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FIRST RECORD OF THE FAMILY MAZACEAE (LAMIALES) IN COLOMBIA AND THE CLARIFICATION OF THE SYNONYMS OF *MAZUS PUMILUS*

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Abstract. Fonseca-Cortés, A. & J. A. Peña-Torres. 2021. First record of the family Mazaceae (Lamiales) in Colombia and the clarification of the synonyms of *Mazus pumilus*. *Darwiniana*, nueva serie 9(1): 245-253.

Mazaceae, a family native to Asia and Oceania, is reported for the first time for the Colombian flora, with *Mazus pumilus* (Burm.f.) Steenis. This species is easily recognized by its herbaceous habit, leaves rosulate, elliptic to obovate cauline leaves, terminal, racemose inflorescences, bilabiate flowers with one 2-lobed upper lip and one 3-lobed lower lip, and fruit completely enclosed in the calyx. To date, this species has been recorded in three departments of Colombia, growing between the pavement. Additionally, we clarify the synonyms of this taxon.

Keywords. Flora of Bogotá; exotic flora; *Mazus*; urban flora.

Resumen. Fonseca-Cortés, A. & J. A. Peña-Torres. 2021. Primer registro de la familia Mazaceae (Lamiales) en Colombia y la clarificación de los sinónimos de *Mazus pumilus*. *Darwiniana*, nueva serie 9(1): 245-253.

Mazaceae, una familia originaria de Asia y Oceanía, es reportada por primera vez para la flora colombiana, con *Mazus pumilus* (Burm.f.) Steenis. Esta especie se reconoce fácilmente por su hábito herbáceo, hojas arrosetadas, alternas, elípticas a obovadas, inflorescencias terminales, racemosas, flores bilabiadas con el labio superior bilobulado y el labio inferior trilobulado y fruto completamente encerrado por el cáliz. A la fecha, esta especie se ha registrado en tres departamentos de Colombia, creciendo entre el pavimento. Adicionalmente, aclaramos los sinónimos de este taxón.

Palabras clave. Flora de Bogotá; flora exótica; flora urbana; *Mazus*.

INTRODUCTION

Mazaceae is a small family native to Asia and Oceania, with ca. 34 species (Deng et al., 2019). It was proposed within the Lamiales (Reveal, 2011) and was separated from Phrymaceae based on several molecular phylogenetic studies (Albach et al., 2005; Xia et al., 2009; Schäferhoff et al., 2010). Mazaceae include four genera, *Mazus* Loureiro, *Lancea* Hook.f. & Thomson, *Dodartia* L. and the recently described *Puchiumazus* Bo Li, D.G. Zhang & C.L. Xiang (Xiang et al., 2021).

Mazus, with ca. 30 species, is the richest genus of the family (Deng et al., 2019). It is distributed in eastern and southeastern Asia, Australia, and New Zealand (Barker, 1991; Hong et al., 1998). China is considered the center of diversification of the genus (Yang, 1979; Hsieh, 2000), with ca. 26 species and three varieties currently recognized (Hong et al., 1998; Deng et al., 2016). This genus is characterized by its herbaceous habit, flowers with zygomorphic corollas, with one 2-lobed upper lip and one 3-lobed lower lip, and fruit usually completely enclosed in the calyx when mature (Xiang et al., 2021).

Mazus pumilus (Burm.f.) Steenis is a species native to South and East Asia (Cao Shu, 1998), and has become established in America and Europe (Kew, 2021a). It grows in wet grasslands, along streams, trailsides, waste fields, wet places, and the edges of forests (Shahid et al., 2013). In Costa Rica and the United States, it has been reported as a naturalized species that appears in urban environments (Nishida et al., 2009; Pringle, 2018 Morales, 2020).

Nowadays, there is a homogenization of the world flora due to the cultivation and the accidentally introduction of foreign species (Mooney & Hobbs, 2000; Cárdenas et al., 2017). Some of these become invasive and cause problems related to species and population declines, habitat degradation, loss of the ecosystem functions, among others (Vitousek et al., 1997). In Colombia, there are reported 1046 exotic species (Bernal et al., 2016) of which only 35 are recognized as invasive (Cárdenas et al., 2017). Recording the exotic species is the first step for making analysis about their invasiveness potential and structuring management plans.

The synonyms of *M. pumilus* has been matter of controversy. Aiton (1812), Sweet (1825), Sweet (1826), Maximowicz (1875), Trautvetter (1884), and Hayata (1908) treated *M. pumilus* as *Mazus rugosus* Lour.; Aiton (1812) just cites as synonym to *Lindernia japonica* Thunb.; Sweet (1825) to *L. japonica*, *Hornemannia bicolor* Willd. and *Gratiola goodenifolia* Hornem. (sic); Sweet (1826) to *L. japonica*, *Titmannia obovata* Bunge and *H. bicolor*; Maximowicz (1875) to *M. vandellioides* Hance (sic), *Vandellia obovata* Walp. (sic), *T. obovata* and *L. japonica*; Trautvetter (1884) to *L. japonica*, *Columnea tomentosa* Roxb.? (sic), *Stemodia tomentosa* G. Don? (sic), *H. bicolor*, *G. goodeniaefolia* (sic), *Trevirania gratiolarum* Roth., *M. vandellioides* (sic), *T. obovata* and *V. obovata*; Hayata (1908) to *M. vandellioides* (sic), *L. japonica* and *M. japonica* (sic). Makino (1901), Matsumura (1912), Ohwi (1965), and Fu-Wu & Yue-Hong (2006) treated *M. pumilus* as *M. japonicus*; Makino (1901) cites as synonyms to *M. rugosus*, *T. obovata*, *V. obovata*, *M. vandellioides* (sic), *H. bicolor*, *M. bicolor*, *G. goodeniaefolia* (sic), *C. tomentosa* and *S. tomentosa*; Matsumura (1912) to *M. rugosus*; Ohwi (1965) is the only one who cites *Lindernia japonica* pro parte for *M. japonicus* and

pro parte for *M. miquelii* Makino, and as synonyms to *M. rugosus* and *T. obovata*; finally Fu-Wu & Yue-Hong (2006) just cites to *M. rugosus* and *L. japonica*. None of these authors cited the location of the types or the reasons for which they included or not some synonyms. Steenis (1958) combined *Lobelia pumila* Burm.f. in *Mazus pumilus* (Burm.f.) Steenis, and mentioned that the synonyms of *M. pumilus* known until the date are *L. japonica*, *M. rugosus*, *M. laevifolius*, and *M. vandellioides* (sic); he only cited the ubication of the type for *M. laevifolius*. Cramer (1981) cited two synonyms for *M. pumilus*, *L. japonica* and *M. rugosus*, and mentioned that the types of these two names are unknown; Cheng-Yih (1984) cited *L. japonica*, *M. rugosus*, *H. bicolor*, *T. obovata*, *V. obovata*, *M. vandellioides* (sic), *M. japonicus*, *M. bodinieri* Bonati pro parte for *M. pumilus* and pro parte for *M. spicatus* Vaniot, and *Lobelia esquirolii* H. Lév. (sic); Smith (1991) to *L. japonica* and *M. japonicus*; Cao Shu (1998) to *H. bicolor*, *L. japonica*, *M. rugosus*, *M. vandellioides*, *T. obovata*, and *V. obovata*; Hsieh (2000) to *M. rugosus* and *L. japonica*, and Moreira & Bove (2008) to *M. japonicus*. None mentioned the types or their ubication or why they included or not some synonyms. In this way, there is no clarity which names are synonyms of *M. pumilus*, in which herbaria are deposited the types or if the types are lost or destroyed.

Herein, the family Mazaceae is reported for the first time for Colombia, with *M. pumilus*. Here we contribute to the knowledge of the Colombian exotic flora and with the clarification of the synonyms of *M. pumilus* and the ubication of their types.

MATERIALS AND METHODS

We made free tours in Bogotá D.C., between January and February of 2021 and collected the individuals in reproductive stage. The herbarium vouchers were deposited in UDBC (herbarium acronyms follow Thiers, 2021). To determine the generic identity of the species, we consulted the pertinent literature on the taxonomy of the Lamiales (Cao Shu, 1998; Deng et al., 2019; Kew, 2021b) and the species of this order reported for Colombia (Bernal et al., 2016). For the circumscription of *Mazus*, we followed Xiang et al. (2021).

For the elaboration of the description, we measured the organs with a digital caliper with an accuracy of 0.01 mm. For the review of the synonyms of *M. pumilus* we consulted in Biodiversity Heritage Library, Scholar Google, Web of Science and Scielo, the publications who included taxonomical treatments or mentioned names related with *Mazus pumilus*, then we analyzed the protologues of these names, available at Biodiversity Heritage Library (www.biodiversitylibrary.org), and saw the types in JSTORPLANTS (<https://plants.jstor.org/>). For the names that did not mention the type, we searched in which herbaria the authors deposited their types (Stafleu & Cowan, 1979) and asking to the curators to search exsiccata with collected by names author or with a label of the name. Finally, for the elaboration of the map, we use the records from our free tours and those of iNaturalist (Naturalista, 2021).

RESULTS AND DISCUSSION

Mazus pumilus (Burm.f.) Steenis, Nova Guinea 9 (1): 31. 1958. Basionym: *Lobelia pumila* Burm. f., Fl. Indica 187, pl. 60, f. 3. 1789. TYPE: Burman, Fl. Indica 187 Ic. pl. 60 f.3 (Lectotype designated by Cramer, 1981). Figs. 1, 2.

Mazus rugosus Lour., Fl. Cochinch. 385. 1790. TYPE: China, Cochinchina, *J. Loureiro s.n.* (holotype: BM-000997856!).

Trevirania gratiolae Roth, in Weber, Beitr. II. 123. 1810. TYPE: *without data* (holotype: M-0188280!).

Mazus laevifolius Blume, Bijdr. Fl. Ned. Ind. 14: 753. 1826. TYPE: Indonesia, Java, Buitenzorg, w.d., w.c. (holotype: L-0003532!).



Fig. 1. *Mazus pumilus*. **A**, habit. **B**, root. **C**, lateral shoots. **D**, variation in the leaf morphology. **E**, upper leaf surface. **F**, lower leaf surface. Photographs: Andrés Fonseca-Cortés. Color version at <http://www.ojs.darwin.edu.ar/index.php/darwiniana/article/view/949/1224>



Fig. 2. *Mazus pumilus*. **A**, inflorescence. **B**, flower in frontal view. **C**, flower side view. **D**, stamens, style and stigma. **E**, fruits. Photographs: Andrés Fonseca-Cortés. Color version at <http://www.ojs.darwin.edu.ar/index.php/darwiniana/article/view/949/1224>

Mazus bicolor (Willd.) Benth., Numer. List. 3913. 1831. Basionym: *Hornemannia bicolor* Willd., Enum. Pl. [Willdenow] 2: 653 1809. TYPE: *without data* (holotype: B -W-11582 -01 0!).

Mazus vandellioides Hance, Ann. Bot. Syst. 3(2): 193. 1852. TYPE: China, Hong Kong, w.d. *Hance s.n.* (holotype: FI-063202).

Lobelia esquirolii H. Lév., Fl. Kouy-Tcheou: 58. 1914. TYPE: China, Kouy-Tcheou, mont du College, IV-1910, *J. Esquirol* 2062 (holotype: E-00284110!).

Mazus goodeniifolius (Hornem.) Pennell, J. Arnold Arbor. 24: 245. 1943. Basionym: *Gratiola goodeniifolia* Hornem., Enum. Pl. Hort. Hafn. 19. 1807. TYPE: *without data* (holotype: C-10019014!).

Prostrate herbs, with one long tap root or with numerous roots, and one to many shoots. Leaves $0.4\text{--}2.4 \times 0.4\text{--}0.8$ cm, basal leaves usually rosulate, cauline leaves alternate; glabrous or with a few trichomes on the margin at the base, elliptic to obovate, base decurrent in the petiole, apex rounded, margin entire, crenulated or with a few teeth, pinnately nerved with

2-4 pairs of secondary veins. Inflorescence 2.5-6.0 cm long; peduncles of 0.5-0.7 cm long, terminal, racemose, glabrous or puberulous. Flowers $0.5\text{--}0.8 \times 0.4\text{--}0.6$ cm, bilabiate, calyx $0.4\text{--}0.5 \times 0.2\text{--}0.3$ cm, tube 0.1-0.2 cm long, glabrous or puberulent, green, with five lanceolate sepals, $0.2\text{--}0.3 \times 0.1\text{--}0.2$ cm, base of the sepals with a red gland; corolla gamopetalous, lilac outside, pale lavender inside with yellow macules, upper petals fused into an emarginate lip, lower petals fused into a trilobate lip, terminal lobe $0.1\text{--}0.2 \times 0.1\text{--}0.2$ cm, lateral lobes $0.3\text{--}0.4 \times 0.2\text{--}0.3$ cm, hairy, with two longitudinal ridges; stamens four, didynamous, filaments 0.2-0.3 cm long, anthers medifixed ca. 0.1 cm long; ovary superior, glabrous, bilocular; style 0.4-0.5 cm long; stigma flabelliform. Fruit a loculicidal capsule with numerous seeds.

Distribution. *Mazus pumilus* is native of Eastern Asia and Oceania (Cao Shu, 1998), and it has spread in many countries of America and Europe (Kew, 2021a). In Colombia (Fig. 3), this species has been collected in Bogotá D.C., and has been recorded in Medellín, Antioquia and in Granada municipality, Meta (Naturalista, 2021), growing between the pavement.



Fig. 3. Records of *Mazus pumilus* in Colombia, the red point correspond where this species were collected for the first time, the blue points were taken from iNaturalist (Naturalista, 2021). Map: Jairo A. Peña-Torres.

Etymology. *Mazus* from the Greek, “μαστός”, breast, alluding to the two ridges on the lower lip of corolla and *pumilus* from the Latin “*pūmilus*” that means dwarf, alluding to the small size of this species.

Uses. Pharmacological studies show that *M. pumilus* is a promising species for medicinal use and treatment, Priya & Rao (2016) report anticancer and antioxidant activity of various leaf extracts of *M. pumilus*. This taxon also possesses antibacterial and antifungal properties (Safdar et al., 2017). Ishtiaq et al. (2019) demonstrated the anti-nociceptive, anti-inflammatory and hepatoprotective effects of the methanol extract of *M. pumilus*. Additionally, this species has wide medicinal uses in the local and popular tradition.

In India, mainly in the Jammu and Kashmir states, indigenous local communities use the leaves of *M. pumilus* to treat epilepsy (Sharma et al., 2013). In urban regions of India, the whole herb is utilized as an antifebrile, emmenagogue and aperitive (Mishra et al., 2015) and the infusion is consumed as tonic (Vardhana, 2008).

Examined material

COLOMBIA. Cundinamarca. Bogotá D.C., Engativá, Unicentro de Occidente, 4°43'22.1"N 74°06' 5.3" W, 2600 m, 27-I-2021, *A. Fonseca-Cortés* 1338 (UDBC); Bogotá D.C., Engativá, Ciudadela Colsubsidio, 4°43'14.4" N 74°06'57.0" W, 2600 m, 24-II-2021, *A. Fonseca-Cortés & J. Peña-Torres* 1450 (UDBC); Barrios Unidos, Museo de Los Niños, 4°39'42.38" N 74°05'18.65" W, 2600 m, 24-II-2021, *A. Fonseca-Cortés & J. Peña-Torres* 1451 (UDBC); Bogotá D.C., Barrios Unidos, Parque del Salitre, 4°39'58.93" N 74°05'19.35" W, 2600 m, 24-II-2021, *A. Fonseca-Cortés & J. Peña-Torres* 1452 (UDBC).

COMMENTS

Burman (1768) in his description of *Lobelia pumila* just cites an illustration (Tab 60 f.3) present in the same publication, and he does not mention any exsiccata. Steenis (1958) mentions that the type of *Lobelia pumila* is at G. There are two exsiccata at G of the collection of Burman, G-00096392 and G-00096393, the former has a label of “TYPE” and the latter of “TYPE DUPLICATE”. However, there is no clarity if that labels were put by Steenis or not. Cramer (1981) states the illustration mentioned by Burman (1768) as the type. Therefore, Steenis (1958) did not lectotypified *L. pumila* (article 7.11, Turland et al., 2018), but Cramer (1981) did (article 9.12, Turland et al., 2018).

After the search in the herbaria, we found all the types of the synonyms listed in the introduction except for *Tittmannia obovata*, for which we cannot contact the curator of the herbarium in which it is probably deposited (LE) (Stafleu & Cowan, 1979).

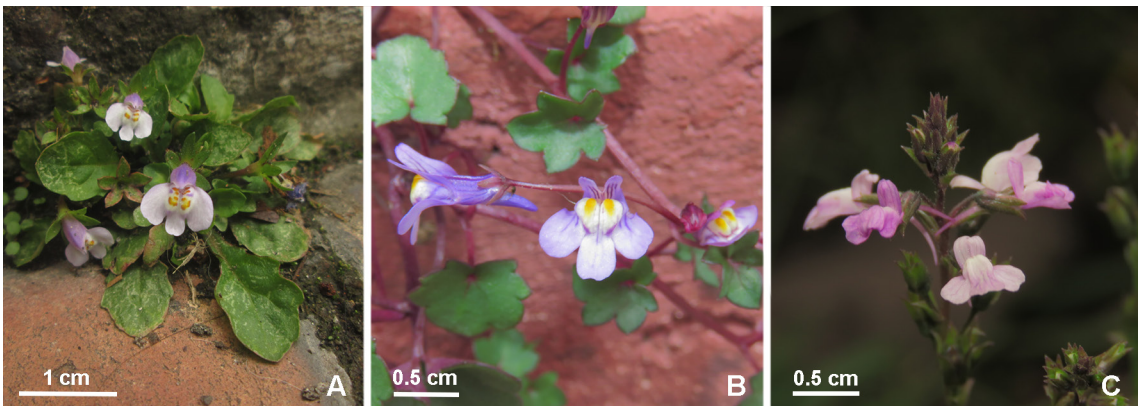


Fig. 4. Genus and species morphologically similar to *M. pumilus*. **A**, *Mazus pumilus*. **B**, *Cymbalaria muralis*. **C**, *Nuttallanthus* sp. Color version at <http://www.ojs.darwin.edu.ar/index.php/darwiniana/article/view/949/1224>

The analysis of the types and of the protologues allow us to confirm that the names cited in the different treatments listed in the introduction, with the exception of *Columnea tomentosa*, *Stemodia tomentosa*, *Lindernia japonica*, *Mazus bodinieri* and *Tittmannia obovata*, are synonyms of *M. pumilus*. The holotype of *M. laevifolius* is at L (L-0003532); the holotype of *M. rugosus* is at BM (BM-000997856); the holotype *M. vandelliioides* is at FI (FI-063202); the holotype of *Hornemannia bicolor* is at B (B-W-11582 -01 0), the holotype of *Lobelia esquirolii* is at E (E-00284110), the holotype of *Trevirania gratiolarum* is at M (M-0188280!) and the holotype of *Gratiola goodenifolia* is at C (C-10019014).

There are two collections at UPS collected by Thunberg and determined as *L. japonica* by him, UPS-14334 (which has written *Lindernia japonica* α) and corresponds to *M. miquelii* Makino, and UPS-14335 (which has written *Lindernia japonica* β) and corresponds to *M. pumilus*. Of the treatments of *Mazus*, only Ohwi (1965) treats the problem and mention *L. japonica* pro parte for *M. miquelii* and *L. japonica* pro parte for *M. japonicus*. However, none has purposely or not tried to lectotypified this name. The original description of *L. japonica* does not cite the α or β, but mentions “ramis... erectiusculis... pollicaribus usque spithamaeis” (Thunberg, 1784); which means, branches... erect... of one to seven inches, this length is only present in *M. miquelii*.

In this sense, here We propose UPS-14334 as the lectotype for *L. japonica*, due to their description fits better with *M. miquelii*.

When Bunge (1831) described *Tittmannia obovata*, mentioned “subsessilibus, glandulosus-pubescentibus”, *M. pumilus* does not present glandular indumentum (Pringle, 2018). Additionally, we can’t analyze the type of this name. Therefore, we could not verify this name as a synonym of *M. pumilus*.

Walpers (1844) mentions “V. (TITTMANNIA Bnge) OBOVATA Wlprs. Mss.”. Maximowicz (1875), Cao Shu (1998), IPNI (2021) and Tropicos (2021) cite this name as *Vandellia obovata* Walp. However, Walpers (1844) did a combination for the name *Tittmannia obovata* Bunge. For this reason, this name should be written as *Vandellia obovata* (Bunge) Walp., and not as *Vandellia obovata* Walp., following the article 41.1 (Turland, et al., 2021).

Although Hornemann (1807) wrote *Gratiola goodenifolia* and Blume (1826) wrote *Mazus laevifolia*, these names should be written as *Gratiola goodeniifolia* and *Mazus laevifolius* following the article 60.10 and 23.5 respectively (Turnland et al., 2018).

Despite Cheng-Yih (1984) listed to *M. bodinieri* Bonati pro parte as a synonym of *M. pumilus*, the analysis of the syntypes listed by Bonati (1908) and disponible at JSTORPLANTS (*P. bodinieri*, 1593, is not present in this platform neither in the virtual collections of P), shows that

Table 1. Differences between *Mazus pumilus* and morphological similar species.

Characters	<i>Mazus pumilus</i>	<i>Cymbalaria muralis</i>	<i>Nuttallanthus</i> sp.
Habit	Rosulate	Reptant	Erect
Leave form	Elliptic to obovate	Palmate	Linear-oblong
Margin type	Irregularly sinuate	Entire	Entire
Inflorescence type	Terminal raceme	Axillar and solitary	Terminal raceme
Spur	Absent	Present	Present

this name is actually a synonym of *M. spicatus*, as reported by Cao Shu (1998). As no author has designated a lectotype for *M. bodinieri*, here we propose to *H. Wilson 931* (E-00284117), following the article 9.12 (Turland et al., 2018).

The holotype of *C. tomentosa* (LINN-HS1102-6) presents bigger plants, wider leaves and serrate margins, characters not seen in *M. pumilus*, for this reason we do not include it in the synonymy.

Mazus pumilus could be confused with *Cymbalaria muralis* G. Gaertn., B. Mey. & Schreb (Plantaginaceae) (Fig. 4b), and the genus *Nuttallanthus* D.A. Sutton (Plantaginaceae) (Fig. 4c), but it is clearly distinguished from these by the characters listed in the Table 1.

In Bogotá there are many plant nurseries, which usually import species from other countries. These plants come with soil, which usually carries seeds of other foreign species (Cárdenas et al., 2017). Due to the lack of control, many exotic species have gotten in Colombia (Cárdenas et al., 2017). In this way, *M. pumilus* probably arrived with imported species, and then become established in the urban zones, as reported in Costa Rica (Nishida et al., 2009; Morales, 2020) and the United States (Pringle, 2018).

Mazus pumilus has been reported as an annual species (Barker, 1991; Shahid et al., 2013; Pringle, 2018). However, we saw great patches covered by this species. Although its inflorescence is terminal, this species can produce many lateral shoots (Fig. 1c) and two or more inflorescences (Fig. 2a), which fits with the concept of perennial species (Albani & Coupland, 2010). In this sense, *M. pumilus* can be an annual or perennial species, and the expression of one of these habits is probably related with the environmental conditions, as reported in *Mimulus guttatus* DC. (Phrymaceae) (Baker & Diggle, 2011).

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