The smut fungi on *Cynodon*, including *Sporisorium normanensis* sp. nov. from Australia

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Sporisorium normanensis sp. nov. (*Ustilaginaceae*, Ustilaginomycetes) is described and illustrated from *Cynodon dactylon* collected in northern Queensland, Australia. Brief descriptions and a key are provided for the six Ustilaginomycetes described from *Cynodon*, including *Sporisorium cynodontis* comb. nov.

Key words: Australia, *Cynodon*, smut fungi, *Sporisorium cynodontis*, *Sporisorium normanensis*, taxonomy, Ustilaginomycetes.

Introduction

Cynodon Rich. (*Poaceae*) belongs to the subfamily *Chloridoideae*, tribe *Cynodonteae*, subtribe *Chloridinae* (Clayton and Renvoize, 1986) and will form hybrids with *Chloris* (Mabberley, 1997). There are eight species of *Cynodon*, six of which occur in Australia, including two native species, *C. dactylon* (L.) Pers. (couch grass, Bermuda grass) and *C. radiatus* Roth ex Roem. and Schult. (Simon, 1993). *Cynodon dactylon*, which is cosmopolitan and native in warm regions of the world, is extensively cultivated in Australia as a lawn grass and grows naturally in northern Australia along rivers and near swamps and springs (Lazarides *et al.*, 1992).

Six species of Ustilaginomycetes have been described from *Cynodon*, namely *Sorosporium cynodontis* Ling, *Tilletia cynodontis* Vánky, *Ustilago cynodontis* (Henn.) Henn., *U. dregeana* Tul. and C. Tul., *U. hitchcockiana* Zundel and *U. paraguariensis* Speg. Some of these species were included in previous treatments of the smut fungi on *Cynodon* (Zundel, 1939; Zambettakis, 1963). Vánky (1997) demonstrated that the host plant of *U. dregeana* was not *C. dactylon* but a *Danthonia* sp. *sensu lato*. In the present study, six species of smut fungi are recognised on *Cynodon*, including an undescribed species found by the senior author on *C. dactylon* during a Northwatch (Queensland

Department of Primary Industries) survey of plant pests and diseases in northern Queensland.

Sporisorium cynodontis (L. Ling) R.G. Shivas and Vánky, **comb. nov.**

≡ *Sorosporium cynodontis* L. Ling, Sydowia 3: 131 (1949). Type on *Cynodon dactylon*, Philippine Islands, Luzon, Bulacan Prov., Station Maria, November 1924, M.S. Clemens 4863, BPI 179720!

Sori involving the entire inflorescence, cylindrical, tapering at both ends, 2-3 × 6-20 mm, partially concealed by the leaf sheaths, covered by a thin, delicate, greyish peridium that disintegrates early revealing a dark, semi-agglutinated mass of spore balls surrounding several fine columellae. *Spore balls* evanescent, subglobose, ellipsoidal or oblong, 30-52 × 40-78 µm, dark reddish-brown, subopaque. *Spores* globose to broadly ellipsoidal, often somewhat angular, 9-13.5 × 10.5-16(-17.5) µm, deep reddish-brown; wall slightly uneven, 1-2(-2.5) µm thick, thickest at the angles and on the free surface, densely verruculose to verrucose-echinulate on the free surface. Spore profile smooth, finely serrulate on the free wall. Inner spores lighter in colour with a *ca.* 0.5 µm thick, finely punctate-verruculose wall. *Sterile cells* not seen. Cells of the peridium chiefly in chains, subglobose to oblong, thin-walled, hyaline.

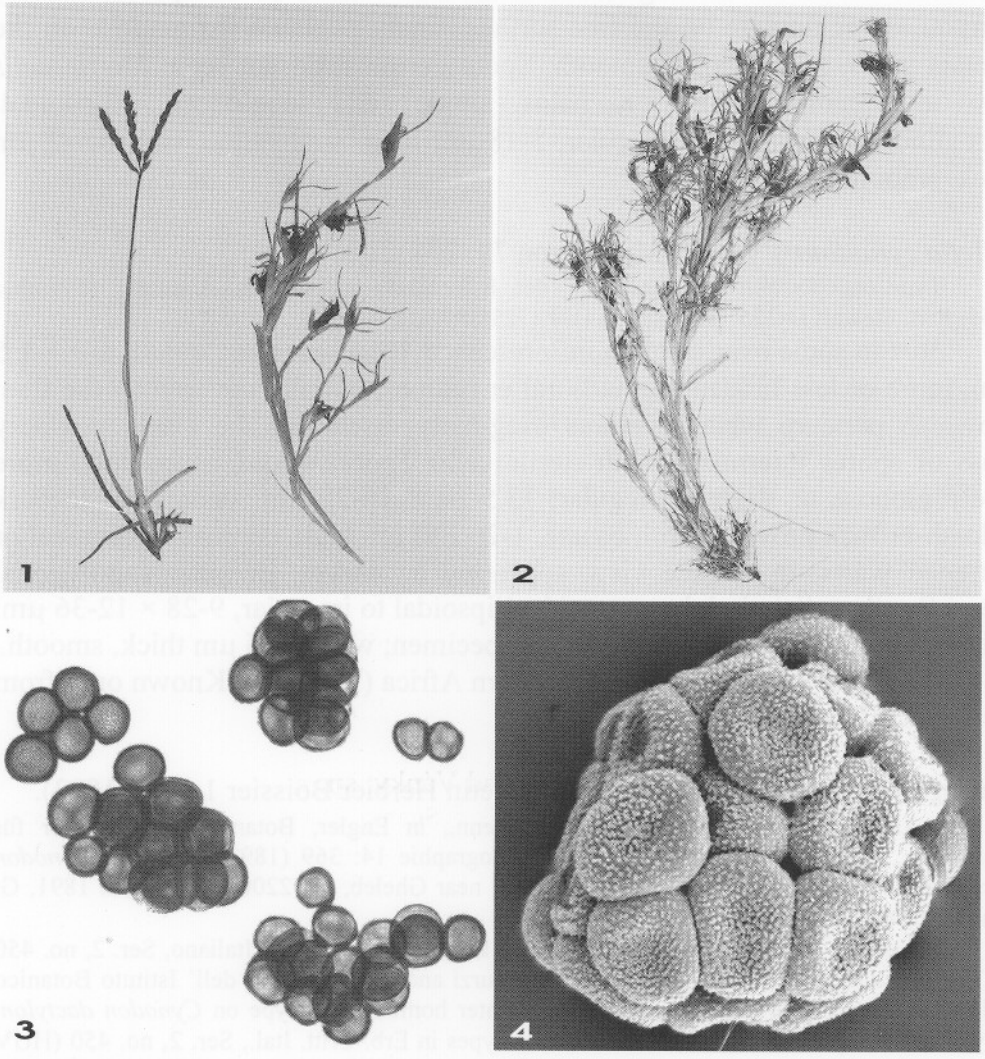
Known only from the type collection in the Philippines.

Sporisorium normanensis R.G. Shivas and Vánky, **sp. nov.** (Figs. 1-4)

Typus in matrice *Cynodon dactylon* (det. B.K. Simon), Australia, Queensland, Norman River Bridge, 18 km SSE Normanton, 17°51' S, 141°08' E, alt. 7 m.s.m., 10 September 1999, R.G. Shivas and M. Gunther. **Holotypus** in BRIP 25751 (designated here), isotypus in HUV 19088.

Sori (Figs. 1-2), flores recentes omnes destruentes, cylindrati, ad apicem attenuati, vaginis foliorum partim celati, 1-3 × 5-20 mm, primo peridio denso, flavidobrunneo tecti quod inaequaliter rumpitur, massam sporarum glomeraminum nigram, granulosam-pulveream et columellas plurimas pluriformes patefaciens. Omnibus floribus recentibus rhizomae contagione infectae nocitur. *Sporarum glomeramina* (Fig. 4), globosa, ovata, elongata vel paulum inaequalia, 15-90 × 25-160 m, rubrobrunnea usque ad vix pellucida, composita e sporis decem usque ad sescentis quae compressione facile separantur. *Sporae* (Fig. 3) subglobosae, ellipsoidales usque ad subpolyedriciter inaequales, 7-10.5 × 8-12 µm, rubrobrunneae; paries paulum inaequalis, *ca.* 0.5-1.0 µm densus, circa angulos et superficiem liberam sporarum densissimus, dense verriculosus-echinulatus in superficie libera, tenuiter punctuatus-verriculosus in lateribus contactis, sporarum facies levis. Germinatio sporarum non conspecta. *Cellulae steriles* paucae, inaequaliter collatae vel catenatae, cellulae singulares subglobosae, ellipsoidales, subcylindratae vel paulum inaequales, 5-18 µm longae, subhyalinae, paries 0.5-2 µm densus, levis.

Sori (Figs. 1-2) destroying the whole inflorescence, cylindrical, tapering at apex, partially concealed by the leaf sheaths, 1-3 × 5-20 mm, first covered by a thick, yellowish-brown peridium which ruptures irregularly exposing a



Figuress. 1-4. *Sporisorium normanensis* (from holotype). **1.** Healthy (left) and infected (right) inflorescences of *Cynodon dactylon*. **2.** Habit showing sori destroying every inflorescence on a rhizome. **3.** Spores (light microscopy). **4.** Spore ball (scanning electron microscopy). Bars: 1-2 = 2 cm; 3-4 = 10 µm.

black, granular-powdery mass of spore balls and several, filiform columellae. All inflorescences on an infected rhizome are affected. *Spore balls* (Fig. 4) globose, ovoid, elongated or slightly irregular, 15-90 × 25-160 µm, reddish-brown to subopaque, composed of 10 to hundreds of spores which readily separate by pressure. *Spores* (Fig. 3) subglobose, ellipsoidal to subpolyhedrally irregular, 7-10.5 × 8-12 µm, reddish-brown; wall slightly uneven, *ca.* 0.5-1.0

μm thick, thickest at the angles and at the free surface of the spores, densely verruculose-echinulate on the free surface, finely punctate-verruculose on the contact sides, spore profile smooth. Spore germination not seen. *Sterile cells* few, in irregular groups or chains, single cells subglobose, ellipsoidal, subcylindrical or slightly irregular, 5-18 μm long, subhyaline, wall 0.5-2 μm thick, smooth.

Tilletia cynodontis Vánky, Mycotaxon 78: 294 (2001).

Type on *Cynodon plectostachyus* (det. R.B. Stewart), Ethiopia, Alamata, November 1955, R.B. Stewart D-225. Holotype in BPI 172310!

Sori in some ovaries of an inflorescence, inconspicuous, ovoid, c. 1 × 1.5 mm, more or less hidden by the floral envelopes, initially covered by the thin, brownish pericarp which ruptures irregularly disclosing the black, powdery mass of spores intermixed with sterile cells. *Spores* ovoid, ellipsoidal, more rarely globose or slightly irregular, 13.5-20 × 16-25 μm, yellowish- to dark reddish-brown, provided with coarse, 1-2(-2.5) μm high, conical, subconical or flattened warts, in surface view appearing as darker, irregularly polygonal areas. *Sterile cells* subglobose, ovoid, ellipsoidal to irregular, 9-28 × 12-36 μm, pale yellowish-brown, collapsed in old specimen; wall 1-2.5 μm thick, smooth.

On *Cynodon plectostachyus*. Eastern Africa (Ethiopia). Known only from the type collection.

Ustilago cynodontis (Henn.) Henn., Bulletin Herbier Boissier 1: 114 (1893).

≡ *Ustilago segetum* var. *cynodontis* Henn., in Engler, Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie 14: 369 (1892). Type on *Cynodon dactylon*, Ethiopia, Erythrea, "Amba" [= mount] near Gheleb, alt. 2200 m, 13 April 1891, G. Schweinfurth.

= *Ustilago carbo* [var.] *cynodontis* Pass., Erbario Crittogamico Italiano, Ser. 2, no. 450 (1871). (*Ustilago cynodontis* (Pass.) Curzi, in Curzi and Barbaini, Atti dell' Istituto Botanico della Universita Pavia, Ser. 3, 3: 153 (1927) [later homonym]). Type on *Cynodon dactylon*, Italy, Parma, September 1870, G. Passerini; isotypes in Erb. Critt. Ital., Ser. 2, no. 450 (HUV 7298!).

Sori destroying more or less the whole inflorescence, powdery. *Spores* 6-8(-8.5) μm long, smooth. For a detailed description and illustration see Vánky, 1994: 356 and 339-340.

On *Cynodon aethiopicus* Clayton and Harlan, *C. dactylon*, *C. nlemfuensis* Vanderyst. Worldwide on *C. dactylon*.

Ustilago hitchcockiana Zundel, Mycologia 29: 585 (1937).

Type on *Cynodon dactylon*, Kenya, Nairobi, 26 September 1929, A.S. Hitchcock 25142, BPI 188935, 160889.

Sori destroying the whole inflorescence, long cylindrical, 0.2-0.7 × 2-10 cm, often comprising also the distal leaf, first covered by a greyish membrane

of host origin which ruptures disclosing the dark brown, powdery mass of spores and remnants of spike axes as long, filiform "columellae". *Spores* more or less laterally compressed, in plane view circular to subcircular, 4-5.5 × 5-6.5 µm, in side view ellipsoidal, 3-4 µm wide, wall evenly thick, *ca.* 0·5 µm, smooth. No sterile cells.

On *Cynodon dactylon*, *C. nlemfuensis* and its var. *robustus* Clayton and Harlan, *C. plectostachyus* (K. Schum.) Pilger. Eastern Africa (Kenya, Tanzania).

Ustilago paraguariensis Speg., Anales de la Sociedad Cientifica Argentina 17: 88 (1884).

Type on *Cynodon dactylon*, Paraguay, Paraguarí, 5 March 1883, B. Balansa, LPS 3058!, isotypes in Roumeg., Fgi. sel. gall. exs. no. 4113, HUV 12071!

Sori in the distal, shortened internodes of the stems, swollen, partly hidden by leaf sheaths and leaves, first covered by a thin, grey membrane of host epidermis which flakes away disclosing the blackish-brown, semiagglutinated to powdery mass of spores. *Spores* globose, subglobose to ellipsoidal, 7-9.5 × 7-11 µm, yellowish-brown; wall evenly thick, *ca.* 0.5 µm, finely, sparsely verrucose, spore profile smooth, in SEM sparsely provided with short spines.

On *Cynodon dactylon*. South America (Paraguay, Uruguay).

Key to the smut fungi of *Cynodon*

1. Sori in the ovaries. Spores 16-25 µm long, with flattened warts ..... ***Tilletia cynodontis***
1. Sori not in the ovaries. Spores less than 17.5 µm long, smooth or smooth in profile 2

2. Spore balls present 3
2. Spore balls absent 4

3. Spores 10.5-17.5 µm long .....***Sporisorium cynodontis***
3. Spores 8-12 µm long .....***Sporisorium normanensis***

4. Sori in the distal internodes. Spores 7-11 µm long ..... ***Ustilago paraguariensis***
4. Sori in the inflorescence. Spores smaller 5

5. Spores 6-8(-8.5) µm long ..... ***Ustilago cynodontis***
5. Spores 5-6.5 µm long .....***Ustilago hitchcockiana***

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