

The identity of a natural hybrid of *Pelargonium* (Geraniaceae)

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The identity of a natural hybrid of *Pelargonium* was determined by comparing macromorphological, anatomical and karyological characters of the hybrid with those of the putative parents. The comparative study showed that *P. patulum* Jacq. var. *patulum* and *P. tomentosum* Jacq. could be considered as parents of the hybrid.

Die identiteit van 'n natuurlike *Pelargonium*-hibried is vasgestel deur die makromorfologiese, anatomiese en karyologiese kenmerke van die hibried met dié van die vermeende ouers te vergelyk. Die vergelykende studie het aangetoon dat *P. patulum* Jacq. var. *patulum* en *P. tomentosum* Jacq. as die ouers van die hibried beskou kan word.

Keywords: Geraniaceae, natural hybrid, *Pelargonium*.

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Introduction

A very large number of artificial hybrids of *Pelargonium* have been produced since the 17th century (Yu 1985). Natural hybrids in *Pelargonium* are also not uncommon and so far almost 50 hybrids have been recognized (Van der Walt, unpubl.). Natural hybrids between members of the same section or between members of different sections are known (Van der Walt 1985; Gibby & Westfold 1986; Albers & Van der Walt 1992). All the known natural hybrids were formed between parent species with the same chromosome size, and with a few exceptions also the same chromosome number. The occurrence of natural hybrids is taxonomically significant because they indicate relationships between taxa. Van der Walt *et al.* (1990) mentioned that the occurrence of natural hybrids between the section *Glaucophyllum* Harv. and section *Pelargonium* supports the presumed relationship between the two sections.

A single plant of an apparent natural hybrid of *Pelargonium* was collected in a ravine on Helderberg, Somerset West. Morphologically the presumed hybrid appeared intermediate between *P. patulum* Jacq. var. *patulum* (section *Glaucophyllum*) and *P. tomentosum* Jacq. (section *Pelargonium*) which occurred in the same locality as the hybrid. In this study, the macromorphology, leaf anatomy and karyology of the presumed hybrid were compared with those of the putative parents to prove the origin of the hybrid.

P. patulum and *P. tomentosum* were described and illustrated by Van der Walt and Vorster (1981) and the differences between the three varieties of *P. patulum* were discussed by Coetzee and Van der Walt (1992). For the purpose of this paper it will be sufficient to give a synopsis of the macromorphological features of the two putative parents. These features will be compared with those of the presumed hybrid.

Material and Methods

The material studied for macromorphology, leaf anatomy and karyology is listed in Table 1.

Table 1 Material studied for macromorphology, leaf anatomy and karyology

Taxon	Collector and number	Project number	Locality
<i>P. patulum</i> var. <i>patulum</i>	Van Wyk 4	3762	Helderberg
<i>P. tomentosum</i>	Van Wyk 5	3004	Helderberg
Hybrid	Van der Walt 1350	3092	Helderberg

For the macromorphological study, living as well as herbarium material of the presumed hybrid and putative parents were studied.

For the leaf anatomical study, transverse sections, 12–15 µm thick, of wax-embedded laminae and petioles were cut with a rotary microtome and stained with Alcian Green–Safranin (Joel 1983). The sections were made through the middle part of the laminae and petioles.

For mitosis, root tips were treated with 0.002 mol 8-hydroquinoline for 24 h at 20°C, fixed in 3:1 absolute ethanol and glacial acid, and stained with aceto-carmine.

Results

Macromorphology

P. patulum var. *patulum*

Much-branched subshrub. Stems often slender and trailing. Leaves 3-palmatilobate to 3-palmatisect, 20–60 × 5–35 mm, margin irregular and coarsely dentate, green and often with a wine-red zone, sparsely covered with short rigid hairs. Pseudo-umbels reduced, with 2–3 flowers each. Hypanthium 15–20 mm long. Petals 5, white to pink with red markings, posterior two 14.5–15 × 3–5 mm, anterior three 12–14 × 3 mm. Fertile stamens 6 or 7.

P. tomentosum

Much-branched, peppermint-scented subshrub. Stems slender and trailing. Leaves 3(–5)-palmatilobate to 3(–5)-palmatisect, 45–110 × 35–80 mm, margin irregularly crenate-serrate, green, discolorous, tomentose. Pseudo-umbels with 4–15 flowers each. Hypanthium ca. 2 mm long. Petals 5, white with purple markings, posterior two ca. 9 × 5 mm, anterior three ca. 11 × 1.5 mm. Fertile stamens 7.

Hybrid

Much-branched, faintly peppermint-scented subshrub. Stems often trailing. Leaves 3(–5)-palmatilobate to 3(–5)-palmatisect, 65–90 × 35–60 mm, margin irregularly crenate to serrate, green, pubescent. Pseudo-umbels reduced, with 2–6 flowers each. Hypanthium 3–4 mm long. Petals 5, white to pale pink with red-purple markings, posterior two ca. 9 × 4–5 mm, anterior three ca. 10 × 1.5 mm. Fertile stamens 7.

Anatomy of the leaves

P. patulum var. *patulum*

Lamina amphistomatic, with an equal number of stomata adaxially and abaxially, cuticle surface smooth, adaxial and abaxial epidermal cells of equal size, guard cells on same level as normal epidermal cells, trichomes consisting of short rigid



Figure 1 Short rigid hairs of *P. patulum* var. *patulum* (Van Wyk 4).

hairs and short glandular hairs, midrib bulging slightly abaxially, palisade parenchyma 1 – 2 layers, mesophyll cells without any secretion (Figure 1). *Petiole* oval, circular or adaxially flattened in transverse sections, cuticle surface locally ridged, trichomes as in lamina, medullary vascular bundle amphivasal and slightly larger than ring bundles, all cells in petiole depleted of any secretion.

P. tomentosum

Lamina amphistomatic but with most stomata abaxially and only a few adaxially, adaxial epidermal cells much larger than abaxial ones, cuticle surface ridged, trichomes consisting of long hairs and long as well as short glandular hairs, guard cells raised above the level of the ordinary epidermal cells, midrib bulging prominently abaxially, palisade parenchyma layer 1, many mesophyll cells with greenish secretion (Figures 2 & 3). *Petiole* adaxially and abaxially flattened, cuticle surface ridged, trichomes as in lamina, medullary vascular bundle incompletely amphivasal and much larger than ring bundles, many cells in petiole with greenish secretion.

Hybrid

Lamina amphistomatic but with more stomata abaxially, cuticle surface ridged, adaxial epidermal cells larger than abaxial ones, guard cells raised above the level of the normal epidermal cells, trichomes consisting of long hairs and long as well as short glandular hairs, palisade parenchyma 1 layer, some mesophyll cells with a greenish secretion (Figures 4 & 5). *Petiole* adaxially flattened in transverse sections, cuticle surface ridged, trichomes as in lamina, medullary vascular bundle incompletely amphivasal, some cells in petiole with a greenish secretion.

Karyology

The following somatic chromosome numbers were established for the taxa: *P. patulum* var. *patulum*: $2n = 22$; *P. tomentosum*: $2n = 44$; Hybrid: $2n = 33$ (Figure 6). The chromosomes of all three taxa have the same size and belong to the small genome type (Van der Walt *et al.* 1990).

Discussion and Conclusions

The ravine where the presumed hybrid and the putative parents were collected, is on the southern side of Helderberg. The habitat is half-shaded, rather moist and at an altitude of 750 m. *P. tomentosum* grows in the close proximity of running water and *P. patulum* some distance from the water. The presumed hybrid was collected between the two putative parents in a disturbed area. It is generally known that disturbed areas favour hybridization (Stace 1980).

The leaves of *P. patulum* var. *patulum* are non-aromatic and

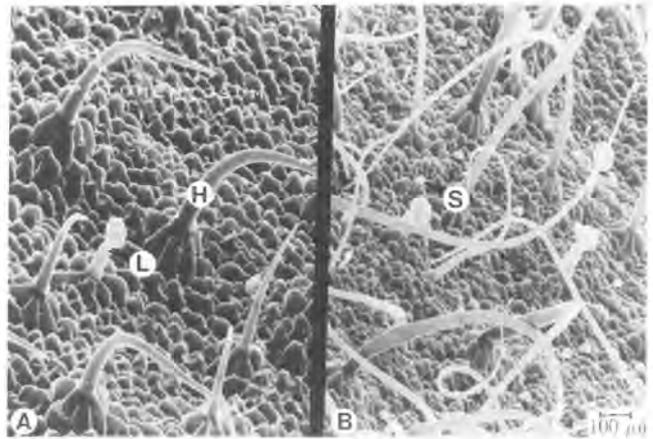


Figure 2 Trichomes on the lamina of *P. tomentosum*. A, adaxial side; B, abaxial side (Van Wyk 5). H, long hair; L, long glandular hair; S, short glandular hair.



Figure 3 Transverse section of the lamina of *P. tomentosum* (Van Wyk 5).

appear glabrous, as only a few scattered short hairs occur on the abaxial side and margin. In contrast, the leaves of *P. tomentosum* are strongly peppermint-scented (Demarne & Van der Walt 1990) and extremely hairy. The leaves of the presumed hybrid are faintly peppermint-scented and the indumentum is intermediate between those of the putative parent species. *P. patulum* var. *patulum* has short glandular hairs on its leaves, but *P. tomentosum* and the presumed hybrid have

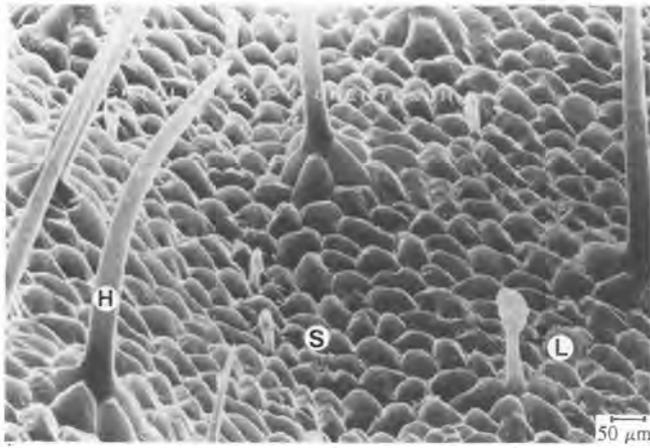


Figure 4 Trichomes on the lamina of the hybrid (*Van der Walt 1350*). H, long hair; L, long glandular hair; S, short glandular hair.

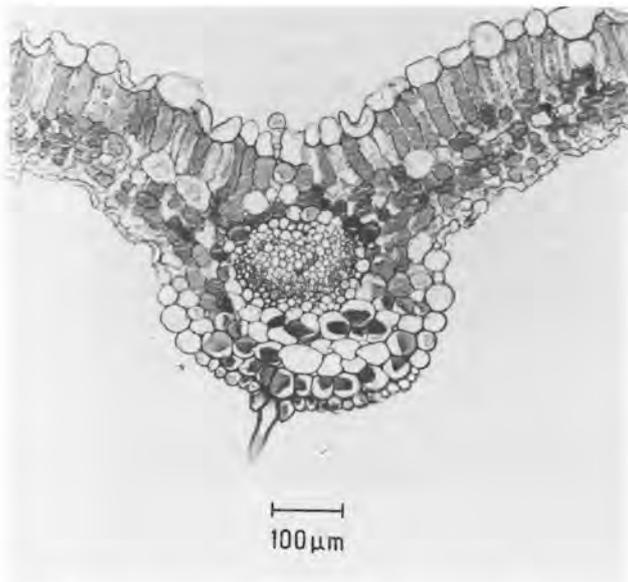


Figure 5 Transverse section of the lamina of the presumed hybrid (*Van der Walt 1350*).

both short and long glandular hairs. The leaf size of the presumed hybrid is more or less intermediate between those of *P. patulum* var. *patulum* and *P. tomentosum* (Figure 7). The distribution of stomata and the presence of a greenish secretion in the mesophyll cells of the presumed hybrid also represent intermediate conditions between those of the two putative parents.

Floral characters of the presumed hybrid, such as the number of flowers per pseudo-umbel, colour and size of the petals, and the length of the hypanthia, are also intermediate between those of the two putative parents, although some characters show a stronger tendency towards *P. tomentosum*.

P. patulum var. *patulum* is diploid with a somatic chromosome number of $2n = 22$ and *P. tomentosum* is a tetraploid species with $2n = 44$. The presumed hybrid is triploid with a somatic chromosome number of $2n = 33$ and, as is typical of triploids, it is completely sterile producing no viable seeds.

A comparative study of the macromorphological, anatomical and karyological characters indicated that the presumed hybrid is most probably an F1 hybrid between *P. patulum* var. *patulum* and *P. tomentosum*. The hybrid was apparently accidentally formed without the potential to produce any progeny.

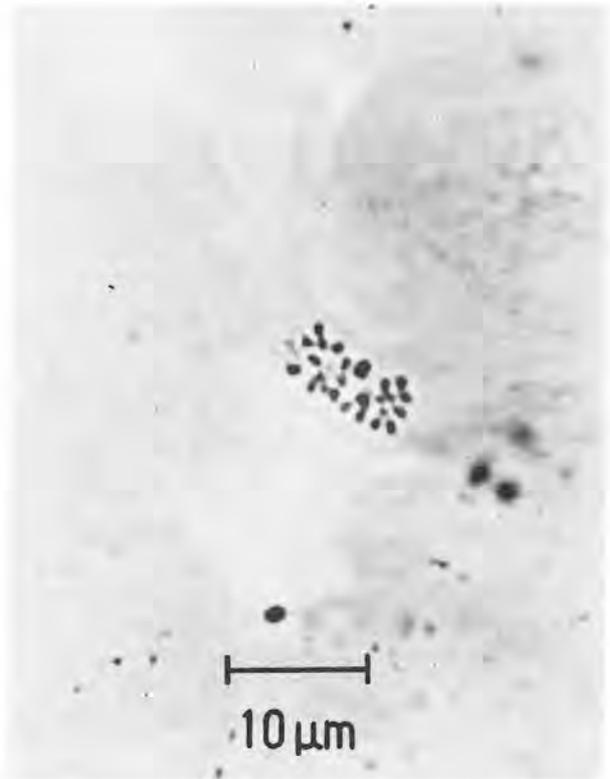
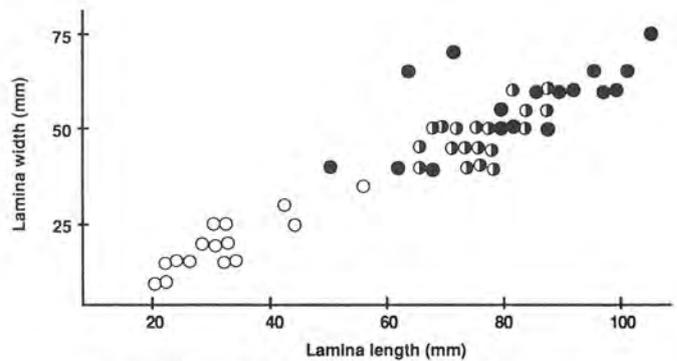


Figure 6 Chromosomes of the hybrid ($2n = 33$) (*Van der Walt 1350*).



Pictorialized scatter diagram of the leaf size of *P. tomentosum*, *P. patulum* var. *patulum* and the hybrid.

- *P. tomentosum*
- *P. patulum* var. *patulum*
- ◐ Hybrid

Figure 7 Pictorialized scatter diagram of the leaf size of *P. tomentosum*, *P. patulum* var. *patulum* and the hybrid.

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Karyotype studies in the genus *Zantedeschia* (Araceae)

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Karyotypes of five species and three cultivars of *Zantedeschia* were studied. Karyotypes were distinct between the evergreen species *Z. aethiopica* (section I) and all winter-dormant species (section II) studied. The karyotypes were not distinct among species within section II. *Z. aethiopica* has mostly subtelocentric chromosomes whereas species in section II have only metacentric or submetacentric chromosomes. The karyotype of the summer-dormant species, *Z. odorata*, falls between *Z. aethiopica* and section II, but is more closely related to *Z. aethiopica* based on karyotype asymmetry.

Kariotipes van vyf spesies en drie kultivars van *Zantedeschia* is bestudeer. Die kariotipes van die immergroen spesie, *Z. aethiopica* (seksie I), het verskil van dié van alle winter-rustende spesies (seksie II) wat ondersoek is. Daar was geen verskille tussen die kariotipes van spesies in seksie II nie. *Z. aethiopica* het hoofsaaklik subtelosentriese chromosome terwyl spesies in seksie II slegs metasentriese of submetasentriese chromosome het. Die kariotipe van die somer-rustende spesie, *Z. odorata*, val tussen *Z. aethiopica* en seksie II, maar is op grond van kariotipe-asimmetrie nader verwant aan *Z. aethiopica*.

Keywords: Calla lily, chromosome karyotype, *Zantedeschia*.

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Introduction

Letty (1973) re-classified the genus *Zantedeschia* Spreng into six species and assigned them to two distinct sections. Section I contains the type species alone, *Z. aethiopica* (L.) Spreng, in which the plants are evergreen and the female flowers in the lower part of the spadix are interspersed with staminodes. The fruit turn orange in colour, become soft and later mucilaginous at maturity. Section II contains the remaining five species, in which the plants are dormant during the winter. Although Letty stated that there were no staminodes among the female flowers, a few staminodes are in fact often interspersed with female flowers in the upper female zone. The fruit remain firm and green until they finally wither and rupture or decompose on the ground. Perry (1989) described a new species, *Z. odorata* L.P. Perry, which appears to fall in between the two sections, having some characters of each section. *Z. odorata* corresponds to *Z. aethiopica* in that the female flowers in the lower part of the spadix are interspersed with staminodes, but is similar to section II species in that the fruit remain firm and green until they finally wither on the ground. *Z. odorata* is dormant during summer. A particular feature of this new species is that it invariably produces a delicate freesia-like scent.

Interspecific hybridization within section II has led to a large number of hybrid cultivars (Amos 1983). However, there are a number of barriers to hybridization between *Z. aethiopica* and species of section II (Chi 1990; Yao 1992). As part of a programme to develop new hybrids, we have used karyotype analysis to study the relationships between the species.

Previous cytogenetic studies (Mookerjee 1955; Earl 1957; Sengupta & Chettri 1989) of *Zantedeschia* have mainly shown chromosome numbers with little data on karyotype, presumably because of the relatively small size of the chromosomes. Chromosomes of the new species, *Z. odorata*, have not previously been described. The present study describes the karyotypes of five species and two hybrid cultivars in the genus. The implications of the karyotype data are discussed in relation to species relationships.

Material and Methods

Rapidly growing root-tips were obtained by planting rhizomes or tubers in potting mix in a greenhouse. Root-tips were pretreated in a saturated solution of para-dichlorobenzene for 4 h, fixed in methanol:glacial acetic acid (3:1) overnight and stored in 70% ethanol. Chromosomes were initially stained with Feulgen, but improved staining was subsequently achieved with Giemsa. Fixed root-tips were hydrolysed in 1N HCl at 60°C for 10 min and stained with Feulgen stain for 60 min. Stained root-tips were washed in distilled water three times. Root meristems were dissected out, macerated on microscope slides in 2% acetocarinine, and squashed under coverslips in the usual manner after heating each slide on a hot block for approximately 1 min at 80°C. Coverslips were removed after slides had been chilled in liquid air. Alternatively, fixed root-tips were macerated on microscope slides in 45% acetic acid, squashed under coverslips in the usual manner after heating each slide for about 1 min at 80°C. After the coverslips had been removed by chilling in liquid air, the