

# Contribution to the smut fungi (*Ustilaginomycetes*) of Togo and Benin

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**Abstract.** *Sporisorium nyassae* is reported for the first time from Togo and Benin. *Hyparrhenia nyassae* and *H. diplandra* var. *mutica* are recorded as new host plants of *Sporisorium nyassae*. Based on the current revision, *Sporisorium barcinonense* is removed from the list of smut fungi in Togo. *Cintractia limitata* is reported for the first time from Benin. All species of smut fungi known from Togo and Benin and their host plants are listed.

**Key words:** Benin, *Cintractia*, *Cyperus*, *Hyparrhenia*, smut fungi, *Sporisorium*, taxonomy, Togo

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## Introduction

The diversity of the smut fungi (*Ustilaginomycotina* and *Microbotryales*) in Western Africa is poorly known. In this region, Togo and Benin are among the least studied countries with only 19 species of smut fungi reported in the literature from Togo, and 6 species from Benin (Hennings 1907b; Scholz 1981; Mordue 1995; Piepenbring 2000; Marley et al. 2002; Vánky et al. 2011; Piątek et al. 2014).

In this article, *Sporisorium nyassae* from Togo and Benin, and *Cintractia limitata* from Benin are reported for the first time. The collections on which these records are based were discovered during a visit to the herbarium at the Botanic Garden and Botanical Museum Berlin-Dahlem (B).

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## Material and methods

Dried specimens from the herbarium of the Botanic Garden and Botanical Museum Berlin-Dahlem were examined under light microscope (LM) and scanning electron microscope (SEM). For LM observations and measurements, spores were mounted in lactoglycerol solution (w : la : gl = 1 : 1 : 2) on glass slides, gently heated to boiling point to rehydrate the spores, and then cooled. The measurements of spores are given in the form: min–max (mean  $\pm$  1 standard deviation). For SEM, spores were attached to specimen holders by double-sided adhesive tape and coated with gold with an ion sputter. The surface structure of spores was observed and photographed at 10 kV accelerating voltage using a JEOL SM-6390 scanning electron microscope. The description given below is based entirely on the specimens examined.

## Taxonomy

*Cintractia limitata* G.P. Clinton, Proceedings of the Boston Society of Natural History 31: 399, 1904. Figs 1–4

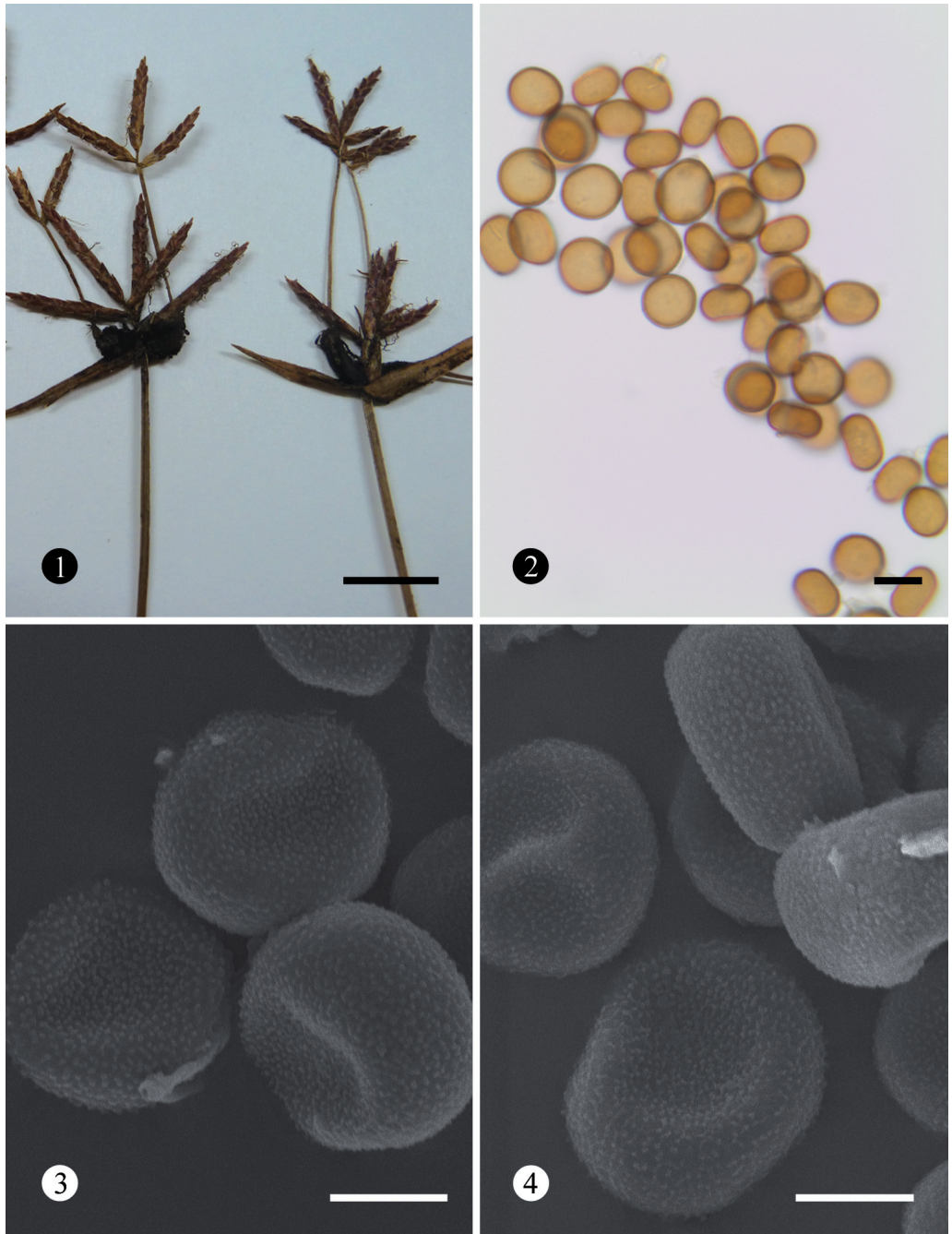
**Sori** surrounding the base of spikelet pedicels or peduncles, fusiform to ovoid, up to 10 mm long, initially covered by a brownish peridium which later flakes away; in old sori, the plant axis may be split. **Spore mass** semi-agglutinated, powdery on the surface, very dark reddish brown, formed in pockets of fungal stroma. **Spores** flattened, in plane view orbicular, suborbicular or broadly elliptic in outline, sometimes slightly irregular, in plane view (9.5–)10–13(–14)  $\times$  (9–)9.5–12(–12.5) (11.7  $\pm$  0.8  $\times$  10.7  $\pm$  0.7)  $\mu\text{m}$  (n = 50), in side view 7–8.5  $\mu\text{m}$  thick, middle reddish brown; wall more or less evenly thickened, 0.7–0.9  $\mu\text{m}$  thick, in LM smooth to punctate, spore profile not affected; in SEM densely punctate, warts up to 0.1  $\mu\text{m}$  high.

*Specimen examined* – On *Cyperus* cf. *rotundus* L.: BENIN, ATLANTIQUE DEPARTMENT, Ouidah, 6 Oct 1974, leg. A. Mathey & H. Scholz, no. 770 (B, sine num.).

*Cyperus rotundus* is distributed in tropical and subtropical regions. *Cintractia limitata* is widely distributed in the tropics and subtropics, mainly on plants of the genus *Cyperus*, as well as on some species of *Kyllinga* and *Pycnus*. In Africa, this smut fungus has been previously reported from Cameroon, Congo, Ethiopia, Gabon, Ghana, Guinea, Ivory Coast, Malawi, Nigeria, Reunion, Sierra Leone, South Africa, Sudan, Tanzania, Togo, Uganda, Zambia, and Zimbabwe (Hennings 1907a, b; Ling 1950; Piepenbring 2000; Vánky 2011; Vánky et al. 2011; Denchev & Denchev 2012; etc.).

*Sporisorium nyassae* (Syd. & P. Syd.) Vánky & Minnis, Smut fungi of the world: 1339, 2011[2012]. – *S. trans fissum* (Tul. & C. Tul.) G. Deml, Zeitschrift für Mykologie 49: 174, 1983. Figs 5–8

**Sori** in all of the spikelets of the raceme, all racemes of an inflorescence affected, 2–3.5  $\times$  0.5–0.7 mm, initially ovoid, completely concealed by the glumes and inconspicuous, later the glumes are spreading slightly, fusiform; initially covered by a thin yellowish brown peridium that soon flakes away in the upper part of the sorus, exposing a single, filiform, not branching columella with longitudinal furrows, surrounded by semi agglutinated to



Figs 1–4. *Cintractia limitata* on *Cyperus* cf. *rotundus* from Benin (A. Mathey & H. Scholz, no. 770). 1. Sori. 2. Spores in LM. 3–4. Spores in SEM. Scale bars: 1 = 1 cm, 2 = 10  $\mu$ m, 3–4 = 5  $\mu$ m

powdery blackish brown mass of spores and sterile cells. **Sterile cells** in small irregular groups, variable in shape, often collapsed, 8.5–17.5 µm long, hyaline or subhyaline, wall 0.6–1.1 µm thick, smooth. **Spores** globose, subglobose, broadly ellipsoidal, ovoid or slightly irregular, (10–)11–15(–16.5) × (9–)10–13(–14) (12.6 ± 0.9 × 11.1 ± 0.7) µm ( $n_4 = 200$ ), not dimorphic, middle reddish brown, with one or two paler, rounded areas (germ pores) of 2.5–4 µm diameter; wall evenly or almost evenly thickened, 0.6–0.9 µm thick, in LM punctate, spore profile not affected; in SEM minutely echinulate, spinules up to 0.3 µm high, between the spinules densely punctate.

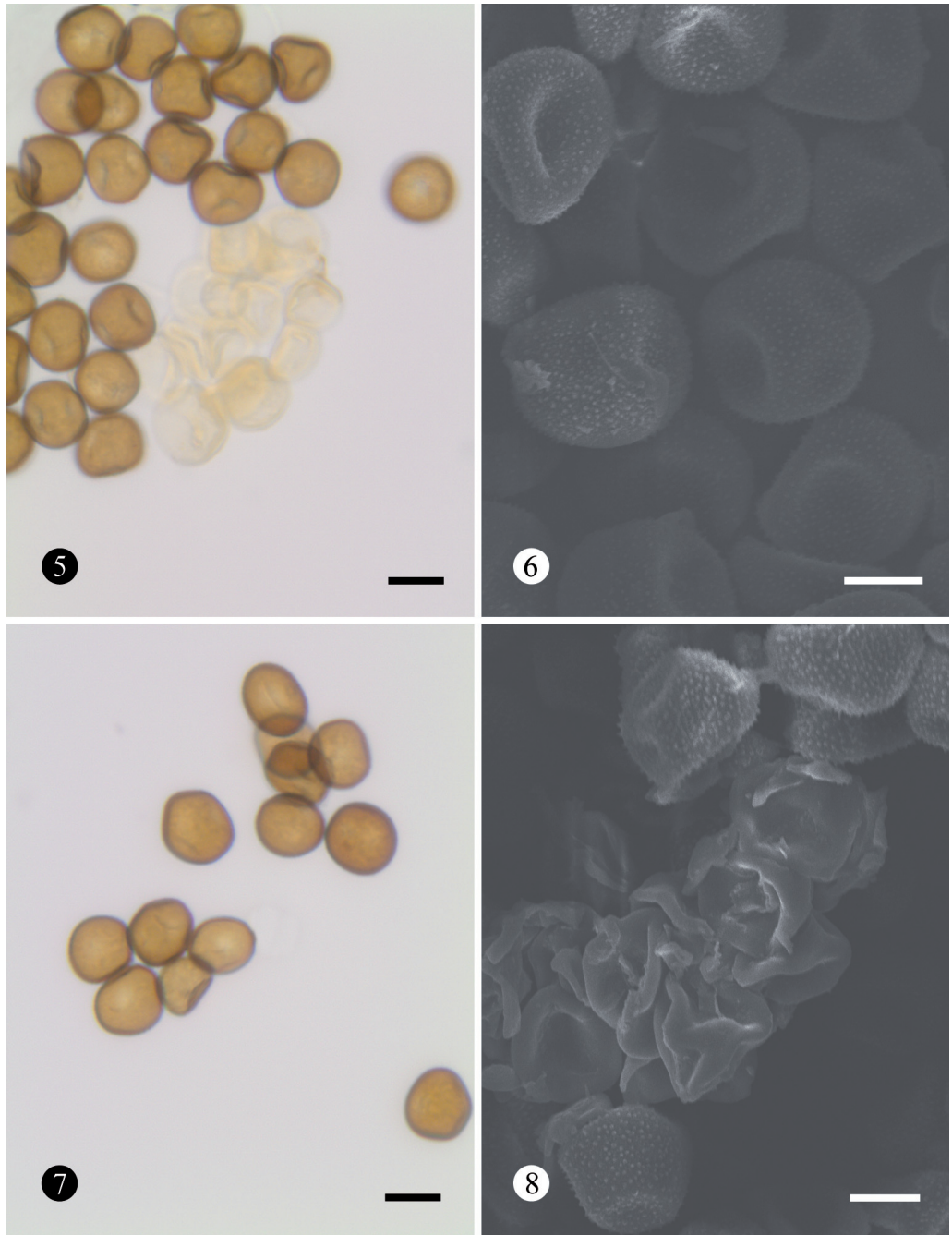
*Specimens examined* – On *Hyparrhenia nyassae* (Rendle) Stapf: **TOGO**, KARA REGION, Réserve de Chasse de la Kéran, Souté, 31 Jul 1979, leg. U. Scholz, P. Koumassi, H. Kühn & H. Peuker, no. 290A, det. H. Scholz (as *Sphacelotheca barcinonensis*, B, sine num.). – On *Hyparrhenia diplandra* var. *mutica* (Clayton) Cope (*H. mutica* Clayton): **TOGO**, CENTRALE REGION, N of Sokodé, 21 Sep 1976, leg. H. Ern, B. Hein & A. Pircher, no. 812A, det. H. Scholz (as *Sphacelotheca barcinonensis* on *Hyparrhenia diplandra*, B, sine num.); **TOGO**, CENTRALE REGION, Park national de Fazao, near Fazao, 400–500 m, 8 Aug 1979, leg. U. Scholz, P. Koumassi, H. Kühn & H. Peuker, no. 445A, det. H. Scholz (as *Sphacelotheca barcinonensis* on *Hyparrhenia diplandra*, B, sine num.); **BENIN**, ATAKORA DEPARTMENT, 20 km from Natitingou, toward Boukoumbé, 11 Oct 1999, leg. J. Krohmer, no. K 6776 (B 70 0015515).

Two of the cited Togolese specimens (U. Scholz et al., no. 290A, and U. Scholz et al., no. 445A) are mistakenly identified by Scholz (1981: 104) as *Sphacelotheca barcinonensis* (a species currently transferred in *Sporisorium*). *Sporisorium barcinonense* (Riofrio) Vánky differs from *Spor. nyassae* in having larger spores, 13–18(–20) µm long. This species was known to infect *Hyparrhenia hirta* in South Europe (Italy and Spain) and Africa (Canary Islands and Togo) (Scholz 1981; Vánky 2003; Vánky et al. 2011). Based on the current revision, *Sporisorium barcinonense* should be removed from the list of smut fungi in Togo.

*Hyparrhenia nyassae* is reported here for the first time as a host plant of *Sporisorium nyassae*. It is distributed in Tropical and Southern Africa, Madagascar, and Indo-China.

The host plants of two of the cited Togolese specimens were identified by H. Scholz as *Hyparrhenia diplandra*. In fact, these specimens do not belong to the typical variety of this species but to var. *mutica*. The presence of an awnless superior lemma of the sessile spikelet is a feature that taxonomically distinguishes *H. diplandra* var. *mutica* from the typical variety. *Hyparrhenia diplandra* var. *mutica* is a new host record for *Sporisorium nyassae*. This plant has a scattered distribution in tropical Africa – from Sierra Leone and Liberia through Western and Central Africa to Ethiopia, south to Mozambique and Zambia (Cope 2002; Friis et al. 2011).

*Sporisorium nyassae* has been previously reported from Africa (Algeria, Chad, Congo, Madagascar, Malawi, Morocco, South Africa, and Zimbabwe) on *Hyparrhenia anamesa* Clayton, *H. diplandra* (Hack.) Stapf, *H. hirta* (L.) Stapf (incl. *H. hirta* var. *longiaristata* Rothm. & P. Silva), *H. newtonii* var. *macra* Stapf, *H. quarrei* Robyns, *H. rufa* (Nees) Stapf, *H. tamba* (Steud.) Stapf, and *Hyperthelia dissoluta* (Nees ex Steud.) Clayton, and from South Europe (Portugal and Spain) on *Hyparrhenia hirta* (Zambettakis 1970, 1979; Vánky 2003, 2011; Vánky et al. 2011). This smut fungus is recorded here for the first time from Togo and Benin.



**Figs 5–6.** *Sporisorium nyassae* on *Hyparrhenia nyassae* from Togo (U. Scholz et al., no. 290A). 5. Spores and sterile cells in LM. 6. Spores in SEM. **Figs 7–8.** *Sporisorium nyassae* on *Hyparrhenia diplandra* var. *mutica* from Benin (B 70 0015515). 7. Spores in LM. 8. Spores and sterile cells in SEM. Scale bars: 5, 7 = 10  $\mu$ m, 6, 8 = 5  $\mu$ m

## Checklists of the smut fungi in Togo and Benin

The following 20 species are currently known from Togo (Hennings 1907b; Scholz 1981; Mordue 1995; Piepenbring 2000; Marley et al. 2002; Vánky et al. 2011; present article):

- Anthracoystis ehrenbergii* (J.G. Kühn) McTaggart & R.G. Shivas on *Sorghum bicolor* (L.) Moench
- Anthracoystis ischaemoides* (Henn.) McTaggart & R.G. Shivas (syn. *Sporisorium ischaemoides* (Henn.) Vánky) on *Schizachyrium sanguineum* (Retz.) Alston
- Cintractia axicola* (Berk.) Cornu on *Fimbristylis dichotoma* (L.) Vahl var. *dichotoma* (TOGO, KARA REGION, W of Kragouda, near Kuwde, NW of Farendé, 10 May 1978, leg. M. Hakki et al., no. 912, det. T.T. Denchev & C.M. Denchev, B 10 0506828) and *F. pilosa* Vahl (Scholz 1981, as *Cintractia limitata*)
- Cintractia limitata* G.P. Clinton (syn. *C. togoensis* Henn.) on *Cyperus cyperoides* (L.) Kuntze (*C. macrocarpus* var. *pseudoflavus* (C.B. Clarke) Kük., *Mariscus cylindristachyus* Steud.) and *C. tenuiculmis* Boeckeler
- Conidiosporomyces ayresii* (Berk.) Vánky & R. Bauer on *Panicum maximum* Jacq., *Setaria helvola* (L.f.) Roem. & Schult. (syn. *Setaria pallide-fusca* (Schumach.) Stapf & C.E. Hubb.), and *S. sphacelata* (Schumach.) Stapf & C.E. Hubb. ex Moss
- Moesziomyces bullatus* (J. Schröt.) Vánky on *Pennisetum glaucum* (L.) R. Br.
- Sporisorium andropogonis* (Opiz) Vánky on *Andropogon pteropholis* Clayton
- Sporisorium andropogonis-tectorum* (L. Ling) Vánky on *Andropogon tectorum* Schumach. & Thonn.
- Sporisorium chudeaui* (Har. & Pat.) Vánky on *Vetiveria nigritana* (Benth.) Stapf
- Sporisorium cruentum* (J.G. Kühn) Vánky on *Sorghum bicolor* (L.) Moench
- Sporisorium moniliferum* (Ellis & Everh.) L. Guo (*Ustilago warneckeana* Henn.) on *Heteropogon contortus* (L.) P. Beauv. ex Roem. & Schult.
- Sporisorium nyassae* (Syd. & P. Syd.) Vánky & Minnis on *Hyparrhenia nyassae* and *H. diplandra* var. *mutica* (in the present article)
- Sporisorium reilianum* (J.G. Kühn) Langdon & Full. on *Sorghum arundinaceum* (Desv.) Stapf and *S. bicolor* (L.) Moench
- Sporisorium sorghi* Ehrenb. ex Link on *Sorghum arundinaceum* (Desv.) Stapf and *S. bicolor* (L.) Moench
- Sporisorium vanderystii* (Henn.) Langdon & Full. on *Hyparrhenia* sp.
- Tilletia barclayana* (Bref.) Sacc. & P. Syd. on *Oryza sativa* L.
- Tolyposporium kuwanoanum* (Togashi & Y. Maki) Denchev & T. Denchev (syn. *Thecaphora africana* H. Scholz) on *Lipocarpa kernii* (Raymond) Goetgh. (*Rikliella kernii* (Raymond) J. Raynal)
- Tranzscheliella hypodytes* (Schltdl.) Vánky & McKenzie on *Andropogon gayanus* Kunth
- Ustilago microchloae* Syd., P. Syd. & E.J. Butler on *Microchloa indica* (L. f.) P. Beauv.
- Ustilago rabenhorstiana* J.G. Kühn on *Digitaria* cf. *nuda* Schumach.

To our knowledge, only six species of smut fungi have been previously recorded from Benin (Marley et al. 2002; Vánky et al. 2011; Piątek et al. 2014). Furthermore, five of these species

are parasites on cultivated plants (sorghum and pearl millet) and only one is found on a wild plant. With the newly reported species, the number of the known smut fungi becomes eight.

*Anthracocystis ehrenbergii* (J.G. Kühn) McTaggart & R.G. Shivas on *Sorghum bicolor* (L.) Moench

*Cintractia limitata* G.P. Clinton (syn. *C. togoensis* Henn.) on *Cyperus* cf. *rotundus* (in the present article)

*Moesziomyces bullatus* (J. Schröt.) Vánky on *Pennisetum glaucum* (L.) R. Br.

*Sporisorium cruentum* (J.G. Kühn) Vánky on *Sorghum bicolor* (L.) Moench

*Sporisorium elegantis* Vánky on *Thelepogon elegans* Roth

*Sporisorium nyassae* (Syd. & P. Syd.) Vánky & Minnis on *Hyparrhenia diplandra* var. *mutica* (in the present article)

*Sporisorium reilianum* (J.G. Kühn) Langdon & Full. on *Sorghum bicolor* (L.) Moench

*Sporisorium sorghi* Ehrenb. ex Link on *Sorghum bicolor* (L.) Moench

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