

## A NEW SECTION OF *BEGONIA* (*BEGONIACEAE*) FROM WEST CENTRAL AFRICA

J. J. F. E. DE WILDE\* & V. PLANA†

Previous analyses of macromorphological and molecular data on the continental African species *Begonia iucunda* (*Begoniaceae*) suggest that it occupies an isolated phylogenetic position within a clade consisting otherwise of species in sections *Cristasemen*, *Filicibegonia*, *Loasibegonia* and *Scutobegonia*. Accordingly, the new monotypic section *Chasmophila* is here described. Its taxonomic position and relationship to other African sections are discussed and data on its distribution and ecology are presented.

*Keywords.* Africa, *Chasmophila*, taxonomy.

### INTRODUCTION

The sectional affinity of the continental African *Begonia iucunda* Irmsch. has long been uncertain. Irmscher (1961) accommodated this species in section *Scutobegonia* Warb., along with others whose male and female flowers have two yellow perianth segments. Subsequent authors, such as Barkley & Golding (1974), followed this sectional placement. Van den Berg (1985) attributed the pollen of *B. iucunda* to a *Begonia filicifolia* N. Hallé type that he considered characteristic for species in section *Filicibegonia* A. DC. Based on these findings and on seed information known at the time he included *B. iucunda* under section *Filicibegonia* A. DC. Later studies on seed micromorphology (de Lange & Bouman, 1992) revealed that species in section *Filicibegonia* formed a distinct group, but that within this group *B. iucunda* occupied an isolated position. The authors suggested that convincing evidence for the recognition of a separate section could result from a critical re-evaluation of its morphology. Sosef (1994), in a revision of sections *Loasibegonia* A. DC. and *Scutobegonia*, excluded *B. iucunda* from these sections. He referred to it as: ‘an odd species, possibly representing a distinct section, probably most closely related to the section *Rostrobegonia* Warb.’. While preparing a sectional revision of *Begonia*, Doorenbos *et al.* (1998) were also unable to place *B. iucunda* in any existing section. The authors supplied a brief description of the species and concluded: ‘it presumably takes up an isolated position in the affinity of section *Filicibegonia*’ (pp. 218–219). Recent molecular research on African *Begonia* species (Plana, 2002; Plana, in press), sampling all sections recognized on the African continent, supports the

\* Nationaal Herbarium, Wageningen University branch, Herbarium Vadense, Gen. Foulkesweg 37, 6703 BL Wageningen, The Netherlands.

† Royal Botanic Garden Edinburgh, 20A Inverleith Row, Edinburgh EH3 5LR, UK.

morphologically isolated position of *B. iucunda*. Therefore, the new monotypic section *Chasmophila* de Wilde & Plana is here described to accommodate this species.

#### MATERIALS AND METHODS

Herbarium specimens of *B. iucunda* from several herbaria were examined to determine whether this taxon was distinct enough for recognition at sectional level. In February 1993, the senior author studied wild populations in Inoni, Congo (Brazzaville). Observations were made, voucher material was collected, and living plants were brought to Wageningen University where their clonal material was used in molecular and morphological studies.

#### TAXONOMY

**Begonia** sect. **Chasmophila** J.J. de Wilde & Plana, **sect. nov.**

Habitu herbarum 6–60cm altorum rhizomatibus subterraneis perennantis tubera usque ad 30 × 8mm botuliformia tunicata producentibus, caulibus foliaceis marcescentibus tubercula usque ad 1cm longa fusiformia axillaria tunicata ferentibus, tunica constanti ex 4 seriebus longitudinalibus squamarum imbricatarum peltatarum, indumento ex pilis moniliformibus glanduliferis constanti, inflorescentiis axillaribus unifloris bracteas bracteolasque carentibus et seminibus minus quam 250µm longis. Sectio nova monotypica differt a Sectionibus *Augustia* (Klotzsch) A. DC., *Cristasemen* J.J. de Wilde, *Filicibegonia* A. DC. et *Rostrobegonia* Warb.

Type species: *B. iucunda* Irmsch.

Herb, 6–60cm tall; stems growing from rhizomes borne on botuliform, tunicate tubers 30 × 8mm; axillary tubercles to 1cm long present on old stems; indumentum of multicellular, uniseriate glandular hairs; flowers axillary, solitary, yellow; seeds 250µm long.

*Derivation.* Greek: *chasma* = crevice; *philein* = to love, referring to the preference of this species for growing in rock crevices.

#### EXTENDED DESCRIPTION OF *BEGONIA IUCUNDA* IRMSCH. (FIG. 1)

Irmscher in Engl., Bot. Jahrb. Syst. 81: 186 (1961); Wilczek, Fl. Congo, Rwanda et Burundi, *Begoniaceae*: 42 (1969); van den Berg, Agric. Univ. Wageningen Papers 84(3): 37 (1985); L.B. Smith *et al.*, *Begoniaceae*, Smithsonian Contr. Bot. 60: 184, 449, Fig. 21.24 (1986); de Lange & Bouman, Agric. Univ. Wageningen Papers 91(4): 11, 12, 71, 73, pl. 7 E & F (1992); Doorenbos *et al.*, The sections of *Begonia*, Agric. Univ. Wageningen Papers 98(2): 218 (1998); Golding & Wasshausen, *Begoniaceae* ed. 2, Smithsonian Contr. U.S. Natl. Herb. 43(1): 75 (2002).

Type: Congo (Kinshasa), Kasai, Kambangu, *Callens* 3205 (holo. K!, iso. BR!).

*Plants* erect, procumbent if growing on cliffs, 6–60cm tall, unbranched or with branches extending from leaf axils on lower part of stem. *Rhizomes* subterranean,

rooted, to 14cm long, borne on botuliform, tunicate, pale brownish tubers to  $30 \times 8$ mm; newly produced tubers white; rhizomes white, thickening upwards from where stem arises. Stems often somewhat zigzag, fleshy and wine red *in vivo*, to 9mm wide at base, sparsely and patently hairy; hairs multicellular, uniseriate, often 2-celled at apex, glandular, very uneven in length. Old often withered stems sometimes with axillary, narrowly ovoid green tubercles to 1cm long, enveloped by imbricate, peltate brownish scales neatly arranged in four longitudinal rows, similar to tunica on tubers. *Stipules* persistent, narrowly triangular to subulate, sometimes fimbriate, 1.5–7mm long, pale green, margin ciliate. *Leaves* not peltate; petiole continuing into blade at a distinct angle, 0.5–3cm long, pink to dark wine red, puberulous; lamina herbaceous, membranaceous when dry, asymmetrical, narrowly oblong to ovate or falcately ovate, attenuate towards apex or acuminate in upper part,  $2\text{--}12 \times 0.8\text{--}4$ cm, with 7–9 palmate main veins, midrib usually the most pronounced, veins green but sometimes wine red below; margin coarsely serrate-dentate, usually with a short cilium between each tooth; cordate to more often obliquely cordate at base with one side cuneate to rounded or slightly cordate and the other lobe cordate, lobes not overlapping, apex acute; upper surface medium green, dull, puberulous; lower surface pale green; main and larger secondary veins not prominent above, prominent and more or less densely covered with patent soft white multicellular hairs below. *Inflorescences* reduced to solitary flowers developing in axils of upper leaves; bracts and bracteoles absent; very rarely a male and a female flower in same axil; 1–4 female flowers usually opening first, followed by male flowers. *Male flower*: buds flat, pedicel at anthesis 5–20mm long, slender, glandular puberulous, wine red; perianth segments 2, very broadly obovate to almost circular,  $5\text{--}10 \times 5\text{--}13$ mm, yellow; androecium a zygomorphic fascicle, stamens 9–19, yellow, arranged like a bunch of bananas; filaments fused at base into a central column, those of inner rows 0.2–1.0mm long, those of outer rows to 2mm; anthers oblong, c.1mm long, apex rounded to emarginate, slightly cucullate, opening by two sublateral slits along whole length of anther. *Female flower*: similar to male but pedicel elongating in fruit, to 47mm; perianth segments 2, very broadly obovate, to  $10 \times 13$ mm, yellow; styles 3, yellow, to 3mm long, fused in lower 1/3, divided above into an elongated V-shape, arms to 1.5mm long, bearing a confluent slender stigmatic band which is spirally twisted for 1 turn around each arm; ovary obovoid to ellipsoid, minutely glandular puberulous, c. $4.5 \times 3$ mm, 3-locular, 3-winged; wings very unequal, widening upwards, two wings narrow, the third much wider, ovate; placentation axillary, placentas 1 per locule, thickened, unbranched, shallowly lobate, densely surrounded by ovules. *Fruit* on an extended erect pedicel, capsule often somewhat nodding, septicidal, oblong, the locular part to  $15 \times 5$ mm; wings distinctly enlarged in fruit, unequal, the largest widely extending beyond the top of the locule, triangular with rounded top, longest side to 21mm, other wings much smaller. Styles persistent in fruit.

*Derivation.* The specific epithet *icunda*, coined by Imscher (1961) for the combination *Begonia icunda*, is derived from the Latin adjective *icundus* meaning pleasant, agreeable or delightful.

*Distribution.* Inoni, 161km N of Brazzaville, Congo. Bas Zaire and Bandundu regions of the Democratic Republic of Congo (Kinshasa). Fig. 2.

*Habitat.* In cracks and on ledges of steep exposed rock faces; on steep slopes near waterfalls; in shaded places among rocks.

*Field notes.* The senior author visited the Inoni locality in February 1993. This area is c.650m above sea level, dominated by undulating savanna with shrubs and small trees, and scattered with forest pockets. Rocky areas occur locally where the rock faces have cracks and ledges running more or less horizontally. Individuals no more than 6cm tall, in flower and fruit, occurred in small cracks containing little soil. However, in a deposit of loose soil at the base of a steep slope, and in the half-shade of small trees, *B. iucunda* was observed to form vigorous branched plants up to 60cm tall. The dimensions of almost all parts of these individuals greatly exceed those of the occupants of the cliffs. This variation is included in the above description (teste *de Wilde, Van der Maesen & Moutsamboté* 11.033, WAG).

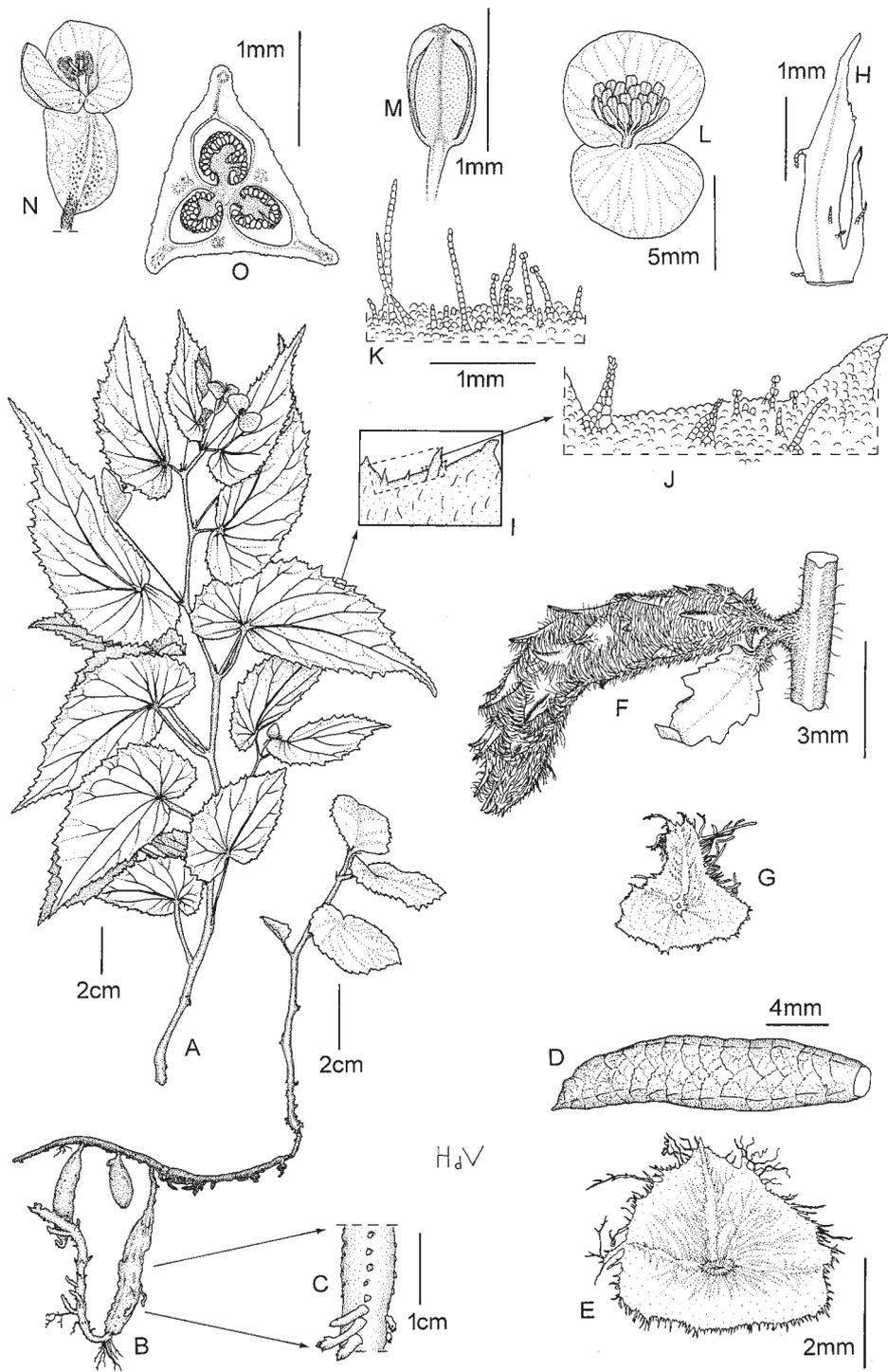
*Specimens examined.* CONGO (Brazzaville). Inoni, 161km along the road N of Brazzaville, fl. & fr., 6 ii 1993, *de Wilde et al.* 11.033 (W, WAG); *ibid.*, 8–20 v 1950, *Koechlin* 718 (IEC); *ibid.*, 10 iii 1971, *Sita* 3067 (IEC, P).

DEM. REP. CONGO (Kinshasa). Lower Congo, Kimbele, between Tumba Mani and Popokabaka, 1902, *Butaye* in *J. Gillet* 2295 (BR); S of Madimba, fl. & fr., 7 ii 1952, *Devred* 1070 (BR, K); Kimvula, 5 i 1959, *Pauwels* 1042 (BR). Kasai, Kingunda, fl. & fr., 16 ii 1950, *Callens* 2435 (BM, BR); Kambangu, fl. & fr., 9 ii 1952, *Callens* 3205 (BR, K, resp. iso- and holotype); Kibunda, fl. & fr., 27 iv 1953, *Callens* 3995 (BR).

The rhizomatous growth habit of *B. iucunda*, with tunicate, sausage-shaped underground tubers, from which a rooted rhizome is produced that develops above ground into a flowering upright stem, is quite unique among African tuberous *Begonia* species. Under glass at Wageningen the stems were observed, after flowering and fruiting, to wither and fall to the ground. At this stage the leaves are more or less dry, but still attached. Long, narrowly ovoid tubercles, reaching a length of 1cm, develop in the axils of these leaves. These tubercles are green, enveloped by longitudinally arranged rows of brown scales, and give rise to newly formed, tiny rooted plants at their tips. This formation of propagules is known in Africa only in section *Rostrobegonia* s.l. where it is reported from *B. wollastonii* E.G. Baker, and section *Augustia* from *B. sutherlandii* Hook.f. The conspicuous, multicellular, uniseriate hairs which in *B. iucunda* often show a glandular two-celled apex are rarely encountered among African begonias. *Cuerrier et al.* (1991) report comparable hairs in

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FIG. 1. *Begonia iucunda* Irmsch.: A, flowering and fruiting stem; B, vegetative habit with tubers; C, detail of sprouting tuber, scales removed; D, underground scaly tuber; E, ditto, peltate scale, inside; F, axillary tubercle; G, ditto, peltate scale, inside; H, stipule; I, leaf, detail of margin; J, ditto, enlarged; K, indumentum, leaf undersurface; L, male flower; M, anther; N, female flower; O, cross-section of ovary. Drawn by Hans de Vries from *de Wilde et al.* 11.033 and cultivated clonal offspring thereof.



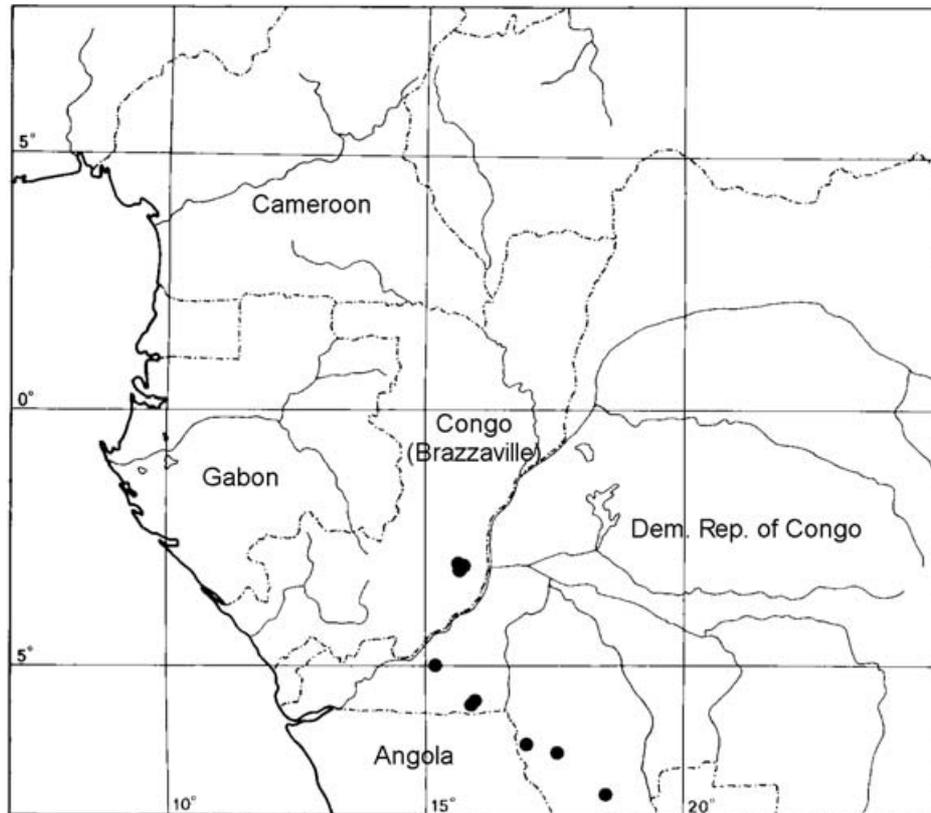


FIG. 2. Distribution of *Begonia iucunda*.

*B. johnstonii* Oliv. ex Hook.f. and *B. engleri* Gilg., both in section *Rostrobegonia* s.s. The occurrence of this type of indumentum was also reported for *B. minutifolia* N. Hallé (section *Filicibegonia*) (Cuerrier *et al.*, 1991) but has not been corroborated by recent observations (J.J.F.E. de Wilde, pers. obs.).

In Table 1, 15 morphological characters found in *B. iucunda* are compared with those of four morphologically similar sections. All taxa in the table share capsular dry dehiscent fruits. The sections *Loasibegonia* and *Scutobegonia*, which contain c.40 species, are omitted as they never show tuberous underground parts and all the species are characterized by more or less juicy indehiscent fruits which disintegrate with age. Section *Rostrobegonia* is here recognized in the narrow circumscription of Warburg (1894) who included in it only *B. rostrata* Welw. ex Hook.f., *B. quintasii* C. DC. (= *B. annobonensis* A. DC.) and *B. johnstonii* Oliv. ex Hook.f. In Irmscher's opinion (1961), sections *Rostrobegonia* and *Augustia* had so much in common that he combined them into one. Recent research (Forrest, 2000; Plana, 2002; Plana, in press; Mark Hughes, pers. comm.), however, indicates that two and possibly even

TABLE 1. Some selected characters which distinguish *Begonia iucunda* from species in sections *Augustia*, *Cristasemen*, *Filicibegonia* and *Rostrobegonia*

	<i>B. iucunda</i>	<i>Augustia</i>	<i>Cristasemen</i>	<i>Filicibegonia</i>	<i>Rostrobegonia</i>
Plant longevity	Perennial	Perennial	Perennial	Perennial	Annual
Tubers/tubercles	Present	Present	Absent	Absent	Absent
Tuft of hair at petiole apex	Absent	Occasionally	Absent	Absent	Present
Venation type	Palmate	Palmate	Palmate	Pinnate	Palmate-pinnate
Inflorescence unisexual/bisexual	Unisexual	Bisexual	Bisexual	Usually bisexual	Bisexual
Inflorescence type	Solitary	Di-/monochasial	Dichasial	Monochasial	Di- and/or monochasial
Female flowers per inflorescence	1	1-3	1-3	1	1-3
Perianth colour	Yellow	White, pink, orange, yellow	Yellow	White or pink	White or pink
No. of perianth segments in male flowers	2	2 or 4	2	2	4
Androecium symmetry	Zygomorphic	Actinomorphic	Zygomorphic	Zygomorphic	Actinomorphic
Anther openings	Sublateral	Sublateral	Sublateral	Sublateral	Lateral
No. of perianth segments in female flowers	2	(3-5)	2	2	(4)5(6)
Style shape	Forked once	Forked once	Forked twice	2-lobed	Forked or lobed
Stigma position	Spiralled	Usually spiralled	Not spiralled	Not spiralled	Spiralled/all over the style
Placental branches per locule	1	1(2)	1	1	1 or 2

three monophyletic groups should be distinguished in this group of species. Therefore, in Table 1, sections *Rostrubegonia* and *Augustia* are recognized in their original circumscriptions. Section *Augustia* thus contains most of the tuberous, perennial species, and section *Rostrubegonia* the non-tuberous annuals. The monotypic section *Cristasemen* is unique in its climbing lianescent habit and its very specialized seed morphology (de Wilde, 1985). In the analytical key to the African sections (Doorenbos *et al.*, 1998) sections *Cristasemen* and *Filicibegonia* key out in the same couplet, reflecting their morphological similarities. Furthermore, when using the set of character states that belong to *B. iucunda*, this species also keys out to this same couplet. Sections *Cristasemen* and *Filicibegonia* are therefore considered to contain close relatives of *B. iucunda*.

From the table, it is unclear which of the presently accepted sections could accommodate *B. iucunda*. Among the 15 important characters listed, this species shares 11, 10, 8 and 5 character states respectively with sections *Augustia*, *Cristasemen*, *Filicibegonia* and *Rostrubegonia*. Though de Lange & Bouman (1992) found *B. iucunda* to have the smallest seeds among African begonias (mean length 220µm), they also found small seeds in sections *Scutobegonia* and *Loasibegonia* and especially in section *Filicibegonia*. They discussed *B. iucunda* under section *Filicibegonia* but remarked that in its micromorphological seed characters it deviates in several respects from the other species in the section that otherwise constitute a distinct group. This species however is well differentiated by its unique habit, among continental African species, consisting of an underground tunicate tuber from which a rhizome sprouts and which develops above ground into the flowering stem.

#### MOLECULAR AND PHYLOGENETIC EVIDENCE

DNA sequence data for *Begonia* from the nuclear ribosomal ITS repeat and 26S regions (Forrest, 2000; Plana, 2002; Plana, in press) and the chloroplast *trnL* intron (Plana, 2002; Plana, in press) have recently been obtained for 58 species of Afro-Malagasy *Begonia*, sampled from among a total of 158 species described from the region. *Begonia iucunda* was sequenced in an attempt to elucidate its phylogenetic position using different sources of data. Maximum parsimony analyses of ITS, *trnL*, 26S and combined data all resolve *B. iucunda* as isolated within a clade consisting of species in sections *Cristasemen*, *Filicibegonia*, *Loasibegonia* and *Scutobegonia*.

The morphological similarities *B. iucunda* shares with species in section *Augustia* and *Rostrubegonia* (see Table 1), such as the presence of tubercles, appear therefore not to reflect shared phylogenetic history but are the result of convergence. Unlike morphology, molecular evidence shows *B. iucunda* to have no relationship to species in these sections, and to be more closely related to terrestrial, hydrophilic, predominantly West and Central African species. Bearing this in mind, the characters which are important in separating section *Chasmophila* and its close relatives in sections *Cristasemen*, *Filicibegonia*, *Loasibegonia* and *Scutobegonia* from sections *Rostrubegonia* and *Augustia* are the zygomorphic androecium, the presence of only

two perianth segments in female flowers, and the presence of two tepals in male flowers, although some species in section *Augustia* may also have two tepals.

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