Taxonomy of the genus Pelargonium (Geraniaceae): the section Polyactium
2. The subsection Caulescensia

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The monospecific subsection Caulescensia of Pelargonium section Polyactium is treated taxonomically. Its systematic position is discussed in terms of its macromorphology, pollen grain sculpturing, anatomy of the petiole, chromosome number, and breeding behaviour.

Die monospeisflike subseksie Caulescensia van Pelargonium seksie Polyactium word taxonomies behandeld. Sy sistematiese posisie word bespreek in die lig van sy makromorfologie, stulfmeelkorrelskulptuur, anatomie van die petiolus, chromosoomgetal, en voortplantingsgedrag.

Keywords: Geraniaceae, Pelargonium, Polyactium, taxonomy.

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Introduction

The subsection Caulescensia of Pelargonium section Polyactium consists of a single species, Pelargonium gibbosum (L.) L’Hér. It differs from the remainder of the section by the absence of an underground tuber and the well-developed perennial growth above ground level; yet in other respects it conforms to the section Polyactium, particularly the subsection Polyactium which it closely resembles in its floral morphology.

Taxonomy


Stem well branched, extensively developed above ground level, semi-succulent with substantial internodes and conspicuously swollen nodes, without an underground tuber. Lamina glaucous, glabrous, pinnatilobate to pinnately compound; stipules ovate with spicis acute. Peduncle up to 120 mm long. Flower ca. 15 mm in diameter, pedicel inconspicuously short, petals pale greenish-yellow and mostly without markings.

A monotypic subsection of the sandy western coastal belt of the Western Cape Province:

Pelargonium gibbosum (L.) L’Hér. in Aiton, Hortus kewensis ed. 1, 2: 422 (1789); Salisb.: 313 (1796); Willd. 3: 684 (1800); Pers.: 233 (1807); Desf.: 1: 463 (1809); Willd.: 711 (1809); Haw.: 308 (1812); Sweet: t. 61 (1821); DC.: 662 (1824); Sprengel: 57 (1826); Harvey: 276 (1860); Marloth: 312, t. 126 (1908); Knuth: 361 (1912); Marloth 2: 89, t. 56 (1925); Adamson & Saller: 515 (1950); Mason: 132, t. 4 (1972); Van der Walt: t. 17 (1977).

Geranium gibbosum L., Species plantarium ed. 1, 2: 667 (1753); Linnaeus 2: 1142 (1759); Burman f.: 39 (1759); Linnaeus 2: 946 (1763); Miller: no. 30 (1768); Burman f.: 18 (1768); Linnaeus 14: 613 (1784); Cav. 4: 265, t. 109.1 (1787); Thunb.: 117 (1800); Andr.: without page number, icon. (1805); Thunb. 2: 513 (1823). Type: unnumbered plate in Hermann, Horti academici Lugduno-batavi catalogus, p. 285 (1687) (PRE, lecto., here designated). 2 (Figure 2.)


Geraniopsispermum gibbosum (L.) Kuntze 1: 95 (1891).

Previous illustrations: Hermann, unnumbered plate on p. 285 (1687); Stisser t. 3 (1697); Cavanilles t. 109.1 (1787); Andrews, unnumbered plate (1805); Sweet t. 61 (1821); Marloth t. 126 (1908); Marloth t. 56 (1925); Mason t. 4 (1972); Van der Walt t. 17 (1977); Ward-Hilhorst, unnumbered plate on p. 55 (1983).

2The protologue of Geranium gibbosum consists of five elements. All are books, and three of them contain illustrations:
1) Linnaeus, Hortus Upsaliensis ..., p. 345 (1748). This page number may be wrongly quoted.
2) Van Royen, Flora Leydenst. prodromus ..., p. 354 (1740).
3) Dillenius, Hortus elthamensis ..., t. 127, fig. 154 (1732).
5) Stisser, Botanica curiosa ..., t. 3 (1697).

Dr. C.A. Jarvis (see acknowledgements) could not trace any specimens which could be considered for typifying Geranium gibbosum. There are no extant specimens associated with Linnaeus (1748), and he unsuccessfully searched Leiden herbarium for specimens associated with van Royen (1740). In LINN there is a specimen (LINN 858.11), annotated in Linnaeus’ hand, but lacking the Species plantarum number 8 which almost invariably indicates that the specimen concerned was seen by Linnaeus when compiling Species plantarum, so that this specimen cannot be considered for lectotypification purposes. Of the remaining elements, fig. 154 which is part of t. 127 of Dillenius (1732) clearly represents not Pelargonium gibbosum but Pelargonium carnosum (L.) L’Hér. Stisser’s (1697) t. 3 and Hermann’s (1687) plate on p. 285 are recognizable representations of P. gibbosum, but as Stisser’s plate was obviously copied from that of Hermann, we selected the Hermann plate as lectotype.

Figure 1  *Pelargonium gibbosum*: a plant collected at Llandudno, near Cape Town. After a watercolour painting by Ellaphie Ward-Hilborst which first appeared in *Veld & Flora* 69: 55 (1983), by courtesy of the Brethurst Library.
A low shrub up to 300 mm tall, or up to 1 m tall when scrambling over surrounding vegetation, well branched above ground level without an underground tuber, in nature deciduous during summer, unarmed. Stems smooth, semi-succulent, glabrous, internodes well-developed and up to 10 mm in diameter, nodes conspicuously swollen to diameter of up to 25 mm. Leaves pinnatifid to pinnate, somewhat succulent, superficially glaucous but sparsely strigose or hispid on abaxial veins and ciliate on apices of segments, with microscopical short glandular hairs; lamina ovate-cordiform in outline, base cordate, apices of lobes round-ed, 25–130 x 15–75 mm; petiole shorter than lamina: up to 65 mm long, deciduous; stipules narrowly ovate with apices acute, 5–12 x 2–4 mm, membranous, abaxially very densely strigose and adaxially glabrous and conspicuously ciliate, deciduous. Inflorescence a peduncle of up to 120 mm long, carrying a many-flowered pseudo-umbel of flowers; flowers ca. 15 mm in diameter, almost regular. Pedicel inconspicuously short. Hypanthium

20–25 mm long, strigose and with densely crowded glandular hairs. Sepals narrowly ovate, abaxially densely strigose, yellow-green with hyaline margins, 6–9 x 1.5–2.0 mm. Petals 5, nearly similar, spatulate with rounded apices, pale greenish-yellow and mostly without markings; 9–13 x 4–6 mm. Stamens hardly exserted, 7 fertile, of three different lengths as per Figure 1, filaments white, anthers 1.0–1.5 mm long, pollen pale yellow. Ovary ovoid, ca. 2.5 mm long and 2.0 mm in diameter, densely covered in apically directed hairs; style hardly exserted, 7 fertile, of three different lengths as per Figure 1, filaments white, anthers 1.0–1.5 mm long, pollen pale yellow. Ovary ovoid, ca. 2.5 mm long and 2.0 mm in diameter, densely covered in apically directed hairs; style hardly exserted, 7 fertile, of three different lengths as per Figure 1, filaments white, anthers 1.0–1.5 mm long, pollen pale yellow. 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Flowering

Flowering takes place at the onset of the dry season, stretching from November to March with a peak in December. A few stragglers may flower as late as April.

The pollen vector has not been identified, but it is suspected of being a dusk-flying moth. The flowers open at dusk more fully than during daytime, while at the same time emitting a strong and characteristic scent. The pale coloration of the petals is also thought to suggest a dusk- or night-flying insect, whereas the long nectar-containing hypanthium suggests exploitation by a moth, as flies with long probosci are normally only active in bright light.

Geographical distribution

Occurs from the western shore of False Bay northwards to Kleinnie (Figure 5). It occurs mostly close to the ocean, often just above the high-water mark where it grows on leached, sandy or rocky soils of the dunes and intervening flats as a component of coastal fynbos and strandveld in association with Rhus mucronata Thunb., Euclea racemosa Murray, and Protasparagus species (Figure 3a). Climatologically this area is characterized by cool and relatively moist winters without frost, and dry but still moderately cool summers due to the cold Benguela Current washing the shores. The rainfall rarely exceeds 750 mm in the south, diminishing to less than 100 mm in the north. In Stellensbosch, under cultivation, plants retain their foliage throughout the year (Figure 3b), but in nature the plants are deciduous during summer (Figure 3a). The plants are almost constantly battered by cold winds from the sea which often reach gale force. This species is not collected as often as one would expect, because the leafless plants when intermingled with other vegetation are difficult to see, and the flower colour is inconspicuous to the human eye.
diate in size between the phloem and xylem vessels as seen in transverse section.

We found that the anatomy of the petiole is remarkably constant throughout the section, and that it made no contribution towards the infrasectional taxonomy. Furthermore, in many respects this pattern is similar to those reported in other sections of the genus Pelargonium.

Cuticle: like in subsection Caulescentia, a smooth cuticle was reported in section Eumorpha (Ecklon & Zeyher) Harvey (P. patulum Jacq. var. patulum, locally slightly grooved, Van Wyk 1990), section Glaucophyllum Harvey [P. lanceolatum (Cav.) Kerner only, Schonken 1980], and section Cortusina DC. excluding section Reniformia (Knut) Dreyer (some species, Dreyer 1990). Cuticles with wavy or irregularly extruded outer surfaces (as seen in transverse section) have been reported in section Glaucophyllum (most species, Schonken 1980), section Pelargonium L'Herit. (P. tomentosum Jacq., Van Wyk 1990), section Cortusina excluding section Reniformia (some species, Dreyer 1990) and section Reniformia (Dreyer 1990). Volschenk (1980) found that in P. cucullatum (L.) L'Herit. the cuticle varies from smooth to grooved in certain areas but grooved in others, while in P. betulinum (L.) L'Herit. the cuticle is invariably grooved as seen in transverse section.

Epidermis: in section Pelargonium, like in the subsection Caulescentia, the guard cells of the stomata are flush with the surface of the epidermis in P. cucullatum subsp. strigifolium Volschenk, but raised above the surface of the epidermis in P. cucullatum subsp. cucullatum and tabulare Volschenk (Volschenk 1980).

Hypodermis: usually well differentiated and uniseriate, but up to two layers thick in section Pelargonium (P. tomentosum, Van Wyk 1990). A completely hyaline hypodermis has previously only been recorded in the section Myrrhidium (Boucher 1978), but not in all species. In sections Cortusina and Reniformia, Dreyer (1990) found the hypodermis to be hyaline, except directly underneath stomata. In the section Eumorpha, Van Wyk (1990) found the hypodermis of Pelargonium patulum var. patulum to be sparsely chlorenchymatous.

Extraxylary fibres: like in the subsection Caulescentia, an unbroken cylinder of extraxylary fibres surrounds the cylinder of peripheral vascular bundles in sections Pelargonium (P. tomentosum, Van Wyk 1990), Eumorpha (P. patulum var. patulum, Van Wyk 1990), Myrrhidium (Boucher 1978), Reniformia (Dreyer 1990), Jenkinsonia (most species, Scheltima & Van der Walt 1990), and Glaucophyllum (most species, Schonken 1980). The fibrous sheath is interrupted, i.e. present only opposite peripheral vascular bundles, in the sections Cortusina (Dreyer 1990) and

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**Figure 6** Pelargonium gibbosum: scanning electron micrograph of a pollen grain, showing reticulate-striate sculpturing. a, complete grain; b, detail of surface. Scale bar = 10 µm. From Van der Walt 597.

**Figure 7** Pelargonium gibbosum: transverse section through middle portion of petiole. Scale bar = 100 µm. From Van der Walt s.n. sub STEU 721.
Jenkinsonia [P. praemorsum (Andr.) Dietr. subsp. praemorsum, Scheltema & Van der Walt 1990]. In P. laevigatum (L.) Willd. subsp. laevigatum and P. fruticosum (Cav.) Willd. of the section Glaucoptallium, the larger leaves were found to have a continuous sheath of extraradial fibres, whereas the sheath is interrupted in smaller leaves (Schonken 1980). In section Campylium the sheath can be continuous or interrupted, depending on the species (Van der Walt & Van Zyl 1988).

Vascular bundles: in most sections, apart from the outer cylinder of collateral vascular bundles, a single central amphivasal medullary vascular bundle is present, including sections Cortusina and Reniformia (Dreyer 1990), Eumorphoa (P. patulum var. patulum, Van Wyk 1990), Glaucoptallium (Schonken 1980), and Pelargonium (P. tomentosum, Van Wyk 1990). In P. cucullatum of section Pelargonium, the central vascular bundle was found to be collateral (Volschken 1980).

In sections Jenkinsonia (Scheltema & Van der Walt 1990) and Myrhhridium (Boucher 1978, Van der Walt & Boucher 1986) the medullary vascular bundle is present in some species and absent in others, whereas in section Campylium the number of medullary vascular bundles can vary from 0 to 3, depending on the species (Hugo 1978). A central fibre bundle is invariably present in section Campylium (Hugo 1978), but absent in the section Pelargonium (Volschken et al. 1982, Volschken 1980).

P. gibbosum occurs sympatrically with several species of the subsection Polyactium, including P. triste (L.) L'Hér. (2n = 66) and P. lobatum (Burman f.) L. Hér. (2n = 44); yet natural hybrids are known, which is strange as there seems to be no obvious barrier against interbreeding. This species is outbreeding, and the bright red pigmentation of the petals seems geared to it is indeed incompatible with natural interbreeding: unlike such as freely with are known.

In section Myrhhridium (Boucher 1978, Van der Walt & Boucher 1986) the medullary vascular bundle is present in all species and absent in others, whereas in section Campylium the number of medullary vascular bundles can vary from 0 to 3, depending on the species (Hugo 1978). A central fibre bundle is invariably present in section Campylium (Hugo 1978), but absent in the section Pelargonium (Volschken et al. 1982, Volschken 1980).

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The following artificial hybrids have been reported (the female parent cited first):

- P. gibbosum x P. lobatum (2n = 44) [Sweet: t. 179 (1823)].
- P. gibbosum x P. reniforme (2n = 16 or 32) x P. cortusofolium L'Hér. (2n = 22) [Sweet: t. 213 (1824)].
- P. gibbosum x P. reniforme Curtis (2n = 16 or 32) x P. echinatum Curtis (2n = 22) [Sweet: t. 239 (1824)].
- P. multifidum Wendl. (2n = 22) x P. gibbosum [Sweet: t. 279 (1825)].
- P. triste (2n = 66) x P. gibbosum [Sweet: t. 425 (1829)].

Also sympatric with P. gibbosum and having similar habitat preferences, is P. fulgidum (L.) L'Hér. It has the same growth form and chromosome number as P. gibbosum, and was grouped together with P. gibbosum by most previous authors. It has been hybridized artificially with species in the subsection Polyactium, such as P. lobatum, and could therefore be expected to hybridize freely with P. gibbosum. However, no natural or artificial hybrids are known. Our own experimental cross pollinations suggest that it is indeed incompatible with P. gibbosum. Apart from its probable innate barriers against interbreeding, the pollination mechanism acts against natural interbreeding: unlike P. gibbosum the flowers are not dusk-scented, the flowers are markedly irregular, and the bright red pigmentation of the petals seems geared to attract quite a different pollinator.

Specimens seen
Acoccks 15189 (PRE); Andreass 553 (PRE, STE); Blyllis 8570 (MO); Becker s.n. sub MEL 94108 (MEL); Berehardis s.n. sub MO 1891633 (MO); Bolus 2982 (BOL); Boucher 2940 (STE); Drijfhoef 2839 (K, PRE, STEU); Dümmer 1819 (E); Engelmann 11917 (MO); Esterhuysen 21174 (BOL); Esterhuysen 21272 (BOL); Hugo 2866 (STE); Leipoldt s.n. (Z); Low 265 (STE); Macnac s.n. sub BOL 31343 (BOL, 2 sheets); Maggs 48 (STEU); Marloth 2530 (PRE); Pillans 17960 (BOL); Pillans s.n. sub BOL 31342 (BOL); Sonder s.n. sub MEL 94110 (MEL); Van der Walt 489 (PRE, STEU); Van der Walt 597 (PRE, STEU); Van der Walt 1052 (STEU); Van der Walt s.n. sub STEU 721 (STEU); Van Jaarsveld 3685 (STE); Van Rensburg 132 (STE); Van Rooyen & Ramsey 257 (STE); Ward s.n. sub STEU 902 (STEU); Wolly Diep 934 (BOL).

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References
ALTON, W.: see L’HÉRITIER de BRUTELLE, C.-L. 1789.
BURMAN, N.L.B. 1768. Flora indica. ... Haak, Leiden.
CANDOLLE, A.P. de: see De Candolle.
DILLENIUS, J.J. 1732. Hortus elthamensis ... Cornelius, Leiden.
HAWORTH, A.H. 1812. Synopsis plantarum succulentarum ... Taylor, London.
LINNAEUS, C. 1748. Hortus episcopalensis ... Salvius, Stockholm.
MARAS, E.M. 1977. 'n Taksonomiese, morfologiese en anatomi se studie van Pelargonium triste. B.Sc. (Hons.) research report, Univ. of Stellenbosch.