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SHORT COMMUNICATION

Davilla hirsuticarpa (Dilleniaceae), a new species from the Atlantic Forest of Brazil

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Background – *Davilla* (Dilleniaceae) currently comprises 28 species and is distributed throughout the Neotropics. Extensive fieldwork conducted in the Atlantic Forest of the Brazilian states Bahia, Espírito Santo, and Rio de Janeiro resulted in the discovery of a new species of *Davilla*, described and illustrated in this paper.
Methods – Herbarium collections including type specimens were consulted for identification and compared to the new species. Morphological data of the new species were obtained through the study of herbarium specimens as well as of live specimens observed in the field.
Key results – *Davilla hirsuticarpa* Fraga & Aymard, a new species endemic to the Atlantic Forest areas, is here described and illustrated, along with comments on its geographical distribution, ecology, and conservation status. The new species resembles *D. bahiana* Aymard and *D. cuspidulata* Mart. ex Eichl., from which it differs by hirsute carpels. In accordance with the categories and criteria of the IUCN Red List, it could be considered as Vulnerable (VU). A new key to all species of *Davilla* sect. *Davilla* is provided.

Key words – *Davilla hirsuticarpa*, *Davilla bahiana*, *Davilla cuspidulata*, Brazilian Atlantic Forest, endemism, taxonomy.

INTRODUCTION

Davilla Vand. currently comprises of 28 species, including the new species described here; many species were described in recent years (Kubitzki 1973, 1980, Aymard 1998, 2002a, 2002b, 2007, Fraga 2008, Fraga & Stehmann 2010). The genus is distributed throughout the Neotropics, with 26 species occurring in Brazil (Fraga 2012). Morphologically, *Davilla* is distinguished from other neotropical genera of Dilleniaceae by sepals that are unequal in size, with the two inner ones large and crustaceous, covering the fruit completely, and by indehiscent fruits of the follicle type, representing the synapomorphies of the genus (Fraga 2012).

In Kubitzki's (1971) taxonomic revision, two sections were recognized: *Davilla* section *Davilla*, defined by reflexed, not alate, margins of the innermost sepals, overlapped by the adjacent inner sepals; and section *Homaloclaena* Kubitzki, defined by margins of the innermost sepals not overlapped by the inner sepals but pressing against each other and forming circular wings (Kubitzki 1971). In a phylogenetic analysis using molecular and morphological data, sect. *Davilla* was recovered as monophyletic (Fraga 2012).

Our extensive fieldwork between 2008 and 2012 in the Brazilian Atlantic Forest in the states Bahia, Espírito Santo, and Rio de Janeiro, along with the study of type materials and herbarium specimens of the genus, resulted in the recognition of a new species that is here described and illustrated. With the objective of facilitating identification of this and other species of *Davilla* sect. *Davilla*, a new key to the species of this section is provided. This work is part of the PhD thesis "Phylogeny and taxonomic revision of *Davilla* Vand. (Dilleniaceae)" of the first author (Fraga 2012).

MATERIAL AND METHODS

Collections of the herbaria CEPEC, K, NY, MBM, MBML, RB, RBR, and SP (acronyms according to Thiers continuously updated) were consulted, and the type specimens of

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all related species were examined; all cited specimens were seen. Morphological data were obtained through the study of herbarium specimens and of c. ten live specimens observed in the field. The description and illustrations are based on living and dried material studied using a stereomicroscope. Morphological characters are based on Harris & Harris (2001) and Hickey & King (2000). Voucher specimens were pressed according to Fidalgo & Bononi (1984) and deposited at the herbaria RB and BHCB.

Distribution of the new species was plotted using SimpleMappr (Shorthouse 2010). The conservation assessment complies with the criteria of the IUCN (2001), where the extent of occurrence (EOO) and the area of occupancy (AOO) were estimated using GeoCAT, with the AOO based on a 2 km grid (Bachman et al. 2011).

SPECIES DESCRIPTION AND DISCUSSION

Davilla hirsuticarpa Fraga & Aymard, **sp. nov.**

The new species resembles *Davilla bahiana* Aymard and *D. cuspidulata* Mart. ex Eichler, but differs from *D. bahiana* by its sparsely tomentose, when young, branches and branchlets, with inclined trichomes, becoming glabrescent when mature; from *D. cuspidulata* by its longer pedicels; and from both species by the hirsute carpels. – Type: Brazil, Espírito Santo, Águia Branca, Propriedade do Sr. Ailton Cortelete, 18º57′16.3″S 40º48′07.8″W, 6 Jul. 2011, *C.N. Fraga* 3411, fl, fr (holo-: RB; iso-: BHCB).

Liana, rarely shrub. Stem tortuous, branches and branchlets cylindrical, striate, sparsely tomentose, becoming glabrescent when mature, brown. Indumentum and cilia on vegetative and reproductive parts always with simple trichomes, inclined, castaneous; Leaf 3.5–29 × 1.8–8 cm, elliptic to elliptic-spathulate, petiolate; petiole 4.5–29.9 × 0.9–1.6 mm, carinate, ciliate at the margin, becoming lacerate when mature; leaf blades 3.6–26.3 × 1.8–10.4 cm, coriaceous, cuneate or rounded at base, rounded to acute or rarely emarginate at apex, margin entire when young or sinuate-dentate mostly in the upper half when mature, flat, ciliate, smooth to glabrescent on upper surface, tomentulose on lower surface, except along the midrib; venation eucamptodromous; midrib impressed and tomentose on upper surface, prominent and villous or tomentose on lower surface; secondary nerves 8–17, upturned and gradually diminishing apically inside the margin, connected to the superadjacent secondary by a series of tertiary crossveins without forming any secondary marginal loops, impressed and glabrescent on the upper surface, prominent and tomentose on the lower surface; tertiary venation reticulate, flat or slightly impressed and glabrous on the upper surface, prominent, villous to tomentose or glabrescent on the lower surface. Inflorescence 7–20 cm long, branched, terminal or axillary, 3–35-flowered, erect or arching when blooming and pendulous when fruiting, rachis sparsely villous or tomentose, glabrescent when mature. Flowers pendulous, opening down, pedicellate; basal bracts 1–1.6 × 3.2–3.7 mm, often caducous, tomentose or rarely glabrescent on upper surface and glabrous on lower surface; pedicels 5–8.5 mm long, 0.5–0.6 mm diam. at the base to 0.8–1 mm at the apex, villous to tomentose or rarely glabrescent; sepals 5, three outer smaller and two inner larger; outer sepals sub-orbicular or ovate, crustaceous, tomentose to glabrescent and rugose externally, glabrous and shiny internally, ciliate at the margin, unequal in size, the external one 3–4 mm diam. when flowering and 3.3–5.1 mm diam. when fruiting, the median one 4.1–5.2 mm diam. when flowering and 5.2–6 mm diam. when fruiting, the internal one 4.8–5.6 mm diam. when flowering and 5.2–6.3 mm diam. when fruiting; inner sepals orbicular, creased in herbarium material, crustaceous, glabrescent and rugose externally, glabrous and shiny internally, ciliate at the margin, green when flowering and orange to castaneous when in fruit, equal in size, 6.3–7.8 mm diam. when flowering and 8.4–12.7 mm diam. when fruiting; petals 5, 8.1–9.3 mm long, 1.2–1.5 mm large at the base and 6.5–7.9 mm at the middle third, early deciduous, membranous, glabrous on both sides, spathulate, emarginate at apex, not ciliate at the margin, yellow; stamens 60–82, arranged in a circle surrounding the carpels, exserted, the filaments 3.1–5.3 × 0.08–0.1 mm, cylindrical to clavate, glabrous, the anthers 0.7–1 × 0.4–0.6 mm, basifixed, oblong, glabrous, longitudinally dehiscent; carpels 2, free; ovary 1–1.5 × 0.5–0.9 mm, conical, hirsute, with 1–2 basal ovules 0.5–0.6 × 0.4–0.5 mm in size; styles 3.2–4.6 × 0.2–0.3 mm, one per ovary, erect to sinuous, hirsute, apex appressed; stigma capitate, discoid, verrucose. Fruit an indehiscent follicle, 6–8.1 × 4.7–6.8 mm; capsule one- or rarely two-seeded, globose or oblong, membranous, hirsute externally; seeds 4.8–5.6 × 4.3–5.7 mm, asymmetric, rugose, glabrous, covered by aril almost to the apex, maroon-red to black; aril papyraceous, toothed at the apex, white. Figs 1 & 2.

Distribution – *Davilla hirsuticarpa* occurs between 17°45′S and 22°25′S, and between 39°30′W and 42°25′W along the Brazilian Atlantic Forest, in areas on Tertiary Tablelands (tabuleiros) of the Barreiras Formation in Bahia and in north of Espírito Santo (Pedro Canário), on the granitic hills in areas of tropical semideciduous forest in Espírito Santo (other locations), and on lowland rainforest in Rio de Janeiro (fig. 3).

At the south coast of Bahia and the north coast of Espírito Santo the predominant vegetation is tabuleiro forest; this area is limited by the Jequitinhonha River to the north, Vitória Bay to the south, by the restinga on the coastal plain vegetation on a local geology dominated by Quaternary sediments to the east, and by the higher mountains to the northwest on a local geology dominated by Precambrian crystalline rocks (Martini et al. 2007, Thomas & Barbosa 2008). The tabuleiro forest vegetation is influenced by geological and edaphic-climatic factors and presents unique physiognomic and floristic characteristics. The seasonal deciduousness of a significant percentage of the trees within this tabuleiro forest is similar to that seen in the dry seasonal forest. This same tabuleiro forest shares many taxa with the Amazon forest, it also harbors species that are disjunct between the Atlantic forest and Amazonian forest, evidence of past periods when these two forests were united. Four natural vegetation types are identified in the tabuleiro forest: mata alta (tall forest), muçununga forest, permanently and seasonally flooded forests, and campos nativos, on a local geology dominated by Tertiary and Quartenary sediments (Peixoto et al. 2008).

In the northwest of the Espírito Santo the seasonal semideciduous forest is one of the most important types of native vegetation, especially in the south of the state (Assis et al. 2007). These forests have a smaller stature and lower basal area than common tropical rain forests and thorny species are often prominent, where the ecological processes are strongly seasonal with the growth taking place during the wet season. There is a build-up of leaf litter during the dry season because sunlight penetrates down to the forest floor and the decomposition ceases in the low relative humidity, and many species bloom synchronously at the transition between the dry and wet seasons whilst the trees are still leafless (Pennington et al. 2000). In addition, the plants are continuously subject to drought not only in the marked dry season, but also in the rainy season due to the thin soil on which they grow. This region is in fact a mosaic of seasonal semi-deciduous

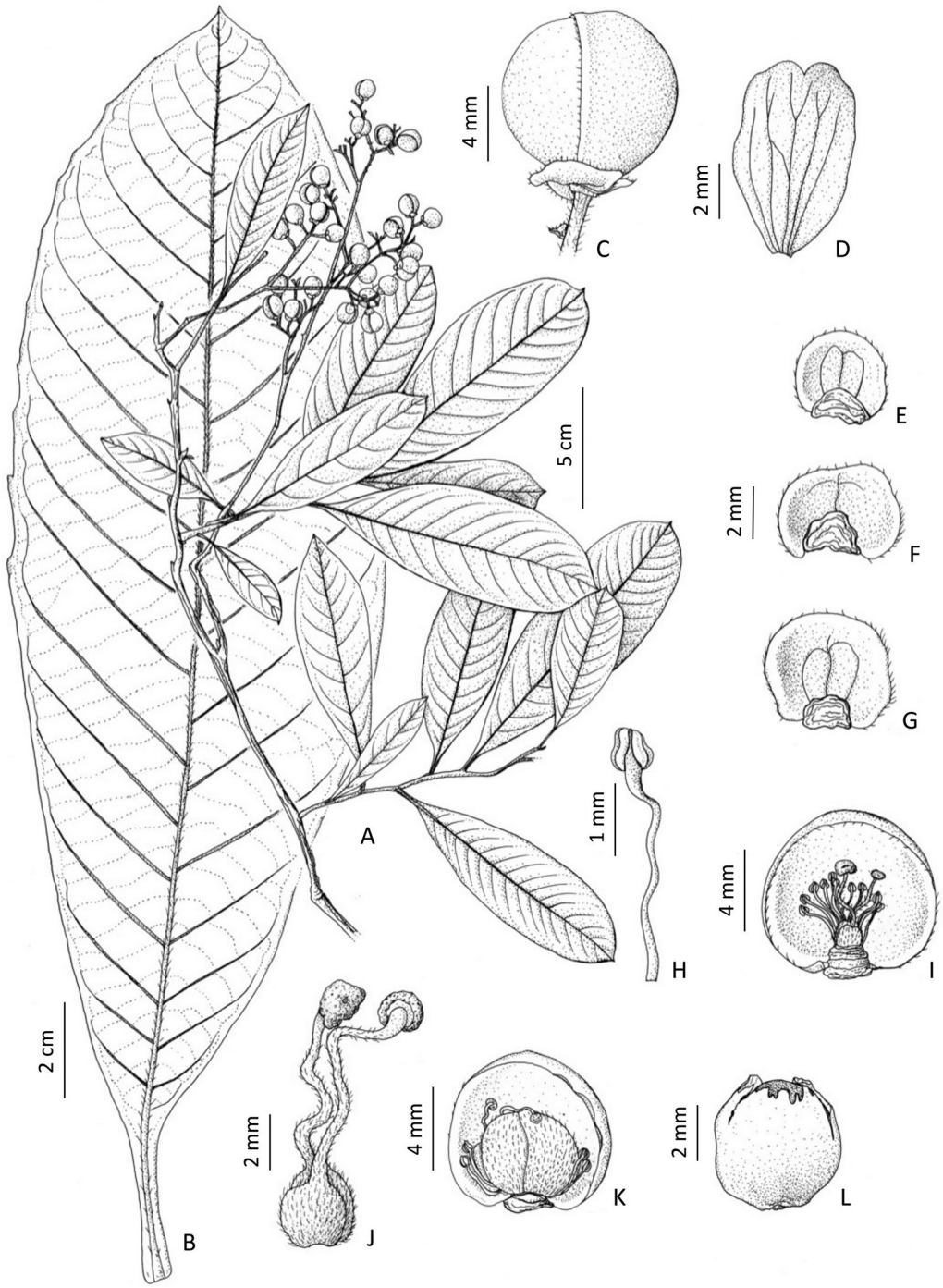

Figure 1 – *Davilla hirsuticarpa*: A, habit and inflorescence; B, lower surface of leaf blade; C, flower, without caducous petals; D, petals; E–G, external sepals; H, stamen; I, frontal view of flower, with one inner sepal removed; J, carpels with hirsute indumentum; K, frontal view of fruit, with one inner sepal removed; L, seed covered by papyraceous aril. From *Fraga* 3411 (RB). Drawn by Maria Alice Rezende.

forest fragments, inserted in a matrix anthropized by agricultural activities, primarily extensive beef cattle livestock and *Eucalyptus* plantations. Thus, these fragments are usually inserted between the inselbergs; rock outcrops usually do not attract much agricultural interest, and they have frequently been preserved from human impact and have kept their refugial character (Porembski et al. 1998).

In Rio de Janeiro, *Davilla hirsuticarpa* was collected only in the Poço das Antas Biological Reserve, municipality of Silva Jardim. The Reserve covers c. 5 000 ha with a perimeter of 44 km. Rainfall is well distributed throughout the year, with a discrete dry season from May to August. This forest remnant shows a topographic gradient from a flood-free site to a periodically flooded site to a permanently flood-

Figure 2 – Vegetation physiognomy of the type locality and morphology of *Davilla hirsuticarpa*: A, general view of the tropical semideciduous forest and inselbergs of Águia Branca, Espírito Santo, Brazil; B, vine canopy of the Tabuleiro Forest, Caravelas, Bahia; C, branches, branchlets, and inflorescence; D, eucamptodromous venation on the upper leaf surface; E, flower, without caducous petals; F, frontal view of flower, with one inner sepal removed; G, Frontal view of fruit, with one inner sepal removed; H, hirsute fruit surface. All photos by C.N. Fraga.

Key to the species of *Davilla* sect. *Davilla*

1. Flowers with 1 carpel....2
1'. Flowers with 2 carpels....6
2. Ovary completely covered by sericeous trichomes....*Davilla neei*
2'. Ovary glabrous or with sparse trichomes at the base....3
3. Leaf venation prominently lacunose-areolate on the lower surface....*Davilla lacunosa*
3'. Leaf venation not prominently lacunose-areolate on the lower surface....4
4. Branches, branchlets and inflorescence covered by patent trichomes forming a villous surface; leaf blades membranaceous, with secondary nerves semi-craspedodromous; flowers with less than 50 stamens....*Davilla rugosa*
4'. Branches, branchlets and inflorescence covered by inclined trichomes forming a tomentose surface; leaf blades coriaceous or sub-coriaceous, with secondary nerves semi-craspedodromous at the base and craspedodromous at the apex, or eucamptodromous; flowers with more than 50 stamens....5
5. Leaf blades coriaceous, with secondary nerves semi-craspedodromous at the base and craspedodromous at the apex; ovary glabrous....*Davilla lucida*
5'. Leaf blades coriaceous or sub-coriaceous, with secondary nerves eucamptodromous; ovary glabrous or covered with sparse trichomes at the base....*Davilla nitida*
6. Inner sepals villous or sericeous; ovary glabrous....*Davilla elliptica*
6'. Inner sepals glabrescent and covered sparsely by trichomes when young; ovary glabrous or hirsute....7
7. Leaves sessile or sub-sessile, woolly on the lower surface....*Davilla lanosa*
7'. Leaves distinctly petiolate, not woolly on the lower surface....8
8. Ovary hirsute....*Davilla hirsuticarpa*
8'. Ovary glabrous....9
9. Branches, branchlets and inflorescence villous or hirsute with patent trichomes, rarely glabrescent when mature; pedicels 2.7–4.7 mm long....*Davilla bahiana*
9'. Branches, branchlets and inflorescence sparsely tomentose with inclined trichomes when young and glabrescent when mature; pedicels with more than 5 mm long....10
10. Leaf blades coriaceous, midrib glabrous on lower surface, rarely with sparsely inclined trichomes at the apex; pedicels 5.5–16 mm long; inner sepals 12–17.5 mm diam. in fruit....*Davilla grandiflora*
10'. Leaf blades papyraceous, midrib pubescent on lower surface, trichomes patent; pedicels 5–8.5 mm long; inner sepals 8–11 mm diam. in fruit....*Davilla cuspidulata*

ed site (Scarano 2006). According to Lima et al. (2006), this area has two forest formations (alluvial forest and lowland forest) and four non-forest formations (fluvial pioneer, alluvial scrub, submontane scrub and manmade grasslands). In this region the new species is common in low forest areas, usually in forest border areas.

Additional specimens examined – **Brazil**: **Bahia**: Nova Viçosa, c. 12 km na Estrada do Boi para Nova Viçosa, 6 Sep. 1989, *Carvalho et al.* 2491, fr (CEPEC); Caravelas, BR-418, ca. 16 km da BR 101 em direção a Caravelas, Floresta de Tabuleiro Costeiro, 17°47′51″S 39° 36′25″W, 30 Jul. 2009, *Fraga et al.* 2792, fl, fr (ALCB, BHCB, CEPEC, HUEFS, K, MBM, MBML, MO, NY, P, PORT, RB, SPF, WU). **Espírito Santo**: Água Doce do Norte, Córrego Havaí, beira da Estrada para a torre de celular/rampa de voo livre, 18°34′19″S 40°59′43″W, 567 m, 27 Apr. 2008, *Fontana et al.* 5049, fr (MBML); Morro da Torre de celular, topo do inselberg, 18°34′11″S 40°59′07″W, 624 m, 22 Apr. 2013, *Pellegrini et al.* 368, fl (RB, MBML); Águia Branca, Rochedo, propr. Arlindo Breda, 18°56′45″S 40°48′10″W, 400–550 m, 16 May 2007, *Demuner et al.* 3909, fl (MBML, RB); Propriedade do Sr. Ailton Cortelete, Mata Semidecidual, 18°57′16″S 40°48′07″W, 16 Jan. 2008, *Saavedra et al.* 649, fr (RB); 18°57′13″S 40°48′07″W, 6 Aug. 2010, *Saavedra et al.* 1038, fr (RB); Águas Claras, propr. Seu Voito, 18°54′10″S 40°40′01″W, 300–330 m, 27 Jul. 2006, *Magnago et al.* 1149, fr (MBML, RB); Governador Lindemberg, Pedra de Santa Luzia, prop. Firmino Sottele, 19°16′54″S 40°27′43″W, 350–650 m, 26 Apr. 2007, *Demuner et al.* 3889, fl (MBML, RB); Propr. José Antônio, 19°13′58.5″S 40°28′51.7″W, 200–250 m, 22 Aug. 2006, *Demuner et al.* 2680, fr (MBML, RB); Pedro Canário, estradas vicinais, próximo ao eixo da BR 101 entre o Rio Itaunas e 5 km em direção a Pinheiros, 21 Oct. 2008, *Farney et al.* 4884, fr (BHCB, K, MBML, NY, RB). **Rio de Janeiro**: Silva Jardim, Reserva Biológica de Poço das Antas, estrada para Jutunaíba, próximo a casa da Cíntia, 22°30′–22°33′S 42°15′-42°19′W, 17 Jun. 1994, *Farias et al.* 277, fl, fr (RB, SPF); Estrada para a casa de Aristides, caminho que vai para o Rio Aldeia, 22°30′–22°33′S 42°15′–42°19′W, 10 m, 7 Jun. 1996, *Silva Neto* 448, fl (K, NY, RB, RBR, SP); Trilha Cambuí Preto, 20 Jun. 1994, *Luchiari* 451, fl, fr (CEPEC, MBM, RB).

Habitat, ecology and phenology – This species is normally found as a canopy liana, often supported by shrubby vegetation, but also near the ground, and always exposed to the sun (Bahia and Rio de Janeiro), or in the forested areas of the rocky outcrops (Espírito Santo). It was collected in flower from April to June, in flower/fruit from June to July, and in fruit from July/August to January.

Etymology – The specific epithet refers to the hirsute indumentum covering the ovaries and persistent in the fruit, a character uncommon in the genus (see fig. 2G & H).

Preliminary conservation assessment – IUCN Red List category: Vulnerable [VU B2ab(i,ii,iii,iv)]. The extent of occurrence (EOO) of *Davilla hirsuticarpa* is estimated to be over of 33,974 km^2 (exceeding the 20,000 km^2 upper limit for Vulnerable status under the criterion B1) whereas its minimal area of occupancy (AOO) is estimated to be 52 km^2 which falls within the limits for Endangered status under the criterion B2. *Davilla hirsuticarpa* is restricted to southeastern Bahia, northern Espírito Santo and northern Rio de Janeiro. The forested areas are severely fragmented due to real estate speculation, crop and livestock farming, and intensively managed *Eucalyptus* plantations. Granite strip mining, with its negative impact on the environment, is also quite common in northwestern Espírito Santo.

This species is known from fourteen specimens representing thirteen subpopulations. These thirteen subpopulations represent a total of six locations, exceeding the upper limit for Endangered status, but falling within the limit for Vulnerable status. We project that the ongoing loss of its habitat will induce a strong continuous decline in the number of subpopulations and mature individuals as well as an important decline of its EOO and AOO. *Davilla hirsuticarpa* therefore is assigned a preliminary status of Vulnerable.

Notes – Because its internal sepals are imbricate and overlapped by the adjacent inner sepals, *Davilla hirsuticarpa* belongs to *Davilla* sect. *Davilla*, with eleven recognized species split into two groups (Fraga 2012). The first group is composed of species with one carpel, with widespread distribution (*D. lucida* C.Presl, *D. nitida* (Vahl.) Kubitzki, and *D. rugosa* Poir.), or with restricted distribution in the Brazilian savanna (*D. lacunosa* Mart.) and the Amazonian forest (*D. neei* Aymard). The second group of species has two carpels, with restricted distribution in parts of the Atlantic Forest (*D. bahiana* Aymard, *D. hirsuticarpa*), or in parts of the Amazonian forest (*D. cuspidulata* Mart. ex Eichl. and *D. lanosa* Fraga & Stehmann), or with widespread distribution in the Brazilian savanna (*D. elliptica* A.St.-Hil. and *D. grandiflora* A.St.-Hil. & Tul.).

Davilla hirsuticarpa resembles *D. bahiana* and *D. cuspidulata* in having elliptic or elliptic-lanceolate leaves with short carinate petioles less than 3 cm. It differs from *D. bahiana* by its sparsely tomentose branches and branchlets, with inclined trichomes, when young, becoming glabrescent when mature (vs. villous or hirsute branches and branchlets, with patent trichomes, rarely glabrescent when mature). It differs from *D. cuspidulata* by its longer pedicels, 5–8.5 mm long (vs. 2.7–4.7 mm long). It differs from both species in having hirsute carpels (vs. glabrous carpels in both other species).

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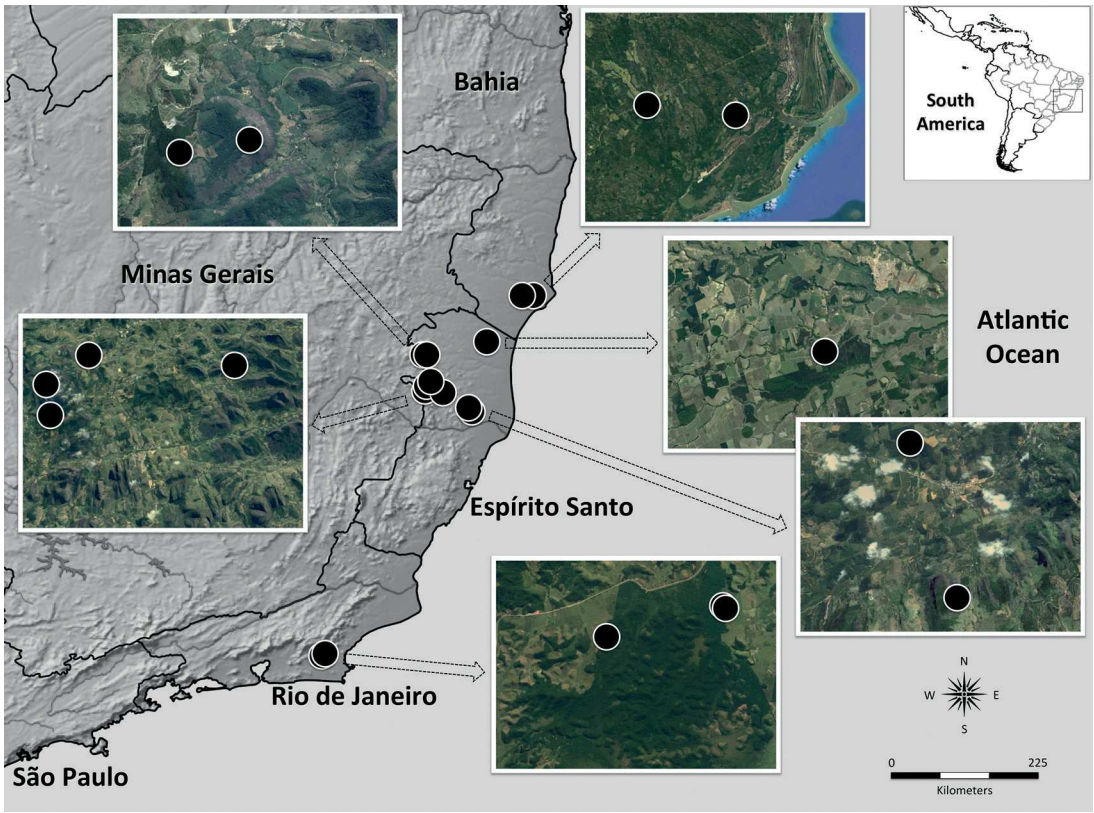

Figure 3 – Geographical distribution of *Davilla hirsuticarpa* (black dots) in southeastern Brazil (fourteen specimens).

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