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Additions to the smut fungi of Pakistan. 1.

CVETOMIR M. DENCHEV^{1*}, MUHAMMAD FIAZ², TEODOR T. DENCHEV,¹
HABIB AHMAD³ & ABDUL NASIR KHALID⁴

¹*Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences,
2 Gagarin St., 1113 Sofia, Bulgaria*

²*Department of Botany, Hazara University Mansehra, Pakistan*

³*Department of Genetics, Hazara University Mansehra, Pakistan*

⁴*Department of Botany, University of the Punjab, Lahore, Pakistan*

* CORRESPONDENCE TO: cmdenchev@yahoo.co.uk

ABSTRACT — A new smut fungus, *Sporisorium pakistanense* on *Pennisetum lanatum*, is described and illustrated from Pakistan. Two species, *Bauhinus tenuisporus* on *Pericaria maculosa* and *Sporisorium dinteri* on *Bothriochloa bladhii*, are reported for the first time from Pakistan.

KEY WORDS — *Microbotryales*, taxonomy, *Ustilaginomycetes*

Introduction

During collecting trips for parasitic fungi in Mansehra District (Khyber Pakhtunkhwa Province, Pakistan), carried out by M. Fiaz in 2009–10, 20 specimens of smut fungi were collected. Based on the study of these specimens, we propose here a new smut fungus, *Sporisorium pakistanense* on *Pennisetum lanatum*, and report two records new for Pakistan: *Bauhinus tenuisporus* on *Pericaria maculosa* and *Sporisorium dinteri* on *Bothriochloa bladhii*.

Material & methods

Dried specimens from the Hazara University Herbarium (HUP), Pakistan were examined under light (LM) and scanning electron (SEM) microscopes. For LM observations, spores were mounted in lactophenol solution on glass slides, gently heated to boiling point to rehydrate the spores, and then cooled. Spore measurements are given in the form: min–max (mean \pm 1 standard deviation). For SEM, spores were attached to specimen holders by double-sided adhesive tape and coated with gold with an ion sputter. The surface structure of spores was observed at 10 kV and photographed with a JEOL SM-6390 scanning electron microscope.

Taxonomy

Bauhinus tenuisporus (Cif.) Denchev & R.T. Moore, in Denchev et al., *Mycologia Balcanica* 3: 74, 2006. FIGS 1–2
= *Microbotryum tenuisporum* (Cif.) Vánky, *Mycotaxon* 67: 50, 1998.

SORI in swollen flowers; systemic infection, all flowers attacked. SPORE MASS powdery, purplish chestnut (based on the Anonymous (1969) Colour identification chart). SPORES globose, subglobose, broadly ellipsoidal or ovoid, $8\text{--}12.5 \times 7.5\text{--}9.5$ ($9.7 \pm 0.9 \times 8.6 \pm 0.6$) μm ($n = 50$); wall $1.3\text{--}1.6$ μm thick (incl. reticulum), reticulate, meshes irregularly polygonal, 4–5(–6) meshes per spore diameter, muri $0.8\text{--}1.3$ μm high; in SEM the interspaces with a hemispherical tuberculum.

SPECIMEN EXAMINED — On *Persicaria maculosa* Gray: PAKISTAN, KHYBER PAKHTUNKHWA PROVINCE, Mansehra District, Dhodial Mansehra, October 2009, leg. M. Fiaz, no. FS–07 (HUP 301).

DISTRIBUTION — On *Persicaria* spp. (*Polygonaceae*), Asia, North & South America, Australia, and New Zealand (Vánky 2011). *Persicaria maculosa* is a new host record for this species.

Sporisorium dinteri (Syd. & P. Syd.) Vánky, *Fungal Diversity* 15: 232, 2004. FIGS 3–4

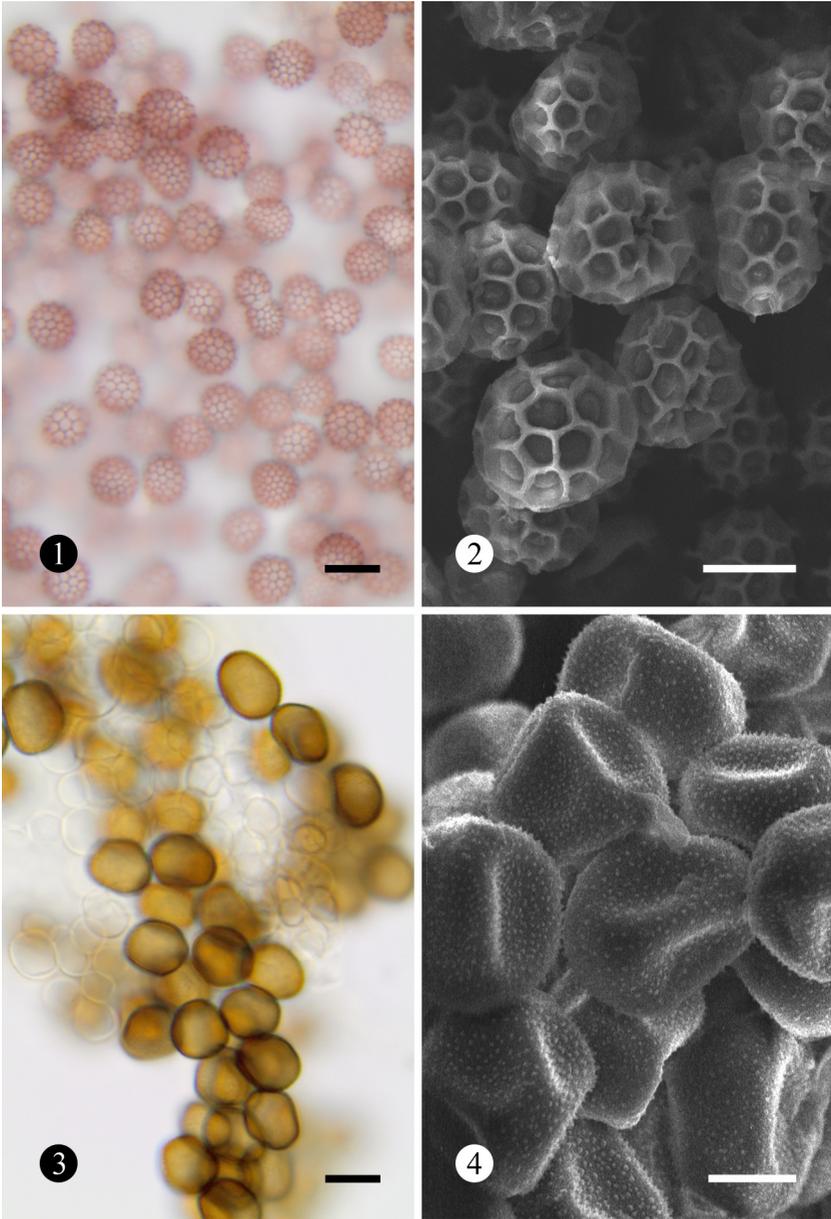
SORI destroying the whole inflorescence, ca. 2.5 cm long, partly hidden by the leaf sheath; initially covered by a yellowish brown peridium which later ruptures irregularly, exposing semi-agglutinated, dark reddish brown mass of spores and sterile cells surrounding a central, stout, simple or branching columella with longitudinal furrows. STERILE CELLS in chains or irregular groups, subglobose, broadly ellipsoidal or slightly irregular, sometimes collapsed, $6.5\text{--}12$ (–14) μm long, hyaline, wall $0.5\text{--}0.7$ μm thick, smooth. SPORES subglobose, broadly ellipsoidal, ovoid or slightly irregular, $9\text{--}14 \times 8.5\text{--}12.5$ ($11.9 \pm 0.9 \times 10.4 \pm 0.9$) μm ($n = 50$), yellowish brown; wall $0.5\text{--}0.7$ μm thick, in LM densely echinulate, spore profile not or slightly affected, in SEM echinulate.

SPECIMEN EXAMINED — On *Bothriochloa bladhii* (Retz.) S.T. Blake: PAKISTAN, KHYBER PAKHTUNKHWA PROVINCE, Mansehra District, Damgala Mansehra, 3 September 2009, leg. M. Fiaz, no. FS–04 (HUP 302).

DISTRIBUTION — On *Bothriochloa* spp., *Dichanthium* spp. (*Poaceae*), South Asia, Africa, and Australia (Vánky 2011, Vánky et al. 2011).

Sporisorium pakistanense Denchev, T. Denchev & Fiaz, *sp. nov.* FIGS 5–6
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Differs from *Sporisorium cenchri* and *S. sphaelatum* by a central stout columella with longitudinal furrows and large spores, from *S. pennisetinum* by a single columella, and from *S. penniseticola* by a single columella and large spores.



FIGS 1–2. Spores of *Bauhinus tenuisporus* on *Persicaria maculosa* (HUP 301) in LM and SEM.

FIGS 3–4. Spores and sterile cells of *Sporisorium dinteri* on *Bothriochloa bladonii* (HUP 302) in LM and SEM. Scale bars: 1, 3 = 10 μm , 2, 4 = 5 μm .

TYPE on *Pennisetum lanatum* Klotzsch (*Poaceae*): Pakistan, Khyber Pakhtunkhwa Province, Mansehra District, Naran Jalkhud, August 2009, leg. M. Fiaz, no. FS-15 (HOLOTYPE, SOMF 28 008; ISOTYPE, HUP 303).

ETYMOLOGY: named after Pakistan, the country from which it was collected.

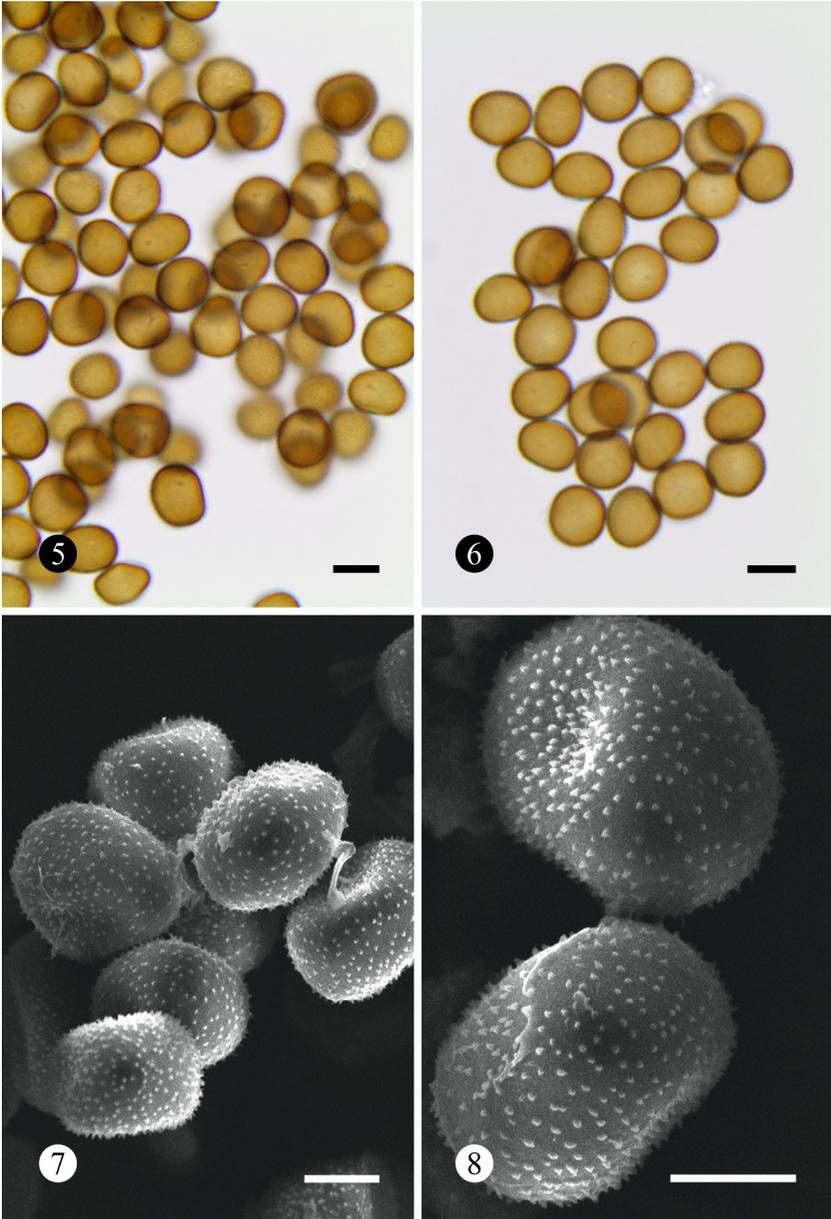
SORI destroying the distal part of sterile shoots, 1–3 cm long, 1.5–3 mm wide, partly hidden by the uppermost leaf sheath; initially covered by a greyish brown peridium which later ruptures irregularly, exposing semi-agglutinated, dark reddish brown spore mass surrounding a central, stout columella with longitudinal furrows. SPORE BALLS and STERILE CELLS not seen. SPORES subglobose, broadly ellipsoidal, ellipsoidal, ovoid or slightly irregular, $11\text{--}15 \times 9\text{--}12.5$ ($12.5 \pm 0.8 \times 10.5 \pm 0.9$) μm ($n = 50$), not dimorphic, light (to middle) reddish brown; wall 0.5–0.8 μm thick, in LM punctate to echinulate, spore profile slightly or not affected, in SEM echinulate.

COMMENTS — Apparently, the spore balls of this *S. pakistanense* are early disintegrating.

Nine *Sporisorium* species have been described on *Pennisetum* (Vánky 2009, 2011). The sori of two of them, *S. ehrenbergii* (Kühner) Vánky and *S. tothii* Vánky, are restricted to the ovaries, while the sori of three species, *S. divisum* Vánky, *S. penniseti* (Rabenh.) Ershad, and *S. penniseti-japonici* (Henn.) Vánky, are restricted to the spikelets. The remaining species possess sori that destroy the whole inflorescence or are located on the top of sterile shoots: (i) *S. cenchri* (Lagerh.) Vánky on *Cenchrus* and *Pennisetum* spp., with type on *Cenchrus* sp. from Ecuador (sori destroying the whole inflorescence, with numerous, thread-like columellae; spore balls persistent, opaque; spores 8–13 μm long); (ii) *S. pennisetinum* (S. Ahmad) Vánky on *Pennisetum flaccidum* Griseb., known only from the type collection from Pakistan (sori destroying the whole inflorescence, with numerous, filiform columellae; spores densely verruculose-echinulate); (iii) *S. penniseticola* Vánky on *Pennisetum sphacelatum* (Nees) T. Durand & Schinz, known only from Ethiopia (sori on the top of sterile shoots, with several, slender columellae; spores (7.5–)8–11(–13) μm long); and (iv) *S. sphacelatum* Vánky, with type on *Pennisetum sphacelatum* from South Africa (sori on the top of sterile shoots, with several, long, filiform columellae; spores 5.5–7.5 μm long, darker on one side, where the wall is thicker).

Sporisorium pakistanense differs from *S. cenchri* and *S. sphacelatum* by having a central, stout columella with longitudinal furrows, and large spores.

We have not seen the type of *S. pennisetinum*, but based on its illustration in Vánky (2011: 708), the spore ornamentation of *S. pennisetinum*, as seen in SEM, consisted of more densely situated ornaments than those of *S. pakistanense*; moreover, the sori of *S. pennisetinum* have numerous, filiform columellae while these of *S. pakistanense* possess a central columella.



FIGS 5–8. Spores of *Sporisorium pakistanense* on *Pennisetum lanatum* (holotype, SOMF 28 008) in LM and SEM. Scale bars: 5–6 = 10 μ m, 7–8 = 5 μ m.

The sori of *S. penniseticola* differ from these of *S. pakistanense* in being situated on the top of sterile shoots comprising the whole inflorescence and its stem, forming long, cylindrical, greyish brown bodies, 5–18 cm long, 1–3 mm wide, partly enclosed by the uppermost leaf sheath, at maturity, the distal part of the sori splits longitudinally in several places, after the dispersion of the spore balls with exposed long, slender columellae, whereas the proximal part of the sori is still entire containing sporogenous hyphae with immature spore balls (Vánky 2005: 93). Additionally, the spores of *S. penniseticola* are smaller.

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