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A New Polyploid Species of *Mimosa* (Leguminosae, Mimosoideae) from the Highlands of Southern Brazil

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Abstract—*Mimosa tucumensis* (Leguminosae), a new species from *M. sect. Mimosa* ser. *Mimosa* subser. *Mimosa* is described and illustrated. This taxon is found in southern Brazil (Paraná State), in “campos de altitude,” an environment different from the typical habitat of other entities in this subseries. *Mimosa tucumensis* is morphologically close to *M. debilis*, *M. velloziana*, and *M. sensibilis*, but differs from these principally by the presence of humifuse stems with adventitious roots, considerably longer petioles and peduncles, and foliar venation. In addition, cytological characterization of this new taxon is provided and discussed in relation to the nearest species. This taxon appears to be narrowly restricted to grasslands on a handful of closely adjacent peaks in the Paraná State adding to the notable endemism of this area. On the basis of morphological, cytological, and geographical data, some evolutionary considerations are inferred.

Keywords—Campos de altitude, *Mimosa tucumensis*, Mimosoideae, *Sensitivae*, southern Brazil.

The pantropical and subtropical genus *Mimosa* L. (Leguminosae, Mimosoideae) comprises ca. 540 species (Simon et al. 2011) with an important center of diversification in southern South America: from the Amazon Basin across the Brazilian Planaltine and adjacent areas of Paraguay, Argentina, and Uruguay (Barneby 1991). Within *Mimosa*, de Candolle (1825) established series *Sensitivae* DC. for the Neotropical mimosas with two pairs of leaflets per pinna with the lower inner leaflet reduced or absent, and haplostemonous flowers. Later, Barneby (1991) subordinated this series to subseries *Mimosa* of section *Mimosa* series *Mimosa* with five species for southern South America: *M. velloziana* Mart., *M. platyphylla* Benth., *M. sensibilis* Griseb., *M. debilis* Humb. & Bonpl. ex Willd., and *M. nuda* Benth., and several infraspecific taxa within the last three species.

Recently, this group was revised in southern South America treating *Mimosa nuda* and *M. platyphylla* as conspecific with *M. debilis*, based on morphology and chromosome numbers (Morales and Fortunato 2010; Morales et al. 2010). Here, we describe a new species assigned to subser. *Mimosa* from the state of Paraná (Brazil), found only in subtropical “campos de altitude” (high-altitude grasslands, >1,700 m), an unusual habitat for this subseries.

MATERIALS AND METHODS

Morphological Studies—We examined all types and other specimens of subser. *Mimosa* from the following herbaria: BA, BAA, BAB, BAF, BM, BRADE, CPAP, CTES, FCQ, G, ICN, LIL, LP, MBM, MO, NY, RB, SI, and W. Selected material of *M. debilis*, *M. velloziana*, and *M. sensibilis* was cited in a previous revision (Morales and Fortunato 2010). In addition, the first two authors made several trips to Santa Catarina and Paraná states (Brazil) during 2009–2011 to collect specimens and seeds from populations of the new taxon. We deposited the specimens of these trips in BAB and MBM.

Cytological Studies—To study mitotic metaphase, seeds of *Mimosa tucumensis* were germinated in Petri dishes at 25°C. We collected seeds from material of the voucher specimen Morales et al. 1034 (BAB, MBM). Roots 1–2 cm in length were pretreated with 0.002M 8-hydroxyquinoline at room temperature for 4 hr and then fixed in absolute ethanol–glacial acetic acid (3:1).

The fixed material was conserved in 70% ethanol and later was washed in a buffer solution of 0.01-M citric acid–sodium citrate at pH 4.6 and then transferred to an enzymatic solution containing 2 mL 2% cellulase (Ozonuka R-10, Merck KGaA, Darmstadt, Germany) and 20% liquid pectinase for 75 min at 37°C. The material was washed again with buffer solution. We observed and photographed the chromosome slides with Leyca DMLB microscope, using a DFC350 FX digital camera.

TAXONOMIC TREATMENT

Mimosa tucumensis Barneby ex O. S. Ribas, M. Morales & J. Santos-Silva, sp. nov.—Type: Brazil. Paraná: Campina Grande do Sul, Morro Tucum, 22 Dec 1999, O. S. Ribas, E. Barbosa & J. M. da Silva 2862 (holotype: MBM 242470!; isotype: NY!).

Mimosae debilis similis, sed cum caulibus stoloniferis; folioliis venatione et margine utrimque aequaliter prominentibus; venis secundaris et nervo primario subperpendicularis; pedunculis longioribus 9.7–34.9 cm (nec 0.3–6 cm) bene differt.

Slender, humifuse, procumbent herbs to ca. 30 cm tall. Stems creeping, unarmed, terete or subterete, glabrous, often forming adventitious roots at nodes. Stipules 2–3.5 × 0.5–1 mm, deciduous, triangular–lanceolate, chartaceous or subcoriaceous, brownish, lustrous, glabrous, generally 3–6-nerved. Leaves bipinnate, pinnae conjugate, and 2 pairs of leaflets per pinna, but only three of the four leaflets fully developed, with the inner leaflets of the lower pair reduced to 0.5–1 × 0.4–0.7 mm, triangular or ovate, coriaceous, 1-nerved paraphyllidia; petioles 2.3–27.3 × ± 0.05 cm, subterete, sometimes compressed distally, glabrous or with a few scattered trichomes; interpinnae lacking; rachis of pinnae 7–12 mm; leaflets 1.2–3.2 × 0.5–2 cm, oblanceolate to obovate or oblong, obtuse apex, semicordate base, convex margin, glabrous, coriaceous, 4–5-nerved with a prominent centric to subcentric midrib and craspedodromous secondary venation (sometimes tenuously anastomosed) into a corneous, continuous, and setose margin, subperpendicular, not incurving to the apex; venation and margin prominent in both surfaces. Peduncles 2.6–34.5 × ± 0.5 cm, erect or flexuously

ascending. Capitula 5–10 mm in diam. at anthesis, globose or subglobose, axillary, solitary, moriform in bud. Floral bracts 1–2 mm long, glabrous and weakly setulose on margins. Flowers 4–merous, haplostemonous, sessile; calyx 0.5–1 mm, campanulate, glabrous or tenuously ciliate on apex of lobes, membranous; corolla 2.5–3.5 mm, the lobes \pm 0.75 mm, glabrous, 1-nerved; staminal filaments 5–7.5 mm, pink, anthers 0.25–0.4 mm; ovary glabrous, style 7–7.5 mm and stigma poriform. Fruit a craspedium 1.3–3.3 \times 0.4–0.6 cm, oblong-elliptic, plano-compressed, mucronate, subglabrous, with 2–6 articles, the replum 0.5–1 mm wide, unarmed, subglabrous, weakly undulate in profile. Seeds (few seen) \pm 2–3 \times 2–3 mm, dark brown when mature. Figure 1.

Distribution and Ecology—*Mimosa tucumensis* has been found only in the Serra do Mar, and specifically on the Ibitiraquire mountain range in the state of Paraná, Brazil (Fig. 2). Ranging from a few km up to 50 km from the ocean, this mountain chain lies between the coastal plain and the interior plateau. The vegetation varies from submontane rain forest, with trees to 30 m high in the foothills, to dwarf forests with trees only a few meters high in a single stratum between 1,200–1,500 m altitude above sea level, and ultimately to sub-temperate grasslands above 1,500 m (Roderjan et al. 2002). *Mimosa tucumensis* grows at ca. 1,700 m, extending the distri-

bution of subser. *Mimosa* to sub-temperate, rocky, montane, grasslands, where no other closely related species are found. With the exception of some Bolivian populations, *M. velloziana*, *M. sensibilis*, and *M. debilis* are always found in tropical and subtropical lowlands or submontane regions of the Chaco, Cerrado, and savannas of northeastern Argentina (Barneby 1991; Morales et al. 2010). *Mimosa debilis*, the species morphologically closest to *M. tucumensis*, is scarcely found in the extratropical Paraná State (Fig. 2), and never in the higher altitude grasslands of Serra do Mar (Barneby 1991; Morales et al. 2010; O. S. Ribas pers. obs.).

We hypothesize that *Mimosa tucumensis* is adapted to ecological conditions that are different from the typical habitats of other members of subser. *Mimosa*. These montane grasslands are located in moist temperate environments, with shallow, poorly drained soils with abundant organic matter (Vaschenko et al. 2007), while the typical habitats of subser. *Mimosa* are tropical and subtropical open areas with ferralitic or sandy entisols, ultisols, and oxisols (Morales et al. 2010). The adventitious roots arising from stoloniferous stems are interpreted as adaptations to these poorly developed soils exposed to water lixiviation.

Mimosa tucumensis has been found only on Tucum and Camapuã peaks. Although it is possible that this species

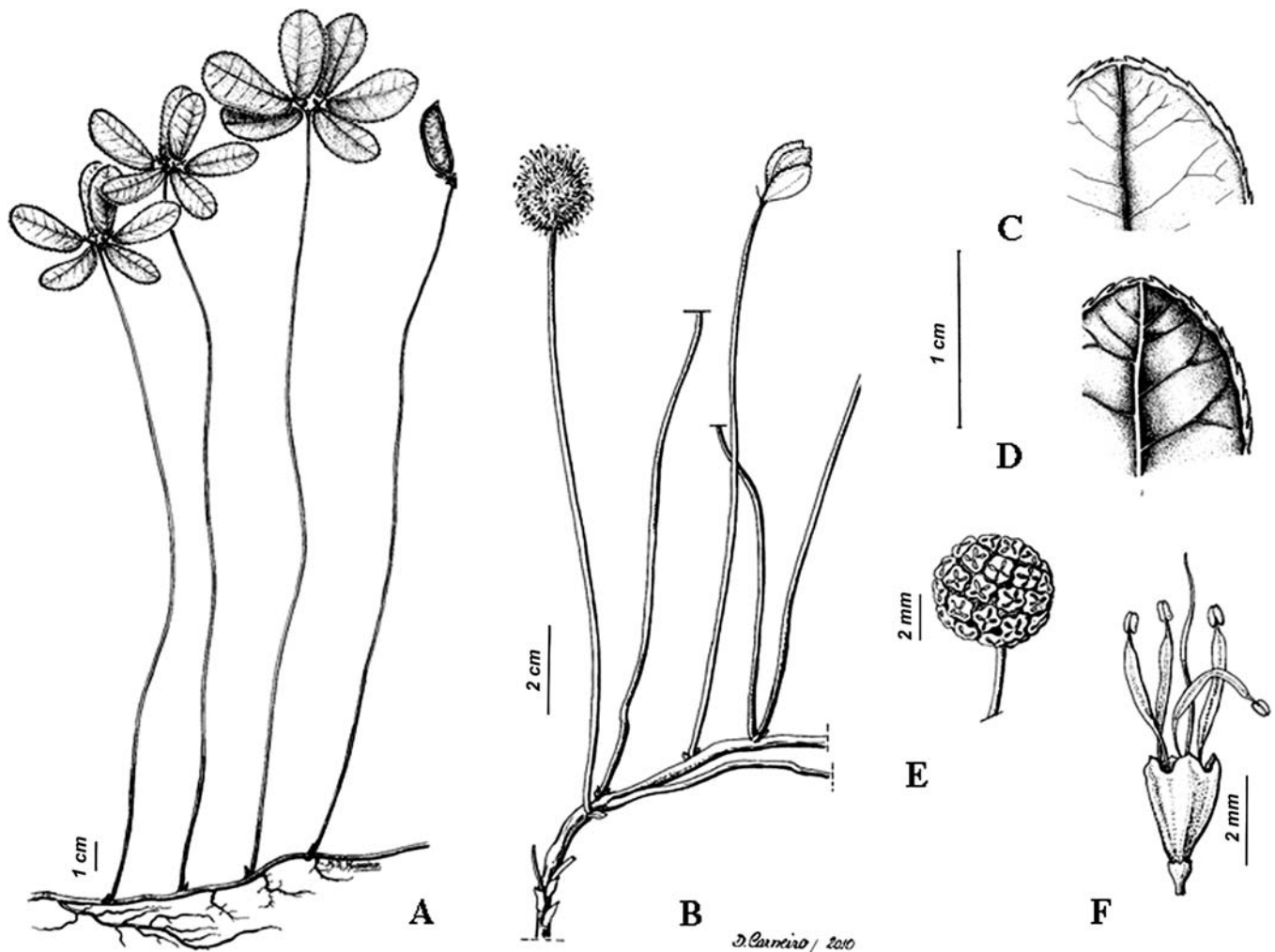


FIG. 1. *Mimosa tucumensis*. A. Fruiting habit. B. Flowering habit. C. Adaxial leaflet surface. D. Abaxial leaflet surface. E. Capitulate inflorescence. F. A single flower. (Fig. 1 A, C, D: Morales et al. 1034, BAB; Fig. 1 B, E, F: Ribas et al. 3077, MBM).

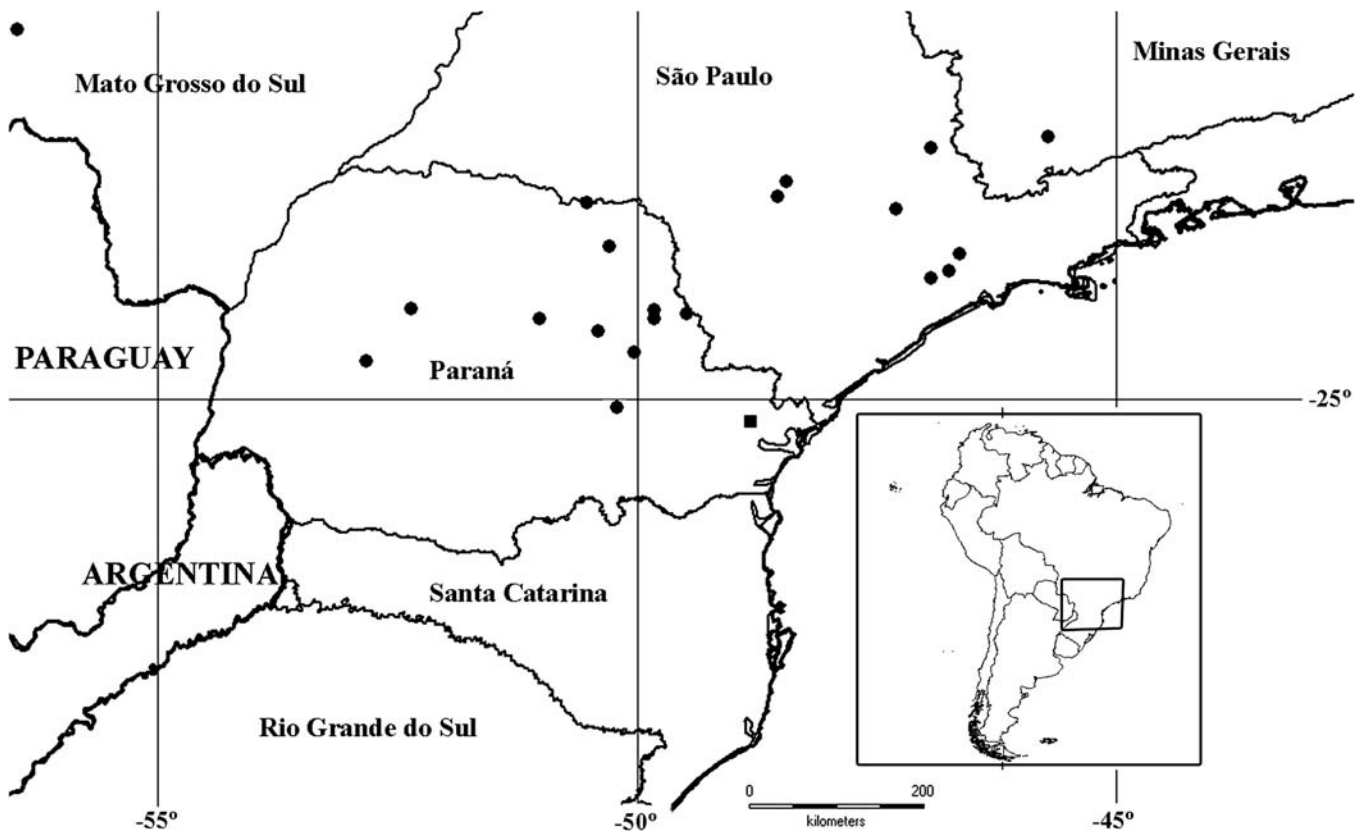


FIG. 2. Geographic distribution of *Mimosa debilis* and *M. tucumensis* in southern Brazil. Square: *M. tucumensis*. Circles: *M. debilis*.

occurs in other parts of the Serra do Mar, we failed to find it in other nearby mountains with campos de altitude (Paraná or Caratuva), suggesting that this species has a restricted distribution. These data also suggest that the environments on Morro Tucum are distinctive, giving rise to distinctive flora and fauna on each mountain (Ribeiro et al. 2005; Alves et al. 2006) and thus are worthy of conservation attention. The highly localized populations increase the extinction risk for narrow endemics like *M. tucumensis*, especially as frequent anthropogenic fires occur in the area (Vaschenko et al. 2007).

Phenology—This species flowers from November to February and fruits in February, May, and July.

Etymology—The specific epithet refers to Pico Tucum, the type locality for the species.

Additional Specimens Examined—BRAZIL. Paraná: Campina Grande do Sul: Serra dos Orgãos, Morro Tucum, 19 Nov 1999, *Cordeiro et al.* 1645 (MBM); idem., 5 Dec 2009, *Lozano et al.* 190 (MBM); idem., 31 May 2009, *Morales et al.* 1034 (BAB, MBM); Serra do Ibitiraquire, Morro Tucum, 3 Feb 2000, *Ribas et al.* 3077 (MBM, NY); idem., 15 Nov 2003, *Scheer et al.* 591 (MBM 301120); Pico Camapuã, 12 Mar 1999, *Roderjan* 1578 (MBM).

Taxonomic Considerations—Barneby (1991) studied the Neotropical mimosas including ca. 480 species in America. Later, he continued studying the genus and describing new taxa (Barneby 1993; 1997). During a visit to the herbarium at Museu Botânico Municipal in Curitiba (Brazil) and to the New York Botanical Garden, two specimens were found that were determined and labeled by Barneby with this name and these were selected as the holotype and isotype, respectively. On the basis of our previous studies in subser. *Mimosa* (Morales and Fortunato 2010; Morales et al. 2010) we realized that the specimens named by Dr. Barneby actually corresponded to a new taxon.

Mimosa tucumensis is placed in series *Mimosa*, subseries *Mimosa*, considering the combination of conjugate pinnae with two pairs of leaflets per pinna, the inner leaflet of each lower pair reduced to a paraphyllidium and haplostemonous flowers. Although this particular leaf formula is also present in two species of subser. *Affines* Barneby: *M. tequilana* S. Watson from Mexico and *M. niomarlei* Afr. Fern. from northern Brazil, both species have small capitula (2.5–4 mm in diameter) with few (12–24) ascending flowers, characters used to distinguish subser. *Affines* (Barneby 1991). The capitula in *M. tucumensis* are 5–10 mm in diameter with many flowers (more than 25) radiating from the receptacle of the inflorescence, characteristic of subser. *Mimosa* (Fig. 1).

Mimosa tucumensis is a humifuse, procumbent, herb with stoloniferous stems and adventitious roots arising from stem nodes as in other *Mimosa* species from temperate areas or rocky soils (Burkart 1948, 1964; Barneby 1991). The growth habit distinguishes *M. tucumensis* from the other species of subser. *Mimosa*, which are all erect or decumbent subshrubs or frutescent herbs. Although certain accessions of *M. debilis* var. *debilis* have prostrate stems, no adventitious roots are observed in that species (Burkart 1948; Barneby 1991; Morales and Fortunato 2010; Morales et al. 2010).

Certain leaflet characters are distinctive for *M. tucumensis*, such as the relatively strong and prominent venation in both surfaces and the secondary nerves that are sub-perpendicular to the midrib and not incurving to the apex. In all specimens of *M. velloziana*, *M. sensibilis*, and *M. debilis* the venation is unequal, more prominent in the abaxial surface, and the secondary nerves are generally incurving to the apex.

Mimosa tucumensis has petioles and peduncles significantly longer than those of *M. debilis*, *M. velloziana*, and *M. sensibilis* with little overlap, providing other clear distinguishing characters (Table 1). This new taxon can also be distinguished from *Mimosa velloziana* and *M. sensibilis* by the stipules, which are chartaceous and brownish, the leaflets oblong to obovate with a continuous and corneous margin and craspedodrome secondary venation, its longer calyx, and narrower pods (Table 1). The latter two species have ovate to lanceolate, papyraceous, and whitish stipules (with the exception of *M. sensibilis* var. *aquidabani* Barneby), leaflets with discontinuous margins and brochidodrome secondary venation, a calyx 0.1–0.5 mm, and pods 6–9 mm wide, usually numerous per capitulum. *Mimosa tucumensis* differs from *M. sensitiva* L. in a diverse range of vegetative and reproductive characters: the last is a strictly tropical subshrub with cat's claw aculei and pappiform calyx, which is more developed than in the rest of the species from subser. *Mimosa* (Barneby 1991).

Cytological and Evolutionary Considerations—The chromosome count of *M. tucumensis* is $2n = 4x = 52$, according to the accession analyzed (Fig. 3), and this is the first report for the species. The same chromosome number is found in other members of subser. *Mimosa*: *M. velloziana* (Seijo 1999) and *M. debilis*, but this last taxon also has a diploid cytotype, with $2n = 2x = 26$ (Seijo 1993, 1999, 2000; Morales et al. 2010; Dahmer et al. 2011). As in *M. debilis*, chromosomes of *M. tucumensis* are smaller than 2 μm long, generally between 0.5 and 1.5 μm (Morales et al. 2010, Morales et al. in press).

It is interesting to point out that *Mimosa tucumensis* and some of the southernmost populations of *M. debilis* that grow in Argentina have the same ploidy level; both are tetraploids and appear in a marginal area of distribution of subser.

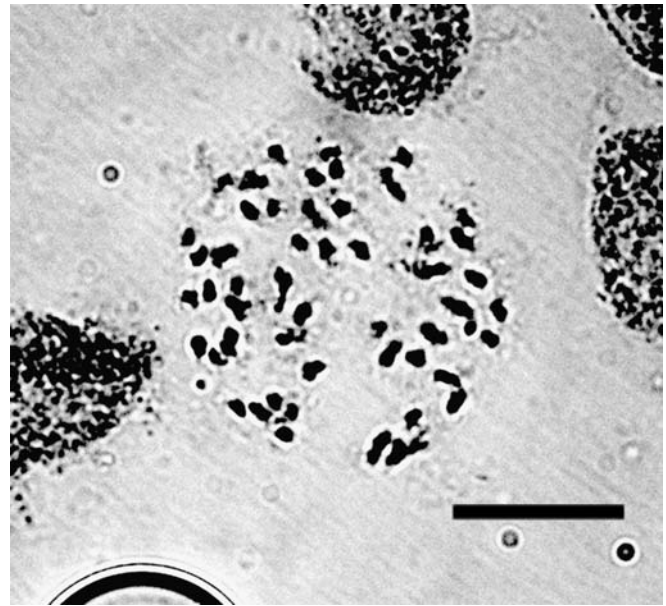


FIG. 3. Chromosomes of *Mimosa tucumensis*. Mitotic prometaphase, $2n = 4x = 52$. Bar = 10 μm .

Mimosa (Seijo 1993, 1999; Morales et al. 2010). Seijo and Fernández (2001) found that the frequency of polyploids in the genus *Mimosa* increases with latitude, possibly related to the better adaptation of polyploids to less favorable ecological conditions. In the case of *M. tucumensis*, environmental conditions appear to be more extreme than in subser. *Mimosa*'s center of diversification, with a colder climate and poorer soils. It is probable that polyploidy contributed to a better adaptation to these areas.

TABLE 1. Morphological characterization of species from *Mimosa* subser. *Mimosa* from Southern Brazil and adjacent areas.

Morphological character	<i>M. tucumensis</i>	<i>M. debilis</i>	<i>M. sensibilis</i>	<i>M. velloziana</i>
Habit growth	Humifuse herb with stoloniferous stems	Subshrubs to frutescent herbs	Subshrubs to frutescent herbs	Procumbent subshrubs
Armament of stems	Unarmed	Unarmed or armed with recurved prickles, not cat's claw aculei	Unarmed or rarely armed with recurved prickles, not cat's claw aculei	Armed stems with cat's claw aculei
Length of larger petioles (cm)	(8.5–)15.6–27.3	0.5–12.3	2.0–5.3	2.1–8.1
Leaflet form	Oblanceolate to obovate or oblong	Oblanceolate to obovate	Ovate to elliptic, rare oblanceolate	Ovate to elliptic
Leaflet apex	Obtuse	Generally acute or mucronate, rare obtuse	Generally acute or mucronate	Generally acute or mucronate
Leaflet pubescence	Glabrous	Glabrous to hispid in both surfaces	Generally glabrous or strigose in lower pair	Generally glabrous or strigose in lower pair
Leaflets, type of secondary venation	Craspedodrome	Craspedodrome, brochidodrome, or eucamptodrome	Brochidodrome	Brochidodrome
Leaflets, orientation of secondary nerves	Subperpendicular	Incurving to the apex	Incurving to the apex	Incurving to the apex
Leaflet margin	Continuous, corneous, setose	Discontinuous to continuous, corneous, glabrous, or setose	Discontinuous, setose	Discontinuous, setose
Length of larger peduncles (cm)	9.7–34.9	0.3–6	0.9–2.7	0.3–2.8
Length of calyx (mm)	0.5–1	0.1–0.5	0.1–0.25	0.2–0.4
Type of calyx	Campanulate	Obsolete or campanulate	Obsolete or campanulate	Obsolete or campanulate
Corolla lobes	Glabrous	Glabrous to pubescent	Glabrous to pubescent	Glabrous to pubescent
Pod width (mm)	4–6	4–5	6–12	6–13
Pod type	Craspedium	Craspedium or legume with entire valves	Craspedium	Craspedium
Pod pubescence	Subglabrous	Glabrous to hispid	Generally hispid in replum	Generally hispid in replum

On the other hand, in subser. *Mimosa*, especially in *M. debilis*, we previously found that tetraploid individuals show high morphological variability and intermediate forms that prevent us from proposing new taxa; in addition, the geographic distribution of the taxonomic or morphological groups appears to be continuous, with ample areas of sympatry (Morales et al. 2010). Despite this, *M. tucumensis* has morphological characters without transitions to other

taxa and the habitat is restricted: its populations appear to be geographically isolated from other species of subser. *Mimosa*. All these data allow us to consider that *M. tucumensis* is a new entity from the highlands of southern Brazil; in this region, other isolated, endemic species of *Mimosa* were previously found (Burkart 1979; Barneby 1991), and it is probable that allopatric speciation could be occurring or could have occurred in this geographic area.

KEY TO *M. TUCUMENSIS* AND RELATED SPECIES FROM SOUTHERN SOUTH AMERICA

1. Humifuse, procumbent herbs with stoloniferous stems, some nodes with adventitious roots. Longer petioles (8.5–)15.6–27.3 cm. Leaflets with venation equally prominent on both surfaces, concolorous on both surfaces and secondary nerves subperpendicular to the midrib. Longer peduncles (in each specimen) 9.7–34.9 cm. Calyx 0.5–1 mm, campanulate, membranous *M. tucumensis*
1. Erect, procumbent or decumbent shrubs or frutescent herbs, sometimes with creeping, but not stoloniferous stems and lacking adventitious roots. Longer petioles 1.5–12.3 cm. Leaflets with venation more prominent on the abaxial surface, discolored between the surfaces and secondary nerves incurving to the midrib. Longer peduncles (in each specimen) 0.3–6 cm. Calyx 0.1–0.5 mm, obsolete or campanulate, membranous, or 0.7–1.6(–2) mm and pappiform 2
 2. Calyx 0.7–1.6(–2) mm, pappiform *M. sensitiva*
 2. Calyx obsolete to 0.5 mm, campanulate, membranous 3
 3. Pods 3–5 mm wide. Leaflets generally oblanceolate to obovate, with secondary venation brochidodrome, eucamptodrome, or craspedodrome, and margin discontinuous or continuous, corneous, setose, or glabrous *M. debilis*
 3. Pods 6–13 mm wide. Leaflets generally ovate to elliptic, with secondary venation brochidodrome and margin discontinuous (rarely continuous in *M. sensibilis* var. *aquidabani*) and setose 4
 4. Nodes of stems and frequently petioles armed with several rows of aculei. Inner leaflets of lower pair of pinnae to 3–13 × 1.5–8 mm, ovate or elliptic. Stipules 3–5–nerved *M. velloziana*
 4. Nodes of stems and petioles unarmed or armed with 1–3 aculei, rare several files of aculei. Inner leaflets of lower pair of pinnae absent or to 2 × 0.5 mm. Stipules 5–plurinerved, rarely 3–nerved *M. sensibilis*

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