

SPORISORIUM KENYANUM, A NEW SMUT FUNGUS WITH LONG TWISTED SORI ON *SETARIA PALLIDE-FUSCA* IN KENYA

MARCIN PIĄTEK

Abstract. A new smut fungus, *Sporisorium keny anum* M. Piątek, is described and illustrated from infected plants of *Setaria pallide-fusca* (Schumach.) C. E. Hubb. collected in Kenya, Africa. The species is characterized by the following: long twisted sori produced on the distal parts of sterile shoots; the presence of spore balls consisting of small, finely verrucose-echinulate spores; and the absence of sterile cells. It is similar to *Sporisorium panici-leucophaei* (Henn.) M. Piepenbr. on various species of *Digitaria*, *Echinochloa*, *Oplismenopsis* and *Panicum* in Australia and North and South America. However, in this latter smut the spores are larger, somewhat more prominently echinulate, and somewhat more variable in shape and size than those of *S. keny anum*.

Key words: *Sporisorium*, *Lundquistia*, Ustilaginaceae, Ustilaginomycetes, smut fungi, taxonomy, new species, Africa

Marcin Piątek, Department of Mycology, W. Szafer Institute of Botany, Polish Academy of Sciences, Lubicz 46, PL-31-512 Kraków, Poland; e-mail: mpiatek@ib-pan.krakow.pl

INTRODUCTION

The genus *Sporisorium* Ehrenb. ex Link, with the type *S. sorghi* Ehrenb. ex Link, is a member of the smut fungi belonging to the family Ustilaginaceae. The main characteristics typical for this genus are occurrence on host plants of the family Poaceae, the presence of a peridium around the sori, more or less developed columella(e), spores arranged in permanent or loose spore balls, and often the presence of hyaline sterile cells intermixed with spores (Vánky 2002). However, in several species the sterile cells are not present and other diagnostic structures are not clearly developed, making it highly problematic to delimit *Sporisorium* from closely related genera like *Ustilago* (Pers.) Roussel and *Macalpinomyces* Langdon & Fullerton (Vánky 2002; Piepenbring 2003; Stoll *et al.* 2005).

The genus *Lundquistia* Vánky was described by Vánky (2001) for a peculiar smut, *L. fascicularis* Vánky, infecting *Digitaria brownii* (Roem. & Schult.) Hughes in Australia. The new genus was characterized by long twisted sori in different parts of the host plants belonging to the family Poaceae, without peridium and columella(e), and with spore balls formed in the parenchymatic

tissues between the vascular fascicles of the host plant. An important difference between the respective type species of *Sporisorium* and *Lundquistia* was the presence of sterile cells in the former and their absence in the latter. Later on, an examination by Vánky of several similar smut fungi (2004), originating mostly from Mexico, revealed that sterile cells may sometimes be present. As a consequence he slightly emended the circumscription of the genus *Lundquistia*, and recognized four species: *L. duranii* (Vánky) Vánky, *L. dieteliana* (Henn.) Vánky, *L. mexicana* Vánky and *L. panici-leucophaei* (Bref.) Vánky. *Lundquistia fascicularis* has been reduced to synonymy with this latter species. Through the emendation, the genus *Lundquistia* came closer to the genus *Sporisorium*, from which it differed only by the absence of a typical peridium and columella(e). Indeed, molecular phylogenetic studies of numerous species of *Ustilago*, *Macalpinomyces*, *Sporisorium*, and four smut fungi described or included in *Lundquistia* (Cunnington *et al.* 2005; Stoll *et al.* 2005) showed that this latter genus should be reduced to synonymy

with *Sporisorium*. The appropriate nomenclatural combinations in this genus are *S. dietelianum* (Henn.) Vánky, *S. duranii* (Vánky) Vánky & Cunnington, *S. mexicanum* (Vánky) Vánky & Cunnington and *S. panici-leucophaei* (Bref.) M. Piepenbr. The combination *S. dietelianum* (Henn.) Vánky & Cunnington made in *Mycologia Balcanica* 2(2): 96, published on 30 June 2005 (Cunnington *et al.* 2005) is superfluous for the combination *S. dietelianum* (Henn.) Vánky published in *Mycotaxon* 91: 266 on 30 March 2005 (Vánky 2005).

My recent examination of various unidentified collections of smut fungi preserved in IMI resulted in the discovery of one specimen with 'lundquistoid' appearance. This smut was collected on *Setaria pallide-fusca* (Schumach.) C. E. Hubb. in Kenya and was previously recorded as *Sorosporium* sp. by Lenné (1990). The morphological characters of this specimen do not fit the concept of any known smut fungus. Accordingly, it is described as a new species.

MATERIAL AND METHODS

The specimen used for the description of the new species is preserved in IMI and is cited in the text. In addition, the following specimen, distributed in W. A. Kellerman, *Fungi Selecti Guatemalenses* no. 10, was used for comparison: *Sporisorium panici-leucophaei* (Bref.) M. Piepenbr., on *Digitaria insularis* (L.) Fedde (*Panicum leucophaeum* H.B.K.), Central America, Guatemala, Depart. Zacapa, Zacapa, alt. 137 m., 457 ft., 25 Jan. 1905, *leg. W. A. Kellerman 4301* (CUP). Both specimens were examined by standard light and phase contrast microscopy (LM), and by scanning electron microscopy (SEM). Morphological observations and measurements of spore balls and spores were made in lactophenol heated to boiling point and then cooled, with a NIKON Eclipse E600 light microscope. The sizes given are the means of 50 measurements of spore balls and spores. The SEM studies proceeded as described by Piątek *et al.* (2005). SEM micrographs were taken in the Laboratory of Field Emission Scanning Electron Microscopy and Microanalysis at the Institute of Geological Sciences of the Jagiellonian University, Kraków. A description and nomenclatural details of the new species were deposited in MycoBank (www.Mycobank.org; see Crous *et al.* 2004).

TAXONOMY

Sporisorium kenyanum M. Piątek, *sp. nov.*

(Figs 1–7)

[MycoBank MB510155]

Typus in matrice *Setaria pallide-fusca* (Schumach.) C. E. Hubb., Kenya, *sine loco*, *leg. P. J. Greenway* [HOLOTYPE IMI 68621!]

Sori in apice surculorum sterilium, cylindrici, usque 7 cm longas vel longiores formantes. Glomeruli sporarum atro-flavidobrunnei, subglobosi, ellipsoidales, elongati usque irregulares, 16–80 × 14–50 μm, e sporis pluries centum compositi. Sporae flavido- usque pallide brunneae, globosae, subglobosae usque parum subpolyedrice irregulares, 5.0–6.0(–6.5) × 4.5–5.5(–6.0) μm; pariete aequali, cca. 0.5 μm crasso, sub LM leniter, moderato dense punctato, sub SEM leniter verrucoso-echinulato. Cellulae steriles nullae.

Sori in distal parts of sterile shoots, preventing development of inflorescences, cylindrical and twisted, up to 7 cm (or more?) long, partly enclosed by healthy leaf sheaths. At first, spore balls and spores embedded in the parenchymatous tissues between the veins, later disclosed by rupturing the epidermis and leaving the fascicles of vascular bundles. Spore balls dark yellowish brown, subglobose, ellipsoidal, elongated to irregular, 16–80 × 14–50 μm, composed of tens to hundreds of spores, permanent when young, later separating. Spores yellowish to pale brown, globose, subglobose to slightly subpolyhedrally irregular, 5.0–6.0(–6.5) × 4.5–5.5(–6.0) μm; wall even, ca 0.5 μm thick, surface in LM finely, moderately densely punctate, spore profile smooth, surface in SEM finely verrucose-echinulate. Sterile cells absent.

ETYMOLOGY. The specific epithet *kenyanum* derives from the name of the country where the new species was collected.

HOST AND DISTRIBUTION. On Poaceae: *Setaria pallide-fusca* (Schumach.) C. E. Hubb.; Kenya, Africa. Known only from the type collection.

DISCUSSION

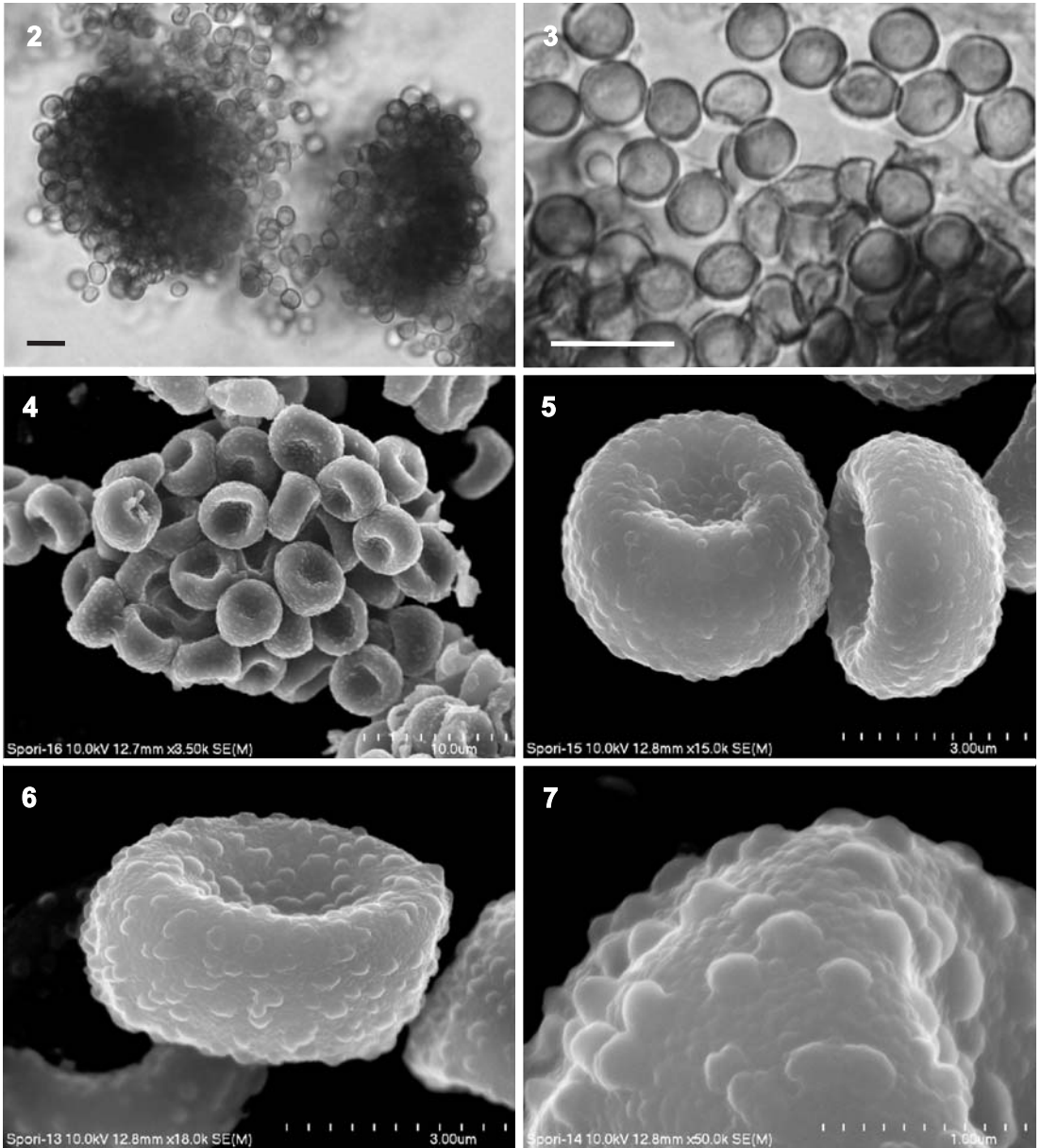
Sporisorium kenyanum is the fourth *Sporisorium* infecting host plants belonging to the grass

genus *Setaria*. The three previously known species are *S. pamparum* (Speg.) Vánky, type on *Setaria glauca* (L.) P. Beauv., Argentina, *S. setariae* (McAlpine) Vánky & R. G. Shivas, type on *Setaria glauca* (L.) P. Beauv., Australia, and *S. setariicola* (Thirum. & Safeeulla) M. K. Bag & D. K. Agarwal, type on *Setaria pallide-fusca* (Schumach.) C. E. Hubb., India (Thirumalachar & Safeeulla 1951; Vánky & Guo 1986; Bag & Agarwal 2001; Vánky & Shivas 2003). All of them differ from *S. kenyanum* by having completely different sori, localized in ovaries or spike-

lets, with well-developed columella(e) and peridia. It should be added here that the taxonomic position of *Sporisorium pamparum* is not completely clear. Recently, Piepenbring (2003) placed it with some reservation in synonymy with *Sporisorium neglectum* (Niessl) Vánky, which is now known as *Macalpinomyces neglectus* (Niessl) Vánky. On the other hand, Vánky (2003) suggested that it may be identical with *Sporisorium penniseti* (Rabenh.) Ershad on various species of *Cenchrus* and *Pennisetum*. Detailed studies are needed to clarify the identity of *S. pamparum*.



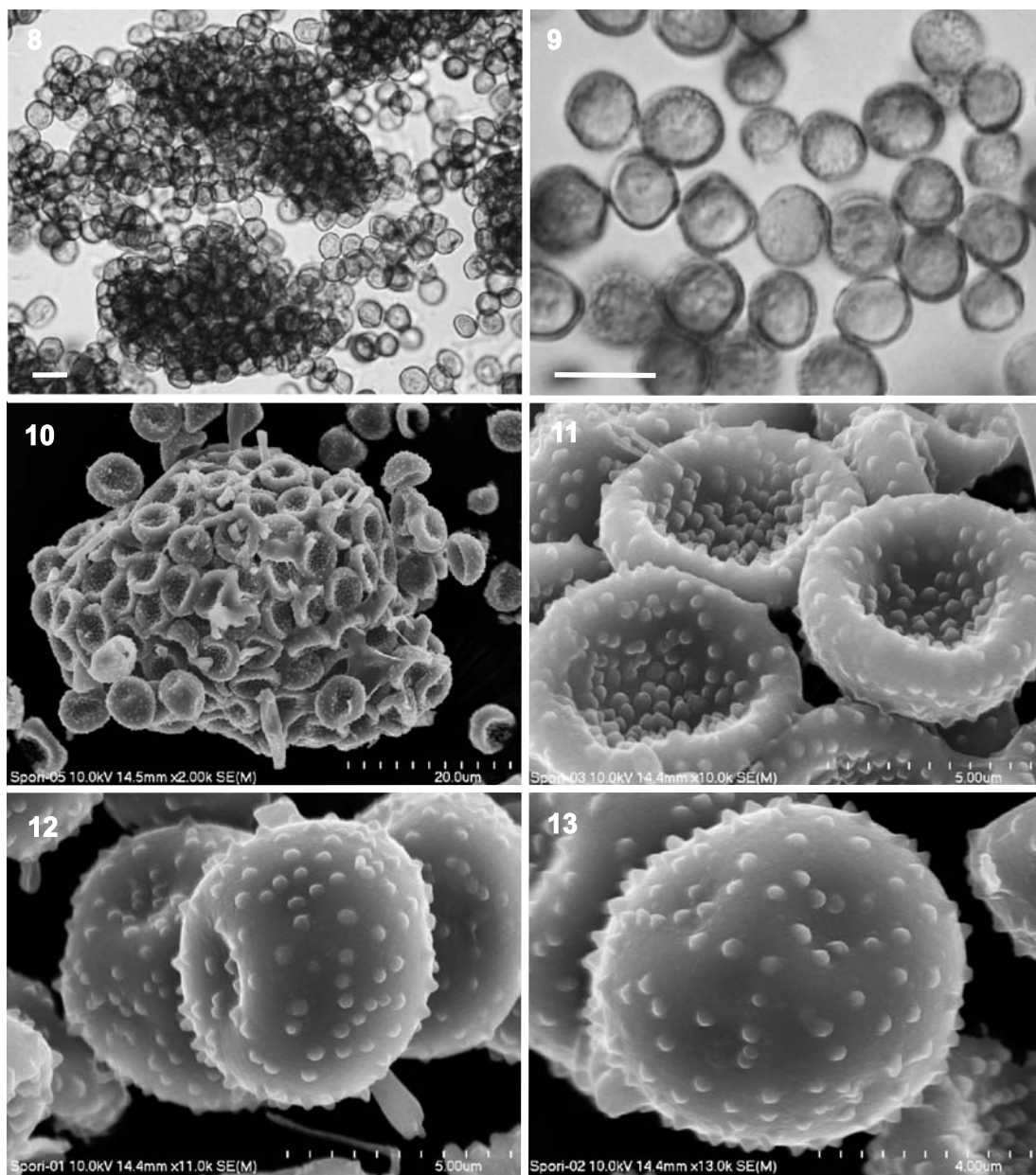
Fig. 1. Sori of *Sporisorium kenyanum* M. Piątek on *Setaria pallide-fusca* (Schumach.) C. E. Hubb. (HOLOTYPE: IMI 68621). Scale bar = 1 cm. Note that sori are produced on the distal parts of sterile shoots.



Figs 2–7. Spore balls and spores of *Sporisorium kenyanum* M. Piątek on *Setaria pallide-fusca* (Schumach.) C. E. Hubb. (HOLOTYPE: IMI 68621). 2 & 3 – spore balls and spores in LM, scale bars = 10 µm; 4–7 – spore ball and spores in SEM.

The macroscopic appearance of the sori and the ornamentation of the spores in *Sporisorium kenyanum* strongly resemble those in *S. panicleucophaei* (Figs 8–13), known from Australia and North and South America. However, the spores of

this latter smut are larger, somewhat more prominently echinulate, and somewhat more variable in shape and size. Vánky (2005) reported the spores of *S. panicleucophaei* as 6.0–9.5 µm long and 5.5–8.0 µm wide, Piepenbring (2003) as (5.0)–6.0–



Figs 8–13. Spore balls and spores of *Sporisorium panici-leucophaei* (Henn.) M. Piepenbr. on *Digitaria insularis* (L.) Fedde (*Fungi Selecti Guatemalenses* no. 10, CUP s.n.). 8 & 9 – spore balls and spores in LM, scale bars = 170 μm ; 10–13 – spore ball and spores in SEM.

8.0–(10.0) μm long and (4.0–)5.0–7.0 μm wide, while the spores I measured from the Guatemalan specimen are 6.0–8.5 μm long and 5.0–8.0 μm wide. The spores of *Sporisorium keny anum* are

smaller, 5.0–6.0(–6.5) μm long and 4.5–5.5(–6.0) μm wide, and less variable in shape and size. The host plants of *Sporisorium panici-leucophaei* belong to the genera *Digitaria* (incl. *Trichachne*),

Echinochloa, *Oplismenopsis* and *Panicum*. *Digitaria* is included in the subtribe Digitariinae, tribe Paniceae, while the three remaining grass genera belong to the subtribe Setariinae, tribe Paniceae (Clayton & Renvoize 1986). However, the type host of *S. panici-leucophaei* is *Digitaria insularis*, and most records of this smut are on *Digitaria* species as well. The identity of collections on *Echinochloa*, *Oplismenopsis* and *Panicum* is to be confirmed. In contrast, the host plant genus of *Sporisorium kenyanum* is *Setaria*, which is included in subtribe Setariinae, tribe Paniceae (Clayton & Renvoize 1986). All of this indicates that *Sporisorium kenyanum* on *Setaria pallidifusca* is a separate species, although rather closely related to *Sporisorium panici-leucophaei*.

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