

Two New Species of *Chusquea* subg. *Magnifoliae* (Poaceae, Bambusoideae, Chusqueinae) from Peru

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Abstract—The present paper describes and illustrates two new species of *Chusquea* subg. *Magnifoliae* in Peru, *C. longipedicellata* and *C. rugoloana*. Keys for the identification of species, based on vegetative and reproductive characters, as well as a comparative table with morphological diagnostic features are included. Additional micromorphological characters of the spikelets and leaves are considered, and a complete description of foliar anatomy is presented. Also, some remarks about the characteristics of the phytogeographical regions and the ecology of these new species are provided.

Keywords—Anatomy, Bambuseae, Central Andes, morphology, taxonomy.

Resumen—El presente trabajo describe e ilustra dos nuevas especies de *Chusquea* subg. *Magnifoliae* en Perú, *C. longipedicellata* y *C. rugoloana*. Se incluyen claves para la identificación de las especies, basadas en caracteres vegetativos y reproductivos, y una tabla comparativa con los caracteres morfológicos diagnósticos. Se incluyen caracteres micromorfológicos adicionales de las espiguillas y hojas y se presenta una descripción completa de la anatomía foliar. Se incorporan observaciones acerca de las características de las regiones fitogeográficas y la ecología de las nuevas especies.

The subtribe *Chusqueinae* Soderstr. & R.P. Ellis is a monophyletic group, endemic to America, previously composed of the genera *Neurolepis* Meisn. and *Chusquea* Kunth (Judziewicz and Clark 2007; Fisher et al. 2009, 2014). According to recent molecular-based phylogenetic studies, *Neurolepis* resolved as paraphyletic to *Chusquea* and all the species were transferred to *Chusquea* (Fisher et al. 2009, 2014; León et al. 2010; Dorr 2012). As presently circumscribed the genus *Chusquea*, in a wide sense, is composed of 172 species classified into 5 subgenera: *Chusquea*, *Magnifoliae* L.G. Clark & Fisher, *Platonia* Nees, *Rettbergia* (Raddi) L.G. Clark and *Swallenochloa* (McClure) L.G. Clark (Fisher et al. 2009, 2014; Clark et al. 2015).

In Peru, 23 species of *Chusquea* have been cited (Tovar 1993; Brako and Zarucchi 1993; Clark 2000; Guerreiro et al. 2014). With regard to subg. *Platonia* and subg. *Magnifoliae*, Hitchcock (1927) cited a single species for Peru, *C. tovarii* L.G. Clark (as *Neurolepis weberbaueri* Pilg.; the specific epithet was corrected to *C. tovarii* by Vorontsova et al. 2016) and Macbride (1936) reported *C. tovarii* and *C. stuebelii* (Pilg.) L.G. Clark [under *N. weberbaueri* and *N. stuebelii* (Pilg.) Pilg., respectively]. Tovar (1993) and Brako and Zarucchi (1993) only cited *C. aristata* Munro [= *N. aristata* (Munro) Hitchc.] since, according to Soderstrom (1969), they considered *N. weberbaueri* and *N. stuebelii* as synonyms of *N. aristata*. Clark (2000) reported for Peru *C. aristata*, *C. tovarii*, *C. stuebelii*, and also included *C. fimbriatigulata* (L.G. Clark) L.G. Clark subsp. *peruviana* (L.G. Clark) L.G. Clark ex B. León & J. Roque. Recent studies also cited *C. asymmetrica* (L.G. Clark) L.G. Clark as a new report from Peru (Guerreiro et al. 2014).

The present paper reports taxonomic novelties in *Chusquea* subg. *Magnifoliae*, describing and illustrating two new species from Peru: *C. longipedicellata* and *C. rugoloana*. Considering the long periods of vegetative growth exhibited by most bamboo species and the frequent collection of sterile herbarium specimens, anatomical and micromorphological characters are also described and may be considered as an additional tool for the

identification of the species. Morphological diagnostic characters are selected and compared among species, and keys for the identification of taxa are also provided. Some remarks about the characteristics of the phytogeographical regions and the ecology of the new species are also included.

MATERIALS AND METHODS

Morphology—Studies are based primarily on herbarium material deposited at AAU, F, SI, US, and USM (acronyms after Thiers 2016). Morphological terminology follows Clark (1989) and Rùgolo and Vega (2016).

Anatomical Studies—Segments of the middle portion of the penultimate foliage leaf blade of a fertile innovation were selected from herbarium material. To obtain foliage leaf blade transverse sections, the herbarium samples were previously hydrated, then dehydrated in alcohol series and embedded in paraffin following traditional anatomical techniques. Sections 20 µm thick were cut with a rotary microtome and stained with safranin-Fast Green (D'Ambrogio de Argüeso 1986). The preparations were observed and photographed with a light microscope Nikon Microphot FXA (Tochigi, Japan) at the Instituto de Botánica Darwinion (San Isidro, Argentina). Descriptions follow current terminology (Ellis 1976; Guerreiro et al. 2013).

Micromorphological Studies—Segments of the middle portion of the penultimate foliage leaf blade of a fertile innovation were selected from herbarium material and cleaned in xylene for 1 hr with an ultrasonic cleaner (Cleanson, model CS 1106, Argentina). Also, spikelets of one of the new species were selected for micromorphological studies. The material was air-dried, mounted, and coated with a gold-palladium (40–60%) alloy by a Thermo VGScientific (West Sussex, U. K.) and then observed using a Phillips XL 30 Scanning Electron Microscope (Eindhoven, The Netherlands) at the Museo Bernardino Rivadavia (Buenos Aires, Argentina). Descriptions follow the terminology proposed by Ellis (1979) and Guerreiro et al. (2013).

TAXONOMIC TREATMENT

Chusquea longipedicellata Alegría & Guerreiro, sp. nov.—
TYPE: PERU. Amazonas: Condorcanqui, Cordillera del Cóndor, la cima del “tepui” Cerro Machinaza, cabeceras del río Comainas, tributario al oeste del río Cenepa, arriba del Puesto de Vigilancia Alfonso Ugarte (PV3), 2,150 m,

3°52.7'S, 78°25.8'W, 21 Jul 1994, fl., H. Beltrán & R. Foster 1162 (holotype: USM!).

Chusquea longipedicellata is distinguished by its short pseudopetiole 4–5 mm long, glabrous leaf sheath with summit

extensions 3–4 mm long, glabrous foliage leaf blade, inner ligule 5–8 mm long, inflorescence open, pedicels 1.5–3 cm long, spikelets 6–7.3 mm long, glumes I and II unequal, 1–3-nerved, glume I 2-keeled, and a well developed internode between the glumes II and III with a glabrous callus.

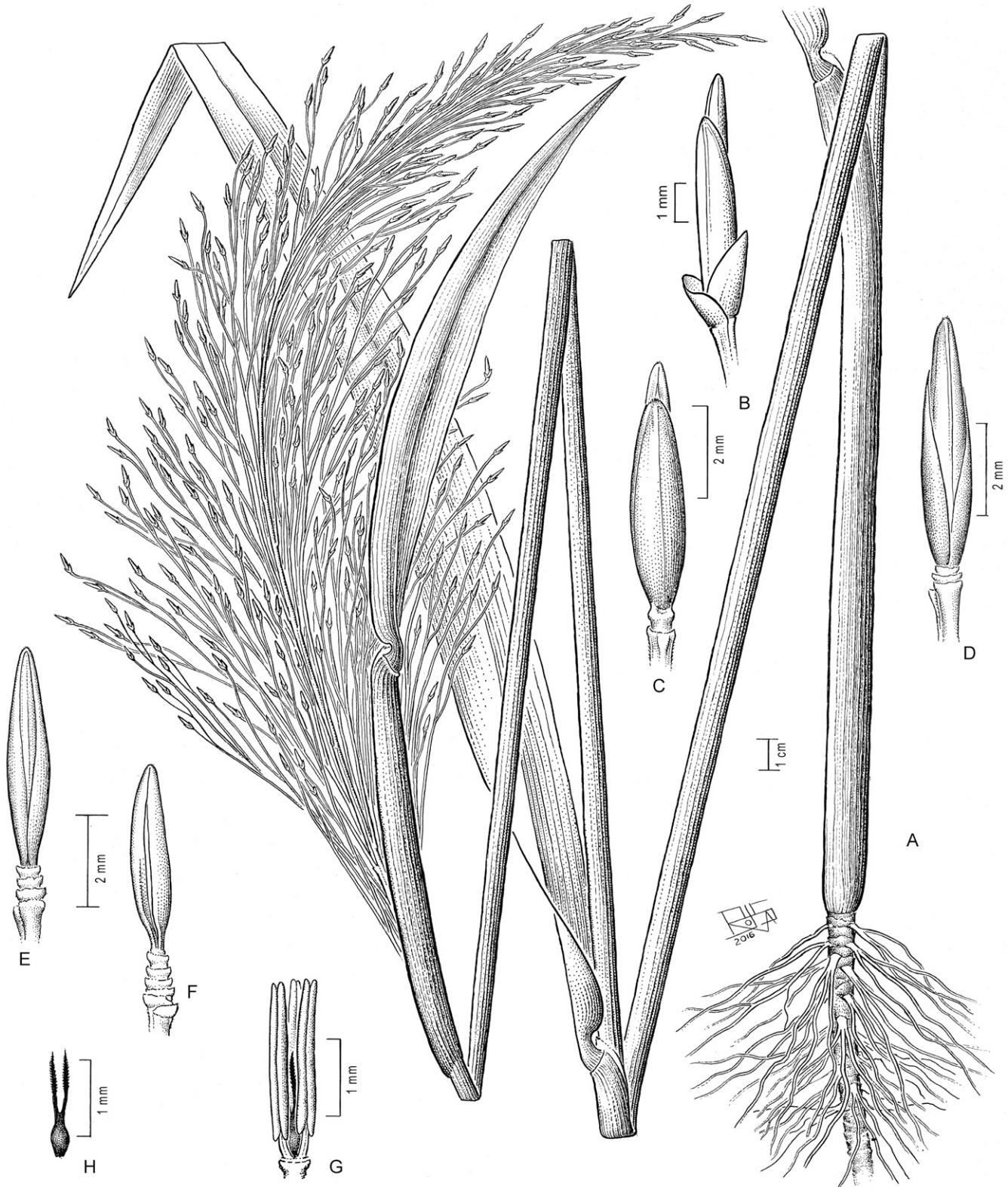


FIG. 1. *Chusquea longipedicellata*. A. Habit. B. Spikelet. C. Glume III, dorsal view. D. Glume III, ventral view, and glume IV, dorsal view. E. Fertile floret, ventral view. F. Palea, ventral view. G. Androecium and gynoecium. H. Gynoecium. (A–E from Beltrán 1162).

Plants 2–3 m tall. Culm ca. 9 mm diam, unbranched, erect; nodes not visible. Culm leaf completely lacerated, with fibrous remains at the base of the plant. Foliage leaf with sheath persistent, striate, glabrous, with summit extensions 3–4 mm long; inner ligule 5–8 mm long, membranous, ciliolate, rounded; outer ligule a depressed rim; pseudopetiole 4–5 mm long, glabrous; blade ca. 41×2 –2.4 cm, L:W = 17–21, linear-lanceolate, apex acuminate, adaxially not tessellate, abaxially tessellate, the midrib slightly eccentric, abaxially visible along the lower third, glabrous on both surfaces, margins scabrous. Inflorescence 44–80 \times 3–10 cm, panicle, open, lax, spreading, terminal, purpureous at maturity; rachis deeply sulcate longitudinally on the side of the branches, glabrous; primary branches numerous, the basalmost ones up to ca. 30 cm long, basally adaxially pulvinate with a glabrous pulvinus, solitary, repeatedly rebranched; pedicels 1.5–3 cm long, much longer than the spikelets, slender, glabrous, apex cup-shaped, up to 0.8 mm wide. Spikelets 6–7.3 \times 1.2–1.4 mm, terete, disarticulating between the glumes II and III. Glumes I and II unequal in length, apex obtuse or 2-dentate, 1–3-nerved, coriaceous, stramineous, glabrous; glume I 1–2.4 mm long, (1–)2-keeled; glume II 2.1–3.5 mm long, wider at the base, convex to 1–2-keeled; conspicuous internode between glumes II and III 0.3–0.5 mm long, glabrous; glumes III and IV coriaceous, stramineous, purplish at the summit, apex navicular, glabrous abaxially, scabrous adaxially but puberulous toward the apex; glume III 4.5–5.5 mm long, oblong-lanceolate, apex obtuse, 3–5-nerved; glume IV 5.7–6.7 mm long, lanceolate, apex acute or obtuse, 3-nerved. Lemma 4.1–5.4 mm long, shorter than the glume IV and completely enclosed by it, oblong-lanceolate, apex obtuse, 3–4-nerved, coriaceous, membranous to the base, stramineous, glabrous abaxially but scaberulous towards the base (on the membranous part), glabrous adaxially but puberulous at the tip. Palea 4–5 mm long, boat-shaped, apex obtuse, 2–4-nerved (when 3- or 4-nerved, with incomplete nerves between the 2 main nerves), nonsulcate, coriaceous, membranous to the base, glabrous. Lodicules 3, flattened, the 2 anterior ones 0.7–0.8 \times 0.5–0.6 mm, ovate to widely ovate,

apex acute or shortly acuminate, multinerved, the posterior one ca. 0.5 \times 0.3 mm, narrowly ovate, apex acute or obtuse. Stamens 3, anthers 2–3.1 mm long. Gynoecium 1.7–2 mm long, ovary 0.4–0.5 mm long, glabrous, styles 2, stigmas plumose. Caryopsis not seen. Figures 1–2.

Etymology—The epithet refers to the long-pedicelled spikelets.

Geographical Distribution and Ecology—Cordillera del Cóndor in northern Peru, near the border with Ecuador. It was collected on sandstone plateau (“tepu”) with a humus layer at 2,150 m. It was found along with sclerophyllous shrubs up to 5 m high and rosette herbs mixed with suffrutescent herbs.

Anatomy—Foliage leaf blade cross section: Outer walls thickened and covered by a distinct, thick cuticle continuous over the epidermal cells. Adaxial, rounded, obtuse ribs situated over the vascular bundles and medium furrows between all vascular bundles. Abaxial surface smooth or with few undulations between vascular bundles. One to three second order bundles between consecutive first order bundles, all of them situated in the centre of the blade. Well-developed adaxial and abaxial sclerenchyma girders, in contact with the bundle sheath and epidermis, narrower than or as wide as the vascular bundles. Conspicuous, elongated, narrow intercellular spaces on each side of all vascular bundles, separated by numerous chlorenchyma cells [sometimes referred to as “fusoid cells” (Vega et al. 2016)]. Fan-shaped bulliform cells located at the base of furrows (Fig. 3).

Micromorphology—Foliage leaf blade abaxial epidermis: Inflated long cells with wavy walls with no papillae. Rounded, ovoid stomatal complex 20–23 \times 11–14 μ m, arranged in three rows of stomata in each intercostal zone adjacent to one another; low dome-shaped subsidiary cells with compound papillae. Dumbbell shaped silica bodies with narrow central portion and rounded ends, arranged in rows alternating with long cells, more abundant near the margins. Prickle hairs present only on blade margins. Scarce bicellular microhairs in intercostal zones, basal cell markedly elongated (Fig. 4).

Observations—This species closely resembles *C. spectabilis* L.G. Clark, but *C. longipedicellata* differs from it in the shorter

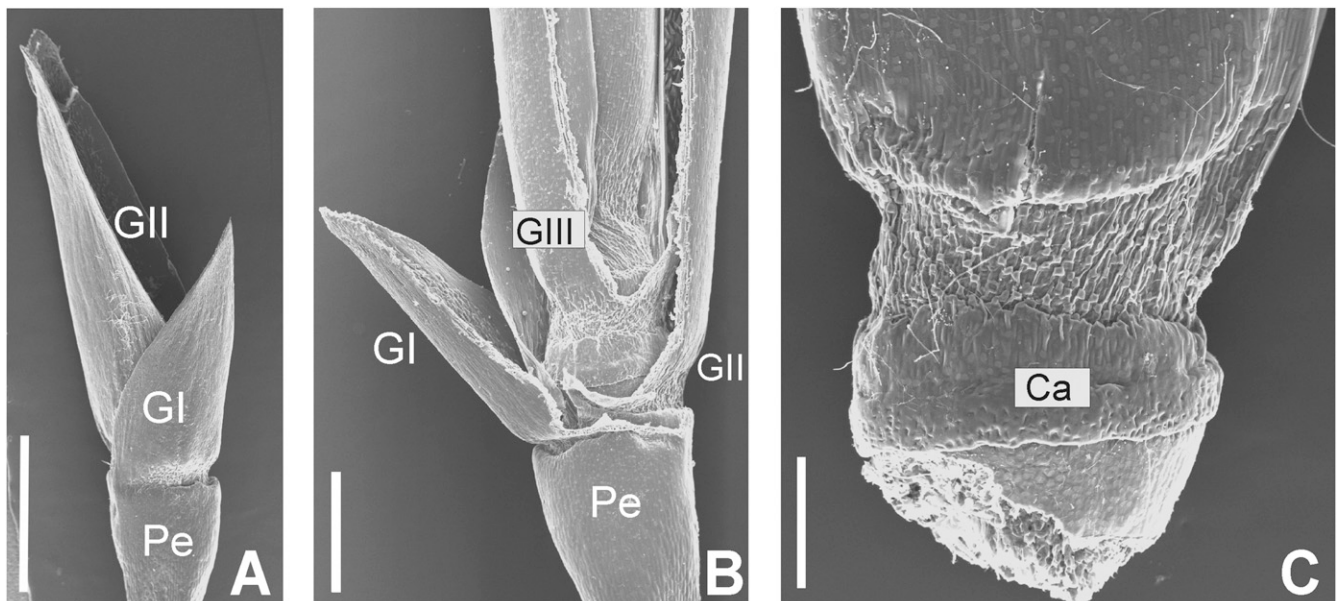


FIG. 2. SEM micrographs of *Chusquea longipedicellata* spikelets. A. Pedicel and glumes I and II. B. Pedicel, glumes I, II, and III. C. Detail of glabrous callus. Ca = callus, GI = glume I, GII = glume II, GIII = glume III, Pe = pedicel. Scale bars: A = 1,000 μ m; B = 500 μ m; C = 200 μ m (from Beltrán 1162).

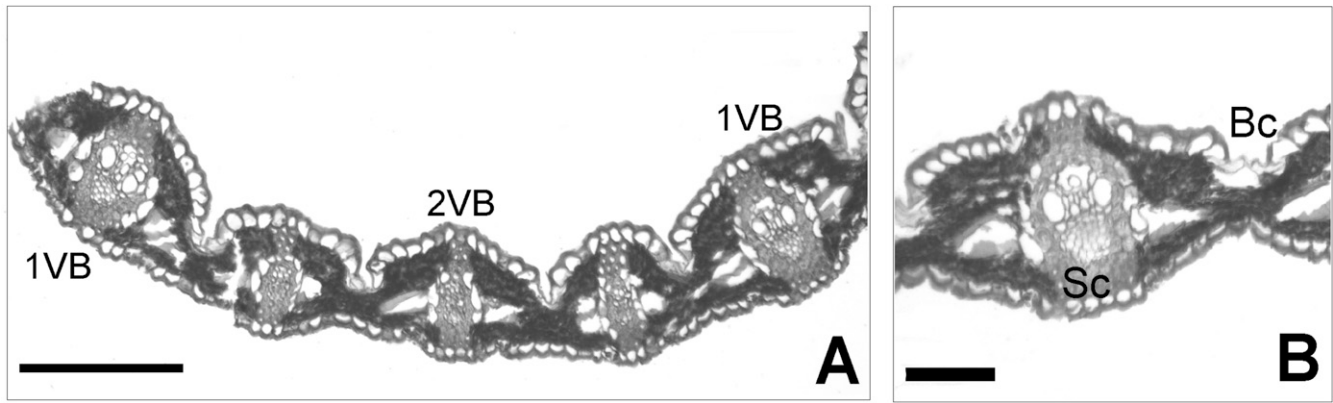


FIG. 3. Foliar anatomical characters in cross section of *Chusquea longipedicellata*. A. General view. B. Detail of first order vascular bundle. 1VB = first order vascular bundle, 2VB = second order vascular bundle, Bc = bulliform cells, Sc = sclerenchyma girder. Scale bars: A = 500 μ m; B = 200 μ m (from Beltrán 1162).

pseudopetiole, the much shorter summit extensions of the foliage leaf sheath, shorter inner ligule, the abaxially glabrous leaf blade, the unequal, 1–3-nerved, longer glumes I and II, the (1–)2-keeled glume I, the longer glumes III and IV, the 2–4-nerved palea, and the shorter anthers (Table 1).

Presently, only three species of *C.* subg. *Magnifoliae* have spikelets bearing long pedicels and a conspicuous internode between the glumes II and III: *C. silverstonei* (Davidse & L.G. Clark) L.G. Clark, *C. spectabilis* and *C. petiolata* (Davidse & L.G. Clark) L.G. Clark. *Chusquea longipedicellata* and these species can be differentiated by the following key:

1. Spikelets with a pilose callus between glumes II and III; callus hairs 0.5–1 mm long. Glumes I and II reduced, ca. 1/10 the length of the spikelet; glume I 0.3–0.6(–1.6) mm long; glume II 0.9–1.7 mm long *C. petiolata*
1. Spikelets with a glabrous callus between glumes II and III. Glumes I and II 1/10–1/2 the spikelet length; glume I 0.9–2.4 mm long; glume II 1–3.5 mm long 2
2. Spikelets 9–10.4 mm long. Glumes I and II unequal; glume I 0.9–1.6 mm long; glume II 1.7–2.5 mm long; glumes III and IV acuminate; glume III 6.1–8.1 mm long; glume IV 7.6–9.8 mm long. Lemma with acuminate apex. Panicle 25–55 cm long. *C. silverstonei*
2. Spikelets 5–7.3 mm long. Glumes I and II unequal or equal; glumes III and IV obtuse; glume III 3.5–5.5 mm long; glume IV 4.5–6.7 mm long. Lemma with obtuse or acute apex. Panicle 40–175 cm long 3
3. Foliage leaf blade pubescent abaxially; pseudopetiole (1–)7–22 cm long; sheath summit extensions 25–50 mm long; inner ligule 20–60 mm long. Glumes I and II equal, 1–1.5 mm long, enerved; glume III ca. 3.5 mm long; glume IV ca. 4.5 mm. Anthers 4–5 mm. *C. spectabilis*
3. Foliage leaf blade glabrous; pseudopetiole 0.4–0.5 cm long; sheath summit extensions 3–4 mm long; inner ligule 5–8 mm long. Glumes I and II unequal, 1–3-nerved; glume I 1–2.4 mm long; glume II 2.1–3.5 mm long; glume III 4.5–5.5 mm long; glume IV 5.7–6.7 mm long. Anthers 2–3.1 mm long *C. longipedicellata*

Chusquea rugoloana Alegría & A. S. Vega, sp. nov.—TYPE: PERU. Amazonas: Condorcanqui, Cordillera del Cóndor, la cima del “tepuí” Cerro Machinaza, cabeceras

del río Comainas, tributario al oeste del río Cenepa, arriba del Puesto de Vigilancia Alfonso Ugarte (PV3), 2,160 m, 3°52.7'S, 78°25.8'W, 31 Jul 1994, fl., H. Beltrán &

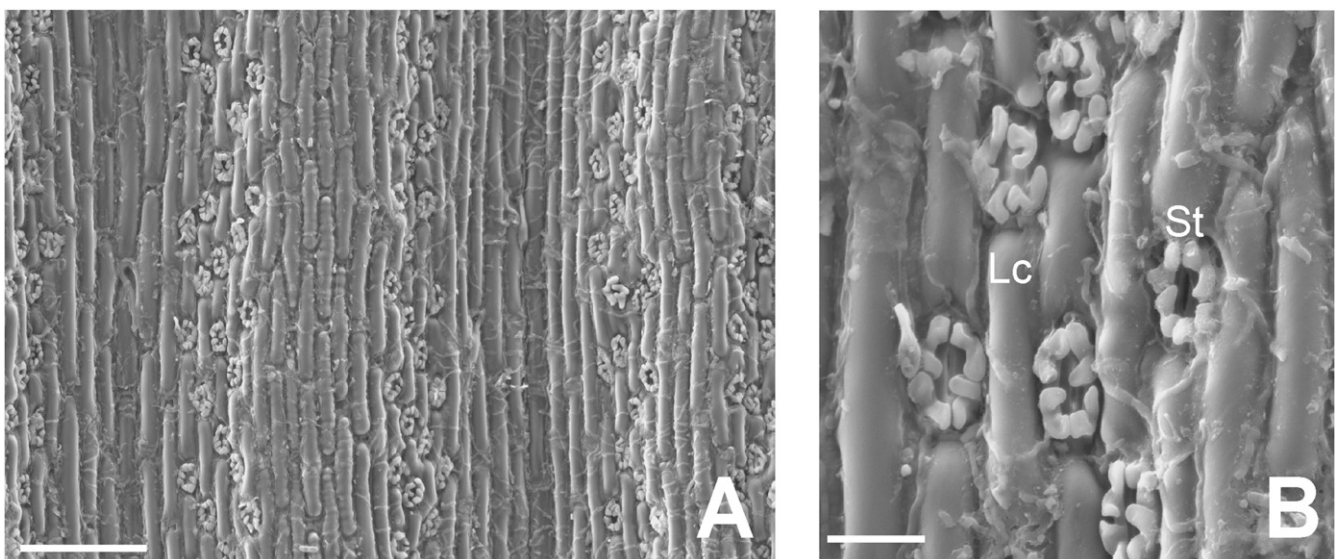


FIG. 4. Micromorphological characters of *Chusquea longipedicellata* abaxial epidermis. A. General view. B. Detail of stomatal complexes. Lc = long cells, St = stomata. Scale bars: A = 100 μ m; B = 20 μ m (from Beltrán 1162).

TABLE 1. Comparative table among *Chusquea longipetiolata* and similar species.

Characters	<i>C. petiolata</i>	<i>C. sibirsonneti</i>	<i>C. spectabilis</i>	<i>C. longipetiolata</i>
Plant height (m)	1-4	1-2	5-6	2-3
Leaf sheath, indumentum	Glabrous	Glabrous	Pubescent	Glabrous
Blade, length x width (cm)	67-93 x 7-11	30-44 x 1.2-2.2	45-76 x ca. 2.5	ca. 41 x 2-2.4
Blade, indumentum	Glabrous	Glabrous with a few hispid hairs along the margin near the base	Pubescent abaxially	Glabrous
Midrib position	Slightly eccentric	Eccentric	Slightly eccentric	Slightly eccentric
Pseudopetiole, length (cm)	21-46	3-5	(1-7)-22	0.4-0.5
Inner ligule, length (mm)	40-120	16-25	20-60	5-8
Fimbriae, length (mm)	-	8-12	-	-
Outer ligule, length (mm)	2-4	Not differentiated	A membranous margin	A depressed rim
Inflorescence, length (cm)	80-160	25-55	40-175	44-80
Spikelet, length (mm)	8-9.8	9-10.4	5-7.2(-8)	6-7.3
Glume I, length (mm)	0.3-0.6(-1.6)	0.9-1.6	1-1.5	1-2.4
Glume I, apex	Obtuse to emarginate or irregularly wavy	Obtuse	Obtuse	Obtuse or 2-dentate, (1-2)-keeled
Glume II, number of nerves	Energved	Energved	Energved	1-3-nerved
Glume II, length (mm)	0.9-1.7	1.7-2.5	1-1.5	2.1-3.5
Glume II, apex	Obtuse to emarginate or irregularly wavy	Obtuse	Obtuse	Obtuse or 2-dentate, convex to 1-2-keeled
Glume III, number of nerves	Energved	Energved	Energved	1-3-nerved
Callus, indumentum	Pilose	Glabrous	Glabrous	Glabrous
Glume III and IV, indumentum distribution	Restricted toward the tips	Restricted toward the tips	Well distributed	Restricted toward the tips
Glume III, length (mm)	4-6	6.1-8.1	ca. 3.5	4.5-5.5
Glume III, apex	Acute	Acuminate	Obtuse	Obtuse
Glume III, number of nerves	3-5-nerved	3-4-nerved	3-nerved	3-5-nerved
Glume IV, length (mm)	6-7	7.6-9.8	ca. 4.5	5.7-6.7
Glume IV, apex	Slightly boat-shaped	Acuminate	Obtuse	Acute or obtuse
Glume IV, number of nerves	5-nerved	3-5-nerved	3-nerved	3-nerved
Lemma, length (mm)	7-9	8-10	6-7	4.1-5.4
Lemma, apex	Acuminate, ending in an awn 0.6 mm long	Acuminately boat-shaped	Acute	Obtuse
Lemma, number of nerves	5-7-nerved	3-5-nerved	3-nerved	3-4-nerved
Palea, length (mm)	6-7	7-9	5-6	4-5
Palea, number of nerves	4-nerved	2-3-nerved	2-nerved	2-4-nerved
Anthers, length (mm)	5.1-5.2	3.5-5	4-5	2-3.1
Geographic distribution	Colombia	Colombia	Colombia, Ecuador, and Venezuela	Peru (probable in Ecuador)
Elevation (m)	2,060-2,400	2,730-2,800	1,900-3,600	ca. 2,150
Habitat	Riverbanks in montane forests	Very humid open communities on the summits of the peaks and cloud forests	Upper montane and cloud forests and paramo vegetation	Sandstone plateaus ("tepuy") in montane forests

R. Foster 1502 (holotype: USM!; isotype: F-2178664 photo SI!).

Chusquea rugoloana is distinguished by its long pseudopetiole, up to 24 cm long, inner ligule bearing disintegrating fimbriae up to ca. 2 cm long, linear-oblong inflorescence

with short (up to 2 cm long), stiff, ascending to spreading, densely-flowered primary branches, pulvinate branches and pedicels, congested spikelets 4.5–5.6 mm long, glumes I and II unequal, $\frac{1}{3}$ – $\frac{1}{2}$ the length of the spikelet, 1-nerved, awned (the awn 0.8–1.4 mm long), awned glumes III and IV

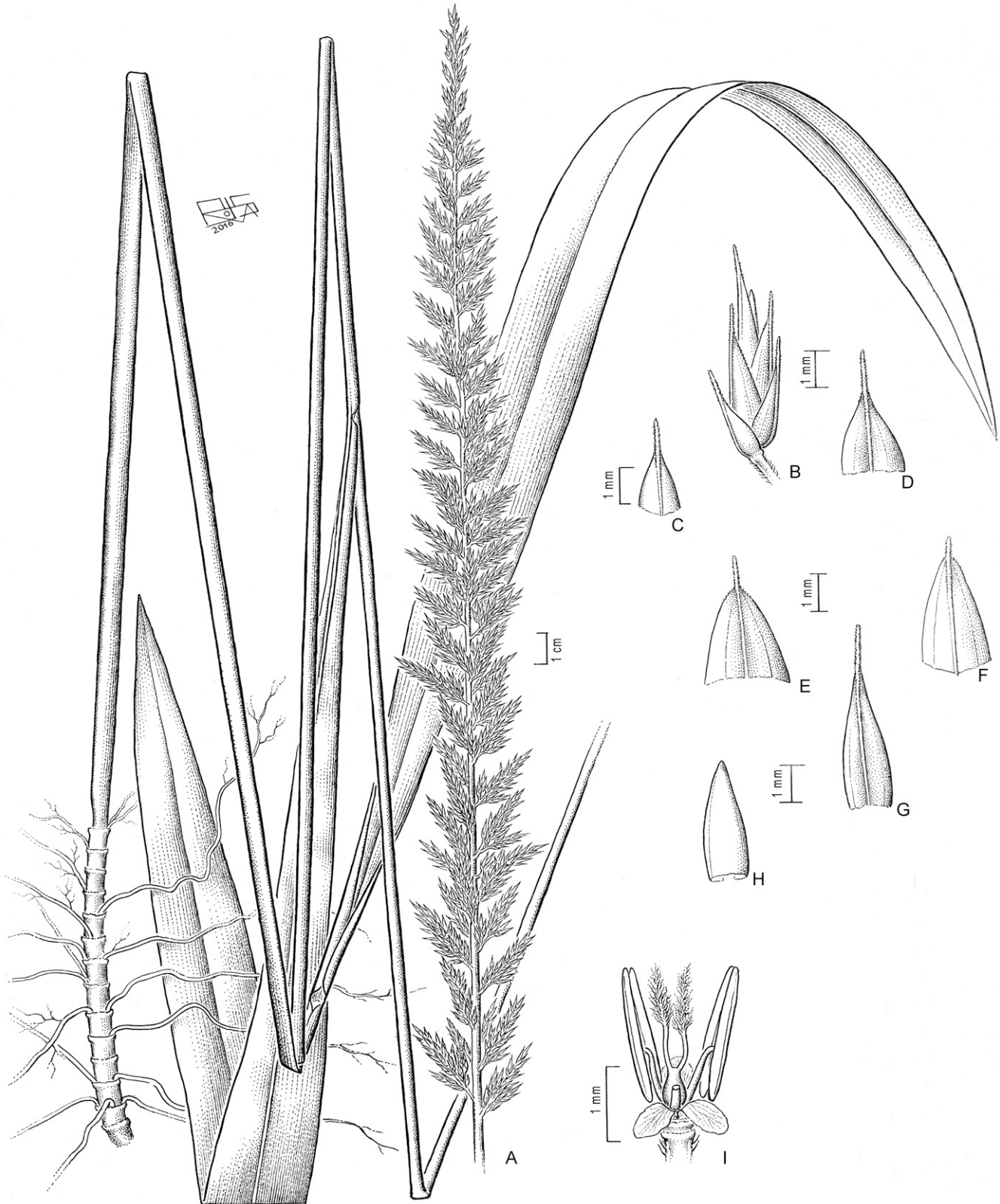


FIG. 5. *Chusquea rugoloana*. A. Habit. B. Spikelet. C. Glume I, dorsal view. D. Glume II, dorsal view. E. Glume III, dorsal view. F. Glume IV, dorsal view. G. Lemma, dorsal view. H. Palea, dorsal view. I. Lodicules, two of the three stamens and gynoecium. (A–J from Beltrán 1502).

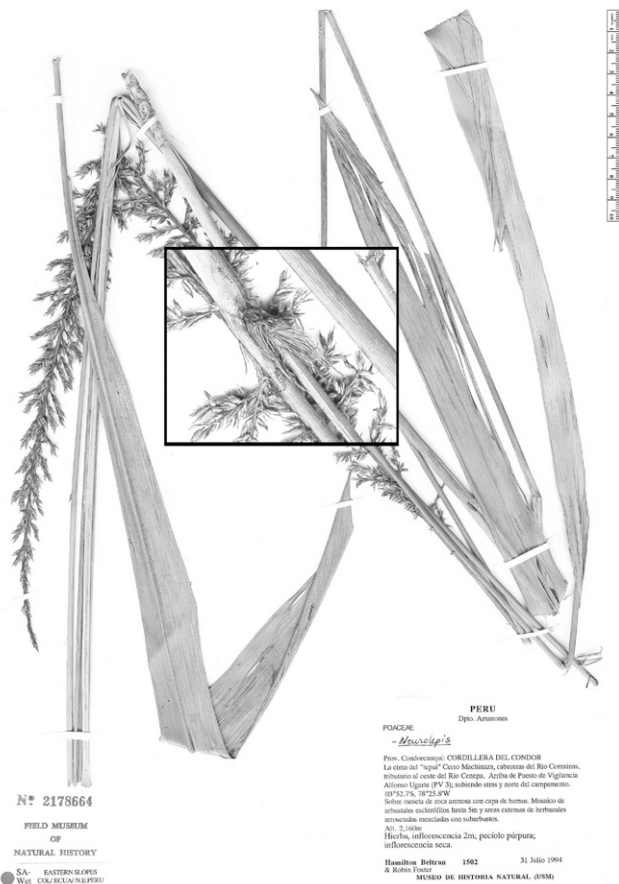


FIG. 6. *Chusquea rugoloana*. Isotype specimen from F, showing developed fimbriae; obtained from Field Museum of Natural History: The Botany Collections Database. Botany Department, Field Museum of Natural History, Chicago. <http://emuweb.fieldmuseum.org/botany/Query.php>

(the awn 0.5–1 mm long), and awned lemma, with the awn (0.8–)1.2–1.5 mm long.

Plants ca. 2 m tall. Culm 5–7 mm diam, unbranched, erect; nodes not visible. Culm leaf completely lacerated, with fibrous remains at the base of the plant. Foliage leaf with sheath striate, glabrous, the summit on each side with a small extension; inner ligule ca. 4 mm long, with a membrane behind it 7–8 mm long, bearing disintegrating fimbriae up to ca. 2 cm long; outer ligule absent; pseudopetiole variable in length, 1.5–24 cm long on the foliage leaves, terete, purpuroseous, glabrous; blade 32–43 × 2.5–3 cm, L:W = 13–15, narrowly elliptic, apex acute, glabrous, midrib slightly eccentric,

margins antrorsely scabrous toward the apex. Inflorescence leaf reduced to a triangular bract, ca. 4 mm long. Inflorescence 43–50 × 2–4 cm, linear-oblong, apex acuminate, terminal, exserted; peduncle 25–27 cm long, terete, finely striate, glabrous; rachis ridged and grooved longitudinally, hirsute on the ridges; primary branches numerous, short, up to 2 cm long, stiff, ascending to spreading at maturity, 30°–60°(–80°) from rachis, densely-flowered, hirsute to scabrous-pubescent, basally adaxially pulvinate with a glabrous pulvinus, with reduced secondary branches; pedicels up to 1 mm long, pubescent to scabrous, pulvinate at base with a glabrous pulvinus. Spikelets 4.5–5.6 × 1.2–2 mm, crowded along primary branches, terete or slightly laterally compressed, disarticulating between the glumes II and III. Glumes I and II unequal, coriaceous, stramineous, awned, 1-nerved, 1-keeled; glume I (1.4–)2–2.7 × 0.8–0.9 mm (including the awn), 1/3–1/2 the spikelet length, ovate-lanceolate, apex gradually attenuate into an awn of 0.8–1.4 mm long, scabrous; glume II 2.6–3.2 × ca. 1.6 mm (including the awn), ca. 1/2 the spikelet length, ovate, apex gradually to abruptly attenuate into an awn, margins scabrous toward the apex, awn 0.8–1.4 mm long, scabrous; glumes III and IV coriaceous, stramineous, awned, 1-keeled, glabrous abaxially, glabrous adaxially but puberulous toward the apex, apex attenuate; glume III 3–3.4 mm long, (including the awn), ca. 2/3 the spikelet length, ovate to ovate-lanceolate, 3–5-nerved, margins scabrous to ciliate toward the apex, awn 0.6–1 mm long, scabrous; glume IV 3–4 mm long, (including the awn), 2/3 the spikelet length, ovate-lanceolate, 3-nerved, margins scabrous toward the apex, awn 0.5–0.8 mm long, scabrous. Lemma (3.5–)4.3–5.4 × ca. 2.2 mm (including the awn), lanceolate, coriaceous, stramineous or purpuroseous, 3–5-nerved, awned, glabrous, apex long-attenuate, awn (0.8–)1.2–1.5 mm long, glabrous. Palea 2.8–3.4(–3.7) mm long, ovate-lanceolate, coriaceous, stramineous, 2-nerved, boat-shaped, glabrous. Lodicules 3, glabrous, the anterior ones 0.7–0.9 × 0.5–0.7 mm, irregularly obovate to suborbicular, 3–5-nerved, apex rounded to shortly acuminate, the posterior one 0.5–0.8 × 0.3–0.5 mm, suborbicular to obovate, 3-nerved, apex shortly acuminate. Stamens 3, anthers 1.6–1.7 mm long. Gynoecium ca. 1.7 mm long, ovary 0.4–0.8 mm long, glabrous, styles 2, stigmas plumose. Caryopsis not seen. Figures 5–6.

Etymology—Dedicated to Zulma E. Rúgolo de Agrasar (1940–), Argentinian botanist and specialist in Poaceae.

Geographical Distribution and Ecology—It is found growing among shrubs and rosette herbs in Ceja de Selva, on sandstone plateaus (“tepu”), at 2,160 m in Cordillera del Cóndor in northern Peru, near the border with Ecuador, sympatrically with *C. longipedicellata*.

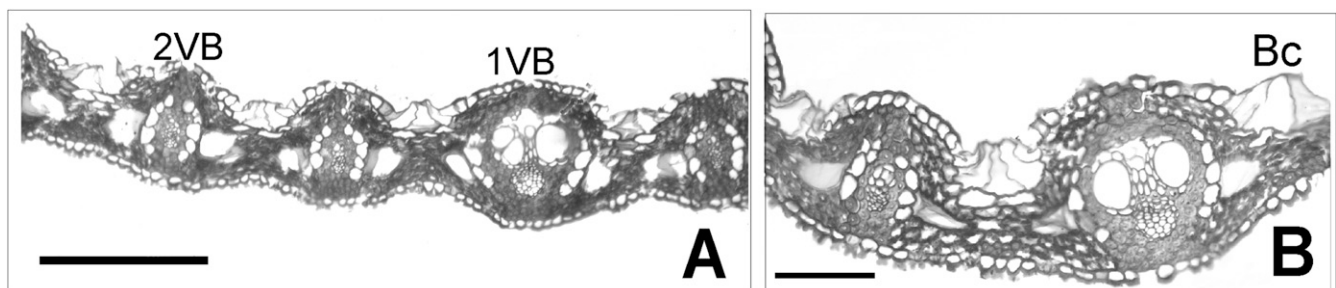


FIG. 7. Foliar anatomical characters in cross section of *Chusquea rugoloana*. A. General view. B. Detail of first and second order vascular bundles. 1VB = first order vascular bundle, 2VB = second order vascular bundle, Bc = elevated bulliform cells. Scale bars: A = 500 μ m; B = 200 μ m (from Beltrán 1902).

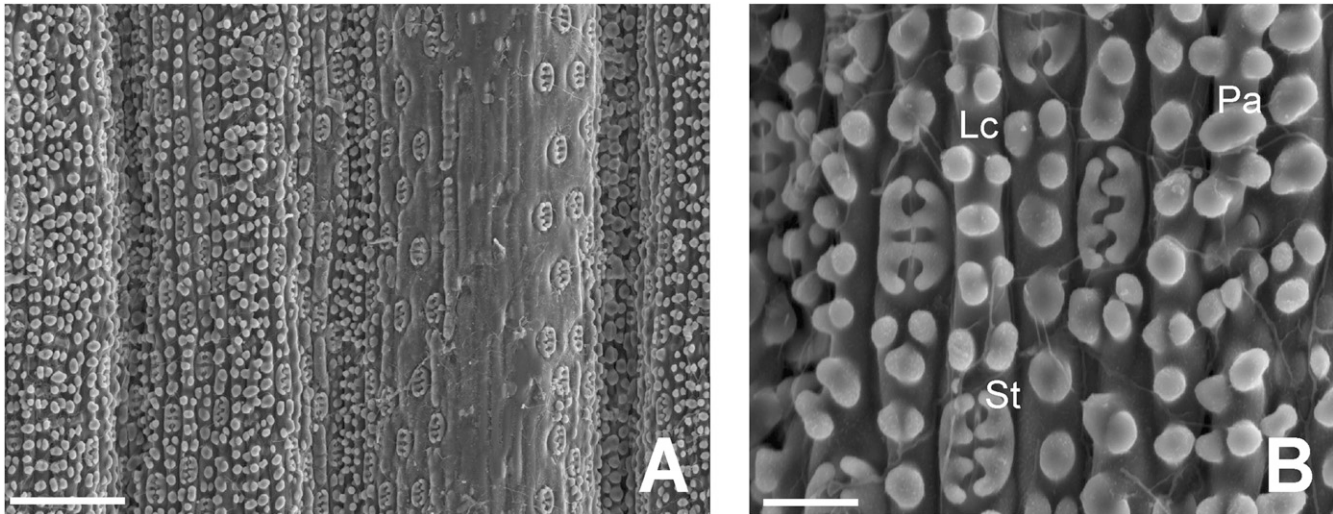


FIG. 8. Micromorphological characters of *Chusquea rugoloana* abaxial epidermis. A. General view. B. Detail of stomatal complexes. Lc = long cells, Pa = papillae, St = stomata. Scale bars: A = 100 μm ; B = 20 μm (from Beltrán 1502).

Anatomy—Foliage leaf blade cross section: Outer walls thickened and covered by a distinct, thick cuticle continuous over the epidermal cells. Adaxial, rounded, obtuse ribs situated over the vascular bundles and shallow furrows between all vascular bundles. Abaxial surface smooth or with few slight undulations between vascular bundles. Five to seven second order bundles between consecutive first order bundles, all of them situated in the centre of the blade.

Well-developed, adaxial and abaxial sclerenchyma girders, in contact with the bundle sheath and epidermis, narrower than or as wide as the vascular bundles. Conspicuous narrow intercellular spaces on each side of all vascular bundles, separated by numerous chlorenchyma cells [sometimes referred to as “fusoid cells” (Vega et al. 2016)]. Large, inflated bulliform cells situated at bases of furrows, projecting above the level of the epidermis. Colourless parenchyma cells

TABLE 2. Comparative table among *Chusquea rugoloana* and similar species.

Characters	<i>C. angusta</i>	<i>C. diversiglumis</i>	<i>C. glomerata</i>	<i>C. rugoloana</i>
Plant height (m)	More than 2.5	ca. 1	6–10	ca. 2
Blade, length \times width (cm)	80–165 \times 6–6.5	Up to 50 \times ca. 3.5	100–450 \times 4–5	32–43 \times 2.5–3
Pseudopetiole, length (cm)	ca. 50	4–16	ca. 10	1.5–24
Inner ligule, length (cm)	ca. 1	ca. 1	0.7–1	ca. 0.4
Fimbriae, length (mm)	10–15	3–5	5–6	ca. 20
Inflorescence, length \times width (cm)	ca. 75 \times 2.5–3	Up to 34 \times ca. 4	80–100 \times 4–20	43–50 \times 2–4
Spikelet, length (mm)	7–9.8	5–5.5	5.5–6.5	4.5–5.6
Glume I, length (mm)	1–1.5	1.7–1.9	(1–)1.3–1.6	(1.4–)2–2.7
Glume I, apex	Obtuse, apiculate	Asymmetrically acute, short-awned, awn 0.5–0.6 mm long	Obtuse or acute	Awned, awn 0.8–1.4 mm long
Glume II, length (mm)	2–2.5	1.6–2.2	(1.5–)2–2.3	2.6–3.2
Glume II, apex	Obtuse, apiculate	Asymmetrical, short-awned, awn 0.5–0.6 mm long	Obtuse or acute	Awned, awn 0.8–1.4 mm long
Glume III, length (mm)	3–4.5	ca. 3.8	2.2–3	3–3.4
Glume III, apex	Obtuse, apiculate	Short-awned, awn 0.5–0.6 mm long	Obtuse, apiculate	Awned, awn 0.6–1 mm long
Glume III, number of nerves	1-nerved	4-nerved	3-nerved	3–5-nerved
Glume IV, length (mm)	4–5.5	ca. 4.4	3.4–4	3–4
Glume IV, apex	Obtuse, apiculate	Short-awned, awn 0.5–0.6 mm long	Obtuse	Awned, awn 0.5–0.8 mm long
Lemma, length (mm)	4–5.5	ca. 5	(4.8–)5.5–6.3	(3.5–) 4.3–5.4
Lemma, apex	Awned, awn 1.5–2 mm long	Short-awned, awn ca. 0.5 mm long	Acute or short-awned (awn 0.5–0.8 mm long)	Awned, awn (0.8–)1.2–1.5 mm long
Palea, length (mm)	4–5.5	ca. 3.7	5.5–6.3	2.8–3.4(–3.7)
Lodicules	Ciliate	Ciliate	Ciliate	Eciliate
Geographic distribution	Colombia and Venezuela	Brazil and Venezuela	Venezuela	Peru (probable in Ecuador)
Elevation (m)	2,300–2,600	2,590–2,743	2,000–2,500	2,160
Habitat	Open places in low brush on slopes	Open slopes to base of cliffs	Open forested slopes of <i>Bonnetia</i> Mart.	Sandstone plateaus (“tepuy”) in montane forests

present, closely associated with and smaller than bulliform cells (Fig. 7).

Micromorphology—Foliage leaf blade abaxial epidermis: Long cells with straight walls and one or two rows of large, rounded, simple papillae. Long and narrow stomatal complex $24\text{--}25 \times 14\text{--}16 \mu\text{m}$, rectangular in outline, with parallel-sided subsidiary cells with compound papillae, arranged in rows in intercostal zones. Silica bodies, prickle hairs and microhairs absent (Fig. 8).

Observations—This species is most similar to *C. diversiglumis* (Soderstr.) L.G. Clark, but *C. rugoloana* differs from it because of its taller habit, the disintegrating fimbriae up to ca. 2 cm long of the inner ligule, the linear-oblong, longer inflorescence with shorter primary branches, the less congested spikelets, the longer glumes I and II with longer awns, the shorter glumes III and IV with longer awns, the lemma with a longer awn, and the shorter palea. It also resembles *C. angusta* (Swallen) L.G. Clark but *C. rugoloana* differs in the shorter pseudopetioles, leaf blades, inflorescences and spikelets, the longer awned glumes I and II, the awned glumes III and IV, and the shorter palea (Table 2).

Specimens of *C. tovarii* were collected in Peru (Prov. Pataz, Dep. La Libertad) and Ecuador (Clark 2000), in proximity to the location where *C. rugoloana* occurs. Nevertheless, *C. tovarii* is easily distinguished from *C. rugoloana* by the following characters: greater foliage leaf blades [(107–)148–180(–250) \times (3.2–)4–6.6 cm] with eccentric midrib, longer inflorescences [(75–)90–108 cm long] with much longer primary branches [(15–)28–35 cm long], glabrous rachis, shorter spikelets (2.5–4 mm long) with glumes I and II $\frac{1}{2}$ -equal the length of the spikelet, glume II 3-nerved and anthers 2 mm long.

Presently, only three species of *C.* subg. *Magnifoliae* have the inner ligule with a membrane behind it [complex ligule, according to Soderstrom (1969: 18)], inflorescences with stiff, ascending to spreading, densely-flowered primary branches, and well developed pulvini at the bases of all the branches and pedicels: *C. angusta*, *C. diversiglumis* and *C. glomerata* (Swallen) Dorr. They also share leaf blades with eccentric or slightly eccentric midrib position and spikelets shortly pedicelled. *Chusquea rugoloana* and these species can be differentiated by the following key:

1. Foliage leaf blade $32\text{--}50 \times 2.5\text{--}3.5$ cm; midrib slightly eccentric or eccentric. Panicle $34\text{--}50 \times 2\text{--}4$ cm. Spikelets 4.5–5.6 mm long. Glume III awned, awn 0.5–1 mm long. 2
1. Foliage leaf blade $80\text{--}450 \times 4\text{--}6.5$ cm; midrib eccentric. Panicle $75\text{--}100 \times 2.5\text{--}20$ cm. Spikelets 5.5–9.8 mm long. Glume III obtuse, apiculate 3
2. Foliage leaf inner ligule with fimbriae 3–5 mm long; midrib eccentric. Panicle narrowly pyramidal, ca. 34 cm long; primary branches up to 4 cm long. Glume I 1.7–1.9, with awn 0.5–0.6 mm long; glume II 1.6–2.2 mm long, with awn 0.5–0.6 mm long; glume III ca. 3.8 mm long, 4-nerved, with awn 0.5–0.6 mm long. Lemma with awn ca. 0.5 mm long. Palea ca. 3.7 mm long. Lodicules ciliate *C. diversiglumis*
2. Foliage leaf inner ligule with fimbriae ca. 20 mm long; midrib slightly eccentric. Panicle linear-oblong, 43–50 cm long; primary branches up to 2 cm long. Glume I (1.4–)2–2.7 mm long, awn 0.8–1.4 mm long; glume II 2.6–3.2 mm long, awn 0.8–1.4 mm long; glume III 3–3.4 mm long, 3–5-nerved, awn 0.6–1 mm long. Lemma with awn (0.8–)1.2–1.5 mm long. Palea 2.8–3.4(–3.7) mm long. Lodicules eciliate *C. rugoloana*
3. Spikelets 7–9.8 mm long. Glume III 3–4.5 mm long, 1-nerved. Lemma awned, awn 1.5–2 mm long. Palea 4–5.5 mm long. Basal leaves with pseudopetiole ca. 50 cm long, the upper ones not pseudopetiolate. Foliage leaf inner ligule with fimbriae 10–15 mm long; blade $80\text{--}165 \times 6\text{--}6.5$ cm. Panicle ca. $75 \times 2.5\text{--}3$ cm *C. angusta*
3. Spikelets 5.5–6.5 mm long. Glume III 2.2–3 mm long, 3-nerved. Lemma acute or short-awned, awn 0.5–0.8 mm long. Palea 5.5–6.3 mm long. Pseudopetiole ca. 10 cm long. Foliage leaf inner ligule with fimbriae 5–6 mm long; blade $100\text{--}450 \times 4\text{--}5$ cm. Panicle $80\text{--}100 \times 4\text{--}20$ cm. *C. glomerata*

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