



## ***Hierobotana* Briq., an intriguing monotypic genus of tribe Verbenaeae (Verbenaceae)**

NATALY O'LEARY\* & PABLO MORONI

Instituto de Botánica Darwinion, Labardén 200, CC 22, B1642HYD San Isidro, Buenos Aires, Argentina.

\*Email: [noleary@darwin.edu.ar](mailto:noleary@darwin.edu.ar)

### **Abstract**

*Hierobotana* is a monotypic genus that belongs to tribe Verbenaeae and is endemic to Ecuador. It is morphologically distinct from the other genera of Verbenaeae in having only two functional stamens instead of four, as occur in most Verbenaceae. In the present work the relationship between *Hierobotana* and the other genera of Verbenaeae is examined for the first time. Its single species, *Hierobotana inflata*, is described and illustrated and a key to the genera of tribe Verbenaeae is provided.

**Key words:** *Hierobotana*, South America, systematics, taxonomy, Verbenaceae

### **Introduction**

Verbenaceae is represented by 34 genera, assembled in 8 tribes (Atkins 2004, Marx *et al.* 2010). Tribe Lantaneae, followed by tribe Verbenaeae, are the two biggest tribes in the family in regard to the number of species (Lu-Irving 2013). Tribe Verbenaeae includes five genera: *Glandularia* Gmelin (1791[1792]: 886, 920), *Hierobotana* Briquet (1895: 148), *Junellia* Moldenke (1940: 392), *Mulguraea* O'Leary & Peralta (2009: 782) and *Verbena* Linnaeus (1753: 18). These genera all share the presence of fruit divided into 4 units, called cluses, as a consequence of the separation of the fruit longitudinally along the transverse plane of the ovary. This constitutes a nonhomoplasious synapomorphy of tribe Verbenaeae (O'Leary *et al.* 2012). The “Verbena complex”, as genera from tribe Verbenaeae have been referred (Yuan & Olmstead 2008a), is a rapidly diversifying group.

*Junellia* and *Mulguraea*, as recently circumscribed, are both monophyletic genera (O'Leary *et al.* 2009, 2011); *Junellia* is morphologically supported by a narrowed cluse base, *Mulguraea* is supported by connective tissue surpassing the thecae and monobotrya inflorescences (absence of axillary florescences) (O'Leary *et al.* 2012).

*Verbena* and *Glandularia* are strongly supported as monophyletic by several genes, though several other genes provide evidence of introgression and chloroplast transfers (Yuan & Olmstead 2008 a, b; Yuan *et al.* 2010), which is not surprising given the close relationship between these genera. Furthermore, morphological features, in addition to chromosome counts, strongly differentiate these two genera (O'Leary *et al.* 2012). *Verbena* is supported by the presence of a short style and basic chromosome number  $x=7$ , while *Glandularia* is supported by the presence of divided leaf blades, glandular anther appendices and basic chromosome number  $x=5$ .

*Hierobotana* was first described by Kunth (1818) as *Verbena inflata*, and in spite of the presence of only two stamens, the author placed it under *Verbena*. Later on, Briquet (1895) transferred it to a new genus, *Hierobotana*, arguing that the composition of the androecium was different enough to establish the new genus. Since then, no further studies have been done, nonetheless based on the fruit morphology (4 cluses) subsequent authors place this genus in the tribe Verbenaeae (Troncoso 1974, Atkins 2004). This inclusion within tribe Verbenaeae has been recently confirmed by molecular phylogenetic studies (Marx *et al.* 2010).

*Hierobotana* is a monotypic genus, present in the central Andean region of Ecuador, distinguished because it has only two stamens and no staminodes. Two stamens are also present in *Stachytarpheta* Vahl (1804: 205) (tribe Duranteate), a genus with ca. 90 species, widely distributed along tropical and subtropical America with some

species introduced in Australia, Asia and Africa. In addition to two functional stamens, *Stachytarpheta* species also have two abaxial staminodes, arranged didynamously (Atkins 2005; O’Leary *et al.* 2012).

*Junellia* and *Mulguraea* are strictly South American genera, while *Glandularia* and *Verbena* both exhibit a distributional pattern with disjunctions between the arid regions of temperate North and South America (Umber 1979, O’Leary *et al.* 2007, 2010). In both *Glandularia* and *Verbena*, the direction of migration has been confirmed to be from South America to North America (Yuan & Olmstead 2008), but no evidence of a possible Andean migration route was found. Classical taxonomic treatments on central Andean species of *Verbena* suggest that they are part of the South American *Verbena* group, series *Pachystachyae* Schauer (1847: 546) (O’Leary *et al.* 2007).

The phylogenetic position of *Hierobotana* is not certain given that the only molecular study using chloroplast genes (Marx *et al.* 2010) place it as sister group to *Verbena* series *Verbena* (O’Leary *et al.* 2010) suggesting that this taxon may be a remnant of an Andean migration route by which genus *Verbena* colonized North America. This makes *Hierobotana* an intriguing taxon from an evolutionary point of view, as a result of its morphological facet (2 stamens) and phylogenetic position. Additional sampling of tribe Verbenae taxa from Bolivia to Ecuador will be needed to test this hypothesis.

## Material & Methods

Morphological studies were carried out on specimens from the following herbaria: AAU, COL, K, MO, NY, P, SI, TEX, US (Thiers 2013).

## Results

### Key to the Genera of Tribe Verbenae

1. Flowers with two stamens..... *Hierobotana*
1. Flowers with four stamens ..... 2
2. Subshrubs or cushion plants, cluse base narrowed, inflorescences generally unbranched (sometimes with simple branching), base chromosome number  $x = 9$  or  $x = 10$  ..... 3
2. Herbs or suffruticose plants, cluse base thickened, branched inflorescences (at times condensed and appearing simple), base chromosome number  $x = 5$  or  $x = 7$  ..... 4
3. Anther connective never surpassing the thecae ..... *Junellia*
3. Anther connective surpassing the thecae ..... *Mulguraea*
4. Style generally more than 3 times longer than ovary, mature calyx usually longer than fruit and with teeth generally contorted, chromosome number  $x = 5$ ..... *Glandularia*
4. Style never more than 3 times longer than ovary, mature calyx shorter than fruit and with teeth not contorted, chromosome number  $x = 7$ ..... *Verbena*

## Taxonomic Treatment

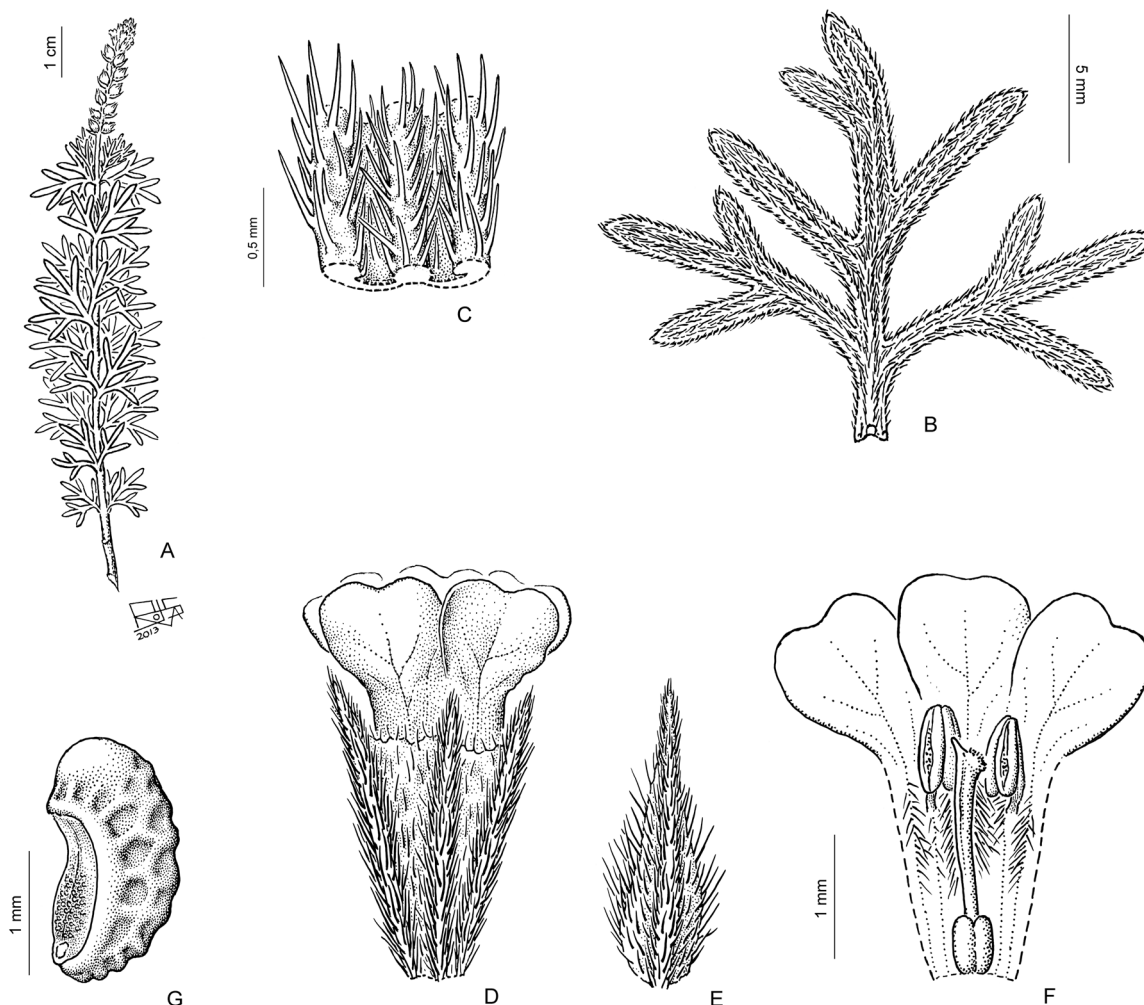
*Hierobotana* Briquet (1895: 148). Type species. *Hierobotana inflata* (Kunth) Briquet.

*Hierobotana inflata* (Kunth 1818: 273) Briquet (1895: 148). *Verbena inflata* Kunth.

Type:—[Ecuador] “locis aridis regno Quitensi juxta Mulalo, Riobamba et Tambillo, alt. 1500” *H. A. Humboldt & A. Bonpland* (holotype P barcode 136081!, isotypes B-W 11116 -010!, F barcode 074518F!, HAL barcode 115256!, P barcode 713620!, SI barcode 3709!). Figure 1.

Procumbent suffruticose *plants*, canescent, hirsute pubescence in stems, internodes 7–25 mm long. *Leaves* sessile, fasciculate, blade 8–25 × 15–20 mm, bipinnatisected to 3 sected with central segment again 3–sected, segments narrow, sericeous-strigose pubescence, somewhat fleshy texture, base subobtusate, apex acute, margin entire subrevolute. *Inflorescences* in heterothetic pleiobotrya, composed of frondose paracladia, lateral paracladia surpassing principal florescence. Florescences dense, plurifloral, 1–4(–5) cm long, rachis enlarged in fructification, basal internode 0.5–3 cm long. *Floral bracts* sublinear, 2–3 mm long, strigose, with some sparse glandular hairs. *Calyx* 2–4 mm long, acute teeth 1–1.2 mm long, densely strigose, with some sparse glandular hairs. *Corolla* white

to pink colored, tube 3–5 mm long, external surface and fauce puberulous. Two stamens, inserted near the middle of the tube, style 1–1.5 mm long. *Fruit* obovoid, 4 cluses, each cluse 1.5–2 mm long, narrowed base, rounded apex, faintly reticulate dorsal surface.



**FIGURE 1.** Diagnostic features of *Hierobotana inflata*. A. Stem with florescence. B. Leaf, abaxial surface. C. Detail of leaf pubescence, adaxial surface. D. Flower. E. Floral bract. F. Open corolla with gynoecia and androecia. G. Cluse, lateral view. Illustration by Francisco Rojas of specimen from “Ecuador, Tungurahua: Sine loc., Octubre 1836, sine legit” (SI).

**Distribution and habitat:**—This genus is endemic to Ecuador. MacBride (1960: 631) mention it as occurring in Perú, however the specimen cited is not *Hierobotana* but *Junellia fasciculata* (Bentham 1844: 153) N. O’Leary & P. Peralta (in O’Leary *et al.* 2011: 56), a very similar looking plant.

*Hierobotana inflata* is found in dry ground, with sandy or volcanic ash soil. It is a crawling, low growing and spreading plant.

**Common name:**—Known as “verbenilla”.

**Specimens examined:**—ECUADOR. Chimborazo: Alausí, 7 May 1956, *Asplund 20464* (TEX); Guamote, October 1952, *Fagerlind & Wibom s.n.* (TEX); Tixán, 3500 m, 31 August 1954, *Rant-Himh E49* (TEX); entre Chunchí y Riobamba, Punto Chipó, 3180 m, June 1959, *Barclay 8216* (COL, NY); Riobamba, 9 May 1939, *Asplund 5932* (US); Riobamba, *Rimbach 176* (US); Guamote, 27 August 1918, *Rose 22400* (US); Riobamba, 2500–3000 m, 30 November 1880, *Lehmann 174* (US). Cotopaxi: Cordillera de Angamarca y Zumbagua, paramo Milín, 3700 m, July 1959, *Barclay 7985* (COL, MO). Imbabura: Laguna San Pablo, 0–2 km along the river towards Otavalo, 2600 m, 18 November 1981, *Filskov 37185* (AAU); near Otavalo, 18 July 1978, *Hart 1712* (US), en la cima del Sinllar, 13 Febrero 1921, *Firmin 366* (US). Pichincha: Cordillera Occidental, 5 km N of Pomasqui, 25 km

NNE Quito, 2640 m, 17 January 1945, *Fosberg 22537* (COL, US); Near Mariscal Sucre Airport, 15 July 1979, *Lojtnant 15983* (AAU); Quito, around Universidad Católica, 14 July 1979, *Lojtnant 15924* (AAU); Vía Mitad del Mundo, Calacalí, 7 April 1979, *Jaramillo 931* (AAU); Panamerican HWY, 1 km N Equator, 2636 m, 24 July 1955, *Asplund 17069* (K, TEX, US); 2 km N san Antonio, 2450 m, 11 April 1973, *Humbles 6199* (AAU, TEX); Quito, 10 km N town, 2750 m, 1 May 1955, *Asplund 16145* (K, TEX); Quito, 5 March 1930, *Benoist 2091* (P, SI); Andes Quitensis, December 1858, *Sparew 5891* (K). Tungurahua: Sine loc., Octubre 1836, sine legit “det Botta 1985” (P, SI); Ambato, 31 March 1931, *Benoist 4122* (P, SI), Ambato, Mocha, July 1939, *Sandeman s.n.* (K); Along FFCC, near Cevallos, 15 April 1945, *Camp E-2427* (US); Hill above Laguna de Yambo, 9 N Ambato, 2860 m, 26 January 1945, *Fosberg 22551* (US); Ambato, 2600m, 21 September 1923, *Hitchcock 21737* (US); Ambato, Ficoa, February 1919, *Pachano 144* (US); idem, *Pachano 156* (US); Luisa, October 1918, *Rose 23906* (US).

## Acknowledgments

This work has received financial support from CONICET PIP 112-200801-00177 to the first author. A special thank is given to Tom Wendt, curator from TEX, and to staff and herbaria curators of AAU and US, and to Francisco Rojas for the illustration. We express thanks to M.J. Belgrano for valuable comments and critical reading.

## References

- Atkins, S. (2004) Verbenaceae. In Kadereit, J.W. (ed.), *The Families and Genera of Flowering Plants*, vol. 7. Springer-Verlag, Berlin, Germany, pp. 449–468.
- Atkins, S. (2005) The genus *Stachytarpheta* (Verbenaceae) in Brazil. *Kew Bulletin* 60(2): 161–272.
- Bentham, G. (1844) *The Botany of the Voyage of H.M.S. Sulphur*. Smith, Elder and Co., London, 269 pp.
- Briquet, J. (1895) Verbenaceae. In: Engler, A. & Prantl, K. (eds.). *Die Natürlichen Pflanzenfamilien nebst ihren Gattungen und wichtigeren Arten, insbesondere den Nutzpflanzen, unter Mitwirkung zahlreicher hervorragender Fachgelehrten begründet* IV, 3a. Wilhelm Engelmann, Leipzig, pp. 132–182.
- Gmelin, J.F. 1791[1792] *Glandularia*. *Systema Naturae* . . . editio decima tertia, aucta, reformata 2: 886, 920.
- Kunth, C.S. (1818) Verbenaceae. In: Humboldt, F., Bonpland, A. & Kunth, C.S. *Nova Genera et Species Plantarum* (quarto ed.) 2. Lutetiae Parisiorum [Paris]: Sumtibus Librairie Graeco-Latino-Germanicae, pp. 244–285.
- Linnaeus, C. (1753) *Species Plantarum* T. 2. Holmiae: Impensis Laurentii Salvii.
- Lu-Irving, P. & Olmstead, R.G. (2013). Investigating the evolution of Lantaneae (Verbenaceae) 600 using multiple loci. *Botanical Journal of the Linnean Society* 171: 103–119.  
<http://dx.doi.org/10.1111/j.1095-8339.2012.01305.x>
- Macbride, J.F. (1960) Verbenaceae. In: Flora of Perú. *Field Museum of Natural History. Botanical series* 13 (5/2): 609–721.
- Marx, H., O’Leary, N., Yuan, Y., Lu-Irving, P., Tank, D., Múlgura, M.E. & Olmstead, R. (2010) A molecular phylogeny and classification of Verbenaceae. *American Journal of Botany* 97(10): 1647–1663.  
<http://dx.doi.org/10.3732/ajb.1000144>
- Moldenke, H.N. (1940) Contributions to the Flora of Extra Tropical South America. *Lilloa* 5: 392–403.
- O’Leary, N., Múlgura, M.E. & Morrone, O. (2007) Revisión taxonómica de las especies del género *Verbena* (Verbenaceae): serie Pachystachyae. *Annals of the Missouri Botanical Garden* 94: 571–621.  
[http://dx.doi.org/10.3417/0026-6493\(2007\)94\[571:rtdled\]2.0.co;2](http://dx.doi.org/10.3417/0026-6493(2007)94[571:rtdled]2.0.co;2)
- O’Leary, N., Yuan, Y.W., Chemisquy, A. & Olmstead R.G. (2009) Reassignment of species of paraphyletic *Junellia* s.l. to the new genus *Mulguraea* (Verbenaceae) and new circumscription of genus *Junellia*: molecular and morphological congruence. *Systematic Botany* 34(4): 777–786.  
<http://dx.doi.org/10.1600/036364409790139691>
- O’Leary, N., Múlgura, M.E. & Morrone, O. (2010) Revisión taxonómica de las especies del género *Verbena* L. (Verbenaceae) II: serie Verbena. *Annals of the Missouri Botanical Garden* 97: 369–428.  
<http://dx.doi.org/10.3417/2007070>
- O’Leary, N., Peralta, P. & Múlgura, M.E. (2011) Sinopsis taxonómica y nomenclatural del género *Junellia* (Verbenaceae). *Darwiniana* 49(1): 47–75.
- O’Leary, N., Calviño, C., Martínez, S., Olmstead, R.G. & Múlgura, M.E. (2012) Evolution of morphological traits in Verbenaceae. *American Journal of Botany* 99(11): 1778–1792.  
<http://dx.doi.org/10.3732/ajb.1200123>
- Schauer, J.C. (1847) Verbenaceae. In: De Candolle, A.P., *Prodromus Systematis Naturalis Regni Vegetabilis* 11. Sumptibus Sociorum Treuttel et Würtz, Paris, pp. 522–700.

- Thiers, B. [continuously updated, accessed 2013] Index Herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium, <http://sweetgum.nybg.org/ih>.
- Troncoso, N.S. (1974) Los géneros de Verbenaceas de Sudamérica extratropical. *Darwiniana* 18: 295–412.
- Umber, R.E. (1979) The genus *Glandularia* in North America. *Systematic Botany* 4: 72–102.  
<http://dx.doi.org/10.2307/2418666>
- Vahl, M. (1804) *Enumeratio Plantarum I. N. Mölleri et Filii*, Copenhagen.
- Yuan, Y.-W., Liu, C., Marx, H.E. & Olmstead, R.G. (2010) An empirical demonstration of using PPR (pentatricopeptide repeat) genes as phylogenetic tools: Phylogeny of Verbenaceae and the *Verbena* complex. *Molecular Phylogenetics and Evolution* 54: 23–35.  
<http://dx.doi.org/10.1016/j.ympev.2009.08.029>
- Yuan, Y.-W. & Olmstead, R.G. (2008a) A species-level phylogenetic study of the *Verbena* complex (Verbenaceae) indicates two independent intergeneric chloroplast transfers. *Molecular Phylogenetics and Evolution* 48: 23–33.  
<http://dx.doi.org/10.1016/j.ympev.2008.04.004>
- Yuan, Y.-W. & Olmstead, R.G. (2008b) Evolution and phylogenetic utility of the PHOT gene duplicates in a recently diversified group: Dramatic intron size variation and footprint of ancestral recombination. *American Journal of Botany* 95: 1166–1176.  
<http://dx.doi.org/10.3732/ajb.0800133>