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## Research article

# Two new species of *Hexasepalum* (Rubiaceae: Spermacoceae) from the ‘campo rupestre’ of Brazil

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**Abstract.** The ‘campo rupestre’ is a montane vegetation mosaic associated with rocky outcrops, with outstanding levels of species diversity and endemism. Among its most diverse lineages, Rubiaceae ranks among the ten richest families. *Hexasepalum* Bartl. ex DC. is nested in the *Spermacoce* clade of Spermacoceae, the largest predominantly herbaceous tribe in the Rubiaceae. The genus comprises 14 accepted species and is distributed mostly in the Americas. Brazil is home to eight species, occurring mainly in the Caatinga and Cerrado (including the ‘campo rupestre’) domains. The analysis of specimens collected in the ‘campo rupestre’ of Bahia (NE Brazil) and Minas Gerais (SE Brazil) revealed two species new to science. *Hexasepalum bacigalupoae* Cabaña Fader & E.L.Cabral sp. nov. and *Hexasepalum motaviananum* Cabaña Fader, J.A.M.Carmo & R.M.Salas sp. nov. are described and illustrated. We comment on their distribution, habitat, and taxonomy. We also provide an updated key to the species of *Hexasepalum* in the Americas. *Hexasepalum bacigalupoae* and *H. motaviananum* are preliminarily assessed as Endangered and Critically Endangered, respectively, underscoring the crucial importance of conserving the ‘campo rupestre’.

**Keywords.** Cerrado, conservation, endemism, *Spermacoce* clade, taxonomy.

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## Introduction

Brazil is home to the richest flora in the world (Forzza *et al.* 2012). Since 2008, it has consistently been a primary source of new plant species discoveries. This is underscored by an annual publication of 200 or more novel species, constituting roughly 10% of the global inventory of plant discoveries (Cheek *et al.* 2020). Moreover, the country hosts two of the world's most critical biodiversity hotspots, the Atlantic Forest and the Cerrado (Brazilian savannah) (Myers *et al.* 2000).

While typically regarded as a component of the Cerrado, the 'campo rupestre' has distinct significance. Lineages within this ecosystem have diversified prior to the Cerrado itself. This temporal distinction suggests that the 'campo rupestre' may represent the earliest form of open vegetation in eastern South America (Silveira *et al.* 2016). It is a montane, grassy-shrubby, fire-prone vegetation mosaic associated with rocky outcrops of quartzite, sandstone, or ironstone, along with sandy, stony, and waterlogged grasslands. Remarkably, the 'campo rupestre' harbours more than 5000 vascular plant species, nearly 15% of Brazil's diversity, in an area corresponding to ca. 0.8% of its territory. Among its most diverse lineages, Rubiaceae Juss. ranks within the ten richest families, which together comprise more than 60% of the local flora (Silveira *et al.* 2016).

*Hexasepalum* Bartl. ex DC. is nested in the *Spermacoce* clade of the Spermacoceae Bercht. & J.Presl (Kårehed *et al.* 2008; Salas *et al.* 2015; Carmo *et al.* 2022, 2025; Nuñez Florentin *et al.* 2022), the largest predominantly herbaceous tribe in the Rubiaceae. The genus is native mostly to the Americas, but also occurs in Africa. Besides, species have been introduced and are considered naturalised in the African and Asian continents and Australia (Cabaña Fader *et al.* 2016). *Hexasepalum* currently includes 14 accepted species (Cabaña Fader *et al.* 2019). The genus presents its highest degree of endemism in Central America and Brazil, the latter harbouring the highest number of species (8 spp.), which occur mainly in the Caatinga and Cerrado (including the 'campo rupestre') domains (Cabaña Fader *et al.* 2019; BFG 2021).

Two groups of species can be distinguished within the genus based on morphology (Cabaña Fader *et al.* 2016), although both may not correspond to monophyletic groups (Carmo *et al.* 2022, 2025; Nuñez Florentin *et al.* 2022). The first one, informally called the '*Hexasepalum teres* group', is characterised by the ventral face of the mericarps showing two depressions, one on each side of the midline; a curved embryo, rarely straight; and pollen grains with two types of suprategal elements, i.e., 1–8 µm long spines and small granules of less than 1 µm (see Cabaña Fader *et al.* 2016 for illustrations). The second group, the '*Hexasepalum sarmentosum* group', is distinguished by having mericarps with a flat ventral face, without depressions; usually ruminate seeds on ventral and dorsal faces; a straight embryo; and pollen grains with only microspines less than 1 µm long (see Cabaña Fader *et al.* 2019 for illustrations).

To date, a comprehensive phylogenetic investigation of *Hexasepalum* remains lacking. Available studies included a maximum of seven species, five of them from the '*Hexasepalum teres* group', which formed a clade with maximum support and an uncertain relationship to the other genera of the *Spermacoce* clade (Nuñez Florentin *et al.* 2022; Carmo *et al.* 2025). On the other hand, *Hexasepalum mello-barreto* (Standl.) J.H.Kirkbr. & Delprete and *Hexasepalum sarmentosum* (Sw.) Delprete & J.H.Kirkbr., from the '*Hexasepalum sarmentosum* group', appeared more related to *Ernodea* Sw. species, with which they form a clade with maximum support (Carmo *et al.* 2025). Increasing sampling to include more species of *Hexasepalum*, as well as closely related genera such as *Planaltina* R.M.Salas & E.L.Cabral (Salas & Cabral 2010b) and *Tessiera* DC. (Salas & Cabral 2010a), which have never been included in phylogenetic studies, is essential for testing the monophyly of *Hexasepalum* and its sister-group relationships.

The analysis of specimens collected in the 'campo rupestre' of the states of Bahia and Minas Gerais, northeastern and southeastern Brazil, respectively, revealed that these do not correspond to any described species in *Hexasepalum* and are new to science. We provide descriptions, illustrations,

photographs, and comments on their distribution, habitat, preliminary conservation status, and taxonomy. Micromorphological characteristics of pollen grains, fruits, and seeds are also described and illustrated. We also provide an updated key to the species of *Hexasepalum* in the Americas.

## Material and methods

This study is based on field collections and analysis of specimens deposited at the BHCb, CTES, HUEFS, SI, and UEC herbaria (acronyms of herbaria follow Index Herbariorum, Thiers continuously updated). For descriptions and morphological comparison, we used conventional taxonomic methods. We followed the Systematics Association Committee for Descriptive Biological Terminology (1962), Clopton (2004), and Simpson (2010) for general morphological terminology, and Weberling *et al.* (1997) and Rua (1999) for inflorescence terminology. The distribution map was created using QGIS® software (QGIS Development Team 2018). A preliminary conservation status assessment was carried out by range size (B criterion), following the IUCN Standards and Petitions Committee (2022) recommendations. The extent of occurrence (EOO) and area of occupancy (AOO) were estimated using GeoCAT (Bachman *et al.* 2011).

Pollen grains were acetolyzed according to Erdtman (1966) and mounted in glycerine jelly for analysis using a light microscope (LM). Exine details, i.e., architecture and ornamentation, were analysed using scanning electron microscopy (SEM). The terminology used to describe the pollen followed Punt *et al.* (2007). Fresh buds, mature flowers, fruits, and seeds fixed in alcohol 70% were also analysed using SEM. We used the terminology proposed by Stearn (1986) for seed descriptions. For the images, the dehydrated material and acetolyzed pollen grains were sputter-coated with gold and then photographed with a JEOL 5800 LV SEM (SGCyT - UNNE, Corrientes, Argentina).

## Results

### Taxonomy

Class Magnoliopsida Brongn.  
Order Gentianales Juss. ex Bercht. & J.Presl.  
Family Rubiaceae Juss.  
Subfamily Rubioideae Verdc.  
Tribe Spermacoceae Bercht. & J.Presl  
Genus *Hexasepalum* Bartl. ex DC.

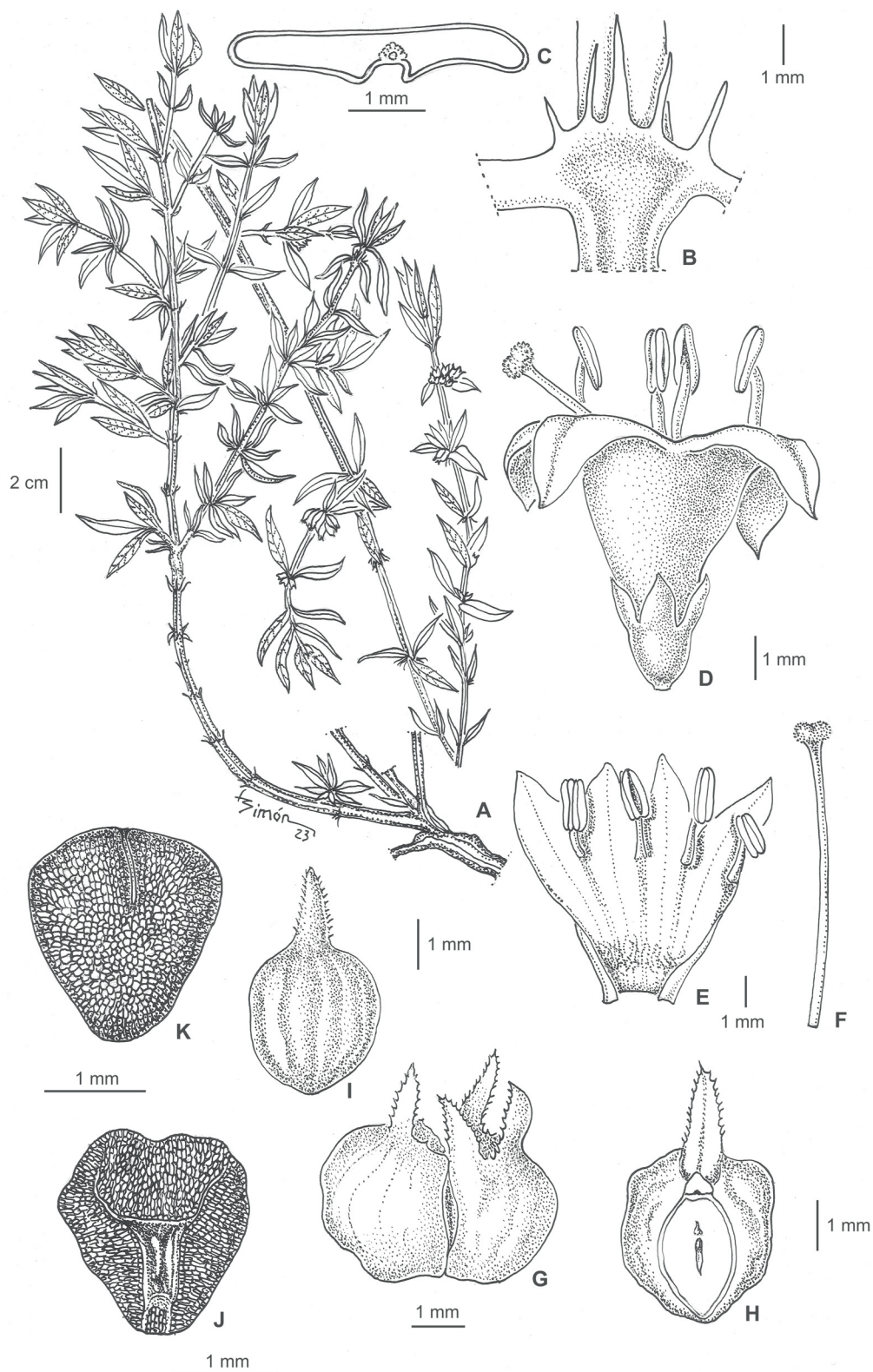
***Hexasepalum bacigalupoe*** Cabaña Fader & E.L.Cabral sp. nov.

urn:lsid:ipni.org:names:77382787-1

Figs 1–3

### Diagnosis

*Hexasepalum bacigalupoe* sp. nov. is similar to *H. apiculatum* (Willd. ex Roem. & Schult.) Delprete & J.H.Kirkbr. but differs by the leaf blade margins without an epidermal thickening (vs leaf blade margins with a white epidermal thickening in *H. apiculatum*), conspicuous secondary veins on the abaxial side (vs inconspicuous), and mericarps with flat ventral faces (vs mericarps with two depressions on ventral faces, one on each side of the midline). *Hexasepalum bacigalupoe* is also similar to *H. radulum* (Willd.) Delprete & J.H.Kirkbr. but differs by the 3–5-fimbriate stipular sheath (vs 6–12-fimbriate), glabrous fimbriae (vs pilose fimbriae), dorsal face of the mericarps with 3–4 soft ribs (vs dorsal face of the mericarps smooth), and exine of pollen grains covered by spines and small granules (vs only microspines).



**Fig. 1.** *Hexasepalum bacigalupoe* Cabaña Fader & E.L.Cabral sp. nov., Queiroz *e. al.* 14587 (CTES). A. Branch portion. B. Stipular sheath. C. Cross-section of the leaf. D. Flower. E. Opened corolla. F. Style and stigma. G. Schizocarp, lateral view. H. Mericarp, ventral view. I. Mericarp, dorsal view. J. Seed, ventral view. K. Seed, dorsal view. Illustration: L. Simón.

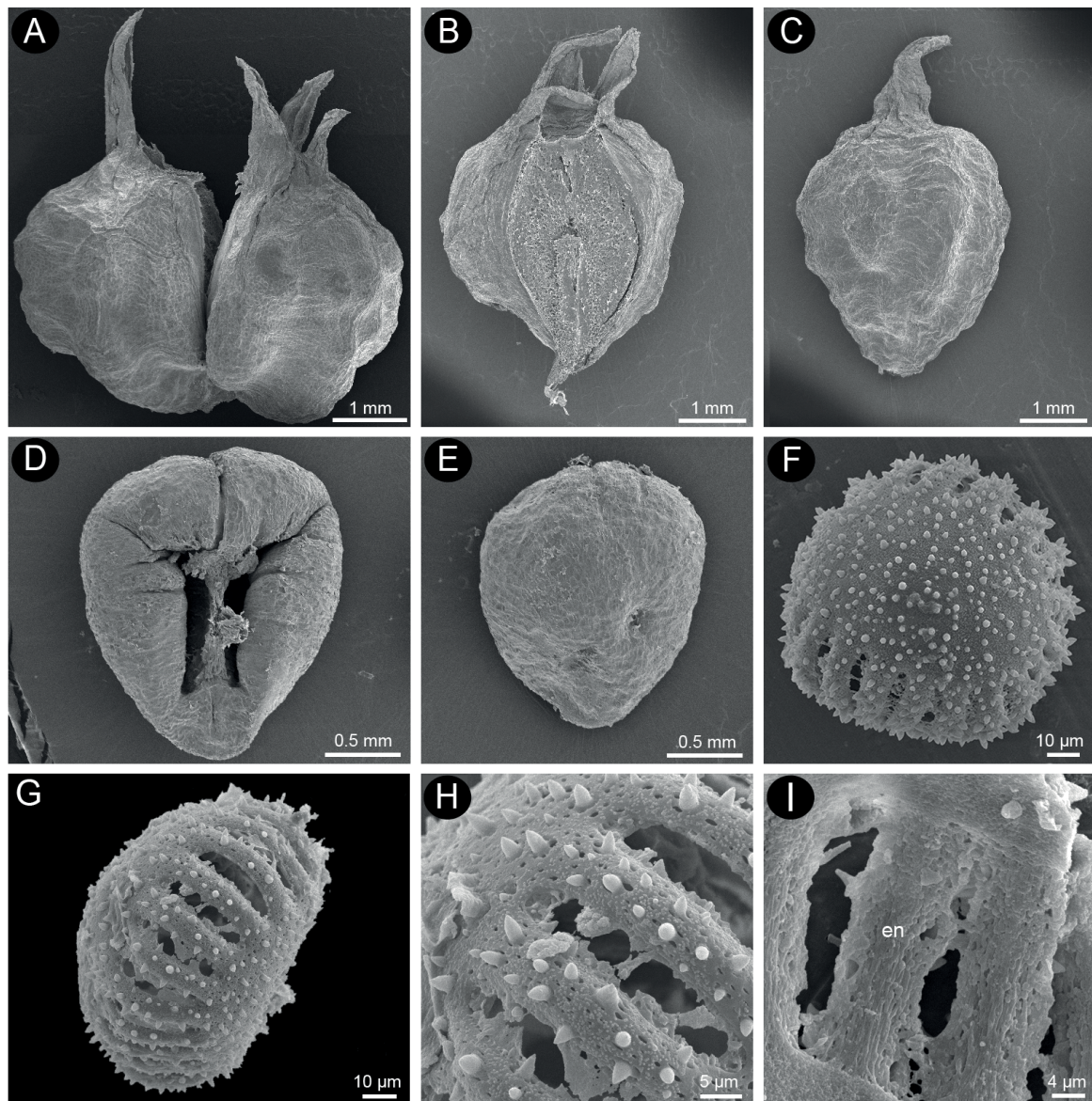
### Etymology

The specific epithet honours the renowned Rubiaceae specialist Professor Nélida Bacigalupo, researcher at the Darwinion Institute in Buenos Aires, Argentina, who pioneered the study of the Spermacoceae tribe in South America.

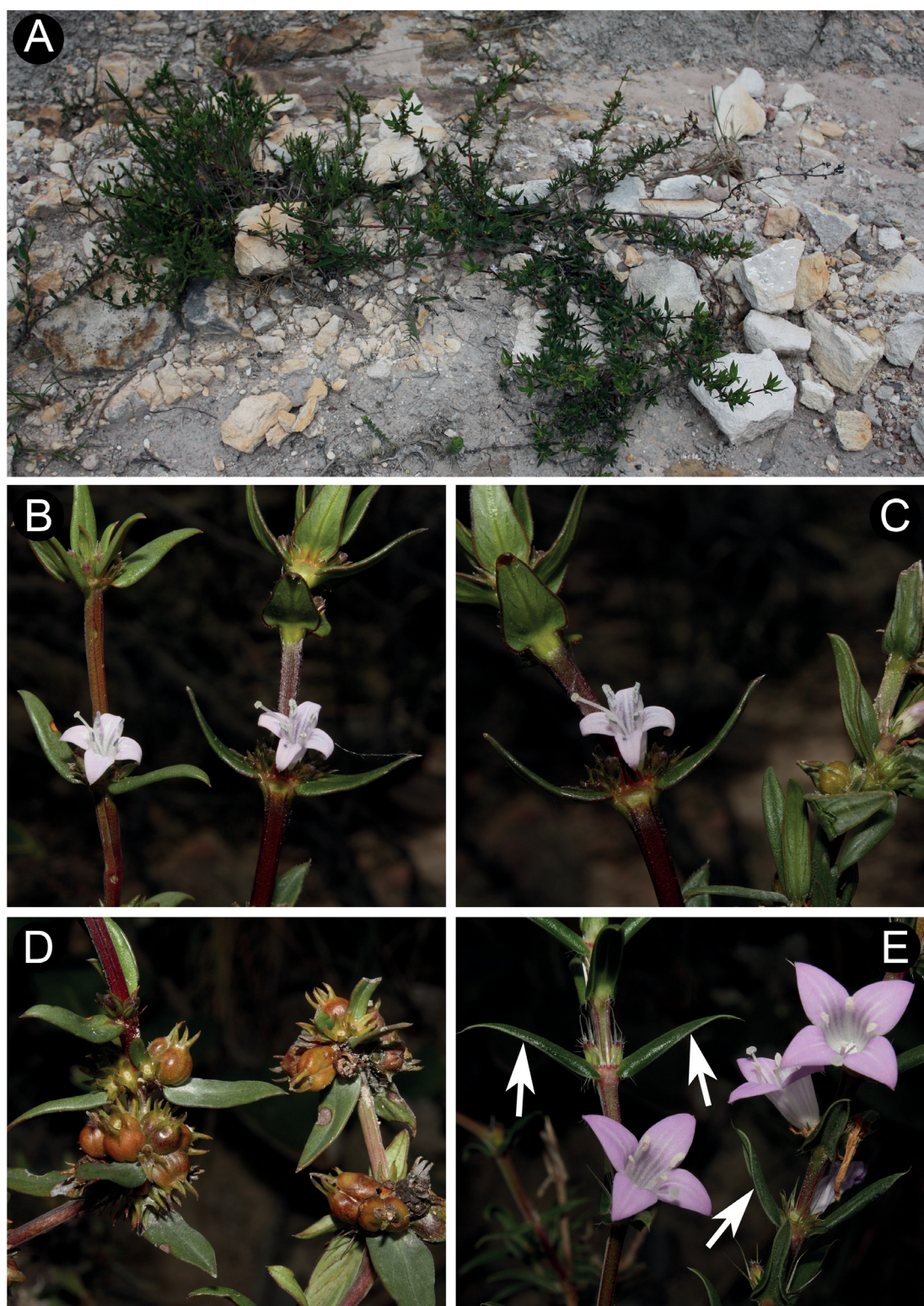
### Material examined

#### Type

BRAZIL – Bahia • Palmeiras, Volta da Serra na estrada de Palmeiras para a Guiné; 12°38'22" S, 41°33'43" W; 1135 m a.s.l.; 4 May 2009; *Queiroz et al. 14587*; holotype: HUEFS [HUEFS 156605]; isotypes: CTES, SI.



**Fig. 2.** *Hexasepalum bacigalupoe* Cabaña Fader & E.L.Cabral sp. nov., *Queiroz e. al. 14587* (CTES). **A.** Schizocarp, lateral view. **B.** Mericarp, ventral view. **C.** Mericarp, dorsal view. **D.** Seed, ventral view. **E.** Seed, dorsal view. **F.** Pollen grain, polar view. **G.** Pollen grain, equatorial view. **H.** Detail of the colpus, granules, and spinules. **I.** Detail of the inner side of a pollen fragment showing the endocingulum (en).



**Fig. 3.** A–D. *Hexasepalum bacigalupoe* Cabaña Fader & E.L.Cabral sp. nov. A. Habit. B. Flowering branches. C. Flowering branches, showing conspicuous veins on the abaxial face of the leaf blade, a flower, and an immature schizocarp. D. Schizocarps. — E. *Hexasepalum apiculatum* (Willd.) Delpret. & J.H.Kirkbr., showing leaf blade margins with a white epidermal thickening (arrows) and inconspicuous veins on the abaxial face. Photos: Domingos Cardoso.

### Paratypes

BRAZIL – **Bahia** • Capão da Volta, estrada para Jussiape; 13°26'39.5" S, 41°24'23.1" W; 1030 m a.s.l.; 18 May 1999; *Souza et al.* 22723; CTES, ESA [ESA 061228] • Mucugê, estrada para Barra da Estiva ao sul de Mucugê; 13°01'28" S, 41°26'18" W; 1030 m a.s.l.; 17 Aug. 2008; *Queiroz et al.* 13709; CTES, HUEFS [HUEFS 141925] • same data as for preceding; *Queiroz et al.* 13711; CTES, HUEFS [HUEFS 141927].

### Description

Subshrubs, up to 50 cm tall. *Stems* decumbent, internodes 1.5–2.5 cm long, tetragonal to cylindrical, glabrous or with few isolated hairs, basally decorticate. *Stipular sheath* glabrous, 3–5-fimbriate, fimbriae 1–2.5 mm long, succulent, glabrous. *Leaves* opposite, sessile; blade 15–30 × 3–5 mm, elliptic to lanceolate, apex acute to mucronate, base attenuate, margins slightly revolute, succulent, coriaceous when dry, glabrous, 3–4 secondary veins on each side of the midrib, conspicuous on the abaxial side. *Inflorescences* axillary, 5–12 glomeruli per flowering branch, glomerules 1–15-flowered, foliaceous bracts, succulent. *Flowers* sessile; hypanthium obovate, glabrous; calyx 4-lobed, tube absent, lobes 0.8–1.5 mm long, glabrous, sometimes trichomes at the margin; corolla 4.8–5 mm long, 4-lobed, infundibuliform, lilac with pink lobes, externally glabrous, internally with a ring of moniliform trichomes near the base of the tube; stamens exserted, slightly shorter than the corolla lobes; pollen grains 19–20-zonocolporate, suboblate to oblate-spheroidal, endoaperture forming an endocingulum, spines and small granules irregularly distributed over the grain; style 5.5 mm long, glabrous, stigma bilobate, each lobe globose; nectariferous disk entire. *Schizocarps* 3.5–4 mm long, globose, glabrous, mericarps with dorsal face convex, with 3–4 soft longitudinal ribs, ventral face flat, without depressions. *Seeds* 1.9–2.1 mm long, subtriangular in outline, brownish-black, dorsal face convex, with longitudinal grooves, ventral face flat, Y-shaped, partially covered by the strophiole, with numerous raphides; testa reticulate-areolate or pitted, elongated or isodiametric cells.

### Distribution, habitat, and phenology

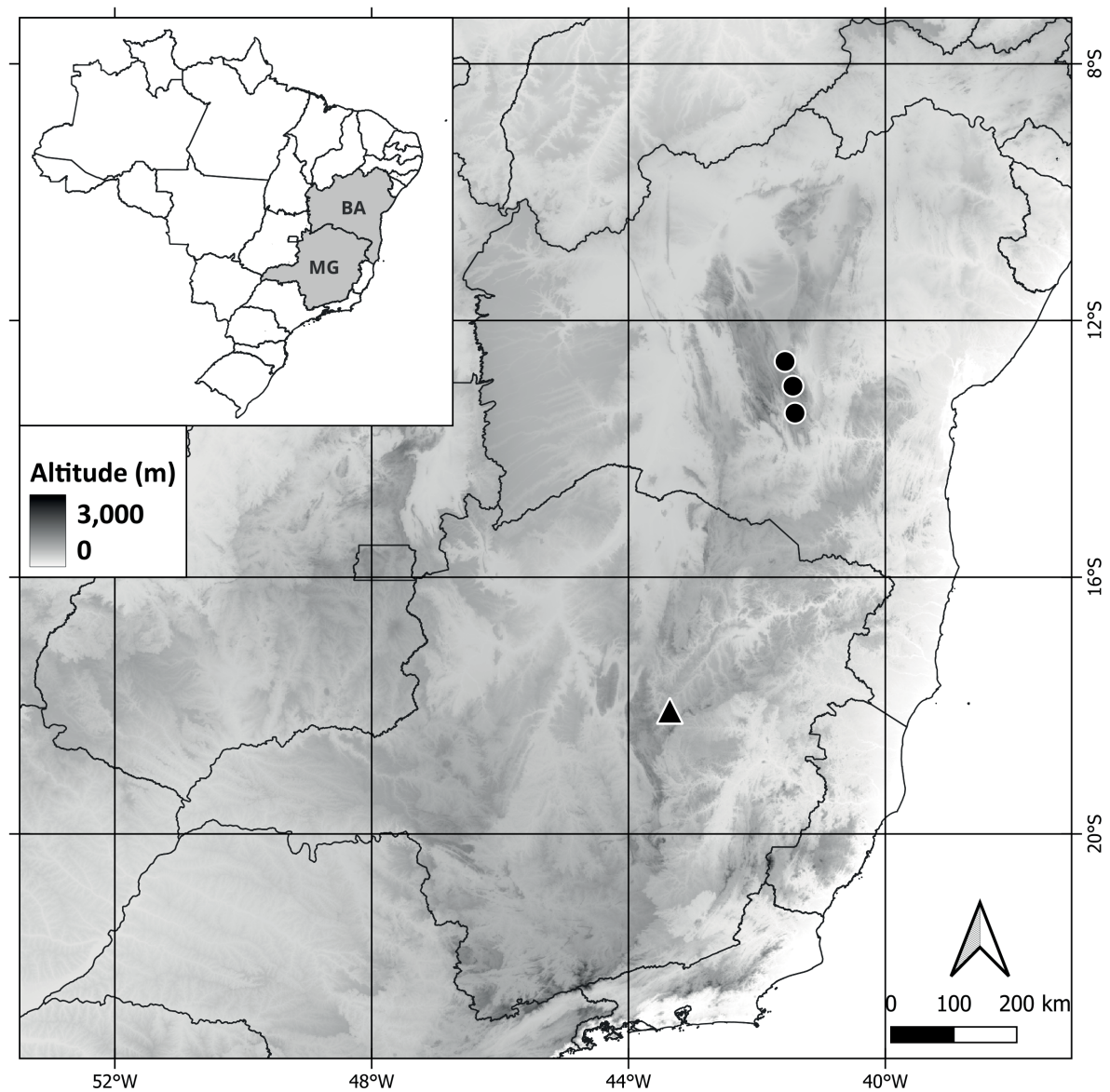
*Hexasepalum bacigalupoe* sp. nov. is endemic to Bahia and grows on white sand and rocky soils in the ‘campo rupestre’ vegetation of the ‘Chapada Diamantina’ (Fig. 3A). It is known from the municipalities of Capão da Volta, Mucugê, and Palmeiras (Fig. 4). Specimens with flowers and fruits were collected in May and August.

### Preliminary conservation status

*Hexasepalum bacigalupoe* sp. nov. is a rare species, known only from four herbarium specimens representing three locations (Fig. 4). Furthermore, to our knowledge, *H. bacigalupoe* does not occur within the limits of the ‘Parque Nacional da Chapada Diamantina’, a conservation unit of integral protection located in the region.

The impacts on the ‘campo rupestre’, the vegetation where *H. bacigalupoe* sp. nov. occurs, are usually associated with opencast mining, annual anthropogenic burnings to support the cattle industry, wood extraction, invasive species, harvesting ornamental plants (orchids, bromeliads, everlastings), road construction, and uncontrolled urbanization, especially linked to tourism expansion, and eucalyptus plantations (Silveira *et al.* 2016). Specifically in the context of the ‘Chapada Diamantina’, severe impacts are caused by the ever-expanding, irrigated, heavily mechanised, and agrochemical-based cropland system developments in the region (Funch *et al.* 2009). Also, road construction and urban expansion in the valleys are quite noticeable in the analysis of satellite images on Google Earth.

*Hexasepalum bacigalupoe* sp. nov. has EOO and AOO equal to 240.640 km<sup>2</sup> and 12 km<sup>2</sup>, respectively (kml file available in Supp. file 1). Therefore, the three occurrences represent three locations, and the species is preliminary assessed as Endangered EN B1ab(iii)+B2ab(iii), based on the EOO (less than 5000 km<sup>2</sup>) and AOO (less than 500 km<sup>2</sup>), number of locations (less than five), and an inferred continuing decline of the quality of the habitat.



**Fig. 4.** Distribution map of *Hexasepalum bacigalupoae* Cabaña Fader & E.L.Cabral sp. nov. (circles) and *H. motaviananum* Cabaña Fader, J.A.M.Carmo & R.M.Salas sp. nov. (triangle) in the states of Bahia (BA) and Minas Gerais (MG), Brazil.

***Hexasepalum motaviananum*** Cabaña Fader, J.A.M.Carmo & R.M.Salas sp. nov.

urn:lsid:ipni.org:names:77382789-1

Figs 5–7

**Diagnosis**

*Hexasepalum motaviananum* sp. nov. is similar to *H. zappiae* E.L.Cabral & Cabaña Fader, but differs by the ovate leaves (vs linear in *H. zappiae*), glabrous fimbriae (vs scabrid margins), 6–7(8)-lobed calyx (vs 4–5-lobed), calyx lobes equal in size (vs 2 major and 2–3 minor), corolla 3.5–4 mm long, white to lilac with pink lobes (vs 7–9 mm long, white), stigma with lamellate lobes (vs with globose lobes), ventral surface of the seed with a Y-shaped groove, delimited by an apical fold, without apical grooves (vs without a Y-shaped groove nor apical fold, with 3–5 apical grooves).

**Etymology**

The specific epithet refers to two esteemed botanists from Minas Gerais. The initial segment, ‘mota’, refers to Nara Mota, a Xyridaceae specialist, while the latter part, ‘viananum’, is in recognition of Pedro Lage Viana, Bambusoideae (Poaceae) specialist. With a dedication spanning over a decade, their exploration of the ‘Parque Estadual do Rio Preto’ culminated in an estimated assemblage of more than 1600 species thriving within this conservation bastion, underscoring its pivotal significance for conservation efforts. Furthermore, they collected the type specimen of the new species described here.

**Material examined**

**Type**

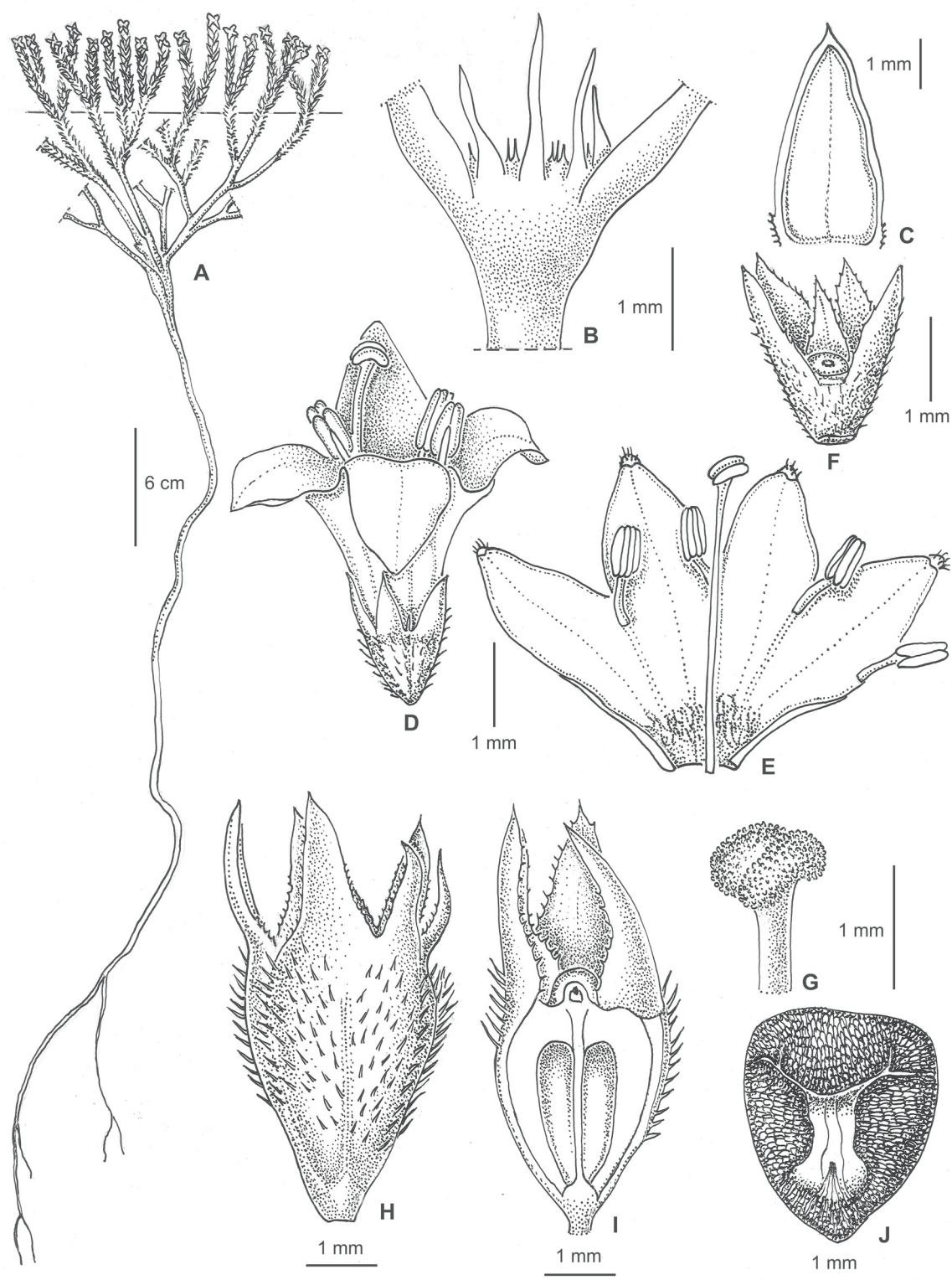
BRAZIL – **Minas Gerais** • São Gonçalo do Rio Preto, Parque Estadual do Rio Preto; *Mota & Viana 2661*; holotype: BHCb; isotypes: CTES, SI.

**Paratypes**

BRAZIL – **Minas Gerais** • São Gonçalo do Rio Preto, Parque Estadual do Rio Preto; 18°05′02″ S, 43°21′23″ W; 5 Jul. 2014; *Carmo, Scatigna & Piassa 212*; UEC [UEC 181477] • São Gonçalo do Rio Preto, Parque Estadual do Rio Preto, Areial, próximo à portaria do parque; 8 Oct. 2006; *Marino et al. 86*; BHCb [BHCb 105413] • São Gonçalo do Rio Preto, Trilha para a lapa do Crescêncio, área após a cerca do Parque Estadual do Rio Preto; 18°04′49″ S, 43°21′21″ W; 11 Jan. 2015; *Carmo & Scatigna 279*; UEC [UEC 181475].

**Description**

Subshrubs, 5–30 cm tall, much-branched, underground branches covered with foliar remains, well-developed main root, up to 1.5 m deep. *Stems* erect or decumbent, internodes 1–3 mm long, subcylindrical to tetragonal, glabrous or glabrescent. *Stipular sheath* 1–1.2 mm long, slightly exceeding the insertion of the pair of leaves, glabrous, 3–5-fimbriate, fimbriae 0.8–1.5 mm long, narrowly triangular, slightly succulent, glabrous. *Leaves* 3–6 × 0.8–1.1 mm, strongly overlapping, ovate, apex acuminate, base truncate, margins slightly revolute, with an epidermal thickening, slightly succulent, glabrous, inconspicuous secondary veins. *Inflorescences* axillary, 3–5 per flowering branch, fascicles 2–5-flowered, bracts 2, foliaceous. *Flowers* sessile to subsessile; hypanthium obovate, hexagonal in section; calyx 6–7(8)-lobed, tube absent, lobes 1–1.4 mm long, narrowly triangular, glabrous, margin scabrous, with glandular intercalary teeth; corolla 3.5–4 mm long, 4(5)-lobed, infundibuliform, white to lilac with pink lobes, externally glabrous, internally with a ring of moniliform trichomes near the base of the tube; stamens exserted, filament 0.4–0.6 mm, anthers shorter than the lobes; pollen grains 11–12-zonocolporate, suboblate to oblate-spheroidal, endoaperture forming an endocingulum, spines and small granules irregularly distributed over the grain; style 4–4.5 mm long, stigma bilobate, lobes lamellate; nectariferous disk entire. *Schizocarps* 2.8–3 mm long, obovoid, pubescent, mericarps with dorsal face convex, conspicuously 3-carinate, ventral

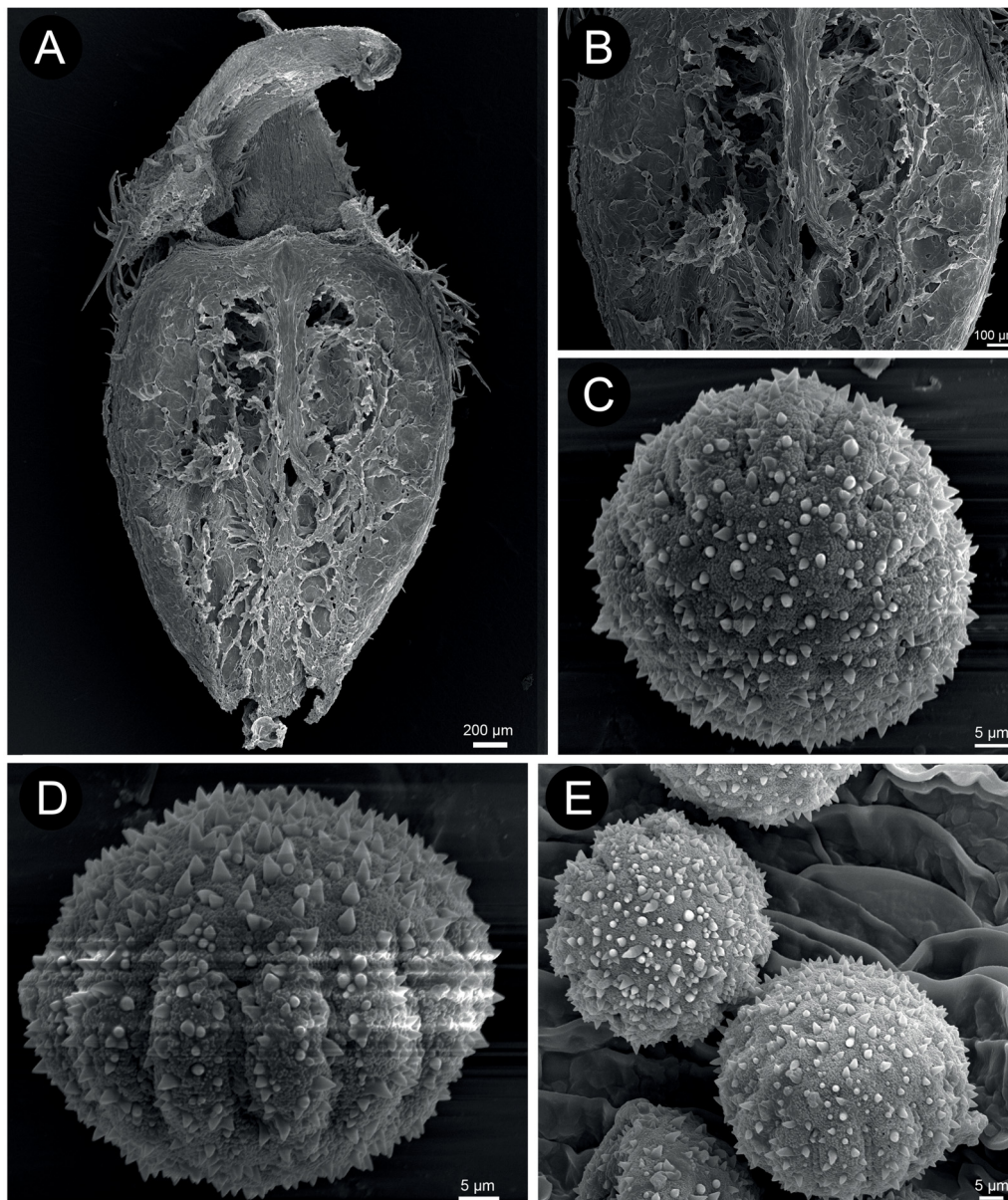


**Fig. 5.** *Hexasepalum motaviananum* Cabaña Fader, J.A.M.Carmo & R.M.Salas sp. nov., *Mota & Viana* 2661 (CTES). **A.** Habit, showing the root system and branches both above and below the soil surface. **B.** Stipular sheath. **C.** Leaf blade. **D.** Flower. **E.** Opened corolla. **F.** Hypanthium, calyx (a calyx lobe has been removed), and nectariferous disk. **G.** Stigma. **H.** Schizocarp, lateral view. **I.** Mericarp, ventral view. **J.** Seed, ventral view. Illustration: L. Simón.

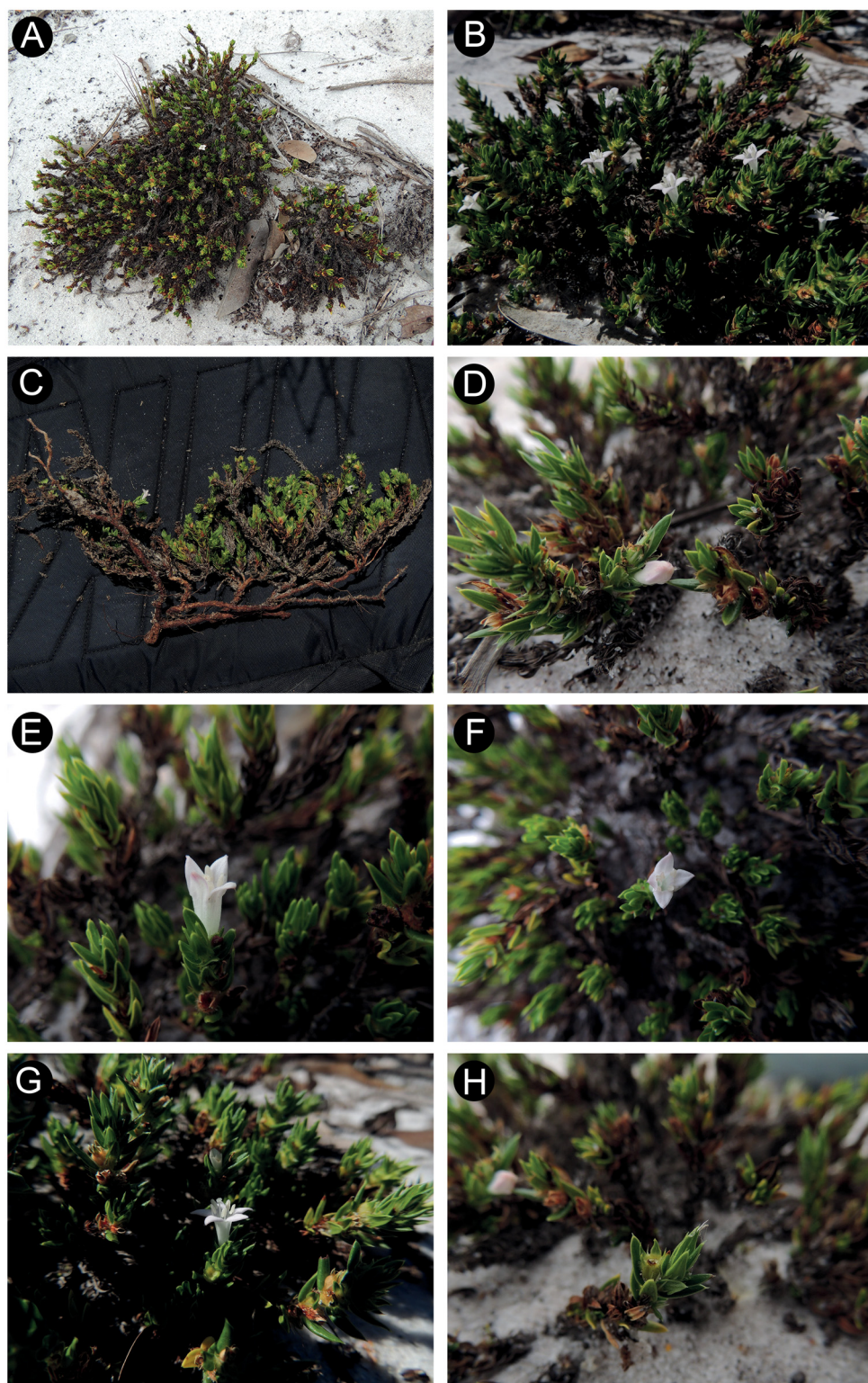
face with 2 depressions on both sides of the midline. *Seeds* 1.3–1.4 mm long, obovate in outline, dorsal face convex, without grooves, ventral face with a Y-shaped groove delimited by an apical fold and the longitudinal groove, forked apical grooves not reaching the dorsal face; testa reticulate-foveate, cells isodiametric or elongated; embryo with curved apex.

#### Distribution, habitat, and phenology

*Hexasepalum motaviananum* sp. nov. is endemic to Minas Gerais, Brazil. It has been recorded in the ‘Parque Estadual do Rio Preto’ and its surroundings, in the municipality of São Gonçalo do Rio Preto (Fig. 4). This species grows on white sand soils surrounded by rocky outcrops in ‘campo rupestre’



**Fig. 6.** *Hexasepalum motaviananum* Cabaña Fader, J.A.M.Carmo & R.M.Salas sp. nov., *Mota & Viana* 2661 (CTES). **A.** Mericarp, ventral view. **B.** Mericarp showing depressions on both sides of the midline in detail, ventral view. **C.** Pollen grain, polar view. **D.** Pollen grain, equatorial view. **E.** Pollen grains on the anther internal tissue.



**Fig. 7.** *Hexasepalum motaviananum* Cabaña Fader, J.A.M.Carmo & R.M.Salas sp. nov. **A.** Habit. **B.** Habit, showing details of flowering branches. **C.** Habit, showing underground portions of branches and roots, beneath the aerial branches bearing dried greyish leaves. **D.** Detail of a preanthetic flower bud. **E.** Flower, lateral view. **F.** Flower, superior view. **G.** Flower, lateral view, showing a 5-lobed corolla. **H.** Immature schizocarp. Photos: J. M. Carmo.

vegetation (Fig. 7A–B). In this environment, only the apical floriferous branches protrude from the soil, while the older branches with foliar remains are buried by the continuous deposition of sand from the erosion of the surrounding rocks (Figs 5A, 7C). This species is also one of the few with such a developed root system, whose taproot can reach down to 1.5 m deep. Specimens were collected with flowers and fruits in April.

### Preliminary conservation status

*Hexasepalum motaviananum* sp. nov. is a rare species, known only from four herbarium specimens representing one location. This species is known to occur within the limits of the ‘Parque Estadual do Rio Preto’, a conservation unit of integral protection located in the municipality of São Gonçalo do Rio Preto (Fig. 4). Nevertheless, the IUCN Standards and Petitions Committee (2022) states that the criteria for the threatened categories are to be applied to a taxon, whatever the level of conservation action affecting it.

The impacts on the ‘campo rupestre’, the vegetation where *Hexasepalum motaviananum* sp. nov. occurs, in the region of the ‘Parque Estadual do Rio Preto’, are usually associated with the expansion of eucalyptus plantations, as noticed by us during fieldwork.

*Hexasepalum motaviananum* sp. nov. has EOO and AOO equal to 0 km<sup>2</sup> and 4 km<sup>2</sup>, respectively (kml file available in Supp. file 2). According to the IUCN Standards and Petitions Committee (2022), if EOO is less than AOO, it should be changed to make them equal and ensure consistency with the definition of AOO, which is an area defined within the EOO. Therefore, the one occurrence represents one location, and the species is preliminary assessed as Critically Endangered CR B1ab(iii)+B2ab(iii), based on its EOO (less than 100 km<sup>2</sup>) and AOO (less than 10 km<sup>2</sup>), number of locations (less than five), and an inferred continuing decline of the quality of the habitat.

### Key to the species of *Hexasepalum* in the Americas

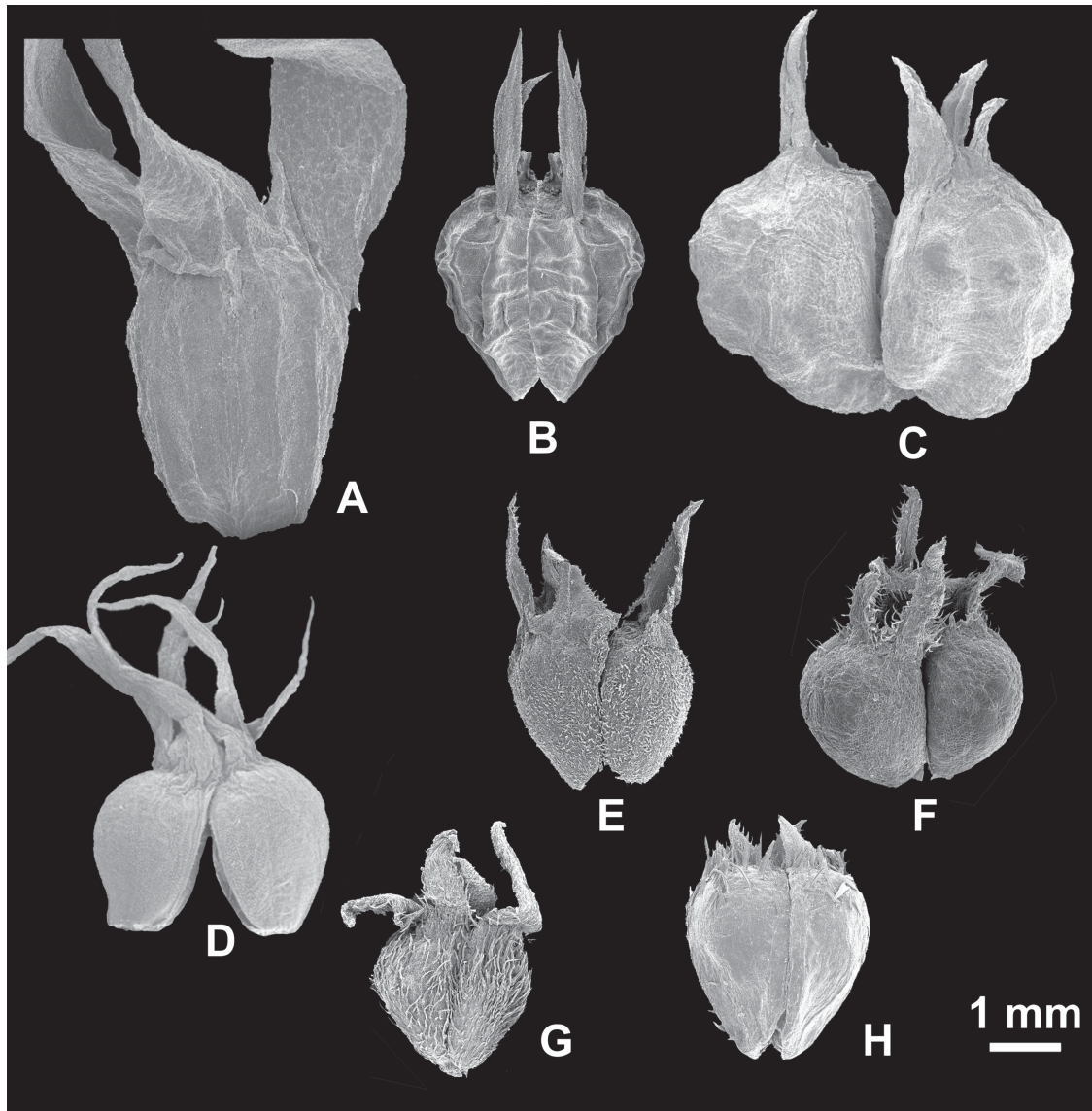
1. Plants up to 3–4 m in diam., with long creeping branches, rooting at the nodes, with short erect flowering shoots ..... 2
- Plants less than 1 m in diam., erect or decumbent, rarely creeping, normally without roots at the nodes ..... 3
2. Leaf blade linear, 1.5–4 mm wide, concolorous, secondary veins inconspicuous on abaxial face; stipular sheath 4.2–7 mm long, tubular, fimbriae 5–6 mm long; flowers partially covered by the stipular sheath; calyx (4)5–6-lobed; corolla 12–18 mm long, purple or lilac; mericarps with 2 ventral depressions (as in Fig. 9A, H, N, Q) scarcely excavated on both sides of the midline; seed 3–3.1 mm long; Mexico ..... *Hexasepalum angustifolium* (Benth.) Borhidi
- Leaf blade elliptic, 3.2–6 mm wide, discolorous, with 3–5 secondary veins visible on abaxial face; stipular sheath 2.5 mm long, with truncate edge, not tubular, fimbriae ca. 2.5 mm long; flowers not covered by the stipular sheath; calyx 4-lobed; corolla 4–7 mm long, white; ventral face of mericarps flat, without depressions (as in Fig. 9B, D, F–G, I–J, L); seed 2–2.1 mm long; Central America and tropical Africa ..... *Hexasepalum serrulatum* (P.Beauv.) J.H.Kirkbr. & Delprete
3. Ventral face of mericarps with two depressions, one on each side of the midline (Fig. 9A, H, N, Q) ..... 4
- Ventral face of mericarps flat, without depressions (Fig. 9B, D, F–G, I–J, L) ..... 8
4. Subshrubs up to 30 cm tall, with well-developed taproots, much-branched below and above the substrate ..... 5
- Annual herbs, subshrubs or shrubs up to 1 m tall, slightly branched above the substrate ..... 6



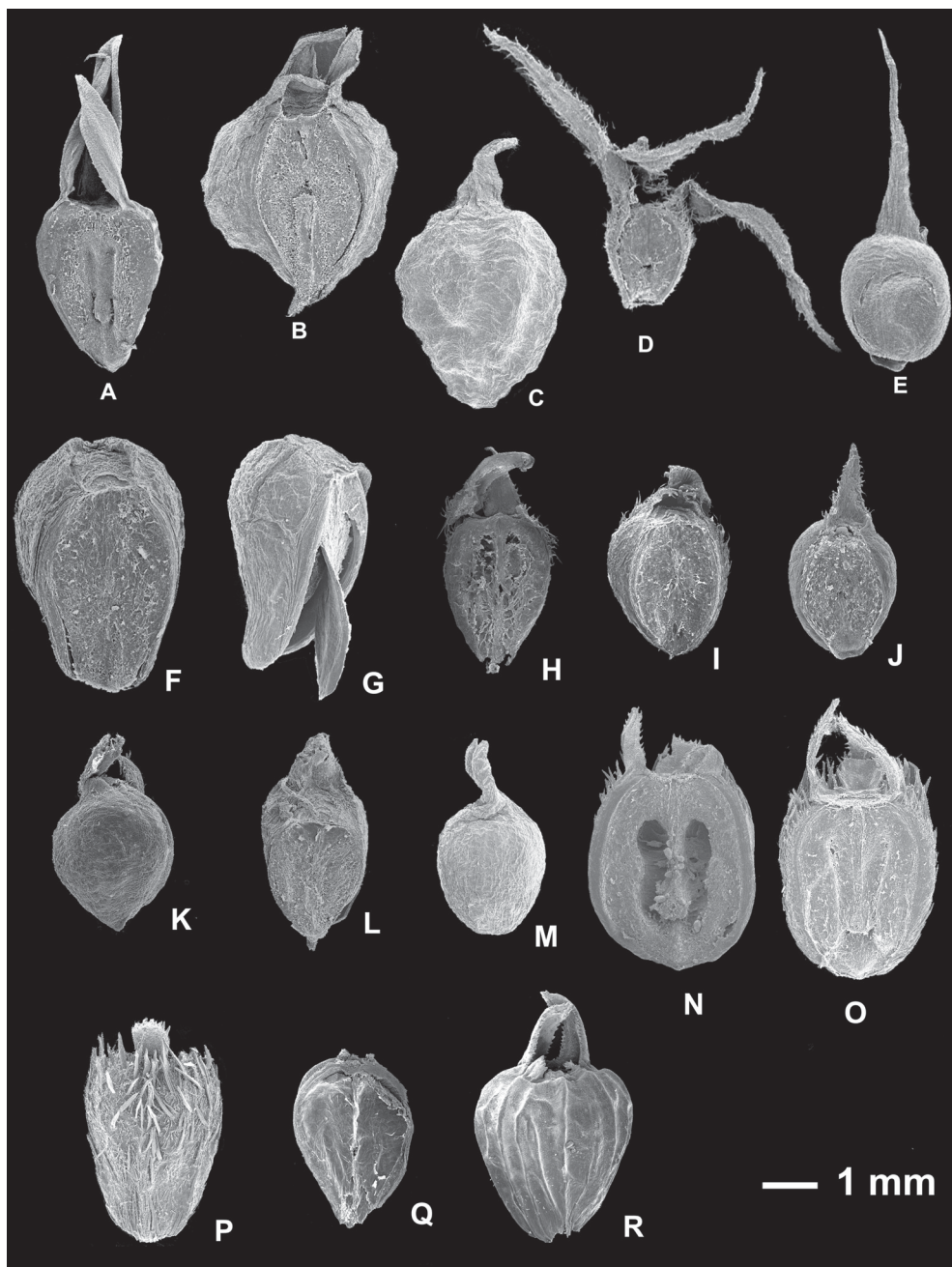
13. Subshrub scandent up to 2–10 m long; leaves 25–50 mm long; stipular sheath with 7–11 fimbriae, fimbriae 2–8 mm long; bracts elliptic, pseudopetiolate; ventral face of seed with short apical furrows (Fig. 11E); tropical regions of America, Africa, and Asia .....

..... *Hexasepalum sarmentosum* (Sw.) Delprete & J.H.Kirkbr.

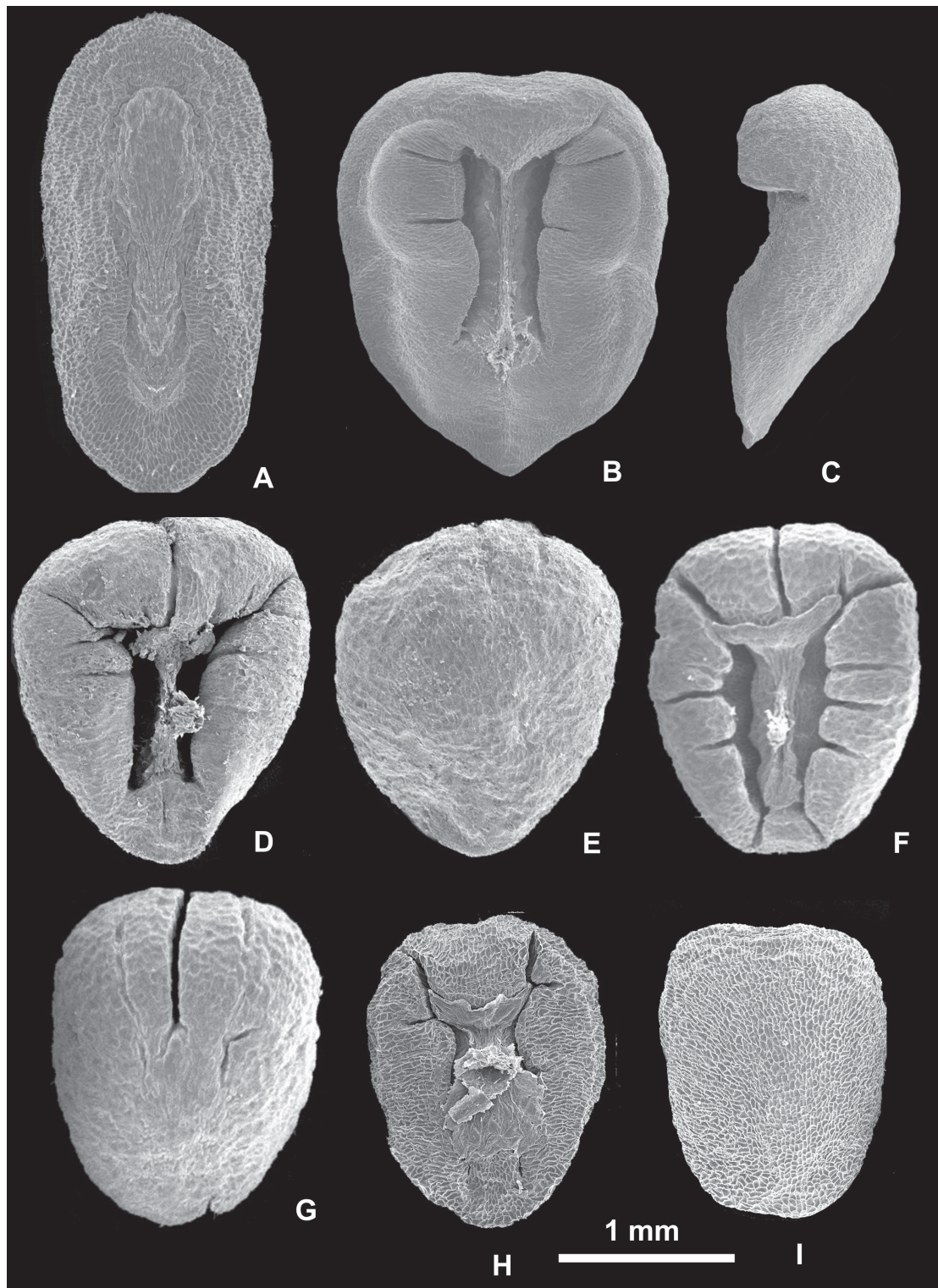
- Subshrub erect 0.5–0.8 m or with scandent branches up to 1 m tall; leaves 10–24 mm long; stipular sheath with 3–5 fimbriae, fimbriae 0.6–1.5 mm long; bracts cordate, sessile; ventral face of seed with 2–5 apical furrows that do not reach the dorsal face (Fig. 11B, with 2 furrows); Piauí and Ceará, Brazil ..... *Hexasepalum nordestinum* Cabaña Fader & E.B.Souza



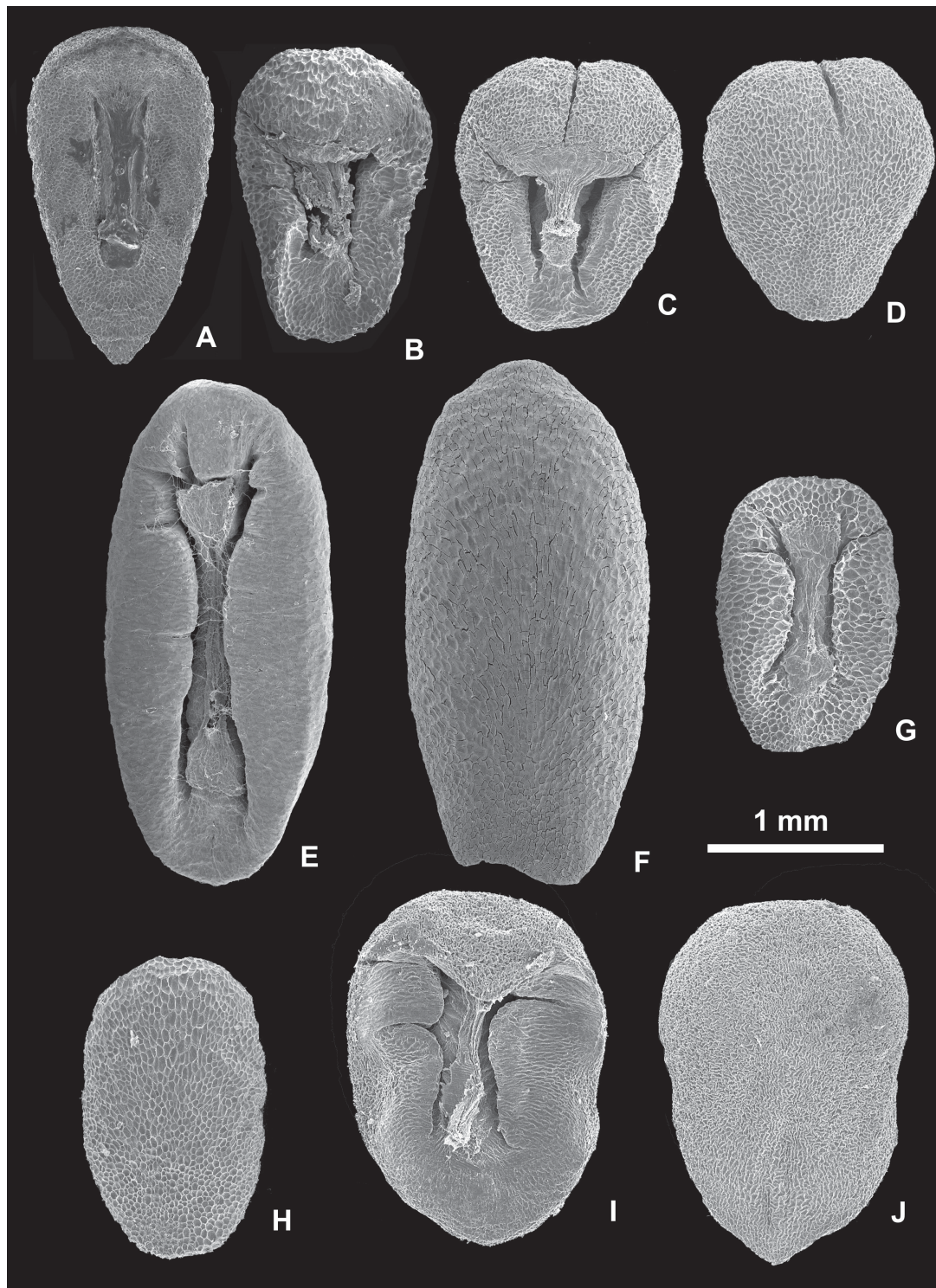
**Fig. 8.** Schizocarp of *Hexasepalum* species, lateral view. **A.** *Hexasepalum angustifolium* (Benth.) Borhidi; Rzedowski 17792 (US). **B.** *H. apiculatum* (Willd. ex Roem. & Schult.) Delprete & J.H.Kirkbr.; Queiroz 12570 (CTES). **C.** *H. bacigalupoae* Cabaña Fader & E.L.Cabral sp. nov.; Queiroz 114587 (CTES). **D.** *H. gardneri* (K.Schum.) J.H.Kirkbr. & Delprete; Salas 455 (HUEFS). **E.** *H. mello-barreto* (Standl.) J.H.Kirkbr. & Delprete; Sobrado *et al.* 141 (CTES). **F.** *H. radula* (Willd.) Delprete & J.H.Kirkbr.; Queiroz 14591 (CTES). **G.** *H. nordestinum* Cabaña Fader & E.B.Souza; Alencar 632 (CTES). **H.** *H. teres* (Walter) J.H.Kirkbr.; Queiroz 14145 (CTES).



**Fig. 9.** Mericarps of *Hexasepalum* species. **A.** *H. apiculatum* (Willd. ex Roem. & Schult.) Delprete & J.H.Kirkbr., ventral view; *Queiroz 14570* (CTES). — **B–C.** *H. bacigalupoae* Cabaña Fader & E.L.Cabral sp. nov.; *Queiroz 14587* (CTES). **B.** Ventral view. **C.** Dorsal view. — **D–E.** *H. gardneri* (K. Schum.) J.H.Kirkbr. & Delprete; *Salas et al. 455* (CTES). **D.** Ventral view. **E.** Dorsal view. — **F–G.** *H. lippioides* (Griseb.) J.H.Kirkbr. & Delprete; *Shafer 2983* (NY). **F.** Ventral view. **G.** Sub-lateral view. — **H.** *H. motaviananum* Cabaña Fader, J.A.M.Carmo & R.M.Salas sp. nov., ventral view; *Mota & Viana 2661* (CTES). — **I.** *H. nordestinum* Cabaña Fader & E.B.Souza, ventral view; *Alencar 632* (CTES). — **J–K.** *H. radula* (Willd.) Delprete & J.H.Kirkbr.; *Queiroz 14591* (CTES). **J.** Ventral view. **K.** Dorsal view. — **L–M.** *H. scandens* (Sw.) J.H.Kirkbr. & Delprete; *Allard 16064* (US). **L.** Ventral view. **M.** Dorsal view. — **N–P.** *H. teres* (Walter) J.H.Kirkbr.; *Queiroz 14145* (CTES). **N–O.** Variations in the depth of the ventral face depression. **P.** Dorsal view. — **Q–R.** *H. zappiae* E.L.Cabral & Cabaña Fader; *Cardoso 2819*, isotype (CTES). **Q.** Ventral view. **R.** Lateral view of immature schizocarp.



**Fig. 10.** Seeds of *Hexasepalum* species. **A.** *H. angustifolium* (Benth.) Borhidi, ventral view; *Rzedowski 17792* (US). — **B–C.** *H. apiculatum* (Willd. ex Roem. & Schult.) Delprete & J.H.Kirkbr.; *Queiroz 14570* (HUEFS). **B.** Ventral view. **C.** Lateral view. — **D–E.** *H. bacigalupoe* Cabaña Fader & E.L.Cabral sp. nov.; *Queiroz 14587* (CTES). **D.** Ventral view. **E.** Dorsal view. — **F–G.** *H. gardneri* (K. Schum.) J.H.Kirkbr. & Delprete; *Salas et al. 455* (CTES). **F.** Ventral view. **G.** Dorsal view. — **H–I.** *H. mello-barreto* (Standl.) J.H.Kirkbr. & Delprete; *Sobrado et al. 141* (CTES). **H.** Ventral view. **I.** Dorsal view.



**Fig. 11.** Seeds of *Hexasepalum* species. **A.** Immature seed of *H. motaviananum* Cabaña Fader, J.A.M.Carmo & R.M.Salas sp. nov., ventral view; *Mota & Viana 2661* (CTES). — **B.** *H. nordestinum* Cabaña Fader & E.B.Souza, ventral view; *Alencar 632* (CTES). — **C–D.** *H. radula* (Willd.) Delprete & J.H.Kirkbr.; *Queiroz 14570* (CTES). **C.** Ventral view. **D.** Dorsal view. — **E–F.** *H. sarmentosum* (Sw.) Delprete & J.H.Kirkbr.; *Croat 11755* (CTES). **E.** Ventral view. **F.** Dorsal view. — **G–H.** *H. scandens* (Sw.) J.H.Kirkbr. & Delprete; *Allard 16064* (US). **G.** Ventral view. **H.** Dorsal view. — **I–J.** *H. teres* (Walter) J.H.Kirkbr.; *Queiroz 14145* (CTES). **I.** Ventral view. **J.** Dorsal view.

## Discussion

We describe two new species of *Hexasepalum*, increasing the total number of species in the genus, as currently circumscribed, to 16. This also raises the number of species occurring in Brazil from eight to ten, seven of which are endemic to the country (Cabaña Fader *et al.* 2016, 2019; BFG 2021).

We present an updated identification key to the species of *Hexasepalum* in the Americas, modified from Cabaña Fader *et al.* (2019). In addition, we provide comparative plates illustrating fruit, mericarp, and seed morphology for American species of the genus (Figs 8–11).

Molecular phylogenetic analyses have indicated that the informal ‘*Hexasepalum teres* group’ appears to be monophyletic. In contrast, species from the ‘*Hexasepalum sarmentosum* group’ appeared paraphyletic in relation to *Ernodea*, forming a clade with maximum support (Carmo *et al.* 2025). The ‘*Hexasepalum teres* group’ is characterised by the ventral face of the mericarps showing two depressions; a curved embryo, rarely straight; and pollen grains with spines and small granules as supratectal elements (Cabaña Fader *et al.* 2016). The ‘*Hexasepalum sarmentosum* group’ is distinguished by having mericarps with a flat ventral face; a straight embryo; and pollen grains with only microspines (Fader *et al.* 2019).

In this context, *Hexasepalum bacigalupoe* sp. nov. appears to represent an intermediate case between the two groups. On the one hand, it bears pollen grains with two types of supratectal elements, i.e., spines and granules (Fig. 2F–H); on the other, its mericarps exhibit a flat ventral face (Figs 1H, 2B) and a slightly curved embryo. Including this species in future molecular phylogenetic analyses would help clarify its relationships within the genus and the *Spermacoce* clade.

*Hexasepalum bacigalupoe* sp. nov. is morphologically most similar to *H. apiculatum*. Indeed, both species occur in sympatry (Fig. 3E) and have often been confused in herbarium collections. However, they can be readily distinguished by several morphological characters: *H. bacigalupoe* presents the leaf blade margins without an epidermal thickening (Fig. 3C) (vs with an epidermal thickening in *H. apiculatum*; Fig. 3E), conspicuous secondary veins on the abaxial surface (Fig. 3C) (vs inconspicuous), and mericarps with flat ventral faces (Figs 1H, 2B) (vs with two depressions).

*Hexasepalum motaviananum* sp. nov. presents the ventral face of the mericarps with two depressions on both sides of the midline (Figs 5I, 6A–B), an embryo with curved apex, and pollen grains with spines and small granules as supratectal elements (Fig. 6C–E), matching the characters of the ‘*Hexasepalum teres* group’ (Cabaña Fader *et al.* 2016). In fact, this species has already been included in a phylogenetic study as ‘*Hexasepalum* sp. nov.’ (DNA sequence obtained from Carmo, Scatigna & Piassa 212; UEC [UEC 181477]) in which its relationship to the ‘*Hexasepalum teres* group’ was confirmed (Carmo *et al.* 2025).

*Hexasepalum motaviananum* sp. nov. is morphologically similar to *H. zappiae*, as both are subshrubs up to 30 cm tall, much-branched, and with well-developed taproots (Figs 5A, 7C). However, they differ in several diagnostic characters: *H. motaviananum* has ovate leaves (Fig. 5A) (vs linear in *H. zappiae*), glabrous fimbriae (Fig. 5B) (vs fimbriae with scabrid margins), a 6–7(8)-lobed calyx (Fig. 5F) (vs 4–5-lobed), calyx lobes equal in size (Fig. 5F) (vs two larger and two to three smaller), corolla 3.5–4 mm long, white to lilac with pink lobes (Fig. 7D–F) (vs 7–9 mm long, white), stigma with lamellate lobes (vs globose lobes), and a seed with the ventral surface bearing a Y-shaped groove delimited by an apical fold, without apical grooves (Fig. 5J) (vs lacking both a Y-shaped groove and apical fold, but with three to five apical grooves).

Notably, *Hexasepalum bacigalupoe* sp. nov. and *H. motaviananum* sp. nov. are preliminarily assessed as Endangered and Critically Endangered, respectively. These findings underscore the urgent need to

preserve the unique and fragile ecosystems of the ‘campo rupestre’ (Silveira *et al.* 2016), which continue to reveal a remarkable, yet highly threatened, plant diversity in Brazil.

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### **Supplementary files**

Supp. file 1. Extent of Occurrence (EOO) and Area of Occupancy (AOO) of *Hexasepalum bacigalupoe* sp. nov.

<https://doi.org/10.5852/ejt.2026.1075.3302.14537>

Supp. file 2. Extent of Occurrence (EOO) and Area of Occupancy (AOO) of *Hexasepalum motaviananum* sp. nov.

<https://doi.org/10.5852/ejt.2026.1075.3302.14538>