Polish Botanical Journal 55(2): 309–314, 2010

SPORISORIUM IGNOTUM – A REMARKABLE SMUT FUNGUS FROM ZIMBABWE ORIGINALLY CLASSIFIED IN THE GENUS *USTILAGO*[*]

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Abstract. The smut fungus *Ustilago ignota* Vánky described recently from Zimbabwe is reassessed. An examination of the holotype revealed that the sori surround the thick central stem from which longitudinal ridges of host origin (probably vascular bundles) emerge radially, and that the sterile cells, not mentioned in the protologue, are intermixed with spores. These features indicate that the species should be placed in the genus *Sporisorium* Ehrenb. *ex* Link rather than *Ustilago* (Pers.) Roussel. Accordingly, the new combination *Sporisorium ignotum* (Vánky) M. Piątek is proposed. The species is re-described and illustrated to include previously omitted morphological details.

Key words: *Sporisorium*, *Ustilago*, smut fungi, new combination, taxonomy, Zimbabwe, Africa

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INTRODUCTION

In the course of ongoing work on African smut fungi (Piątek & Vánky 2005, 2007; Piątek 2006, 2009a, b; Vánky & Piątek 2006; Piątek *et al.* 2008), the type and other collections of species described from this continent are routinely and successively re-examined to gain better insight into their variability and to obtain good illustrations for comparative and identification purposes, as many of them are inadequately or poorly illustrated in the available literature. The holotype of *Ustilago ignota* Vánky is among the specimens studied recently. This smut was described as new by Vánky (2005) from one collection on *Panicum* sp. collected in 1955 in Zimbabwe. The smut has not been found by Vánky himself in the field but was detected in the herbarium materials. Based on the description, *Ustilago ignota* is very similar to *Ustilago trichophora* (Link) Körn., with some subtle differences in the macroscopic appearance of infection (presence of witches' brooms *vs*. absence of such structures) and spore size and morphology [spores echinulate, 5.5–11.0(–12.0) × 5–8(–9) µm *vs*. spores echinulate-verruculose, 7–12 × 6–11 µm]. When preparing the original description, Vánky (2005) did not study the holotype designated by him and preserved in IMI, but only the isotype deposited in his personal herbarium H.U.V. (the symbol '!', which means that the collection was examined by Vánky is given only for the H.U.V. specimen). My examination of the holotype of *Ustilago ignota* revealed some morphological details which apparently were either omitted or misinterpreted in the protologue, but were important for the proper generic classification of this smut. Thus, the aim of this paper is to re-evaluate the taxonomic status of *Ustilago ignota* based on examination of the holotype specimen, and to re-describe and illustrate this smut in detail as I believe that the original description and illustration misinterpret or do not cover some important data essential to delimitation of this species.

MATERIALS AND METHODS

Sori, spore and sterile cells characteristics were studied using dried herbarium material. The specimen was examined by light microscopy (LM) and scanning electron

[*] This paper is dedicated to Professor Tomasz Majewski on the occasion of his 70th birthday.

microscopy (SEM). For LM, small pieces of sori were mounted in lactic acid, heated to boiling point and cooled, then examined under a Nikon Eclipse 80i light microscope. LM micrographs were taken with a Nikon DS-Fi1 camera. The spores and sterile cells were measured using NIS-Elements BR 3.0 imaging software. The variation of spore measurements is presented as a range, with extreme values (1–3 spores per slide) given in parentheses. Mean and standard deviation is given after the spore size range, but atypically large spores occasionally present in the specimen were not included in the calculations. Only extreme values are given for sterile cells, as they are generally of lesser taxonomical value than fertile spores. For SEM, spores and sterile cells were dusted onto carbon tabs and fixed to an aluminum stub with double-sided transparent tape. The stubs were sputter-coated with carbon using a Cressington sputter-coater and viewed with a Hitachi S-4700 scanning electron microscope, with a working distance of 12–13 mm. SEM images were made in the Laboratory of Field Emission Scanning Electron Microscopy and Microanalysis at the Institute of Geological Sciences, Jagiellonian University, Kraków (Poland).

Results

The examination of the holotype of *Ustilago ignota* confirms that it is a separate species, distinct from *U. trichophora*, belonging to the genus *Sporisorium* Ehrenb. *ex* Link rather than to *Ustilago* (Pers.) Roussel. Accordingly, the following new combination and amended description and illustrations are proposed.

Sporisorium ignotum (Vánky) M. Piątek, ***comb. nov.*** Figs 1 & 2

Basionym: *Ustilago ignota* Vánky, Mycotaxon **91**: 242. 2005.

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Sori around the stems and at the nodes, forming bullate, globoid or elongated hypertrophied swellings, covered by leathery, smooth epidermis of host origin, and composed of a thick central stem from which radially emerge longitudinal ridges of host origin (probably vascular bundles) which may correspond to columellae; the spores and sterile cells are produced in lacunae between the ridges. Spores yellowish-brown, globose, subglobose, broadly ellipsoidal, rarely ovoid, 5.0–10.7(–11.5) × (4.4–)5.0–7.8(–9.2) µm [av. ± SD, 7.6±1.4 × 6.5±0.9 µm (n = 62)], occasionally larger spores (11.2–16.3 × 8.5–11.3 µm) present intermixed with normal spores; wall even, 0.4–0.7 µm thick, finely verruculose in LM, sparsely echinulate in SEM, spore profile wavy or finely serrulate. Sterile cells usually in smaller or larger irregular groups or chains, rarely single, single cells hyaline, irregularly rounded, broadly ellipsoidal, almost always collapsed, 6.4–17.8 × 5.0–12.2 µm, often with one or two spherical bodies (?lipid granules) in the cytoplasm; wall rather even, 0.7–2.3 µm thick, surface smooth in LM and smooth or finely granulose in SEM.

Specimen examined: [ZIMBABWE] South Rhodesia, on *Panicum* sp., 2 Sept. 1955, *leg. A. Rothwell* (IMI 61014 – holotype).

Note. The present description is based on the holotype, which contains five plant fragments of *Panicum* sp. (identification not verified by me) with smut sori. The holotype specimen is moderately well preserved, but most sori are almost empty, with low abundance of spore mass inside.

Discussion

The placement of this species illustrates the problematic nature of generic boundaries within the *Macalpinomyces-Sporisorium-Ustilago* genus complex (Stoll *et al.* 2005). The development of sori with structures resembling columellae, and especially the presence of sterile cells, indicate that this smut belongs to the genus *Sporisorium* and

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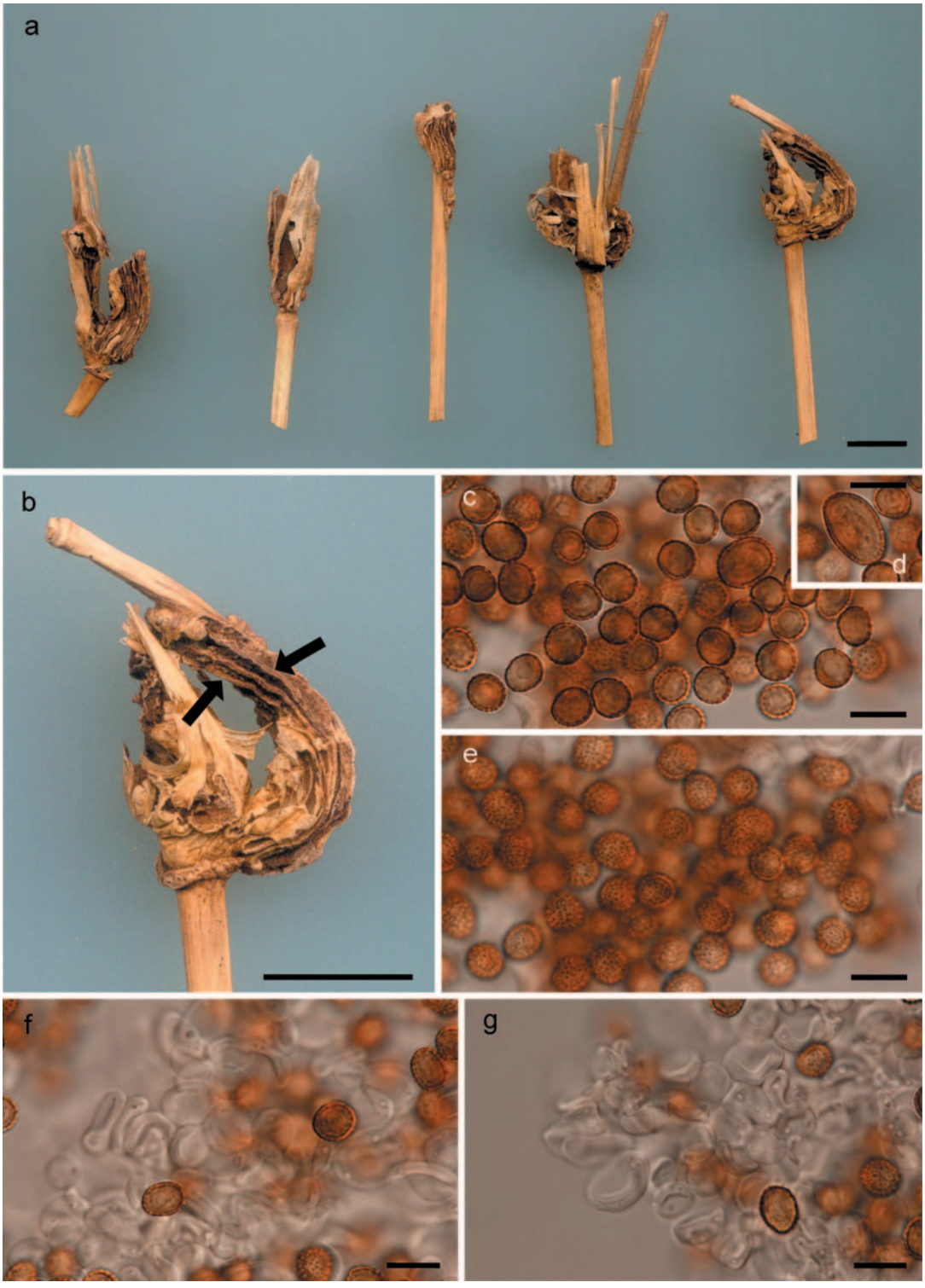
Fig. 1. *Sporisorium ignotum* (Vánky) M. Piątek, *comb. nov.* on *Panicum* sp. (holotype: IMI 61014). a – the holotype material comprising five plant fragments with sori around the stems and at the nodes of the host, b – enlarged, the last fragment from figure 'a' to show internal organization of sori with longitudinal ridges of host origin indicated by arrows, c – spores seen by LM, median view, d – atypically large spore intermixed with normal spores seen by LM, e – spores seen by LM, superficial view, f & g – sterile cells and single spores seen by LM. Scale bars: a–b = 1 cm, c–g = 10 µm.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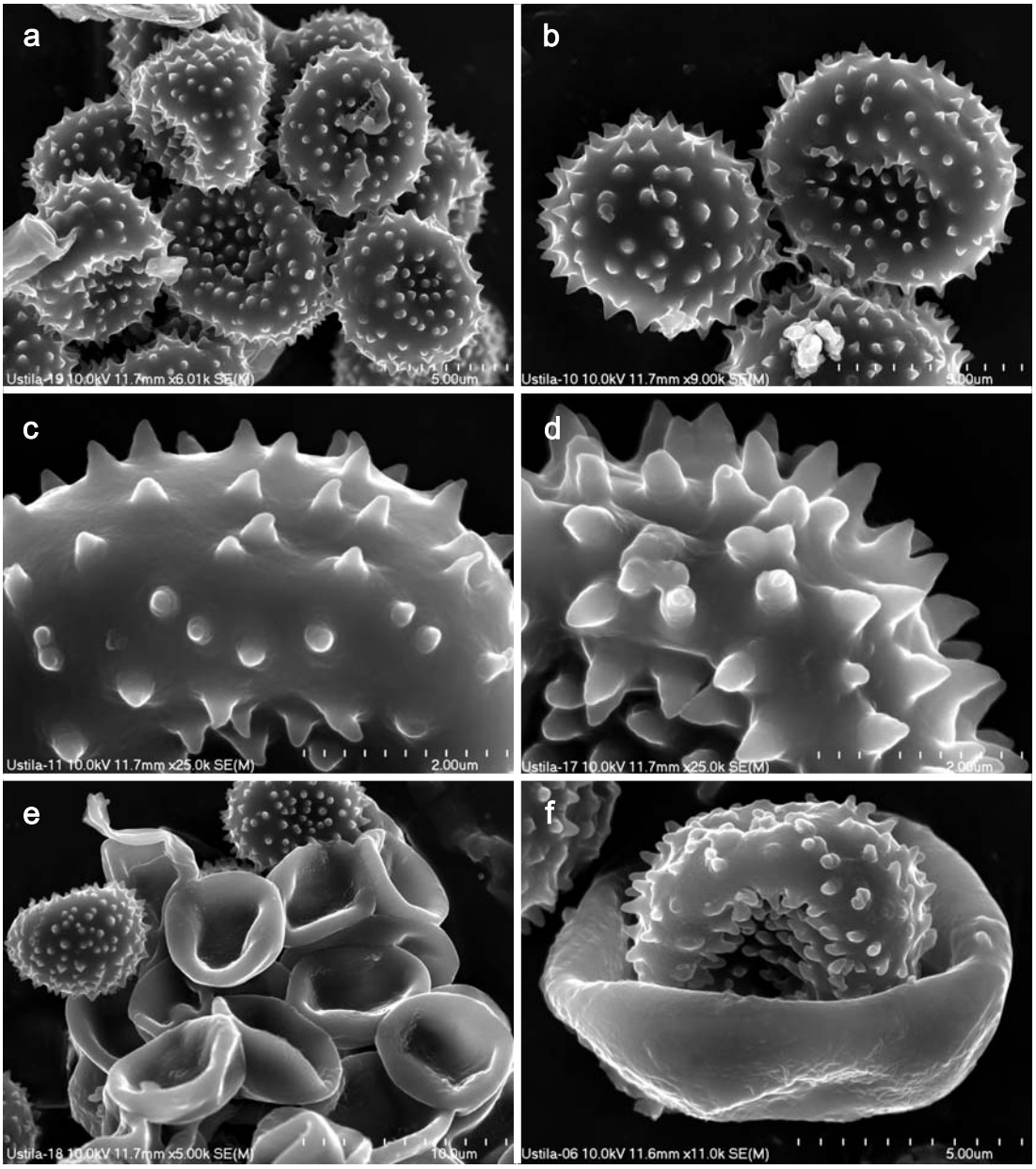

Fig. 2. *Sporisorium ignotum* (Vánky) M. Piątek, *comb. nov.* on *Panicum* sp. (HOLOTYPE: IMI 61014). a & b – spores seen by SEM, c & d – spore walls seen by SEM, e & f – sterile cells and spores seen by SEM. Scale bars: a–b and f = 5 µm, c–d = 2 µm, e = 10 µm.

not to *Ustilago* where such elements are absent, or to *Macalpinomyces* Langdon & Full. which lacks columellae (Vánky 2002), and in the strict sense it is probably confined to species infecting ovaries of *Eriachne* grasses in Australia. The recently described genus *Anomalomyces* Vánky, M. Lutz & R. G. Shivas also belongs to this genus complex, but is characterized by having multilocular

sori without columellae, spore balls enclosed by a thick, pigmented layer of an unknown substance, and two kinds of sterile cells (Vánky *et al.* 2006), and therefore it is not suitable for accommodation of *Ustilago ignota*.

The sori of *Sporisorium ignotum* are formed around the thick central stem, with radially emerging longitudinal ridges of host origin which probably are vascular bundles, and the spores and sterile cells are produced in the lacunae between the ridges. Although such structures are not true columellae, they may be treated as their equivalent, as in species previously classified in the genus *Lundquistia* Vánky and now considered to be members of *Sporisorium* (Cunnington *et al.* 2005; Stoll *et al.* 2005). The internal organization of sori was not described in the protologue by Vánky (2005). Instead, he described and illustrated the witches' brooms at the nodes of proliferating shoots with short, congested leaves in the isotype specimen, which in turn were not observed in the holotype material.

Sterile cells were observed by Vánky (2005), but misinterpreted as very young spores. He stated that they are 'hyaline, globose or ovoid, often with a narrowing end, about the size of the spores, usually with a globose body (nucleus?)', and further concluded that 'traces of and even differentiated warts of spines on still hyaline or subhyaline spores reveal their identity.' According to my observations, the hyaline cells are quite abundant in the holotype specimen. I consider them to be true sterile cells because of their similarity to sterile cells observed in many other *Sporisorium* species. As a rule they are larger than spores and always smooth in LM, and are smooth or only slightly granulose in SEM. I did not observe any hyaline or subhyaline cells with 'traces of and even differentiated warts of spines' mentioned by Vánky (2005).

Based on my observations, *Sporisorium ignotum* can be distinguished from *Ustilago trichophora* primarily by the presence of sterile cells in the former and their absence in the latter. The spores are echinulate with smooth interspaces in *Sporisorium ignotum* and echinulate with verruculose interspaces in *Ustilago trichophora*. Macroscopic symptoms of infection are less suitable for distinguishing the species, as the sori are quite similar and columellae were also reported in *U. trichophora* (Fullerton & Langdon 1969; Mordue 1995).

Panicum sp. is the host plant of *Sporisorium ignotum* according to the information given on the herbarium label and in the protologue (Vánky 2005). Considering the collection time, many other panicoid grass genera could now be included under the generic name *Panicum*. This is not unusual and is often enough reported in smut fungi. Indeed, many host plants in old collections originally included in the genus *Panicum* later appeared to belong to other grass genera (Vánky 2005). It is impossible to identify the host plant to the species level based on plant fragments in the type collection of *Sporisorium ignotum*. The only way is to recollect a smut with similar symptoms in the area of the original collection, identify its host plant, and epitypify this name to fix its application definitively. The smut fungi are strongly host-specific, usually to the genus and not rarely to the species level, and thus, having the host plant of *Sporisorium ignotum* identified to the species level is very important for clear delimitation of this species and especially for its usefulness in modern phylogenetic or evolutionary studies on ustilaginaceous smuts.

ACKNOWLEDGEMENTS. I thank Anna Łatkiewicz (Kraków, Poland) for her help with SEM images, and the Curator of IMI for the loan of specimen. This work was supported by the Polish Ministry of Science and Higher Education (grant no. N N303 414037 for the years 2009–2012).

REFERENCES

CUNNINGTON J. H., VÁNKY K. & SHIVAS R. G. 2005. *Lundquistia* is a synonym of *Sporisorium* (Ustilaginomycetes). *Mycol. Balcanica* **2**: 95–100.

FULLERTON R. A. & LANGDON R. F. N. 1969. A study of some smuts on *Echinochloa* spp. *Proc. Linn. Soc. New South Wales* **93**: 281–293.

MORDUE J. E. M. 1995. IMI Descriptions of Fungi and Bacteria No. 1250. *Ustilago trichophora*. *Mycopathologia* **131**: 59–61.

PIĄTEK M. 2006. *Sporisorium kenyanum*, a new smut fungus with long twisted sori on *Setaria pallide-fusca* in Kenya. *Polish Bot. J.* **51**: 159–164.

PIĄTEK M. 2009a. *Sporisorium themedae* new to Mauritius, and *Tilletia mauritiana* new to Madagascar. *Polish Bot. J.* **54**: 21–26.

PIĄTEK M. 2009b. Two smut fungi on *Ischaemum*: *Sporisorium austroafricanum* sp. nova and *Tolyposporium bogoriense* revisited. *Ann. Bot. Fenn.* **46**: 425–430.

PIĄTEK M. & VÁNKY K. 2005. *Cintractia majewskii*, a new smut fungus (Ustilaginomycetes) on *Fimbristylis* (Cyperaceae) from Africa. *Polish Bot. J.* **50**: 1–6.

PIĄTEK M. & VÁNKY K. 2007. *Ustilago aldabrensis*, a new species from Seychelles, and two other smut fungi on *Dactyloctenium*. *Mycol. Progr.* **6**: 213–219.

PIĄTEK M., VÁNKY K., MOSSEBO D. C. & PIĄTEK J. 2008. *Doassansiopsis caldesiae* sp. nov. and *Doassansiopsis tomasii*: two remarkable smut fungi from Cameroon. *Mycologia* **100**: 662–672.

STOLL M., BEGEROW D. & OBERWINKLER F. 2005. Molecular phylogeny of *Ustilago* and *Sporisorium*, and related taxa based on combined analysis of rDNA sequences. *Mycol. Res.* **109**: 342–356.

VÁNKY K. 2002. Illustrated Genera of Smut Fungi. Ed. 2. APS Press, U.S.A.

VÁNKY K. 2005. Taxonomic studies on Ustilaginomycetes – 25. *Mycotaxon* **91**: 217–272.

VÁNKY K. & PIĄTEK M. 2006. The genus *Testicularia* (Ustilaginomycetes). *Mycol. Balcanica* **3**: 163–167.

VÁNKY K., LUTZ M. & SHIVAS R. G. 2006. *Anomalomyces panici*, new genus and species of Ustilaginomycetes from Australia. *Mycol. Balcanica* **3**: 119–126.

Received 28 July 2010