New species of *Pelargonium* (Geraniaceae) from Namaqualand

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*Pelargonium angustipetalum* E.M. Marais, *P. parvipetalum* E.M. Marais and *P. rubiginosum* E.M. Marais are described as new species. Although all three of them are tuberous species with turnip-shaped tubers covered with dark brown peeling periderms and apically a short flattened stem from which the leaves and scape emerge, and thus belonging to the section *Hoarea* (Sweet) DC., they have different types of floral structures. To ascertain their interrelationships within section *Hoarea*, their macromorphological characters, leaf anatomy and pollen morphology are compared to those of other species within section *Hoarea*. Illustrations of the three species as well as electronmicrographs of their pollen grains and a distribution map are provided.


**Introduction**

*Pelargonium angustipetalum* E.M. Marais, *P. parvipetalum* E.M. Marais and *P. rubiginosum* E.M. Marais are deciduous geophytes with regularly or turnip-shaped tubers covered with dark brown peeling periderms and apically a short flattened stem from which the leaves and scape emerge, and thus belonging to the section *Hoarea* (Sweet) DC. All three species occur in Namaqualand in areas with an annual rainfall of less than 200 mm. The distribution areas of the three species are bordering each other, but seem not to overlap. *P. rubiginosum* occurs from the northern part of the Richtersveld to the Kourkamma Mountains in the south and the first known collection was made by H. Hall in 1953. Another two collections were made by B. Nordensiam in 1962 and all other collections were made only since the start of the *Pelargonium* L’Hérit. project at the University of Stellenbosch in 1975. *P. angustipetalum* occurs from the southern part of the Richtersveld to the vicinity of Kamieskroon. The only known collections of this species made before 1975 are two specimens collected by W.C. Scully. Unfortunately both specimens are without dates, but were probably collected during the previous century when Scully was Resident Magistrate in Namaqualand (Gunn & Codd 1981). *P. parvipetalum* occurs in central Namaqualand and occupies the largest distribution area of the three species. It is also represented by the largest number of herbarium species of the three species. The first known collections were made by E.I. Markötter at Menzieskraal near Nieuwoudtville and by L. Leipoldt near Pakhuis, both during September 1933. The three species also differ with regard to flowering time. *P. parvipetalum* is an early flowering species with the peak of its flowering time in September when leaves are still present. This coincides with the main blooming season in Namaqualand (Le Roux *et al.* 1989; Struck 1992) and is probably the reason for the relatively large number of herbarium specimens available. *P. rubiginosum* flowers in October and November and the flowering time of *P. angustipetalum* is in November and December after the leaves have died, with the result that herbarium specimens have either leaves or flowers, but seldom both.

All three species have compound leaves, but they differ with regard to their floral structure. *P. angustipetalum* has short stamens, concealed in the floral sheath, whereas *P. parvipetalum* and *P. rubiginosum* have long protruding stamens. The latter two species differ in that the staminal column in *P. parvipetalum* is papillate and that of *P. rubiginosum* is smooth. To ascertain the systematic position of these three species within section *Hoarea*, their macromorphological characters, leaf anatomy and pollen morphology were compared to those of other species within section *Hoarea*.

**Materials and Methods**

Morphological studies were performed on herbarium specimens and on plants collected in the field and cultivated in the Botanical Garden of the University of Stellenbosch. Complete herbarium specimens were prepared from plants in cultivation. Leaf anatomical studies were performed on fresh material from plants growing in the garden for more than one season (Table 1). This ensured that the material studied, was from plants growing for a considerable time under similar conditions. Transverse sections of wax-embedded laminae were cut with a rotary microtome and stained with Alcian Green Safranin (Joel 1983). Sections were made through the middle part of the pinnae. Pollen grains of all three species were collected from plants in cultivation, treated according to the acetolysis method (Erdtmann 1960) and studied with both light and scanning electron microscopes. At least twenty five pollen grains of each specimen were studied and measured (Table 1).

**Table 1** Specimens studied for pollen morphology and leaf anatomy

<table>
<thead>
<tr>
<th>Taxon Specimen</th>
<th>STEU Number</th>
<th>Pollen measurements</th>
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<tr>
<td><em>P. angustipetalum</em></td>
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<tr>
<td>Meve 236</td>
<td>3745</td>
<td>46 53 49</td>
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<td>Drijfhout 1371*</td>
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<td>43 55 51</td>
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<td><em>P. parvipetalum</em></td>
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<td>Bruyns 1519*</td>
<td>1455</td>
<td>58 67 61</td>
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<td>Sirion 9242*</td>
<td>3066</td>
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<td>Le Roux s.n.</td>
<td>3240</td>
<td>55 64 60</td>
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<td>Marais 327</td>
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<td>46 65 56</td>
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<td><em>P. rubiginosum</em></td>
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<tr>
<td>Von Joursveld 4100*</td>
<td>2371</td>
<td>48 58 53</td>
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<td>Drijfhout 2811*</td>
<td>2888</td>
<td>53 67 62</td>
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Figure 1 *Pelargonium angustipetalum*. A. Flowering plant x1; B. Leaf x1; C. Petals x1; D. Gynoecium x6; E. Androecium x3.
**Pelargonium angustipetalum** E.M. Marais, sp. nov. in sectione Hoarea, affine *P. attenuatum*.

Herba perennis acaulescens tuberosa. **Tuber**: subterraneum, napiforme vel oblongum, 30–35 mm longum, 15–20 mm in diam. *Folia* viridia, petiolata; lamina palmatisecta, pinnae 50–90 mm longae, adaxiale et abaxiale hirsuta et breviter glandulosae; petiolus 80–260 mm longus, rigidus, erectus, setosus et breviter glandulosus; stipulae petiolo adnatae. **Inflorescentia**: scapus pseudoumbellis 2–7, utraque 4–12 floribus. **Pedicellum** ca. 0.5 mm longum. **Hypanthium** 21–35 mm longum, hirsutum et glandulosum. Sepalae 5, lanceolata, 6–8 mm longa, 1.5–3 mm lata, patentia. Petala 5, crema vel pallide flava, due postica ligulata, subtiliter carmine rubra, 21–26 mm longa, 2–3 mm lata, tria antica ligulata, 19–23 mm longa, 1–2 mm lata. **Stamina** fertilia 5, staminodia 5.

**TYPE** - Northern Cape Province: ‘Between Wildepaardehoek and Komaggas, 3 km from Sannagas’ *Drijfhout* 1371 (NBG, holø.; BOL; K; MO; PRE; S).

A deciduous geophyte with a subterranean tuber, 80–240 mm tall when in flower. **Tuber**: a turnip-shaped or elongated root with a short flattened stem, covered with flaking dark brown periderms, 30–35 mm long and 15–20 mm in diameter. **Leaves** radical, green, petiolata; lamina palmately compound with 3–5 pinnae; pinnae 50–90 mm long, sometimes deeply incised, segments 20–40 mm long and 2–7 mm wide, apices acute, hisrule with appressed stiff hairs interspersed with very short glandular hairs; petiole 80–260 mm long and 1–1.5 mm in diameter, rigid, erect, setose with short appressed hairs interspersed with very short glandular hairs; stipules subulate, adnate to petioles for half their length, 10–15 mm long and 2–3 mm wide, hisrule. **Inflorescence**: scape 15–150 mm long and 1.5–2 mm in diameter, branched, bearing 2–7 pseudo-umbellets with 4–12 flowers each; peduncles 20–100 mm long, 1–1.5 mm in diameter, hisrule with short appressed stiff hairs interspersed with short glandular hairs; bracts lanceolate, apices acute, 2 mm long, 1 mm wide, abaxially densely hisrule with appressed hairs interspersed with short glandular hairs; flower buds, flowers and fruits erect. **Pedicel** ca. 0.5 mm long. **Hypanthium** 21–35 mm long, 2.5–5 times the length of the sepals, pale green to reddish brown, indumentum as on peduncle. **Sepals** 5, lanceolate, apices acuminate, 6–8 mm long, 1.5–3 mm wide, posterior one erect, others patent, green with margins white, indumentum abaxially as on peduncle. **Petals** 5, cream-coloured or pale yellow, claws forming a sheath, apices patent or recurved; posterior two ligulate with pink feather-like markings on the lower half, bases cuneate, apices rounded, 21–26 × 2–3 mm, length/width ratio 7.5–9; anterior three ligulate, bases attenuate, apices rounded, 19–23 × 1–2 mm. **Stamens** 10, basally connate, staminal column 0.5–1 mm long, white; perfect stamens 5, concealed in the floral sheath, posterior one 1.5–2 mm long, lateral two 2.5–4 mm long, anterior two 5–6 mm long, 0.6–0.8 times the length of the sepals, white; staminodes 1.2 mm long; anthers red, 1.5–2 mm long, pollen orange. **Gynoecium**: ovary superior, oblong-conical, 5-lobed, 2–3 mm long, densely sericeous; style filiform, 0.2–1.5 mm long, pale green; stigma with 5 recurved branches, 1–2 mm long, adaxially pink. **Fruit**: a schizocarp consisting of 5 mericarps, bases of mericarps 5 mm long, with glandular hairs, tails 21–26 mm long. (Figure 1).

**Diagnostic features and affinities**

*P. angustipetalum* is a geophyte with palmately compound leaves with long, thin, upright petioles. It is characterized by the cream-coloured or pale yellow flowers with long, narrow petals, hence the specific epithet *angustipetalum*. The very short stamens are concealed within the floral sheath. This floral structure is similar to that of *P. attenuatum* Harv. and *P. fergusoniæ* L. Bol. Comparing these three species, they all have pale yellow flowers with long ligulate petals and short stamens, and they all have palmately compound leaves with long, thin petioles. The petioles of *P. fergusoniæ* spread horizontally from the growing point and bend vertically in the middle, whereas those of *P. angustipetalum* and *P. attenuatum* are erect. The petals of *P. attenuatum* (posterior two 31–42 mm long) are much longer than those of *P. fergusoniæ* (posterior two 20–33 mm long) and *P. angustipetalum* (posterior two 21–26 mm long). The indumentum on the peduncles and hypanths of *P. angustipetalum* differs from the other two species. The peduncles of *P. angustipetalum* are covered with short appressed stiff hairs, whereas those of the other two species are covered with curly hairs.

**Geographical distribution and ecology**

*P. angustipetalum* has a small distribution area in Namaqualand, occurring from Kosies in the Richtersveld in the north to Kamieskroon in the south (Figure 2). This area has a very scant rainfall of 100–200 mm per annum, occurring during the winter. The summers are very hot and dry. Plants grow in deep sand in karroid vegetation and usually occur in partial shade under bushes. Flowering time is in summer, from November to December after the leaves have died.

**Material studied**

—2917 (Springbok): Kosies, Richtersveld (–BA), Roux 265 (STEU); O’Kiep (–DB), Scully s.n. (K); Between Wildepaardehoek...
Figure 3  *Pelargonium parvipedatum*. A. Flowering plant ×1; B. Sepals ×3; C. Petals ×3; D. Androecium ×3; E. Gynoecium ×4.
& Komagga (–DC, Dreyfous 1371 (BOL, K, MO, NBG, PRE, S)), —3017 (Hondoeklipbai): 4.5 miles N of Kamieskroon on Springbok road (–BB), Hardy & Bailey 1125 (PRE); 3 km E of Kamieskroon (–BB), Meve 236 (STEU).

Without exact locality: Namaland Minor, Scully 231 (BOL).

**Pelargonium parvipetalum** E.M. Marais, sp. nov. in section *Hoarea* distincta propter petala minima, *P. leipoldtii* Knuth affinis sed petala semper 5 non 2 ad 5.

Herba perennis acaulescens tuberosa. *Tuber* subtunnelare, nippiforme, internodium moniliforme, 15–40 mm longum, 10–25 mm in diam. Folia rosulata, viridia, petiolata; lamina elliptica, 25–95 (–140) mm longa, irregulariter pinnatisecta vel bipinnata, pinnae lobatae vel laciniaeae, axillare ad axilvae hirsute; petioli 15–60 (–90) mm longus, rigidus, erectus, dense hirsutus, sparsim glandulosus; stipulae petiolo adnatae. *Inflorescens*: scapus pseudoumbellifer (2–3–5–6), utractae 7–14–(18) floribus. *Pedicellum* ca. 0.5 mm longum. *Hypanthium* 8–16 mm longum, dense hirsutum et glandulosum. *Sepala* 5, lanceolata, 6–10 mm longa, 2–4.5 mm lata, recurvata. *Petala* 5, alba, sepalis brevioris, stellata, due postica leviter curvata, 5–8.5 mm longa, 1.5–3 mm lata, subtillit cammineo-rubra picta, tria anteic 4.5–8 mm longa, 1.5–2.2 mm lata. *Stamina* fertilia 5, staminodia 5.

**TYPE** = Northern Cape Province: Gamoep, Farm Vaalkoei, 3 km south of Gamoep, Bryuns 1519 (NBG, holo; BOL, K, MO; PRE, S).

A geophyte 80–250(–280) mm tall when in flower. *Tuber*: a turnip-shaped or elongated, sometimes moniliform root, 15–40 mm long and 10–25 mm in diameter. *Leaves* green, petiolate; lamina elliptica, 25–95 (–140) mm long, regularly pinnate; pinnae irregularly lobate to pinnatisect or laciniate, 10–30 × 6–20 mm, axially and abaxially hirsute with long apressed stiff hairs; petiolo 15–60 (–90) mm long and 1–2 mm in diameter, rigid, erect, hirsute with apressed stiff hairs interspersed with bristle-like hairs and very short glandular hairs; stipulas subulate, adnate to petioles with apices free, 10–22 mm long and ca. 1 mm wide, ciliata. *Inflorescens*: scape 20–160 (–200) mm long, branched, bearing (2–3–5–6) pseudo-umbellules with 7–14–(18) flowers each; peduncules 40–120 mm long, 1–3 mm in diameter, green, densely covered with appressed curly hairs interspersed with long glandular hairs; bracts subulate, 2–5 × 1 mm, abaxially hirsute with distally appressed hairs. *Pedicel ca. 0.5 mm long.* *Hypanthium* 8–16 mm long, 1–1.8 times the length of the sepals. reddish brown, densely hirsute with appressed hairs interspersed with long glandular hairs. *Sepals* 5, lanceolata, apices acute, 6–10 mm long, 2–4.5 mm wide, recurved, green, indumentum abaxially as on hypanthium. *Petals* 5, white, patient during anthesis; posterior two with dark red feather-like markings, liguulate to subacute, slightly curved, bases cuneate, apices obtuse, rounded or emarginate, recurved during anthesis, 5–8.5 × 1.5–3.3 mm, length/width ratio 3–4; anterior three spathulate, bases attenuate, apices rounded, 4.5–8 × 1.5–2 mm. *Stamens*: staminal column 2–4 mm long, white, papillate; perfect stamens 5, protruding from the flower, posterior one 7–9 mm long, lateral two 8–10 mm long, anterior two 8–10 mm long, 1–1.2 times the length of the sepals, white; staminodes 3–5 mm long; anthers dark red, ca. 2 mm long, pollen orange. *Gynoeceum*: ovary 3.5–6 mm long; style 1.5–5 mm long, pale green; stigma branches 1–3 mm long, adaxially wine-red. *Fruit*: bases of mericarps ca. 5 mm long, with glandular hairs, tails 18–32 mm long. (Figure 3).

**Diagnostic features and affinities** *P. parvipetalum* is a geophyte with small tubers and pinnate to irregularly bipinnatisect erect leaves. The flowers are inconspicuous because of the very small, white petals, which motivated the choice for the specific epithet *parvus*, meaning small in Latin). The sepals are larger than the petals, but recurved so that the protruding stamens with their rather large, dark red anthers (ca. 2 mm long) become the prominent point of attraction during the male phase and the long wine-red recurved stigma branches during the female phase of the flower. The five fertile stamens are almost of the same length and the staminal column is papillate. In this respect *P. parvipetalum* resembles *P. auritum* (L.) Wild., *P. bubonfolium* (Andr.) Pers, and all the two-petalled species of section *Hoarea*. Because of the very small petals, *P. parvipetalum* shows a close resemblance to *P. leipoldtii* Knuth. Both have very small, white petals; *P. parvipetalum* always has five petals, whereas in *P. leipoldtii* the number of petals varies from two to five (Marais 1989). The leaves of the two species also differ. *P. parvipetalum* has elliptic, pinnate to bipinnatisect leaves, whereas those of *P. leipoldtii* are trifoliolate with a trulate outline.

The indumentum of the leaves, peduncles, hypanthia and sepals of *P. parvipetalum* is very similar to that of *P. bubonfolium*. There is also a resemblance between the morphology of the leaves of these two species. Both species have similar pinnate to bipinnatisect leaves and both of them occur in Namaqualand. The petals of *P. bubonfolium* are longer than the sepals, whereas those of *P. parvipetalum* are shorter than the sepals.

**Geographical distribution and ecology** *P. parvipetalum* occurs from Gamoep in the north, the Platbakkies area east of Kamiesberge and as far south as Pakhuis Pass (Figure 2). This area receives an annual rainfall of 100–200 mm, mainly in winter. It grows in sandy soil and quartzite patches in short succulent Karoo, in mountain renosterveld (veld type 43, Acocks 1988), marginal western mountain Karoo (veld type 28, Acocks 1988) or in arid fynbos. The occurrence of this species varies from rare to fairly frequent and it is heavily grazed by sheep. *P. parvipetalum* is one of the early-flowering species of section *Hoarea* and the peak of the flowering time is in September when leaves are still present.

**Material studied** —2918 (Gamoep): Vaalkoei, 3 km S of Gamoep (–CD), Bryuns 1519 (BOL, K, MO, NBG, PRE, S). —3018 (Kamiesberg): Between Bloudraai and Witwater (–AC), Le Roux & Leister 681 (STE); Between Bloudraai and Paulshoek (–AD), Siermon 9242 (PRE, STE); Garing (–AB), Lloyd 325 (STE); Vaaipuits, near Platbakkies (–BC), Le Roux s.n. (STE); Banke near Platbakkies (–BC), Oliver 9855 (STE). —3118 (Vanrhynsdorp): 7 km E of Nuwerus on the Kliprand road (–AB), Thompson 2839 (STE); Sandkraal, Vanrhynsdorp (–DA), Acocks 14822 (PRE); Barker 5651 (NBG); Flats west of Matzikamma (–DB), Oliver 4991 (PRE, STE). —3119 (Calvinia): Lokenburg (–CA). Acocks 17722 (K, PRE, Z); Leister 315 (PRE); Leister 454 (K); Menzieskraal, Nieuwoudtville (–CB), Markötter s.n. (STE). —3219 (Wuppertal): Near Pakhuis (–AA), Leipoldt 20760 (BOL); Perdelfontein on Nardouw Pass road to Calvinia (–AA), Marais 327 (STE).

**Pelargonium rubiginosum** E.M. Marais, sp. nov. in section *Hoarea*. Herba perennis acaulescens tuberosa. *Tuber*: subtunnelare, nippiforme vel oblongum, 20–60 mm longum, 15–20 mm in diam. *Folia*: rosulata, petiolata; lamina ovata, irregulariter pinnatilobata vel bipinnatifida, 15–60 mm longa, 10–45 mm lata, viridia, dense albipilosa et glandulos; petioli 10–60 mm longus, erecto-patens, glandulosus et pilosus; stipulae petiolo adnatae. *Inflorescens*: scapus pseudoumbellifer 2–5, utraque 10–30 floribus; pedunculus rubiginosus. *Pedicellum ca. 0.5 mm
Figure 4 *Pelargonium rubiginosum*. A. Flowering plant ×1; B. Androecium ×4; C. Gynoecium ×5; D. Petals ×2; E. Leaf base with stipules ×2.
longum. **Hypanthium** 14–32 mm longum, rubiginosum, glandulosum et sparsim hirsutum. **Sepala** 5, lanceolata, 4.5–6 mm longa, 1–3 mm lata, reflexa. **Petala** 5, alba, cremae vel pallide flava, dua postica unguiculato-spathulata vel unguiculato-obcordata, 9–16 mm longa, 2.5–4.5 mm lata, tria antica spathulata, 5.5–13 mm longa, 1.5–4 mm lata. **Stamina** fertilia 2, staminodia 8.

**TYPE** - Northern Cape Province: 'Jenkinskop, 17 km N of Ekteenfontein, Richtersveld', *Van Jaarsveld 4100* (NBG, holo.; BOL; K; MO; PRE; S).

A deciduous geophyte with a small subterranean tuber, 70–200 mm tall when in flower. **Tuber**: a turnip-shaped or elongated root with a short flattened stem, covered with flaking dark brown periderms, 20–60 mm long and 15–20 mm in diameter. **Leaves** radical, green, petiolate; lamina broadly ovate, base cuneate, apex rounded, 15–60 x 10–45 mm, pinnately compound, irregularly pinnatifid to bipinnatifid, densely pilose with white patent hairs interspersed with glandular hairs; segments linear, 5–10 mm long, 2–6 mm wide, apices obtuse; petiole 10–60 mm long and 1–3 mm in diameter, erecto-patent, indumentum as on lamina; stipules subulate, adnate to petioles for one third of their length, 3–7 mm long and ca. 1 mm wide, hirsute. **Inflorescence**: scape 10–30 mm long, 2–5 mm in diameter, branched, bearing 2–5 pseudo-umbels with 10–30 flowers each; peduncles wine-red to brown-red, 30–170 mm long, 1–2.5 mm in diameter, pilose with glandular hairs interspersed; bracts green, erect, subulate, 3–6 mm long, 1 mm wide, abaxially hirsute; flower buds, flowers and fruits erect. **Pedicel** ca. 0.5 mm long, green. **Hypanthium** 14–32 mm long, 4.6–6 times the length of the sepals, wine-red to brown-red, covered with glandular hairs interspersed with non-glandular hairs. **Sepals** 5, lanceolate, apices acute, 4.5–6 mm long, 1–2 mm wide, reflexed; green, indumentum abaxially as on hypanthium. **Petals** 5, white, cream-coloured or yellow with red or crimson markings in the centre, patent during anthesis; posterior two unguiculato-spathulate to unguicula-obcordate, bases cuneate, apices rounded to emarginate, 9–16 x 2.5–4.5 mm, length/width ratio 2–4; anterior three spathulate, bases attenuate, apices obtuse. 

**Figure 5** SEM micrographs of pollen grains of *Pelargonium*. **A.** Polar view of a pollen grain of *P. angustipetalum* (Drifhout 1371, STEU). **B.** Polar view of a pollen grain of *P. parvipedatum* (Bruyns 1519, STEU). **C.** Polar view of a pollen grain of *P. rubiginosum* (Drifhout 2811, STEU). **D.** Colpus with pore (p) of a pollen grain of *P. rubiginosum* (Van Jaarsveld 4100 STEU). Scale bar = 5 μm.
Discussion

Leaf anatomy

The anatomy of the laminae of all three species resembles that of other Hoarea species with compound leaves, which is characterised by a rather compact mesophyll with small air spaces (Marais 1997). The laminae have adaxially two layers of short but broad palisade cells and in the case of P. rubiginosum it can rather be described as palisade-like cells. In P. angustipetalum and P. rubiginosum the leaves are dorsiventral, but in P. parvipeetalum the leaves are isobilateral with abaxially a single layer of small palisade cells. The anatomy of the palmately divided leaves of P. angustipetalum resembles that of other species with palmately divided leaves like P. tripolium E.M. Marais (Marais 1996a), P. fergusoniae and P. lutescens N.E. Br. (Marais 1994a). The morphology as well as the anatomy of the leaves of P. parvipeetalum are similar to that of P. bubonifolium (Marais 1994a), P. hirtipetalum E.M. Marais, P. pubipetala E.M. Marais and P. aridicola E.M. Marais (Marais 1997). All five species have regularly pinnatisect to bipinnatisect leaves, all of them occur in Namaqualand and all have a chromosome number of 2n = 20 (Gibby et al. 1996). Although P. parvipeetalum and P. bubonifolium have the same floral structure with long protruding stamens and a papillate staminal column, they differ from the other three species where the staminal column is short. P. rubiginosum does not only share macromorphological characters of the leaves of P. caroli-henrici, but also an identical anatomy of the lamina.

Pollen morphology

The morphology of the pollen grains of all three species corresponds to that of the rest of the genus Pelargonium, in that the grains are spherical and tricolpate and the structure of the pollen grain wall is semitectate (Verhoef & Marais 1990). The tectum of P. angustipetalum and P. parvipeetalum can be described as striate-reticulate (Figure 5A & B; Bortenschlager 1967), a structure which occurs in almost half the species of section Hoarea (Marais 1994a). The tectum of P. rubiginosum can be described as extremely striate (Figure 5C & D; Marais 1994a). The corpus is very small and is almost fully occupied by the pore (Figure 5D). These structures are uncommon in Pelargonium pollen grains and occur in only three species of the genus Pelargonium, all three belonging to section Hoarea and all of them having a reduction in the number of fertile stamens (P. tripodium; three stamens; P. punctatum; two stamens; Marais 1994b). The size of the pollen grains of P. rubiginosum (53–62 mm in diameter) is similar to that of P. punctatum (57–60 mm in diameter; Marais 1994b), but much smaller than that of P. tripodium (70–85 mm in diameter; Marais 1994b). However, these three species do not share a similar floral structure. P. angustipetalum, with a striate-reticate tectum, resembles P. attenuatum in this respect, but differs from all species in section Hoarea with very short stamens and ligulate petals (P. fergusoniae, P. glabripilium E.M. Marais, P. leptum L. Bol., P. longiflorum Jacq., P. longiflorum (Burm. f.) Jacq., P. undulatum (Andr.) Pers. and P. viciifolium DC.), and which all have a reticulate tectum (Marais 1996b). The size of the pollen grains of P. angustipetalum (43–55 mm in diameter) coincides with that of P. attenuatum (43–58 mm in diameter) and also with those of the above mentioned species (Marais 1994a). The size of the pollen grains of P. parvipeetalum (56–61 mm in diameter), as well as the pattern of the tectum fit in well with those species of section Hoarea with long protruding stamens and papillate staminal columns (Marais 1994a).

Conclusion

With regard to morphological characters, P. angustipetalum seems to be closely related to P. attenuatum and except for the

Geographical distribution and ecology

P. rubiginosum occurs in the Richtersveld, from Khubus in the north to Eksteensfontein in the south. It was also collected on the foothills of the Kourkamma Mountains south of Komaggas (Figure 2). This area receives a scant rainfall of less than 100 mm per annum, occurring mainly during the winter months. P. rubiginosum occurs on granite, in coarse sand or quartzite and plants are found in rock crevices at high elevations or on foothills in direct sunlight or light shade. The plants are usually locally abundant. P. rubiginosum flowers from October to November. Herbarium specimens collected in the field do not have leaves and flowers together, but in the garden there are still leaves present at flowering time. The illustration by Ellaphie Ward-Hilhorst (Figure 4) was made from a plant of which the dead leaves were removed and only a few atypical leaves were left.

Material studied

—2816 (Oranjemund): S of Khubus (–BD), Nordheistam 1775 (S, STE); Doornpoort (–DB), Hall NBG70653 (NBG).
—2817 (Violsdrif): Jenkin (–CB), Van Jaarsveld 4100 (BOL, K, MO, NBG, PRE, S); 2 miles NE of Eksteensfontein (–CD), Nordheistam 1839 (S, STE).
—2817 (Springbok): Kourkamma Mountain (–CD), Drijibnout 2811 (STEU); Van Jaarsveld s.n. (STEU).

-rounded, 5.5–13 × 1.5–4 mm. Stamens 10, basally convolute, staminal column 1.5–3 mm long, white, smooth; perfect stamens 2 (anterior position), white, 5–9 mm long, 1–1.6 times the length of the sepals, protruding from the flower; staminodes 2–6.5 mm long; anthers pale pink, ca. 1 mm long, yellow yellow. Gynoecium: ovary superior, obovate-conical, 5-lobed, 2–4.5 mm long, densely serecious interspersed with glandular hairs; style filiform, 1.5–4.5 mm long, pink; stigma with 5 branches, 0.5 mm long, pink. Fruit: a schizocarp consisting of 5 mericarps, bases of mericarps 4–5 mm long, without glandular hairs, tails 22–30 mm long. (Figure 4).
structure of the tectum of the pollen grain, these two species have several characters in common with other species with short stamens and long ligulate petals.

*P. parvipeetalum* with the long protruding stamens and a papillate staminal column is related to *P. auritum, P. babonifolium* and all the two-petalled species of section *Hoarea*.

Although the leaf morphology, leaf anatomy, pollen morphology and chromosome number (2n ~22, Gibby et al. 1996) of *P. rubiginosum* correspond well with several other species of section *Hoarea*, the floral structure is different from all the species mentioned above. It remains difficult to determine, on morphological characters alone, the closest relatives of *P. rubiginosum* or its position within section *Hoarea*.

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**References**


