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Tachigali inca (Caesalpinioideae – Leguminosae), a new species of giant tree from Amazonian forests

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Abstract. The new species *Tachigali inca* is described and illustrated. It grows in lowland 'terra firme' forest of Amazonian Brazil, in the sub-Andean Amazon region of Peru, and in northeastern Bolivia. The species differs markedly from its most closely related species (*T. amarumayu, T. prancei* and *T. setifera*, all belonging to the "setifera group"), by the large cylindrical domatia on the leaf rachis, and by the brown-orange pulverulent indumentum on the abaxial surface of the leaflets and the young twigs; on older branches the indumentum becomes darker, degrades and then breaks off. It also differs by its linear petals with the upper half densely tomentose, the hairs forming small tufts.

Keywords: Amazon region, ant domatia, Fabaceae, taxonomy.

INTRODUCTION

Tachigali Aubl. is a neotropical genus of leguminous trees widely distributed from the south of Mexico to southern Brazil and Bolivia. It is a member of subfamily Caesalpinioideae (LPWG 2017). *Tachigali* contains an estimated 75 species and is most speciose and morphologically diverse in the Amazon forest (Dwyer 1954, 1957a, 1957b; van der Werff 2008), with approximately 60 species (Huamantupa-Chuquimaco et al. 2019; van der Werff 2013).

Tachigali was first described by Aublet (1775), since then until recent years with several studies and others recently has been discovering up to an estimate of about 90 species, with more than 75% found in the Amazon region (Huamantupa-Chuquimaco et al. 2019; Huamantupa-Chuquimaco et al., unpubl. data). *Tachigali* is among the tree genera with the widest distri-

bution in the Amazon region, for example *T. paniculata* and *T. vaupesiana* are recognized as hyperdominant tree species (ter Steege et al. 2013, 2019). The Amazon region below the foothills of the eastern slopes of the Andes (Eva et al. 2005) is considered as a global biodiversity hotspot (Myers et al. 2000), and here the diversity of *Tachigali* is high. For example, the Amazonian forest of Cusco in southern Peru is home to 12 species of the genus (Huamantupa-Chuquimaco et al. 2016).

Tachigali also presents several specimens collected and monitored in permanent tree plots (Baker et al. 2014), however when they are collected without flowers or fruits they are difficult to identify, for example in RAINFOR plots in Peru they can only be determined up to a just over 50% (Baker et al. 2017). Recently, emphasis has been given to studying species complexes within *Tachigali*. One of these is the informal group "setifera" group comprising three species: *T. amarumayu, T. prancei*, and *T. setifera*, which has the shared morphological characteristics of the linear petals with an apical tuft of tomentose hairs and the abaxial surface of the leaflets with radially grouped hairs forming circles (Huamantupa-Chuquimaco et al. 2019). The group is supported in a preliminary molecular analysis which also reveals several undescribed species (Huamantupa-Chuquimaco et al., unpubl. data).

Here we describe a new species of *Tachigali* related to the "setifera group" from the Amazon forests of Bolivia, Brazil, and Peru.

MATERIALS AND METHODS

We conducted fieldwork at a number of localities in 'terra firme' forest of the Amazon region of Bolivia, Brazil, and Peru. In addition, we examined specimens in the following herbaria: Bolivia (LPB, USZ), Brazil (CEN, IAN, MG, RB, RON, UB), Peru (AMAZ, CUZ, MOL, SUMPA, USM), and the USA (F, MO, NY), (acronyms according to Thiers et al. 2019).

The morphological terminology follows the specialized Leguminosae literature, including Polhill & Raven (1981), van der Werff (2008), and LPWG (2017). Indumentum terminology follows Font-Quer (1989), Beentje et al. (2001), and Schmid et al. (2002), complemented by Ellis et al. (2009), Payne (1978), and Theobald et al. (1979). The conservation status was assessed using GeoCat software (http://geocat.kew.org; Bachman et al. 2011), following IUCN (2019) criteria. The Amazon region was delimited using the proposal of Eva et al. (2005), And the species distribution map was prepared using ArcGIS 10.2 (ESRI 2013).

Tachigali inca Huamantupa, H.C. Lima & D. B.O.S. Cardoso, **sp. nov.** (Figures 1-3).

Type: Peru. Cusco: La Convención, Echarati, Bajo Urubamba, Comunidad nativa Camana. 11°59'16.39"S, 73°7'44.66"W, 466 m, 01 May. 2014 (fl.), *I. Huamantupa, W. Candia & J. Condori, 17675* (holotype, CUZ!; isotypes, USM!, MOL!, RB!).

Diagnosis

Tachigali inca differs from the most closely related species *T. amarumayu*, *T. prancei*, and *T. setifera* by having trunk fenestrate (vs. not in the others three), brown-orange pulverulent indumentum with some black dots, and in mature leaflets the indumentum having turned black on the abaxial surface of the leaflets (vs. the radially grouped hairs forming circles indumentum, on the abaxial surface of the leaflets), and the cylindrical, slightly ribbed laterally domatia immersed in the leaf rachis and on part of the petiole (vs. domatia absent).

Description

Tree to 40 m tall; trunk right fenestrate, slightly canaliculated, cortex red, with cream colored wood; buttress roots 50–90 cm long; twigs terete to sub-terete, smooth, slightly sulcate, glabrous or black pulverulence. *Stipules* foliose; 2(–3) lobate, persistent, but on old branches fugacious, petiole 4.0–8.0 mm long, blade oblong, ovate, obovate, or cordate, slightly revolute, major lobe 1.2–2.1 × 1.5–2.5 cm, minor lobe 0.7–1.5 × 0.6–1.8 cm, 3–6 pairs of veins, glabrous with brown–orange pulverulence. *Leaves* 18–32 cm (–48 cm, on juvenile specimens); petiole 4.5–11.0 cm long, terete, ribbed, puberulous and black punctate, with domatia; rachis 12.0–35.0 cm long, terete to semi-terete, canaliculate, with black appressed pilosule of minute hairs. *Domatia* 6.5–12.0 cm long, on young leaves 10.0–20.0 cm long, 0.5–1.5 cm diameter, cylindrical, slightly bulging in the central part, commonly laterally ribbed, placed from below the first basal pair of leaflets on the petiole then along the leaf rachis. *Leaflets* in 4–7 pairs; petiolules 4.0–10.5 mm long, terete, minutely to sparsely tomentulose; leaflet blade 6–31 × 8–11.5 cm, lanceolate, oblong-lanceolate, or elliptic; coriaceous; base symmetrical, slightly rounded to cuneate, apex 0.8–1.7 cm long, acuminate and caudate; margin entire; slightly undulate; adaxial surface glabrous, lustrous or scabrous on the central vein; abaxial surface brown-orange pulverulent, with sparse, stiff ferruginous hairs on the veins and some black gland dots on the mature leaflets; in old leaflets the pulverulence turns black, degrades and then breaks off; secondary veins in 8–15 (–21, in young

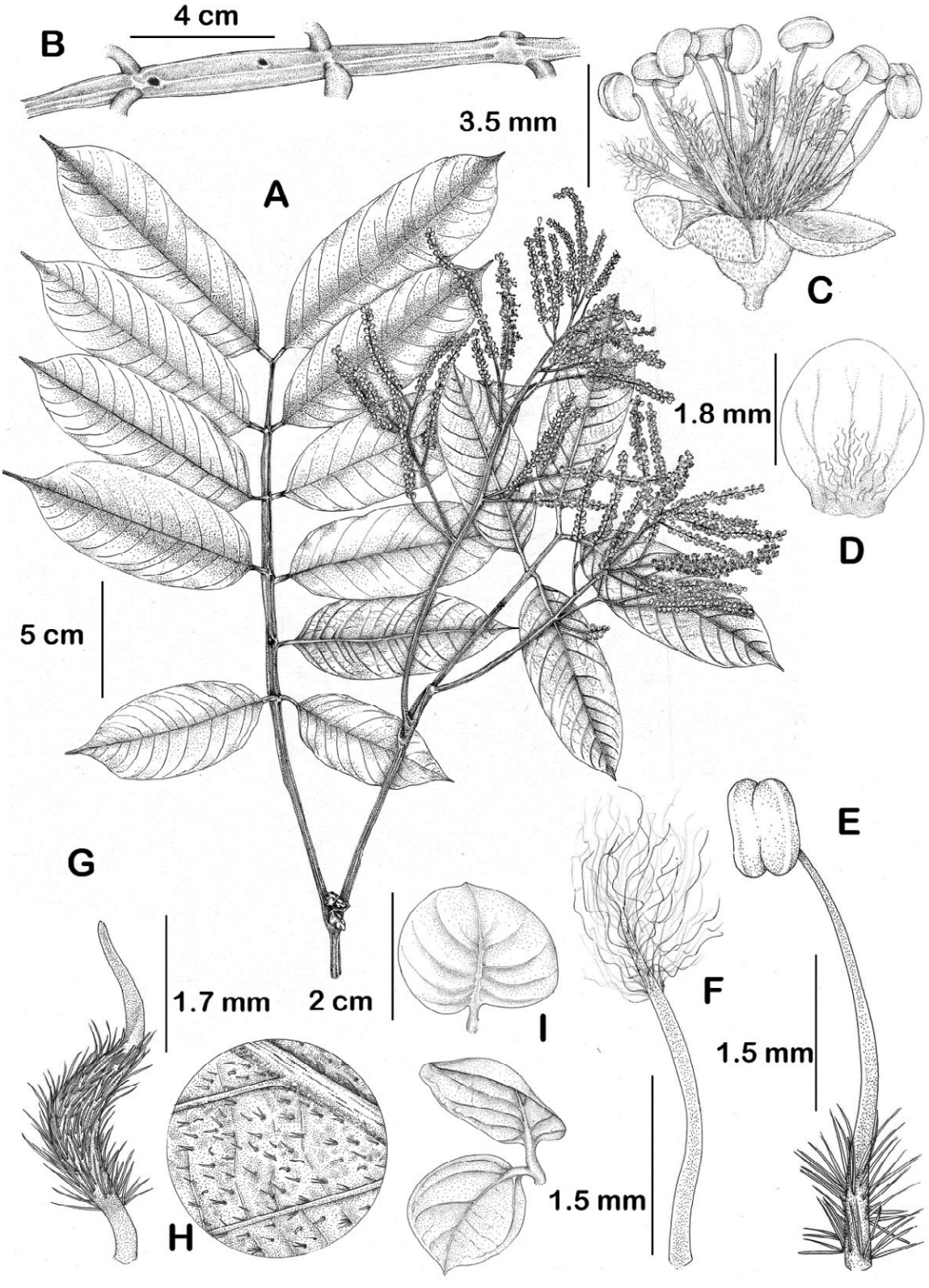

Figure 1. *Tachigali inca*, **A.** Flowering branchlet, **B.** Domatia on leaf rachis, **C.** Flower, **D.** Sepal (inner surface), **E.** Stamen, **F**. Petal, **G.** Gynoecium (ovary, style, stipe), **H.** Hairs on the abaxial surface of a leaflet, **I.** Foliose stipule (adaxial and abaxial surfaces). Line drawing by S. Sans from the specimen *Huamantupa et al. 17675*.

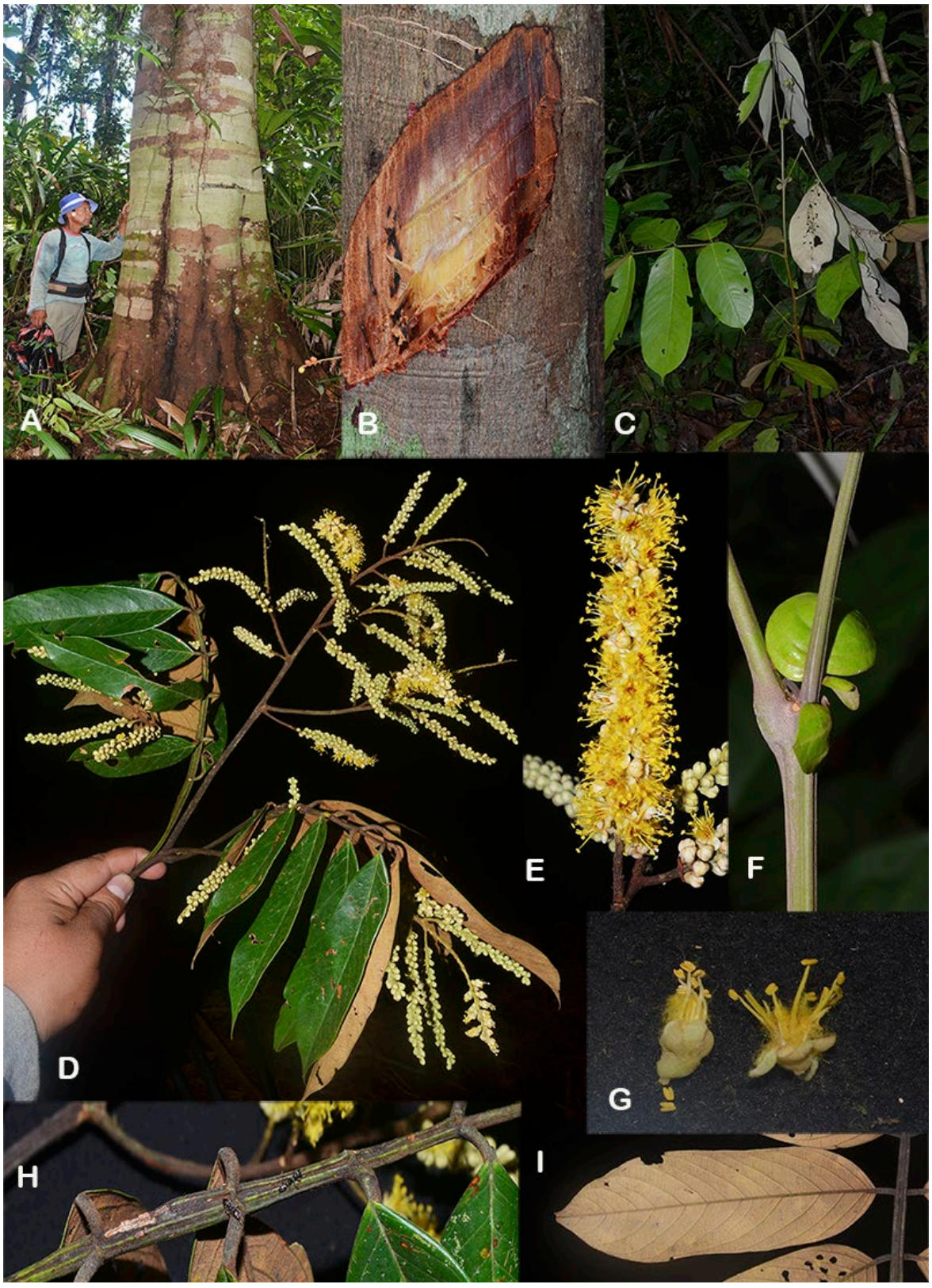

Figure 2. *Tachigali inca*, **A.** Trunk, **B.** Cortex, **C.** Seedling, **D.** Flowering branchlet**, E.** Part inflorescence, **F**. Stipule, **G.** Flowers, **H.** Domatia, **I.** Pulverulent indumentum on the under surface of a leaflet. Photographs by the first author based on the specimen *Huamantupa et al. 20310.*

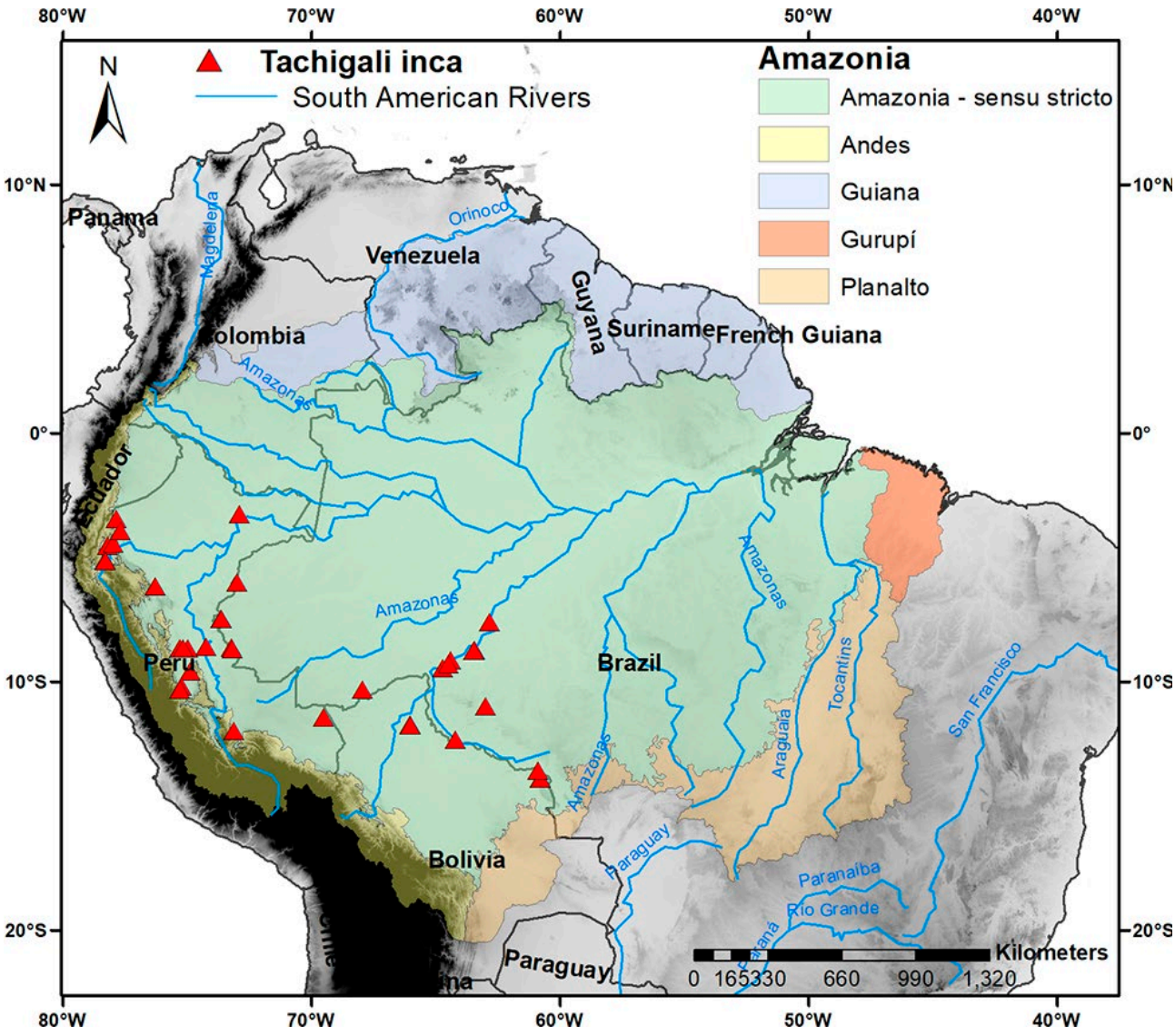

Figure 3. Distribution of *Tachigali inca* in terra firme forest of Amazonian region.

leaflets) pairs, impressed on the upper surface, conspicuous and arcuate; tertiary veins on the abaxial surface slightly conspicuous, scalariform; quaternary veins on the abaxial surface inconspicuous. *Inflorescence* panicle 18–28 cm long, main axis terete, ribbed, minutely brown-tomentulose; bracts not seen. *Flower* 6–7 mm long; buds densely white sericeous; sessile or pedicel up to 0.5 mm long; bracteoles 5.0–6.5 × 1.0–1.3 mm, subulate, sparsely tomentose, early caducous; hypanthium 1.7–2.0 × 1.6–1.9 mm, cupular, slightly symmetrical, densely white sericeous; sepals 2.3–2.7 × 1.8–2.4 mm, oblong or oblong–elliptic, inner surface sparsely tomentose with yellow hairs (0.5–0.8 mm long), more dense in the middle, outer surface densely white villose, margin ciliate; petals 2.9–3.2 × 0.2–0.3 mm yellow-orange, linear, glabrous from the base to the middle and the upper half densely tomentose forming tufts (hairs 2–2.5 mm long); stamens 10, monomorphic, filaments slightly variable, 4.0–5.0 mm long, densely tomentose with stiff brown hairs from the base to the middle; anthers 1.0–1.3 × 0.6–0.8 mm, elliptic, glabrous; ovary 1.8–2.0 × 1.0–1.4 mm, oblong, slightly gibbous, sparsely pubescent, with stiff red-brown hairs; stipe 1.0–1.5 mm long, attached in middle of hypanthium; style 1.5–1.8 mm long, glabrous, sigmoid; stigma apiculate. *Fruit* 5.0–7.5 × 1.8–2.5 cm, crypto-samara, ellipsoid, exocarp black, glabrous. *Seeds* 1–2 per fruit.

Etymology

The epithet "inca" is named in honor to the Inca culture, who inhabited a large part of the Amazon at the base of the eastern Andes and part of central-southern Amazon, in which *Tachigali inca* is distributed.

Distribution and ecology

Tachigali inca is well distributed in Amazonian terra firme forest region, especially along the Andean foothills of Peru at a maximum of 700 meters elevation, and part of central-southern Amazon, into the north-west of Bolivia, and extending to the low Amazon of western Brazil in the states of Acre, Amazonas, Mato grosso and Rondônia (Fig. 3). *Tachigali inca* inhabits forests associated with clay soils and white sands.

Phenology

Collected in flower from January to May, in fruit from May to November. During flowering the entire tree crown is yellow and attracts many pollinators, including bees and butterflies.

Conservation status

Based on the extent of occurrence estimated at 1,024,042.723 km^2, the Conservation status of *T. inca* is provisionally assessed as being of Least Concern (LC). However, in some areas such as central Amazonian of Peru, the white sand forests where it lives are threatened by the oil palm crops that are being implemented in recent years.

Common names and uses

Tachigali inca species are known in Brazil as 'tachi' or 'taxi' (meaning ant), as mentioned on the field label of *Campbell 6419* collection. In Peru, common names of *T. inca* include 'tangarana', and 'palisanto' (*Gutierrez 43*) and 'ucshaquiro colorado' (*Begazo 111*). These three names refer to the presence of ants with strong formic acid that live in the domatias. The hard wood and straight trunk is ideal for local construction timber (Huamantupa-Chuquimaco et al. 2016).

Remarks

Tachigali inca differs from other species in the "setifera group" (*T. amarumayu*, *T. prancei* and *T. setifera*), mainly by its trunk being irregularly fenestrate; the abaxial surface of leaflets with a brown-orange pulverulent indumentum, which on old leaflets gradually degrades and detaches until the surface becomes a dark color (this characteristic has not been seen in any other species of the genus); and the cylindrical, slightly ribbed domatia immersed in the leaf rachis and on part of petiole (Fig. 2, Table 1), a type of domatia that is unknown in all other species of *Tachigali*. The other three species of the "setifera group" do not have a fenestrate trunk, their leaflets abaxial surfaces have sparsely or densely radiate clusters of hairs, with some additional free ferruginous hairs on the veins, and they all lack domatia. *Tachigali amarumayu* also has leaflets in 5–11 (often 8) pairs, and secondary veins on each leaflet in 11–23 pairs (Huamantupa-Chuquimaco et al. 2019). *Tachigali prancei* shares stamens and petals of a similar type with *T. inca* (table 1). Additional comparison between the four species is presented in Table 1.

Previously van der Werff (2008) considered some specimens of *T. inca* to belong within *T. setifera* sensu lato, by the similar leaflets shape and petals indumentum. Historically, other taxonomists have treated the majority of the specimens of *T. inca* as either *T. amarumayu, T. setifera* or *T. vasquezii* (Baker et al. 2017).

In a recent phylogenetic analysis, the "setifera group" is supported as distinct from all other *Tachigali* species and is geographically associated with species from the Amazon region of the eastern Andean foothills (Huamantupa-Chuquimaco et al., unpubl. data).

Additional Specimens Examined

BOLIVIA: Beni: Vaca Diez, *B. K. Boom 4431* (LPB, NY), *B. M. Boom 4393* (MO), *B. M. Boom 4394* (MO). Santa Cruz: Velasco, *P. L. Arroyo 644* (MO, USZ), *P. L. Arroyo 672* (MO, USZ), *C. A. F. Fuentes 1698* (USZ), *A. Soto 519* (MO, USZ); **BRAZIL**: Acre: Mâncio Lima, *D. G. Campbell 6419* (MO), *D. G. Campbell 8283* (MO), *D. G. Campbell 8312* (BR, NY), *D. G. Campbell 8346* (MO), *D. G. Campbell 8369* (MO), *D. G. Campbell 8370* (MO), *D. G. Campbell 8376* (MO), *D. G. Campbell 8450* (MO), *C. A. Ferreira 8736* (HUFAC, MO, NY). Amazonas: *B. Rosa 44-85* (MO); Novo Aripuanã, *C. A. Cid Ferreira 5925* (INPA, MG, NY, RB). Mato Grosso: Aripuanã, *N. A. Rosa 2074* (F, NY, RB). Rondônia: Porto Velho, *M.R. Cordeiro 620* (IAN, MG, MO, NY), *G. T. Prance 6435* (NY); Costa Marques, Porto Velho, *C. A. Cid Ferreira 7453* (MO, NY), *M. F. Simon 1422* (CEN, IAN, INPA, NY, RB, RON), *M. F. Simon et al. 1275* (CEN, IAN, RB, RON); Vilhena, *J.U.M. dos Santos 765* (MG); **PERU**: Amazonas: Bagua, *S. C. Díaz 8326* (AMAZ), *S. C. Díaz 8430* (MO); Condorcanqui, *A. E. Ancuash, 275* (MO), *V. Huashikat 514* (MO), *V. Huashikat 654* (MO), *G. R. P. Rojas 97* (MO). Loreto: Maynas, *A. H. Gentry 18691* (AMAZ, MO), *R. C. Grández 2997* (MO). Cusco: Paucartambo, Kosñipata, Chontachaca, *I. Huamantupa 23120* (CUZ). Madre de Dios: *C. J. Ruiz 27* (MO, MOL). Pasco: Oxapampa, *R. B. Foster 7985* (MO), *A. H. Gentry 41578*

Table 1. Characters separating *Tachigali inca* from the morphologically related *T. amarumayu, T. prancei*, and *T. setifera.*

Character	*Tachigali inca*	*Tachigali amarumayu*	*Tachigali prancei*	*Tachigali setifera*
Leaflet number (pairs)	(2–) 4–7	5–11	6–8	5–7
Indumentum type on lower surface of the leaflets	sparsely stiff ferrugineous hairs on the veins, some black gland dots, and with brown-orange pulverulence.	radially grouped hairs forming circles, without pulverulence	radially grouped hairs forming circles, without pulverulence	radially grouped hairs forming circles, without pulverulence
Leaflet base	equilateral, slightly rounded, or cuneate	equilateral, rounded, acute, or subcordate	inequilateral, rounded, to sub-cordate	equilateral, acute
Tertiary vein prominence abaxially	inconspicuously raised	conspicuously raised	conspicuously raised	inconspicuously raised
Quaternary vein prominence abaxially	inconspicuous	conspicuously raised	conspicuously raised	inconspicuously raised
Stipules	foliose, slightly revolute, persistent, on old branches caducous, 2– (3) lobed	foliose, regularly revolute, persistent	foliose, caducous on old branches	foliose, revolute, persistent
Domatia in the leaf rachis and petiole	cylindrical, slightly ribbed laterally, immersed in the rachis and part of petiole.	absent	absent	absent
Pedicel length	sessile–0.5 mm	sessile–0.5 mm	0.5–2.0 mm	0.5–1.0 mm
Petal indumentum	glabrous from base to middle and densely yellow tomentose in tufts on the upper half	sparse except for a tuft of cream–colored flexuous hairs at the apex	sparse except for a tuft of cream–colored flexuous hairs at the apex	dense, yellow
Length of the hairs on the petals	1.5–2.0 mm	ca. 0.8–1.1 mm	ca. 0.7–0.9 mm	ca. 0.6–0.7 mm

(MO). San Martín: Lamas, *I. Huamantupa et al. 20253* (CUZ, SUMPA), *I. Huamantupa et al. 20310* (CUZ). Ucayali: *G. S. Hartshorn 1739* (MO), *S. L Wherrem 81* (MO); Coronel Portillo, *Aquino 2* (MO), *N. Begazo 111* (MO), *N. Begazo 129* (MO), *A. H. Gentry 29425* (MO).

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