Two new species and synopsis of *Chusquea* subg. *Platonia* (Poaceae: Bambusoideae: *Chusqueinae*) in Bolivia and a new record for Peru

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Abstract

The present study describes and illustrates two new species of *Chusquea* subg. *Platonia*, *C. parodii* and *C. paucispiculata*. *Chusquea laegaardii* is cited for the first time in Bolivia and *C. asymmetrica* for Peru. Two keys for the identification of the species, mainly based on vegetative or reproductive characters, and a comparative table with micromorphological diagnostic features of foliage leaf blades are included. Finally, some remarks about the characteristics of the phytogeographical regions and the ecology of these new species are given.

Resumen

El presente trabajo describe e ilustra dos nuevas especies de *Chusquea* subgén. *Platonia*, *C. parodii* y *C. paucispiculata*. *Chusquea laegaardii* se cita por primera vez en Bolivia y *C. asymmetrica* en Perú. Se incluyen dos claves para la identificación de las especies basadas principalmente en caracteres vegetativos o reproductivos y una tabla comparativa con los caracteres micromorfológicos diagnósticos de las hojas del follaje. Se incorporan observaciones acerca de las características de las regiones fitogeográficas y la ecología de las nuevas especies.

Key words: Bambuseae, Central Andes, Micromorphology, Morphology, New taxa, New report, Taxonomy

The subtribe *Chusqueinae* Soderstrom & Ellis (1987: 235) is a monophyletic group, endemic to the New World, previously composed of two genera: *Neurolepis* Meisner (1843: 426) and *Chusquea* Kunth (1822: 151; Judziewicz & Clark 2007). This subtribe comprises 64% of Andean woody bamboo diversity (Clark 2001).

*Neurolepis* has been characterized by the absence of aerial branching and by the longest leaves known of all genera of Bambusoideae. Spikelet characteristics unify *Neurolepis* and *Chusquea* (Clayton & Renvoize 1986). The three flowered spikelets with two glumes, two sterile lemmas and one fertile floret, no rachilla extension, papillate subsidiary cells of the stomatal apparatus and seedling morphology of some species indicate its affinity with *Chusquea* (Clark 1995).

Chusquea subg. Platonia and subg. Magnifoliae are distributed in the Caribbean, Central America (Costa Rica and Panama), and South America (Bolivia, Brazil, Colombia, Ecuador, Peru and Venezuela). All the species grow at relatively high elevations (1500–4500 m) in ecological formations characterized as “páramos” (McClure 1973) although some species, like C. cylindrica L.G. Clark in Fisher et al. (2009: 680) were also collected in lower altitudes of about 800 m (Clark 1996).

Species of C. subg. Platonia and subg. Magnifoliae have not been cited in Bolivia (Hitchcock 1927), neither in the catalogue of the ferns and flowering plants of Bolivia (Foster 1958), nor in the checklist of vascular plants of the Madidi region of northern Bolivia (Jørgensen et al. 2005), although there are some sterile specimens kept in LPB collected in Madidi National Park. These species inhabit two phytogeographical regions (Beck 1998): “Páramo Yungueño” and “Ceja de Monte” (3000–3700 m), as well as “Bosque húmedo montano de las Yungas” (500–3500 m). The presence of C. subg. Platonia and subg. Magnifoliae (sub Neurolepis) in Bolivia has been previously mentioned by Renvoize (1998) on the basis of two indeterminate sterile materials collected in La Paz, Nor Yungas [Beck 17683 (K, LPB, SI) and Solomon et al. 18997 (LPB, MO)]. Both specimens were identified (in herb.) as C. asymmetrica (Clark 1996: 336) L.G. Clark in Fisher et al. (2009: 680) and, at present, it is the only species reported from Bolivia (Clark 2000). According to Clark (2001), woody bamboos of Peru and Bolivia have been poorly collected and not fully described and, among Andean bamboos, there is a large number of species that remains to be described. Also, the long vegetative periods prior to flowering and the frequent collection of sterile specimens hinder a complete knowledge of them. The duration of the entire life cycle in species of subg. Platonia and subg. Magnifoliae is poorly known; in C. magnifolia L.G. Clark in Fisher et al. (2009: 681), plants die after flowering, regenerating itself from seed, and completing the whole life cycle in five years [sub Neurolepis pittieri McClure (1942: 181) in Davids & Huber 1979]. In other species, flowering behaviour seems to be sporadic or continuous (Clark 1996), although scarce information is available.

The present paper reports taxonomical novelties in Chusquea in Bolivia and Peru. Two new species of Chusquea subg. Platonia are described and illustrated: C. parodii A.S. Vega & Rúgolo and C. paucispiculata A.S. Vega & Rúgolo. Both taxa vegetate for at least 20 years prior to flowering (Beck, pers. obs.). Chusquea laegaardii (Clark 1996: 342) L.G. Clark in Fisher et al. (2009: 681) is here cited for the first time for Bolivia and C. asymmetrica for Peru. Morphological diagnostic characters (vegetative and reproductive) as well as micromorphological ones are selected and compared among the species. Also, some remarks about the characteristics of the phytogeographical regions and the ecology of the species are included.

Material and Methods

Studies are based primarily on herbarium material deposited at AAU, BAA, JE, K, LPB, MO, QCA, SI, US and USM (Thiers 2014). Type specimen images were seen from BM, G, K, MO, QCN, QCA, US and W.

Considering the long periods of vegetative growth previous to flowering and the existence of sterile herbarium collections, a key based on vegetative characters is provided. Another key using reproductive characters is also given in order to confirm the identity of specimens when fertile material is available.

Micromorphological studies were based on herbarium material. Segments of the middle portion of the penultimate foliage leaf blade of a sterile or fertile (when it was possible) innovation were selected and cleaned in xylene for 1.5 hr with an ultrasonic cleaner (Cleanson, model CS 1106, Argentina). The material was air-dried, mounted and coated with a gold-palladium (40%–60%) alloy by a Thermo VGScientific (West Sussex, UK) and then observed using a Phillips XL 30 (Einhoven, The Netherlands) Scanning Electron Microscope (SEM) at the Museo Bernardino Rivadavia (Buenos Aires, Argentina).

For foliage leaf blade transverse sections, the samples were dehydrated in alcohol series and embedded in paraffin following traditional anatomical techniques. Sections 20 µm wide were cut with a rotary microtome and stained with safranine-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). Selected characters and states are in accordance to the terminology proposed by Ellis (1976). Anatomical characters are also useful for taxonomical purposes when sterile material is available.
Taxonomic treatment

1. *Chusquea asymmetrica* (L.G. Clark) L.G. Clark.


Type:—ECUADOR. Loja: páramo at road Yangana, Cerro Toledo, 3150 m, 26 February 1985, fl., *Lægaard 53681* (holotype QCA-84013, photo SI!, isotypes AAU!, LOJA, QCNE-650 photo SI!).

**Geographic Distribution and Ecology:**—Bolivia, Ecuador (Clark 2000) and Peru. It is found in páramos, sometimes on ridges or in bogs at 3000–3400 m. In Bolivia, it grows at Ceja de Montaña.

**Iconography:**—Clark (1996: 337, Fig. 1, A–C, leaf, synflorescence and spikelet).

**Additional Material Examined:**—BOLIVIA. La Paz: Nor Yungas, 1 km antes de llegar a Chuspipata viniendo de Unduavi, 3160 m, 26 May 1990, veg., *Beck 17683* (K, LPB, SI); Nor Yungas, Chusipipata, 5 km via Unduavi, 3150 m, 2 April 1982, veg., *Beck 7596* (LPB).


PERU. Cusco: La Convención, ca. 28 km walking distance NE from the Hacienda Luisiana and the Apurimac River, ca. 3400 m, 12°30’S, 73°30’W, 19 July 1968, fl., *Dudley 11219* (USM).

2. *Chusquea laegaardii* (L.G. Clark) L.G. Clark.

**Neurolepis laegaardii** L.G. Clark (1996: 342).

Type:—ECUADOR. Loja: Parque Nacional Podocarpus, Cerro Toledo, 3350 m, 4°22´S, 79°08´W, 2 June 1992, fl., *Clark et al. 1112* (holotype QCA-144121 photo SI!, isotypes AAU!, ISC, MO-115331 photo SI!, QCA-700363 photo SI!, US-479170 photo SI!).

**Fig. 1.**

**Geographic Distribution and Ecology:**—Ecuador (Clark 2000) and Bolivia. Originally mentioned as endemic to the Parque Nacional de Podocarpus in Loja (Ecuador) being sometimes dominant. It inhabits páramos at 3200–3500 m. In Bolivia, it has been collected in Ceja de Monte at 3500 m. According to specimens kept at LPB, the life cycle of this species is approximately 11 years (I. Jiménez, pers. comm.)

**Iconography:**—Clark (1996: 343, Fig. 3, A–D, habit, synflorescence, spikelet and inner ligule).

**Additional Material Examined:**—BOLIVIA. La Paz: Nor Yungas, cerca de Cotapata, 3500 m, 16°17´S, 67°53´W, 12 October 1997, fl., *Beck 24403* (K, LPB, SI); Franz Tamayo, Parque Nacional Madidi, Mosquito Wichay, bajando de Tambo Quemado por el camino entre Queara y Mojos, 3370 m, 14°41´04´´S, 68°57´54´´W, 26 February 2008, fl., *Jiménez 4833* (LPB, MO); Franz Tamayo, senda Pelechuco-Mojos, a media hora de Tambo Quemado, 3506 m, 14°41´04´´S, 68°58´16´´W, 10 May 2003, fl., *Maldonado et al. 3351* (LPB, MO); Franz Tamayo, entre Queara y Mojos, sector Mosquito, 3400 m, 14°39´37´´S, 68°57´52´´W, 24 June 2005, fl., *Fuentes 8681* (LPB, MO); Bautista Saavedra, área natural de manejo integrado Apolobamba, sector Codo, 3316 m, 14°53´06´´S, 68°46´42´´W, 4 April 2009, fl., *Fuentes et al. 13815* (LPB, MO).


**Observation:**—The specimen *Beck 24403* (K, LPB, SI) was previously identified (in herb.) as *Chusquea fimbriligulata* (Clark 1996: 338) L.G. Clark in Fisher et al. (2009: 681). This specimen differs from *C. fimbriligulata* in having a smaller habit (15–80 cm high), foliage leaves (sheath and blade) crowded towards the apex of culm, leaf-blades 8–26 × 1.7–2.6 cm, erect, broadly lanceolate, apex acute, base obtuse, adaxially weakly tessellate on the lower half and not tessellate on the upper half; abaxially not tessellate; fimbriae 5–10 mm long and synflorescence (16–)21–56 cm with paracladia weakly adaxially pulvinate.

Type:—BOLIVIA. La Paz: Nor Yungas, Cotapata, fin del camino asfaltado hacia Coroico, cerca de 3 km de Chuspipata hacia La Paz, 3100 m, 16º18´S, 67º50´W, 7 August 1999, fl., Beck 26221 (holotype LPB!, isotypes K, SI!). Fig. 2.

*Chusquea parodii* is related to *C. asymmetrica* and differs from it by having synflorescences 85–87.5 × 26–32 cm with basal primary branches 13–37 cm long; spikelets (5–)5.2–6.7(–7.5) × 1.7–2 mm, including awns; lower glume 1.2–2.4 mm long, generally $\frac{1}{4}$–$\frac{1}{2}$ the length of the spikelet, 3-nerved, ovate, apex acute, mucronate or abruptly acuminate; upper glume 4.5–6.7(–8) mm long, equal to subequal to the length of the spikelet body, exceptionally shortly exceeding the spikelet, abruptly acuminate; and stigmas plumose.

Perennials, ca. 3 m tall, including the synflorescences, densely caespitose, growing in extended colonies. Rhizome 5–6 mm diam., sympodial; cataphylls papyraceous, shining, stramineous-brownish, apex acute, with a rigid mucro 0.2–0.3 mm long, margin and surfaces glabrous. Foliar succession between cataphylls to culm leaves gradual. Culm leaves: with two triangular auricles, blade reduced to a rigid mucro, inner ligule ca. 0.5 mm long, membranaceous. Succession between culm to foliage leaves abrupt. Foliage leaves: pseudopetiole 12–22 cm long, rigid, adaxially surcated, with purplish tints; outer ligule absent; abscission zone between leaf sheath and pseudopetiole conspicuous, irregular; inner ligule ca. 4.5 mm long, entire, without fimbriae; blades 75–86 × 2.5–4 cm, narrowly lanceolate, midrib notoriously eccentric, abaxially prominent on the lower half, abaxially tessellate and weakly tessellate on adaxial surface, apex acuminate, keeled, glabrous. Synflorescence 85–87.5 × 26–32 cm, paniculate, lax. Main axis pluricarinate, scabriusculus on the carina. Basal primary branches 13–37 cm long. Pulvini well developed, yellow, basally at the axils of the branches and pedicels, glabrous. Rachis scabrous on the margins. Pedicels 1–2.5 mm long, scabrous. Spikelets (5–)5.2–6.7(–7.5) × 1.7–2 mm, including awns. Glumes stramineous and lower lemmas and upper floret brown with purplish tints. Lower glume 1.2–2.4 mm long, variable in length, generally $\frac{1}{4}$–$\frac{1}{2}$ the length of the spikelet, 3-nerved, midrib centric, ovate, apex acute, mucronate or abruptly acuminate, scabrous toward the apex in both surfaces. Upper glume 4.5–6.7(–8) mm long, variable in length, equal to subequal to the length of the spikelet body, exceptionally shortly exceeding the spikelet, ovate at the base and abruptly acuminate, 3-nerved, scabrous toward the apex in both surfaces. Lower and upper sterile lemmas short-awned, both smaller or subequal to the spikelet body, scabrous toward the apex in both surfaces. Sterile lemmas (3–)4–5 mm long, 3-nerved. Fertile floret scabrous toward the apex in both surfaces. Fertile lemma (4.5–)5.5–6 mm long, 5-nerved, mucronate. Palea (4.5–)5.5–5.7 mm long, subequal to the length of the upper sterile lemma, 4-nerved, dorsally sulcate toward the apex, bimucronulate. Lodicules 3, 0.5–1 mm long, membranous, apex acute, keeled. Stamens 3; anthers 2–2.5 mm long, pale-yellow. Ovary glabrous; stigmas 2, plumose. Caryopsis not developed.

**Etymology:**—Dedicated to Lorenzo R. Parodi (1895–1966), Argentinean botanist and agrostologist.

**Geographic Distribution and Ecology:**—In Bolivia, it inhabits humid montane Yungas forests and evergreen forests of Ceja de Monte. It occurs in Ceja de Monte together with *Llerasia* Triana (1858: 37) and *Rhynchospora* Vahl (1805: 229).

**Dispersion:**—The unit of dispersal is disarticulated above the glumes. The diaspore is composed of both sterile lemmas and the upper fertile floret. At maturity the glumes remain stramineous and the diaspore turns brown with purplish tints.


**Observations:**—The type specimen (*Beck 26221*) was previously identified (in herb.) as *Chusquea tovari* L.G. Clark in Fisher et al. (2009: 682) (= *Neurolepis weberbaueri* Pilger 1921: 446). *Chusquea tovari* differs from *C. parodii* by its larger leaf blades (107–)148–180(–250) × 4–6.6 cm, longer synflorescences (75–)90–108 cm long and shorter spikelets 2.5–4 mm long. Also, the palea is dorsally convex, not sulcate at the summit, with an apex acute. The specimen *Solomon et al. 18997* (LPB, MO, SI, US) was previously identified as *C. asymmetrica*, although anatomical studies placed it under *C. parodii*. 

**Type:**—BOLIVIA. La Paz: Nor Yungas, Chuspipata 1 km hacia Cotapata, 3080 m, 22 August 1999, fl., Beck 26225 (holotype LPB!, isotypes K, SI!). Figs. 3–4.

*Chusquea paucispiculata* is related to *C. asymmetrica* and differs from it by having synflorescences (50–)55–88 × 47–56 cm with basal primary branches 10–29 cm long; spikelets (3.5–)4–4.5(–5.1) × 2.5–4 mm including awns, purplish at maturity; lower glume (2–)3–4.5 mm long, ca. ½ or subequal to the length of the spikelet, 1-nerved, base ovate, abruptly acuminate, short awn ca. 1 mm long; upper glume (2.5–)5–6 mm long, ca. ¾, equal or exceeding the length of the spikelet body, apex acuminate, the short awn ca. 1 mm long; fertile floret glabrous in both surfaces; anthers 1.7–2 mm long; and stigmas bearded.

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**FIGURE 4. Chusquea paucispiculata.** A. Habit. B. Synflorescences. Scale bars = 50 cm for A, 10 cm for B. Photographs: S. Beck.

Perennials 2.5–3 m tall, including the synflorescences, caespitose, growing isolated or in small colonies. Culms 0.4 cm diam., hollow, glabrous. Rhizome sympodial; cataphylls papyraceous, shining, stramineous-brownish, apex acute, with a rigid mucro, glabrous. Foliar succession between cataphylls to culm leaves gradual. Culm leaves: blade reduced to a rigid mucro. Succession between culm to foliage leaves abrupt. Foliage leaves: pseudopetiole 5–8 cm long, in subtending leaf of the synflorescence ca. 0.7 cm long, glabrous; outer ligule ca. 1 mm long, cartilaginous, glabrous; abscission zone between leaf sheath and pseudopetiole inconspicuous; inner ligule ca. 9 mm long, margin denticulate, without fimbriae, cartilaginous, decurrent to the leaf sheath, glabrous; blades (91–)150–200 × 2–3 cm, erect, narrowly lanceolate, midrib eccentric, abaxially prominent on the lower half, adaxially not tessellate, abaxially weakly tessellate, margin scabrous, apex acute, glabrous. Synflorescence (50–)55–88 × 47–56 cm, paniculate, exserted from the subtending leaf at maturity, lax, branches paucispiculate. Main axis pluricarinate, scabriusculus on the carinas. Basal primary branches 10–29 cm long. Pulvini well developed, yellow, basally at the base of the branches and pedicels, glabrous. Rachis pluricarinate, scabrous on the carinas. Pedicels 0.5 mm long, scabrous. Spikelets (3.5–)4–4.5(–5.1) × 2.5–4 mm, purplish at maturity. Glumes unequal in length. Lower glume (2–)3–4.5 mm long, ca. ½ or subequal to the length of the spikelet, 1-nerved, midrib centric, base ovate, abruptly acuminate, short awn ca. 1 mm long, scabrous on both surfaces. Upper glume (2.5–)5–6 mm long, ca. ¾, equal or exceeding the length of the spikelet body,
3-nerved, base ovate, apex acuminate, the short awn ca. 1 mm long., scabrous on both surfaces. Lower sterile lemma 3–3.5 mm long, 3-nerved, apex mucronate, keeled, margins with purplish tints. Upper sterile lemma 3.3–4 mm long, 3-nerved, apex mucronate, keeled, margins with purplish tints. Fertile floret glabrous in both surfaces. Fertile lemma 4.3–4.5 mm long, 3-nerved, navicular. Palea 4.3–4.5 mm long, 5-nerved, navicular, bimucronulate. Lodicules 3, 0.5–0.7 mm long, membranaceous, ovobate, apex obtuse, crenate. Stamens 3; anthers 1.7–2 mm long, pale-yellow. Ovary glabrous; stigmas 2, bearded, pale with purplish tints, exserted. Caryopsis immature. 

**Geographic Distribution and Ecology:**—Bolivia and Peru. In Bolivia, it occurs at 3000–3100 m in “Ceja de Monte”. In Peru, it has been considered as a common species, collected in Ceja de Monte, in a very wet and reduced elfin forest.

**Additional Material Examined:**—BOLIVIA. La Paz: Nor Yungas, Road La Paz-Coroico, ca. 2 km NW Chusipipata, ca. 3100 m, 16°17′S, 67°50′W, 22 August 1999, veg., J. Müller 7475 (JE, LPB); ditto, 24 April 2000, fl., Wood 16300 (K, LPB); 0.5 km from Cotapata to Chusipipata, ca. 3100 m, 16°17′11″S, 67°50′43″W, 25 July 2010, veg., Beck 32668 (LPB).

PERU. Cusco: La Convención, peak between Camps 3 & 4, ca. 2555 m, 12°37′S, 73°34′W, 3 July 1968, fl., Dudley 10686 (USM).

**Observation:**—*Chusquea paucispiculata* is also similar to *C. tovari*, which differs from the former by its wider foliage leaf blades 4–6.6 cm lat., its greater synflorescences (75–)90–108 cm long and the palea that bears an acute apex, while in *C. paucispiculata*, it is bimucronulate.

The micromorphological characters of foliage leaf blades of *C. parodii* and *C. paucispiculata* are compared with those of related and sympatric species of *Chusquea* subg. *Platonia* (*C. laegaardii* and *C. asymmetrica*) in Tables 1–2 and Figs. 5–6.

### TABLE 1

<table>
<thead>
<tr>
<th>Characters</th>
<th><em>C. asymmetrica</em></th>
<th><em>C. laegaardii</em></th>
<th><em>C. parodii</em></th>
<th><em>C. paucispiculata</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Keel, number of 1st order VB</td>
<td>1</td>
<td>1</td>
<td>6 (–)8</td>
<td>1</td>
</tr>
<tr>
<td>Keel, number of 2nd order VB</td>
<td>2</td>
<td>2</td>
<td>2 (–7)</td>
<td>4</td>
</tr>
<tr>
<td>Keel, number of 3rd order VB</td>
<td>2</td>
<td>0</td>
<td>6 (–13)</td>
<td>2</td>
</tr>
<tr>
<td>Keel, shape in transverse section</td>
<td>Distinct, V-shaped with inverted triangular keel</td>
<td>Scarcely distinct, abaxially rounded, adaxially flat</td>
<td>Distinct, abaxially rounded, adaxially flat</td>
<td>Distinct, abaxially rounded, adaxially flat</td>
</tr>
<tr>
<td>Keel, adaxial sclerenchyma</td>
<td>Discontinuous</td>
<td>Discontinuous</td>
<td>Continuous</td>
<td>Discontinuous</td>
</tr>
<tr>
<td>Keel, abaxial sclerenchyma</td>
<td>Discontinuous</td>
<td>Discontinuous</td>
<td>Continuous</td>
<td>Discontinuous</td>
</tr>
<tr>
<td>Adaxial ribs, shape</td>
<td>Rounded, obtuse</td>
<td>Rounded, obtuse</td>
<td>Flat-topped, square</td>
<td>Rounded, obtuse</td>
</tr>
<tr>
<td>Abaxial ribs, shape</td>
<td>Strongly undulated</td>
<td>Slightly undulated</td>
<td>Slightly undulated</td>
<td>Strongly undulated</td>
</tr>
<tr>
<td>Adaxial sclerenchyma of leaf</td>
<td>Discontinuous and only associated to VB</td>
<td>Continuous, fibres in contact with bulliform cells</td>
<td>Discontinuous and only associated to VB</td>
<td>Discontinuous and only associated to VB</td>
</tr>
<tr>
<td>Leaf blade margin, shape</td>
<td>Pointed</td>
<td>Pointed</td>
<td>Pointed</td>
<td>Rounded</td>
</tr>
<tr>
<td>Marginal sclerenchyma cell wall</td>
<td>Very thick</td>
<td>Very thick</td>
<td>Very thick</td>
<td>Not markedly thickened</td>
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<tr>
<td>Marginal sclerenchyma extensions</td>
<td>Adaxially</td>
<td>Abaxially</td>
<td>Abaxially/adaxially</td>
<td>Abaxially</td>
</tr>
<tr>
<td>Sclerenchyma, towards the abaxial surface and opposite to bulliform cells</td>
<td>-/+</td>
<td>-/+</td>
<td>-/+</td>
<td>-/+</td>
</tr>
<tr>
<td>Comparative diameter: metaxylem vessels/parenchyma bundle sheath cells</td>
<td>Similar</td>
<td>&gt;</td>
<td>&gt;</td>
<td>&gt;</td>
</tr>
<tr>
<td>Parenchyma bundle sheath, layers</td>
<td>1</td>
<td>1–2</td>
<td>1–2</td>
<td>1–2</td>
</tr>
<tr>
<td>Colourless parenchyma cells, associated to bulliform cells</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

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TABLE 2. Comparative micromorphological characters of foliage leaf blade abaxial epidermis among species of Chusquea subg. Platonia in Bolivia. +, present; ++, abundant; -, absent.

<table>
<thead>
<tr>
<th>Characters</th>
<th>C. asymmetrica</th>
<th>C. laegaardii</th>
<th>C. parodii</th>
<th>C. paucispiculata</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ribs and furrows</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Compound papilae on subsidiary cells</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Microhairs</td>
<td>+</td>
<td>+</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Prickles</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Inflated long cells</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Key to the species of Chusquea subg. Platonia from Bolivia based on vegetative characters**

1. Foliage leaf blades with midrib in centric position, 8–26 × 1.7–2.6 cm, broadly lanceolate, base obtuse, apex acute; pseudopetirole 0.2–0.4 cm long, scarcely developed, or absent; inner ligule 1–2 mm long with fimbriae 5–10 mm long; culms plurinoded with internodes well developed throughout its length; foliage leaves cauline, numerous, with persistent sheaths and deciduous blades. Foliage leaves (with sheath and blade) crowded toward the apex of the culms.................................................................C. laegaardii

- Foliage leaf blades with midrib in eccentric position, (27–)35–200 × (1.5–)2–4 cm, narrowly lanceolate, base attenuate, apex acuminate and navicular. Pseudopetirole (1.5–)9–17.5 cm long, variable in length in subtending leaves of the synflorescence and foliage leaves of the same specimen, or well developed. Inner ligule 6–9 mm long, without fimbriae. Culms few-noded with basal internodes scarcely elongated. Foliage leaves basal, scanty, with persistent sheaths and blades .......................................................2

2. Foliage leaf blades (27–)35–65 (–120) × (1.5–)2–3.3 cm, adaxially not tessellate, abaxially weakly tessellate. Outer ligule 0.5 mm long. Inner ligule 6–8 mm long. Pseudopetirole (1.5–)9–17.5 cm long. Plants 2–2.5 m high, including synflorescence. Culm leaves 1–10 cm long, sheath margin sometimes ciliate, blades reduced to a rigid micro and inner ligule 0.2 mm long, a membranous margin ..............................................................................................................................C. asymmetrica

- Foliage leaf blades 75–200 × 2–4 cm, adaxially weakly tessellate or not tessellate, abaxially tessellate or weakly tessellate. Outer ligule absent or reduced. Inner ligule 4.5–9 mm long. Pseudopetirole 0.7 cm long (in subtending leaf of the synflorescence) or well developed. Plants 2.5–3 m high, including synflorescence. Culm leaves mucronate or with a reduced blade, sheath margin glabrous ......................................................................................................................................

3. Foliage leaf blades 75–86 × 2.5–4 cm, apex acuminate, abaxially weakly tessellate, abaxially tessellate. Outer ligule absent. Inner ligule 4.5 mm long. Pseudopetirole 12–22 cm long..............................................................................................................................................C. parodii

- Foliage leaf blades (91–)150–200 × 2 cm, apex acute, adaxially not tessellate, abaxially weakly tessellate. Outer ligule ca. 1 mm long. Inner ligule ca. 9 mm long. Pseudopetirole 0.7 cm long (in subtending leaf of the inflorescence) or 5–8 cm in foliage leaves..............................................................................................................................................................C. paucispiculata

**Key to the species of Chusquea subg. Platonia from Bolivia based on reproductive characters**

1. Spikelets 9.5–11.5 mm long, including awns. Glumes with long awns; awns much longer than the spikelet body. Lower glume 2–3 (–4) times the length of the spikelet body .......................................................................................................................... C. laegaardii

- Spikelets 3.5–7.5 mm, including awns. Glumes scapellike, mucronate or awned; if awned, ¼–shortly exceeding the length of the spikelet. Lower glume ¼–equal to the length of the spikelet .......................................................................................................................................2

2. Synflorescence (21–)30–47 (–60) × 7–10 cm. Lower glume enerved or 1-nerved. Upper glume 1- or 3-nerved. Fertile floret adaxially pubescent and abaxially glabrous or scabrous. Fertile lemma 3.2–3.7 mm long. Palea 3–3.7 mm long. Anthers 1.5–2 mm .................................................................................................................C. asymmetrica

- Synflorescence 50–88 × 26–56 cm. Lower glume 1- or 3-nerved. Upper glume 3-nerved. Fertile floret glabrous or scabrous toward the apex in both surfaces. Fertile lemma 4.3–6 mm long. Palea 4.3–5.7 mm long. Anthers 1.7–2.5 mm ...............................................................................................................................................3

3. Synflorescence 85–87.5 × 26–32 cm. Spikelets (5–)5.2–6.7 (–7.5) × 1.7–2 mm, including awns. Lower glume 1.2–2.4 mm long, variable in length, generally ¼–¼ the length of the spikelet, 3-nerved, ovate, apex acute, mucronate or abruptly acuminate. Upper glume 4.5–6.7 (–8) mm long, variable in length, equal to subequal to the length of the spikelet body, exceptionally short exceeding the spikelet, abruptly acuminate. Anthers 2–2.5 mm long. Stigmas plumose ...............................................................................................................................................C. parodii

- Synflorescence (50–)55–88 × 47–56 cm. Spikelets (3.5–)4.5 (–5.1) × 2.5–4 mm including awns. Lower glume (2–)3–4.5 mm long, ca. ½ or subequal to the length of the spikelet, 1-nerved, base ovate, abruptly acuminate, short awn ca. 1 mm long. Upper glume (2.5–)3–6 mm long, ca. ¾, equal or exceeding the length of the spikelet body, apex acuminate, the short awn ca. 1 mm long. Anthers 1.7–2 mm long. Stigmas bearded ..................................................................................................................................................C. paucispiculata
FIGURE 6. Foliage leaf blade abaxial epidermis SEM micrographs. Chusquea asymmetrica [from Clark 1113 (AAU)]. A. General view. B. Detail of furrow. Chusquea laegaardii [from Laegaard 101903B (AAU)]. C. General view. D. Detail of stomata. Chusquea parodii [from Beck 26221 (SI)]. E. General view. F. Detail of stomata. Chusquea paucispiculata [from Beck 26225 (SI)]. G. General view. H. Detail of prickle hair. Scale bars = 100 μm for C, G and H, 50 μm for A and E, 20 μm for B and D, 10 μm for F. Abbreviations: In, inflated long cell; Mi, microhair; Pa, papillae; Pr, prickle; St, stomata.
Discussion

Among the woody bamboos, *Chusquea* has long been recognized as a large and diverse genus. In this paper, two new species of *Chusquea*, *C. parodii* and *C. paucispiculata*, are described. These new taxa show some affinity with *C. asymmetrica* based on their vegetative characters. Reproductive features show major differences, but these are seldom available. Collection of complete specimens, which is a difficult task in woody bamboos due to long periods of vegetative growth, allowed us to detect these new species. Micromorphological characters turned out to be useful for taxonomic purposes and may be considered as an additional tool for the identification of the species. Since most woody bamboos are monocarpic, with long vegetative periods, the identification of new anatomical characters is of considerable taxonomic significance contributing to the determination of vegetative material. Regarding foliage leaf blade cross sectional characters, the new species described here may be distinguished by the number of vascular bundles in the keel, the allocation of sclerenchyma over the blade, and the shape of the margin, among others characters (Table 1, Fig. 5). As for epidermal characters, the new species can be distinguished by the presence or absence of ribs, furrows and compound papillae on stomata subsidiary cells, and the abundance of microhairs and prickles on the abaxial epidermis of foliage leaf blades (Table 2, Fig. 6).

Both new species, as well as *C. asymmetrica*, occur sympatrically in a range between 2900 and 3500 m, in the nearly permanent moist upper montane forest of the Yungas, connected to the lower Páramo Yungueño with daily presence of clouds. The annual precipitations range from 4000–5000 mm and mean temperature is around 9–10ºC (Gerold *et al.* 2008). The *Chusquea* species of subg. *Platonia* and subg. *Magnifoliae* grow as individuals, in small assemblies, or occasionally they cover a large area with 100s of plants. In Bolivia, Stephan Beck has observed a particular patch of the newly described species since 1978 and fertile plants were collected for the first time in August 1999. Therefore, their life cycle extends for at least 20 years. After having flowered, the population died and other species of the surroundings invaded the opened gap. Ten years later, a few specimens of these new species were found on the road side and along a small creek. Both of them form dense clumps 1.5–3 m high and 1–2 m in diameter and occur in patches of 100 m². Higher plants are distributed in shady forests and their base is covered with bryophytes and lacerated foliage leaves.

In the dense low forest, the trees are covered with epiphytes, mostly bryophytes but also some orchids. The natural cloud forest is highly diverse, with a lot of endemic species; typical trees are *Podocarpus* L’Héritier ex Persoon (1807: 580), a rare small palm of the genus *Geonoma* Willdenow (1805: 174), different species of *Weinmannia* Linnaeus (1759: 997), *Clusia* Linnaeus (1753: 509), *Brunellia boliviana* Britton ex Rusby (1893: 13), *Ilex teratopis* Loesener (1901: 93), *Llerasia beckii* Cabrera (1982: 281), *Symplocos denticulata* Ståhl (1994: 371), some Melastomataceae and small tree ferns. In open areas, where no trees occur, and on road sides several species of struggling *Chusquea*, such as *C. peruviana* Camus (1913: 53) and *C. renvoizei* Clark (2003: 55), Ericaceae and Lycopodiaceae shrubs are dominant (Beck, pers. obs.).

At present the diagnostic characters of *Chusquea* subg. *Platonia* and subg. *Magnifoliae* are imprecise and insufficient for a correct classification of taxa. According to Fisher *et al.* (2009, 2014), further research using molecular and morphological data, as well as additional taxa and populations, is needed to clarify the positions of some controversial species. A systematic treatment of *Chusquea* subg. *Platonia* and subg. *Magnifoliae*, including keys for the identification of the species based on vegetative and reproductive characters is being undertaken (Vega *et al*., unpublished data).

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References


