



## *Scleria pantadenia* and *Scleria tricristata*: Two new species of *Scleria* subgenus *Hypoporum* (Cyperaceae, Cyperoideae, Sclerieae) from Tanzania

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### Abstract

*Scleria pantadenia* Meganck & Bauters and *Scleria tricristata* Meganck & Bauters are presented as new species of *Scleria* (Cyperaceae) from Tanzania. *Scleria pantadenia* is a small, tufted annual sedge species characterized by its delicate, brittle appearance and its small nutlets with gland-like tubercules and basal rim of swollen tuberculate cells. *Scleria tricristata* is a small, tufted annual sedge species characterized by a single, terminal unbranched spike and its remarkable nutlets with three protruding dentate ridges of translucent tissue. Both species are described, illustrated and compared with their closest relatives.

### Introduction

*Scleria* P.J. Bergius (1765: 142) is, with 250 or more herbaceous annual or perennial species (Govaerts *et al.* 2015), one of the major genera in the Cyperaceae. The genus has a pantropical distribution, locally extending into (warm) temperate regions. Within the Cyperaceae, the genus is placed in the monotypic tribe Sclerieae (Muasya *et al.* 1998; Hirahara *et al.* 2007; Hinchliff *et al.* 2010; Viljoen *et al.* 2013; Jung *et al.* 2013). Although many authors have suggested different infrageneric classifications for *Scleria* (e.g., Nees 1842; Clarke 1908; Core 1936; Kern 1961; Camelbeke 2001), most authors now seem to agree upon two subgenera: *Scleria* subgenus *Hypoporum* Nees (1834: 303) C.B. Clarke (1894: 684) and *Scleria* subgenus *Scleria*. At the sectional level, seven sections are recognized based on Clarke (1908) and Core (1936). Kern (1961) added two new sections, resulting in nine commonly recognized sections (e.g., Camelbeke 2001). However, until now this classification has not been tested using molecular phylogenetic data, and an extensive molecular evolutionary revision of the genus is required.

*Scleria* displays wide variation in the structure of the inflorescence and in spikelet morphology. Seven inflorescence types were described, all derived from the basic paniculate type by contraction and reduction of branches (Camelbeke 2001). Flowers are always unisexual and arranged in androgynous, subandrogynous, male or female spikelets. The fruit is a nutlet with, at its base, an often trilobed hypogynium in *Scleria* subgenus *Scleria*. The hypogynium is generally absent or reduced in *Scleria* subgenus *Hypoporum*.

While working on a molecular phylogenetic study of the genus *Scleria*, several species could not be identified with existing identification keys. These species also could not be matched with any previously described species. Here, we describe two new species of *Scleria* subgenus *Hypoporum* from central Tanzania. Subgenus *Hypoporum* comprises slender, narrow-leaved annuals or perennials, sometimes hairy and usually growing in open, seasonally dry habitats. The inflorescence is terminal, glomerate-spicate with usually many clusters of spikelets, commonly called glomerules, or sometimes paniculate and then the spikelet-clusters tend to be very small (Haines and Lye 1983). The spikelets are androgynous, sometimes with additional male spikelets. The hypogynium is always absent or rudimentary.

## Material and methods

Besides examining the holo-, iso- and paratypes of the two new species, 33 specimens of other east African resembling species of *Scleria* were studied in detail at GENT, BR, K, MO, NY and US (abbreviations according to Holmgren *et al.* 1990). Species comparative measurements were taken with a Kyowa, Model SZM stereomicroscope. Images of the habitus and spikelets presented in the figure were taken with a Nikon SMZ800 stereoscopic microscope, equipped with a Nikon digital camera DXM1200 (Nikon, Tokyo, Japan) and edited with Adobe Photoshop CS3 (Adobe Systems Inc., San Jose, USA). Additionally, seeing them as potentially informative characters for the genus, low-vacuum Scanning Electrode Microscopy (Hitachi Tabletop Microscope TM-1000) pictures of the nutlets were taken at the VIB Department of Plant Systems Biology, Ghent University.

## Taxonomic treatment

*Scleria pantadenia* Meganck & Bauters, *sp. nov.* (Fig. 1)

Small annual herb with delicate leaves, very small tuberculate nutlets with swollen cells forming a tuberculate rim at the base. Inflorescence with up to 20 glomerules always branched with branches up to 10 cm.

TYPE:—TANZANIA. Mpanda District: Uzondo Plateau, 1550 m elevation, 05°29'S 30°32'E, 16 April 2006, *S. Bidgood, I. Darbyshire, K. Hoenselaar, G. Leliyo, G. Sanchez-Ken & K. Vollesen 5550* (Holotype NHT!, Isotype DSM!, EA!, K!, MO!).

Paratypes:—TANZANIA. Mpanda District: 10 km N of Uzondo Camp, 1550 m elevation, 05°25'S 30° 29'E, 13 March 2009, *S. Bidgood, G. Leliyo & K. Vollesen 8133* (DSM!, K!, MO!, NHT!, P!); Mpanda District: Uzondo Plateau, 1550 m elevation, 05°29'S 30°32'E, 3 May 2008, *S. Bidgood, G. Leliyo & K. Vollesen 6643* (BR!, C!, CAS!, DSM!, ETH!, K!, MO!, NHT, P, UPS!, US!, WAG!); Mpanda District: 2 km S of Uzondo Camp, 1600 m elevation, 5°30'S 30°32'E, 11 March 2009, *S. Bidgood, G. Leliyo & K. Vollesen 8105* (DSM!, K!, NHT!).

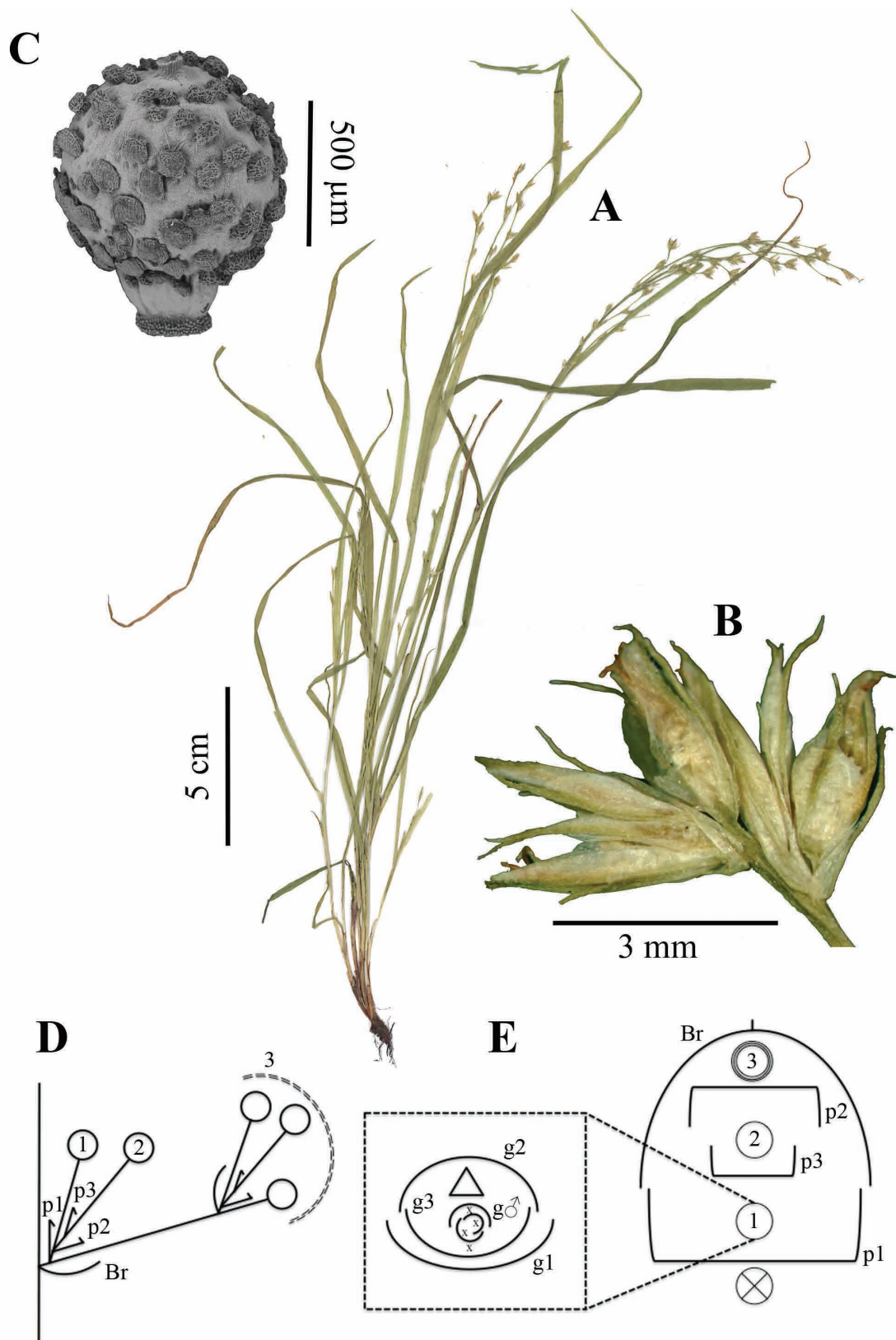
Small, decumbent or erect annual *herb*, single stemmed or in small tufts. *Roots* fibrous 0.1–0.2 mm across, rhizome absent. Culms 10–30 cm long and 0.5–1.0 mm thick at mid height, triangular and glabrous. *Leaves* tristichous, delicate and brittle, 5–35 cm long, 1.0–3.0 mm wide, glabrous; sheaths glabrous, reddish-brown. *Inflorescence bracts* 2–10 cm long; sheaths up to 10 cm, glabrous. *Ligule absent* and *contraligule* unpronounced. *Inflorescence* terminal, 3–10 cm long, glomerate-spicate, always branching, these branches up to 10 cm long. *Glomerules* up to 20, following a prophyll branching pattern, always erect, each with 2–6 spikelets; glomerule bract (0.9–)1.5–4 mm long with small mucro of (0.3–)0.5–3 mm long. *Spikelets* 2–3(–4) mm long, all androgynous; prophyll of the spikelet 0.5–1.1 mm long, often with additional spikelets in its axil. *Glumes* 6–9, pale to light castaneous with clear green midrib; lowest glume 1.7–2.6 mm long, 0.6 mm wide, empty, mucro 0.5–1.1 mm long; second glume 2.0–2.4 mm long, 6.6 mm wide, female, mucro 1.9–1.3 mm long; third glume 2.0–2.6 mm long, 1.1 mm wide, male, mucro 0.2–0.5 mm long; higher glumes 3–5, spirally arranged, ca. 1.7 x 0.3 mm, all male; male glumes all bearing 2 stamens. *Flowers* unisexual; style trifid, dark brown coloured, ca. 2.5 mm of which branches ca. 0.9 mm; stamens 2, filaments ca. 1.5 mm, anthers ca. 0.8 mm. *Nutlet* 0.8–1.1 mm long and 0.7–0.9 mm broad (Fig. 3A), wide elliptic to almost globose, surface tuberculate (Fig. 3B); apex truncate, short and base trigonous; tubercules gland-like ca. 0.095 mm in diameter; with a small rim of tuberculate swollen cells at the base (Fig. 3C); hypogynium absent; in dried condition white to whitish-grey, often with three longitudinal darker bands, between paler, raised ribs.

Distribution and ecology:—Known only from the Uzondo Plateau in Mpanda District in West Central Tanzania. Annual growing in small wet shady ledges and seepage areas on large rocky sandstone outcrops, at ca. 1550 m elevation.

Etymology:—The specific epithet *pantadenia* refers to the many glands all over the surface of the fruit.

Phenology:—Flowering has been observed in the field in March and April (seasonal rain).

Conservation status:—Following the IUCN Red List Criteria and Categories (IUCN 2012), *Scleria pantadenia* should be considered as “Endangered” (EN) following the AOO criterion in GeoCAT (Bachman *et al.* 2011).



**FIGURE 1.** *Scleria pantadenia*.—A. Habit.—B. Glomerule with several spikelets.—C. Nutlet.—D. Schematic overview of a glomerule.—E. Diagram of glomerule with detail of spikelet diagram. From the type specimen *S. Bidgood et al.* 5550 (MO). Br = gomerula bract; g = glume; p = prophyll; x = represents two stamens.

Additional specimens examined (related species):—*Scleria pergracilis* (Nees 1834: 267) Kunth (1837: 354) ANGOLA. Prov. da Huila, im bush bei der mission Cubango, 15 February 1952, *H. & E. Hess* 52/700 (GENT); Prov.

da Huila, 3 km westlich der Mission Galangue, am Ufer des Rio Cuangue, 18 February 1952, *H. & E. Hess 52/752* (GENT). BURKINA FASO. Yenderé-Ouangolodougou ca. km 8, 275 m elevation, 04°55'W 10°10'N, 19 October 2000, *S. Laegaard 21176* (GENT); Boulgou, some km SE of Tenkodogo, 300 m elevation, 00°18'W 11°44'N, 10 April 1996, *J.E. Madsen 5978* (GENT); Boulgou, some KM SE of Tenkodogo, 00°20'W 11°41'N, 300 m elevation, 26 October 1996, *J.E. Madsen 6197* (GENT). BURUNDI. Ruyigi, Nyakazu, steppe rocheuse, 2000 m elevation, 3 April 1972, *M. Reekmans 1881* (MO). DEMOCRATIC REPUBLIC CONGO. Haut-Shaba, contrefort des Kundelungu, au-dessus de Gobella, Lieu marécageux au bord de la route, 1080 m elevation, 19 April 1971, *S. Lisowski 11184* (GENT); Kinshasa, Haut-Katanga, 50 km au NE de Lubumbashi, au bord de la rivière Luiswishi, 4 November 1969, *S. Lisowski, F. Malaisse, J.-J. Symoens 442* (GENT); IVORY COAST. Quellmoa, südl. von Karpin, Franiffelsplateau, 250 m elevation, 8°3'N 3°4'W, 17 September 1991, *S. Porembski 595* (GENT); Comoe-National Park, 170 m elevation, 8°7'N 3°5'W, 12 January 1991, *S. Porembski 615* (GENT). LIBERIA. Central Province: Gbarnga District, outcrop 3 miles east of Palilah, 20 August 1947, *J.T. Baldwin Jr. 9152* (MO). SENEGAL. Basse Casamace Tobor, prairie humide, 6 m elevation, 15 November 1978, *C. Vanden Berghen 3170* (GENT). TOGO. Région Savanes Mango, 6 km N de Mango, 125 m elevation, 0°22'E 10°25'N, 20 November 1983, *P.A. Schafer 7911* (MO). ZAMBIA. Northern Province, 5 km SE of Fat hill, 11 March 1961, *E.A. Robinson 4441* (MO); Kasama, Chishimba Falls, 2 April 1961, *E.A. Robinson 4565* (MO); Kasama, Chishimba Falls, 02 April 1961, *E.A. Robinson 4585* (NY).—*Scleria pulchella* Ridley (1884: 168). ANGOLA. Prov. da Huila, Plateau des Kibara 800 m östlich von Humpata, Abhang gegen den Nenfluss, 1850 m elevation, 15 Mai 1952, *H. & E. Hess 52/1745* (GENT); Prov. da Huila, Humpala, 1900 m elevation, 6 Mai 1937, *Gossweiler 11089* (COI). CONGO. Katanga, env. de Lusinga, 1800 m elevation, 14 April 1969, *S. Lisowski, F. Malaisse, J.-J. Symoens 5002* (GENT). MALAWI. Sothern Region, Zomba District, Zomba Plateau, west side, by stream north of summit, 1830 m elevation, 4 Mai 1970, *R.K. Brummitt & E.A. Banda 10351* (K). TANZANIA. Sumbawanga District, Tatanda, 8°29'S 31°30'E, 1650 m elevation, 25 April 2006, *S. Bidgood et al. 5693* (MO). ZAMBIA. Nyika Plateau, near Rest House, 2250 m elevation, 15 March 1961, *E.A. Robinson 4527* (NY). ZAMBIA. Mutinondo Wilderness Area, inserberg near falls, 12°27.06'S 31°17.38'E, 1460 m elevation, 7 April 2003, *Paul Smith & Clement Chishala 1844* (GENT, K).

*Scleria tricristata* Meganck & Bauters *sp. nov.* (Fig. 2)

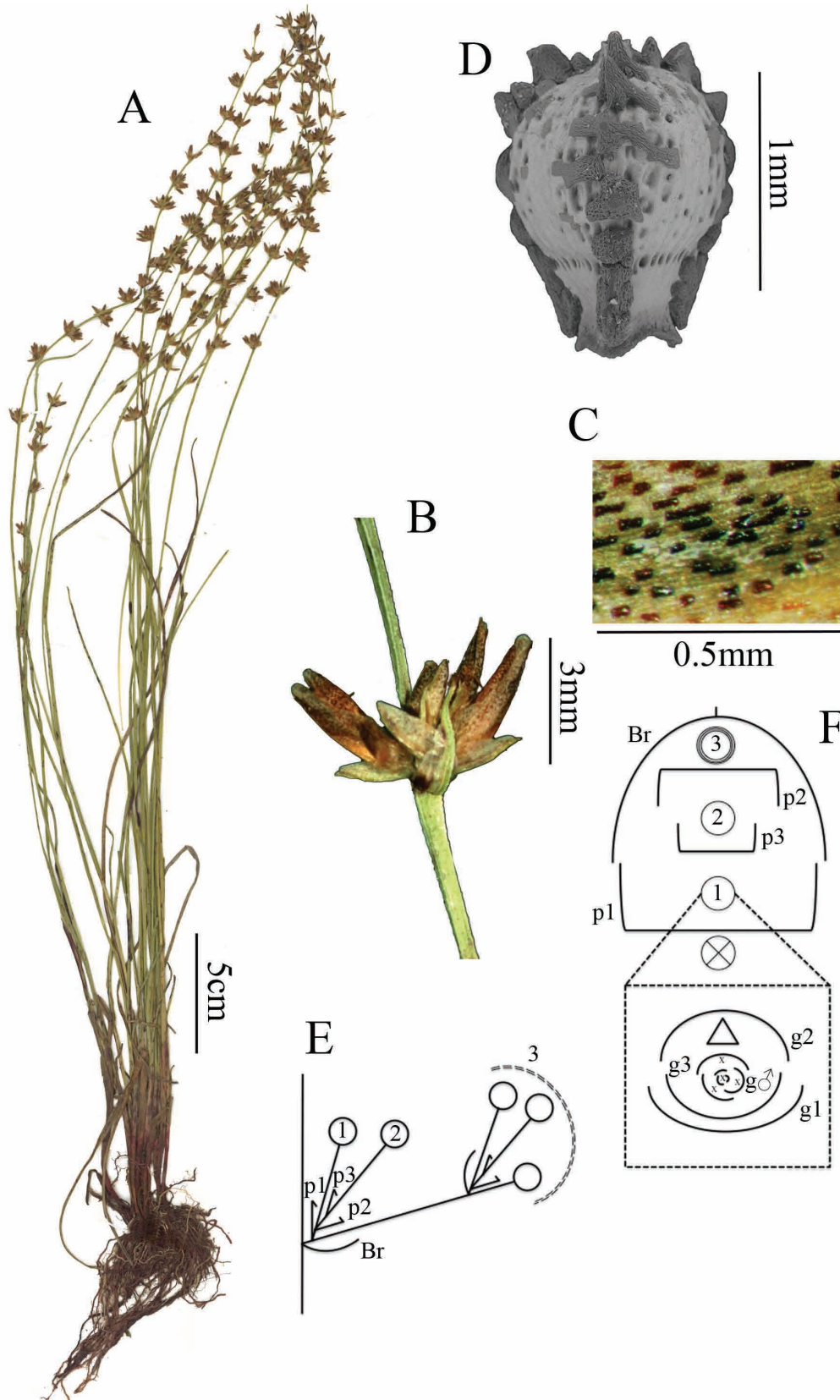
Small tufted annual herb with unbranched glomerate-spicate inflorescences, composed of 6 to 14 glomerules, each containing up to seven spikelets. *Scleria tricristata* is unique in having ovoid to globose nutlets with a pitted surface, and the three ribs of the nutlet, three protruding, dentate ridges of translucent tissue. It resembles most closely *S. delicatula* in this character, but differs in the much more pronounced translucent tissue. The latter species is in general smaller than *S. tricristata* and has glabrous leaf sheaths.

TYPE:—TANZANIA, Sikonge District: 15 km on Ipole-Inyonga road, 1025 m elevation, 05°53'S 32°38'E, 18 May 2006, *Bidgood S., Hoenselaar K., Leliyo G. & Vollesen K. 6083* (Holotype NHT!, Isotype DSM!, K!, MO!, P!).

Paratypes:—TANZANIA. Mpanda District: 55 km on Inyonga-Tabora road, 1000 m elevation, 06°18'S 32°12'E, 8 May 2006, *Bidgood S., Hoenselaar K., Leliyo G. & Vollesen K. 5846* (DSM!, K!, MO!, NHT, P!); Tabora District, 29 km on Tabora-Nzega road, 1100 m elevation, 04°57'S 33°02'E. 12 May 2006. *Bidgood S., Hoenselaar K., Leliyo G. & Vollesen K. 5933* (K!, MO!, NHT!).

Small, erect annual *herb*, growing in tufts. *Roots* fibrous, 0.2–0.4 mm across, purple; rhizome absent. *Culms* 22–40 cm long, 0.5–1 mm thick at mid height, triangular and glabrous. *Leaves* tristichous, slender, 10–30 cm long, 1–2 mm wide, glabrous; sheaths hairy, brown to reddish-brown coloured. *Ligule* absent and *contraligule* unpronounced. *Inflorescence bracts* up to 15 cm long; sheaths up to 10 cm. *Inflorescence* terminal, 10–20 cm long, glomerate-spicate, never branching. *Glomerules* 6–14 per culm, following a prophyll branching pattern, always erect, each with 3–5–(7) spikelets; glomerule bract 3.0–4.5 x 0.5–1.1 mm with mucro 1.0–2.5 mm long. *Spikelets* 2.5–4 mm long, all androgynous or male; prophyll of the spikelet 0.9–1.2 mm, often with additional spikelets in its axil. *Glumes* 6–many, glabrous, castaneous to red, without clear midrib, spotted with red-brown dots except for the higher male glumes; lowest glume 1.4–2.0 mm long, empty, sometimes with short mucro of 0.1 mm, protruding 0.2 mm below glume tip; second glume 2.0–2.5 mm long, female, occasionally empty; mucro 0.1–0.2 mm, protruding 0.1 mm below the glume tip; next 3–4 glumes 3.0–3.6 mm long, spirally arranged, male, pattern as described above; higher glumes 2–many, somewhat smaller, reduced, linear, transparent, spirally arranged, male. *Flowers* unisexual; style trifid, dark brown, ca. 1.7 mm of which branches ca. 0.7 mm; stamens 2, filaments ca. 2.4 mm, anthers ca. 1.8 mm, scaberulous at the top.

*Nutlet* 1.5–1.0 mm long, 1.0–1.2 mm broad (Fig. 3E), ovoid to globose, surface pitted, apex short and base trigonous with small yellow-brown rim; in dried material white-greyish to pink-reddish and almost black; with three protruding, dentate ridges of yellow-transparent tissue.



**FIGURE 2.** *Scleria tricristata*.—A. Habit.—B. Glomerule with several spikelets.—C. Detail of glume surface.—D. Nutlet.—E. Schematic overview of a glomerule.—F. Diagram of glomerule with detail of spikelet diagram. From the type specimen *S. Bidgood et al.* 6083 (MO). Br = spikelet bract; g = glume; p = prophyll; x = represents two stamens.t

Distribution and ecology:—Sikonge and Tabora districts in the Tabora region in Central Tanzania; also known from Mpanda District in West Central Tanzania. Annual growing in seasonally wet, open grasslands on sandy-loamy soils, at ca. 1100 m elevation.

Etymology:—The specific epithet *tricristata* refers to the crested projections on each of the three ribs of the nutlet.

Phenology:—Flowering has been observed in the field in May.

Conservation status:—Following the IUCN Red List Criteria and Categories (IUCN 2012), *Scleria tricristata* should be considered as “Critical” (CR) following the AOO criterium in GeoCAT (Bachman *et al.* 2011 ).

Additional specimens examined—*Scleria delicatula* Nelmes (1955: 448) ZAMBIA. Kasama District, 10 km E of Kasama, Damp shallow soil over horizontal sandstone outcrop, 6 March 1961, *E.A. Robinson 4426* (MO); Chilongolwelo, Abercorn, 1400 m elevation, Very shallow soil over laterite outcrop, seasonally damp, 17 March 1961, *E.A. Robinson 4535* (MO, NY); Kasama District, 10 km east of Kasama, Damp shallow soil over horizontal sandstone outcrop, 26 March 1961, *E.A. Robinson 4555* (K, MO, NY); Kasama District, 95 km E of Kasama, Deep damp, sandy soil among outcrops of laterite and sandstone, 3 April 1961, *E.A. Robinson 14577* (MO!); 13 km NE of Kasama, Sandy soil at edge of laterite pan, 27 April 1961, *E.A. Robinson 4621* (MO!); Kashashi Dambo, 55 km ESE of Mporokoso, Shallow soil over sandstone, 4 February 1962, *E.A. Robinson 4920* (K, MO); Kashashi Dambo, 55 km ESE of Mporokoso, Black loam, seasonally damp, 4 February 1962, *E.A. Robinson 4922* (MO); Mporokoso District, Northern Province, Five miles North of Muzombwe, West side of Mweru-Wa-Ntipa, 16 April 1961, *D.E.F. Vesey-Fitzgerald 3231* (MO).—*Scleria robinsoniana* J. Raynal (1967: 239) GUINEE. On very shallow soil overhanging sandstone outcrop in seepage area, 2 September 1962, *P. Adams 336* (K); Nyika Plateau, shady bog, 6 January 1959, *E.A. Robinson 3099* (K).—*Scleria sheilae* J. Raynal (1967: 243). CAMEROUN, Nkolbison, 8 km W Yaoundé, 800 m elevation, 19 November 1964, *J. & A. Raynal 11970* (K).

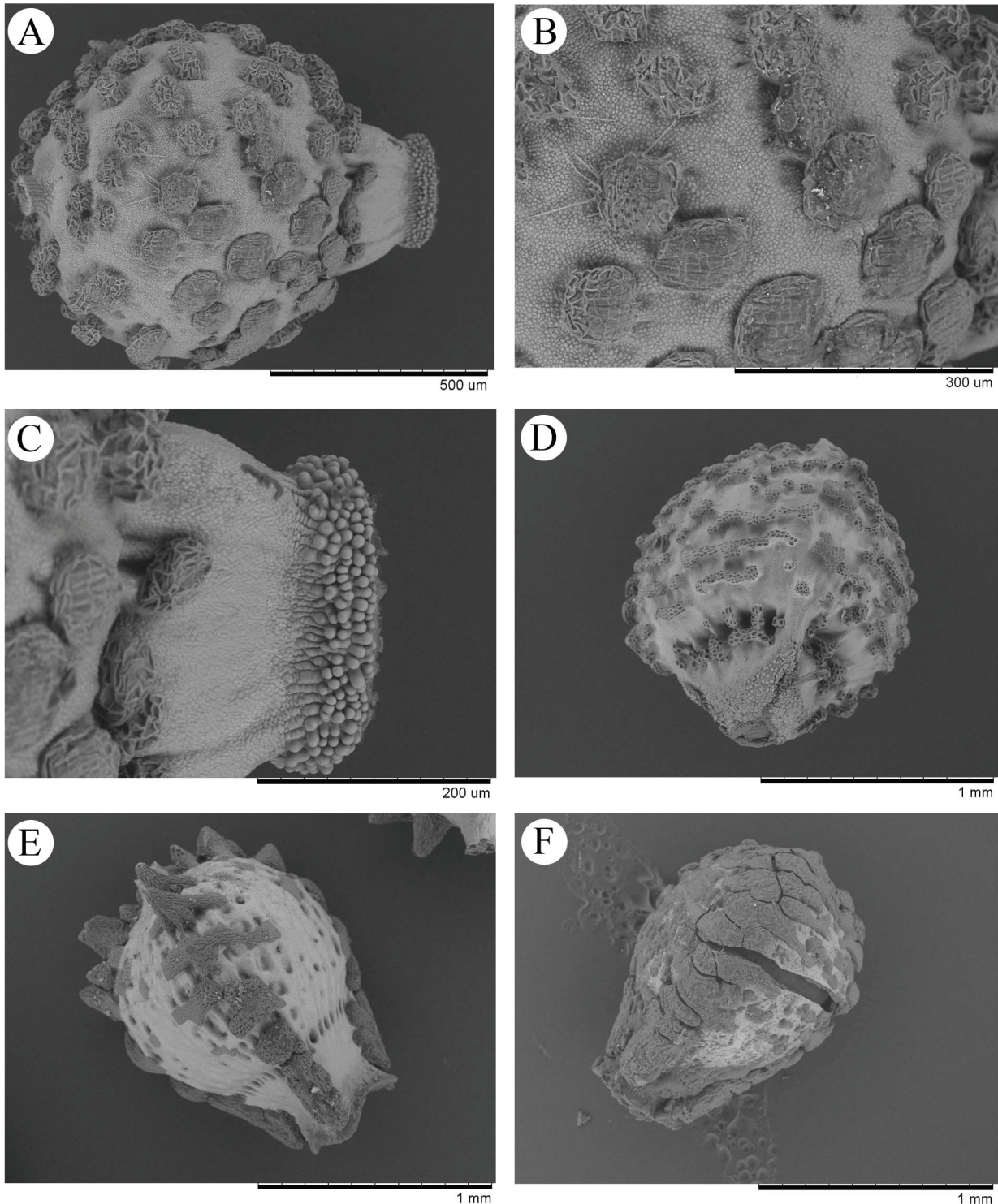
## Discussion

The delicate and brittle appearance of *Scleria pantadenia*, together with its small nutlets that have remarkable glands on their surface, make this species unique in the genus. When trying to identify the specimens of this species with the available literature (e.g., Nelmes 1955; Robinson 1966; Haines & Lye 1983; Hoenselaar *et al.* 2010), no satisfactory identification can be reached. Most commonly, the existing literature led to the species *S. pergracilis*. However, this species is always taller and its leaves do not appear delicate and brittle. Also, while in *S. pantadenia* the inflorescence is always branched, this is not the case in *S. pergracilis*, which is rarely branched and then only very shortly near the base of the inflorescence. In general, the nutlet of *S. pergracilis* is larger (1.3–1.8 x 1.2–1.5 mm) and trabeculate to tuberculate (Fig. 3D). Moreover, the tubercles on the surface are not gland-like as in *S. pantadenia* (Fig. 3A, B), and tuberculate swollen cells are absent at the base of the nutlet.

Also, *Scleria pulchella* superficially resembles *S. pantadenia*. This species is generally smaller than *S. pergracilis* but apart from its size it is similar in most characters, thus differing from *S. pantadenia* in the same way as *S. pergracilis*. A comparison of these three species is given in Table 1. The gland-like tubercles on the surface of the nutlet and the tuberculate swollen cells at the base are possibly linked with the dispersal of the species. *Scleria triglomerata* Michaux (1803: 168) is known to be dispersed by ants (Gaddy 1986). At the base of the nutlets in this species, a rim of tubercles occurs that is superficially similar to what is found in *S. pantadenia*. Further studies are needed to confirm whether these gland-like structures and small tubercles at the base of the nutlets are produced as rewards for ants.

*Scleria tricristata* is remarkable in having protruding dentate ridges of yellowish translucent tissue on the ribs of the nutlets (Fig. 3E). This translucent tissue is also found in other species but never so pronounced as in *S. tricristata*. When identifying the specimens of this species using the most important published literature for the region (e.g., Nelmes 1955; Robinson 1966; Haines & Lye 1983; Hoenselaar *et al.* 2010), it is always identified as *Scleria delicatula*. Both are tufted annual herbs, with *S. delicatula* slightly smaller in all its parts. The diagnostic differences are found in the nutlets. While *S. delicatula* has oblong-ellipsoid to broadly ovoid nutlets with a muricate-trabeculate surface (Fig. 3F), *S. tricristata* has broadly ovoid to almost globose nutlets with a pitted surface. *Scleria delicatula* also has the raised, translucent tissue, however, in this species it is not dentate and does not protrude as much, and is in general less conspicuous than in *S. tricristata*. Both species do share nutlet colour going from pink to dark red or even black with only the translucent tissue being yellowish. In overall morphology, *S. tricristata* rather closely approaches *S. pergracilis*. However, the specimens of *S. pergracilis* studied lack the translucent tissue on the nutlets. Furthermore, the nutlet of

*S. pergracilis* is trabeculate to tuberculate, while in *S. tricristata* it always has a pitted surface. A comparison of these three species is given in Table 2. Both *Scleria robinsoniana* Raynal and *Scleria sheilae* Raynal also have a kind of translucent tissue on the nutlet surface. In these two species, the tissue is not restricted to three ridges of the nutlet, but scattered all over the surface. The presence of this tissue type seems to be a case of parallel evolution, since the general morphology of both species greatly differs from that of *S. tricristata*. Their inflorescences are always branched, very fine and almost grass-like. There is no morphological evidence that these species are related to the newly described *S. tricristata*.



**FIGURE 3.** SEM micrographs.—*Scleria pantadenia* (*S. Bidgood et al.* 5550 (MO)).—A. Nutlet.—B. Detail of nutlet surface.—C. Detail of basal tubercles.—*Scleria pergracilis* (*E.A. Robinson* 4585 (NY)).—D. Nutlet.—*Scleria tricristata* (*S. Bidgood et al.* 6083 (MO)).—E. Nutlet.—*Scleria delicatula* (*E.A. Robinson* 4555 (NY)).—F. Nutlet.

**TABLE 1.** Morphological comparison of *Scleria pantadenia* with *S. pergracilis* and *S. pulchella* (based on Nelmes 1955; Robinson 1966; Haines & Lye 1983; Hoenselaar *et al.* 2010) and personal observations of the specimens listed in the Taxonomical Treatment)

	<i>Scleria pantadenia</i>	<i>Scleria pergracilis</i>	<i>Scleria pulchella</i>
<b>Habit</b>	tufted annual herb	tufted annual herb	tufted annual herb
<b>Culms</b>	10–30 cm × 0.5–1.0 mm	15–95 cm × 0.5–1.0 mm	8–15 cm × 0.3–1.0 mm
<b>Leaves</b>	up to 35 cm × 2–3 mm, glabrous; sheaths glabrous	up to 40 cm × 1–2 mm, glabrous; sheaths glabrous or sparsely hairy	up to 10 cm × 1–2 mm, glabrous or sparsely hairy; sheaths glabrous or sparsely hairy
<b>Inflorescence</b>	3–10 cm; branches up to 10 cm	5–13 cm; sometimes slightly branched	1–4 cm; sometimes slightly branched
<b>Glomerules</b>	up to 20 per culm; 2–6 spikelets;	5–30 per culm; 1–5 spikelets;	3–10 on main axis; 1–5 spikelets;
<b>Spikelet</b>	2.0–3.0 mm	4.0–5.0 mm	2.0–4.0 mm
<b>Glumes</b>	6–9; glabrous; all glumes pale to light castaneous with clear green midrib and short mucro of 0.2–1.9 mm	5–6; glabrous; female glumes pale reddish; male glumes darker	5–6; glabrous; female glumes blackish-red with greenish midrib, excurrent in a smooth mucro of 0.3–1.0 mm long
Lowest	1.7–2.6 mm (empty)	2.5–3.25 mm (empty)	1.2–2.5 mm (empty)
Second	2.0–2.4 mm (female)	2.5–3.25 mm (female)	1.2–2.5 mm (female)
Higher	2.0–2.6 mm (male)	2.0–3.0 mm (male)	2.25–2.5 mm (male)
<b>Nutlets</b>	0.8–1.1 × 0.7–0.9 mm; wide elliptic-globose, surface tuberculate; tubercules gland-like; at base small rim of swollen tuberculate cells	1.4–1.6 × 1.2–1.6 mm; globose, surface tessellate-lacunose, muricate-lacunose; no such glands and tubercules	0.9–1.3 × 0.8–1.0 mm; subglobose, surface lacunose-trabeculate, sometimes with three longitudinal smooth areas; no such glands and tubercules

A final comment can be made on nutlet surface of *Scleria* subgenus *Hypoporum* in general. Different ornamentations are often found on different nutlets from the same specimen, due to the fact that, during their development, the surface of the nutlets can drastically change in appearance. When comparing specimens and species, one should always be aware of this and try to study only fully mature nutlets. For the two new species described here, nutlet configuration was remarkably constant on all specimens.

## Acknowledgments

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**TABLE 2.** Morphological comparison of *Scleria tricristata* with *Scleria delicatula* and *Scleria pergracilis* (based on Nelmes 1955; Robinson 1966; Haines & Lye 1983; Hoenselaar *et al.* 2010) and personal observation of the specimens listed under Taxonomical Treatment)

	<i>Scleria tricristata</i>	<i>Scleria delicatula</i>	<i>Scleria pergracilis</i>
<b>Habit</b>	tufted annual herb	tufted annual herb	tufted annual herb
<b>Culms</b>	22–40 cm × 0.5–1.0 mm	12–35 cm × 0.3–0.6 mm	15–95 cm × 0.5–1.0 mm
<b>Leaves</b>	10–30 cm × 1–2 mm sheaths (sparsely) hairy	5–15 cm × 0.5–0.9 mm sheaths glabrous or sparsely hairy	Up to 40 cm × 1–2 mm sheaths glabrous or sparsely hairy
<b>Inflorescence</b>	10–20 cm; unbranched	2–14 cm; unbranched	5–13 cm; sometimes very shortly branched near the base
<b>Glomerules</b>	6–14 per culm; 3–5–(7) spikelets; bract 3.0–4.5 × 0.5–1.1 mm with apex 1.0–2.5 mm, glabrous	4–15 per culm; 1–8 spikelets; bract 3.0–5.0 × 0.5–1.0 mm with apex 0.5–1.5 mm, glabrous or hairy	5–30 per culm; 1–5 spikelets; bract 4.0–5.0 × 1.0–1.5 mm with apex 1.0–2.5 mm, glabrous
<b>Spikelet</b>	2.5–4 mm	2.5–4.5 mm	4.0–5.0 mm
<b>Glumes</b>	6–many; glabrous; castaneous to red; spotted red.	5–many; glabrous; pale castaneous to red; spotted red	5–6; glabrous; female glumes pale reddish; male glumes darker
Lowest	1.4–2.0 mm (empty)	1.5–2.0 mm (empty)	2.5–3.25 mm (empty)
Second	2.0–2.5 mm (female)	1.6–2.3 mm (female)	2.5–3.25 mm (female)
Higher	3.0–3.6 mm (male)	2.2–3.2 mm (male)	2.0–3.0 mm (male)
<b>Nutlets</b>	1.5–1.0 × 1.0–1.2 mm; broadly ovoid to globose; surface pitted; 3 protruding dentate ridges of translucent tissue	1.0 × 0.8–1.0 mm; oblong-ellipsoid to broadly ovoid; surface muricate- trabeculate; 3 ridges of translucent tissue	1.4–1.6 × 1.2–1.6 mm; globose, surface tessellate-lacunose, muricate-lacunose; no such translucent tissue

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