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Cardiospermum bahianum (Sapindaceae: Paullinieae), a New Species from Bahia, Brazil

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Abstract*—*Cardiospermum bahianum, a new species from Bahia, Brazil, is described, illustrated, and compared to its putative closest relatives *C. anomalum* and *C. cuchujaquense*. The new species is endemic to the caatinga vegetation. In addition, micromorphological characters of leaf epidermis, seed coat, and pollen grains are described. A somatic chromosome number of $2n = 36$ is reported. Detailed light and scanning electron microscope photographs of the main characters are presented. The new species belongs to *Cardiospermum* section *Carphospermum*. It is distinguished from the similar *C. anomalum* by its conspicuous lenticels, seeds nearly spherical, and it differs in chromosome number. Additionally, new synonymies for *C. anomalum* are established. A key to the species of *Cardiospermum* in Brazil is provided.

***Keywords*—**Brazil, caatinga, *Cardiospermum bahianum*, *Cardiospermum* sect. *Carphospermum*, Sapindaceae.

Cardiospermum L. (tribe *Paullinieae,* Sapindaceae), is comprised of herbaceous vines and less frequently subshrubs throughout the Neotropics. The most currently used classification system for Sapindaceae was developed by Radlkofer (1932), in which the tribe Paullinieae exhibits the most derived characters in the family (Solís and Ferrucci 2009). Additionally, tribe Paullinieae exhibits monoecy, the most common breeding system in the family. The climbing habit and development of tendrils and stipules are synapomorphies for Paullinieae (Buerki et al. 2009). Within the Paullinieae, *Cardiospermum* L. is recognized by its inflated capsules, and contains 14 species, all occurring in tropical America, with three species having a nearly cosmopolitan distribution (Ferrucci 2000a). The genus was divided by Radlkofer (1878) into three sections, *Cardiospermum* sect. *Cardiospermum* (= Brachyadenia), sect. *Ceratadenia* and sect. *Carphospermum*. These sections were differentiated by nectary lobe development, and the presence or absence of chaffy trichomes on the seed coat. *Cardiospermum* exhibits two centers of diversity, one in west-central Brazil and the other in north-central Mexico (Ferrucci and Acevedo-Rodríguez 1998). It is one of the most variable genera in the tribe, and exhibits marked differences in growth habit, morphological characters, and chromosome numbers (Ferrucci 2000a, 2000b; Urdampilleta 2009). Within the Paullineae, *Cardiospermum* shares the hemitrisyncolporate, peroblate or oblate, pollen grains with *Urvillea* Kunth, *Serjania* Mill., and *Houssayanthus* Hunz. (Ferrucci and Anzótegui 1993). Among these genera, *Cardiospermum* is most similar to *Urvillea*, and these genera are difficult to tell apart (Ferrucci and Acevedo-Rodríguez 1998).

The species described here was first discovered in 1982 by the senior author, but the original specimen analyzed lacked fruit; subsequent specimens found in Brazilian herbaria were also only in flower. In 2008, the species was collected in the field, in flower and fruit, at the same time, however, the fruits were observed to fall off after ripening. In this species, the characters of inflorescence development and habit are unique for the genus. The new species is here described, illustrated, and compared to its closest relatives. To provide a complete description, details of leaf epidermis, seed coat, pollen grains, and the chromosome count are included. A key to all *Cardiospermum* species of Brazil is provided.

Materials and Methods

The current study is based on observations from the published literature, fieldwork and the analysis of herbarium material from ALCB, BAH, BM, BR, C, CEN, CEPEC, CTES, EAC, ESA, F, G, GH, GUA, HRB, HUEFS, IPA, K, L, MBM, MO, NY, OXF, P, PEUFR, R, RB, SP, U, UB, UEC, US and W. Its morphology was studied from dried collections, which in some cases were rehydrated in boiling water.

Leaf and seed samples were preserved in FAA, then dehydrated and immersed in CO_2 for critical-point drying before sputter coating with gold palladium.

Pollen grains were obtained from anthers of three collections of the new species. Samples for light microscopy (LM) were acetolyzed according to the procedure of Erdtman (1966) and mounted in glycerine jelly. Permanent slides were deposited at the Palynological Laboratory of the Universidad Nacional del Nordeste, Corrientes, Argentina (PAL-CTES). The polar axis and equatorial diameter were measured on 20 grains per specimen using a Leica DM LB2 microscope. The terminology used to describe pollen grains follows that of Erdtman (1966) and Punt et al. (2007).

Scanning electron micrographs (SEM) were made on leaf epidermis, seed coat and acetolyzed pollen grains. The equipment used was a JEOL 5800 LV scanning electron microscope operating at 20 KV.

Chromosome preparations were made from root tips pretreated with 2 mM 8-hydroxyquinoline for 4–5 h at 15°C, fixed in ethanol-acetic acid (3: 1, v/v) for 12 h, and stored at -20°C or followed by the HCL/Giemsa staining procedure (Guerra 1983).

These studies were based on *Urdampilleta, Ferrucci et Las Peñas 389* (CTES, UEC), while pollen analysis was based on two specimens, *Harley et al. 5266* (CTES) and *Oliveira 234* (CTES).

Taxonomic Treatment

Cardiospermum bahianum Ferrucci & Urdampilleta, sp. nov.—TYPE: BRAZIL. Bahia: Mun. Rio de Contas, Boa Sentença, subindo ao Cerro da Morceguinha, 637 m, 13°49.536S, 41°35.054W, 19 Feb 2008 (fl, fr), *J. D. Urdampilleta, M. S. Ferrucci & M. L. Las Peñas 389* (holotype: UEC!; isotypes: ALCB!, CESJ!, CTES!, HUEFS!, IBGE!, K!, MO!, NY!, SI!, SPF!, US!).

Cardiospermum anomalum Cambess. similis, differt suffrutex vel frutex, ramosus, erectus 1–2.5m altus; thyrse

abbreviatis, breviter pedunculatis e rachi saepe subnulla; semen subsphaericus.

Erect subshrubs or shrubs, branched, 1–2.5 m high, without tendrils, not producing milky sap; stem nodes with contracted inflorescences. Young flowering branches green, with 5 obtuse ribs, sparsely setulose, old branches subterete, woody, brown-grayish to dark brown, 2.2–2.8 mm in diameter, with numerous ferruginous lenticels, cross section of stem with a single stele. Stipules triangular, cartilaginous or subcoriaceous, brown, caducous, puberulous, or glabrous, 0.2–1 × 0.2–0.5 mm. Leaves trifoliolate: petiole subterete, adaxially furrowed, pilose along margins of the furrow, 2.8–4.4 cm long; petiolules to 5 mm long on distal leaflet, 2 mm on lateral leaflets; leaflets chartaceous, slightly discolorous, narrowly ovate, terminal leaflet 4–6.7 × 1.3–3.2 cm, lateral ones 2.8–4.1 × 1.3–2.4 cm, asymmetric with a narrower acroscopic side; apex acuminate or acute, glandular; base decurrent into petiole, obtuse, rounded or acute; margins ciliate, dentate-serrate with 8–16 obtuse or acute glandular teeth, often 1-lobed on external margin; sparsely puberulous and with primary vein somewhat prominent in both surfaces, stomata only on the lower side; venation craspedodromous with secondary straight veins. Inflorescence sessile (rachis 0–2 mm long), reduced to 1–3 (–5) cincinni, these nearly sessile (peduncles 0.5–3 mm long), many-flowered; pedicels ca. 2 mm long, (ca. 3 mm long in fruit), articulate in the lower 1/3 or 1/4, reflexed; bracts triangular, ca. 1 mm long, ciliate, with few glandular trichomes at apex; bracteoles similar but smaller. Flowers whitish or pink, 3.5–4.36 mm long. Sepals 4, glabrous and minutely glandular at margins; submembranaceous, partly colored with reddish pigments, the outer two suborbicular, 1–1.5 × 1.5–2 mm, the inner cucullate, obovate, 3–3.2 × 2–2.5 mm, in immature fruit reflexed. Petals broadly obovate, clawed as seen from dorsal view, 3–4 × 2–3 mm, adaxially densely glandular and producing secretions which are evident under SEM, with minutely erose or subcrenate margins; appendages of posterior petals symmetrical, with an entire or bifid yellowish crest, appendages of anterior petals asymmetrical. Nectary with two, semiorbicular whitish lobes, situated at base of a short, glabrous androgynophore. Stamens in staminate flower 2–2.5 mm long, filaments flattened, pilose; anthers glabrous. Stamens in pistillate flower 2–3 mm long, with cylindrical and pilose filaments, anthers indehiscent. Pistillode ca. 0.3 mm long, glabrous. Gynoecium 3.5–4 mm long, ovary trigonous-obovoid, covered in short curved glandular hairs, the style straight or oblique, 0.5 mm long, glabrous, as long as the stigmas. Capsule subchartaceous, trigonous, obovoid or sub-orbicular, stramineous, 14–15 mm long, ca. 8 mm wide (including the stipe 0.8–1 mm long), locules inflated, 4–5 mm wide, with a dorsal wing 1–2 mm wide; epicarp stramineous, glabrous except for the ciliate dorsal veins; endocarp glabrous, septal walls ca. 1 mm wide, glabrous. Seeds nearly spherical, 3.2–3.5 mm in diameter, seed coat crustaceous, with chaffy trichomes, attached near the base of the locule; arillode slightly emarginate, dry, whitish, ca. 1.5 × 2.3 mm. Embryo with biplicate, smaller, adaxial cotyledon, and curved, larger, abaxial cotyledon. Figures 1–3.

Distribution, Ecology, and Phenology—*Cardiospermum bahianum* is an erect, branched shrub or subshrub restricted to the Bahian caatinga (Fig. 4), a forest composed of stunted trees and thorny bushes found in areas of small rainfall. The type specimen was collected in flower and fruit in February, other collections cited here were found in flower in August and December; although it is likely that fruits were present earlier, but they may have fallen off.

Etymology—The specific epithet refers to the state of Bahia, where the species is known to occur.

Cardiospermum bahianum belongs to sect. *Carphospermum* Radlk. characterized by the presence of chaffy (paleaceous) hairs on the seed coat (Radlkofer 1878), along with *C. anomalum* Cambess., and *C. cuchujaquense* Ferrucci & Acev.- Rodr. The features that characterize these three species are presented in Table 1.

Leaf Epidermis—Micromorphological characters of the epidermis are of taxonomic significance within *Cardiospermum*. All species share the presence of anomocitic stomata, and non-glandular and glandular trichomes. Within the genus, most of the species have stomata on the lower surface and few stomata on the upper surface, mainly near the midrib, these leaves are called hypoamphistomatic (Martínez Quesada 2009). *Cardiospermum bahianum* has stomata only on the lower side (Fig. 2B), whereas the other two species of the sect. *Carphospermum* have either hypoamphistomatic leaves in *C. cuchujaquense*, or amphistomatic leaves in *C. anomalum* (Ferrucci 2000a). In *Cardiospermum*, the cuticle generally has striae, well marked in the epiphyll and less notable in the hypophyll (Ferrucci 2000a). Most species show striae radiating from around the stomata, except for *C. procumbens* and *C. pterocarpum* which show the stomata surrounded by concentric rings of striae (Ferrucci 2000a; Solís and Ferrucci 2006).

Pollen Morphology—In *C. bahianum*, pollen grains are heteropolar, hemitrysincolporate, oblate, rarely peroblate, with an average polar axis of 30 μm (23.25–40.3 μm) and average equatorial diameter of 55.66 μm (41.85–62 μm). The sexine is tectate, reticulate with nano perforations (Fig. 5). In sect. *Carphospermum*, *C. anomalum* has medium to large sized grains, with protrudent pores and ectoapertures reduced to colpoids, whereas in *C. cuchujaquense* grains are medium sized, with linear ectoapertures; ornamentation in both species varies from reticulate to reticulate-microreticulate (Ferrucci and Acevedo-Rodríguez 1998; Ferrucci 2000a). Pollen grains are heteropolar, hemitrysincolporate, oblate, rarely peroblate, polar axis 23.25 (30) 40.3 μm, equatorial diameter 41.85 (55.66) 62 μm; sexine tectate, reticulate with nano perforations (Fig. 5). In sect. *Carphospermum*, *C. anomalum* has medium to large sized grains, with protrudent pores and ectoapertures reduced to colpoids; whereas in *C. cuchujaquense* grains are of medium size, and the ectoapertures are linear; the ornamentation of both species varies from reticulate to reticulate-microreticulate (Ferrucci and Acevedo-Rodríguez 1998; Ferrucci 2000a).

Cytology—*Cardiospermum bahianum*, with $2n = 4x = 36$ (Fig. 6), is the only known polyploid species in *Cardiospermum* studied, with chromosomes 1.2–2 μm in length. *Cardiospermum bahianum* shares the basic number of $x = 9$ with *C. anomalum* (Ferrucci 2000b; Urdampilleta, 2009). Our results suggest that section *Carphospermum* is characterized by a base number of $x = 9$, an additional character supporting the recognition of this section.

Additional Specimens Examined—BRAZIL. Bahia: Mun. Irecê, prox. a Baixões de Cima, rumo ao Algodão, margem da estrada, sub arbusto ca. 1m, muito ramificado, flores brancas caatinga, 21 Aug 1980 (fl), *Oliveira 234* (CTES, BAH). Mun. Rio de Contas, proximidades de Boa Sentença, Morro da Morceguinha, 13°49′27″S, 41°34′56″W, caatinga arbórea, com rochas quartzíticas e de arenito metamórfica, alt. 572 m, arbusto ereto até 2 m alt., com caules delgados com ritidoma marrom escuro com lenticelas claros, folhas membranáceas, discolores, face superior verde escura, face inferior

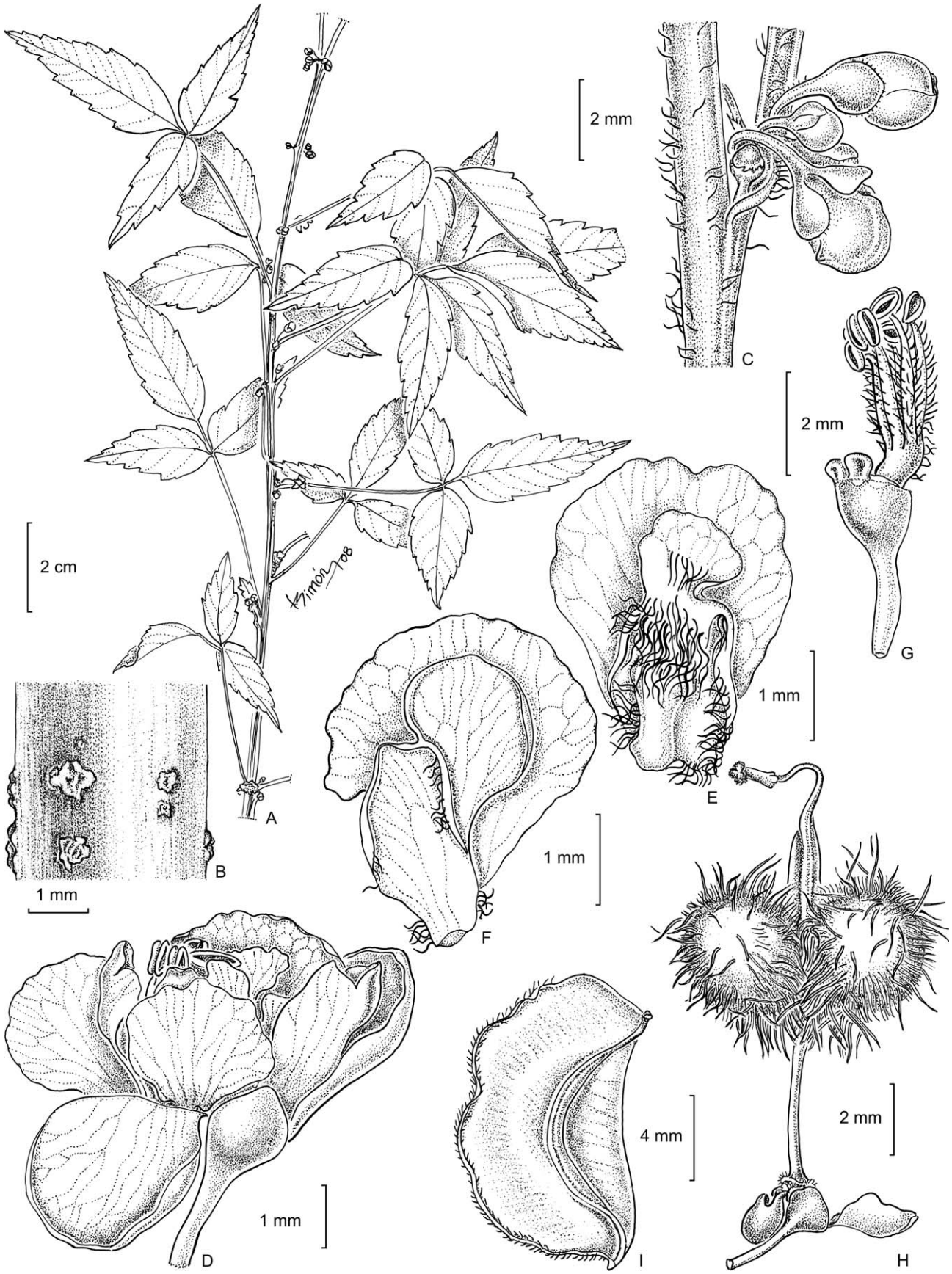

Fig. 1. *Cardiospermum bahianum* Ferrucci & Urdampilleta. A. Flowering branch. B. Portion of stem showing lenticels. C. Detail of axillary inflorescence. D. Staminate flower. E. Posterior petal with adnate appendage. F. Anterior petal with adnate appendage. G. Staminate flower, devoid of sepals and petals, showing the two posterior nectariferous lobes. H. Opened fruit showing two seeds, a persistent style and stigmatic lobes, and sepals. I. Carpellate fruit wall. (A-G, *Harley et al. 5266*, CTES; H-I, *Urdampilleta et al. 389*, CTES).

verde mais clara, flor com sépalas verde claras, pétalas brancas, estames com anteras creme e estaminodios com limbo amarelo-ouro, 5 Dec 2004 (fl), *Harley et al. 5266* (CTES, HUEFS); Mun. Rio de Contas, caminho para Lagoa Nova, 13°47′42″S, 41°46′44″W, alt. 490 m, caatinga, arenoso com afloramentos rochosos, arbusto escandente de ca. 1.50 m, folhas com folíolos levemente discolores, botões esverdeados, flores com pétalas alvas, frutos imaturos verdes, levemente inflados, raro, 5 Feb 1997 (fl), *Saar et al. s. n.*, *PCD 5099* (ALCB, CTES, HRB, HUEFS); Mun. São Gabriel, Fazenda Boa Sorte, 11°1′S, 41°39′W, área antropizada, alt. 798–800 m, arbusto com ca. de 2.5 m de alt., caule marrom-avermelhado, folhas papiráceas, glabras e discolores, face abaxial verde-clara e adaxial verde-escura, flores brancas, 4 Apr 2009 (fl), *Machado et al. 156* (HUEFS).

Key to the Sections and Brazilian Species of *Cardiospermum*

The area of distribution of theses species are cited in Somner et al. (2010).

1. Herbs or subshrubs, climbing or erect, or rhizomatous hemicryptophytes; leaves trifoliolate, biternate or decompound, stipules persistent or deciduous. Flowers with 4(–2), short, obtuse, ovoid-elliptic, or suborbicular nectariferous lobes. Seeds glabrous or with chaffy trichomes 2
   2. Seeds glabrous ..... Sect. *Cardiospermum*
      3. Herbs or subshrubs, climbing or erect; tendrils present or less often absent, or obsolete. Seeds with a dry aril. Sepals 4–5 4
         4. Sepals 4 5
            5. Capsules with dorsal wings absent or narrow, 0.5–2 mm wide. Seeds spherical or subspherical. Leaves biternate or decompound, exceptionally reduced to three leaflets 6
               6. Erect or climbing herb. Inflorescence with a single trimerous whorl of cincinni (sometimes tetramerous). Seeds with cordiform aril. Leaf biternate ..... 1. *C. halicacabum* L.
               6. Climbing subshrubs. Inflorescence with many cincinni separated by conspicuous internodes or a single whorl with (3–)4–5 cincinni. Seeds with an emarginate or slightly semicircular aril. Leaf generally biternate, or less frequent imparipinnate with a single terminal leaflet, 2–4-jugate, lower pair of juga with 3 or 5 leaflets, or rarely 3-foliolate ..... 2. *C. corindum* L.
            5. Capsule with well developed dorsal wings, 4–14 mm wide. Inflorescence with a single trimerous whorl of cincinni Seeds trigonous. Leaf 3-foliolate ..... 3. *C. oliveirae* Ferrucci
         4. Sepals 5 ..... 4. *C. urvilleoides* (Radlk.) Ferrucci
      3. Hemicryptophytes, rhizomatous, decumbent; tendrils short or absent. Seeds with flesh aril. Sepals 5 7
         7. Leaf trilobed ..... 5 *C. procumbens* Radlk.
         7. Leaf 3-foliolate ..... 6. *C. pterocarpum* Radlk.
   2. Seed coat with whitish chaffy trichomes ..... Sect. *Carphospermum*
      8. Erect subshrubs, 10–60 cm high. Seeds obovate, laterally complanate. Leaf biternate or 3-foliolate. Inflorescence erect, peduncle to 10–23 cm long, cincinni 1–3(-7) whorls, usually trimerous separated by 0.9–7 cm long internodes .... 7. *C. anomalum* Cambess.
      8. Erect subshrubs or shrubs, branched, 1–2.5 m high. Leaf 3-foliolate. Inflorescence contracted, axis (0–)1–2 mm long, cincinnus 1–3(-5), nearly sessile, peduncle 0–3 mm long ..... 8. *C. bahianum* Ferrucci & Urdampilleta
1. Climbing subshrubs, leaf biternate, stipules persistent. Flowers with 2 corniculiform nectariferous lobes, (1.25 -) 2–3.5 mm long. Seeds glabrous ..... Sect. *Ceratadenia*
   12. Sepals 4; petals adaxially sparsely glandular. Capsule papery, wingless, ellipsoid or ovoid, seed coat bluish black, bony, aril triangular in outline. Leaflets dentate-serrate ..... 9. *C. grandiflorum* Sw.
   12. Sepals 5, anterior sepals sometimes partly or wholly fused; petals eglandular. Capsule 3(4–)-winged, inversely pyramidal, seed coat brown. Leaflets entire or subentire margins 13
      13. Capsule glabrous. Seeds subspherical, 17–20 mm diam.; testa bony, aril cordate. Internal lateral foliole with two subapical teeth and the apex obtuse-glandular ..... 10. *C. integerrimum* Radlk.
      13. Capsule pubescent. Seeds subspherical, 4.5–5.5 mm diam.; testa crustaceous, aril subtriangular. Internal lateral foliole entire with an emarginate-glandular apex ..... 11. *C. heringeri* Ferrucci

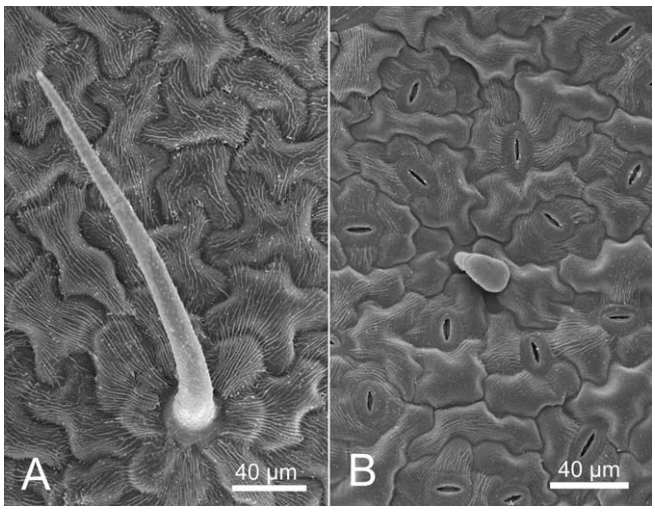

Fig. 2. *Cardiospermum bahianum* Ferrucci & Urdampilleta. Scanning electron micrographs of foliar epidermis. A. Upper surface, epidermal cells with cuticular striations and a trichome. B. Lower surface, epidermal cells with inconspicuous cuticular striations, anomocitic stomata and a bent glandular trichome (A-B, *Urdampilleta et al. 389*, CTES).

New Synonymies for C. anomalum—

Cardiospermum anomalum A. St.-Hil., A. Juss. et Cambess., Fl. Bras. merid. 1**:** 351–352. 1828. TYPE: BRAZIL. Minas Gerais: In campis prope vicos Contendas et Olho d'Agoa, in parte occidentali desertaque, vulgo Certâo, Set 1879, *Hilaire s. n.* (holotype: P!; isotypes: F!, G-DC!, foto F 5645 B!).

Cardiospermum strictum Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 8: 262, n. 9. 1878. TYPE. BRAZIL. S. Luzia, *Pohl 694* (lectotype: M!, here designated; isotypes: F!, K!, NY!, W!).

Cardiospermum strictum Radlk. f. s*tenophyllum* Radlk., in Martius, Fl. bras. 13(3): 452. 1897. TYPE. BRAZIL. Goiás: As Brancas dans les campos, 30 Dic 1894, *Glaziou 20855* (holotype: P!, isotypes: G!, K!).

Distribution, Ecology, and Phenology—*Cardiospermum anomalum* occurs in Northeastern Brazil, Goiás, Distrito Federal, and Northern Minas Gerais, and is found between 500–1,100 m elevation. This species is well represented in the

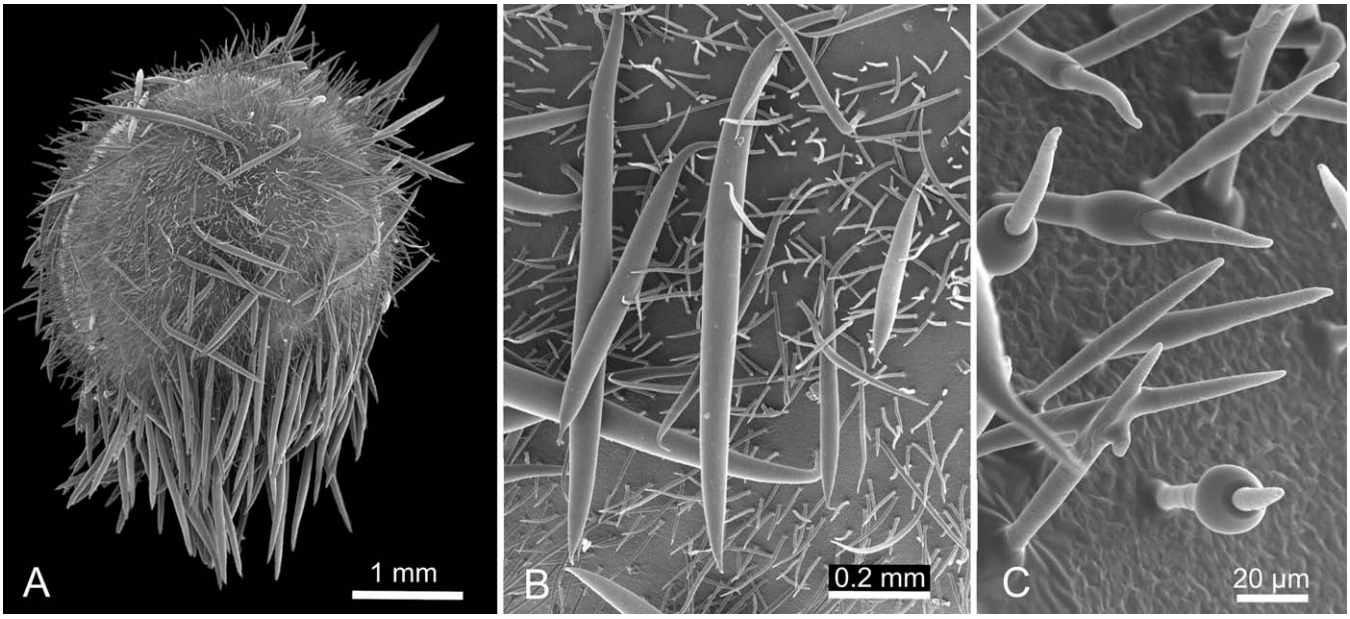

Fig. 3. *Cardiospermum bahianum*. Scanning electron micrographs of seed coat. A. Seed. B. Paleaceous hairs and short hairs. C. Detail of short hair (A-C, *Urdampilleta et al. 389*, CTES).

cerrado (vast tropical savanna characterized by a dry season of 4–5 mo, rainfall 1,400–1,500 mm, xeromorphic characteristics are due to nutrient-poor soil, not lack of water), in the cerradão (characterized by the presence of species that occur in the cerrado in its strictest sense, and also by forest species, particularly those of dry and semideciduous forests and gallery forests, physiognomically cerradão is a forest, but more floristically resembles a cerrado), and in the caatinga (xeric shrubland and thorn forest, which consists primarily of small, thorny trees that shed their leaves seasonally, dry nine months or more, annual rainfall 250–500 mm, temperatures are high and the soils are fertile) (Ferri 1974; Heringer et al. 1977). Their known distribution is depicted in Fig. 4. Flowering and fruiting occurs from June to April.

Representative Specimens Examined—BRAZIL. Bahia: Espigão Mestre, Serra 34 km W of Barreiras, 710 m, 2 Mar 1972, *Anderson et al. 36411* (BM, F, NY, U, UB, W); Ad Serra de Açurua, Sertão de Rio S. Francisco, 1838, *Blanchet 2846* (BM, G, GH, K, OXF, W); Paulo Afonso, Aldeia Serrota, 9°29′S, 38°5′W, 16 Jun 2006, Colaço 187 (CTES, HUEFS); Mun. de Morro do Chapéu, Estrada para o "morrão" (Morro do Chapéu), ca. 3 km da rodovia para Utinga, caatinga, 11°34′40″S, 41°11′08″W, 1,080 m, 28 Jan 2005, *Ferrucci et al. 3236* (CTES, ESA); Remanso, caminho para Pau Ferro, 9°38′44″S, 42°14′5″W, 27 Feb 2000, *Fonseca et al. 1287* (ALCB, CTES); Correntina, 17 Nov 1991, *Fontes et al. 1122* (CEN, CTES); Estação Ecológica do Raso da Catarina, 18 Jun 1981, *Guedes 244* (ALCB); Serrado Açuruá, ca. 4 km N of São Inácio on road to Xique Xique, ca. 500 m, 25 Feb 1977, *Harley 19043* (CEPEC, IPA, K, NY, RB, U); Mun. Oliveira dos Brejinhos a Macaúbas, BR-122, km 8, 20 Apr 1996, *Hatschbach et al. 65090* (BR, CTES); Serra do Tombador, cerrado at base of Morro do Chapéu, ca. 7 km S of town of Morro do Chapéu, 17 Feb 1971, *Irwin et al. 32333* (C, F, K, NY, P, SP, U, US); 20 km S de Ibotirama, 19 Mar 1982, *Krapovickas et al. 37897* (CEN, CTES); Entre Jeremoabo e Cícero Dantas, 5 Mar 1958, *Lima de A. 58–2894* (BM, K, IPA); Inhambupe, ca. 28 km N de Inhambupe na estrada para Olindina (Br.110), 23 Aug 1996, *Paganucci de Q. & Nascimento 4538* (HUEFS); Mun. Xique-Xique, 20 km de Xique-Xique, no sentido de Santo Inácio, 18 Mar 1996, *Stannard et al. PCD 2529* (ALCB, CEPEC). Ceará: Guaraciaba do Norte, Andrade, 27 Feb 1981, *Fernandes & Martins s. n. EAC 9816* (CTES, F); Ibotirama, BA160, a 20 km de Ibotirama, 12°21.326, 43°11.857, 14 Apr 2007, *Urdampilleta & Obando 330* (CTES, UEC). Distrito Federal: Ponte Alta-Gama, 6 Nov 1976, *Allem 310* (CEN). Goiás: Formoza, 21 Dec 1894, *Glaziou 20854* (K, P, R); Luziânia, 13 Mar 1976, *Heringer 15445* (UB). Maranhão: Estrada para Alto Parnaiba, a 6 km de Balsas, 7 Dec 1980, *Baslas s. n.* (EAC). Minas Gerais: 7.5 km by road W of Rio Pandeiros on road from Januária to Serra das Araras, 17 Apr 1973, *Anderson et al. 9020* (F, MO, NY, R, UB); Mun. Joaquim Felício, Serra do Cabral, 15 Apr 1996, *Hatschbach et al. 64784* (CTES, MBM). Pernambuco: Ibimirim, 2 Jun 1982, *Ataide et al. 17* (HRB); Petrolina, à margem do Rio São Francisco, depois da Ilha de Nossa Senhora, 22 Jan 1970, *Carauta 1002* (GUA, RB); Mun. Ibimirim, BR 101, entre Ibimirim e Petrolândia, 2 Aug 1996, *Oliveira et al. 49* (ALCB); Bulque, Catimbau, Serra do Catimbau, 19 Oct 1994, *Travassos 229* (CTES, PEUFR); Brejos de altitude de Pernambuco, 3 km N de Petrolina, 4 Apr 1983, *Fotius 3386P* (IPA); BR 110, Estrada de barro Ibimirim/Petrolândia, 23 Jul 1994, *Miranda et al. 1942* (PEUFR). Piauí: Serra da Capivara, *Emperaire 592–1979* (IPA); Estrada Bom Jesus, Alegrete, 15 Dec 1977, *Fernandes & Matos de Abreu s. n.* (EAC); Estrada Canto do Buriti a Eliseu Martins 12 km para Eliseu Martins, 11 Nov 1979, *Fernandes & Matos de Abreu s. n.* (EAC); Near Santa Anna das Murces, Mar 1839, *Gardner 2078* (BM, G, GH, K, L, MO, NY, OXF, P, W); 5 km S de Eliseu Martins, BR-135, 4 Apr 1983, *Krapovickas et al. 38748* (CEN, CTES, G, P); Faz. Itaueira Agropecuária S/A, Canto do Burití, 9 May 1995, *Pinto Filho s. n.* (EAC); Serra Branca, Jan 1907, *Ule 7458* (G, K, L).

Radlkofer (1878) described *C. strictum* on the basis of two specimens, *Pohl s. n.* and *Olfers 694*, and distinguished it from *C. anomalum* by its ternate (trifoliolate) leaves (vs. biternate leaves). However, this difference cannot be maintained as we have observed both types of leaves within individual plants.

Observations—*Cardiospermum anomalum* has a xylopodium, that is dormant during winter and sprouts at the beginning of the spring. This structure, although present in numerous herbarium collections, has so far not been described for the species. It has been described as a water storage organ of herbaceous species from the cerrado (Rizzini and Heringer 1962). This feature seems to be unique in the genus, although the xylopodium is characteristic of many plants of the cerrado, and is associated with xerophytic plants that resist drought (Fahn and Cutler 1992).

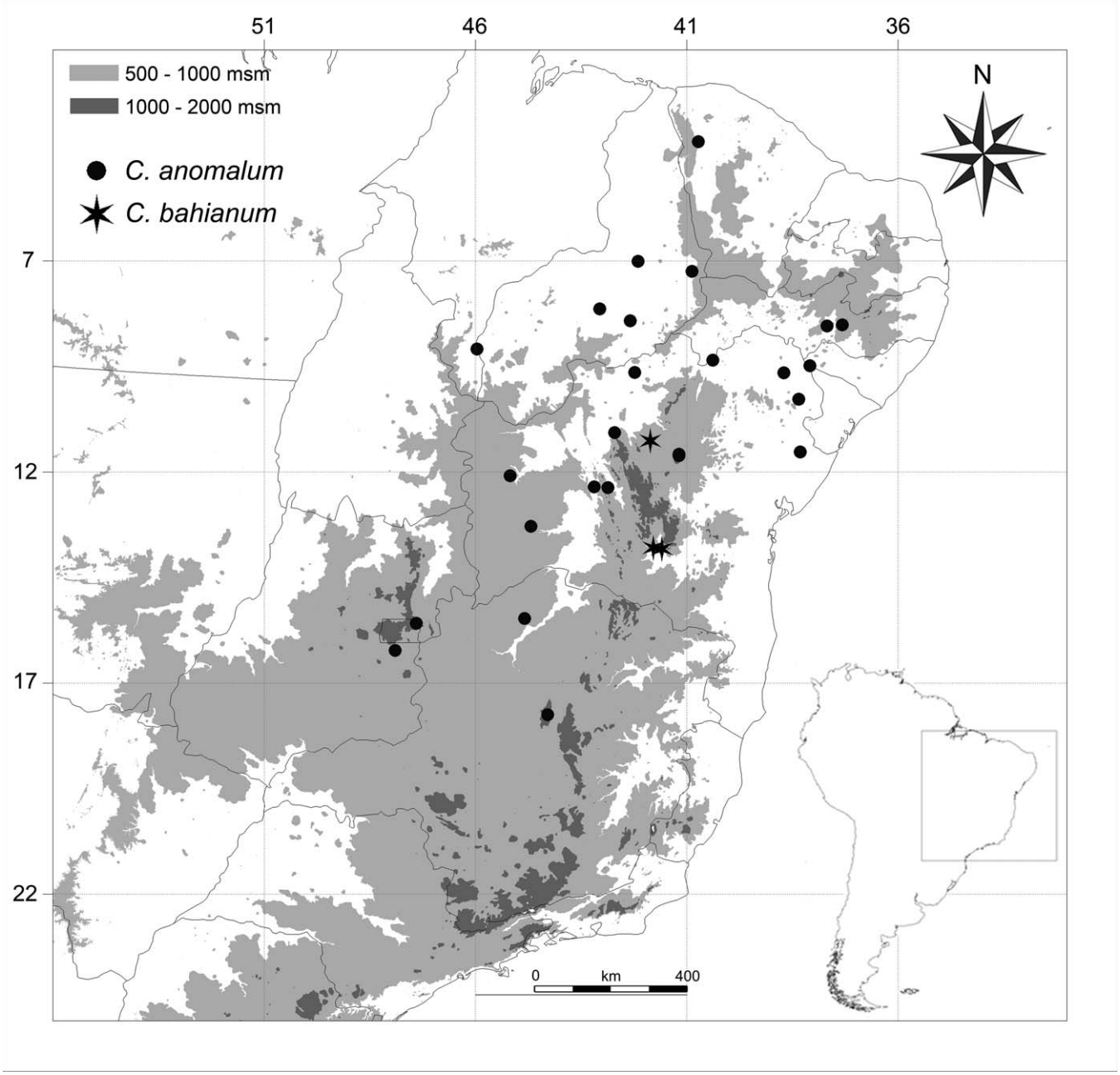

Fig. 4. Known geographical distribution of *Cardiospermum bahianum*, this new species is restricted to the caatinga, and *C. anomalum*, well represented in the three biomes, cerrado, cerradão, and caatinga, which were briefly characterized in the text.

Table 1. Comparison of morphological and ecological characters of *C. bahianum*, *C. anomalum* and *C. cuchujaquense*.

Character	*C. bahianum*	*C. anomalum*	*C. cuchujaquense*
Habit	Erect subshrub or shrub, without tendrils, from 1–2.5 m de high	Erect subshrub, without tendrils, from 0.10–0.60 m high	Climbing subshrub, with delicate tendrils, to 3.5 m long
Stipules	Deciduous	Deciduous	Persistent
Calyx	Tetramerous	Tetramerous	Pentamerous, the third and fifth sepals connate through ¾ of their lengh
Inflorescences	Peduncle and rachis undeveloped	Peduncle and rachis developed	Peduncle developed, rachis punctiform
Seeds	Subspherical	Obovoid, laterally complanate	Subspherical
Distribution	Bahia, Brazil	Northeastern Brazil, Northern Minas Gerais, Distrito Federal and Goiás	Sonora, Mexico
Environment	Caatinga	Cerrado, cerradão or caatinga	Deciduous tropical forest

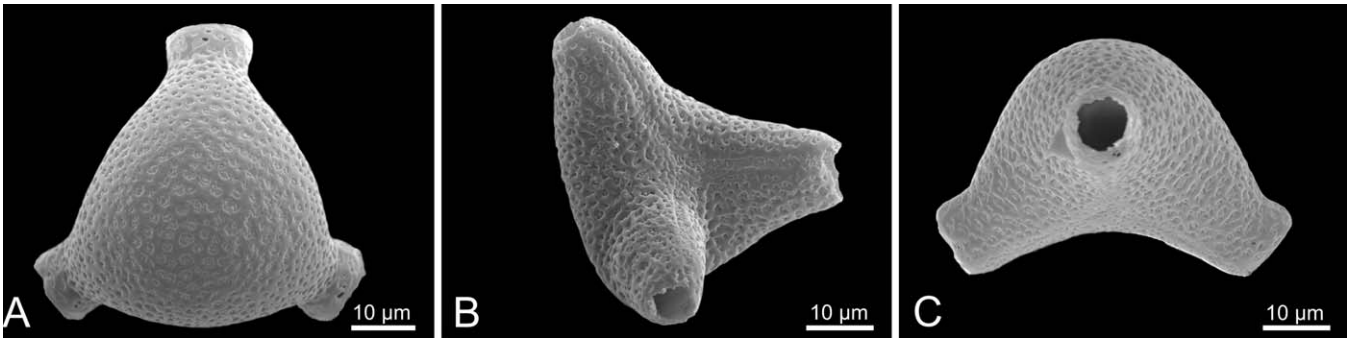

Fig. 5. *Cardiospermum bahianum*. Scanning electron micrographs of pollen grains. A. distal view. B. Proximal view. C. Equatorial view. (A-C, *Harley et al. 5266*, CTES).

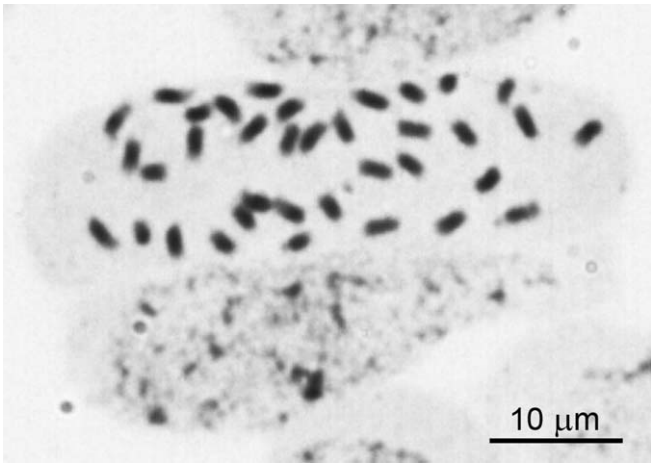

Fig. 6. *Cardiospermum bahianum.* Photomicrograph of mitotic metaphase, $2n = 36$.

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