

Additions to the knowledge of smut fungi (*Ustilaginomycetes*) of Iran اطلاعات جدیدی در مورد قارچ‌های مولد سیاهک (*Ustilaginomycetes*) در ایران

Received: 21.11.2010 / Accepted: 29.12.2010

دریافت: ۱۳۸۹/۸/۳۰ / پذیرش: ۱۳۸۹/۱۰/۸

K. Vánky: Researcher, Herbarium Ustilaginales Vánky (HUV), Gabriel-Biel-Str. 5, D-72076 Tübingen, Germany

M. Abbasi✉: Research Associate Prof., Department of Botany, Iranian Research Institute of Plant Protection, P.O. Box 1454, Tehran 19395, Iran (E-mail: puccinia_2000@yahoo.com)

S. Samadi: Former M.Sc. student, Department of Biology, Faculty of Science, Tehran University, Tehran, Iran

کلمن ونکی: محقق هرباریوم HUV، توبینگن، آلمان

مهرداد عباسی✉: دانشیار پژوهش بخش تحقیقات

رستنی‌ها، موسسه تحقیقات گیاه‌پزشکی کشور، صندوق

پستی ۱۴۵۴، تهران ۱۹۳۹۵

(E-mail: puccinia_2000@yahoo.com)

سحر صمدی: دانشجوی سابق کارشناسی ارشد دانشکده

زیست‌شناسی، پردیس علوم، دانشگاه تهران، تهران

Abstract

Five smut fungi viz. *Microbotryum scorzonerae* on *Scorzonera caliculata*, *Sporisorium aristidae-lanuginosae* on *Stipagrostis plumosa*, *Sporisorium desertorum* on *Lasiurus indicus*, *Sporisorium foveolati* on *Dichanthium foveolatum*, and *Sporisorium vanderystii* on *Hyparrhenia hirta* are reported for the first time for Iranian mycobiota. *Sporisorium foveolati* is also probably new to Asia. *Bellevalia saviczii* is also reported as a new host for *Antherospora tourneouxii*. The latter species was previously known from Iran as *Vankya vaillantii* on *Bellevalia glauca*. All recorded species are redescribed and illustrated by microphotographs.

Keywords: Fungus, biodiversity, taxonomy

چکیده

در این بررسی، پنج گونه سیاهک شامل: *Microbotryum scorzonerae* روی *Scorzonera caliculata*، *Sporisorium aristidae-lanuginosae* روی *Stipagrostis plumosa*، *Sporisorium desertorum* روی *Lasiurus indicus*، *Sporisorium foveolati* روی *Dichanthium foveolatum* و *Sporisorium vanderystii* روی *Hyparrhenia hirta* به عنوان اعضای جدید برای میکوبیوتای ایران گزارش می‌شوند. با توجه به منابع در دسترس، به نظر می‌رسد این اولین گزارش از وجود *Sporisorium foveolati* در آسیا باشد. گونه *Antherospora tourneouxii* که قبلاً با نام *Vankya vaillantii* از ایران گزارش شده بود، به طور مشروح معرفی و همچنین گیاه میزبان *Bellevalia saviczii* به عنوان میزبان جدیدی برای *Antherospora torneouxii* در دنیا گزارش می‌شود.

واژه‌های کلیدی: قارچ، تنوع زیستی، تاکسونومی

Introduction

The first report about smut fungi was given by Rabenhorst (1871), who reported *Tilletia sorghi-vulgaris* Tul. & C. Tul. (= *Sporisorium sorghi* Ehrenb. ex Link) on *Sorghum* from Avroman mountain. Since 1871 many reports and papers have been published about Iranian smut fungi by Iranian and foreign scientists (Ershad 2009). The most important work is the monograph of Iranian smut fungi was written by Ershad (2001).

During the last ten years the generic and species concept of smut fungi and also their suprafamilial classification have been changed considerably. Several smut fungi, new to Iran were also discovered. Some misidentifications were also published in Iranian literature about smut fungi. For these reasons, a fresh revision of the smut mycobiota of Iran is much needed.

Materials and Methods

The present study was based on herbarium and newly collected specimens. The morphology of the spores was studied using an Olympus BH2 light microscope (all microphotographs were taken with a G5 Canon Camera attached to an Axiophot Zeiss microscope). Voucher specimens were deposited in the fungal reference collection of the Ministry of Jihad-e-Agriculture (IRAN) at the Iranian Research Institute of Plant Protection, Tehran.

Results and Discussion

Antherospora tourneouxii (A.A. Fisch. Waldh.) R. Bauer, M. Lutz, Begerow, Piątek & Vánky, in Bauer, Lutz, Begerow, Piątek, Vánky, Bacigálová & Oberwinkler, Mycol. Res. 112: 1302 (2008)

Sori in all deformed, globose flowers of an inflorescence, in the anthers and on the surface of inner floral organs, producing blackish brown, powdery spore mass, for a long time enclosed by the outermost floral envelopes. Spores ovoid, ellipsoidal, elongate, often bent, usually irregular, rarely subglobose, 6.5–8 × (5.5–)6.5–17(–17.5) μm, yellowish brown; wall even, c. 0.5 μm thick, finely and densely punctate-verruculose, spore profile smooth to finely wavy (Fig. 1).

On *Hyacinthaceae* (*Liliaceae* s. lat.): *Bellevalia saviczii* Woronow, Kermanshah province, Ravansar toward Paveh, 17 km SE of Paveh, S slope of Shahu mount, 2200 m, 15.5.2006, coll. M. Abbasi, R. Fritsch & M. Keusgen, IRAN 14782 F, HUV 21824.

Smut fungus in the anthers of *Bellevalia trifoliata* was known since long time under the name of *Ustilago vaillantii*, described from Egypt. Recently, Bauer *et al.* (2008), using molecular phylogenetic and ultrastructural evidences, demonstrated that anther smuts of Monocots belong to a different, new genus, described as *Antherospora* R. Bauer, M. Lutz, Begerow, Piątek & Vánky. The smut on *Bellevalia* belongs to this genus. This species has previously been reported from Iran as *Vankya vaillantii* (Tul. & C. Tul.) Ershad (Ershad 2000, 2001).

Microbotryum scorzonerae (Alb. & Schwein.) G. Deml & Prillinger, in Prillinger, Deml, Dörfler, Laaser & Lockau, Bot. Acta 104: 10 (1991)

Sori in flower heads transforming the florets into blackish violet, powdery spore mass. Infection systemic. Spores globose, subglobose, ovoid to slightly irregular or sometimes elongate, 9–15(–16) × 11–15(–17) μm, pale brownish violet, often with a light-coloured, nearly hyaline area on one side; wall finely reticulate, 8–12 meshes per spore diam., muri 1–1.5 μm high, in SEM a few warts appear on the lower part of the muri and interspaces. Spore germination of *Ustilago*-type (Fig. 2).

On *Asteraceae*: *Scorzonera caliculata* Boiss., Kermanshah province, Ravansar toward Paveh, 17 km SE of Paveh, S slope of Shahu mount, 2200 m, 15.5.2006, coll. M. Abbasi, R. Fritsch & M. Keusgen, IRAN 14786 F, HUV 21825.

Microbotryum scorzonerae is a new member of the Iranian mycobiota.

Sporisorium aristidae-lanuginosae (Maire) Vánky, Mycotaxon 78: 304 (2001)

Sori comprise the whole inflorescence destroying all of them in a plant, ovoid with acute tip, c. 0.5 × 1 cm, partly hidden by leaf sheaths, initially covered by a



Fig. 1. *Antherospora tourneouxii* on *Bellevalia saviczii*, spores (Bar = 10 μ m).

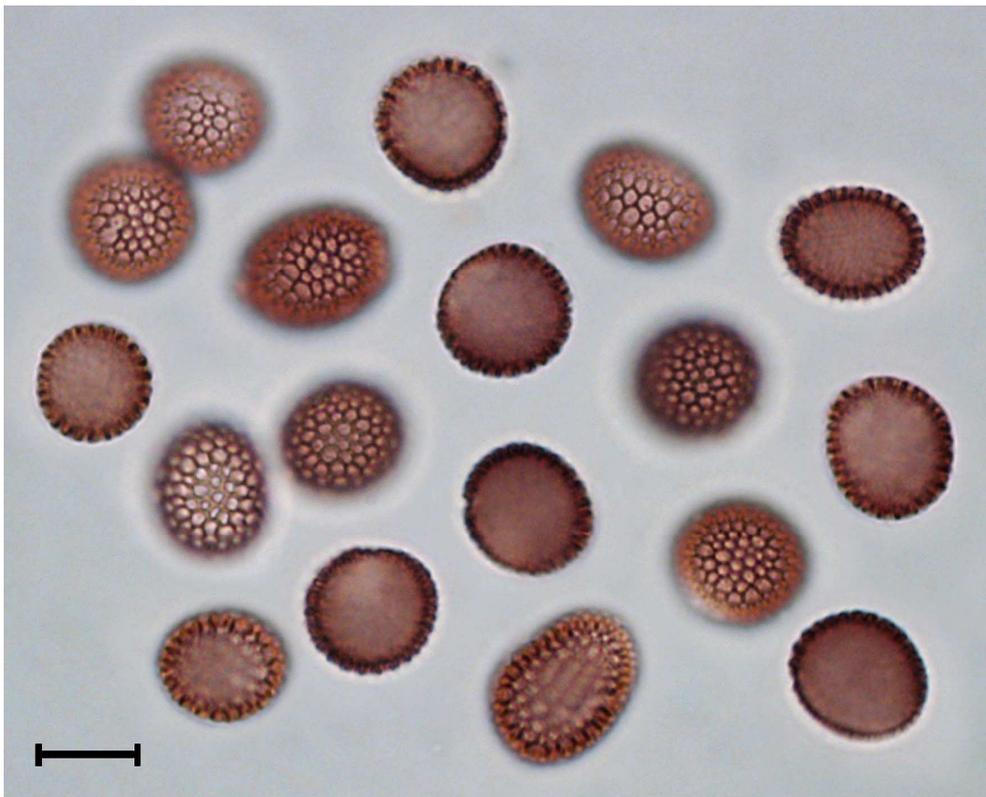


Fig. 2. *Microbotryum scorzonerae* on *Scorzonera caliculata*, spores (Bar = 10 μ m).

whitish to pale brown peridium that ruptures exposing the blackish brown, semi-agglutinated to powdery mass of spore balls and spores surrounding numerous, stout, 0.5–1 cm long columellae. Spore balls subglobose, ellipsoidal, elongate to irregular, 25–70 × 30–80 µm, dark reddish brown, composed of tens of easily separating spores. Spores subglobose, ellipsoidal, elongate, usually subpolyhedrally irregular, 8–12 × 9.5–13.5(–15) µm, yellowish brown; wall evenly thick, c. 1 µm, finely and densely verruculose, spore profile smooth to very finely serrulate. Sterile cells absent (Fig. 3).

On *Poaceae*: *Stipagrostis plumosa* (L.) Munro ex T. Anderson, Yazd province, Anar, Bahramabad, 23.4.1948, coll. Rechinger, Aellen & Esfandiari, IRAN 8300 F, HUV 15311; Tehran province, 45 km NW of Kashan, road towards Qom, 5.8.1974, coll. Wendelbo, Rafii & Riazi, Herb. TARI 14441, HUV 7480; Kerman province, Rafsanjan, 21.4.1946, coll. Kriukhin, IRAN 4427 F; Sistan va Baluchestan province, Zabol, Dashtal police station, 6.11.2009, coll. M. Sarani, IRAN 14881 F.

Because *Sporisorium saharianum* is restricted to host plants in the genus *Sporobolus* (type on *S. pungens*), whereas the smut on *Aristida* and *Stipagrostis* species represents another species, known under the name *Sporisorium aristidae-lanuginosae* (Maire) Vánky (type on *Aristida lanuginosa* = *A. lanosa*), they also differ morphologically. *S. saharianum*: Sori comprise the whole inflorescence, branches of the inflorescence or single spikelets, are several cm or only a few mm long, covered by a thin, yellowish brown peridium enclosing the agglutinated or granular-powdery mass of spore balls surrounding one or several columellae. Spore balls 30–180 µm long, composed of tens to hundreds of spores that separate under pressure. Spores 9–16(–17.5) µm long; wall even to slightly uneven, 0.5–1 µm thick, densely and finely punctate-verruculose. In *S. aristidae-lanuginosae*, the sori comprise the whole inflorescence, destroying all of them in a plant, ovoid with acute tip, c. 1 cm long, partly hidden by leaf sheaths, initially covered by a whitish to pale brown peridium that ruptures exposing the blackish brown, semi-agglutinated to powdery mass of spore balls

and spores surrounding numerous, stout, 0.5–1 cm long columellae. Spore balls 30–80 µm long, composed of tens of easily separating spores. Spores 9.5–13.5(–15) µm long; wall even, c. 1 µm thick, finely and densely verruculose. This species was treated in Ershad (2001: 99) under the name *Sporisorium saharianum* (Trotter) Karatygin. This is the first report of *S. aristidae-lanuginosae* from Iran.

Sporisorium desertorum (Thüm.) Vánky, Mycotaxon 74: 169 (2000)

Sori destroying the whole inflorescence (raceme), more rarely only a part of it or only a few spikelets in the raceme, fusiform, 1–2(–3) × 10–35 mm, partly hidden by leaf sheaths, covered by a thick, brown peridium that ruptures irregularly exposing the dark brown mass of spore balls, spores, sterile cells and several long, filiform columellae. All racemes or only some of them in a plant may be affected. Spore balls globose to irregularly ellipsoidal, 35–60(–75) µm long, dark reddish brown, easily separating into single spores. Spores globose, subglobose, ellipsoidal, slightly irregular, 8.5–10.5 × 9.5–12(–13) µm, reddish brown; wall uneven, 1–1.5 µm thick, thickest at the angles, outer spores coarsely verrucose-echinulate, especially on their free surface, inner spores finely punctate. Sterile cells single, globose, subglobose, ellipsoidal, usually more or less flattened, 8–16 µm long, hyaline; wall 1–1.5 µm thick, smooth (Fig. 4).

On *Poaceae*: *Lasiurus indicus* Henrard [*L. hirsutus* (Forssk.) Boiss.; *Coelorachis hirsuta* (Forssk.) Brongn.]; Sistan va Baluchestan province, Pasabandar port toward Goatr port, 2 km NE Pasabandar, 5.11.2000, coll. Z. Ghanbari & M. Moghadam, IRAN 11288 F.

Sporisorium desertorum and *S. andropogonis* differ in many respects. The most important differences are shown below:

S. desertorum: Sori 1–3.5 cm, columellae several, long, filiform. Spore balls 35–60(–75) µm long. Spores 9.5–12(–13) µm long; wall uneven, 1–1.5 µm thick, thickest at the angles, outer spores coarsely verrucose-echinulate, especially on their free surface, inner spores



Fig. 3. *Sporisorium aristidae-lanuginosae* on *Stipagrostis plumosa*, spores (Bar = 10 μ m).



Fig. 4. *Sporisorium desertorum* on *Lasiurus indicus*, spores (Bar = 10 μ m).

finely punctate. Sterile cells single, 8–16 μm long, hyaline; wall 1–1.5 μm thick.

S. andropogonis: Sori 1.5–7 cm long, columella one, simple or ramified, irregular. Spore balls 40–160 μm , dark reddish brown, composed of tens of spores that separate very easily. Spores 7.5–11 μm long; wall even, 0.5–1 μm thick, finely and densely punctate-verruculose, spore profile smooth to wavy. Sterile cells in irregular groups or chains among the spores, 6–16(–22) μm long, subhyaline to yellow tinted, with numerous droplets; wall 0.5–1 μm thick. Host plants: *Andropogon*, *Bothriochloa*, *Dichanthium*, *Diheteropogon*, *Heteropogon* and *Schizachyrium* species.

Sporisorium desertorum, treated in Ershad (2001: 83) as *S. andropogonis*, is known from a few countries in Africa (Chad, Egypt, Mauritania) and in S Asia (India, Pakistan). It is new to Iran.

Sporisorium foveolati (Maire) Vánky, *Mycotaxon* 33: 367 (1988)

Sori destroying the whole inflorescence, 1–2 \times 5–15 mm, partly hidden by the uppermost leaf sheath, initially covered by a yellowish brown peridium which flakes away revealing the dark brown, semi-agglutinated to powdery mass of spores and sterile cells surrounding a usually flagelliform columella. Spores rounded subpolyhedral, often irregular, 8–11 \times 9–13 μm , olive-brown; wall even, 0.5–0.8 μm thick, densely verruculose-echinulate, spore profile wavy to finely serrulate. Sterile cells in loose, irregular groups or solitary, globose, ellipsoidal to slightly irregular, 9–20 \times 13–22 μm , pale yellowish-brown; wall 1.5–3 μm thick, smooth (Fig. 5).

On *Poaceae*: *Dichanthium foveolatum* (Delile) Roberty (*Andropogon foveolatus* Delile; *Eremopogon foveolatus* (Delile) Stapf), Hormozgan province, Persian Gulf, Lavan Island, 6.12.1976, coll. F. Termeh, IRAN 4425 F, HUV 21819.

Sporisorium foveolati (type on *Dichanthium foveolatum*) differs from *S. andropogonis* (type on *Dichanthium ischaemum*) in having darker, slightly

larger, more irregular spores with coarser ornamentation and much larger, thick-walled sterile cells.

This smut fungus, known from several countries in Africa, is new to Iran, and probably also to Asia. In Ershad (2001: 82), it was treated as *Sporisorium andropogonis*.

Sporisorium vanderystii (Henn.) Langd. & Fullerton, *Mycotaxon* 6: 451 (1978)

Sori comprising all raceme-pairs or racemes of an inflorescence, cylindrical, usually forked, Y- or V-shaped, 1–2(–2.5) \times 4–8 mm, partly concealed by the spathae, initially covered by a thick, brown peridium that ruptures irregularly exposing the semi-agglutinated to powdery mass of spores and sterile cells surrounding a stout, bifurcate or a simple columella, the length of the sori often with short branches. Rarely, the sori are restricted to the spikelet-pairs only. Spores when mature single, globose, ovoid, ellipsoidal to rarely elongate or slightly irregular, (6.5–)7–10.5 \times (7–)8–11 μm , yellowish brown; wall evenly thick, 0.5–0.8 μm , finely and densely punctate-verruculose, spore profile smooth, in SEM spore surface finely and densely echinulate, between the spines finely and densely verruculose. Sterile cells in small, irregular groups, individual cells globose, ellipsoidal or irregularly polyangular with flattened side(s), 9–24(–30) μm long, hyaline or subhyaline; wall 0.5–1.5 μm thick, smooth. Spore germination results in a ramified, multicellular, monokaryotic mycelium (Fig. 6).

On *Poaceae*: *Hyparrhenia hirta* (L.) Stapf, Kermanshah province, Rijab, Shalan village toward Sarab-e Shalan, besides the rocks around the river, 1100 m, 14.5.2006, coll. M. Abbasi, R. Fritsch and M. Keusgen, IRAN 14783 F, HUV 21826.

Based on literature available to us two *Sporisorium* spp. have been previously reported on *Hyparrhenia hirta* from Iran: *S. andropogonis* (Opiz) Vánky, reported by González Fragoso (1916), and *S. tricholaenae* (Henn.) Vánky, reported by Karampour *et al.* (2008). *Sporisorium vanderystii* is new to Iran.



Fig. 5. *Sporisorium foveolati* on *Dichanthium foveolatum*, spores (Bar = 10 μ m).



Fig. 6. *Sporisorium vanderystii* on *Hypparrhenia hirta*, spores (Bar = 10 μ m).

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