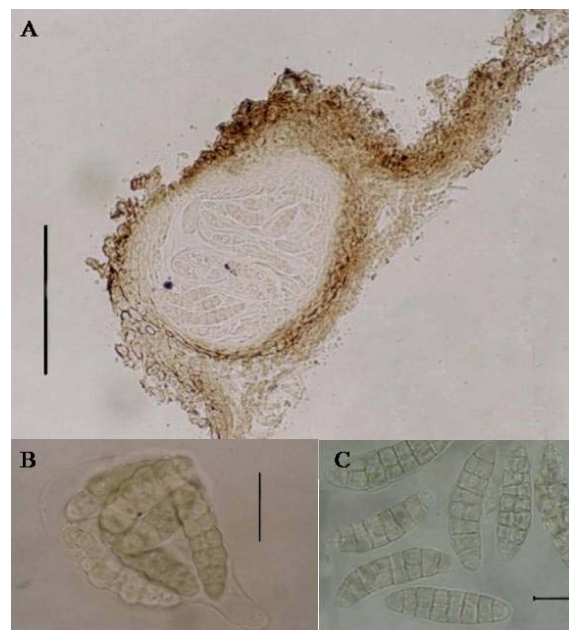


Figure 5 *Phaeosaccardinula epicarpa* cross section of ascoma, scale bar=100 µm (A), Asci with six ascospores, scale bar=20 µm (B), Ascospores, scale bar =10 µm (C).

Specimens examined: On *Citrus sinensis*, Sumaehsara 18 May 2003 (952), Lahijan, 20 July 2003 (953), 20 May 2003 (954), 7 June 2004 (956), Roodsar, 20 July 2003 (955); Ramsar, 14 May 2007 (943), S. A. Khodaparast.

Acknowledgments

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گزارش آرایه‌های جدید از قارچ‌های مولد دوده مرکبات از شمال ایران

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چکیده: در ادامه شناسایی قارچ‌های مولد دوده مرکبات در شمال ایران، نمونه‌های متعددی از غرب استان مازندران جمع‌آوری و همراه با نمونه‌های موجود در هرباریوم دانشگاه گیلان بررسی شدند. در این بررسی پنج گونه قارچ میتوسپوریک شامل *Cylindroxyphium virginianum*، *Chaetasbolisia falcata*، *Fumiglobus foedus*، *Fumiglobus citrinus* و *Polychaeton tenellum* و یک گونه آسکومیست به نام *Phaeosaccardinula epicarpa* شناسایی شدند. گونه‌های شناسایی شده در این مقاله به‌طور مختصر توصیف می‌شوند. کلیه گونه‌ها برای میکوبیوتای ایران جدید می‌باشند.

واژگان کلیدی: تاکسونومی، *Phaeosaccardinula*، *Chaetasbolisia*، *Fumiglobus*، *Cylindroxyphium*، *Polychaeton*