THAI FOREST BULL., BOT. 46(2): 113–122. 2018.
DOI https://doi.org/10.20531/tfb.2018.46.2.01

A new species of *Scleria* P.J.Bergius (Cyperaceae) from North-Eastern Thailand

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ABSTRACT

Scleria aureovillosa Kiaosanthie & K.Wangwasit, a new species of Cyperaceae from North-Eastern Thailand, is described and illustrated. It is closely related to *S. benthamii* C.B.Clarke but differs in the leaf and culm surfaces, culm shape, the absence of wings at the leaf sheath, contraligule features, nutlet morphology and micromorphology, and leaf and culm anatomy. An emended section of the key to the species in the Flora of Thailand account of *Scleria* is provided.

KEYWORDS: anatomy, nutlet, *Scleria aureovillosa*, taxonomy, Thailand.

Published online: 21 September 2018

INTRODUCTION

The genus *Scleria* P.J.Bergius (Cyperaceae) comprises ca 250 species, mainly distributed in the tropics and subtropics but also extending into warm temperate regions (Goetghebeur, 1986 & 1998; Haines & Lye, 1983; Zhang *et al.*, 2010). In the Thai flora, the genus is the fourth largest in the Cyperaceae with 22 species (Simpson & Koyama, 1998), and in surrounding regions, 29 species in India, 34 species in Malaysia, 22 species in Indo-China, 25 species in Vietnam, 11 species in Laos and 24 species in China, have been recorded (Clarke, 1894; Camus, 1912; Kern, 1961 & 1974; Khoi, 2002; Newman *et al.*, 2007; Zhang *et al.*, 2010). *Scleria* can be easily recognized by the bony nutlets, which often have a lobed hypogynium at the base and are not covered by the spikelet glumes. In the past, the genus has been variously classified into seven subgenera and up to 13 sections (e.g. Bentham & Hooker, 1883; Clarke, 1894 & 1908; Haines & Lye, 1983; Koyama, 1961; Kern, 1974). Recently, a new infrageneric classification by Bauters *et al.* (2016), based on molecular evidence and supported by morphology, confirmed *Scleria* as monophyletic and sister to tribe Bisboeckelereae, with four, strongly supported subgenera (*Browniae* (C.B.Clarke) C.B.Clarke, *Hypoporum* (Nees) C.B.Clarke, *Scleria* and *Trachylomia* (Nees) Bauters).

During fieldwork undertaken as part of a Ph.D. study by the first author, specimens were collected in Phu Rua District, Loei Province, which could not be identified using existing identification keys. Moreover, the combination of characters from the morphology, nutlet micromorphology and anatomy of these specimens differed from any previously known species from Thailand and elsewhere.

MATERIALS AND METHODS

Materials were examined from field collections and herbarium specimens at ABD, BK, BKF, BM, BO, CMUB, E, K, KEP, KKU, P, PSU, QBG and SING. Identification was attempted using keys in the Flora of Thailand (Simpson & Koyama, 1998), as well as other publications such as Flora of Générale de I' Indo-Chine, the Flora of the Malay Peninsula, Flora Malesiana, Flora of Vietnam, a Checklist of the Vascular Plants of Lao PDR and Flora of China etc. Images of the inflorescences, habit and habitat were taken with a Ricoh CX4 digital camera. Morphological observations were made using an Olympus SZ-PT stereo microscope.

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Nutlets were taken from dry specimens and placed on a stub with carbon tape, coated with gold by SPI-MODULE and examined using a JEOL JSM6460LV scanning electron microscope (SEM) at the Laboratory Equipment Center, Mahasarakham University. The outer walls of nutlets were removed by soaking in 70% sulphuric acid for 60–90 minutes. The samples were then sonicated in an ultrasonic cleaner for 30 minutes and washed with distilled water in the ultrasonic cleaner for a further 10 minutes. The samples were dried overnight in silica gel and were examined with the SEM. Confirmation of the siliceous on nutlet were obtained by analysis using a SEM fitted with an energy dispersive X-ray analyser (EDX). The comparative leaf and culm anatomy were observed. Samples were prepared using epidermal peeling and paraffin methods and stained with safranin and fast green (Johansen, 1940; Thamathaworn, 1996). Observations were made using an Olympus CH30 light microscope.

TAXONOMIC TREATMENT

Scleria aureovillosa Kiaosanthie & K.Wangwasit, **sp. nov.**

Similar to *Scleria benthamii* C.B.Clarke but differs in having trigonous culms (vs triquetrous in *S. benthamii*), an obtuse contraligule (vs rounded to truncate) and nutlets 2.1–2.5 mm long (vs 2.6–2.9 mm long), subglobose to globose, terete, with a black, apiculate apex (vs ovoid, subterete to trigonous and obtuse apex) (Fig. 3 & Table 1). Type: Thailand, Loei, Phu Rua, 1,155 m, 12 Nov. 2012, *Kiaosanthie WK 0152012* (holotype **BKF** [194620**!**]; isotypes **KKU!**, **QBG!**) (Figs. 1, 2 & 3A–C).

Erect perennial herb, rhizome brown. *Culms* loosely tufted (37–)50–100 cm x 1–2(–4) mm, trigonous, smooth and glabrous. *Leaves* cauline; blade linear, (12–)21–40 cm x 2–3 mm, acute, flat, smooth and glabrous; sheath closed, 2.5–7.2 cm long, wingless, purplish to brown, slightly scabrid to smooth; contraligule obtuse, ciliate. *Involucral bracts* leaf-like, (3.2–)7–9(–19.5) cm x 1–2 mm. *Inflorescences* truncate, linear, loose, 14.5–34 cm x (5–)10–15 mm; 1-noded, with 1 lateral panicle, the panicle sometimes absent; lateral panicle linear-oblong or spike-like, loose, 4.6–11 cm x 5–6 mm, peduncle 2–6 cm long, somewhat short branches; bracteole glume-like, (3–)10–15 mm long, apex awned, margins hispid. *Spikelets* in clusters with 1–2 subandrogynous spikelets and 1–2 staminate spikelets; prophyll usually borne at the base of spikelet, obovate, 1.5–2 mm long, 2-keeled, sides membranous, glabrous, reddish-brown, apex obtuse. *Subandrogynous spikelets* ovate-oblong, 4–5 x 1–2 mm; with 3 glumes, ovate to broadly-ovate, 2–4 x 1–2 mm, sides membranous, glabrous, reddish-brown, apex awned, lowest glume empty, shortest; lateral staminate flower remnant present. *Staminate spikelets* sessile to pedunculate, ovate-lanceolate, 4–6 x 1 mm; with many glumes, ovate to broad-ovate, 2–4 x 1–2 mm, sides membranous or hyaline, glabrous, reddish-brown, apex acute, obtuse or emarginate, the two lowest glumes empty, shortest, apex awned. *Stamens* 3, linear, 1.5 mm long, yellow to brown. *Stigmas* 3. *Nutlets* subglobose to globose, terete, 2.1–2.5 x 2.1–2.2 mm, white, apex black apiculate, surface reticulate, densely irregular silica deposits, single, 2–4 x 2–3.5 µm, and clusters, 5–9.5 x 5–10 µm, hairs 116–173 µm long, golden villous in 3–6 rows on ridges; disk well developed, 3-lobed, deeply sinus at the base, lobes broadly ovate or deltoid, apex acuminate.

Thailand.— NORTH-EASTERN: Loei [Phu Rua, 23 Aug. 2014, *Kiaosanthie WK 1122014* (**QBG!**, **KKU!**)]; Nong Khai [Phu Wua Wildlife Sanctuary, Summit plateau, 200 m, 14 Oct. 1998, *Muasya et al. 1340* (*T71*) (**K!**)]; Bueng Kan [Bung Khla, 306 m, 28 July 2014, *Kiaosanthie WK 1032014* (**QBG!**, **KKU!**)].

Distribution.— Cambodia [Kampot, 27 June 1938, *Poilane 27349* (**P!**); Preah Sihanouk, Kampong Seila, 100 m, 13 Sept. 2013, *Maxwell 13-178* (**CMUB!**)].

Ecology.— Growing in seasonally wet, open grassy places on hillsides and on sandy soil; 100–1155 m alt.

Phenology.— Flowering and fruiting June–November.

Vernacular.— Kok luk khon thong (กกลูกขนทอง). The Thai name translates as 'sedge with golden hairs on the nutlet surface'.

Etymology.— The specific epithet of this new species is taken from the Latin *aureus* and *villus*, which refers to the distinctive feature of the species having golden villous hairs on the mature nutlet surface.

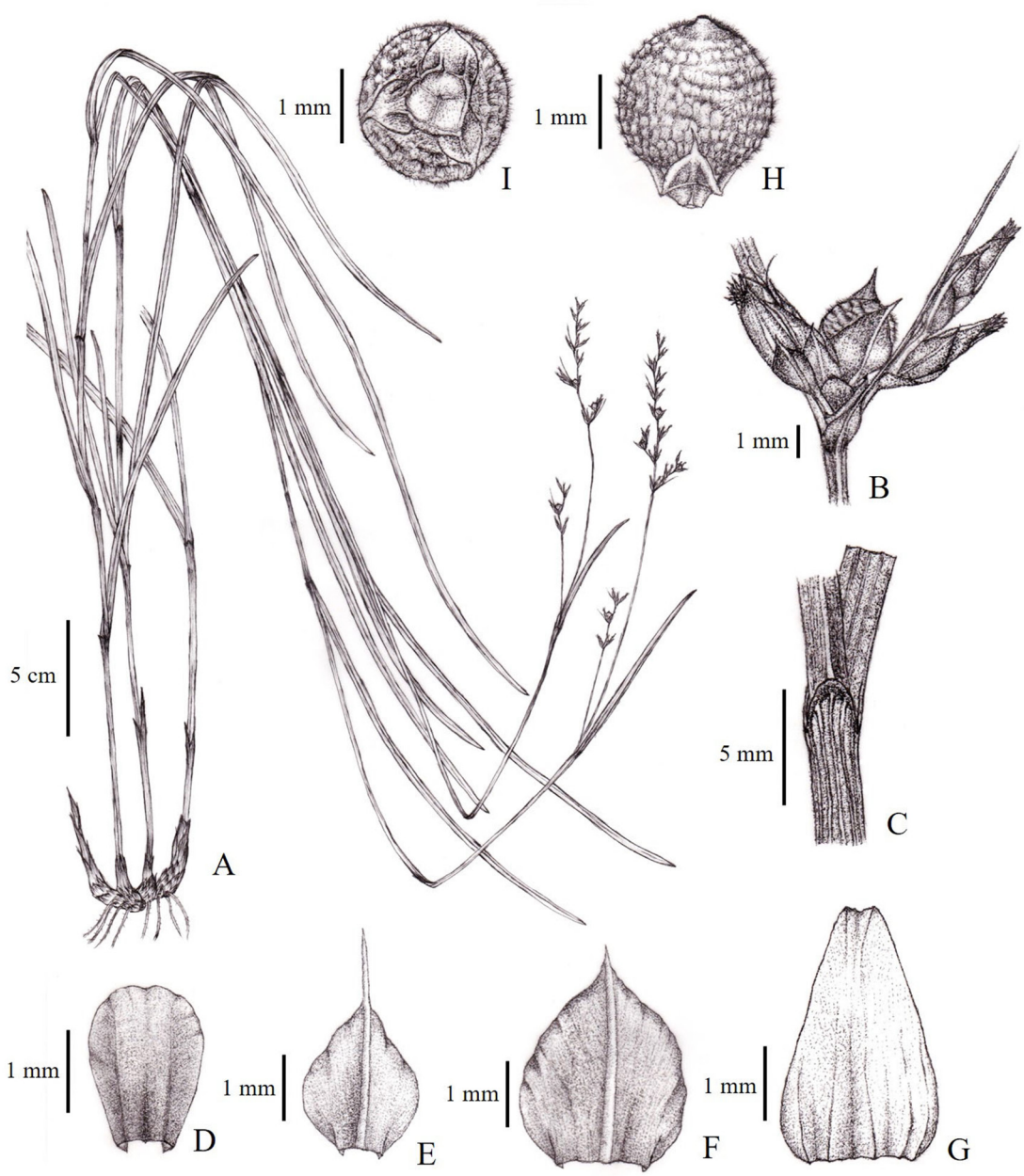

Figure 1. *Scleria aureovillosa* Kiaosanthie & K.Wangwasit. A. habit; B. part of inflorescence; C. contraligule; D. prophyll; E–G. glumes; H. nutlet; I. disk 3-lobed. All from the holotype. Drawn by Wipawan Kiaosanthie.

Figure 2. *Scleria aureovillosa* Kiaosanthie & K.Wangwasit. A–B. part of inflorescence; C. nutlet; D. disk 3-lobed; E. rhizome; F. habitat.

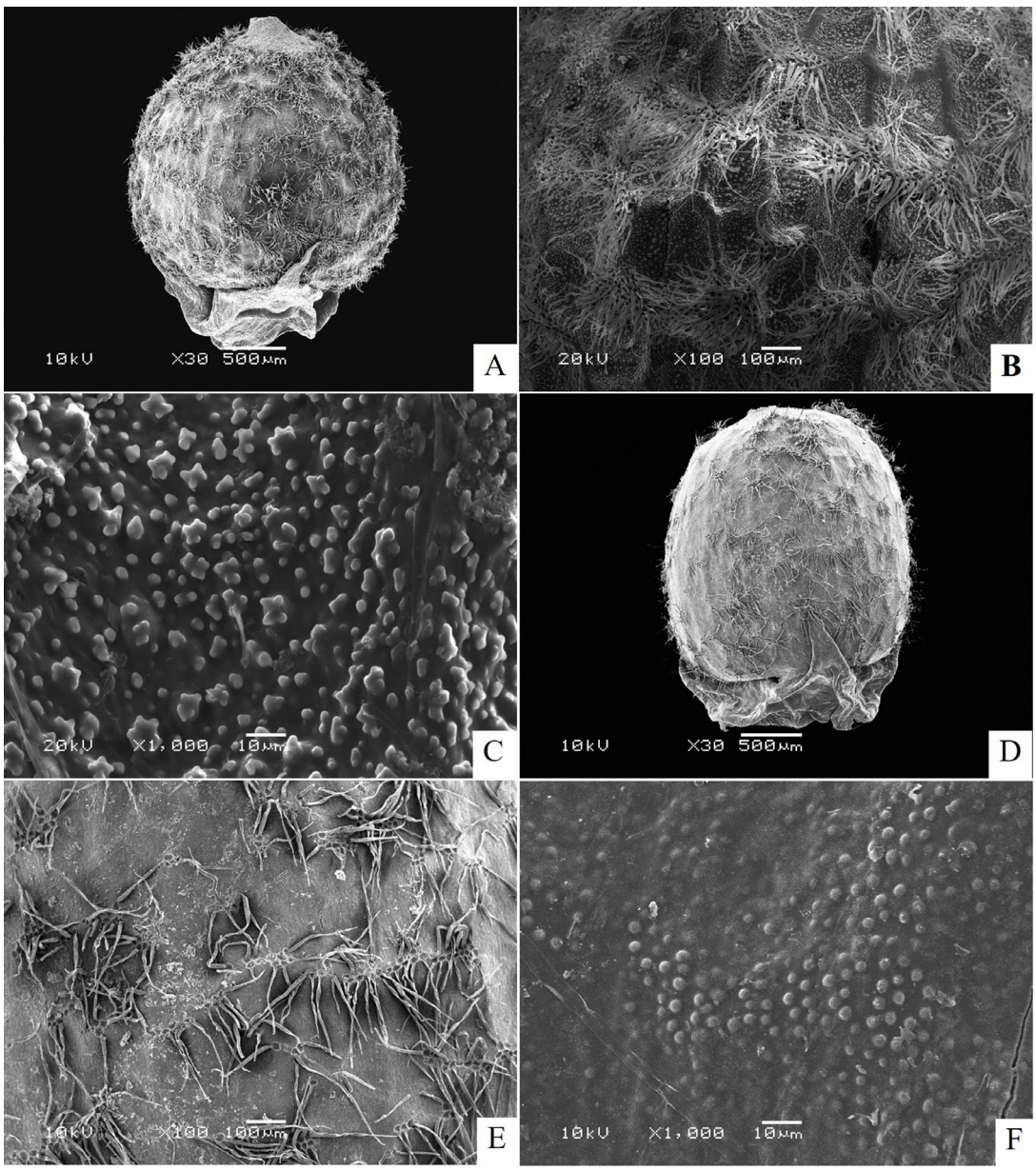

Figure 3. Scanning electron micrographs of nutlets of *Scleria*. A–C. *Scleria aureovillosa* Kiaosanthie & K.Wangwasit, all from the *Kiaosanthie WK 0152012* (BKF); D–F. *S. benthamii* C.B.Clarke, all from the *Kiaosanthie WK 0682013* (BKF).

Conservation Status.— Following the IUCN Red List Criteria and Categories (IUCN 2012), *Scleria aureovillosa* Kiaosanthie & K.Wangwasit should be considered as "Least Concern" (LC). The species is widespread in north-eastern Thailand and was recorded in Cambodia.

Notes.— *Scleria aureovillosa* Kiaosanthie & K.Wangwasit is classified in sect. *Foveolidia* Raf. based on the truncated inflorescences, subandrogynous and staminate spikelets and 3-lobed disk (Bauters *et al.*, 2016). The section is mainly distributed in Africa but with eight species occurring in Thailand: six species, *S. rugosa* R.Br., *S. thwaitesiana* Boeckeler, *S. tessellata* Willd., *S. mikawana* Makino, *S. parvula* Steud., and *S. biflora* Roxb., are annuals, while the remaining two species, *S. benthamii* C.B.Clarke and *S. aureovillosa* Kiaosanthie & K.Wangwasit, are perennials. Kern (1961, 1974) described this section as comprising of annuals only, while Bauters *et al.* (2016) confirmed that the section comprises both

Table 1. Comparisons of diagnostic morphological, nutlet micromorphological and anatomical characteristics of *Scleria aureovillosa* Kiaosanthie & K.Wangwasit and *S. benthamii* C.B.Clarke.

Characters	*S. aureovillosa*	*S. benthamii*
Morphology		
Culm shape	trigonous	triquetrous
Culm surface	glabrous	glabrous to pubescent
Leaf surface	glabrous	glabrous to pubescent
Leaf sheath	wingless	winged or wingless
Contraligule	obtuse	rounded to truncate
Inflorescence node	1 node, with 1 lateral panicle (sometimes 0)	1–3 nodes, with 1–2 lateral panicles
Nutlet shape	subglobose to globose, terete	ovoid, subterete to trigonous
Nutlet length	2.1–2.5 mm	2.6–2.9 mm
Nutlet apex	apiculate, black	obtuse, not blac
Nutlet micromorphology		
Silica deposits	single and clustered	single
Silica shape	irregular	rounded
Leaf anatomy		
Leaf types	hypostomatic	amphistomatic
Unicellular prickles on leaf margins	absent	present
Papillae on adaxial surface	absent	present
Keel shape	obtuse	acute
Leaf margin shape	obtuse	acute
Adaxial parenchymatous hypodermis	present at mid rib	absent
Radiated palisade cells	absent	present
Lateral rib sclerenchyma	adaxial girders	adaxial strands
Culm anatomy		
Papillae	absent	present
Angular sclerenchyma	girders	strands

annuals and perennials. Perennial species, with golden hairs on the reticulated nutlet surface, are present in Africa (*S. achtenii* De Wild., *S. nyasensis* C.B.Clarke, and *S. unguiculata* E.A.Rob.) and America (*S. reticularis* Michx.). The American species is separated from the others by the inflorescence having lateral clusters, while the three African species and *S. aureovillosa* Kiaosanthie & K.Wangwasit have loose lateral panicles. *Scleria aureovillosa* Kiaosanthie & K.Wangwasit differs from the three African species by having a single node with 1 lateral panicle (sometimes absent), the African species having at least two nodes with 1–6 lateral panicles at each node.

Leaf and culm anatomical investigations reveal diagnostic features between *Scleria aureovillosa* Kiaosanthie & K.Wangwasit and *S. benthamii* C.B.Clarke. *Scleria aureovillosa* Kiaosanthie & K.Wangwasit has hypostomatic leaves with an obtuse keel and margins, bifacial mesophyll with palisade and spongy parenchyma, lateral ribs with adaxial sclerenchymatous girders, and leaf and culm surfaces without trichomes and papillae. *Scleria benthamii* C.B.Clarke has amphistomatic leaves with an acute keel and acute margins, mesophyll with radiated palisade cells surrounding the vascular bundles, lateral ribs with adaxial sclerenchymatous strands, and leaf and culm surfaces with unicellular hairs and papillae (Figs. 4 & 5). Micromorphology also provides additional detail of the silica deposits on nutlet surfaces. *Scleria aureovillosa* Kiaosanthie & K.Wangwasit has both single and clusters of silica deposits, whereas *S. benthamii* C.B.Clarke has only single silica deposits (Figs. 3C & F).

The following key is emended from the key to *Scleria* in the Flora of Thailand Cyperaceae account (Simpson & Koyama, 1998).

21. Nutlets not patterned, smoothish to pubescent; disk lobe acute often bidentate at apex **S. levis**
21. Nutlets reticulate, pubescent or villous; disk lobe acuminate at apex
21a. Leaves and culms glabrous to pubescent; contraligule rounded to truncate; nutlets ovoid, subterete to trigonous, apex obtuse, not black **S. benthamii**
21b. Leaves and culms glabrous; contraligule obtuse; nutlets subglobose to globose, terete, apex distinctly apiculate, black **S. aureovillosa**

ACKNOWLEDGEMENTS

This work was supported by Science Achievement Scholarship of Thailand. The authors would like to thank Department of Biology, Faculty of Science, Mahasarakham University for generous places to work and Ph.D. study of first author, Prof. Dr David A. Simpson and Dr Khanit Wangwasit for the suggestions, Mrs Nualanong Wichaikul for her assisted in a SEM examinations, the curators and staffs of the herbarium for allowing access to herbarium materials, Asst Prof. Pasakorn Bunchalee, Asst Prof. Worachat Tokeaw, Mrs Wilailux Zumstein, Miss Nittiya Chueawangkham, and Miss Primprapa Poosongsee for their helping during the field studies.

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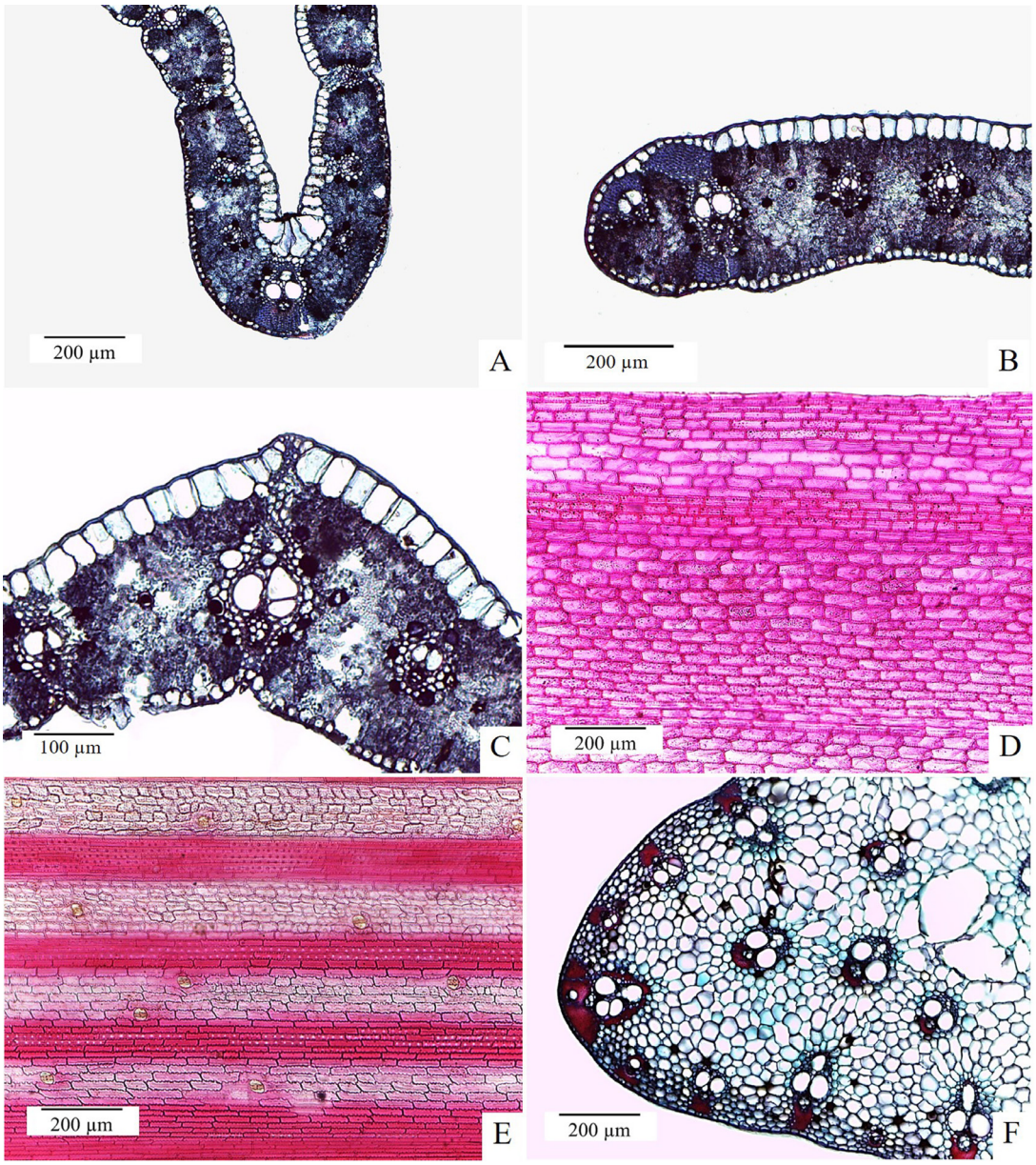

Figure 4. Leaf and culm anatomical characteristics of *Scleria aureovillosa* Kiaosanthie & K.Wangwasit. A–C. leaf in transverse section: A. keel; B. leaf margin; C. lateral rib; D. adaxial leaf surface; E. culm surface; F. culm in transverse section. All from *Kiaosanthie WK 0152012* (BKF).

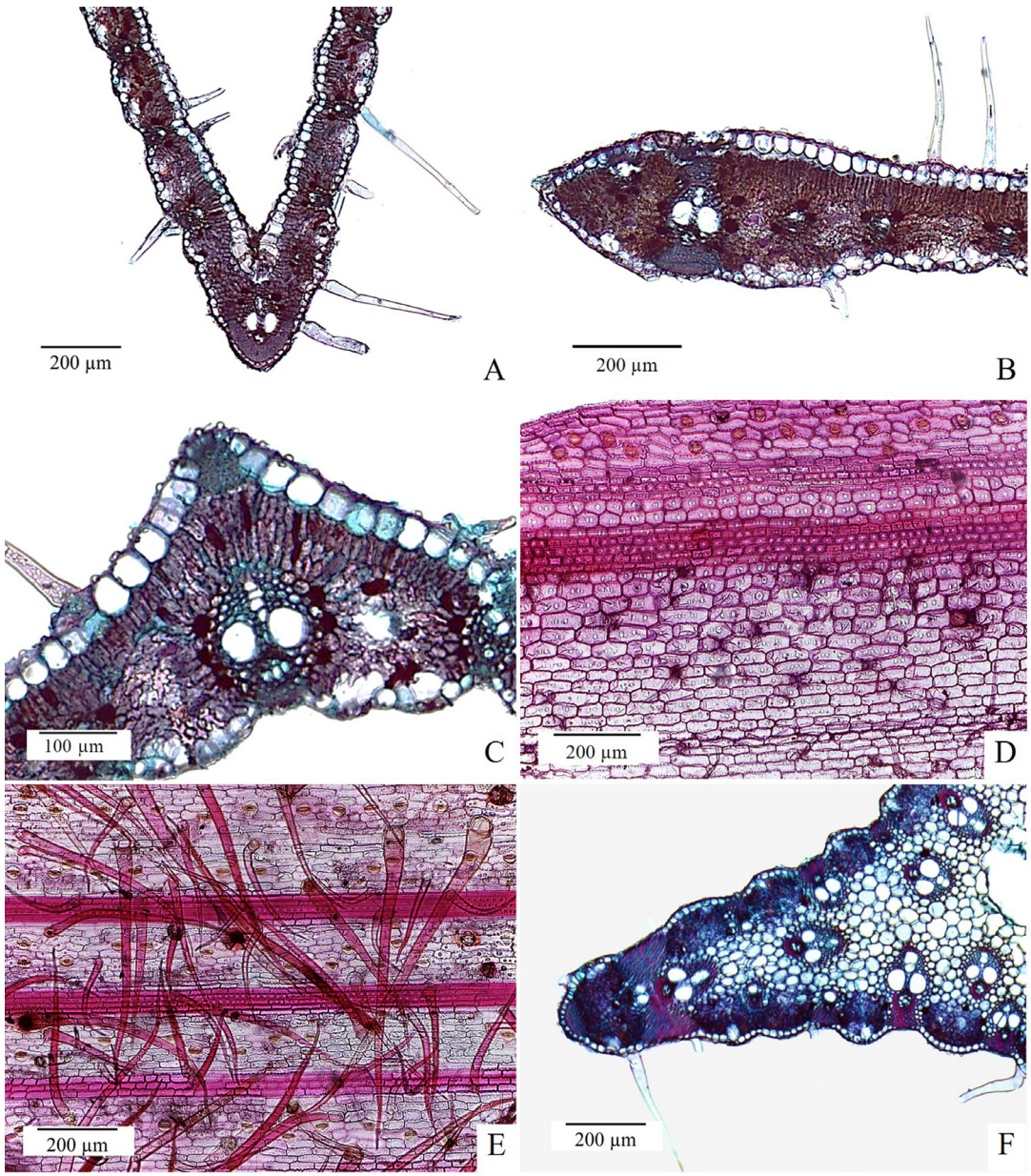

Figure 5. Leaf and culm anatomical characteristics of *Scleria benthamii* C.B.Clarke. A–C. leaf in transverse section: A. keel; B. leaf margin; C. lateral rib; D. adaxial leaf surface; E. culm surface; F. culm in transverse section. All from *Kiaosanthie WK 0682013* (BKF).

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