

## Foliar micromorphology in the classification of South American *Hybanthus* species (Violaceae)

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The infrageneric classification of *Hybanthus* subgen. *Ionidium* (Violaceae) is unclear and needs to be redefined. In the present study, it is proposed to be separated into five clearly distinct sections, based on the leaf micromorphology, according to the presence or absence of different trichomes and papillae. Scanning electron microscopy provided evidence supporting changes in the systematics of *Hybanthus* subgen. *Ionidium*. Five well-defined leaf micromorphological types were identified for the South American species studied. Additionally, three new sections are established in this study: *Hybanthus* sect. *Ionidium*, *Hybanthus* sect. *Parviflorae* and *Hybanthus* sect. *Pombaliae*. *Hybanthus atropurpureus* is designated as the lectotype of *Hybanthus* sect. *Micranthae*.

### Introduction

*Hybanthus* subg. *Ionidium* (Violaceae) is a tropical and subtropical taxon comprising more than 100 species (Bennett 1972). With more than 45 species it includes the largest number of the South American species (Schulze-Menz 1936, Ballard *et al.* 2005), mostly distributed in Argentina, Brazil, Paraguay and Uruguay (Xifreda & Sanso 1999, Sanso *et al.* 2008).

Schulze-Menz (1936), who revised the taxonomy of *Hybanthus* subg. *Ionidium* in South America, subdivided it into four sections: *Anomalae* (“*Anomali*”): *Micranthae* (“*Micranthi*”):

*Bigibbosae* (“*Bigibbosi*”) and *Suffruticosae* (“*Suffruticosi*”). After revising the genus based on specimens from Argentina, Sparre (1950) recognized two sections, *Micranthae* and *Anomalae* and suggested the circumscription of three new groups, *Parviflorae*, *Oppositifoliae* and *Alternifoliae*, but these names were not validly published. Bennett (1972), who studied the classification of the Australian *Hybanthus*, included two taxa in *H.* sect. *Suffruticosae* and the remaining taxa in another section, *H.* sect. *Variabiles*.

The infrageneric classification of *Hybanthus* subg. *Ionidium* is still largely unresolved and the taxonomic position of these sections and

the relationship among them need to be clarified. The complexity of the sectional treatment is related to the lack of a clear morphological delimitation of species.

Recent molecular studies dealing with *Violaceae* (Feng *et al.* 2005, Tokuoka 2008) have shown that *Hybanthus s. lato* is not a monophyletic genus, as inferred from a chloroplast DNA data set. Based on these analyses, Ballard *et al.* (2005) postulated that *Hybanthus* contains as many as seven clades and proposed to split it into seven genera supported by distinctive combinations of molecular, morphological and anatomical characters. In particular, they grouped the species distributed in Latin America and southwestern USA into a genus with the earliest available name, *Pombalia*.

The position and shape of the leaves are important characters in the two principal classifications (Schulze-Menz 1936, Sparre 1950). The microcharacters of the leaf surfaces may contribute data, which reinforce the taxonomic classification by those authors and may provide further information for a better circumscription. The micromorphological surfaces of the leaves were studied in the Brazilian species (Souza 2002), some of which possess star-shaped trichomes.

The principal objectives of this study were to characterize the microstructure of the leaf surfaces and margins of some South American species of *Hybanthus* using a scanning electron microscope (SEM), and to determine whether these characters can be used to distinguish taxa or groups of taxa. Finally, some new sections are described to provide precision in the application of the proposed classification.

## Material and methods

The material studied was obtained from herbaria and plants collected in the field in north-eastern Argentina, in the provinces of Misiones, Corrientes and Entre Rios during the summers of 2005–2007. The provenance and vouchers of each species together with the different micromorphological types are summarized in Table 1. Voucher specimens are deposited in the Herbaria BAFC (Facultad de Ciencias Exactas y Natura-

les, Universidad de Buenos Aires, Argentina) and SI (Instituto de Botánica Darwinion, Argentina).

The SEM studies were performed on leaves mounted on stubs and then methalized in a JEOL JPC-1100 with gold in the Microscopic Electronic Service, Museo de La Plata, La Plata, Argentina. The analysis was performed using at least five leaves from each species.

## Results

SEM observations revealed that the leaf margins vary according to the presence or absence of some trichomes and papillae. These differences in the foliar micromorphology provided useful characters in the delimitation of some species or groups of species. Five SEM types of micromorphological features could be defined for the 17 analyzed species, here referred to as SEM I, II, III, IV and V (Table 1), which represent three of the four sections of *Hybanthus* recognized by Schulze-Menz (1936) in South America. A description of each SEM type, the scientific names of the corresponding species and the vouchers of the studied materials are detailed as follows:

SEM type I. This is characterized by the presence of long hairs on the adaxial surfaces and at the margin of the leaves (Fig. 1A–F). In this pattern, the margins are hairy and denticulate, as in *Hybanthus bicolor* (Fig. 1A), *H. communis* (Fig. 1B), *H. hasslerianus* (Fig. 1C), *H. nanus* (Fig. 1D), *H. paraguariensis* (Fig. 1E) and *H. serratus* (Fig. 1F). Dense hair on both faces and at the margin are characteristic of plants with alternate leaves, such as *H. calceolaria* and *H. velutinus* (Table 1). In general, each tooth is tipped with an ovoid or globose gland (Fig. 1C and D).

SEM type II. This presents a particular micromorphological feature consisting of four or more rows of short trichomes and some papillae at the leaf margin (Fig. 2A–F). *Hybanthus hieronymi* (Fig. 2A), *H. graminifolius* (Fig. 2B), *H. leucopogon* (Figs. 2C and D) and *H. longistylus* (Fig. 2E and F) are some of the species included in this SEM type (Table 1).

The leaf of *H. leucopogon* (Fig. 2D) has a globose gland on the adaxial face.

SEM type III. In this type short trichomes on the surface of the leaves (Fig. 3A and B) and at the leaf margin are observed (Table 1). Only one species, *H. bigibbosus*, belongs here. It has ovoid glands at the base of the leaf margin (Fig. 3A).

SEM type IV. The lack of hairs on the leaf surface of *H. atropurpureus* is a distinctive feature (Table 1 and Fig. 3C and D). Some ovoid and pointed glands are observed at the base between the lobes of the leaf margin (Fig. 3D).

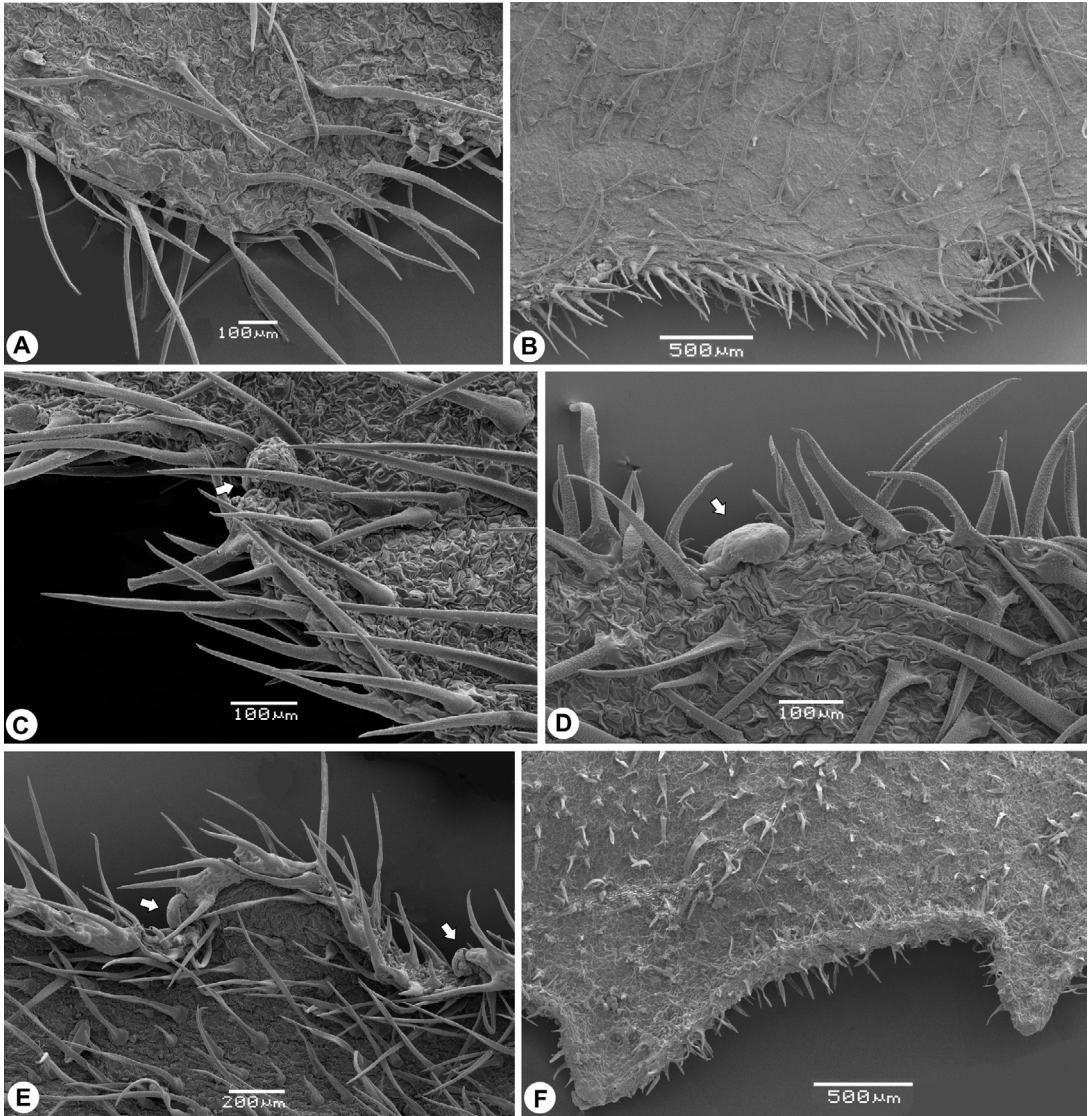
SEM type V. This includes only one species, *H. parviflorus* (Table 1), with some short trichomes at the leaf margin (Fig. 3E and F) and ovoid glands between the lobes (Fig. 3F). However, there are no trichomes on the leaf surface.

## Taxonomic treatment of *Hybanthus* subg. *Ionidium*

A new classification of *Hybanthus* from South America is proposed, based on the five combinations of leaf micromorphological characters observed with SEM. These combinations are consistent with macromorphological characters used in the classification of the genus, such as the position of leaves (Schulze-Menz 1936, Sparre 1950). Three new sections are described in order to validate the names previously published by Sparre (1950), according to MacNeill *et al.* (2006) (see Table 2). The monotypic *H. sect. Anomalae* was not considered in this study because of its clear delimitation from the rest of the species of *Hybanthus* in South America (Schulze-Menz 1936, Sparre 1950). The principal differences between the previous classifications are summarized in Table 2, and a new

**Table 1.** List of studied species of *Hybanthus* with the details of provenance, voucher specimens and SEM type.

Species	SEM type	Provenance and details of vouchers
<i>H. atropurpureus</i>	IV	Tucumán, Dpto. Tucumán, Tucumán, Jardín Botánico de la Fundación Lillo. <i>Seo 55</i> (BAFC).
<i>H. bicolor</i>	I	Corrientes, Dpto. Santo Tomé, 6 km de Virasoro a Garruchos. <i>Seo 36 &amp; 62</i> (BAFC).
<i>H. bigibbosus</i>	III	Misiones, Dpto. Iguazú, Pto. Iguazú, PN. Cataratas del Iguazú, sendero Macuco. <i>Seo 7 &amp; 23</i> (BAFC).
<i>H. bigibbosus</i>	III	Misiones, Dpto. Iguazú, Pto. Iguazú, PN. Cataratas del Iguazú, sendero Macuco. <i>Seo 19, 27 &amp; 47</i> (BAFC).
<i>H. calceolaria</i>	I	Corrientes, Dpto. Ituzaingó, Bo. Mil viviendas Yaciretá. Camping Municipal Soro. <i>Seo 16, 17 &amp; 59</i> (BAFC).
<i>H. communis</i>	I	Chaco, Dpto. 1 de Mayo, Isla del Cerrito, <i>Seo 31</i> (BAFC).
<i>H. communis</i>	I	Misiones, Dpto. Iguazú, PN. Cataratas del Iguazú, Isla San Martin. <i>Seo 42 &amp; 51</i> (BAFC).
<i>H. hasslerianus</i>	I	Misiones, Dpto. San Ignacio, San Ignacio, casa de Horacio Quiroga. <i>Seo 37 &amp; 48</i> (BAFC).
<i>H. leucopogon</i>	II	Corrientes, Dpto. Mercedes, 11 km S. de Mercedes. <i>Seo 34</i> (BAFC).
<i>H. longistylus</i>	II	Misiones, Dpto. San Ignacio, San Ignacio, casa de Horacio Quiroga. <i>Seo 61</i> (BAFC).
<i>H. nanus</i>	I	Entre Ríos, Dpto. Colón, PN. El Palmar, zona de camping, ayo de los Loros, entre zonas 18 y 21. <i>Seo 29, 30 &amp; 53</i> (BAFC).
<i>H. paraguariensis</i>	I	Corrientes, Dpto. Ituzaingó, Ituzaingó, 16 km al E de Ituzaingo, sobre la ruta 12. <i>Seo 35 &amp; 60</i> (BAFC).
<i>H. parviflorus</i>	V	Entre Ríos, Dpto. Gualeguaychú, médanos entre ruta 12 y vías del Ferrocarril. <i>Demkura 45</i> (BAFC).
<i>H. velutinus</i>	I	Bolivia, Santa Cruz, 72 km al W de San José de Chiquitos. <i>Seijo &amp; Solis Neffa 3340</i> (CTES).

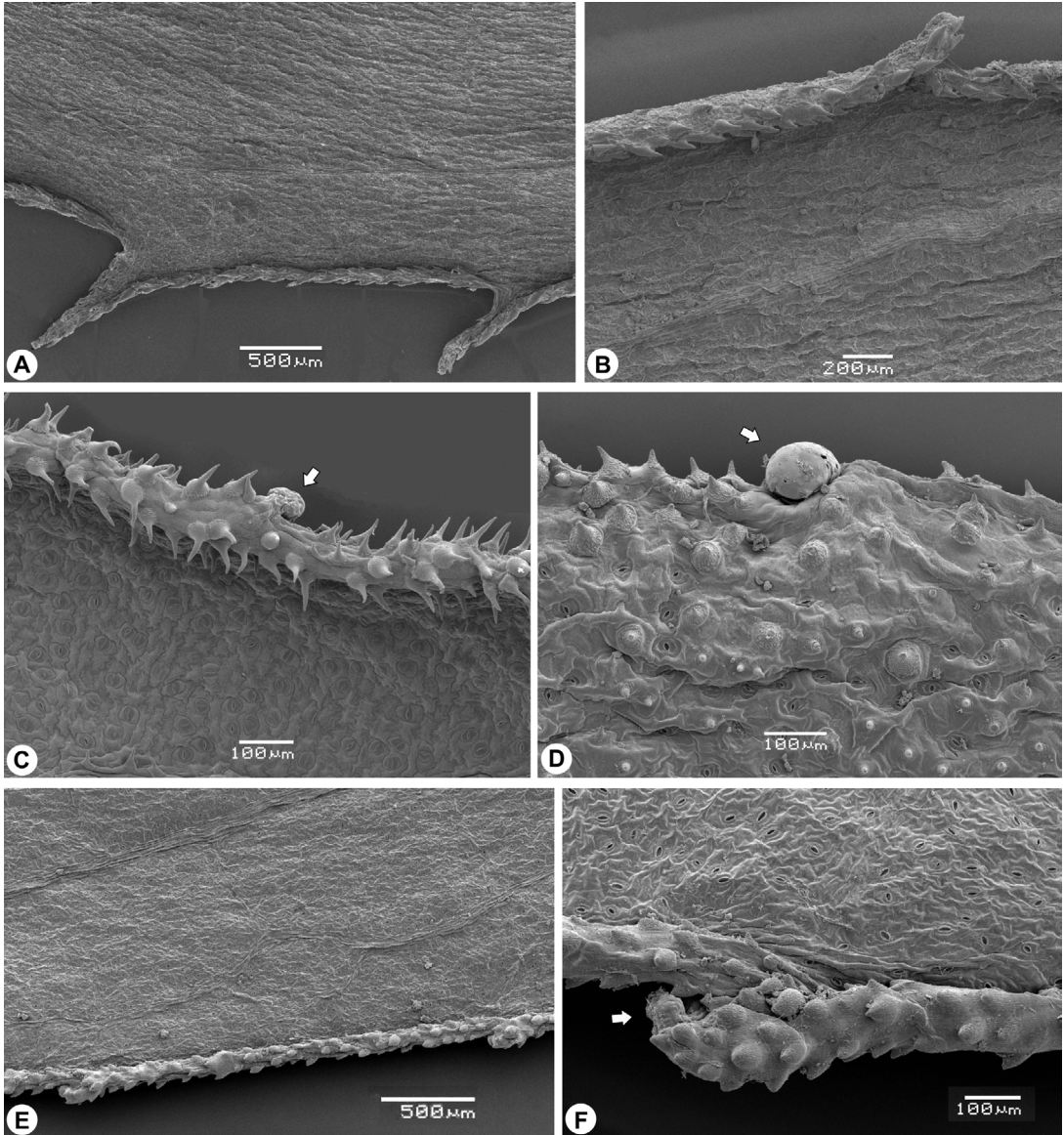


**Fig. 1.** Scanning electron photomicrographs of foliar margins of hairy *Hybanthus* species SEM type I. — **A:** *H. bicolor* (Seo 36, BAFC). — **B:** *H. communis* (Seo 51, BAFC). — **C:** *H. hasslerianus* (Seo 37, BAFC). — **D:** *H. nanus* (Seo 29, BAFC). — **E:** *H. paraguariensis* (Seo 60, BAFC). — **F:** *H. serratus* (Ragonese & Piccinini 6186, SI). Abaxial face: **A–D**. Adaxial face: **E and F**.

diagnostic key of South American sections was created reflecting this new classification.

**Key to the sections of *Hybanthus* subg. *Ionidium* in South America**

- |   |  |
|---|--|
| <p>1. Leaves alternate. Foliar surface densely hairy with long trichomes ..... 2</p> <p>1. Leaves opposite. Foliar surface glabrous or with short trichomes ..... 3</p> | <p>2. Habit tall shrub to tree. Flowers large, length of anterior petal of 2.5 cm or more ..... sect. <i>Anomala</i></p> <p>2. Habit short herb. Flowers small, length of anterior petal of 0.5 to 2.5 cm ..... sect. <i>Pombaliae</i></p> <p>3. Flowers large, length of anterior petal of 0.5 cm or more ..... 4</p> <p>3. Flowers small, length of anterior petal of 0.1 to 0.5 cm . ..... 5</p> <p>4. Flowers with the anterior petal longer than 15 mm. Foliar surface without short trichomes. Foliar margin with rows of papillae ..... sect. <i>Ionidium</i></p> |
|---|--|



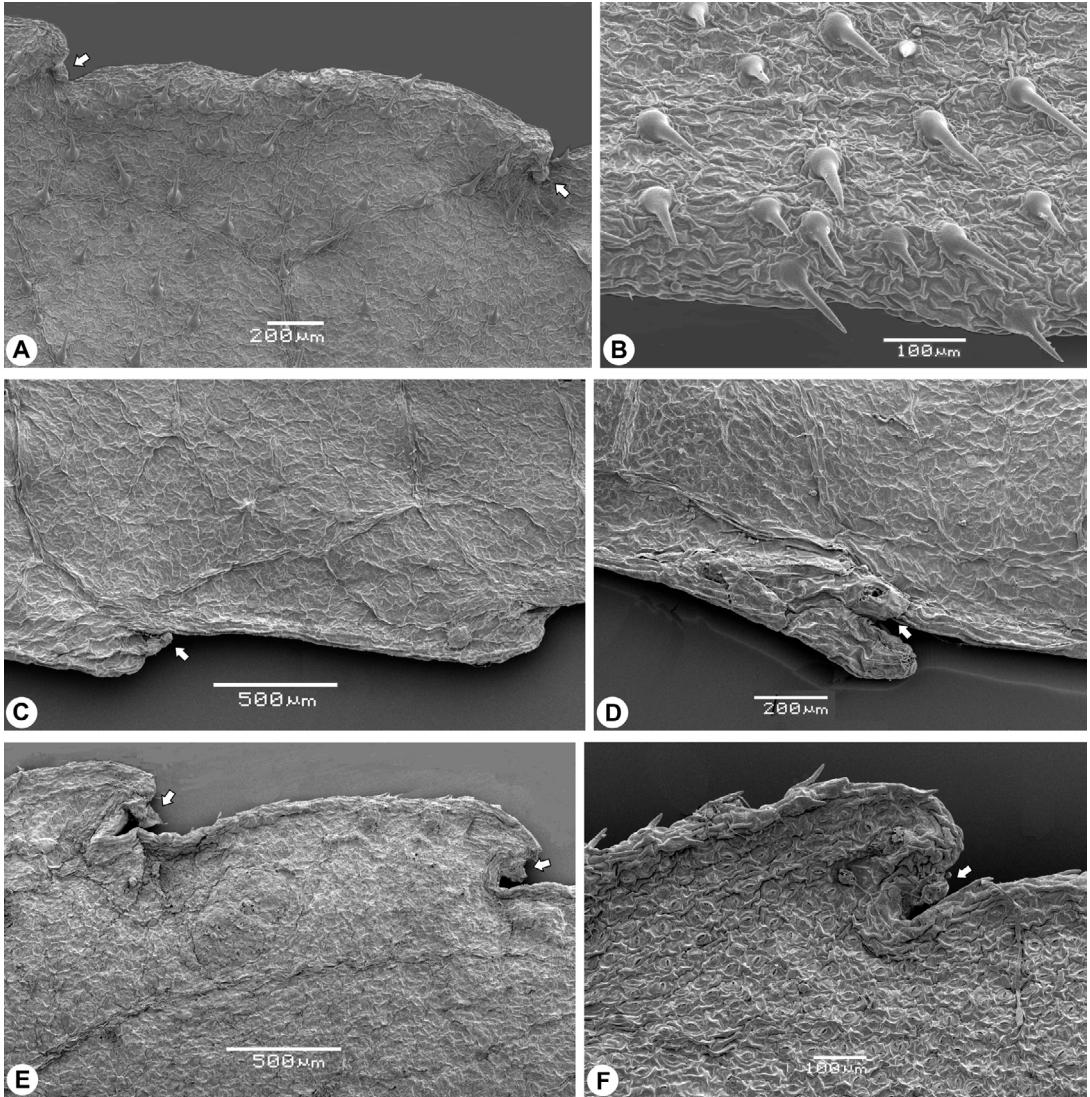
**Fig. 2.** Scanning electron photomicrographs of foliar margins of papillate *Hybanthus* species, SEM type II. — **A:** *H. hieronymi* (Krapovickas & Seijo 47755, CTES). — **B:** *H. graminifolius* (Cabrera 17250, SI). — **C** and **D:** *H. leucopogon* (Seo 34, BAFC). — **E** and **F:** *H. longistylus* (Seo 61, BAFC). Abaxial face: **A–C, E–F**. Adaxial face: **D**.

4. Flowers with the anterior petal shorter than 15 mm of length. Foliar surface with short trichomes. Foliar margin without papillae ..... sect. *Bigibbosae*
5. Habit tall shrub to subshrub. Flowers disposed in terminal inflorescence. Foliar margin without trichomes ..... sect. *Micranthae*
5. Habit short herb. Solitary and axillary flowers, not disposed in inflorescence. Foliar margin with short trichomes ..... sect. *Parviflorae*

***Hybanthus* subg. *Ionidium* sect. *Ionidium*, sect. nov.**

*Ionidium* Vent., Jard. Malmaison t. 27. 1803. — TYPE SPECIES: *Ionidium polygalaefolium* Vent., Jard. Malmaison t. 27. 1803.

This section comprises eight species in South America (Table 2) with axillary and solitary flow-



**Fig. 3.** Scanning electron photomicrographs of foliar margins of *Hybanthus* species that are glabrous or have short trichomes. — **A** and **B**: SEM type III: *H. bigibbosus* (Seo 47, BAFC). — **C** and **D**: SEM type IV: *H. atropurpureus* (Seo 55, BAFC). — **E** and **F**: SEM type V: *H. parviflorus* (Demkura 45, BAFC). Abaxial face: **D–F**. Adaxial face: **A–C**.

ers with a large anterior petal. The opposite leaves and the glabrous plants have been regarded as the most important diagnostic characters. SEM analysis of this species revealed leaves with papillate margins (Fig. 2A–F). When Schulze-Menz (1936) described the subgenus *Ionidium* he did not include a section with this name. However, Recommendation 22A.1. of the ICBN states that one of the sections of the subgenus *Ionidium* should be named *Ionidium*, with the inclusion of the

type species, *I. polygalaefolium* (synonym of *H. verticillatus*). The species of the group *Oppositifoliae* are assigned to this section (Table 2), as suggested previously by Sparre (1950), and that author included *Hybanthus leucopogon* in the group *Alternifoliae*, but it has opposite basal leaves with a feature at the leaf margin (Table 2 and Fig. 2D–F) resembling that of the section *Ionidium*. Therefore, *H. leucopogon* is considered here to belong to the section *Ionidium*.

SELECTED SPECIMENS EXAMINED: — *H. circaeoides*. **Argentina**. Misiones: Dpto. Candelaria, Loreto, Schinini s.n. (CTES 194296). **Paraguay**. Dpto. Nueva Concepción: Chaco, *Schinini 16446* (CTES). — *H. graminifolius*. **Argentina**. Corrientes: Dpto. Gral. Paz, Lomas Vallejos, *Ibarola 3456* (LIL); Jujuy: Dpto. San Pedro, Santa Clara, *Cabrera 17250* (BAA, SI). — *H. hieronymi*. **Argentina**. Salta: Dpto. Rivadavia, Dragones, *Krapovickas & Seijo 47755* (CTES); Dpto. Orán, San Román de la Nueva Orán, *Pensiero & Marino 4586* (CTES). — *H. leucopogon*. **Argentina**. Corrientes: Dpto. Mercedes, Mercedes, *Seo 349* (BAFC); Yofré, *Solis Neffa 48* (CTES). — *H. longistylus*. **Argentina**. Formosa: Dpto. Maticos, Ing. G. Juárez, *Schinini 35335* (CTES). **Paraguay**. Dpto. Presidente Hayes: Isla Poí, *Schinini 45503* (CTES).

### *Hybanthus* subg. *Ionidium* sect. *Bigibbosae* Schulze-Menz

Bot. Jahrb. Syst. 67: 457.1936. — TYPE SPECIES: *Ionidium bigibbosum* A. St.-Hil., Mem. Mus. Hist. Nat. 11: 482. 1824.

This monotypic section, which only includes *Hybanthus bigibbosus*, comprises shrubs or subshrubs with opposite leaves and small, solitary

and axillary flowers possessing a bigibbose anterior petal. Sparre (1950) included this taxon in the group *Oppositifoliae*. However, it should be included in SEM type II due to its particular leaf micromorphology, as revealed by SEM. The recognition of *Bigibbosae* as a section is in agreement with Schulze-Menz (Table 2).

SELECTED SPECIMENS EXAMINED: — *H. bigibbosus*. **Argentina**. Misiones: Dpto. Gral. Belgrano, Reserva de Vida Silvestre Uruguái, Múlgura de Romero 3866 (SI); Dpto. Iguazú, PN Cataratas del Iguazú, camping municipal, *Cuezzo Ruiz y De Marco 11084* (CTES); Dpto. San Pedro, Parque Prov. Moconá, *Rodriguez 539* (SI).

### *Hybanthus* subg. *Ionidium* sect. *Micranthae* Schulze-Menz

Bot. Jahrb. Syst. 67: 454. 1936. — TYPE SPECIES: *Ionidium atropurpureus* A. St.-Hil., Mem. Mus. Hist. Nat. 11: 490. 1824 (lectotype, here designated: P!).

This section comprises four species (Table 2) of shrubs with opposite leaves and small flowers.

**Table 2.** Comparative infrageneric classifications of *Hybanthus* subgen. *Ionidium* between the proposed and the previous systematic with the inclusion of the South American species.

<i>Hybanthus</i> subg. <i>Ionidium</i>	Schulze-Menz (1936) sections	Sparre (1950) groups	Seo <i>et al.</i> sections
<i>H. atropurpureus</i>	<i>Micranthae</i>	<i>Micranthae</i>	<i>Micranthae</i>
<i>H. biacuminatus</i>	<i>Micranthae</i>	<i>Micranthae</i>	<i>Micranthae</i>
<i>H. sprucei</i>	<i>Micranthae</i>	<i>Micranthae</i>	<i>Micranthae</i>
<i>H. verrucosus</i>	<i>Micranthae</i>	<i>Micranthae</i>	<i>Micranthae</i>
<i>H. bigibbosus</i>	<i>Bigibbosae</i>	<i>Oppositifoliae</i>	<i>Bigibbosae</i>
<i>H. attenuatus</i>	<i>Suffruticosae</i>	<i>Oppositifoliae</i>	<i>Ionidium</i>
<i>H. circaeoides</i>	<i>Suffruticosae</i>	<i>Oppositifoliae</i>	<i>Ionidium</i>
<i>H. glaucus</i>	<i>Suffruticosae</i>	<i>Oppositifoliae</i>	<i>Ionidium</i>
<i>H. graminifolius</i>	<i>Suffruticosae</i>	<i>Oppositifoliae</i>	<i>Ionidium</i>
<i>H. hieronymi</i>	<i>Suffruticosae</i>	<i>Oppositifoliae</i>	<i>Ionidium</i>
<i>H. longistylus</i>	<i>Suffruticosae</i>	<i>Oppositifoliae</i>	<i>Ionidium</i>
<i>H. melchorianus</i>	<i>Suffruticosae</i>	<i>Oppositifoliae</i>	<i>Ionidium</i>
<i>H. verticillatus</i>	<i>Suffruticosae</i>	<i>Oppositifoliae</i>	<i>Ionidium</i>
<i>H. leucopogon</i>	<i>Suffruticosae</i>	<i>Alternifoliae</i>	<i>Ionidium</i>
<i>H. albus</i>	<i>Suffruticosae</i>	<i>Alternifoliae</i>	<i>Pombaliae</i>
<i>H. bicolor</i>	<i>Suffruticosae</i>	<i>Alternifoliae</i>	<i>Pombaliae</i>
<i>H. calceolaria</i>	<i>Suffruticosae</i>	<i>Alternifoliae</i>	<i>Pombaliae</i>
<i>H. communis</i>	<i>Suffruticosae</i>	<i>Alternifoliae</i>	<i>Pombaliae</i>
<i>H. hasslerianus</i>	<i>Suffruticosae</i>	<i>Alternifoliae</i>	<i>Pombaliae</i>
<i>H. lanatus</i>	<i>Suffruticosae</i>	<i>Alternifoliae</i>	<i>Pombaliae</i>
<i>H. nanus</i>	<i>Suffruticosae</i>	<i>Alternifoliae</i>	<i>Pombaliae</i>
<i>H. paraguariensis</i>	<i>Suffruticosae</i>	<i>Alternifoliae</i>	<i>Pombaliae</i>
<i>H. serratus</i>	<i>Suffruticosae</i>	<i>Alternifoliae</i>	<i>Pombaliae</i>
<i>H. velutinus</i>	<i>Suffruticosae</i>	<i>Alternifoliae</i>	<i>Pombaliae</i>
<i>H. parviflorus</i>	<i>Suffruticosae</i>	<i>Parviflorae</i>	<i>Parviflorae</i>

The small flowers disposed in terminal racemes are the most important feature in this group. The SEM observations of *H. atropurpureus* revealed the lack of trichomes in the foliar surface which is typical of the SEM type IV (Table 1).

Schulze-Menz (1936) described this section without indicating a holotype. *Hybanthus atropurpureus* is here designated as the lectotype because it exhibits the typical features of *Micranthae*.

SELECTED SPECIMENS EXAMINED: — *H. atropurpureus*. **Argentina**. Jujuy: Dpto. Ledesma, Calilegua, camino a Los Cafetales, *Cabrera 31485 & 62174* (SI); Salta: Dpto. Tartagal, ruta prov. 19, camino de Aguas Blancas a Angosto del Río Pescado, *Zuloaga 7682* (SI); Tucumán: San Miguel de Tucumán, Fundación Miguel Lillo, *Seo 55* (BAFC). **Bolivia**. Dpto. Santa Cruz, Prov. de Cordillera, *Nee 51288* (SI).

***Hybanthus* subg. *Ionidium* sect. *Parviflorae* Sparre ex Seo, Sanso & Xifreda, sect. nov.**

*Suffrutices vel herbae. Folia inferiora opposita: superiora plerumque alterna. Flores parvi: 3–4 mm longim axillares: solitarii et saepe foliis superioribus abbreviatis racemos terminales formantes. Ovarium glabrum.*

TYPE SPECIES: *Viola parviflora* Mutis ex L. f., Suppl. Pl. 396. 1781.

This monotypic section including *Hybanthus parviflorus* comprises suffrutices with small, axillary and white flowers, and opposite, alternate or irregularly arranged leaves. The flower possesses an anterior petal varying from 1 to 5 mm in length.

Sparre (1950) suggested the subdivision of the sect. *Suffruticosae* described by Schulze-Menz (1936) into three groups, one of which he named “*Parviflorae* Group” despite the fact that it was not validly published (Table 2). In this work, the name of *Parviflorae* is validated. The sectional name is derived from the epithet of this species, in accordance with the Art. 22.6. of the ICBN.

SELECTED SPECIMENS EXAMINED: — *H. parviflorus*. **Argentina**. Entre Ríos: Dpto. Colón, PN El Palmar, Palmar ralo, *Batista 1578 & 2236* (SI); Misiones: Dpto. Gral. Belgrano,

RVS-Uruguay, *Johnson 870* (SI); Jujuy: Dpto. Tumbaya, Volcán, *Morrone 2378* (SI); Salta: Dpto. Capital, Univ. Nac. de Salta, terrenos aledaños a la facultad de Ciencias Naturales, *Tolaba 567* (MCNS); Dpto. Rosario de Lerma, Campo Quijano, Dique Las Lomitas, *Novara 4697* (MCNS).

***Hybanthus* subg. *Ionidium* sect. *Pombaliae* (Vand.) Seo, Sanso & Xifreda, sect. nov.**

*Pombalia* Vand., Fasc. Pl.: 7. 1771. — TYPE SPECIES: *Viola ipecacuanha* L., Mant. Pl. 2: 484. 1771.

This section comprises more than 20 species in South America (Table 2). It comprises suffrutices with alternate leaves, pubescent reproductive parts and solitary axillary flowers. The alternate leaves and the hairiness of the plant have been considered as the most important diagnostic characters. The SEM observations revealed that the leaf margin is fringed with long hairs. The SEM type II revealed a characteristic pattern of this group. The name *Pombaliae* corresponds to the group “*Alternifoliae*” (Table 2), which was suggested previously by Sparre (1950), however that name was not published validly. The particular leaf micromorphology observed by SEM indicates that it should be recognized as a section, in agreement with Sparre (1950). In addition, Ballard *et al.* (2005) suggested the name *Pombalia* for the South American species of *Hybanthus*. Schulze-Menz (1936) included most of the South American species in the sect. *Suffruticosae*, however this section would include the type species *Hybanthus suffruticosus*, which is an Asian taxon, and the micromorphology has not been analyzed and their systematic position is unknown.

SELECTED SPECIMENS EXAMINED: — *H. bicolor*. **Argentina**. Corrientes: Dpto. Concepción: Isla del Bosque, *Biganzoli 1619* (SI). — *H. communis*. **Argentina**. Chaco: Isla del Cerrito, *Seo 51* (BAFC); Entre Ríos: Dpto. Concordia, Balneario la Tortuga Alegre, *Bacigalupo 1612* (SI); Misiones: Dpto. Concepción, Isla del Bosque, *Biganzoli 1628* (SI); Misiones: Dpto. Iguazú, PN Cataratas del Iguazú, *Múlgura de Romero 3526* (SI). — *H. hasslerianus*. **Argentina**. Misiones: Dpto. Cainguas, reserva biológica Arroyo Cuña Pirú, *Biganzoli 1543* (SI). — *H. nanus*. **Argentina**. Entre Ríos: Dpto. Villaguay, Paso de la Laguna, *Troncoso 2787* (SI). — *H. serratus*. **Argentina**. Córdoba: Dpto. Punilla, entre Molinari y Pampa de Olaen, *Ragonese & Piccinini 6186* (BAB); La



Pampa, Levontae, 5 km de El Durazno, *Cano 2845* (BAB); San Luis: Dpto. Capital, Cerro El Lince, *Lee Anderson 1677* (SI). — *H. velutinus*. **Bolivia**. Dpto. Chuquisaca, Pcia. L. Calvo, EL Salvador, *Saravia Toledo 11454* (CTES, MCNS).

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