

Two new species of *Pelargonium* (Geraniaceae) from the Western Cape

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Pelargonium curviandrum E.M. Marais and *P. triandrum* E.M. Marais are described as new species. Both are tuberous species, belonging to the section *Hoarea* (Sweet) DC. They correspond in respect to their leaf structure, the colour and shape of the petals and the markings on the posterior petals. Both species have long protruding stamens which are curved upwards during anthesis. A description of the pollen morphology and the leaf anatomy, a distribution map, as well as an illustration of each species, are provided together with a discussion of their relationships within section *Hoarea*.

Pelargonium curviandrum E.M. Marais en *P. triandrum* E.M. Marais word as nuwe spesies beskryf. Al twee is geofiete wat aan die seksie *Hoarea* (Sweet) DC. behoort. Morfologies toon die twee spesies ooreenkomste wat betref die blaarstruktuur, die kleur en vorm van die kroonblare en die merke op die agterste twee kroonblare. Albei spesies het lang meeldrade wat by die blom uitsteek en opwaarts buig gedurende antese. 'n Beskrywing van die stuifmeelmorfologie en blaaranatomie, 'n verspreidingskaart sowel as 'n illustrasie van elke spesie word voorsien saam met 'n bespreking van hul verwantskappe binne die seksie *Hoarea*.

Keywords: Geraniaceae, *Hoarea*, new species, *Pelargonium*, southern Africa

Introduction

Pelargonium curviandrum E.M. Marais and *P. triandrum* E.M. Marais are deciduous geophytes belonging to the section *Hoarea* (Sweet) DC. The first known collections of *P. curviandrum* were made by R.H. Compton in 1931 and W.F. Barker in 1932, and of *P. triandrum* by M.A. Pocock in 1923. Since then only a few collections of any of these species have been recorded. Both species flower from October to November, usually after the leaves have died, thus herbarium specimens are usually without leaves. Proper herbarium specimens were prepared from plants collected in the field and grown in the garden. Leaves and flowers were collected at different stages.

Pelargonium curviandrum E.M. Marais, sp. nov. in sectione *Hoarea*, *P. punctato* affine.

Herba perennis acaulescens tuberosa. *Tuber* subterraneum, napi-forme vel oblongum, 15–50 mm longum, 12–25 mm in diam. *Folia* hysterrantha, rosulata, viridia, petiolata; lamina ovata, crenata, 25–80 mm longa, 20–60 mm lata, adaxiale glandulosa et pilosa, abaxiale velutina et glandulosa; petiolus 10–55 mm longus, prostratus, glandulosus et pilosus; stipulae petiolo adnatae, ciliatae. *Inflorescentia*: scapus pseudumbellus 2–4(–6), utraque 7–23(–29) floribus. *Pedicellum* ca. 0.5 mm longum. *Hypanthium* 18–30 mm longum, sparsim breveque glandulosum et hirsutum. *Sepala* 5, lanceolata, 7–12 mm longa, 1.5–3 mm lata, patentia. *Petala* 5, alba, dua postica ligulata, 17–23 mm longa, 2.5–3 mm lata, subtiliter carmineo-rubra, tria antica anguste spatulata, 12–15 mm longa, 2.5–3 mm lata. *Stamina* fertilia 4, dua anterioria 13–20 mm long sursum curvata, staminodia 6.

TYPUS:— Cape Province: 12 km E of Vanwyksdorp, *Lavranos 20941* (STE, holo.; BOL, K, MO, NBG, PRE).

A deciduous geophyte with a small regularly shaped subterranean tuber, 100–300 mm tall when in flower. *Tuber*: a turnip-shaped or elongated root with a short flattened stem, covered with flaking dark brown periderms, 15–50 mm long and 12–25 mm in diameter. *Leaves* radical, hysterranthous, rosulate, simple, green, petiolate; lamina ovate, apex obtuse, base cuneate to truncate, margin crenate, 25–80 × 20–60 mm, adaxially covered with long glandular hairs interspersed with very long soft patent non-glandular hairs, abaxially velutinous interspersed with long glandular hairs; petiole 10–55 mm long and 2–4 mm in diameter, prostrate, covered with short glandular hairs and long soft patent non-glandular hairs; stipules subulate, adnate to petioles for half of their length, 4–8 × 1–2 mm, ciliate, apices laterally curved. *Inflorescence*: scape 30–200 mm long, 1–3 mm in diameter, branched, bearing 2–4(–6) pseudo-umbellets with 7–23(–29) flowers each; peduncles 50–120 mm long, 1–2 mm in diameter, covered with short glandular hairs interspersed with long soft patent non-glandular hairs; bracts narrowly triangular, 4–5 × 1–1.5 mm, hirsute; flower buds, flowers and fruits erect. *Pedicel* ca. 0.5 mm long. *Hypanthium* 18–30 mm long, reddish brown, sparsely covered with short glandular hairs and non-glandular hairs. *Sepals* 5, lanceolate, apices acute, 7–12 × 1.5–3 mm, patent, reddish brown with white margins, indumentum abaxially as on peduncle. *Petals* 5, white to cream-coloured, patent during anthesis; posterior two with wine-red feather-like markings, ligulate, bases cuneate, apices rounded, 17–23 × 2.5–3 mm; anterior three narrowly spatulate, bases attenuate, apices rounded, 12–15 × 2.5–3 mm. *Stamens* 10, basally connate, staminal column 1.5–3.5 mm long, white, smooth; perfect stamens 4, lateral two 11–18 mm long, anterior two 13–20 mm long, protruding from the flower, curved upwards during anthesis, white; staminodes 2.5–6 mm long; anthers wine-red, 2–2.5 mm long, pollen orange. *Gynoecium* lengthens conspicuously during anthesis; ovary superior, oblong-conical, 5-lobed, 3.5–5.5 mm long, densely sericeous; style filiform, 6–12 mm long, white; stigma with 5 branches, 0.5–1 mm long, adaxially pink. *Fruit*: a schizocarp consisting of 5 mericarps, bases of mericarps 5–6 mm long, with glandular hairs, tails 22–25 mm long. (Figure 1).

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Diagnostic features

P. curviandrum is a geophyte with simple prostrate leaves, of which the older ones are bigger than the younger ones. The long and narrow ligulate petals are white to cream-coloured and as a result of the orientation of the two posterior petals the feather-like markings on them appear as a unit. *P. curviandrum* has four fertile stamens (11–20 mm long) which are more or less 1.5 times the length of the sepals (7–12 mm) and protrude from the flower. The flower is protandrous and the stamens are initially bent upwards during anthesis, hence the specific epithet *curviandrum*. Later on the anthers are dropped and the filaments bend

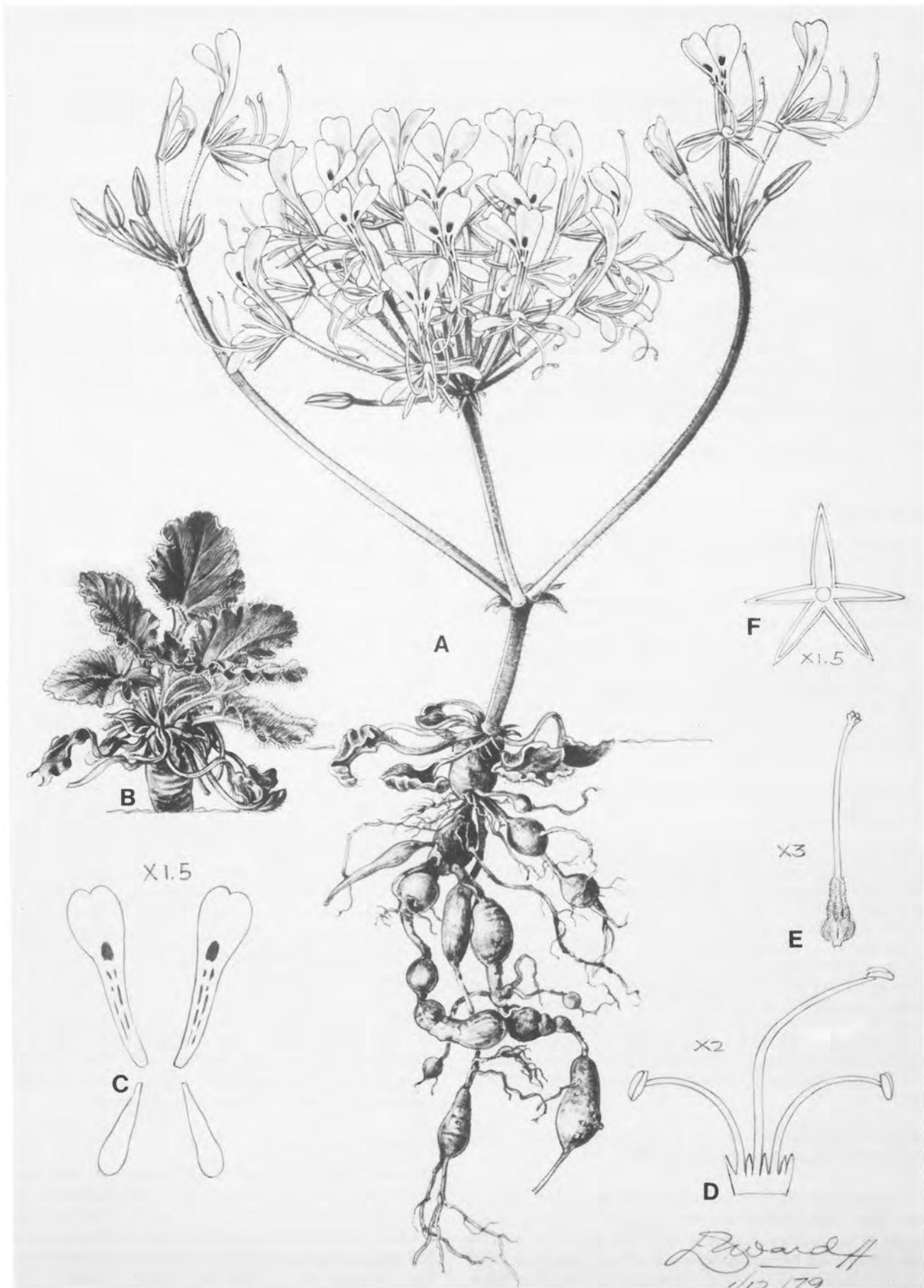


Figure 1 *Pelargonium curviandrum*. A. Flowering plant $\times 1$. B. Tuber $\times 1$. C. Petals $\times 2$. D. Gynoecium $\times 3$. E. Androecium $\times 2$. F. Leaf base with stipules $\times 1$.

downwards. At the same time the gynoecium lengthens and the stigma finally takes up the original position of the anthers.

Geographical distribution and ecology

P. curviandrum occurs in the southern Cape on the mountain ranges between the 33 and 34° latitudes, from Montagu in the west to Oudtshoorn in the east (Figure 2), an area with an annual rainfall of 100–200 mm. It grows in mountain fynbos or in a vegetation dominated by *Portulacaria afra* (spekboomveld) and usually occurs in very small populations. The peak of the flowering time is from October to November.

Material studied

—3320 (Montagu): 8 km N of Montagu (–CA), Hall 2117 (NBG); Jouberts-kop (–DA), Van Jaarsveld 10324 (STEU).

—3321 (Ladismith): Huisrivier Pass, Matjiesvlei turnoff (–BC), Marais 168 (STEU); Roodeberg, Ladismith (–CB), Compton 3864 (BOL); 12 km E of Vanwyksdorp (–DA), Lavranos 20941 (BOL, K, MO, NBG, PRE, STE).

—3322 (Oudtshoorn): Bakenskraal, 12 km S of Oudtshoorn (–CA), Barker 65 (BOL, K).

Pelargonium triandrum E.M. Marais, sp. nov. in sectione *Hoarea* distincta propter stamina fertilia solum tria, *P. punctato* affine.

Herba perennis acaulescens tuberosa. *Tuber* subterraneum, napi-forme, interdum moniliforme, 20–60 mm longum, 10–15 mm in diam. *Folia* hysteraantha, rosulata, viridia, petiolata; lamina ovata, crenata, 15–75 mm longa, 15–65 mm lata, adaxiale et abaxiale pilosa et glandulosa; petiolus 14–80 mm longus, prostratus, pilosus et glandulosus; stipulae petiolo adnatae. *Inflorescentia*: scapus pseudo-umbellus 2–4(–7), utraque 7–26(–30) floribus. *Pedicellum* ca. 0.5 mm longum. *Hypanthium* 23–32 mm longum, glandulosum et sparsim hirsutum. *Sepala* 5, lanceolata, 7–11 mm longa, 1–3 mm lata, unum posterius erectum, cetera patentia. *Petala* 4, crenea vel pallida flava, dua postica ligulata vel unguiculata spathulata, subtiliter carmineo rubra, 19–25 mm longa, 3–5.5 mm lata, tria antica anguste spathulata, 9.5–17 mm longa, 2–3 mm lata. *Stamina* fertilia 3, unicum anterius 20–32 mm longum, staminodia 5.

TYPUS:– Cape Province; 27 km N of Citrusdal on old road to Clanwilliam, at turnoff to Algeria Forestry Station, Van der Walt & Vorster 1276 (STE, holo.; BOL, K, MO, NBG, PRE).

A deciduous geophyte with a small regularly shaped subterranean tuber, 100–200 mm tall when in flower. *Tuber*: a turnip-shaped or elongated, sometimes moniliform root with a short flattened stem, covered with flaking dark brown periderms, 20–60 mm long and 10–15 mm in diameter. *Leaves* radical, hysteraanthous, rosulate, simple, green, petiolate; lamina broadly ovate, apex rounded or obtuse, base cuneate, truncate or cordate, margin irregularly crenate, 15–50 × 15–65 mm, adaxially and abaxially densely pilose and densely covered with glandular hairs; petiole 14–80 mm long and 1–4 mm in diameter, prostrate, densely pilose interspersed with long and short glandular hairs; stipules subulate, adnate to petioles for half their length, 10–14 × 1–2 mm, ciliate, apices laterally curved. *Inflorescence*: scape 20–90 mm long, 2–4 mm in diameter, branched, bearing 2–4(–7) pseudo-umbellules with 7–26(–30) flowers each; peduncles 30–90 mm long, 1.5–2 mm in diameter, covered with glandular hairs interspersed with patent non-glandular hairs; bracts lanceolate, 5–7 × 1–2 mm, abaxially hirsute; flower buds, flowers and fruits erect. *Pedicel* ca. 0.5 mm long. *Hypanthium* 23–32 mm long, straw-coloured to pale reddish brown, indumentum as on peduncle. *Sepals* 5, lanceolate, apices acute, 7–11 × 1–3 mm, posterior

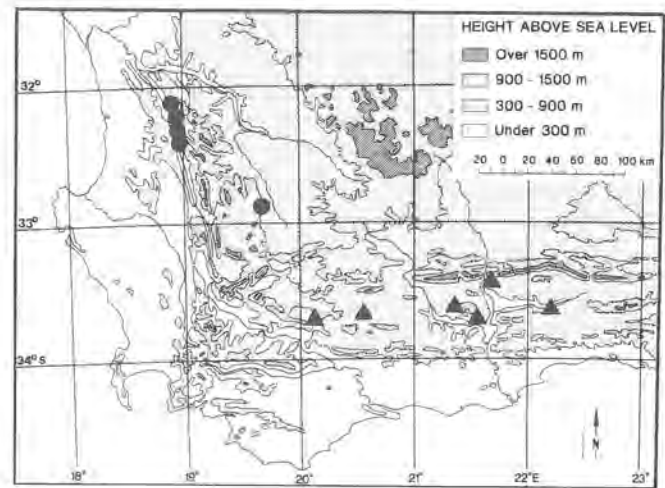


Figure 2 Known geographical distribution of *P. curviandrum* (Δ) and *P. triandrum* (■).

one erect, others patent, pale reddish brown with margins white, indumentum abaxially as on peduncle. *Petals* 4, cream-coloured to pale yellow, patent during anthesis; posterior two with wine-red feather-like markings, ligulate to unguiculate-spathulate, bases cuneate, apices emarginate, 19–25 × 3–5.5 mm; anterior two narrowly spathulate, bases attenuate, apices rounded, 9.5–17 × 2–3 mm. *Stamens* 8, basally connate, staminal column 1.5–3 mm long, white, smooth; perfect stamens 3, protruding from the flower, curved upwards during anthesis, lateral two 11–21.5 mm long, anterior one 20–32 mm long, white; staminodes 2–5 mm long; anthers dark pink, 1.5–2 mm long, pollen orange. *Gynoecium*: lengthens conspicuously during anthesis; ovary superior, oblong-conical, 4–5-lobed, 3–4.5 mm long, densely sericeous; style filiform, 3.5–10 mm long, white to pale pink; stigma with 4–5 branches, 0.3–0.5 mm long, adaxially dark pink. *Fruit*: a schizocarp consisting of 4–5 mericarps, bases of mericarps 4 mm long, without glandular hairs, papillate at distal end, tails 23–32 mm long. (Figure 3).

Diagnostic features

P. triandrum is characterized by the reduced number of filaments (eight) and only three very long fertile stamens, hence the specific epithet. An androecium, comprising eight filaments only and three fertile stamens, is unique for the genus. The anterior stamen is not only more than 2.5 times the length of the sepals but is also longer than the posterior petals. *P. triandrum*, like *P. curviandrum*, has simple prostrate leaves, pseudo-umbellules with a large number of flowers, long hypanthia, very long and narrow petals, very long protruding fertile stamens, long styles and very short stigma branches. In both species there is a marked lengthening of the style during anthesis.

Geographical distribution and ecology

P. triandrum is known from a small distribution area along the Olifants River, south of Clanwilliam. Recently it was also collected in Hartnekskloof on the Ceres-Karoo side of the escarpment (Figure 2). This area receives an annual rainfall of 100–200 mm occurring mainly in winter. *P. triandrum* occurs in broken succulent veld or dry fynbos on sandstone. Plants grow amongst rocks in red loam or under bushes in partial shadow or in direct sunlight and are usually locally abundant. It flowers from late October to November.

Material studied

—3218 (Clanwilliam): Clanwilliam (–BB), Hall NBG719/52

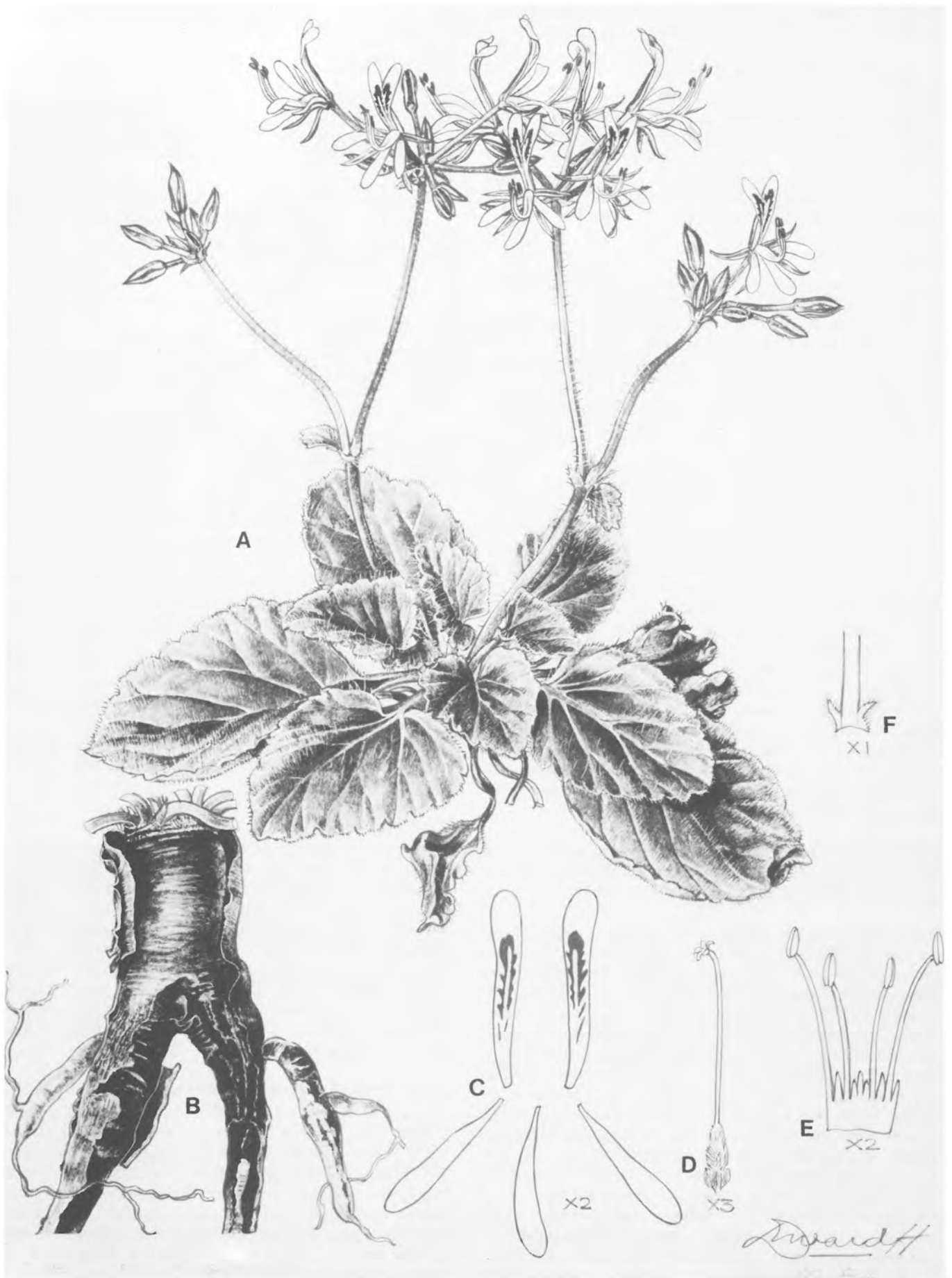


Figure 3 *Pelargonium triandrum*. A. Flowering plant $\times 1$. B. Plant with leaves $\times 1$. C. Petals $\times 1.5$. D. Androecium $\times 2$. E. Gynoecium $\times 3$. F. Sepals $\times 1.5$.

(NBG); *Van Niekerk s.n.* (STEU); 8 km S of Clanwilliam on gravelled road (-BB), *Marais 304* (STEU); Ramskop Nature Reserve, Clanwilliam (-BB), *Van der Walt 1278* (STEU); 20 km from Algeria to Clanwilliam (-BB), *Van der Walt s.n.* (STEU); Rondegat, 25 km S of Clanwilliam (-BD), *Friedrich 452* (STEU); Kriedouwkrantz (-BD), *Leighton 3346* (BOL), *Pocock 771* (PRE); Olifantsrivier, at turnoff to Algeria (-BD), *Van der Walt s.n.* (STEU), *Van der Walt & Vorster 1276* (BOL, K, MO, NBG, PRE, STE).

—3219 (Wuppertal): Hartnekskloof, Ceres Karoo (-DC), *Van Zyl s.n.* (STEU).

Leaf anatomy

Leaf anatomical studies were performed on fresh material from plants growing in the garden for more than one season (Table 1). This ensured that all the material studied was from plants growing for a considerable time under similar conditions. Transverse sections of wax-embedded petioles and laminae of both species were cut with a rotary microtome and stained with Alcian Green Safranin (Joel 1983). Sections were made through the middle part of the petioles and laminae.

The petioles of both *P. curviandrum* and *P. triandrum* are circular to adaxially flattened in transverse section. In both species the petioles are covered by a uniseriate epidermis with short or long and short glandular hairs and long soft unicellular non-glandular hairs. The cortex comprises a uniseriate collenchymatous hypodermis and four to five layers of large chlorenchyma cells. The vascular tissue consists of a cylinder of four main bundles alternating with a varying number of smaller bundles and with a varying number of medullary bundles. No sclerenchymatous tissue occurs on the periphery of the vascular cylinder. In this, *P. curviandrum* and *P. triandrum*, both with prostrate leaves, differ from species in section *Hoarea* with erect leaves, where a cylinder of sclerenchyma surrounds the vascular tissue (Marais 1991, 1993). The pith consists of rather large parenchyma cells, and idioblasts with druses are scattered through the pith, usually in the vicinity of the vascular bundles.

The laminae of both species are amphistomatic with a uniseriate epidermis covered by a thin and smooth cuticle. The abaxial epidermal cells are smaller than those of the adaxial epidermis. The leaves are dorsiventral with adaxially only one layer (*P. triandrum*) or two to three layers (*P. curviandrum*) of broad palisade cells. The cells of the outer layer are longer than those of the inner layer. The spongy tissue has larger intercellular spaces than

those found in *P. aciculatum* E.M. Marais and related species which also belong to section *Hoarea* (Marais 1991). Druse crystals occur usually on the border between the palisade and spongy tissues.

Pollen morphology

Pollen grains of both *P. curviandrum* and *P. triandrum* were collected from fresh material as well as herbarium specimens (Table 1) and were treated according to the acetolysis method and studied with the light and scanning electron microscope. At least twenty-five pollen grains of each specimen were studied and measured (Table 1). The morphology of the pollen grains corresponds to that of the rest of the genus *Pelargonium*, in that the grains are spherical and tricolporate (Marais 1990). In *P. curviandrum* the tectum can be described as striate-reticulate (Bortenschlager 1967; Figure 4a) because the main muri are on a higher level and are more or less parallel to one another. In *P. triandrum* the tectum can be described as extremely striate (Marais 1994) because the main parallel muri are thicker and more prominent than the lower connecting ones forming smaller lumina than those of *P. curviandrum* (Figure 4). The pollen grains of *P. curviandrum* (73–76 µm in diameter) are more or less similar in size to those of *P. triandrum* (70–85 µm in diameter).

Discussion

Both *P. curviandrum* and *P. triandrum* have very long protruding stamens which are curved upwards during anthesis. This character of the androecium is shared with *P. oblongatum* Harv. (Van der Walt 1977) and *P. punctatum* (Andr.) Willd. (Van der Walt & Vorster 1981), both of them belonging to section *Hoarea*. The leaves of these four species are also very similar. All of them have simple prostrate leaves with the older ones bigger than the younger ones. The indumentum of the leaves, scape, peduncle and hypanthia of the different species is also very similar, comprising different combinations of long and short glandular hairs and long soft patent non-glandular hairs. The non-glandular hairs are usually very long.

All four species have branched scapes with 2–7(–8) pseudo-umbellets, and although *P. oblongatum* [4–8(–24)] does not have a similar large number of flowers per pseudo-umbellet as the others [*P. curviandrum*, 7–23(–29); *P. triandrum*, 7–26(–30); *P. punctatum*, (10–)17–45(–60)], all of them can be regarded as

Table 1 Specimens studied for pollen morphology and leaf anatomy

Taxon Specimen	Herbarium and number	Pollen measurements			Leaf anatomy
		Min	Max	x (µm)	
<i>P. curviandrum</i>					
<i>Halt 2117</i>	NBG	67	84	76	
<i>Barker 65</i>	BOL	67	79	74	
<i>Lavranoš 20941</i>	STEU 3214	65	79	73	+
<i>Marais 168</i>	STEU 3543	67	84	75	
<i>P. triandrum</i>					
<i>Van der Walt s.n.</i>	STEU 1464	67	91	80	+
<i>Van der Walt s.n.</i>	STEU 1477	67	74	72	+
<i>Friedrich 452</i>	STEU 2184				+
<i>Van der Walt 1276</i>	STEU 2947	62	79	70	+
<i>Van Niekerk s.n.</i>	STEU 3627	72	91	85	+

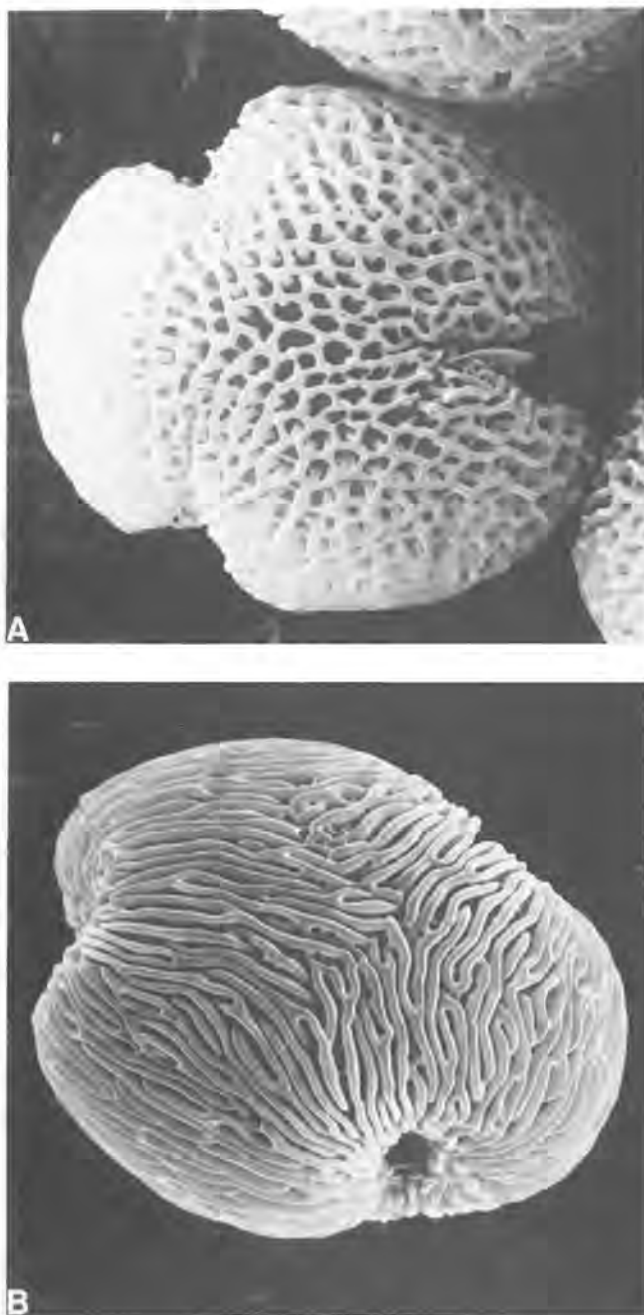


Figure 4 Polar view of a pollen grain of *P. curviandrum* (A) (Hall 2117, NBG) and *P. triandrum* (B) (Van Niekerk s.n., STEU). Scale bar: 10 μ m.

having many-flowered pseudo-umbellets. All four species have long hypanthia [(1.6–)2.5–5.5 times the length of the sepals]. The colour of the flowers of the different species vary from pale yellow, cream-coloured or white with wine-red feather-like markings on the posterior petals. There is, however, a difference in the shape and the size of the petals. *P. oblongatum* has unguiculate-obovate to widely unguiculate-obovate petals, whereas those of *P. curviandrum*, *P. triandrum* and *P. punctatum* are ligulate to narrowly spatulate and as a result of the orientation of the posterior petals of the latter three species, the feather-like markings on them appear as a unit (Marais 1994).

Although all four species have very long protruding stamens, there is a difference in the structure of the androecium. Both *P. curviandrum* and *P. oblongatum* have ten filaments of which, in the case of *P. oblongatum*, only five bear anthers and in *P. curviandrum* only four (Figure 1). This structure fits in with the an-

droecium of the genus (Marais 1994). Both *P. punctatum* and *P. triandrum* have a reduced number of filaments as well as fertile stamens; with seven filaments and two fertile stamens in *P. punctatum* or eight filaments and three fertile stamens in *P. triandrum* (Figure 3). A further resemblance between *P. curviandrum* and *P. oblongatum* is that both of them have a striate-reticulate pattern of the tectum of the pollen grains (Figure 4A), and this pattern differs from the extremely striate pattern occurring in *P. punctatum* and *P. triandrum* (Figure 4B). The size of the pollen grains in *P. curviandrum*, *P. oblongatum* and *P. triandrum* fits within the range of 70–85 μ m in diameter, but in *P. punctatum* the size is much smaller (57–60 μ m in diameter; Marais 1994).

P. punctatum and *P. triandrum* sometimes show a reduction in the number of carpels also, and can have a four- or five-lobed ovary. *P. curviandrum* and *P. oblongatum* always have five-lobed ovaries. *P. punctatum* (0.3–0.5 mm), *P. triandrum* (0.3–0.5 mm) and *P. curviandrum* (0.5–1 mm) have very short stigma branches, whereas the length of the stigma branches of *P. oblongatum* (1.2–2.5 mm) resembles that of the majority of species in section *Hoarea* (Marais 1994). In all four species there is a marked lengthening of the style during anthesis.

All four species occur in the winter rainfall region, in areas with an annual precipitation of less than 300 mm, and although all of them grow under rather harsh conditions, the leaves exhibit no xeromorphic characteristics. The prostrate simple leaves are short-lived, appearing in April or May after the raining season has started, and die before flowering time in October or November. No sclerenchymatous tissue occurs on the periphery of the vascular cylinder of the petioles and very little mechanical tissue occurs around the veins of the laminae. The spongy tissue has large intercellular spaces. In respect of the leaf anatomy, only *P. triandrum* reveals a slight difference from the others by having only one layer of palisade tissue on the adaxial side of the mesophyll, whereas the others have two to three layers. Although the number of palisade cell layers is a variable character which is easily influenced by environmental conditions (Cutler 1978), it must be kept in mind that the material studied here grew under similar conditions for more than one season.

The distribution areas of the four species do not overlap. *P. oblongatum* occurs in Namaqualand and the Richtersveld, north of the 31° latitude (Van der Walt 1977; Marais 1994), *P. triandrum* on the western side of the Cederberg, between 32 and 33° S (Figure 2), *P. punctatum* occurs more to the north than *P. triandrum* (between 31 and 32° S) on the eastern side of the escarpment (Van der Walt & Vorster 1981; Marais 1994), and *P. curviandrum* occurs on the mountain range in the southern Cape (Figure 2). All of them are often found in dry fynbos on sandstone.

The petals of *P. curviandrum* are similar to those of *P. triandrum* and *P. punctatum*, but the structure of the androecium and the pollen morphology of *P. curviandrum* reveal a closer relationship to *P. oblongatum*. The four species referred to here, exhibit many morphological similarities, but because of the differences in the structure of the tectum of the pollen grains, these similarities should rather be ascribed to convergent evolution than a phylogenetic relationship.

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