
The smut fungi (Ustilaginomycetes) of *Bothriochloa*, *Capillipedium* and *Dichanthium* (Poaceae)

Kálmán Vánky*

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

Vánky, K. (2004). The smut fungi (Ustilaginomycetes) of *Bothriochloa*, *Capillipedium* and *Dichanthium* (Poaceae). *Fungal Diversity* 15: 221-246.

Two NEW SPECIES proposed are: *Sporisorium dichanthii* Vánky & N.D. Sharma (type on *Dichanthium aristatum*, India), and *S. ruby anum* Vánky & N.D. Sharma (type on *Capillipedium assimile*, India). Eight NEW COMBINATIONS are: *Macalpinomyces bothriochloae* (L. Ling) Vánky (based on *Ustilago bothriochloae*, type on *Bothriochloa pertusa*, China); *Sporisorium bothriochloae* (L. Ling) Vánky (based on *Sorosporium bothriochloae*, type on *Bothriochloa glabra*, Malawi); *Sporisorium dichanthicola* (Mundkur & Thirum.) Vánky (based on *Sphacelotheca dichanthicola*, type on *Dichanthium caricosum*, India); *Sporisorium dinteri* (H. & P. Sydow) Vánky (based on *Ustilago dinteri*, type *Andropogon papillosus*, Namibia); *Sporisorium reticulatum* (B. Liu, Z.Y. Li & Du) Vánky (based on *Sphacelotheca reticulata*, type *Bothriochloa ischaemum*, China); *Sporisorium sahayai* (Mundkur) Vánky (based on *Sphacelotheca sahayai*, type on *Dichanthium annulatum*, India); *Sporisorium superfluum* (H. & P. Sydow) Vánky (based on *Ustilago superflua*, type *Andropogon foveolatus*, India), and *Sporisorium tenue* (H. & P. Sydow) Vánky (based on *Ustilago tenuis*, type *Andropogon pertusus*, India). The following thirteen names are considered to be SYNONYMS: *Sphacelotheca chloridis* Mundkur (type on *Bothriochloa pertusa*, India), *Ustilago bothriochloae-intermediae* Padwick (type on *Bothriochloa intermedia*, India) and *Sorosporium baluchistani* Ahmad (type on *Bothriochloa* sp., Pakistan) are *Sporisorium andropogonis* (Opiz) Vánky (type on *Dichanthium ischaemum*, Czech Rep.); *Schroeteria annulata* Ellis & Everh., *Ustilago duthiei* Ricker, *Ustilago amphiphididis* Zundel, and *Ustilago sabourieana* Mishra (all on *Dichanthium annulatum* from India) represent *Sporisorium andropogonis-annulati* (Bref.) S.R. Wang & M. Piepenbr. (type on *Dichanthium annulatum*, India); *Sorosporium andropogonis-micranthi* Y. Ling & T.L. Chen (type on *Capillipedium parviflorum*, China), *Sphacelotheca capillipedii* L. Ling (type on *Capillipedium parviflorum* China), and *Sphacelotheca pakistanica* S. Ahmad (type on *Capillipedium parviflorum*, Pakistan) are synonyms of *Sporisorium doidgeae* (Zundel) Langdon & Fullerton (lectotype on *Bothriochloa bladhii*, South Africa); *Sphacelotheca amphiphidis* H. Sydow (type on *Bothriochloa insculpta*, South Africa), *Sphacelotheca bothriochloae* Zundel (type on *Bothriochloa decipiens*, Australia), and *Sphacelotheca macalpinae* Zundel (type on *Bothriochloa bladhii*, Australia) represent *Sporisorium tenue* (H. & P. Sydow) Vánky (type on *Bothriochloa pertusa* India). A host-parasite list and a key facilitate the identification of the 19 species of smut fungi now recognised on the grass genera *Bothriochloa*, *Capillipedium* and *Dichanthium*.

Key words: new species, new combinations, synonyms, taxonomy

*e-mail: VANKY.K@cityinfonetz.de

Introduction

The present study is part of a series in which I am reviewing the smut fungi occurring on various grass genera (e.g. Vánky, 2000b, 2003a, b, Vánky & Shivas, 2001, Shivas & Vánky, 2001). In this paper I report on the smut fungi from *Bothriochloa*, *Capillipedium* and *Dichanthium*.

Bothriochloa Kuntze with ca. 35 species throughout the tropics, *Capillipedium* Stapf with ca. 14 species in Eastern Africa, tropical Asia and Australia, and *Dichanthium* Willemet with ca. 20 species in the Old World tropics, are three closely related grass genera in the subfamily Panicoideae, tribe Andropogoneae, subtribe Sorghinae (Clayton and Renvoize, 1986). The boundaries between these three genera are somewhat blurred, the reason why some agrostologists advocated uniting them.

On *Capillipedium* I recognised four smut fungi: 1. *Macalpinomyces chrysopogoncola* (Mundkur & Thirum.) Vánky, 2. *Sporisorium andropogonis-micranthi* (Y. Ling & T.L. Chen) Vánky, 3. *S. taianum* (H. Sydow) L. Guo, and 4. *S. mysorensense* (Pavgi & Thirum.) Vánky (comp. Vánky, 1995: 228-231, 2000a: 176-177, 2001: 320).

At least 26 smut fungi have been reported on *Bothriochloa* and *Dichanthium*. Several of them are synonyms, while others are on misidentified host plants. In revising the smut fungi of *Capillipedium* (Vánky, 2000a: 176), I found that *Sphacelotheca capillipedii* L. Ling and *S. pakistanica* S. Ahmad are identical with, and synonyms of the earlier described *Sporisorium andropogonis-micranthi*, all three from Asia, on *Capillipedium parviflorum*. When comparing the smut fungi of *Bothriochloa*, *Capillipedium* and *Dichanthium*, *Sporisorium andropogonis-micranthi* was found to be identical with, and thus a synonym of the older *Sporisorium doidgeae* (Zundel) Langdon & Full. (lectotype on *Bothriochloa bladhii*, South Africa). In addition, *Schroeteria annulata* Ellis & Everh., *Ustilago amphiphididis* Zundel, *U. duthiei* Ricker, and *U. sabourieana* Mishra were found to be synonyms of *Sporisorium andropogonis-annulati* (Brefeld) S.R. Wang & M. Piepenbr., all five on *Dichanthium annulatum* from India. Furthermore, *Sporisorium amphiphidis* (H. Sydow) Langdon & Full. (type on *Bothriochloa insculpta*, South Africa) was found to be identical with the older *Ustilago tenuis* H. & P. Sydow (= *Sporisorium tenue* (H. & P. Sydow) Vánky, type on *Bothriochloa pertusa*, India). *Ustilago bothriochloae-intermediae* Padwick, *Sphacelotheca bothriochloae* Wang (both on *Bothriochloa intermedia* from Asia), and *Sphacelotheca chloridis* Mundkur (on misnamed *Bothriochloa pertusa*, India) are indistinguishable from *Sporisorium andropogonis* (Opiz) Vánky (type on *Dichanthium ischaemum*, Czech Rep.).

The reduction of the enumerated names into synonymy, simplified the rather complicated situation in this group of smut fungi. However, there are still some closely related species, such as *Sporisorium andropogonis*, *S. doidgeae* and *S. tenue*, where the boundaries are not always clear.

In the literature, the sori of several smuts of these host genera are given to be in the ovaries. Actually, the sori comprise besides the ovaries also the innermost floral organs. This is evident when remnants of such organs, e.g. filaments and anthers, can be seen attached to the covering peridium.

Taxonomy

The nineteen recognised smut fungi, including two new species, on *Bothriochloa*, *Capillipedium* and *Dichanthium* are:

Jamesdicksonia brunckii (Ellis & Galloway) J. Walker & R.G. Shivas, 1998: 1212.

≡ *Ustilago brunckii* Ellis & Galloway, 1890: 31.

≡ *Tolyposporella brunckii* (Ellis & Galloway) G.P. Clinton, 1902: 147.

≡ *Tilletia brunckii* (Ellis & Galloway) Durán, 1972: 2572 (invalid comb., no basionym and place of publication indicated; ICBN 33.2). — Type on *Andropogon argenteus* Ell., USA, Texas, Brazos Co., College Station, 1890, H.S. Jennings.

= *Ustilago apiculata* Ellis & Galloway, in Jennings, 1890: 29. — Type on *Andropogon saccharoides* Swartz, USA (published without locality, date and collector), Texas, Brazos Co., College Station, 1890, H.S. Jennings, BPI 192453; isotype BPI 157287. (syn. by Clinton, 1902: 129).

Sori on adaxial surface of the leaf-sheaths, forming striae fusing into a blackish-brown, agglutinated to granular-powdery coat of spore masses, showing through the outer surface of the leaf-sheaths, between the veins, as pale lead coloured striae of different length. *Spores* globose, subglobose to ovoid (in some specimens to subpolyhedrally irregular), extremely variable in size, 10-18 × 10-20(-24) µm in diameter, yellow to dark reddish-brown; wall 3-8 µm thick, composed of a homogenous, uniform endospore of 1-2 µm and a multilayered, smooth exospore, sometimes with a short, hyaline papilla. (Spore measurements made in unheated lactophenol because in heated lactophenol or in water the spore wall and the spores swell considerably). *Germination* results in a holobasidium bearing apically 4-6(-8) bent basidiospores which may fuse producing ballistospores.

Hosts: *Andropogon bicornis* L., *A. gerardii* Vitman, *A. hirtiflorus* (Nees) Kunth var. *pubiflorus* (Nees) Kunth, *A. perforatus* Trin. ex Fourn., *A. saccharoides* Swartz (*A. torreianus* Steud.), *A. ternarius* Michaux (*A. argenteus* Ell.; *A. argyraeus* Schult.), *Bothriochloa barbinodis* (Lag.) Herter (*A. barbinodis* Lag.; *A. saccharoides* Swartz var. *barbinodis* (Lag.)

Hack.; *A. saccharoides* Swartz var. *leucopogon* (Nees) Hack.), *Dichanthium sericeum* (R. Br.) A. Camus, and its subsp. *polystachyum* (Benth.) B.K. Simon, *Schizachyrium sanguineum* (Retz.) Alston var. *hirtiflorum* (Nees) S.L. Hatch (*A. hirtiflorus* (Nees) Kunth).

Known distribution: N., C.- and S. America (USA, Mexico, Ecuador), West Indian Antilles (Puerto Rico, Dominican Republic), Australia.

Jamesdicksonia obesa (H. & P. Sydow) Thirumalachar, Pavgi & Payak, 1960(1961): 478.

≡ *Entyloma obesum* H. & P. Sydow, 1911: 145.

≡ *Tolyposporella obesa* (H. & P. Sydow) G.P. Clinton & Zundel, in Zundel, 1930: 157.

— Type on *Andropogon annulatus* Forssk. (= *Dichanthium annulatum* (Forssk.) Stapf), India, Nagpur, 21.X.1907, P.A. Pundit, BPI 176115, BPI 195050.

Sori in the leaves as fusiform pustules, 0.3-1 × 1-10 mm, or larger by confluence, first covered by the epidermis which later ruptures longitudinally exposing the black, agglutinated mass of spores. *Spores* variable in shape and size, globose, ovoid, ellipsoidal, elongate, pyriform, often subpolyhedrally irregular or elongate, 8-11 × 9-13(-15) μm, light olivaceous- to dark reddish-brown; wall 3-6.5 μm thick, composed of a homogenous, thin (0.5-1 μm), uniform endospore and a multilayered, smooth exospore of variable thickness. Spores mature in a basipetal succession in the sorus. *Spore germination*, without dormancy, results in holobasidium bearing apically a whorl of 2-4, monokaryotic, haploid basidiospores which conjugate in pairs in situ, and successively bud off dikaryotic, either short, allantoid, crescent-shaped ballistospores or long, tubular, secondary and tertiary sporidia (Raghu-nath, 1969: 760).

Hosts: *Dichanthium annulatum* (Forssk.) Stapf (*Andropogon annulatus* Forssk.), *Hyparrhenia rufa* (Nees) Stapf.

Known distribution: S. Asia (India), S. America (Colombia).

In the literature, there is a great variation regarding spore measurements and wall thickness of *Jamesdicksonia obesa*. According to H. and P. Sydow (1911: 145), the spores measure 8-11 × 24-35 μm, and the wall is 3-14 μm thick. Zundel (1953: 126) gives 13-29 μm for the spore diam., and a wall thickness of 8-19 μm. Walker and Shivas (1998: 1209) give 12-24 × 12-30 μm for the spore measurements, and 4-10(-12) μm for the wall thickness. The reason for this lies in the property of the spore wall to swell considerably in water or in heated lactophenol. Spore measurements, made in unheated lactophenol, gave the above mentioned smaller values (8-11 × 9-13(-15) μm for the spores and 3-6.5 μm for the wall thickness).

Macalpinomyces bothriochloae* (L. Ling) Vánky, **comb. nov.*

Basionym: \equiv *Ustilago bothriochloae* L. Ling, Mycological Papers 11 :4, 1945. — Type on *Bothriochloa pertusa* (L.) A. Camus, China, Szechwan Prov., Chengtu, 5.XI.1941, L. Ling, BPI 196318!; isotypes BPI 196319!, IMI 504.

Sori in some ovaries of an inflorescence, swollen, globoid to ellipsoidal, usually with a short acute tip, partly hidden by the floral envelopes, ca. 1.5-2.5 \times 2-3 mm, covered by a brown peridium which ruptures irregularly exposing the dark brown, semiagglutinated mass of spores and groups of sterile cells. *Spores* globose, subglobose to ellipsoidal, 10.5-14.5 \times 11.5-16(-17) μm , olivaceous-brown; wall evenly thick, provided with moderately densely situated, 1-1.5 μm high spines, ca. 0.5-0.8 μm wide at their base; spore profile serrate. *Sterile cells* between the spores in irregular groups, subhyaline to pale yellow, collapsed. *Spore germination* results in septate basidia on which ovoid to long ellipsoidal basidiospores are produced laterally and apically (Ling, 1945: 4).

Host: Bothriochloa pertusa (L.) A. Camus.

Known distribution: E. Asia (China). Known only from the type collection.

***Macalpinomyces chrysopogonicola* (Mundkur & Thirum.) Vánky, 2001: 320.**

\equiv *Sphacelotheca chrysopogonicola* Mundk. & Thirum., in Thirumalachar and Mundkur, 1951: 2. — Type on *Chrysopogon* sp., India, Mysore, Bangalore, Uttarahalli, 2.IX.1943, M.J. Thirumalachar, HClO 10781!

\equiv *Ustilago chrysopogonis* S. Ahmad, 1956: 2.

\equiv *Macalpinomyces chrysopogonis* (S. Ahmad) Vánky, 1997: 129. — Type on *Chrysopogon gryllus* (L.) Trin., Pakistan, Swat State, Kulali-Kalam, 19.VIII.1958, S. Ahmad; isotype HUV 8999! (syn. by Vánky, 2001: 320).

\equiv *Sorosporium capillipedii* Mishra, 1957: 257.

\equiv *Endosporisorium capillipedii* (Mishra) Vánky, 1995: 228. — Type on *Capillipedium parviflorum* (R. Br.) Stapf, India, Bihar, Hazaribagh, 10.X.1955, J.N. Mishra, BPI 179479! (syn. by Vánky, 2001: 320).

Sori comprise the distal part of the stems transforming them into 3-16 cm long, ca. 1 mm wide, whitish, straight or whip-like, twisted, sometimes looped tubes which split longitudinally liberating the blackish-brown, powdery mass of groups of spores and spores intermixed with sterile cells. Usually all shoots of a plant are transformed into sori and infected plants do not flower. *Spores* subpolyhedrally globoid, ovoid or irregular, 8-10.5 \times 8-11 μm , medium reddish-brown; wall thin (0.5-0.8 μm), densely echinulate, spines short (0.3-0.4 μm), just affecting the spore profile which appears undulate or serrulate, in SEM spore surface provided with short, conical spines. *Sterile cells* variable in form and size, subglobose, ellipsoidal or subpolyhedrally irregular, 4-9(-13) \times 5-11(-15) μm , hyaline, usually forming irregular groups; wall thin (ca. 0.5 μm), smooth, content hyaline.

Hosts: Capillipedium parviflorum (R. Br.) Stapf, *Chrysopogon echinulatus* (Nees) W. Wats, *Ch. fulvus* (Spreng.) Chiov., *Ch. gryllus* (L.) Trin.
Known distribution: S. Asia (India, Pakistan).

The sole collection of this smut on *Capillipedium* is the type of *Sorosporium capillipedii*. Confirmation of the host plant identity is desired.

***Sporisorium andropogonis* (Opiz) Vánky, 1985: 113.**

≡ *Uredo (Ustilago) andropogonis* Opiz, 1824: 43 (as *andropogi*).

≡ *Sphacelotheca andropogonis* (Opiz) Bubák, 1912: 25.

≡ *Cintractia andropogonis* (Opiz) Kochman, 1936: 75. — Type on *Andropogon angustifolius* Sib. and Sm. (= *Dichanthium ischaemum* (L.) Roberty), Czech Rep., Dablizerberg [= Ďáblice] Mt., near Prague, F.M. Opiz. (I did not see the type, but there are several samples of this species in PRM with Opiz's handwritten labels, collected in or around Prague, with or without the date of collection).

= *Ustilago ischaemi* Fuckel, 1860: 22.

≡ *Cintractia ischaemi* (Fuckel) H. & P. Sydow, 1901: 12.

≡ *Sphacelotheca ischaemi* (Fuckel) G.P. Clinton, 1902: 140. — Type on *Andropogon ischaemum* L. (= *Dichanthium ischaemum* (L.) Roberty), Germany, Nassovia [= Nassau], Biebrich near Wiesbaden, L. Fuckel. (syn. by Fischer, 1953: 130).

= *Ustilago cylindrica* Peck, 1882: 55. — Type on *Andropogon* (?), USA, Arizona, VI., C.G. Pringle. (syn. by Clinton, 1902:129).

= *Sphacelotheca chloridis* Mundkur, 1944: 50. — Type on "*Chloris barbata* Sw." = misnamed *Bothriochloa pertusa* (L.) A. Camus (teste K. Vánky), India, Mysore, Bangalore, Karnataka, 20.VIII.1942, M.J. Thirumalachar, HClO 10000; isotypes BPI 195098, HUV 17273! (syn. nov.).

= *Sphacelotheca heteropogonis-triticei* L. Ling, 1950: 77. — Type on *Heteropogon triticeus* (R. Br.) Stapf, Philippine Islands, Luzon, Pangasinan Prov., south of Alaminos, III.1928, M.S. Clemens, BPI 177833! (syn. by Vánky, 2000: 178).

= *Ustilago bothriochloae-intermediae* Padwick, 1946: 5.

≡ *Sphacelotheca bothriochloae-intermediae* (Padwick) Narasimhan, in Thirumalachar and Pavgi, 1956: 287. — Type on *Bothriochloa intermedia* (R. Br.) A. Camus, India, Bengal, Dacca, Tejagon, 9.XI.1944, G.W. Padwick 895, HClO 10837; isotypes IMI 30085, HUV 17332! (syn. nov.)

= *Sorosporium baluchistani* Ahmad, 1956: 10. — Type on *Bothriochloa* sp., Pakistan, Baluchistan, Hindubag, 7.VI.1951, I. Ilahi 9033, IMI 57440; isotype HUV 17366! (syn. by Vánky 1997: 148).

= *Sphacelotheca bothriochloae* Wang, 1962: 134 (later homonym, not Zundel, 1939). — Type on *Bothriochloa intermedia* (R. Br.) A. Camus, China, Sichuan, 11.IX.1958, X.-J. Liu 644, HMAS 31561; isotype HUV 7987! (syn. nov.).

Sori usually destroying the whole inflorescence, rarely confined to the spikelets, cylindrical or bifurcate at their distal part, 1-10 mm wide, 1.5-7 cm long, partly hidden by the terminal leaf-sheath, at first covered by a well-developed, yellowish-brown peridium which ruptures irregularly and flakes away disclosing the dark brown, semi-agglutinated to powdery mass of spores and groups of sterile cells surrounding a simple or ramified, irregular columella

of the length of the sorus, the remnants of the floral axis and branches. Infection systemic. *Spores* when young in loose, irregular spore balls, 40–160 µm long, when mature single, globose, ovoid, ellipsoidal to slightly irregular, (6.5-)7-10 × 7.5-11 µm, light olivaceous-brown; wall even, ca. 0.5 µm thick, densely punctate-verruculose, spore profile smooth to wavy, in SEM spores minutely echinulate, between the spines, finely and densely verruculose. *Sterile cells* in irregular groups or chains among the spores and also forming the peridium, globose to irregularly polygonal, flattened on contact sides, 6–16(-22) µm long, subhyaline to yellow tinted, with numerous droplets collapsed in old specimens; wall even, 0.5-1 µm thick, smooth. *Spore germination* results in four-celled basidia on which lateral and terminal basidiospores are produced (Brefeld, 1883: 96, Pl. XI, figs. 1–2; Vánky & al. , 1988: 185).

Hosts: *Andropogon* spp. (not revised), *Bothriochloa bladhii* (Retz.) S.T. Blake (*B. glabra* (Roxb.) A. Camus), *B. caucasica* (Trin.) C.E. Hubb., *B. decipiens* (Hackel) C.E. Hubb., *B. ewartiana* (Domin) C.E. Hubb., *B. intermedia* (R. Br.) A. Camus, *B. pertusa* (L.) A. Camus, *Dichanthium annulatum* (Forssk.) Stapf, *D. ischaemum* (L.) Roberty (*Andropogon ischaemum* L.), *Diheteropogon amplexens* (Nees) D. Clayton (*Andropogon amplexens* Nees), *Heteropogon contortus* (L.) P. Beauv. ex Roem. and Schult., and *H. triticeus* (R. Br.) Stapf.

Known distribution: cosmopolitan. Europe, Africa, Asia, Australia, N. America.

Sporisorium andropogonis-annulati (Bref.) S.R. Wang & M. Piepenbring, 2002: 403.

≡ *Ustilago andropogonis-annulati* Brefeld, 1895: 109.

≡ *Sphacelotheca andropogonis-annulati* (Bref.) Zundel, 1930: 132. — Type on *Andropogon annulatus* Forssk. (= *Dichanthium annulatum* (Forssk.) Stapf), India, Dehra Dun, comm. by D.D. Cunningham, Calcutta. The type specimen was lost in Berlin (B), during World War II.

= *Schroeteria annulata* Ellis & Everhart, 1890: 118.

≡ *Sphacelotheca annulata* (Ellis & Everh.) Mundkur, 1939: 92. — Type on *Andropogon annulatus* Forssk. (= *Dichanthium annulatum* (Forssk.) Stapf), India, Saharan Prov., 11.X.1888, Herb. S.M. Tracy, BPI 192888; isotypes NY, HUV 1858! (syn. nov.).

= *Ustilago duthiei* Ricker, 1905: 111.

≡ *Sphacelotheca duthiei* (Ricker) Zundel, 1930: 134. — Type on *Andropogon bladhii* Retz. (= misnamed *Dichanthium annulatum* (Forssk.) Stapf), India, Dehra Dun, 22.X.1888, F. Duthie 7679 (not 7699 as given in the original description; comp. Mundkur, 1939: 92), WIS; isotypes DD, K, HUV 17404! (syn. nov.).

= *Ustilago amphiphididis* Zundel, 1944: 400. — Type on *Amphilophis ischaemum* Nash (*Bothriochloa ischaemum* (L.) Keng; = misnamed *Dichanthium annulatum* (Forssk.) Stapf,

teste K. Vánky), India, Punjab, Gurdaspur Distr., Pathankot, alt. 1000 ft., 11.V.1917, R.R. Stewart, BPI 157059!; isotype BPI 188923! (syn. nov.).

= *Ustilago sabourieana* Mishra, 1956: 873. — Type on *Bothriochloa pertusa* (L.) A. Camus (= misnamed *Dichanthium annulatum* (Forssk.) Stapf, teste K. Vánky, confirmed by I. Scholz, B), India, Bihar, Netarhat, alt. 3000 ft, 25.XI.1954, J.N. Mishra, HClO 25280; isotypes IMI 60489, HUV 17345! (syn. nov.).

Sori destroying the innermost floral organs ("ovaries"), infecting all in the inflorescence, ovoid to short cylindrical, 0.7-1 × 1.5-3 mm, partly hidden by the floral envelopes, at first covered by a greyish-brown peridium (sometimes with remnants of sterile anthers) which ruptures irregularly disclosing the dark brown, semi-agglutinated to powdery mass of spore balls, spores and sterile cells surrounding a simple, stout, narrowing columella. *Spore balls* loose, irregular, reddish-brown, early separating into single spores. *Spores* when mature single, globose, subglobose, ovoid, ellipsoidal to slightly irregular, 9-11 × 9.5-12(-13.5) μm, yellowish-brown; wall even, ca. 0.5 μm thick, finely, sparsely to moderately densely verrucose-echinulate, spore profile smooth or nearly so. *Sterile cells* in small, irregular groups, in pairs or single, subglobose, ellipsoidal or irregular with one or two flattened sides, 5-15(-20) × 7-20(-25) μm, hyaline, collapsed in old specimens; wall even, 1-2.5 μm thick, smooth.

Hosts: *Dichanthium annulatum* (Forssk.) Stapf (*Andropogon annulatus* Forssk.), *Dichanthium annulatum* var. *bullisetosum* B.S. Sun & S. Wang, ?*D. caricosum* (L.) A. Camus.

Known distribution: S. and E. Asia (China, India, Pakistan).

Brefeld (1895: 109) describing *Ustilago andropogonis-annulati* Bref. gave a very summary description: *Sori* in all ovaries of an inflorescence. *Spores* globoid, 8-9 μm diam., dark-brown. In addition, Brefeld described in detail the *spore germination* which results in two-celled basidia, in water giving rise to mycelia, in nutrient media to ovoid basidiospores (Pl. VI, figs. 27-31). Fortunately, Mundkur (1939: 89), studied Brefeld's type specimen and provided a more detailed description: "*Sori* completely destroying the ovaries, later protruding from the glumes by forcing them apart, 3-4 mm long, covered by a dusky cream false membrane, the cells of which are brownish. *Spores* subglobose to globose, Kaiser Brown (Ridgway), clearly echinulate under an oil immersion objective". For the spore measurements of Brefeld's type specimen, Mundkur gives (8-)9-12(-13) μm. This description fits very well with the smut fungi of a great number of collections on *Dichanthium annulatum* from S. Asia, between them also the types of *Schroeteria annulata* Ellis & Everh., *Ustilago amphilophidis* Zundel, *U. duthiei* Ricker, and *U. sabouriana* Mishra. Therefore, I consider these five names to be synonyms. In some collections a few spores (0.5% or less) may be elongated, measuring

1-2(-3) μm more than other spores. This led Mundkur (1939) to recognise *Sphacelotheca andropogonis-annulati* and *S. annulata* as two separate species. However, all other characters of the sori, spores and sterile cells are identical, including the typical, finely, sparsely to moderately densely verrucose-echinulate spore surface ornamentation, which supports my decision regarding synonymy. Ellis and Everh. (1890: 118) considered the hyaline, sterile cells, often in pairs, to be young, immature spores, hence their generic placement of this fungus into *Schroeteria*.

Sporisorium bothriochloae* (L. Ling) Vánky, **comb. nov.*

Basionym: \equiv *Sorosporium bothriochloae* L. Ling, Lloydia 16: 186, 1953. — Type on *Bothriochloa glabra* (Roxb.) A. Camus (= *B. bladhii* (Retz.) S.T. Blake), Nyasaland [= Malawi], Kalembo, 2.IV.1949, P.O. Wiehe 142, IMI 35066!; isotype BPI 179467.

Sori in some ovaries of an inflorescence, long cylindrical or fusiform, tapering at both ends, 1-2 \times 5-13 mm, protruding beyond the glumes, covered by a pale yellowish-brown, rather tough peridium which dehisces from its apex exposing a blackish-brown, granular mass of spore balls surrounding 1–2 simple, narrowing, sometimes ramified columellae. *Spore balls* rather permanent, extremely variable in shape and size, from ellipsoidal to usually irregular, polyhedral, oblong, fusiform or even bent, 30-100(-120) \times 40-180(-200) μm , yellowish- to reddish-brown, larger balls subopaque, composed of tens or hundreds of spores which separate by pressure. *Spores* slightly dimorphic, globose, subglobose, ellipsoidal or subpolyhedrally slightly irregular, 8-13 \times 10-14.5 μm , yellowish-brown; inner spores of larger balls paler, wall even, ca. 0.5 μm thick, apparently smooth to finely punctate; outer spores darker, wall even or slightly uneven, 0.5–0.8 μm thick, finely, densely verrucose-echinulate, spore profile smooth, finely wavy or very finely serrulate on the free surface of the outer spores. *Sterile cells* absent.

Hosts: *Bothriochloa bladhii* (Retz.) S.T. Blake (*B. glabra* (Roxb.) A. Camus), *Dichanthium fecundum* S.T. Blake, *D. sericeum* (R. Br.) A. Camus.

Known distribution: C. Africa (Malawi, Zambia), Australia.

Sporisorium dichanthicola* (Mundkur & Thirum.) Vánky, **comb. nov.*

Basionym: \equiv *Sphacelotheca dichanthicola* Mundkur & Thirum., in Thirumalachar and Mundkur, Mycological Papers 40: 3, 1951. — Type on *Dichanthium caricosum* (L.) A. Camus, India, Mysore, Hebbal, 28.V.1945, M.J. Thirumalachar, HClO 10699; isotypes BPI 195078, HUV 17281!

Sori destroying the innermost floral organs ('ovaries'), all in the inflorescence, ovoid, ca. 1 \times 2-3 mm, hidden by the glumes, at first covered by a thin, brown peridium which dehisces from its apex exposing the dark brown, semi-agglutinated to powdery mass of spores and sterile cells, surrounding a 2-3 mm long, flagelliform, central columella. *Spores* when mature single,

subglobose, ellipsoidal, usually subpolyhedrally slightly irregular, $5.5-7(-8) \times 5.5-8(-9) \mu\text{m}$, yellowish-brown; wall even, ca. $0.5 \mu\text{m}$ thick, moderately densely, minutely punctate-echinulate, spore profile smooth. *Sterile cells* in irregular groups or short chains, collapsed in old specimen, single cells $7-15 \mu\text{m}$ long, subhyaline; wall thin (ca. $0.5 \mu\text{m}$), smooth.

Host: Dichanthium caricosum (L.) A. Camus.

Known distribution: S. Asia (India).

***Sporisorium dichanthii* Vánky & N.D. Sharma, sp. nov.** (Figs. 1, 3-4)

Typus in matrice *Dichanthium aristatum* (Poir.) C.E. Hubb., India, Madhya Pradesh, cca. 200 km SW urbe Jabalpur, Pachmarhi, 30.X.1992, leg. R. Sharma et S. Raich, HUV 20263; isotypes BPI, HClO.

Sporisorium dichanthii a specie *S. rubyanum* Vánky & N.D. Sharma (diagn. in opere praesenti) imprimis sporis majoribus, atrioribus, crasse tunicatis distinctum. Sporae externae *S. dichanthii* $10.5-13.5 \times 13-18(-20) \mu\text{m}$, atro-rubrobrunneae; pariete inaequali, $1.5-2.5(-3) \mu\text{m}$ crasso. Sporae externae speciei *S. rubyanum* $8-10.5 \times 9-13 \mu\text{m}$, rubrobrunneae; pariete parum inaequali, $0.5-1(-1.5) \mu\text{m}$ crasso.

Sori (Fig. 1) in all spikelets of an inflorescence, long ellipsoidal, $0.6-1 \times 4-7 \text{ mm}$, partly hidden by the floral envelopes, first covered by a pale brown peridium which ruptures irregularly disclosing the black, first agglutinated, later granular-powdery mass of spore balls surrounding a central columella, usually with 2-4, long, filiform branches. *Spore balls* (Figs 3, 4) subglobose, ovoid, ellipsoidal, elongated or slightly irregular, $25-50 \times 30-60(-80) \mu\text{m}$, dark reddish-brown to subopaque, composed of 5-50 or more spores which separate rather easily by pressure. *Spores* (Figs 3, 4) dimorphic; outer spores ovoid, ellipsoidal, elongated or slightly irregular, $10.5-13.5 \times 13-18(-20) \mu\text{m}$, dark reddish-brown; wall uneven, $1.5-2.5(-3) \mu\text{m}$ thick, densely, prominently verrucose on the free surface where the spore profile is serrulate. Inner spores subglobose, ovoid or rounded irregular, $8-10.5 \times 9-14 \mu\text{m}$, pale olivaceous-brown; wall even, ca. $0.5 \mu\text{m}$ thick, smooth. *Sterile cells* absent.

Host: Dichanthium aristatum (Poir.) C.E. Hubb.

Known distribution: India. Known only from the type collection.

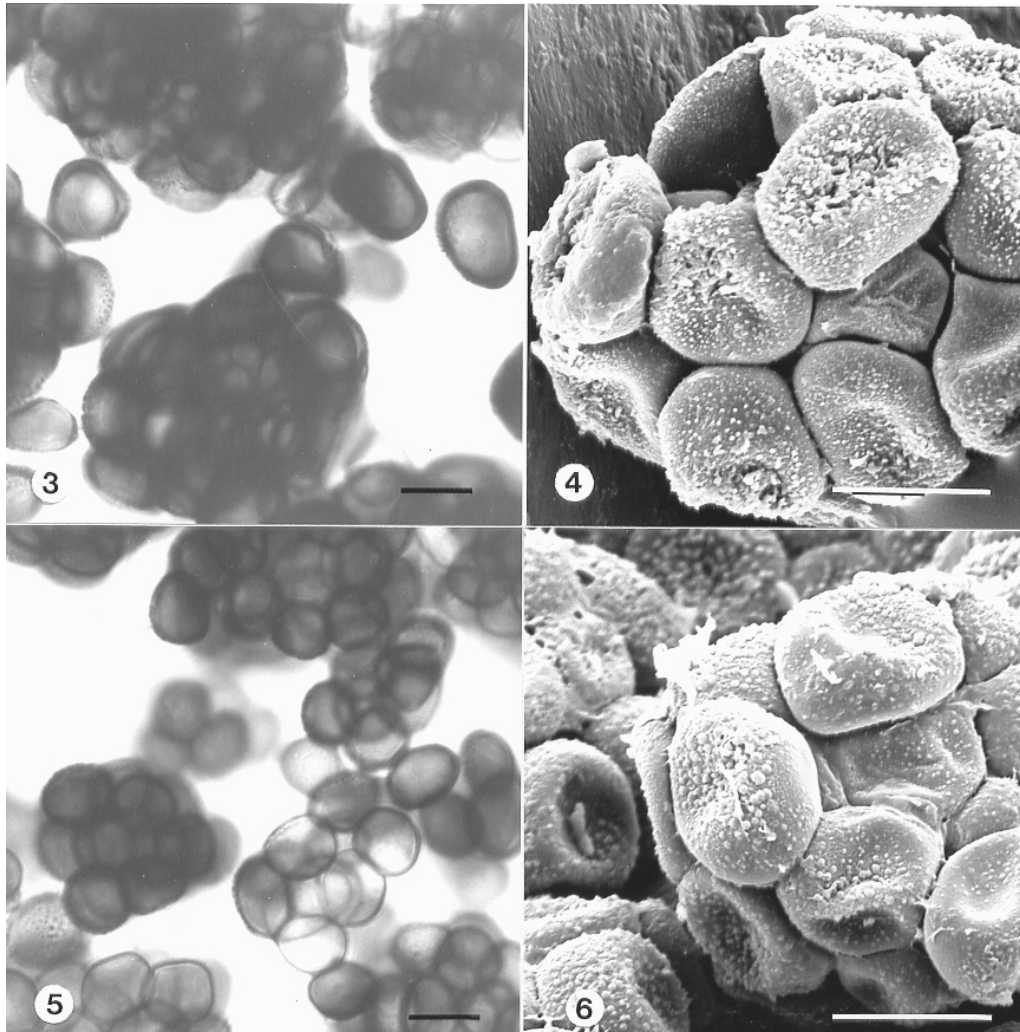
Sporisorium dichanthii differs from *S. rubyanum* Vánky & N.D. Sharma (opus praesens) especially by the larger, darker, thick-walled spores. The outer spores of *S. dichanthii* measure $10.5-13.5 \times 13-20 \mu\text{m}$, are dark reddish-brown, with an uneven, $1.5-2.5(-3) \mu\text{m}$ thick wall. These, in *S. rubyanum* are $8-10.5 \times 9-13 \mu\text{m}$, reddish-brown, with a slightly uneven, $0.5-1(-1.5) \mu\text{m}$ thick wall.



Fig. 1. Sori of *Sporisorium dichanthii* in all spikelets of an inflorescence of *Dichanthium aristatum* (from holotype). Habit and enlarged a sessile and a pedicelled spikelet with sori.

Fig. 2. Sori of *Sporisorium rubyanum* in all spikelets of an inflorescence of *Capillipedium assimile* (from holotype). Habit and enlarged a sessile and a pedicelled spikelet with sori.

Bars = 1 cm, and 2 mm for enlargement.



Figs 3, 4. Spore balls and spores of *Sporisorium dichanthii* Vánky & N.D. Sharma on *Dichanthium aristatum* (Poir.) C.E. Hubb., in LM and in SEM (from holotype).

Figs 5, 6. Spore balls and spores of *Sporisorium rubyanum* Vánky & N.D. Sharma on *Capillipedium assimile* (Steud.) A. Camus, in LM and in SEM (from holotype).

Bars = 10 μ m.

Sporisorium dinteri* (H. & P. Sydow) Vánky, **comb. nov.*

Basionym: \equiv *Ustilago dinteri* H. & P. Sydow, Annales Mycologici 13: 37, 1915.

\equiv *Sphacelotheca dinteri* (H. & P. Sydow) Zundel, 1930: 140. — Type on *Andropogon papillosum* A. Rich. (= *Dichanthium papillosum* (A. Rich.) Stapf, = *D. annulatum* (Forsk.) Stapf var. *papillosum* (A. Rich.) De Wet and Harlan), Namibia, Oljikuara-Okahami, 7.III.1913, Dinter 3286, BPI 160215!; isotypes BPI 188928, BPI 188929.

Sori destroying the whole inflorescence, partly hidden by the terminal leaf-sheath, long linear, 1.5-6 cm long, covered by a thick, pale brown peridium which flakes away revealing the dark brown, semi-powdery mass of spores and sterile cells surrounding a well formed, simple or branching columella. *Spores* globose, subglobose, ellipsoidal, frequently rounded subpolyhedral, 9-12 × 10.5-14 µm, yellowish-brown; wall even, 0.8-1 µm thick, minutely, densely echinulate; spore profile wavy to finely serrulate. *Sterile cells* in irregular groups, single cells 7-13(-16) µm long, subhyaline, collapsed in old specimens; wall 0.5-0.8 µm thick, smooth.

Hosts: *Bothriochloa bladhii* (Retz.) S.T. Blake, *Dichanthium annulatum* (Forsk.) Stapf var. *papillosum* (A. Rich.) De Wet and Harlan (*Andropogon papillosum* A. Rich.; *Dichanthium papillosum* (A. Rich.) Stapf), *D. fecungum* S.T. Blake, *D. ischaemum* (L.) Roberty (*Bothriochloa ischaemum* (L.) Keng).

Known distribution: Africa (Namibia, Zimbabwe), S. Asia (Pakistan), Australia.

11. *Sporisorium doidgeae* (Zundel) Langdon & Fullerton, 1978: 452.

≡ *Sphacelotheca doidgeae* Zundel, 1930: 131. — Lectotype (designated by Doidge, 1950: 382) on *Bothriochloa glabra* (Roxb.) A. Camus (= *B. bladhii* (Retz.) S.T. Blake), South Africa, Natal, Edendale, 26.XII.1911, E.M. Doidge, PREM 1997; isolectotypes BPI 195079!, HUV 18065! Syntypes on *Bothriochloa* sp. (= *B. insculpta* (Hochst. ex A. Rich.) A. Camus, teste K. Vánky), South Africa, Transvaal, Pretoria, Onderstepoort, 20.XII.1921, A.O.D. Mogg, PREM 15058, BPI 160222!, HUV 1899!; on *Bothriochloa glabra* (= *B. bladhii*), South Africa, Natal, Maritzburg, 15.III.1915, J.M. Sim, PREM 8939, HUV 18066!

= *Sorosporium andropogonis-micranthi* Y. Ling & T.L. Chen, 1945: 21.

≡ *Sporisorium andropogonis-micranthi* (Y. Ling & T.L. Chen) Vánky, 2000a: 176. — Syntypes on *Andropogon micranthus* Kunth (= *Capillipedium parviflorum* (R. Br.) Stapf), China, Fukien Prov., Yungan, Moping, 26.IX.1942, T.L. Chen 294, and Fukien Prov., vicinity of Sha-hsien, 15.X.1942, T.L. Chen 300 (syn. nov.).

= *Sphacelotheca capillipedii* L. Ling, 1945: 8.

≡ *Sporisorium capillipedii* (L. Ling) L. Guo, 1990: 78. — Type on *Capillipedium parviflorum* (R. Br.) Stapf, China, Szechwan Prov., Chengtu, 11.XI.1938, L. Ling, IMI 498! Topotypes: 5.IX.1939, L. Ling, BPI 177299!, 5.II.1940, L. Ling, BPI 195086!, and XI.1947, K.R. Lin, BPI 177298! (syn. nov.).

= *Sphacelotheca pakistanica* S. Ahmad, 1956: 7. — Type on *Capillipedium parviflorum* (R. Br.) Stapf, Pakistan, Murree, VIII.1952, S. Ahmad; isotype HUV 7245! (syn. nov.).

Sori variable, may destroy the whole inflorescence, all or only some branches of the inflorescence, some racemes or some spikelets of a raceme. Accordingly, the sori may be cylindrical, irregularly branched or compound, often with intact inflorescence branches or groups of spikelets, 1-4 mm × 1-7 cm, partly hidden by the distal leaf sheath, first covered by a brown peridium which ruptures irregularly, flakes away, disclosing the dark brown, semi-agglutinated to powdery mass of loose spore balls, spores and sterile cells surrounding a simple or irregularly ramified columella. *Spore balls* ephemeral,

when young subglobose, ellipsoidal, 80–100 μm in diameter, dark brown, composed of 50–200? spores surrounded by a hyaline coat of hyphae which gelatinises and disappears at maturity. *Spores* when mature single, globose, subglobose, ellipsoidal to subpolyhedrally slightly irregular, 8-9.5 \times 8-10.5(-12) μm , yellowish-brown; wall even, ca. 0.5 μm thick, from apparently smooth to finely, densely punctate or verruculose-echinulate; spore profile smooth or nearly so, in SEM between short spines densely, finely verruculose. *Sterile cells* in irregular groups or in chains, single cells irregular, with one or several flattened sides, rarely globose or ellipsoidal, 5-10 \times 6-11(-15) μm , hyaline, collapsed in old specimens; wall ca. 0.5 μm thick, smooth.

Hosts: *Bothriochloa bladhii* (Retz.) S.T. Blake (*B. glabra* (Roxb.) A. Camus), *B. ewartiana* (Domin) C.E. Hubb., *B. insculpta* (Hochst. ex A. Rich.) A. Camus, *Capillipedium parviflorum* (R. Br.) Stapf, *C. spicigerum* (Benth.) S.T. Blake (*Bothriochloa spicigera* (Benth.) T. Koyama), *Dichanthium sericeum* (R. Br.) A. Camus.

Known distribution: Africa (Ethiopia, S. Africa), Asia (China, India, Pakistan), Australia.

***Sporisorium foveolati* (Maire) Vánky, 1988: 367.**

≡ *Sphacelotheca foveolati* Maire, 1931: 21. — Type on *Andropogon foveolatus* Delile (= *Dichanthium foveolatum* (Delile) Roberty), Algeria, in the mountains of C. Sahara, Tefedest, Oued Araghan, 10.IV.1928, R. Maire, MPU, Herb. Maire 9455!

Sori destroying the whole inflorescence, 1-2 \times 10-15 mm, partly hidden by the uppermost leaf sheath, at first 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 simple, flagelliform columella. *Spores* rounded subpolyhedral, often irregular, 8-11 \times 9-13 μm , olivaceous-brown; wall even, 0.5-0.8 μm thick, densely, finely to evidently 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.

Hosts: *Dichanthium foveolatum* (Delile) Roberty (*Eremopogon foveolatus* (Delile) Stapf).

Known distribution: Africa (Algeria, Cape Verde I., Chad, Egypt, Morocco).

Sporisorium foveolati differs from *S. andropogonis* (Opiz) Vánky (type on *Dichanthium ischaemum* (L.) Roberty) in having darker, slightly larger, more irregular spores with coarser ornamentation and much larger, thick-walled sterile cells. It differs also from *S. dinteri* (H. & P. Sydow) Vánky, in which the sterile cells are smaller (7-13 μm long), thin-walled (0.5-0.8 μm) and hyaline.

Sporisorium mysorensense (Pavgi & Thirum.) Vánky, 1995: 230.

≡ *Sphacelotheca mysorensis* Pavgi & Thirum., in Thirumalachar and Pavgi, 1952: 394.
 — Type on *Capillipedium huegelii* (Hackel) A. Camus, India, Mysore, Shimoga Distr., at Bedur, V.1951, B.T. Lingappa, HClO 20130!; isotypes IMI 52805, HUV 16039!

Sori in all spikelets of an inflorescence, cylindrical, ca. 1 × 2–4 mm, covered by a thick, light brown peridium which ruptures and opens from its apex like a tulip, disclosing the blackish-brown, first agglutinated, later powdery mass of spore balls and spores intermixed with sterile cells, surrounding a simple, rarely shortly ramified, central columella. *Spore balls* loose, many-spored, early breaking into single spores. *Spores* subglobose, ellipsoidal, usually subpolyhedrally irregular, 9.5–12 × 10.5–13.5 μm, olivaceous-brown, with 4–6 lighter, rounded areas where the c. 1 μm thick wall is thinner and often collapsed when the spores are dried; wall apparently smooth to very finely and densely punctate. *Sterile cells* in irregular groups, single cells globose, subglobose, ellipsoidal or flattened on one or two sides, 6.5–15 μm in diameter, pale yellow, collapsed in old specimens; wall thin, ca. 0.5 μm, smooth.

Host: *Capillipedium huegelii* (Hackel) A. Camus.

Known distribution: S. Asia (India).

Sporisorium reticulatum (B. Liu, Z.Y. Li & Du) Vánky, **comb. nov.**

Basionym: ≡ *Sphacelotheca reticulata* B. Liu, Z.Y. Li & Du, Journal of Shanxi University 3-4: 37, 1979. — Type on *Bothriochloa ischaemum* (L.) Keng (= *Dichanthium ischaemum* (L.) Roberty), China, Gansu Prov., Cheng Xian (Chengsien), 20.VIII.1974, Zhang Lang 1231 (Type no longer exists*).

Sori destroying the whole inflorescence, partly hidden by the uppermost leaf sheaths, cylindrical, 2–3 cm long, at first covered by a whitish peridium which ruptures at maturity disclosing the blackish-brown, powdery mass of spores, sterile cells and numerous, filiform columellae. *Spores* globose, ovoid or subellipsoidal, 5.7–11.6 μm diam., reddish-brown; wall minutely reticulate, areolae 1.8–2.8 μm wide, muri 0.6 μm high. *Sterile cells* subglobose, irregularly globoid to subpolyhedrally irregular, 9.5–17 diam., hyaline.

Host: *Dichanthium ischaemum* (L.) Roberty (*Bothriochloa ischaemum* (L.) Keng).

Known distribution: E. Asia (China). Known only from the type locality.

*Unfortunately, the type specimen at the Herb. Dept. of Biology, Shanxi University, Taiyuan City, China, was destroyed by a fire in 1985. No isotypes were deposited at HMAS or other herbaria (Dr. L. Guo, in litt.). The description above is taken from the original. If it is true that the spores are reticulate, it would be a unique feature between the grass-infecting *Sporisorium/Ustilago* complex. Unfortunately, the quality of the published LM

microphotographs do not allow to verify and confirm the presence of such a reticulum. Recollection of this species is desired to clarify this problem.

***Sporisorium rubyanum* Vánky & N.D. Sharma, sp. nov.** (Figs 2, 5-6)

Typus in matrice *Capillipedium assimile* (Steud.) A. Camus (det. S.G. Pradham), India, Madhya Pradesh, Pachmarhi, Patherchatta, 22°28' N, 78°26' E, alt. cca. 1130 m.s.m., 8.X.1994, leg. Ruby Sharma, Herb. Ustil. Vánky, HUV 20261!; isotypi in BPI, HCIO, & in Herb. Dept. of Plant. Pathology, J.N. Agricultural University, Jabalpur, India. Paratypus in matrice *Capillipedium assimile*, India, Madhya Pradesh, Pachmarhi, 31.X.1992, leg. R. Sharma & S. Raich, HUV 20264!; isoparatypi in HCIO & in Herb. Dept. of Plant. Pathology, J.N. Agricultural University, Jabalpur, India.

Sori in spiculis omnibus inflorescentiae eiusdem, longe ellipsoidales, 0,5-1 × 3-6 mm, involucris floralibus partim obtecti, primum peridio pallide brunneo cooperti, quo irregulariter disrupto massam glomerulorum sporarum nigram, semiagglutinatum usque granuloso-pulveream, columellam crassam, flagelliformem, plerumque bi- vel trifidam circumdantem ostendentes. *Glomeruli sporarum* forma et magnitudine varii, subglobosi, ellipsoidales, elongati vel irregulares, 20-40 × 25-90 µm, rufobrunnei, e sporis 6-50(-100?), pressu separabilibus compositi. *Sporae* dimorphae; externae earum subglobosae, ovoideae, ellipsoidales usque parum irregulares, 8-10,5 × 9-13 µm, rufobrunneae; pariete parum inaequali, 0,5-1(-1,5) µm crasso, in superficie libera moderate dense proeminenter verrucoso; imago obliqua sporae levis, ad superficiem liberam serrulata. Sporae internae roundae usque parum irregulares, magnitudine sporis externis cca. aequales, pallide flavidobrunneae; pariete aequali, tenui, 0,3-0,4 µm, levi. *Cellulae steriles* absentes.

Sori (Fig. 2) in all spikelets of an inflorescence, long ellipsoidal, 0.5-1 × 3-6 mm, partly hidden by the floral envelopes, first covered by a pale brown peridium which ruptures irregularly disclosing the black, semiagglutinated to granular-powdery mass of spore balls surrounding a stout, flagelliform, usually bi- or trifid columella. *Spore balls* (Figs 5, 6) variable in shape and size, subglobose, ellipsoidal, elongated or irregular, 20-40 × 25-90 µm, reddish-brown, composed of 6-50(-100?) spores which separate by pressure. *Spores* (Figs 5, 6) dimorphic; outer spores subglobose, ovoid, ellipsoidal to slightly irregular, 8-10.5 × 9-13 µm, reddish-brown; wall slightly uneven, 0.5-1(-1.5) µm thick, moderately densely, prominently verrucose on the free surface; spore profile smooth, serrulate on the free surface. Inner spores rounded to slightly irregular, about the size of the outer spores, pale yellowish-brown; wall even, thin, 0.3-0.4 µm, smooth. *Sterile cells* absent.

Host: *Capillipedium assimile* (Steud.) A. Camus (*Dichanthium assimile* (Steud.) Deshpande), India.

Known distribution: Known only from the type collection.

Etymology: This fungus is named after its collector, the young Mrs. Ruby Sharma (Jabalpur, India), MSc in botany, eager collector, working on threatened plants of Central India.

***Sporisorium sahayai* (Mundkur) Vánky, comb. nov.**

Basionym: \equiv *Sphacelotheca sahayai* Mundkur, Trans. Brit. Mycol. Soc. 23: 93, 1939. — Type on *Dichanthium annulatum* (Forssk.) Stapf, India, Orissa, Ganjam Distr., at Chatrapur, 30.VIII.1904, E.J. Butler, HClO 7333; isotypes IMI, HUV 17303!

Sori destroying all the innermost floral organs ("ovaries") of an inflorescence, ellipsoidal, 2-3 mm long, at first hidden, later visible between the spreading glumes, covered by a delicate peridium which flakes away exposing the semi-agglutinated, blackish-brown mass of spores and sterile cells surrounding a well-developed columella. *Spores* when mature single, globose, subglobose, broadly ellipsoidal to slightly irregular, 9-13.5 \times 10.5-14 μ m, dark yellowish-brown; wall 1-2 μ m thick, prominently, rather densely echinulate, spore profile serrulate. *Sterile cells* in small, irregular groups, in short chains or single, variable in shape and size, globose, ellipsoidal to irregular, with flattened contact sides, 7-13 μ m long, subhyaline or with pale yellowish-brown tint; wall 0.5–1 μ m thick, smooth.

Hosts: *Dichanthium affine* (R. Br.) A. Camus, *D. annulatum* (Forssk.) Stapf.

Known distribution: S. Asia (India), Australia.

Sporisorium sahayai is close to *S. andropogonis-annulati* (both on the same host plant), from which it differs especially in the darker, prominently echinulate spores with serrulate spore profile. In *S. andropogonis-annulati* the spores are finely, sparsely to moderately densely verrucose-echinulate which hardly affects the spore profile.

***Sporisorium superfluum* (H. & P. Sydow) Vánky, comb. nov.**

Basionym: \equiv *Ustilago superflua* H. & P. Sydow, in Sydow, H., Sydow P. and Butler, Annales Mycologici 10: 249, 1912.

\equiv *Sphacelotheca superflua* (H. & P. Sydow) Zundel, 1930: 138. — Type on *Andropogon foveolatus* Delile (= *Dichanthium foveolatum* (Delile) Roberty), India, Madras Presidency, Samalkota, 21.XI.1910, Shaw, HClO 1431; isotypes BPI 188946, HUV 17310!

Sori destroying the whole inflorescence, cylindrical, 7-12 mm long, at first concealed by a leaf sheath and covered by a brown peridium which flakes away revealing a dark brown spore mass surrounding a well developed columella. *Spores* subglobose, ellipsoidal to rounded subpolyhedrally irregular, 11-14.5 \times 13-16 μ m, yellowish-brown; wall even, ca. 1 μ m thick, rather densely, finely echinulate, spore profile serrulate, in SEM between the spores finely verrucose. *Sterile cells* in small or large groups or single, globose, ellipsoidal or irregular, with flattened sides, 10-20 μ m long, subhyaline to pale yellow; wall 1.5-2.5 μ m thick, smooth.

Hosts: *Dichanthium foveolatum* (Delile) Roberty (*Andropogon foveolatus* Delile); *Eremopogon foveolatus* (Delile) Stapf).

Known distribution: S. Asia (India).

Sporisorium taianum (H. Sydow) L. Guo, 1990: 85.

≡ *Ustilago taiana* H. Sydow, 1929: 421.

≡ *Sphacelotheca taiana* (H. Sydow) L. Ling, 1945: 9.

≡ *Sorosporium taianum* (H. Sydow) Zundel, 1953: 75. — Type on *Andropogon micranthus* Kunth (= *Capillipedium parviflorum* (R. Br.) Stapf), China, Kiangsu Prov., Nanking, 12.IX.1928, F.L. Tai 2190, HMAS 10693; isotypes BPI 180799, 180780, 188947, 188948, IMI 503, HUV 12006!, 12221!

Sori in the spikelets, ca. 1 × 3-4 mm, first covered by a delicate greyish peridium which flakes away disclosing the brown, powdery mass of spores and sterile cells surrounding a simple, 1-2 mm long central columella. *Spores* when mature single, globose, subglobose, ovoid, usually ellipsoidal with a more or less flattened side (where the spore wall is thinner), 5.5-7 × 6.5-8 μm, light olivaceous-brown; wall smooth, 0.5-0.8 μm thick, thinner on one side, where the spore colour is somewhat paler. *Sterile cells* in shorter or longer chains, flattened, rarely single, globose, 7-11 μm wide, hyaline, thin-walled (ca. 0.5 μm), smooth.

Host: *Capillipedium parviflorum* (R. Br.) Stapf.

Known distribution: E. Asia (China).

Sporisorium tenue (H. & P. Sydow) Vánky, **comb. nov.**

Basionym: ≡ *Ustilago tenue* H. & P. Sydow, in Sydow, H., Sydow P. and Butler, *Annales Mycologici* 4: 425, 1906.

≡ *Sphacelotheca tenue* (H. & P. Sydow) Zundel, 1930: 137. — Type on *Andropogon pertusus* L. (= *Bothriochloa pertusa* (L.) A. Camus), India, Mysore, Hunsur, 21.IX.1903, E.J. Butler 452, BPI 168150!; isotypes BPI 188949! (date of collection incorrectly as "21.XI.1903"), BPI 192075! (date of collection as "29.III.1903").

= *Sphacelotheca amphiphis* H. Sydow, 1935: 232.

≡ *Sporisorium amphiphis* (H. Sydow) Langdon and Full., 1978: 451. — Type on *Amphiphis insculpta* (A. Rich.) Stapf (= *Bothriochloa insculpta* (Hochst. ex A. Rich.) A. Camus), South Africa, Transvaal, Barberton Distr., along Crocodile River at Schagen, VI.1931, L.C.C. Liebenberg 2297, PREM 26023; isotypes BPI 177156, HUV 17936! (syn. nov.)

= *Sphacelotheca bothriochloae* Zundel, 1939: 587 (as '*botriochloae*'). — Type on *Bothriochloa decipiens* (Hack.) C.E. Hubb., Australia, New South Wales, Walla Walla, 17.V.1937, R.A. Black, BPI 195096! (syn. nov.).

= *Sphacelotheca macalpiniae* Zundel, 1939: 583. — Type on *Andropogon intermedius* R. Br. (= *Bothriochloa intermedia* (R. Br.) A. Camus, = *B. bladhii* (Retz.) S.T. Blake), Australia, New South Wales, 1912 (without exact place, date and collector; as *Cintractia columellifera*), BPI 178058! (syn. nov.).

Sori destroying the whole inflorescence, long linear, 1-7 cm long, partly hidden by the uppermost leaf sheath, at first covered by a yellowish-brown peridium which flakes away disclosing the dark brown, semi-agglutinated to powdery mass of spores intermixed with sterile cells surrounding a well-developed, simple or ramified columella. *Spore balls* ephemeral. *Spores* when

mature single, variable in shape and size, globose, subglobose, ovoid, ellipsoidal to rounded, subpolyhedrally irregular, 5.5-8(-9) × 6.5-9.5 µm, yellowish-brown; wall even, c. 0.5 µm thick, from apparently smooth to finely punctate or verrucose-echinulate; spore profile smooth, wavy to finely serrulate. *Sterile cells* in irregular groups, single cells globose, ellipsoidal to irregular, 6-15 µm long, hyaline, collapsed in old specimens; wall even, ca. 0.8 µm thick, smooth.

Hosts: *Bothriochloa bladhii* (Retz.) S.T. Blake (*Dichanthium bladhii* (Retz.) W.D. Clayton), *B. decipiens* (Hack.) C.E. Hubb. (*Amphilophis decipiens* (Hack.) Stapf), *B. ewartiana* (Domin) C.E. Hubb., *B. insculpta* (Hochst. ex A. Rich.) A. Camus (*Amphilophis insculpta* (A. Rich.) Stapf), *B. intermedia* (R. Br.) A. Camus, *B. macra* (Steudel) S.T. Blake, *B. pertusa* (L.) A. Camus (*Andropogon pertusus* L.), *Dichanthium annulatum* (Forsk.) Stapf.

Known distribution: Africa (Ethiopia, Malawi, S. Africa, Zimbabwe), Asia (India, Pakistan), Australasia (Australia, Papua New Guinea).

Key to the smut fungi of *Bothriochloa*, *Capillipedium* and *Dichanthium*

(*S.* = *Sporisorium*)

1. Sori as long tubes on the top of the stems.....*Macalpinomyces chrysopogonicola*
1. Sori not so2
2. Sori on the leaves or leaf sheaths.....3
2. Sori in the flowers, spikelets, racemes or inflorescence4
3. Sori on adaxial surface of leaf sheaths. Spores 10-20(-24) µm long*Jamesdicksonia brunkii*
3. Sori on the leaves. Spores 9-13(-15) µm long*Jamesdicksonia obesa*
4. Sori in the flowers ("ovaries")5
4. Sori in the spikelets, racemes or whole inflorescence.....13
5. Sori in some ovaries or flowers of an inflorescence6
5. Sori in all flowers ("ovaries") of an inflorescence7
6. Sori 5-13 mm long. Spore balls and columella present. Spores 10-14.5 µm long, finely, densely verrucose-echinulate*S. bothriochloae*
6. Sori 2-3 mm long. Spore balls and columella absent. Spores 11.5-17 µm long, densely, coarsely echinulate.....*Macalpinomyces bothriochloae*
7. Spores smooth, lighter on one half*S. taianum*
7. Spores ornamented, sometimes very finely, not lighter on one half8
8. Spores 5.5–8(-9) µm long*S. dichanthicola*

Fungal Diversity

8.	Spores larger, over 9 μm long.....	9
9.	Spores dimorphic, i.e. outer and inner spores in a ball different. Sterile cells absent.....	10
9.	Spores not dimorphic. Sterile cells present.....	11
10.	Outer spores 9-13 μm long, wall 0.5-1(-1.5) μm thick.....	<i>S. rubyanum</i>
10.	Outer spores 13-18(-20) μm long, wall 1.5-2.5(-3) μm thick.....	<i>S. dichanthii</i>
11.	Spores dark yellowish-brown, wall 1-2 μm thick, prominently echinulate, spore profile serrulate.....	<i>S. sahayai</i>
11.	Spores yellowish-brown, wall ca. 0.5 μm thick, finely verrucose-echinulate, spore profile smooth to wavy.....	12
12.	Spores with 4-6, thin-walled, light areas.....	<i>S. mysorensis</i>
12.	Spores without light areas.....	<i>S. andropogonis-annulati</i>
13(4).	Sori destroying some spikelets of a few racemes or all of an inflorescence, usually with remnants of spikelets.....	<i>S. doidgeae</i>
13.	Sori destroying the whole inflorescence.....	14
14.	Columellae numerous, filiform. Spores reticulate(?).....	<i>S. reticulatum</i>
14.	Columella one, simple or ramified. Spores not reticulate.....	15
15.	Spores 13-16 μm long.....	<i>S. superfluum</i>
15.	Spores smaller.....	16
16.	Spores between 9-14 μm long.....	17
16.	Spores smaller.....	18
17.	Sterile cells 13-22 μm long, pale yellowish-brown; wall 1.5-3 μm thick.....	<i>S. foveolati</i>
17.	Sterile cells 7-13(-16) μm long, subhyaline; wall 0.5-0.8 μm thick.....	<i>S. dinteri</i>
18.	Spores 6.5-9.5 μm long.....	<i>S. tenue</i>
18.	Spores 7.5-11 μm long.....	<i>S. andropogonis</i>

HOST – PARASITE LIST

(*S.* = *Sporisorium*)

Amphilophis decipiens = *Bothriochloa decipiens*
Amphilophis insculpta = *Bothriochloa insculpta*
Andropogon amplexans = *Diheteropogon amplexans*
Andropogon annulatus = *Dichanthium annulatum*
Andropogon argenteus = *Andropogon ternarius*
Andropogon argyraeus = *Andropogon ternarius*
Andropogon barbinodis = *Bothriochloa barbinodis*
Andropogon bicornis – *Jamesdicksonia brunkii*

- Andropogon foveolatus* = *Dichanthium foveolatum*
Andropogon gerardii – *Jamesdicksonia brunkii*
Andropogon hirtiflorus = *Schizachyrium sanguineum* var. *hirtiflorum*
Andropogon hirtiflorus var. **pubiflorus** – *Jamesdicksonia brunkii*
Andropogon papillosus = *Dichanthium annulatum* var. *papillosum*
Andropogon perforatus – *Jamesdicksonia brunkii*
Andropogon pertusus = *Bothriochloa pertusa*
Andropogon saccharoides – *Jamesdicksonia brunkii*
Andropogon saccharoides var. *barbinodis* = *Bothriochloa barbinodis*
Andropogon saccharoides var. *leucopogon* = *Bothriochloa barbinodis*
Andropogon ternarius – *Jamesdicksonia brunkii*
Andropogon torreianus = *Andropogon saccharoides*
Andropogon sp. – *S. andropogonis*
Bothriochloa barbinodis – *Jamesdicksonia brunkii*
Bothriochloa bladhii – *S. andropogonis*; *S. bothriochloae*; *S. dinteri*; *S. doidgeae*; *S. tenue*
Bothriochloa caucasica – *S. andropogonis*
Bothriochloa decipiens – *S. andropogonis*; *S. tenue*
Bothriochloa ewartiana – *S. andropogonis*; *S. doidgeae*; *S. tenue*
Bothriochloa glabra = *Bothriochloa bladhii*
Bothriochloa insculpta – *S. doidgeae*; *S. tenue*
Bothriochloa intermedia – *S. andropogonis*; *S. tenue*
Bothriochloa ischaemum = *Dichanthium ischaemum*
Bothriochloa macra – *S. tenue*
Bothriochloa pertusa – *Macalpinomyces bothriochloae*; *S. andropogonis*; *S. tenue*
Bothriochloa spicigera = *Capillipedium spicigerum*
Capillipedium assimile – *S. rubyanum*
Capillipedium huegelii – *S. mysorensense*
Capillipedium parviflorum – *Macalpinomyces chrysopogonicola*; *S. doidgeae*; *S. taianum*
Capillipedium spicigerum – *S. doidgeae*
Chrysopogon echinulatus – *Macalpinomyces chrysopogonicola*
Chrysopogon fulvus – *Macalpinomyces chrysopogonicola*
Chrysopogon gryllus – *Macalpinomyces chrysopogonicola*
Dichanthium affine – *S. sahayai*
Dichanthium annulatum – *Jamesdicksonia obesa*; *S. andropogonis*; *S. andropogonis-annulati*; *S. sahayai*; *S. tenue*
Dichanthium annulatum var. **bullisetosum** – *S. andropogonis-annulati*
Dichanthium annulatum var. **papillosum** – *S. dinteri*
Dichanthium aristatum – *S. dichanthii*
Dichanthium assimile = *Capillipedium assimile*
Dichanthium bladhii = *Bothriochloa bladhii*
Dichanthium caricosum – *S. andropogonis-annulati*; *S. dichanthicola*
Dichanthium fecundum – *S. bothriochloae*, *S. dinteri*
Dichanthium foveolatum – *S. foveolati*; *S. superfluum*
Dichanthium ischaemum – *S. andropogonis*; *S. dinteri*; *S. reticulatum*
Dichanthium papillosum = *Dichanthium annulatum* var. *papillosum*
Dichanthium sericeum – *Jamesdicksonia brunkii*; *S. bothriochloae*; *S. doidgeae*
Dichanthium sericeum subsp. **polystachyum** – *Jamesdicksonia brunkii*
Diheteropogon amplectens – *S. andropogonis*

Eremopogon foveolatus = *Dichanthium foveolatum*
Heteropogon contortus – *S. andropogonis*
Heteropogon triticeus – *S. andropogonis*
Hyparrhenia rufa – *Jamesdicksonia obesa*
Schizachyrium sanguineum var. ***hirtiflorum*** – *Jamesdicksonia brunkii*

FUNGUS NAMES

(valid names in bold face; *S.* = *Sporisorium*)

amphilophidis Ustilago = ***S. andropogonis-annulati***
amphilophis Sphacelotheca = ***S. tenue***
amphilophis Sporisorium = ***S. tenue***
andropogonis Cintractia = ***S. andropogonis***
andropogonis Sphacelotheca = ***S. andropogonis***
andropogonis Sporisorium
andropogonis Uredo (Ustilago) = ***S. andropogonis***
andropogonis-annulati Sphacelotheca = ***S. andropogonis-annulati***
andropogonis-annulati Sporisorium
andropogonis-annulati Ustilago = ***S. andropogonis-annulati***
andropogonis-micranthi Sorosporium = ***S. doidgeae***
andropogonis-micranthi Sporisorium = ***S. doidgeae***
annulata Schroeteria = ***S. andropogonis-annulati***
annulata Sphacelotheca = ***S. andropogonis-annulati***
apiculata Ustilago = ***Jamesdicksonia brunkii***
bothriochloae Macalpinomyces
bothriochloae Sorosporium = ***S. bothriochloae***
bothriochloae Sphacelotheca = ***S. andropogonis***
bothriochloae Sphacelotheca = ***S. tenue***
bothriochloae Sporisorium
bothriochloae Ustilago = ***Macalpinomyces bothriochloae***
bothriochloae-intermediae Sphacelotheca = ***S. andropogonis***
bothriochloae-intermediae Ustilago = ***S. andropogonis***
brunkii Jamesdicksonia
brunkii Tilletia = ***Jamesdicksonia brunkii***
brunkii Tolyposporella = ***Jamesdicksonia brunkii***
brunkii Ustilago = ***Jamesdicksonia brunkii***
capillipedii Endosporisorium = ***Macalpinomyces chrysopogonicola***
capillipedii Sorosporium = ***Macalpinomyces chrysopogonicola***
capillipedii Sphacelotheca = ***S. doidgeae***
capillipedii Sporisorium = ***S. doidgeae***
chloridis Sphacelotheca = ***S. andropogonis***
chrysopogonicola Macalpinomyces
chrysopogonicola Sphacelotheca = ***Macalpinomyces chrysopogonicola***
chrysopogonis Macalpinomyces = ***Macalpinomyces chrysopogonicola***
chrysopogonis Ustilago = ***Macalpinomyces chrysopogonicola***
cylindrica Ustilago = ***S. andropogonis***
dichanthicola Sphacelotheca = ***S. dichanthicola***
dichanthicola Sporisorium

***dichanthii* Sporisorium**

dinteri Sphacelotheca = *S. dinteri*

***dinteri* Sporisorium**

dinteri Ustilago = *S. dinteri*

doidgeae Sphacelotheca = *S. doidgeae*

***doidgeae* Sporisorium**

duthiei Sphacelotheca = *S. andropogonis-annulati*

duthiei Ustilago = *S. andropogonis-annulati*

foveolati Sphacelotheca = *S. foveolati*

***foveolati* Sporisorium**

heteropogonis-triticei Sphacelotheca = *S. andropogonis*

ischaemi Cintractia = *S. andropogonis*

ischaemi Sphacelotheca = *S. andropogonis*

ischaemi Ustilago = *S. andropogonis*

macalpinae Sphacelotheca = *S. tenue*

***mysorensis* Sporisorium**

mysorensis Sphacelotheca = *S. mysorensis*

***obesa* Jamesdicksonia**

obesa Tolyposporella = *Jamesdicksonia obesa*

obesum Entyloma = *Jamesdicksonia obesa*

pakistanica Sphacelotheca = *S. doidgeae*

reticulata Sphacelotheca = *S. reticulatum*

***reticulatum* Sporisorium**

***rubyanum* Sporisorium**

sabourieana Ustilago = *S. andropogonis-annulati*

sahayai Sphacelotheca = *S. sahayai*

***sahayai* Sporisorium**

superflua Sphacelotheca = *S. superfluum*

superflua Ustilago = *S. superfluum*

***superfluum* Sporisorium**

taiana Sphacelotheca = *S. taianum*

taiana Ustilago = *S. taianum*

taianum Sorosporium = *S. taianum*

***taianum* Sporisorium**

***tenue* Sporisorium**

tenuis Sphacelotheca = *S. tenue*

tenuis Ustilago = *S. tenue*

Acknowledgements

I am grateful to S. Tóth (Gödöllő, Hungary) for providing the Latin descriptions, and to E.H.C. McKenzie (Auckland, New Zealand), for reading the manuscript and checking my English. Thanks are also due to S. Ahmad (Lahore, Pakistan), and the Directors and Curators of the Herbaria BPI, HClO, HMAS, IMI, MPU and PREM for loan and also exchange of herbarium specimens.

References

- Ahmad, S. (1956). Ustilaginales of West Pakistan. *Mycological Papers* 64: 1-17.
- Brefeld, O. (1883). *Botanische Untersuchungen über Hefenpilze*. 5. Die Brandpilze I (Ustilagineen). Leipzig, Verlag v. A. Felix, VI + 220 pp. + Pls. I-XIII.
- Brefeld, O. (1895). *Untersuchungen aus dem Gesamtgebiete der Mykologie*. XII. Hemibasidii. Brandpilze III. Münster i. W., Commissions-Verlag v. H. Schöningh. IV + 99-236 pp. + Pls. VI-XII.
- Bubák, F., (1912). Houby České. Díl II. Sněti (Hemibasidii). *Archiv pro Přírodovědecký Výzkum Čech* 15(3): 1-84.
- Clayton, W.D. and Renvoize, S.A. (1986). *Genera graminum. Grasses of the world*. Kew Bulletin Additional Series XIII. London, UK.
- Clinton, G.P. (1902). North American Ustilagineae. *Journal of Mycology* 8: 128-156.
- Doidge, E.M. (1950). The South African fungi and lichens to the end of 1945. *Bothalia* 5: 1-1045. (Ustilaginales pp. 377-393).
- Durán, R. (1972). Aspects of teliospore germination in North American smut fungi. II. *Canadian Journal of Botany* 50: 2569-2573 + Pls. I-IV.
- Ellis, J.B. and Everhart, B.M. (1890). New species of Uredineae and Ustilagineae. *Journal of Mycology* 6: 118-121.
- Ellis, J.B. and Galloway, B.T. (1890). New species of fungi. *Journal of Mycology* 6: 31-33.
- Fischer, G.W. (1953). *Manual of the North American Smut Fungi*. Ronald Press Co., New York.
- Fuckel, L. (1860). *Enumeratio fungorum Nassoviae*. *Jahrbücher des Vereins für Naturkunde im Herzogthum Nassau* 15: 1-126.
- Guo, L. (1990). The genera *Sorosporium* and *Sporisorium* in China. *Mycosystema* 3: 67-88.
- Jennings, H.S. (1890). Some parasitic fungi of Texas. *Bulletin of the Texas Agricultural Experimental Station*. 9: 23-29.
- Kochman, J. (1936). Grzyby Główniowe Polski. Ustilaginales Poloniae. *Planta Polonica*. 4: 1-161 + 12 Pls.
- Langdon, R.F.N. and Fullerton, R.A. (1978). The genus *Sphacelotheca* (Ustilaginales): criteria for its delimitation and the consequences thereof. *Mycotaxon* 6: 421-456.
- Ling, L. (1945). A contribution to the knowledge of the Ustilaginales in China. *Mycological Papers* 11: 1-12.
- Ling, L. (1950). Taxonomic notes on Asiatic smuts. II. *Sydowia* 4: 74-81.
- Ling, L. (1953). Taxonomic notes on the Ustilaginales. II. *Lloydia* 16: 180-192.
- Ling, Y. and Chen, T.L. (1945). Notes on some Fukien species of the family Ustilaginaceae. *Research Bulletin of the Institute of Zoology and Botany Fukien Academy* 1: 1-26.
- Liu, B., Li, Z. Y. and Du, F. (1979). A new species of the genus *Sphacelotheca*. *Journal of Shanxi University* 3-4: 37-39.
- Maire, R. (1931). Champignons nord-africains nouveaux ou peu connus. Fascicule 5. *Bulletin de la Société d'Histoire Naturelle de l'Afrique du Nord* 22: 13-24.
- Mishra, J.N. (1956). The Ustilaginales of Bihar. II. Five undescribed species. *Mycologia* 48: 872-876.
- Mishra, J.N. (1957). Ustilaginales of Bihar. III. Some new and interesting smuts. *Mycologia* 49: 256-261.
- Mundkur, B.B. (1939). A contribution towards a knowledge of Indian Ustilaginales. *Transactions of the British Mycological Society* 23: 86-121.

Fungal Diversity

- Mundkur, B.B. (1944). Some rare and new smuts from India. *Indian Journal of Agricultural Science* 14: 49-52.
- Opiz, P.M. (1823-25). *Naturalientausch*. No. 1-10. Prag. Sechstes Verzeichniss 1924: 37-52.
- Padwick, G.W. (1946). Notes on Indian fungi. IV. *Mycological Papers* 17: 1-12.
- Peck, C.H. (1882). New species of fungi. *Botanical Gazette (Crawfordsville)* 7: 54-57.
- Raghunath, T. (1969). Repeating sporidia in *Jamesdicksonia obesa* (Ustilaginales). *Experientia* 25: 760.
- Ricker, P.L. (1905). Notes on fungi II. with new species from various localities. *Journal of Mycology* 11: 111-115.
- Shivas, R.G. and Vánky, K. (2001). The smut fungi on *Cynodon*, including *Sporisorium normanense* sp. nov. from Australia. *Fungal Diversity* 8: 149-154.
- Sydow, H. (1929). Fungi chinenses. *Annales Mycologici* 27: 418-434.
- Sydow, H. (1935). Beschreibungen neuer südafrikanischer Pilze. VI. *Annales Mycologici* 33: 230-237.
- Sydow, H. and Sydow, P. (1901). Zur Pilzflora Tirols. *Oesterreichische Botanische Zeitschrift* 51: 11-29.
- Sydow, H. and Sydow, P. (1911). Novae fungorum species. VI. *Annales Mycologici* 9: 142-146 + Pl. 9.
- Sydow, H. and Sydow, P. (1915). Novae fungorum species. XIII. *Annales Mycologici* 13: 35-43.
- Sydow, H., Sydow, P. and Butler, E.J. (1906). Fungi Indiae orientalis. Pars I. *Annales Mycologici* 4: 424-445.
- Sydow, H., Sydow, P. and Butler, E.J. (1912). Fungi Indiae orientalis. Pars IV. *Annales Mycologici* 10: 243-280.
- Thirumalachar, M.J. and Mundkur, B.B. (1951). Revisions of and additions to Indian fungi. III. *Mycological Papers* 40: 1-15.
- Thirumalachar, M.J. and Pavgi, M.S. (1952). Notes on some Indian Ustilagineae. V. *Sydowia* 6: 389-395 + Pls. IV-V.
- Thirumalachar, M.J. and Pavgi, M.S. (1956). Notes on Indian Ustilagineae. VI. *Mycopathologia & Mycologia Applicata* 7: 282-290 + Pls. I-II.
- Thirumalachar, M.J., Pavgi, M.S. and Payak, M.M. (1960[1961]). *Jamesdicksonia*, a new genus of the Ustilaginales. *Mycologia* 52: 475-479.
- Vánky, K. (1985). Carpathian Ustilaginales. *Symbolae Botanicae Upsalienses* 24(2): 1-309.
- Vánky, K. (1988). Taxonomical studies on Ustilaginales. III. *Mycotaxon* 33: 365-374.
- Vánky, K. (1995). Taxonomical studies on Ustilaginales. XII. *Mycotaxon* 54: 215-238.
- Vánky, K. (1997). Taxonomical studies on Ustilaginales. XV. *Mycotaxon* 62: 127-150.
- Vánky, K. (2000a). Taxonomical studies on Ustilaginales. XX. *Mycotaxon* 74: 161-215.
- Vánky, K. (2000b). The smut fungi of *Saccharum* and related grasses. *Australasian Plant Pathology* 29: 155-163.
- Vánky, K. (2001). Taxonomical studies on Ustilaginales. XXI. *Mycotaxon* 78: 265-326.
- Vánky, K. (2003a). The smut fungi (Ustilaginomycetes) of *Hyparrhenia* (Poaceae). *Fungal Diversity* 12: 179-205.
- Vánky, K. (2003b). The smut fungi (Ustilaginomycetes) of *Sporobolus* (Poaceae). *Fungal Diversity* 14: 205-241.
- Vánky, K., Deml, G. and Oberwinkler, F. (1988). The smut fungi of *Hyparrhenia hirta* (Gramineae). *Journal of Phytopathology* 121: 181-191.
- Vánky, K. and Shivas, R.G. (2001). Smut fungi (Ustilaginomycetes) of *Sorghum* (Gramineae) with special regards to Australasia. *Mycotaxon* 80: 339-353.

Fungal Diversity

- Walker, J. and Shivas, R.G. (1998). Two species of *Sporisorium* on *Chionachne* in tropical Australia, the first Australian record of *Ustilago brunkei* and its transfer to *Jamesdicksonia*. *Mycological Research* 102: 1203-1214.
- Wang, S.R. and Piepenbring, M. (2002). New species and new records of smut fungi from China. *Mycological Progress* 1: 399-408.
- Wang, Y.C. (1962). (Some new species and new combination of smut fungi). *Acta Botanica Sinica* 10: 133-136.
- Zundel, G.L. (1930). Monographic studies on the Ustilaginales attacking *Andropogon*. *Mycologia* 22: 125-158.
- Zundel, G.L. (1939). Studies on the Ustilaginales of the world. *Mycologia* 31: 572-589.
- Zundel, G.L. (1944). Notes on the Ustilaginales of the world. IV. *Mycologia* 36: 400-412.
- Zundel, G.L. (1953). The Ustilaginales of the World. Pennsylvania State College, School of Agriculture, Department of Botany, Contribution No. 176: XI + 1-410.

(Received 1 August 2003; accepted 8 December 2003)

Fungal Diversity

Fig. 1. Sori of *Sporisorium dichanthii* in all spikelets of an inflorescence of *Dichanthium aristatum* (from holotype). Habit and enlarged a sessile and a pedicelled spikelet with sori.

Fig. 2. Sori of *Sporisorium rubyanum* in all spikelets of an inflorescence of *Capillipedium assimile* (from holotype). Habit and enlarged a sessile and a pedicelled spikelet with sori.

Bars = 1 cm, and 2 mm for enlargement.

Figs 3, 4. Spore balls and spores of *Sporisorium dichanthii* Vánky and N.D. Sharma on *Dichanthium aristatum* (Poir.) C.E. Hubb., in LM and in SEM (from holotype).

Figs 5, 6. Spore balls and spores of *Sporisorium rubyanum* Vánky and N.D. Sharma on *Capillipedium assimile* (Steud.) A. Camus, in LM and in SEM (from holotype).

Bars = 10 μ m.