

Systematics of the hypervariable *Moraea tripetala* complex (Iridaceae: Iridoideae) of the southern African winter rainfall zone

P. GOLDBLATT* and J.C. MANNING**

Keywords: Chromosome cytology, Iridaceae, Iridoideae, *Moraea* Mill., new species, southern Africa, taxonomy

ABSTRACT

Field and laboratory research has shown that the *Moraea tripetala* complex of western South Africa, traditionally treated as a single species, sometimes with two additional varieties, has a pattern of morphological and cytological variation too complex to be accommodated in a single species. Variation in floral structure, especially the shape of the inner tepals, degree of union of the filaments, anther length and pollen colour form coherent patterns closely correlated with morphology of the corm tunics, mode of vegetative reproduction, and in some instances capsule and seed shape and size. The morphological patterns also correlate with geography, flowering time and sometimes habitat. It is especially significant that different variants of the complex may co-occur, each with overlapping or separate flowering times, a situation that conflicts with a single species taxonomy. We propose recognizing nine species and three additional subspecies for plants currently assigned to *M. tripetala*. *M. grandis*, from the western Karoo, has virtually free filaments and leaves often \pm plane distally; closely allied *M. amabilis*, also with \pm free filaments and often hairy leaves, is centred in the western Karoo and Olifants River Valley. Its range overlaps that of *M. cuspidata*, which has narrowly channelled, smooth leaves, linear inner tepals spreading distally and filaments united for up to 1.5 mm. *M. decipiens* from the Piketberg, *M. hainebachiana*, a local endemic of coastal limestone fynbos in the Saldanha District, *M. ogamana* from seasonally wet lowlands, and early flowering *M. mutila* constitute the remaining species of the complex in the southwestern Western Cape. *M. helmei*, a local endemic of middle elevations in the Kamiesberg, Namaqualand, has small flowers with short, tricuspidate inner tepals. All but *M. amabilis* and *M. mutila* are new species. We divide *M. tripetala sensu stricto* into three subspecies: widespread subsp. *tripetala*, subsp. *violacea* from the interior Cape flora region, and late-flowering subsp. *jacquiniana* from the Cape Peninsula and surrounding mountains.

INTRODUCTION

The Afro-Eurasian and largely sub-Saharan genus *Moraea* Mill. (Iridaceae: Iridoideae) comprises \pm 215 species of cormous geophytes (Goldblatt & Manning 2009, 2010). Although florally diverse, the genus is recognized by a bifacial and channelled (rarely terete) leaf blade (isobilateral leaves are ancestral for Iridoideae) and a corm of a single internode derived from a lateral bud in the axil of the lowermost cataphyll. The majority of *Moraea* species have *Iris*-like flowers with clawed tepals, prominent, spreading outer tepal limbs marked with nectar guides, and flattened, petaloid style branches to which the anthers are appressed. Unlike *Iris* L., the tepals of *Moraea* are normally free and the filaments are at least partially united or rarely secondarily free in a few species (always free in *Iris*). Species of *Moraea* with other flower types (Goldblatt 1986b; 1998), usually with subequal tepals, reduced style branches and, in some species, a perianth tube, are derived and limit the utility of floral characters in circumscribing the genus.

Relatively widespread in the southern Africa winter-rainfall zone, *Moraea tripetala* is one of the more common species of subgenus *Vieusseuxia* (D. Delaroché) Goldblatt (\pm 30 spp.). The group is distinguished by the flowers usually lasting three days (vs. fugaceous and

lasting less than a single day, the plesiomorphic condition), a single, channelled foliage leaf, and inner tepals variously modified in most species into trilobed or linear structures, occasionally reduced to short hair-like cusps or rarely absent (Goldblatt 1976a; 1986a). As currently understood (Goldblatt 1976b) *M. tripetala* is recognized by a blue, violet or purple perianth, reduced inner tepals that are usually represented by short, hair-like cusps 2–3 mm long, filaments either free or shortly united for 1–2 mm (1/4 to 1/3 their entire length) and an associated short style with the style branches appressed to the stamens for almost their entire length. Variation in the colour and texture of the corm tunics, length and shape of the leaves, in the size and shape of the inner tepals, and the occasional development of pubescence on the stems and leaves, was documented in some detail by Goldblatt (1976b), who at that stage preferred not to accord any of the variant forms taxonomic recognition. Goldblatt (1976b) also noted that *M. tripetala* was variable cytologically but the three populations sampled were diploid with a basic chromosome number of $x = 6$, this shared with all species of subgenus *Vieusseuxia*.

During extensive field work in western southern Africa over the past decade we have encountered a wide range of plants currently identified as *Moraea tripetala*. The patterns of variation in the flower, especially the form of the inner tepals, and associated differences in corm, capsule and seed morphology, and in the means of asexual reproduction have led us to the conclusion that recognition of a single species for the complex does not reflect biological reality. Particularly difficult to reconcile with a single species treatment for *M. tripetala* is the co-occurrence of two morphological variants, either flowering virtually side-by-side, or in bloom several weeks or months apart in the same locality, and some-

* B.A. Krukoff Curator of African Botany, Missouri Botanical Garden, P. O. Box 299, St. Louis, Missouri 63166, USA. E-mail: peter.goldblatt@mobot.org

** Compton Herbarium, South African National Biodiversity Institute, Private Bag X7, Claremont 7735, South Africa / Research Centre for Plant Growth and Development, School of Life Sciences, University of KwaZulu-Natal, Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa. E-mail: J.Manning@sanbi.org.za.

MS. received: 2012-01-06.

times differing in their habitat. With this in mind we have undertaken an extensive review of the variation in *M. tripetala*. We conclude that a better treatment of the complex, which we consider monophyletic, is to recognize nine species, with *M. tripetala* subdivided into three subspecies.

MATERIALS AND METHODS

We first made field observations across the entire range of the *Moraea tripetala* complex, noting in addition to floral morphology, details of corm tunics, mode of vegetative reproduction, and whenever possible capsule and seed morphology. These observations were then integrated with an examination of specimens in herbaria with important holdings of southern Africa flora, BOL, K, MO, NBG, PRE, and S (abbreviations following Holmgren *et al.* 1990), plus a study of type material of the named variants in the complex. Abbreviation of author names follows Brummitt & Powell (1992).

Chromosome counts were determined from mitotic squashes using root tips. Material for the original counts reported here was prepared according to the protocol described by Goldblatt & Takei (1993). The vouchers are housed at the Missouri Botanical Garden Herbarium (MO). Counts are based on samples of three to four individuals and, following standard practice in plant cytology, are assumed to represent an entire population.

RESULTS

The lectotype of *Moraea tripetala* (designated by Goldblatt 1976b), is a Thunberg collection from the southwestern Cape, with filaments united for ± 1 mm, inner tepals reduced to linear, acute cusps ± 3 mm long, and a linear, narrowly channelled, glabrous leaf. Corms are lacking in the type material but we are confident that a range of plants recorded from Aurora on the west coast of the Western Cape eastward to Knysna and mainly flowering from August to the end of September accord with the type. These often have slightly sweet-scented flowers and the inner tepals vary from short hair-like vestiges to linear structures up to 5 mm long. Apart from plants matching the type relatively well, there is a range of somewhat to significantly different populations both in the southwestern Cape and in the interior, in the western Karoo and Little Karoo. We describe the variant populations below, dealing first with plants from the near southwestern Cape followed by those from the interior.

Variant 1: the first significant variant in the southwestern Cape is an early flowering taxon, mostly blooming from mid-August to early September, often with relatively broad leaves. These are sometimes plane distally, 3–5(–7) mm wide and laxly twisted, \pm half as long to \pm as long as the stem, or rarely exceeding it. Plants occur at low elevations on clay or loamy soils. The inner tepals are linear to narrowly lanceolate, up to 12.5 mm long, and differentiated into an erect portion (equivalent to the claw of the outer tepals) and an outspread portion (equivalent to the limb) that is either slightly expanded at the base or, in some populations (e.g. *Goldblatt 2310*

MO), with two obtuse, lateral lobes, rendering the limb \pm trilobed. The filaments are united for 1.0–1.5 mm, rarely only ± 0.5 mm. In two collections the leaves and stem of some plants are thinly hairy (e.g. *Nordenstam & Lundgren 1998* MO, NBG, S; *Acocks 1912* S). This variant was first recognized at species rank by C.F. Ecklon (1827) as *Viesseuxia mutila* and later by J.G. Baker (1904) as *Moraea punctata* but has remained poorly understood. *Moraea monophylla* (Baker 1906) and *M. tripetala* var. *mutila* (Baker 1896) represent the same variant.

Plants from the immediate area of Sir Lowry's Pass, east of Cape Town, flowering in August, have inner tepals ± 10 mm long, consisting of a limb with a short central tapering cusp and short rounded lateral lobes. They are somewhat out of range for variant 1 and have a narrow, channelled, smooth leaf (e.g. *Loubser 872* NBG; *Goldblatt 2506* MO). These plants may belong here or alternatively may be hybrids with *M. unguiculata* or another species: we discuss them below in more detail.

Variant 2: a second southwestern Cape variant is the plant G.J. Lewis (1941) named *Moraea tripetala* var. *jacquiniana* (= *M. jacquiniana* Schltr. ined.). Often shorter in stature, 140–300 mm high and with smaller flowers than in typical *M. tripetala*, it usually has exceptionally slender leaves, mostly 2–3 mm wide, V-shaped in cross section. When dry the blades are closely folded together and appear terete. Flowering in this plant is from mid-November to January on the Cape Peninsula (Lewis 1950), but sometimes in late October elsewhere. Illustrated in *Flora of the Cape Peninsula* (Maytham Kidd 1950), the flowers are often dark purple, but sometimes light mauve to \pm blue as in *M. tripetala sensu stricto*, and as far as known, consistently have white nectar guides. The linear inner tepals are 5–6 mm long (e.g. *Pillans 10279* BOL, MO), thus slightly more than 1/2 as long as the outer tepal claws and reaching to between the base and middle of the anthers. The outer tepals have limbs 11–16 mm long and claws 8–11 mm long (vs. limbs 12–18 and claws 10–12 mm long in *M. tripetala sensu stricto*). At several localities, notably in the southern Cape Peninsula, at Jonkershoek and in the Grabouw area, both typical *M. tripetala* and var. *jacquiniana* occur, the former blooming two to four months earlier, late July to September. *M. pulchra* Eckl. (1827) from 'Hottentotshollandkloof' collected in flower on 25 November represents the earliest name for this plant at species rank.

Variant 3: restricted to lowland wetlands of the southwestern Cape and flowering in September, this variant has an unusual, narrow ovary, cylindrical rather than ovoid, 10–13 mm long, and darkly lined vertically on locules, and nearly cylindrical capsules (15–)20–24 mm long, somewhat angled on the locules. Typical *M. tripetala* has an ellipsoid ovary 6–10 mm long and capsules 8–14 mm long, both round in cross section. The flowers of this variant are also unusual in having the outer tepal limbs pale blue with darker veins radiating from a yellow nectar guide. Plants are always relatively short, rarely exceeding 200 mm, have leaves usually shorter than the stems, and small corms with blackish, wiry tunics. There is also invariably a small cormlet in the axil of the foliage leaf, and plants often grow in small

groups, the result of vegetative reproduction from these cormlets. Typical *M. tripetala* does not normally produce cormlets either in the leaf axils or at the corm base, and is always a solitary plant, favouring well-drained habitats. Variant 3 extends from Voëlvelei in the north to Harmony Flats at Strand in the south.

Variant 4: a last variant in the southwestern Cape is a vegetative apomict, restricted to limestone pavement or calcareous sands in the Saldanha Bay area, and blooming in August and early September, rarely later. Relatively short, up to 300 mm high, plants have lilac or pale to mid-blue flowers with pale yellow nectar guides, outer tepals 27–29 mm long and unusual inner tepals \pm 4 mm long, spindle-shaped, sometimes oblanceolate and obscurely 3-lobed, tapering distally with the apex curving inward, sometimes the inner distal surface pilose. Unusual for the complex, it has pale grey-blue anthers and off-white or yellow pollen. Capsules never develop to maturity and are shed several days after flowers fade and seeds are not formed. Microscopic examination of pollen confirms that the grains are all malformed. Propagation of new plants is accomplished by the production of several cormlets born in the axil of the foliage leaf and sometimes the lowermost sheathing leaf. Non-flowering individuals produce similar cormlets at the base of the main corm. This variant co-occurs with typical *M. tripetala*, which blooms in the same sites in late September and early October, and has paler blue flowers and dark blue or purple anthers and red pollen typical of the species.

Variant 5: some plants from the Piketberg assigned to *Moraea tripetala* by Goldblatt (1976b) have large inner tepals 7–10 mm long with distally expanded limbs that are \pm trilobed and tapering to an attenuate, twisted tip. These plants are also unusually tall, reaching up to 450 mm, but the flowers are relatively small for the complex, with outer tepals 20–23 mm long and claws 8–9 mm long. The filaments, only \pm 4 mm long, are united for \pm 2 mm. In general appearance these plants resemble *M. unguiculata* Ker Gawl., but the filaments, united for less than 1/2 (slightly more than 1/3) their length, are characteristic of the *M. tripetala* complex. Both typical *M. tripetala* and white-flowered *M. unguiculata* occur locally in the Piketberg, where the former has the short, hair-like inner tepals typical of the species.

Variant 6: outside the immediate southwestern Cape, in the western Karoo, plants included in *Moraea tripetala* usually have free filaments (sometimes united basally for $<$ 0.4 mm), inner tepals reduced to small hair-like cusps mostly 1–2 mm long, a linear leaf, shallowly channelled below but often plane distally, and light brown corm tunics of medium-textured to soft fibres. Plants always form clonal colonies, the result of vegetative propagation by the production of two or more cormlets at the base of the flowering stem that replace the parent corm, and/or by axillary cormlets (Figure 14).

Populations of this variant fall into two main groups. The first of these, from the western Karoo and the Olifants River Valley and surrounding mountains, mostly from lighter, sandstone or shale-derived soils, has smaller flowers with outer tepals 23–25 mm long (claws 10–14 mm), anthers 4.5–7.0(–8.0) mm long and \pm

as long as to $1.5 \times$ as long as the filaments, and either white to yellow pollen (eastern populations) or red pollen (western populations) (Figure 14). Pollen colour is lost in older collections but our observations are based on examination of living plants across almost the entire range of this morph. The 5(6)-sided seeds are $1.7\text{--}2.0 \times \pm 1$ mm and stand out in having pale, spongy, ridged angles and an extended pale spongy mass at the micropylar end. Seeds of typical *M. tripetala* and related variants are $1.0\text{--}1.3 \times \pm 1$ mm, with sharply raised, pale angles and a finely wrinkled surface through which the underlying dark brown seed body is evident. This variant matches the type of *M. amabilis* Diels.

Plants closely resembling this variant growing on sandstone pavement in the Bokkeveld and Gifberg–Matsikamma Mtns are often particularly short, usually $<$ 180 mm high. Capsules and seeds in these plants are consistent with this variant.

A second western Karoo variant comprises large-flowered plants, mostly of dolerite-derived soils, with outer tepals 30–40 mm long (claws 12–18 mm long), anthers 8–11 mm long and \pm twice as long as the filaments, and consistently red pollen (Figure 15). The capsules are 16–19 mm long, narrowly ellipsoid-oblong with a markedly thickened apical rim. Seeds in the few fruiting collections that we have been able to examine have exceptionally large, brown seeds, $2\text{--}3 \times 1.8\text{--}2.3$ mm.

Variant 7: also in the western Karoo and adjacent interior southern Cape, another variant of the complex has linear inner tepals (8–)10–15 mm long, ascending below and spreading distally, filaments united for 0.5–1.8 mm, and narrowly channelled leaves with the leaf halves often appressed. The relatively large corms have tunics of wiry, usually thickened fibres, and cataphylls that decay into a particularly prominent collar of vertical fibres around the base. The filaments are (3–)4–6 mm long and the anthers, 4–8 mm long, with red pollen. Late flowering, these populations seldom bloom before the last week of September and only in late October at higher elevations in the Swartberg Mtns. Plants are sympatric in the Roggeveld and Klein Roggeveld with the western Karoo morph of variant 6, which has short, hair-like inner tepals and pale corm tunics, and their flowering times often overlap (e.g. Goldblatt & Porter 13461 and 13462, MO, NBG, from the Farms Fortuin and Nuwerus). The few plants we have seen with mature capsules have distinctive seeds with a spongy testa slightly thicker on the angles.

Variant 8: plants from the Kamiesberg, Namaqualand, discovered only in 2009 by Cape Town botanist N.A. Helme, and evidently belonging to the *Moraea tripetala* complex, have filaments united in the lower 1.5 mm but differ notably in their short, trifold inner tepals, represent the last significant variant of the complex (Figure 4). Apart from the unique inner tepals, the flowers are small, with outer tepals 21.0–23.5 mm long bearing bright yellow, velvety nectar guides. The outer tepal claws have a pair of marginal teeth just below their apices.

Even with the exclusion of these variants, the remaining populations of *Moraea tripetala* are still variable,

and we discuss the major patterns below under that species. Extending from Aurora and the Piketberg on the west coast to the Cape Peninsula and thence across the southern Cape to Knysna, plants have moderately-sized, pale blue, purple or violet flowers with white or yellow nectar guides (many populations are variable for flower colour), inner tepals hair-like and rarely > 4 mm long, and the ovary is ellipsoid and 8–10 mm long. Vegetative reproduction via axillary or basal cormlets is rare. Among these populations, plants from the southern Cape sometimes lack inner tepals entirely and those from the Langeberg foothills may have free filaments. Neither trend is consistent as far as we can determine. From the few fruiting specimens available, seeds of what we consider typical *M. tripetala* are consistently small, with pale, raised, \pm winged angles.

DISCUSSION

Species, subspecies or merely ecotypes?: the immediate question our observations raise is whether or not any of the several morphological variants should be recognized taxonomically, thereby reducing the otherwise florally distinctive *Moraea tripetala* to just one of several taxa that are only moderately distinctive florally and not easily distinguished without examination of corms, capsules, and seeds. We conclude that the patterns of variation that we now recognize renders the single species solution unacceptable, particularly because of the correlated character differences in the corm, leaf, flower, and seeds, and the examples of sympatry of two variants at some sites, either flowering at the same time or flowering weeks to months apart. Moreover, the range of habitats and flowering times would be remarkable for a single species and unacceptable for the lack of conformity with any but the broadest morphological species concepts. Similarly, treatment of the major variants as subspecies violates any biological species concept. We conclude that all the distinctive entities that co-occur and have overlapping flowering times should be treated as separate species. Likewise, co-occurring variants that have flowering times separated by weeks or months require taxonomic recognition if they can be readily identified by more than one unique morphological marker.

This framework has been the underlying philosophy in our decision to dismember *Moraea tripetala* sensu Goldblatt (1976b). We also note that Baker (1896) in *Flora capensis* recognized one variety in the species and later added two more (Baker 1904, 1906). Lewis (1950) recognized *M. tripetala* as one species with three varieties in *Flora of the Cape Peninsula* alone. Three of the eight segregate species we recognize already have names in the literature, providing a precedent for our revised taxonomy [*M. amabilis*, *M. tripetala* var. *jacquiniana* (= *Vieusseuxia pulchra*) (Variant 2), *M. punctata* (= *Vieusseuxia mutila* = *M. tripetala* var. *mutila*) (Variant 1)]. To these we now add *M. decipiens* (variant 5); *M. hainebachiana* (variant 4); *M. ogamana* (variant 3); *M. cuspidata* (variant 7); and *M. helmei* (variant 8). We also recognize *M. amabilis* and *M. grandis* from the western Karoo for the two subsets of variant 6.

With the recognition of nine species in the *Moraea tripetala* complex, section *Vieusseuxia* now includes 36

species, and the genus *Moraea* \pm 215 species (Goldblatt & Manning 2010 and unpublished).

Floral and reproductive biology: as might be expected in species with similar flowers, all members of the complex share the same pollination system, large bodied, mostly anthophorine bees (usually *Amegilla* and *Anthophora* spp.), or sometimes *Apis mellifera* (Goldblatt *et al.* 2005). Our impression is that the species of the complex are remarkably successful and it is rare to see plants later in the season without multiple capsules with full complements of seeds; autogamous selfing can be dismissed because in these iris-type flowers the anthers do not reach the stigmatic lobes (Goldblatt 1998) and we infer that insect mediated pollen transfer is necessary to achieve pollination.

Propagation by seed is complemented in several species either by production of cormlets in the leaf or cataphyll axils and at the base of the corm (*Moraea hainebachiana*, *M. ogamana*) or sometimes by production of two new corms in place of the parent corm (*Moraea amabilis* and often *M. grandis*). Enhanced vegetative reproduction in these species results in plants forming clonal colonies. These two vegetative propagation strategies are uncommon elsewhere in the *M. tripetala* complex. The lowland wetland populations we treat as *M. ogamana* consistently produce a single cormlet in the foliage leaf axil but the vegetative apomict, *M. hainebachiana* produces multiple cormlets in the foliage leaf axil as well as at the corm base, a feature particularly well-developed in non-flowering individuals. This last species produces malformed pollen, and the capsules are invariably shed soon after flowers wilt, without the ovules developing into seeds.

Chromosome cytology: as noted by Goldblatt (1976a), chromosomal karyotypes are variable for populations then included in *Moraea tripetala*. Sampling is limited (Table 1) but we note the following. *M. amabilis*, *M. cuspidata*, and *M. grandis* have the longest three chromosome pairs either metacentric or sub-metacentric (Figures 1A, B) and a small satellite on the fourth longest \pm acrocentric pair (Goldblatt 1971 and Table 1, as sat type 1). This karyotype is the common one in subgen. *Vieusseuxia*. The karyotype of *M. mutila* has small satellites on the two longest, submetacentric chromosome pairs (sat type 3) (Figure 1C). In contrast, plants of *M. tripetala* subsp. *tripetala* and subsp. *violacea* (Table 1), have very large satellites on a long, telocentric chromosome pair (sat type 2). In three of four populations of subsp. *tripetala* sampled a second large satellite (Figure 1D) is evident on a relatively short acrocentric chromosome pair (sat type 2a) (poor preparation in the fourth sample makes it uncertain whether the second pair of satellites is present or not). These examples, inadequate though they are, show that chromosomal rearrangements via inversion or translocation occur with some frequency in the complex and potentially provide a genetic basis for reproductive isolation because of meiotic disruption in any inter-population hybrids. The three karyotypes also provide support of our revised taxonomy in showing different karyotypes, consistent within species. *M. decipiens*, *M. hainebachiana*, *M. helmei*, *M. ogamana*, and *M. tripetala* subsp. *jacquiniana* remain to be examined cytologically.

TABLE 1.—Chromosome counts in *Moraea tripetala* complex with corrected taxonomy. Satellite characteristics are as follows: small on acrocentric chromosome, sat type 1; large on telocentric chromosome, sat type 2, type 2a with second large satellite on short acrocentric pair; small on large submetacentric chromosome, sat type 3. Original counts are in bold type in column 2 and their voucher specimens are at the Missouri Botanical Garden Herbarium (MO).

Species	Diploid number, 2n; satellite position	Reference for previous count or voucher data for new count
<i>grandis</i>	12; sat type 1 12; sat type 1	Goldblatt (1971) as <i>M. tripetala</i> , <i>Goldblatt 101</i> W Cape, near Nieuwoudtville, <i>Goldblatt 3948</i>
<i>cuspidata</i>	12; sat type 1	Goldblatt (1976) as <i>M. tripetala</i> , <i>Goldblatt 547</i>
<i>amabilis</i>	12; sat type 1 12; sat type 1 12; sat type 1	W Cape, Clanwilliam, Boskloof road, <i>Goldblatt 2547</i> W Cape, 70 km N Matjiesfontein, <i>Goldblatt 3222</i> N Cape, Calvinia to Middelpoos, <i>Goldblatt 4381</i>
<i>mutila</i>	12; sat type 1 12; sat type 3 12; sat type 3	W Cape, Nardouw Pass, <i>Goldblatt 3852</i> W Cape, north of Piketberg, <i>Goldblatt 6127</i> W Cape, Camphill Village road, <i>Goldblatt</i> no voucher
<i>tripetala</i> subsp. <i>tripetala</i>	12; sat type 2a 12; sat type 2a 12; sat type 2a 12; sat type 2	W Cape, Pearly Beach, <i>Goldblatt 2607</i> W Cape, Caledon Swartberg, <i>Goldblatt 2509</i> W Cape, near Bot River, <i>Goldblatt 3997A</i> W Cape, Mamre Road Station, <i>Goldblatt 2487</i>
subsp. <i>violacea</i>	12; sat type 2 12; sat type 2	Goldblatt (1976) as <i>M. tripetala</i> , <i>Goldblatt 667</i> W Cape, Op-de-Tradouw, <i>Goldblatt 4184</i>

TAXONOMY

Key to the species of the *Moraea tripetala* complex

- 1a Inner tepals 7–20 mm long, linear or expanded and lobed in middle or 3-lobed with central lobe tapering and twisted:
- 2a. Inner tepals 7–9 mm long, 3-lobed with longer, tapering, often twisted central lobe; style crests ± 5 mm long; plants from middle elevations of the Piketberg, flowering mainly November 1. *M. decipiens*
- 2b. Inner tepals 7.5–15.0 mm long, linear throughout or expanded and lobed in middle; style crests 5–10 mm long; plants widespread on a variety of soils, flowering mainly August to October:
- 3a Foliage leaf usually shorter than stem, even half as long, leaf blade distally at most shallowly channelled or ± plane and laxly twisted, mostly 3.5–5.0 mm wide; leaf blades and/or stem or spathes and sheathing leaves sometimes hairy; inner tepals 7.5–12.5 mm long, often expanded in middle, sometimes into small rounded lobes at base of spreading distal half; ovary 7–8 mm long; plants flowering mainly in August (September) 3. *M. mutila*
- 3b Foliage leaf as long as or more often exceeding stem, sometimes twice as long; leaf blade narrowly channelled with leaf halves often folded together, 1.5–3.0 mm wide; vegetative parts never hairy; inner tepals 8–15 mm long, linear for entire length, spreading in distal half to one third; ovary 11–15 mm long 4. *M. cuspidata*
- 1b Inner tepals (1–)2–6 mm long or occasionally absent, either 3-lobed in upper third or reduced to hair-like or lanceolate to linear cusps, acute and usually widest at base:
- 4a Inner tepal ± 4 mm long, 3-lobed in upper third; filament column and lower abaxial surface of inner tepals puberulous; plants of the Kamiesberg, Namaqualand 2. *M. helmei*
- 4b Inner tepal variable in length (1–6 mm), a hair-like, linear cusp; filament column and lower abaxial surface of inner tepals smooth; plants of the western and southern Cape and western Karoo:
- 5a Axil of foliage leaf bearing several dark-coloured cormlets breaking through leaf sheath; plants never forming mature capsules or seeds; anthers pale blue and pollen blue or white to yellow; plants restricted to Western Cape west coast near Saldanha on limestone pavement or calcareous sands 6. *M. hainebachiana*
- 5b Axil of foliage leaf rarely with a solitary cormlet enclosed in sheath or without cormlets; anthers and pollen orange-red or white (rarely yellow); plants always forming mature capsules and fertile seeds; plants widespread from the Western Cape coast and

Western Karoo on various soils:

- 6a Filaments usually united for 0.5–1.5 mm (rarely free); plants not forming colonies, occasionally a single cormlet present in axil of foliage leaf; leaves narrowly channelled and leaf halves often closely appressed; stems and abaxial leaf surface smooth:
- 7a Ovary narrowly ellipsoid, mostly 4–9 mm long; capsules ellipsoid, 8–14 mm long; foliage leaf (or leaves) usually as long as or longer than stem; axillary cormlets absent; pollen usually orange-red, occasionally white 5. *M. tripetala*
- 7b Ovary linear-cylindric, 10–13 mm long; capsules ± cylindric (15–)20–24 mm long; foliage leaf often shorter than stem, sometimes half as long; bearing a single cormlet in axil of foliage leaf; pollen white 7. *M. ogamana*
- 6b Filaments ± free or united basally for up to 0.4 mm; plants usually forming colonies due to vegetative reproduction by axillary cormlets and/or two new cormlets replacing parent corm; leaves widely channelled, often ± plane distally; plants sometimes velvety on stems and abaxial surface of leaves:
- 8a Flowers with outer tepal limbs (9–)11–18 × 10–14 mm, always as long as or longer than wide; anthers 4.5–7.0(–8.0) mm long and up to one and a half times as long as filaments; corm tunics usually of hard, coarse, light brown (occasionally dark brown) fibres 8. *M. amabilis*
- 8b Flowers with outer tepal limbs 15–20(–23) × 15–20 mm, often ± as long as wide; anthers 8–11 mm long and ± twice as long as filaments; corm tunics usually of soft, fine (rarely medium-textured), light to dark brown fibres 9. *M. grandis*

1. *Moraea decipiens* Goldblatt & J.C.Manning, sp. nov.

TYPE.—Western Cape, 3218 (Clanwilliam): Piketberg, Farm Noupoort, south-trending, rocky sandstone slope in shallow pockets of soil, (–DA), 2 Nov. 2011, *Goldblatt & Porter 13709* (NBG, holo.; K, MO, PRE, iso.).

Plants 300–450 mm high. *Corm* 9–12 mm diam. with pale, fibrous tunics. *Stem* usually simple, rarely 1-branched, glabrous. *Foliage leaf* solitary, linear, conduplicate with margins tightly folded together, 0.7–1.5

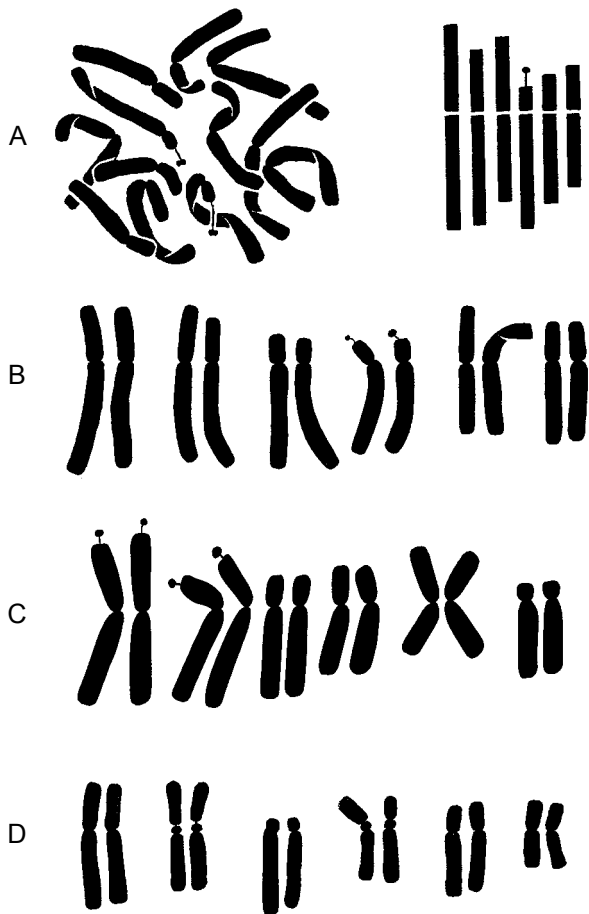


FIGURE 1.—A. Mitotic metaphase and idiogram of karyotype of *Moraea grandis*, Goldblatt 101); B–D, karyotypes from mitotic metaphases with chromosomes arranged in pairs for comparison; B. *M. amabilis*, Goldblatt 3852; C. *M. mutila*, Goldblatt 6127). D. *M. tripetala* subsp. *tripetala*, Goldblatt 2607B).

mm diam., exceeding stem and often trailing above, sometimes with axillary cormlet; sheathing cauline leaves 45–55 mm long, green with dry attenuate apices. *Rhipidia* mostly 3–5-flowered; spathes green with dry, brown, attenuate tips, inner 35–40 mm long, outer \pm half as long as inner. *Flowers* pale to deep purple, outer tepal limb bases with white, wedge- or V-shaped, minutely papillate nectar guides dark purple in centre; outer tepals 20–23 mm long, claw 8–9 mm long, with wide, dark violet median stripe, limb 12–15 \times 6–8 mm; inner tepals 7–10 long, violet, claw suberect, plane, expanded to 2 mm wide at apex, often into rounded lobes, limb 3–4 mm long, tapering to attenuate tip, laxly twisted distally. *Stamens* with filaments 3.5–4.0 mm long, united in lower \pm 2 mm; anthers 4.5–6.0 mm long, reaching or shortly exceeding stigma lobe, dark purple-black; pollen orange-red. *Ovary* narrowly oblong-truncate, 7–9 mm long, usually exserted when flower mature; style \pm 2 mm long, dividing \pm 0.5 mm above top of filament column, branches, 7–9 \times 1–2 mm; stigma shallowly bilobed; style crests narrowly wedge-shaped, \pm 5 mm long, erect. *Capsules* narrowly ovoid, 8–11 mm long. *Seeds* 5(6)-sided, 1.2–1.5 mm \times \pm 1 mm, facets slightly wrinkled, brown seed body visible though testa, angles between facets forming narrow, raised, pale, slightly spongy ridges. *Chromosome number* unknown. *Flowering time*: late Oct.–mid-Nov. Figure 2.

Distribution: known only from the western half of the Piketberg in Western Cape (Figure 3), *Moraea decipiens* is evidently restricted to middle elevations of the range, rather than the emergent peaks, and based on our own collection, occurs on stony sandstone slopes in shallow pockets of soil among Restionaceae and low shrubs. None of the other three collections that we have seen include information about the habitat.

Diagnosis: named for the deceptive (*decipiens* = Latin deceiving) appearance of the flowers to those of *M. tripetala*, *M. decipiens*, nevertheless, differs in having the inner tepal claws distinctly expanded distally, sometimes into rounded lobes, with the limb linear-attenuate and curved inward above. The inner tepals recall those of *M. unguiculata* and *M. algoensis* but unlike those species, the filaments of *M. decipiens* are only shortly united for \pm 2 mm and the style branches diverge above the fused part of the filaments whereas in *M. unguiculata* and *M. algoensis* the filaments are united almost to their apices in a relatively thick column. The style branches of *M. decipiens* are relatively short, \pm 7 mm long, unlike those in *M. tripetala* which are usually 9–12 mm long. The markings on the outer tepals are also notable, consisting of a wedge- or V-shaped white zone surrounding a dark purple basal mark that is continuous as a wide, longitudinal purple streak on the claw. Plants from Pakhuis Pass, flowering in late October (*Helme* 5726, NBG) bear a superficial resemblance to *M. decipiens* in size of the flowers, colour of the nectar guides and the broad inner tepals but the filaments are united for 2.5 mm and 6.5 mm long, thus longer than the anthers, which are just 4 mm long. More material of this plant is needed before an informed decision can be made about its status but we suspect it represents yet one more undescribed species of subgen. *Vieusseuxia*.

Typical *Moraea tripetala* itself also occurs at higher elevations on the Piketberg, e.g. *Linder* 414 BOL, from Levant Mtn where *M. decipiens* also occurs, but flowers some two to four weeks later. Early flowering *M. mutila* of the complex occurs in renosterveld on the lower eastern slopes of the range and has inner tepals broadly similar to those of *M. decipiens*, although narrower and longer. The population at the type locality was relatively large and plants showed no variation in critical features, thus unlikely to be hybrid between *M. tripetala* and *M. mutila*. Barker's collection of *M. decipiens* likewise comprises several plants (*Barker* 7563), all uniform for flower features, and the pollen appears normal under the microscope.

Additional specimens

WESTERN CAPE.—3218 (Clanwilliam): hills NW of Mouton's Vlei, (–DA), Nov. 1934, *Pillans* 7489 (BOL); Piketberg, Levant Mtn, Farm Avontuur, (–DA), 5 Nov. 1973, *Linder* 81 (BOL); Piketberg, without precise locality, 3 Nov. 1951, *Barker* 7563 (NBG).

2. *Moraea helmei* Goldblatt & J.C.Manning, sp. nov.

TYPE.—Northern Cape, 3018 (Kamiesberg): southern Kamiesberg south of Farm Karas, near top of Langkloof, 1 125 m, (–AB), 28 Oct. 2011, *Goldblatt & Porter* 13688 (NBG, holo.; MO, iso.).

Plants 250–350 mm high. *Corm* 9–12 mm diam. with pale, fibrous tunics. *Stem* simple or with 1 or 2



FIGURE 2.—*Moraea decipiens*, Goldblatt & Porter 13709. A, flowering stems and corm; B, inner tepal variation; C, inner perianth whorl plus filaments and style; D, capsules. Scale bar: A, D, 10 mm; B, C, 2 mm. Artist: John Manning.

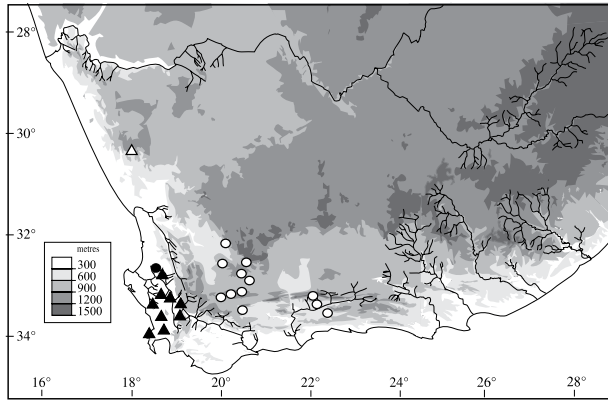


FIGURE 3.—Distribution of *Moraea cuspidata*, ○; *M. decipiens*, ●; *M. helmei*, ▲; and *M. mutila*, △.

short branches, glabrous. *Foliage leaf* solitary, linear, channelled, remaining \pm erect, \pm 2 mm wide when opened flat; sheathing cauline leaves 2 or 3, 35–45 mm long, green, attenuate, becoming dry at tips. *Rhipidia* 2(3)-flowered; spathes green with dry tips, attenuate, inner 40–45 mm long, outer \pm two thirds as long, entirely sheathing. *Flowers* pale blue to violet, outer tepal limbs darkly veined, with narrowly triangular, shortly velvety, yellow nectar guides at base of outer tepal limbs outlined pale blue to dark violet; outer tepals 21.0–23.5 mm long, claw 8–10 mm long, with a shallow raised tooth either side just below apex, limb 12.5–13.5 \times 7–8 mm; inner tepals short, \pm 4 mm long, 3-forked in upper 1 mm, inner lobe slightly larger than laterals, \pm puberulous. *Stamens* with filaments \pm 4 mm long, united in lower 1.5 mm, column puberulous; anthers \pm 6.5 mm long, dark violet; pollen yellow. *Ovary* narrowly ellipsoid, \pm 7 mm long, initially partly included, ultimately fully exerted; style \pm 2 mm long, dividing at top of filament column, branches linear, 9 \times 1 mm; style crests \pm 7 mm long, erect. *Capsules* and *seeds* unknown. Flowering time: late Oct.–mid-Nov. Figure 4.

Distribution and habitat: known only from the Kamiesberg in central Namaqualand (Figure 3), *Moraea helmei* has been collected just twice, from a “somewhat marshy site the top of the Langkloof south of the Farm Karas” and “from a seasonal seep south of Karas at the upper end of the Langkloof”. Plants occur at an altitude of about 1 125 m. Conservation status is impossible to assess from the limited data available about the species, but the species is undoubtedly rare.

Diagnosis and relationships: the filaments, united for 1.5 mm and slightly more than one third their length, and the short style, \pm 2 mm long, are consistent with the *M. tripetala* complex but the inner tepals of *M. helmei* are short and expanded distally into three short, subequal lobes (vs. linear and usually cusp-like in *M. tripetala*). The puberulous filament column appears to be unique in the complex. The trilobed inner tepals of *M. helmei* recall those of *M. unguiculata*, which has a longer, narrow, coiled central lobe and rounded lateral lobes, but the filaments of this species are united in a prominent column for more than half their length. A peculiarity of the outer tepal claws of *M. helmei* is the pair of shallow tooth-like projections just below the apices, a feature not known elsewhere in *Moraea*: the tepal claws in all other

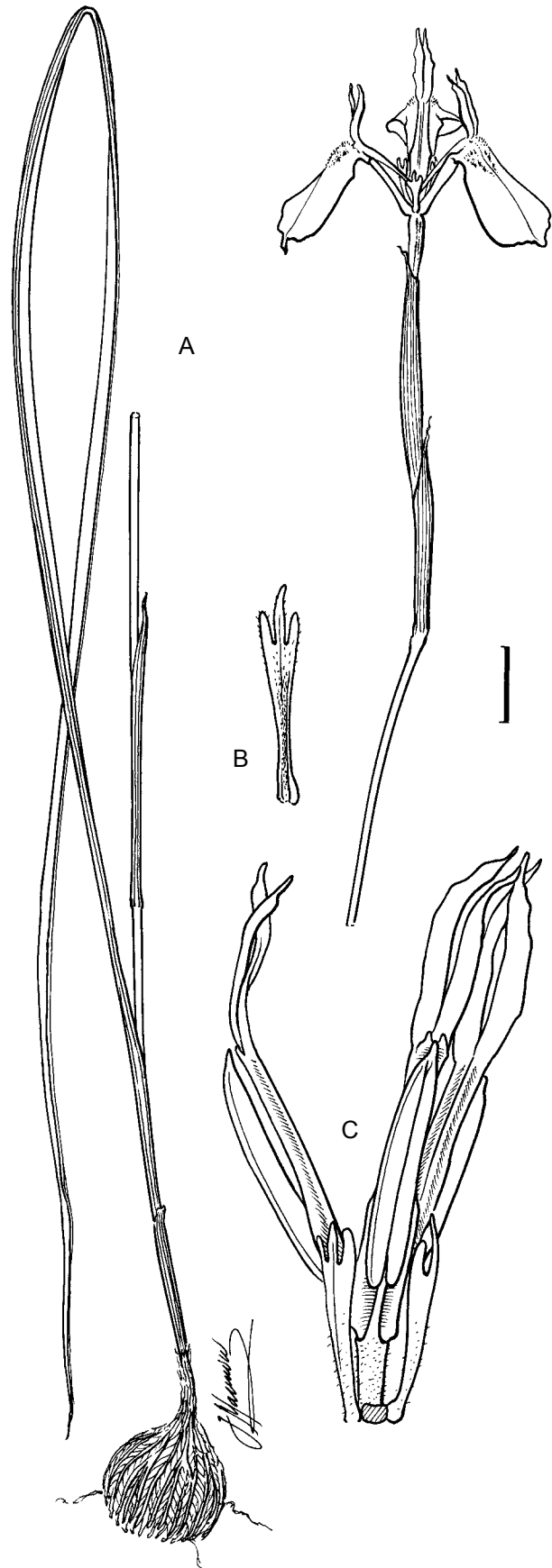


FIGURE 4.—*Moraea helmei*, Goldblatt & Porter 13688. A, flowering stem and corm; B, inner tepal; C, inner perianth whorl plus filaments and style. Scale bar: A, 10 mm; B, C, 2 mm. Artist: John Manning.

species are straight or slightly bowed outward and have plane margins.

Additional specimen

NORTHERN CAPE.—**3018** (Kamiesberg): Kamiesberg, ± 1–2 km south of Farm Karas [Welkom], in seep area west of Langkloof road, 1 125 m, (–AC), 28 Oct. 2009, *Helme 3269* (NBG, photo).

3. *Moraea mutila* (C.H.Bergius ex Eckl.) Goldblatt & J.C.Manning, comb. nov. *Vieusseuxia mutila* C.H.Bergius ex Eckl.: 12 (1827). Type: [Western Cape], vicinity of Camps Bay, *Bergius 15 S7238* (S, lecto.), designated by Goldblatt: 715 (1976b) [Syntype: [Western Cape], ‘Löwenrücken’ [Lion’s Rump], *Ecklon s.n.* (S, syn.!), two collections made on different dates, also probably *M. mutila*].

Iris tripetala Thunb.: 13 (1782, Dec.), hom. illegit. et nom superfl. pro *M. tripetala* L.f. (1782, Apr.). Type: South Africa, without precise locality, *Thunberg s.n.* (UPS: Herb. Thunberg, syn.).

M. tripetala var. *mutila* Baker: 23 (1896), as nom. nov. pro *Vieusseuxia mutila* Licht. ex Klatt: 621 (1866), hom. illegit. non Eckl. (1827). Type: [Western Cape], vicinity of Camps Bay, *Bergius 15 S7238* (S, holo.!).

M. punctata Baker: 1003 (1904). Type: [Western Cape], ‘Piketberg Road’ [Gouda], 17 Aug. 1897, *Schlechter 4851* (K, lecto.), designated by Goldblatt: 751 (1976); B!, GRA!, PRE!, isolecto.).

M. monophylla Baker: 24 (1906). Type: [Western Cape], ‘Olifants River, Clanwilliam’, Aug. 1894, *Penther 685* [K, lecto.), designated by Goldblatt: 751 (1976)].

Plants 15–30 cm high. *Corm* mostly 10–15 mm diam., evidently without cormlets at base, tunics of medium to coarse fibres, vertical members often thickened below into prominent claws. *Stem* simple, rarely 1-branched (1 of 28 plants seen), glabrous or occasionally pilose, sheathed below by brown, fibrous cataphylls, these often accumulating. *Foliage leaf* solitary, linear, shallowly channeled below, often becoming flat and slightly twisted in distal third, ± half to as long as stem, 3–5(–7) mm wide, glabrous or sometimes pilose abaxially or on margins; sheathing cauline leaves 20–40 mm long. *Rhipidia* mostly 2- or 3-flowered; spathes green, inner 35–40(–45) mm long, outer ± half as long as inner, rarely pilose. *Flowers* pale blue or white, nectar guides triangular, white to pale yellow with dark blue dots and often edged with darker color, velvety (or smooth?); outer tepal claws 9–12 mm long, limbs dipping at 45°, ovate, widest in distal third, 14–15 × ± 10 mm, margins recurving later, inner tepals ± linear to slightly expanded in middle, sometimes as rounded lobes, 7.5–12.5 mm long. *Stamens* with filaments 3.0–3.5 mm long, united for 0.5–1.5 mm; anthers 4.5–6.5(–7.5) mm long, pollen red or yellow. *Ovary* narrowly ellipsoid, 7–8 mm long; style 1–2 mm long, style branches 7–9 mm long, crests linear, 8–10 mm long. *Capsules* ellipsoid, 15–17 × ± 5 mm. *Seeds* ± 1.8 × 1.3–1.4 mm, pale straw-coloured, testa spongy, angles narrowed into wings. *Chromosome number* $2n = 12$ (Table 1). *Flowering time*: late Aug.–late Sept., depending on subspecies. Figure 5.

Distribution: largely a species of renosterveld, *Moraea mutila* is centred in the western lowlands of Western Cape, extending from the Cape Peninsula to Piketberg, and extending locally inland to the Tulbagh Valley (Figure 3). A collection said to be from the Olifants River Valley near Clanwilliam made by Arnold Penther is more likely mislabelled and was perhaps gathered en route from Porterville to Clanwilliam. At the very least the Olifants River Valley record requires confirmation. Soils on which *M. mutila* has been collected are described as shale and clay, consistent with renosterveld but probably also on granites, and plants we have seen grew on loamy clay. *M. mutila* is evidently rare on the Cape Peninsula and as far as we have been able to determine was first collected there by C.H. Bergius in 1817, then by Ecklon and by Zeyher in the 1820s, and later by Friedrich Wilms, Rudolf Marloth, and Harry Bolus but there are no recent records. Nevertheless, it probably persists on clay soils, its preferred habitat, on the lower slopes of Lions Head and Signal Hill above Cape Town.

Possibly belonging here are pale blue-flowered plants from the western lower slopes of Sir Lowry’s Pass (*Loubser 872* NBG, *Goldblatt 2506* MO) with the inner tepals trilobed as in *M. mutila* but the filaments are united for ± 2.5 mm and the style is 4 mm long. Alternatively these plants may be hybrids between *M. tripetala* and *M. unguiculata*.

Diagnosis: early blooming *Moraea mutila* (the name means mutilated, presumably due to the reduced inner tepals) is recognized by the pale blue, rarely white flowers with linear to narrowly lanceolate inner tepals 7.5–12.5 mm long, erect below and spreading distally. Often difficult to see in preserved specimens, the inner tepals are usually slightly wider in the midline and sometimes expanded into rounded lobes near the base of the spreading distal half. The flowers otherwise seem little different from those of *M. tripetala* but the pilose nectar guides are usually white or palest yellow and dotted with dark blue to purple, whereas the nectar guides of *M. tripetala* are more often yellow, edged with dark blue

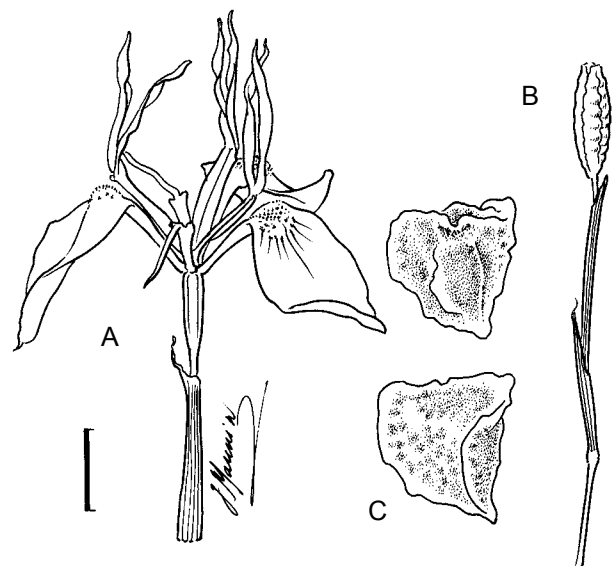


FIGURE 5.—*Moraea mutila*, Goldblatt 2310. A, flower; B, capsule; C, seeds. Scale bar: A, B, 10 mm; C, 2 mm. Artist: John Manning.

or purple. The leaf is typically relatively short, in most collections shorter than the stem, and widely channelled, sometimes plane in the distal half. Several specimens of two collections (*Acocks 1912* and *Nordenstam & Lundgren 1998*) have leaves velvety on the abaxial surface and velvety spathes. The few collections from the Cape Peninsula also have partly hairy leaves, either on the abaxial surface or on the margins. The pubescence is evidently variable in the populations that show the character, thus of limited value for identification, although we have not seen any collections of true *M. tripetala* with pubescence of any kind on the vegetative parts.

Taxonomic history: the earliest record of *Moraea mutila* is the plant described in detail by C.P. Thunberg (Dec. 1782) under the name *Iris tripetala*. Thunberg's plant had smooth, channelled leaves, a blue flower with yellowish nectar guides, and notably, inner tepals with very narrow claws, convex abaxially, and patent limbs at the base of which were two opposed lobes (*denticibus duobus*). Thunberg's *M. tripetala* has, however, no nomenclatural status or is at best superfluous as he cited *I. tripetala* L.f. (April 1782) in his account. The latter, described incompletely but said to have subulate (awl-shaped or needle-like) inner tepals, is the basionym for *M. tripetala*. Thunberg actually collected multiple specimens of the *M. tripetala* complex from at least three sites but clearly had *M. mutila* in mind in his extended description of *I. tripetala*. Since his description conflicts with that of Linnaeus fil. we treat Thunberg's *I. tripetala* as a separate, but superfluous name.

Moraea mutila appears again as *Vieusseuxia mutila* C.H.Bergius ex Eckl. (Ecklon 1827), published with the brief diagnosis, '*Blumen blassblau*' (flowers pale blue), with citations of a C.H.Bergius collection from Camp's Bay (August 1817), and two Ecklon collections from Lion's Head [as Löwenrücken], Cape Town, one collected in August (year not stated), and the other in September 1826. Nordenstam (1972) accepted the name as valid despite the brief diagnosis that mentions neither the leaf vestiture nor the form of the inner tepals, features critical to identification of the species. The epithet '*mutila*' was taken from the manuscript name on Bergius's collection, now in the Stockholm Herbarium and annotated '*Iris nov. species mutila mihi*' in Bergius's hand. We wonder whether Ecklon actually saw the Bergius specimen, which was probably already in Berlin when he arrived in Cape Town in 1823 but, nevertheless, cited it. Bergius, incidentally, almost certainly took the epithet '*mutila*' from Martin Lichtenstein's manuscript *Spicilegium flora capensis*, which he would have seen when he was in Berlin under Lichtenstein's patronage at Berlin before he departed for the Cape (Gunn & Codd 1981). The Bergius collection was designated the lectotype of *V. mutila* (Goldblatt 1976b), thus maintaining the link between Bergius's epithet and specimen.

Klatt's *Vieusseuxia mutila*, a homonym for Ecklon's *V. mutila*, explicitly excludes the specimens on a sheet then at the Berlin Herbarium (now at Stockholm), collected by C.H. Bergius that has smooth vegetative parts (referring them to *Moraea tripetaloides* DC. = *M. tripetala*). Other specimens on that sheet with hairy leaf margins, a pilose stem and linear inner tepals are the type of the name and are *M. mutila*. Baker (1896) in *Flora*

capensis recognized one variety of his *M. tripetala*, var. *mutila*, with 'leaf pilose' [the entire diagnosis] and references to both *Vieusseuxia mutila* Klatt and *Iris mutila* Licht. ex Roem. & Schult. The latter, described as glabrous on all parts according to the protologue (Roemer & Schultes 1817) (there is no extant type material), is in conflict with Baker's variety. Both name and description of *Iris mutila* were taken directly from Martin Lichtenstein's manuscript, *Spicilegium flora capensis*. Klatt's species, however, matches Baker's var. *mutila*, but as it is illegitimate, we treat Baker's variety as an inadvertent new name but based on the same type as *V. mutila* Klatt. Baker's variety is *M. mutila*, and identical with a second species, *M. punctata*, which he described in 1904, from smooth-leaved specimens collected by Rudolph Schlechter. Baker (1906) clearly did not realize that his *M. monophylla* was a close match for *M. punctata*, which now falls into synonymy under *M. mutila*.

Representative specimens

WESTERN CAPE.—**3218** (Clanwilliam): flats N of Piketberg at Eendekuil turnoff, renosterveld, (–DB), 1 Sept. 1981, *Goldblatt 6127* (K, MO, NBG, PRE); Piketberg, Jobskloof, (–DB), 11 Aug. 1973, *Linder 635* (BOL). **3318** (Cape Town): Dassenberg N of Mamre, W slopes, (–AD), 23 Sept. 1974, *Nordenstam & Lundgren 1998* (MO, S); near Moorreesburg, Klein Swartfontein, renosterveld on shale, (–BA), 25 Aug. 1970, *Acocks 24320* (K, MO, PRE); Porterville, flats, (–BB), 10 August 1959, *Loubser 933* (NBG); slopes of Lions Rump near Tamboerskloof, (–CD), Aug., *Zeyher 5010* (SAM); Rosebank, Cape Town, (–CD), Aug. 1877, *H. Bolus 3732* (BOL); Signal Hill, 100 m, (–CD), Aug. 1894, *Marloth 195* (PRE), 26 Aug. 1883, *Wilms 3670* (K); 29 miles [45 km] from Cape Town to Malmesbury, (–DA), 29 Aug. 1932, *Lewis s.n. (BOL45082)*; between Salt River and Kalabas Kraal, (–DA), 4 Sept., *Hutchinson 161a* (K, PRE); damp flats N of Bottelary road, (–DC), 26 Aug. 1933, *Acocks 1912* (S); Stellenbosch, (–DD), 1865, *Sanderson 959* (K). **3319** (Worcester): flats S of Tulbagh Road Station, (–AC), 11 Aug. 1974, *Goldblatt 2310* (MO); Voëlvlei Tortoise Reserve, (–AC), 10 Aug. 1989, *Solomon 16* (NBG); Wolsley, Farm Romansrivier, burned April 2011, (–AC), 11 Aug. 2011, *Boucher 7670* (MO, NBG); near Wellington, (–CC), 15 August 1926, *Grant 2361* (MO).

4. *Moraea cuspidata* Goldblatt & J.C.Manning, sp. nov.

TYPE.—Western Cape, 3220 (Sutherland): near Farm Fortuin, north of Matjiesfontein, near shaded rest stop (co-blooming with *M. amabilis*), (–DC), 28 Sept. 2009, *Goldblatt & Porter 13462* (NBG, holo.; MO, iso.).

Plants solitary, 180–300 mm high. *Corm* 15–25 mm diam., without cormlets at base, tunics of brown to almost black, tough, medium to coarse fibres. *Stem* smooth, simple or 1(2)-branched exceptionally with up to 6 branches, with cataphylls of medium textured, light brown, mostly vertical fibres forming a collar around base, sometimes accumulating in a dense mass. *Foliage leaf* solitary, linear(–linear-filiform), channelled, 1.5–3.0 mm wide, glabrous, V-shaped in section, leaf halves closely appressed in dry conditions; sheathing cauline leaves (30–)40–55 mm long, with dry attenuate tips. *Rhipidia* several-flowered; spathes green with attenuate, dry tips, inner (40–)50–80 mm long, outer ± half as long as inner, glabrous. *Flowers* pale blue, mauve or violet blue, outer tepal limbs lanceolate, with large white, velvety nectar guides dotted and usually edged with dark violet; outer tepal claws (8–)10–12 mm, usually speckled with dark blue to violet dots or purple in midline, limbs (12–)16–22 × 10–16 mm, inner tepals linear,

(8–)10–15 mm long, ascending below, distal third to half usually spreading horizontally (or \pm erect when short), often pilose at base. *Stamens* with filaments (3–)4–6 mm long, united basally for 0.5–1.8 mm; anthers 4–8 mm long, pollen red (rarely white). *Ovary* exerted, 11–15 mm long; style vestigial, branches 8–10 mm long; crests 5–8 mm long, linear, arching inward. *Capsules* ovoid-ellipsoid, 14–16 mm long. *Seeds* 1.8–2.0 \times 1.3–1.4 mm, pale straw-coloured, testa spongy, thicker on angles. *Chromosome number* $2n = 12$ (Table 1) *Flowering time*: mid-Sept. and Oct. Figure 6.

Distribution: a species of semi-arid habitats, *Moraea cuspidata* grows in both mountain renosterveld and dry,

marginal fynbos, usually in sandy or sandy loam soils derived from sandstones of the Cape System or from the Beaufort Series of the Karoo System. It flowers late in the season—the earliest record is in mid-September but mid- to late October is usual. It is relatively poorly collected, not (we suspect) because it is rare, but because it grows in areas not much botanized at that time of year. In the late spring of 2009 we found the species at several sites we visited between Touw's River and Komsberg Pass in the Klein Roggeveld. The recorded range (Figure 3) extends from the Bonteberg and Voetpadsberg near Touw's River through the Klein Roggeveld and southern Roggeveld to the Swartberg and higher mountains of the



FIGURE 6.—*Moraea cuspidata*, Goldblatt & Porter 13462. A, flowering stems and corm; B, inner perianth whorl plus filaments and style. Scale bar: A, 10 mm; B, 2 mm. Artist: John Manning.

Little Karoo. An outlying record from Perdekloof, south-east of Oudtshoorn near Camfer (*Goldblatt & Porter 12575*), probably belongs here, although the flowers are exceptionally small, the inner tepals are 8–9 mm long, consistent with *M. cuspidata*. The apparent gap in the range between the Roggeveld and the Swartberg may be an artifact due to incomplete collecting.

Diagnosis: recognized immediately by the linear inner tepals up to 15 mm long (rarely less than 10 mm), spreading in the distal half (Figure 6B), *Moraea cuspidata* (named for the long, cusp-like inner tepals) also usually has a particularly narrow foliage leaf, the leaf halves tightly appressed in dry conditions, and brown, sometimes almost black corm tunics, the vertical fibres of which are usually heavily thickened. In addition, the cataphylls tend to persist as a collar of stiff fibres around the base (not always present in herbarium material). The flowers are pale blue to violet with the large, velvety nectar guides spotted with dark blue on a white background. The filaments are usually united for 1.0–1.5 mm but occasionally less, and \pm as long as or slightly shorter than the dark purple anthers that bear red pollen. We have seen only two collections with ripe capsules and these are relatively large, 14–16 mm long. The seeds of these two collections are also relatively large for the complex, 1.8–2.0 mm long and unique in having a pale, spongy testa much thickened into prominent ridges on the angles.

The species is sympatric at some sites and even co-blooming with the smaller-flowered *Moraea amabilis* (also of the *M. tripetala* complex), but this species has a broadly channeled foliage leaf, sometimes plane distally and often pilose on the abaxial surface, and consistently short, hair-like inner tepals typically 1.5–2.0 mm long. At sites where we have seen the two growing together, anthers of *M. amabilis* have white pollen, contrasting with the orange-red pollen of *M. cuspidata*. The range of *M. cuspidata* also coincides in part with *M. tripetala* subsp. *violacea*, which extends from Gydo Pass to the Hex River Valley and Touw's River, but we have not seen them growing near one another.

Representative specimens

NORTHERN CAPE.—**3220** (Sutherland): Roggeveld, Soekop, Huis Kamp, (–AA), 16 Sept. 2006, *Rosch 556* (NBG); Koedoes Pass, W slopes, (–CC), 22 Sept. 1970, *Goldblatt 547* (BOL); Klein Roggeveld, Smoustrand, (–DC), Sept. 2009, *Goldblatt & Porter 13459* (MO, NBG); Klein Roggeveld, slopes near Farm Meintjiesplaas, (–DC), 28 Sept. 2009, *Goldblatt & Porter 13456A* (MO, NBG).

WESTERN CAPE.—**3319** (Worcester): Bonteberg, Farm Karona, (–BD), 15 Sept. 1971, *Thompson 1257* (NBG); **3320** (Montagu): Bonteberg, flats at N entrance to Pienaarspoort, (–AA), 27 Sept. 2009, *Goldblatt & Porter 13453* (MO, NBG, PRE); Cabidu Karoo, Laingsburg, (–AA), 28 Sept. 1951, *Barker 7503* (NBG); Tweedside, (–AB), ex Hort. Kirstenbosch, *Barker 7466* (NBG), Sept. 1932, *Lewis s.n. Nat. Bot. Gard 2708/32* (BOL); Matjiesgoed Mtns, Farm Klein Spreefontein, \pm 990 m, (–BC), 16 Sept. 1987, *Bean, Vlok & Viviers 1938* (MO, PRE). **3322** (Oudtshoorn): Swartberg Pass, rocky slopes near picnic site, (–AC), 23 Oct. 1986, *Goldblatt 8003* (MO, PRE); top of Swartberg Pass, (–AC), Nov. 1896, *H. Bolus s.n.* (BOL); Cango Caves, Oudtshoorn, (–AC), 16 Oct. 1928, *Gillett 1695* (NBG); Perdepoot N of Camfer, sandstone slopes, (–CD), 28 Sept. 2004, *Goldblatt & Porter 12575* (MO).

5. *Moraea tripetala* (L.f.) Ker Gawl. in Curtis's Botanical Magazine 19: t. 702 (1803). *Iris tripetala* L.f.: 92 (1782).

Viousseuxia tripetaloides DC.: 138 (1803), nom. illegit. superfl. pro *I. tripetala* L.f. (1782). *Viousseuxia tripetala* (L.f.) Voigt: 602 (1845). *Viousseuxia tripetala* (L.f.) Klatt: 155 (1894), hom. illegit., non (L.f.) Voigt (1845). Type: [Western Cape], without precise locality, *Thunberg s.n. Herb. Thunb. 1186* [UPS-THUNB, lecto.! designated by Goldblatt: 175 (1976)].

Plants (140–)250–450 mm high, glabrous on all vegetative parts. Corm mostly 8–15 mm diam., without cormlets at base, tunics of moderately coarse, wiry, usually dark grey fibres. Stem simple or 1- or 2(–6)-branched, sheathed below by brown cataphylls and sometimes with collar of brown fibres. Foliage leaf solitary (rarely 2 in subsp. *violacea*), leathery, narrowly channeled, C- or V-shaped in section, to 5 mm wide, usually exceeding stem and distally trailing; sheathing cauline leaves mostly 45–60 mm long. *Rhipidia* 3–several-flowered; spathes green with dry attenuate tips, inner 35–65(–70) mm long, outer \pm half as long as inner. Flowers pale blue, purple, or violet, nectar guides triangular, yellow edged with violet, or white dotted with dark blue and edged with darker blue, lightly honey scented, unscented or strongly scented of carnation (subsp. *violacea*); outer tepals 20–30(–32) mm long, claws 9–12 mm long, limbs obovate, widest in distal third, 11–18 \times \pm 8–13 mm, plane, spreading at 45°, margins eventually recurved, inner tepals hair-like to \pm linear, 1–4(–6) mm long, or lacking. Stamens with filaments 4–6 mm long, united for 0.5–1.5 mm, occasionally (southern populations) \pm free; anthers 4–7 long, pollen usually orange-red, rarely white. Ovary 4–9 mm long; style 1–2 mm long, style branches 9–12 mm long, crests \pm linear, 5–12 mm long. Capsules ellipsoid, 8–14 mm long. Seeds 1.0–1.3 mm \times \pm 1 mm, flat surfaces slightly wrinkled, brown seed body visible through testa, angles forming raised, golden-brown ridges. Chromosome number $2n = 12$ (only subspp. *tripetala* and *violacea* counted) (Table 1). Flowering time: mainly Aug.–mid-Sept., occasionally in Oct. Figures 7, 8.

Distribution: widespread in Western Cape, *Moraea tripetala* extends from Aurora on the west coast to near Knysna in the east, and inland to Ceres and the Little Karoo (Figure 9). Habitats vary from limestone flats in fynbos, to neutral and acid sands in sandveld, to loamy alluvium in coastal and montane fynbos. Interior populations from the Warm Bokkeveld (Ceres) and western Little Karoo, here segregated as subsp. *violacea*, occur in significantly drier habitats on clay soils in renosterfeld. Populations segregated as subsp. *jacquiniana* are mostly montane and occur above 500 m but at lower elevations in the southern Cape Peninsula, and flower significantly later in the year. Although much of its lowland habitat has been lost to agriculture and its original range significantly reduced, *M. tripetala* still occurs extensively in undisturbed low to middle elevation sites. Interior populations have lost little of their original habitat except immediately around Ceres where orchards have replaced much of the original vegetation.

Diagnosis: in our revised, narrower circumscription, *Moraea tripetala* includes plants with reduced hair-like to linear inner tepals mostly 2–4, rarely up to 6 mm long, and filaments united for up to 1.5 mm and occasionally free. The outer tepal limbs are broadly ovate,

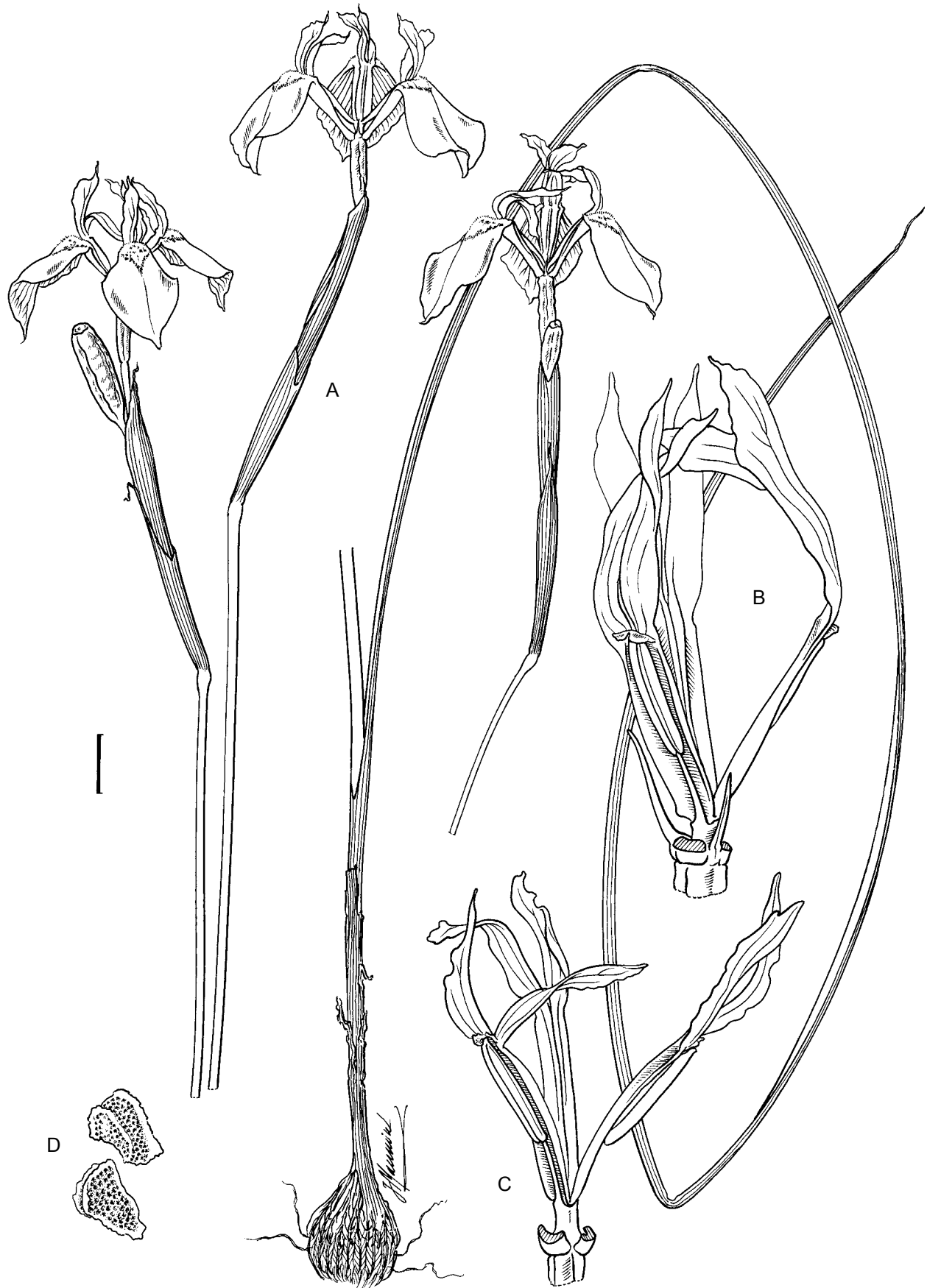


FIGURE 7.—*Moraea tripetala* subsp. *tripetala*, A, B, D, Goldblatt & Porter 13467 (MO); C, Goldblatt & Porter 12374. A, flowering stems and corm; B, C, inner perianth whorl plus filaments and style; D, seeds. Scale bar: A, 10 mm; B–D, 2 mm. Artist: John Manning.

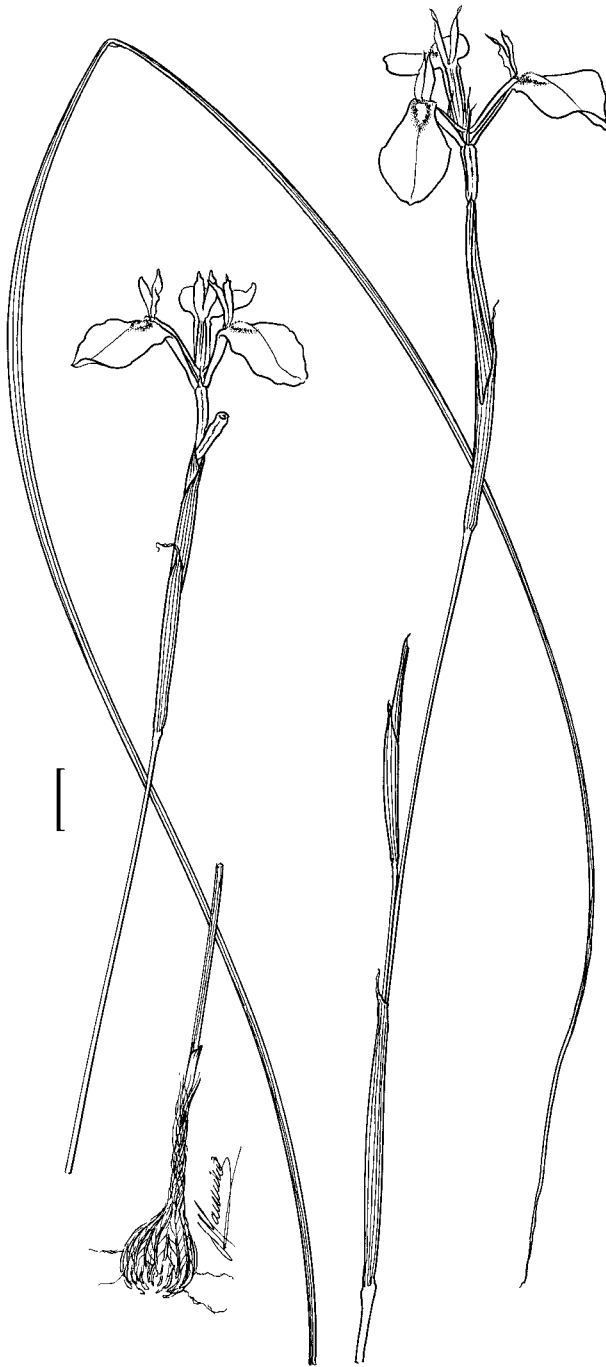


FIGURE 8.—*Moraea tripetala* subsp. *jacquiniana*, Red Hill, no voucher. Scale bar: 10 mm. Artist: John Manning.

longer than wide and oriented $\pm 45^\circ$ below horizontal. The corms have dark brown to grey tunics, usually composed of medium-textured fibres, and do not produce cormlets at the base. The linear leaves, normally exceeding the stem, are narrowly channelled, and in dry conditions the leaf halves lie parallel to one another. As far as we can determine, vegetative reproduction by production of cormlets does not occur in *M. tripetala* as now circumscribed. Flower colour ranges from pale to deep blue or violet or rarely light purple, sometimes even in the same population. Nectar guides are often yellow edged with dark blue or purple, but occasionally white, then dotted with blue to purple. The seeds are small, and typical of the complex in being 5(6)-sided with the fac-

ets slightly wrinkled and showing the brown color of the seed body (Figure 7D). The angles are raised into narrow wings of pale straw colour. In contrast, *M. amabilis*, *M. cuspidate*, and *M. grandis* have larger seeds of more complex structure.

Variation: there are a number of notable variants among the plants we include in *Moraea tripetala*, one of the most important of which includes populations from the interior Western Cape on clays and shales from Ceres to the western Little Karoo. These plants have dark violet outer tepals with yellow nectar guides, are usually relatively short in stature, and have short stiff, hair-like inner tepals, mostly ± 2 mm long. The flowers we have examined alive have a strong clove or carnation-like scent. Unusually for the complex, and for subg. *Vieusseuxia* as a whole, some populations of this morph have two foliage leaves (e.g. *Dymond s.n.* from near Ouberg Pass; *Goldblatt 4184, 11438* from Op-de-Tradouw near Barrydale; *Van Wyk 61* from the Voetpadsberg; *Goldblatt & Snijman 6976A* from Worcester). We recognize these populations of the interior Western Cape as subsp. *violacea*.

Elsewhere, *Moraea tripetala* has pale or deep blue, or sometimes purple outer tepals, either with yellow or white nectar guides, in the latter case usually speckled with dark blue or purple, and flowers are faintly sweet-scented or odourless. It is also relatively tall (allowing for reduced stature in years of poor rainfall) and usually has hair-like to linear inner tepals 2–4(–6) mm long (occasionally the inner tepals are absent in southern Cape populations). Among these populations, those that flower from November to January on the Cape Peninsula and surrounding mountains stand out in their softly fibrous corm tunics, slightly smaller flowers, and usually very narrow leaves. The flowers also often have inner tepals 4–6 mm long. Typical *M. tripetala* in the same area flowers from August to early October. We think it useful to recognize these two sets of populations taxonomically but favour subspecies rank because the morphological differences between them and typical *M. tripetala* are small and not absolute. The taxon was treated by Lewis (1941, 1950) as var. *jacquiniana*.

Variation elsewhere across the wide range of *Moraea tripetala* seems to us less taxonomically significant and less consistent. We discuss this under subsp. *tripetala*.

History: although the type of *Moraea tripetala* was collected by C.P. Thunberg, the basionym *Iris tripetala* was described by Linnaeus fil. (April, 1782), several months before Thunberg (Dec. 1782) published his own, much more extensive description. Goldblatt (1976b) selected as lectotype a specimen that had short, hair-like inner tepals and a long, narrow, channelled leaf, thus fixing the application of the name. Thunberg's plant is obviously a different species, and has the distinctive inner tepals of what is now *M. mutila* (see extended discussion under that species). The reduced inner tepals rendered *M. tripetala* so distinctive that it acquired few synonyms. De Candolle (1804), when transferring *I. tripetala* to *Vieusseuxia*, the genus then used for southern African species originally treated as *Iris*, renamed it *V. tripetaloides*, a morphologically more apt epithet. The name is superfluous as De Candolle cited *I. tripetala* L.f.

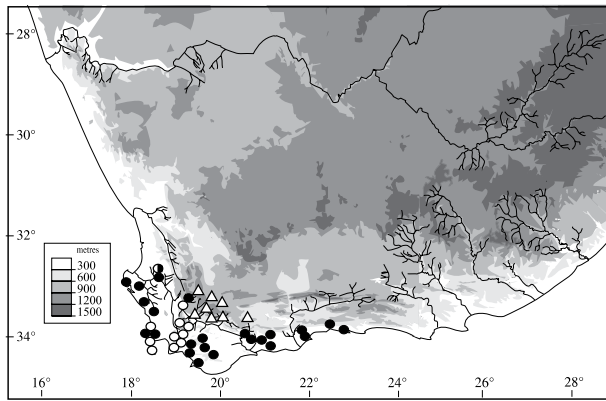


FIGURE 9.—Distribution of *Moraea tripetala* subsp. *tripetala*, ●; *M. tripetala* subsp. *violacea*, ▲; *M. tripetala* subsp. *jacquiniana*, ○.

and *I. tripetala* Thunb. in synonymy. *I. tripetala* was transferred to *Moraea* in 1803 by Ker Gawler but the confusion over the circumscription of *Moraea* persisted and Voigt (1847) and then Klatt (1866) independently transferred *I. tripetala* to *Viesseuxia*.

Key to subspecies

- 1a Plants mostly of montane habitats in rocky sandstone soils, flowering mainly November to January, occasionally in October; ovary 4–6 mm long; inner tepals often 5–6 mm long, reaching bases of anthers; tepals mostly dark violet 5c. subsp. *jacquiniana*
- 1b Plants of clay, granitic or sometimes rocky limestone or sandstone soils, flowering mainly August to early October; ovary 6–9 mm long; inner tepals 1–3(–5) mm long (or absent), rarely reaching base of anthers; tepals pale to dark blue to violet:
- 2a Ovary 6–8 mm long; outer tepals 24–26 mm long and inner tepals 1–2 mm long; tepals violet with yellow nectar guides; foliage leaves 1 or 2; plants of clay soils in renosterveld in the Warm Bokkeveld, Bonteberg, and Little Karoo 5b. subsp. *violacea*
- 2b Ovary 8–9 mm long; outer tepals 23–30(–32) mm long; and inner tepals absent or 1–3(–5) mm long; tepals pale blue or deep blue or purple usually with white (occasionally yellow) nectar guides; foliage leaf always solitary; plants of sandy flats and slopes, sometimes in limestone, extending from Aurora to Knysna 5a. subsp. *tripetala*

5a. subsp. *tripetala*

?*Iris mutila* Licht. ex Roem. & Schult.: 447 (1817). *Viesseuxia mutila* (Licht. ex Roem. & Schult.) A. Dietr.: 494 (1833), hom. illeg. non Eckl. (1827). Type: unknown, assigned here based on description alone.

Plants 250–450 mm high, stem sometimes sheathed below by collar of brown fibres. *Corm* mostly 12–15 mm diam. *Foliage leaf* always solitary, linear. *Inner spathes* 45–65(–70) mm long. *Flowers* pale blue or purple with yellow or white nectar guides, faintly honey-scented or unscented; outer tepals 23–30(–32) mm long, claws 10–12 mm long, limbs 12–18 mm long; inner tepals usually hair-like, 1–3(–5) mm long, or absent. *Stamen filaments* 4–6 mm long, united for 1.0–1.5 mm, occasionally (southern populations) ± free; anthers 4.5–7.0 long; pollen usually red or white. *Ovary* 8–9 mm long; style branches ± 12 mm long, crests mostly 8–12 mm. *Capsules* 12–14 mm long. *Flowering time*: late Aug.–mid-Sept., occasionally in Oct. (exceptionally July, e.g. *Wurts* 212). Figure 7.

Distribution: largely a plant of coastal forelands, subsp. *tripetala* extends from Aurora on the west coast of Western Cape to near Knysna in the east. It also occurs on lower mountain slopes, occasionally up to ± 700 m, and has been recorded on the Piketberg, the Hottentots Holland–Jonkershoek mountain complex, the Witzenberg at Ceres, and the lower southern slopes of the Langeberg (Figure 9). Populations along the southern Cape, notably in the De Hoop area, the Agulhas Peninsula (*Goldblatt* 2607), and some from near Caledon (*Goldblatt* 6196) occasionally lack inner tepals, or individual flowers may lack one or two of the inner tepals (e.g. *Goldblatt & Manning* 12248, east of Swellendam). Plants from the southern foothills and lower slopes of the Langeberg sometimes have free filaments (e.g. *Thorne s.n.* SAM, from Garcia's Pass; *Goldblatt* 3741 from near Suurbraak). Subsp. *tripetala* is usually found in sandy habitats or on coastal limestone, thus in sandveld, strandveld and fynbos vegetation.

Representative specimens

WESTERN CAPE.—3218 (Clanwilliam): Piketberg, plateau on Kapteins Kloof Mtn, (–DA), 21 Oct. 1935, *Pillans* 7796 (BOL); Piketberg, plateau E of Levant Mt., edge of dam, (–DD), 20 September 1974, *Linder* 414 (BOL). 3318 (Cape Town): R27 to Langebaanweg, sandveld, (–AC), 29 Sept. 2009, *Goldblatt & Porter* 13467 (MO); Dassenberg, N of Mamre, (–AD), 23 Sept. 1974, *Nordenstam & Lundgren* 1999 (MO, S); near Mamre Road Station, sandy waterlogged ground, (–BC), 3 Sept. 1974, *Goldblatt* 2487 (MO); sandy flats near Wynberg, (–CD), Sept. 1884, *Macowan* 215 (BOL); Camps Bay, (–CD), Sept. 1886, *Thode* 8531 (NBG). 3319 (Worcester): Ceres Nature Reserve, top of Michell's Pass, rocky sandstone slopes, (–CD), 29 Sept. 2009, *Goldblatt & Porter* 13463 (MO, NBG). 3320 (Montagu): Swellendam, below Langeberg range at Clock Peaks, (–CD), 2 July 1952, *Wurts* 212 (NBG). 3419 (Caledon): Caledon Swartberg and the Baths, (–AB), Aug., *Ecklon & Zeyher s.n.* (MO); 18.4 km SW of Greyton, shale ground in renosterveld, (–BA), 28 August 1970, *Acoccks* 24337 (K, MO, PRE); Rotary Drive, Hermanus, (–AC), 10 October 1974, *Goldblatt* 3009 (MO, PRE); hill above, Pearly Beach, (–CB), 11 Sept. 1974, *Goldblatt* 2607 (K, MO, PRE). 3420 (Bredasdorp): Suurbraak to Heidelberg, W of Strawberry Hill, (–BA), *Goldblatt* 3741 (MO); clay bank E of Swellendam, (–BB), 7 Sept. 2003, *Goldblatt & Manning* 12248 (MO, NBG); 10 km S of Bredasdorp, entrance to Die Poort, limestone, (–CA), 13 Sept. 1978, *Goldblatt* 4860 (MO). 3421 (Riversdale): Riversdale, Garcias Pass, (–AA), Oct. 1926, in *Thorne s.n.* (SAM 43214); 2 km from Herbertsdale to Cloete's Pass, (–BA), 26 Sept. 2003, *Goldblatt & Porter* 12374 (MO). 3422 (Mossel Bay): Pacaltsdorp, George, (–AB), 22 Aug. 1978, *Moriarty* 339 (MO); Goukamma Nature Reserve, (–BB), 1968, *Heinecken* 206 (PRE).

5b. subsp. *violacea* *Goldblatt & J.C. Manning*, subsp. nov.

TYPE.—Western Cape, 3320 (Montagu): Op-de-Tradouw, Barrydale to Montagu, south facing clay slope in renosterveld, (–DC), 26 Aug. 2000, *Goldblatt* 11438 (NBG, holo.; K, MO, PRE, iso.).

Plants mostly 200–300 mm high, stem sometimes with collar of fine fibres around base. *Corm* mostly 8–10 mm diam., tunics of medium-textured, usually pale fibres, sometimes thickened below. *Foliage leaf* 1 or 2, linear, mostly 1.5–2.5 mm wide, leaf halves often folded together and blade appearing terete. *Inner spathes* 35–45(–50) mm long. *Flowers* violet with yellow, velvety nectar guides, strongly scented of cloves (?always); outer tepals 24–26 mm long, claws ± 10 mm long, limbs 14–16 mm long, inner tepals hair-like, 1–2(3) mm long. *Stamen filaments* 4.0–6.5 mm long, united for 0.5–1.2 mm; anthers 4.0–6.5 mm long, pale violet, pollen white.

Ovary 6–8 mm long; style branches \pm 12 mm long, crests 6–8(10) mm long. Capsules 8–11 mm long. Flowering time: late Aug.–late Oct.

Distribution: subsp. *violacea* extends from Gydo Pass and the Warm Bokkeveld through the southern foothills of the Hex River Mtns near Worcester inland to the Bonteberg, Touws River and the western Little Karoo near Barrydale (Figure 9). Populations with two foliage leaves appear to occur randomly across its range. Plants almost invariably occur on clay soils in renosterveld but we have also seen the species growing among low succulent shrubs.

Representative specimens

WESTERN CAPE.—**3319** (Worcester): Gydo Pass, (–AB), *Barker 6836* (NBG); Hottentots Kloof, (–BA), 28 Sept. 1944, *Barker 3031* (NBG); E slopes of Theronberg Pass, (–BC), 31 Oct. 1974, *Goldblatt 3228* (MO); Ceres, Lakenvlei, (–BC), 10 Oct. 1941, *Barker 1336* (NBG); 2 km east of De Doorns, Hex River Valley, (–BC), 27 Sept. 1974, *Nordenstam & Lundgren 2056* (MO, S); \pm 12 km N of Worcester at Brandwagt turnoff, Worcester West, (–CB), 26 Sept. 1983 (fr.), ex hort. Missouri, Mar. 1986, *Goldblatt & Snijman 6976A* (MO); Doringkloof, Voetpadsberg, (–DB), 24 Aug. 1985, *Van Wyk 61* (NBG); Koo, foot of Naudesberg, (–DD), 12 Sept. 1962, *Lewis 6054* (NBG). **3320** (Montagu): Ouberg to Touws River, (–CB), 29 Sept. 1932, *Dymond s.n.* (*BOL21234*); Keurkloof, off Cogman's Kloof, (–CC), 24 Sept. 1935, *Lewis s.n.* (*BOL*); Op-de-Tradouw, Barrydale to Montagu, S facing clay slope in renosterveld, (–DC), 23 Sept. 1976, *Goldblatt 4184* (MO), 12 Sept. 1994, *Goldblatt & Manning 9990* (K, MO, NBG).

5c. subsp. *jacquiniana* (*Schltr. ex G.J.Lewis*) *Goldblatt & J.C.Manning*, stat. et comb. nov. *Moraea tripetala* var. *jacquiniana* Schltr. ex G.J.Lewis: 54 (1941). Type: [Western Cape], Constantiaberg, Dec. [without year], *Wolley Dod 1919* (*BOL*, lecto.!, designated by Goldblatt: 751(1976b); K!, iso.).

Vieusseuxia pulchra Eckl.: 13 (1827). Type: [Western Cape], 'Hottentotshollandkloof', 25 Nov. [without year], *Ecklon & Zeyher s.n.* (S, holo.!).

Plants 140–300 mm high, stem usually sheathed below by collar of fine, loosely netted fibres. Corms \pm 10 mm diam., tunics of relatively fine fibres, not usually accumulating. Foliage leaf solitary, narrowly channelled or leaf halves appressed together thus appearing terete, exceeding stem and up to twice as long, 2–3(–5) mm wide (when dry often apparently \pm 1.5 mm diam.). Inner spathes 40–50 mm long. Flowers usually purple or blue with triangular, white nectar guides spotted with dark blue and edged darker color, unscented, outer tepals 20–25 mm long, claws 9–11 mm long, limbs lanceolate, 11–16 \times 8–11 mm, inner tepals hair-like, mostly 5–6 mm long, reaching or exceeding anther bases. Stamen filaments 4–6 mm long, united for 1.0–1.5 mm; anthers 5–6 long, pollen usually (always?) red. Ovary 4–6 mm long; style branches 10–11 \times 2 mm long, crests linear, 5–8 mm long. Capsules mostly 10–14 mm long. Flowering time: mid-Nov.–Jan., rarely in late Oct. Figure 8.

Distribution: occurring entirely within the range of subsp. *tripetala*, subsp. *jacquiniana* extends from the Cape Peninsula to the Hottentots Holland and Houw Hoek Mtns and north to the mountains around Franschhoek, Paarl, and Wellington (Figure 9). There are also isolated records from the Piketberg, the mountains near Ceres, and in the vicinity of Citrusdal (*Ecklon & Zey-*

her Irid 20), this last in need of confirmation. Although largely montane, subsp. *jacquiniana* occurs at quite low elevations in the southern Cape Peninsula. Plants grow in fynbos on stony sandstone slopes. Flowering is very late in the season, mostly November and December, but plants have been collected in January and sometimes in late October. Subsp. *tripetala* flowers in August and September, usually at lower elevations, sometimes in similar habitats.

Diagnosis: subsp. *jacquiniana* is poorly differentiated from subsp. *tripetala* but apart from the later flowering time it can be distinguished by the finely fibrous corm tunics, shorter rhipidial spathes 40–50 mm long, and slightly smaller flowers, usually deep violet, consistently with inner tepals 4–6 mm long (usually shorter or absent in subsp. *tripetala*). The outer tepals are typically 20–25 mm long, the ovary 4–6 mm long and capsules, 10–14 mm long, all smaller than in subsp. *tripetala*. As far as is recorded, the violet flowers consistently have white nectar guides whereas *M. tripetala* has yellow or less often white nectar guides, then speckled with blue dots. The colour illustrations of flowers of the two taxa can readily be compared in *Wild Flowers of the Cape Peninsula* (Maytham Kidd 1950).

The taxon was named in honor of N.J. Jacquin, whose monumental volumes of coloured illustrations of plants, many of them from the Western Cape and Namaqualand, were an inspiration and major resource for accurate plant depictions, including his painting of three variants of *Moraea tripetala* (*Icones plantarum rariorum* vol. 2, t. 211), one of which perhaps was thought by Schlechter to represent what is now subsp. *jacquiniana*. The epithet was first used, without description, by Bolus & Wolley Dod (1903) in a checklist of plants of the Cape Peninsula as if validly published by Schlechter. The epithet was taken from the collection labels of *Schlechter 7222* (collected in 1896) and was only validated at varietal rank by G.J. Lewis in 1941. A collection from 'Hottentots Holland Kloof' was named *Vieusseuxia pulchra* by Ecklon in 1827. Ecklon's descriptive phrase, 'flowers darker blue' [than *M. setacea* the name Ecklon used for *V. tripetala*] barely qualifies as a diagnosis but Nordenstam (1972) regarded the name as validly published.

Representative specimens

WESTERN CAPE.—**3218** (Clanwilliam): along the Olifants River, Clanwilliam to Citrusdal, (–?BB), Nov., *Ecklon & Zeyher Irid 20* (MO); Piketberg, plateau on Kapteins Kloof Mtn, (–DA), 21 Oct. 1935, *Pillans 7796* (*BOL*). **3318** (Cape Town): Cape Peninsula, Table Mt., (–AD), Dec. 1950, *Pillans 10279* (*BOL*, MO); Table Mt., lower plateau, Nov. 1944, *Lewis 946* (*SAM*). **3319** (Worcester): Michell's Peak, Ceres, (–AD), 16 Dec. 1948, *Esterhuysen 14767* (*BOL*); Upper Wellington Sneeuwkop, moist slope below shale band, flowers dark violet-blue, (–CA), 23 Jan. 1972, *Esterhuysen 32799a* (*BOL*); Groot Drakenstein Mtns, Devil's Tooth, (–CC), 12 Dec. 1943, *Esterhuysen 9549* (*BOL*); mountain at top of Franschhoek Pass, (–CC), 18 Nov. 1974, *Nordenstam & Lundgren 2259* (MO, NBG); burned lower slopes of Klaasjagersberg adjacent to Cape Point Reserve, (–AB), 26 Nov. 1979, *Goldblatt 5258* (MO, PRE); Paulsberg slopes, (–AB), 6 Nov. 1939, *Lewis 675* (*SAM*). Muizenberg Mt., 1 500 ft [465 m], (–AB), 29 Nov. 1938, *Wall s.n.* (S); Sir Lowry's Pass, 1 219 m, '*Moraea jacquiniana* Schltr., n. sp.', (–BB), 14 Jan. 1896, *Schlechter 7222* (*GRA*, PRE). **3419** (Caledon): Haasvlakte, Houwhoek road to Highlands, (–AA),



FIGURE 10.—*Moraea hainebachiana*, Goldblatt & Porter 13262. A, flowering stems and corm; B, inner perianth whorl plus filaments and style. Scale bar: 10 mm. Artist: John Manning.

14 Oct. 1988, *Boucher & Stindt* 5452 (NBG, PRE); Lebanon Forest Reserve, Jakkalsrivier Catchment 1a, (–AA), 23 Nov. 1970, *Haynes* 476 (NBG, PRE).

6. *Moraea hainebachiana* Goldblatt & J.C.Manning, sp. nov.

TYPE.—Western Cape, 3217 (Vredenburg): Jacobsbaai, 1 km E of town on calcrete ridge, Erf 890, (–DD), 31 Aug. 2011, *Claassens* 95 (NBG, holo.; MO, iso.).

Plants 180–280 mm high. *Corm* mostly 7–12 diam., usually with cormlets at base, tunics of coarse, almost black, hard, wiry fibres, thickened below into claw-like ridges. *Stem* usually simple, rarely 1-branched, glabrous, bearing several, dark-coloured cormlets just below ground level in foliage leaf axil. *Foliage leaf* solitary, linear, channelled, inserted well above top of cataphyll, trailing above, (1.5–)2.0–4.0 mm wide, exceeding stem by 100–150 mm; sheathing cauline leaves \pm 55 mm long, green with dry attenuate apices, lowermost some-

times with axillary cormlets. *Rhipidia* usually 2-flowered, spathes green with dry attenuate tips, inner 60–65 mm long, outer \pm half as long as inner. *Flowers* pale violet to deep blue, outer tepal limbs darkly veined, nectar guide white with lines of dark blue radiating from limb base, scented of vanilla, outer tepals 24–25 mm long, claw \pm 10 mm long, white-hairy on adaxial surface, with prominent basal, yellow nectary \pm 1.5 mm long, limb 14–15 \times 9 mm, usually ultimately recurving, inner tepals spindle-shaped, sometimes oblanceolate and obscurely 3-lobed, 5–6 \times 0.5 mm, tapering distally with apex curving inward, sometimes inner distal surface pilose. *Stamens* with filaments \pm 6 mm long, united in lower 1.0–1.5 mm; anthers 5–6 mm long, blue-grey, pollen off-white or yellow. *Ovary* narrowly oblong-truncate, included or exerted, 7–9 mm long; style \pm 2 mm long, dividing \pm 1 mm above top of filament column, branches wedge-shaped, 7–8 \times \pm 1.5 mm at apex; stigma shallowly bilobed; style crests narrowly wedge-shaped (or sublinear), \pm 10 \times 1 mm. *Capsules* not developed, shed soon after flowers wilt. *Seeds* not produced. *Chromosome number* unknown. *Flowering time*: Aug.–mid Sept. Figure 10.

Distribution: restricted to the Saldanha District in Western Cape (Figure 11), *Moraea hainebachiana* is a narrow edaphic endemic of rocky, limestone flats and slopes and calcareous sands along the coast and adjacent hills. Plants grow in humus-rich pockets of loam between fractured limestone as well as in coarse calcareous sand. Populations extend from the Farm Trekoskraal north of Jacobsbaai through the limestone hills north of Saldanha to the southern end of the Donkergat Peninsula in West Coast National Park. Distinctive as the habitat is, typical *M. tripetala* grows in the same places, but blooms four to five weeks later. *M. hainebachiana* was evidently first collected in 1932 near Langebaan by the late G.J. Lewis, expert on the systematics of southern African Iridaceae. Her collection was referred without question to *M. tripetala* at the time. The probability that the species was distinct from *M. tripetala* was brought to our attention by Koos (Jakobus) Claassens of Jacobsbaai, who has made a thorough study of the local and strongly endemic flora of the Saldanha limestone areas. Given its very narrow range, *M. hainebachiana* must be considered threatened by coastal development although it is probably secure at the southern end of its

range in the West Coast National Park under current low wildlife stocking levels.

Diagnosis: named for the Hainebach family of Cape Town for their generous contribution to conservation of the Cape flora, *Moraea hainebachiana* at first seems to be fairly typical *M. tripetala* except for its low stature and slightly smaller flowers. On close examination, however, the species exhibits several unusual features. The first of these is the cluster of small, dark grey or bluish cormlets in the foliage leaf axil and at the base of the corm, the latter feature especially pronounced in non-flowering individuals. The foliage leaf is always inserted on the stem well above the top of the cataphyll and clearly separated from it whereas in other species in the complex, the insertion of the foliage leaf is concealed by the cataphyll. The flowers of *M. hainebachiana* are consistently pale violet to deep blue and have inner tepals 5–6 mm long, somewhat longer than is typical for *M. tripetala* and unusual in being expanded in the middle, thus spindle-shaped or sometimes oblanceolate and obscurely 3-lobed, and occasionally pilose on the inner (adaxial) surface. More significantly, the filaments are as long as or slightly longer than the anthers, whereas the anthers are slightly longer than the filaments in *M. tripetala* and in some species of the complex considerably so. The anthers are pale grey-blue and contain whitish or yellow pollen. Orange-red pollen is more frequent in the complex. The nectar guides of *M. hainebachiana* are also somewhat unusual, consisting of lines of dots on a whitish background with the edges not clearly defined as they are in *M. tripetala* in which the yellow or white nectar guides are typically edged in darker blue to violet. Vegetative reproduction does not occur in *M. tripetala* as circumscribed here and the production of multiple cormlets in leaf axils and at the base of the corm is unknown elsewhere in the *M. tripetala* complex.

Visiting the type locality at Jacobsbaai after flowering to examine capsules and seeds, we found all capsules poorly developed and ready to be shed, if not already fallen, before developing any seeds. We confirmed the condition for two more populations. Microscopic examination of pollen grains shows them to be malformed and evidently infertile. We conclude that *M. hainebachiana* is a vegetative apomict. Propagation is effected by cormlets that plants liberally produce.

Representative specimens

WESTERN CAPE.—3217 (Vredenburg): Jacobsbaai, Swartriet Farm, calcrete ridge to N of road to farm house, 50 m, (–DD), 7 Aug. 1993, *Boucher 5801* (NBG); Jacobsbaai, limestone pavement, (–DD), 1 Sept. 2010 (fr.), *Goldblatt & Manning 13491* (MO, NBG, PRE); limestone hill N of Saldanha, limestone pavement, (–DD), 4 Sept. 2009 (fl.), *Goldblatt & Porter 13262* (MO). 3318 (Cape Town): Langebaan, (–AA), 4 Sept. 1932, *Lewis s.n.BOL45094* (BOL); West Coast National Park, flats SW of Konstabel Kop on calcareous sands, (–AA), 13 Sept. 2011, *Manning & Goldblatt 3338* (NBG).

7. *Moraea ogamana* Goldblatt & J.C.Manning, sp. nov.

TYPE.—Western Cape, 3319 (Worcester): Elandsberg Farm, foot of Elandskloof Mts, seasonally wet alluvial flats, in fynbos, (–AC), 9 Sept. 2010, *Goldblatt & Manning 13520* (NBG, holo.; MO, iso.).

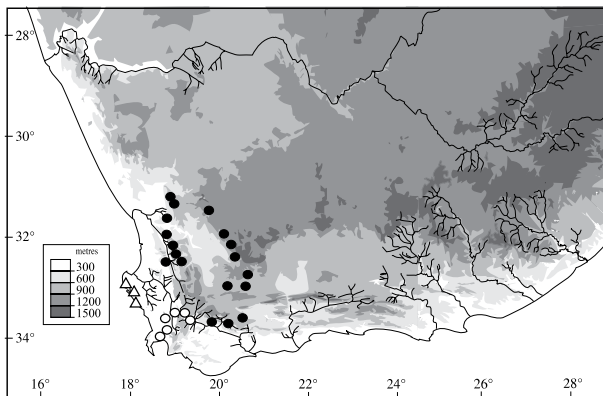


FIGURE 11.—Distribution of *Moraea amabilis*, ●; *M. hainebachiana*, ▲; *M. ogamana*, ○.

Plants 150–200(–380) mm high. *Corm* 6–12 mm diam., tunics of hard, wiry, black fibres. *Stem* usually unbranched, 2 or 3 internodes long. *Foliage leaf* solitary, sometimes with second leaf from axillary cormlet, usually shorter than stem, rarely longer, 2–3 mm wide when opened flat, widely channelled or leaf halves almost folded together, smooth, apple-green, inserted at ground level or shortly below ground, usually bearing small axillary cormlet; sheathing cauline leaves (30–)45 mm long, green with dry attenuate tips. *Rhipidia* mostly 3-flowered; spathes green with dry brown attenuate tips, inner to 55 mm long, outer \pm half as long as inner. *Flowers* pale blue, with triangular yellow nectar guides, with dark veins radiating from nectar guide, outer tepal claws 12–14 mm long, limbs ovate, \pm 15 mm long, inner tepals hair-like, up to 4 mm long. *Stamens* with filaments \pm 5 mm long, united for \pm 1 mm; anthers \pm 6 mm long, dark bluish black, pollen white. *Ovary* linear-cylindric, 10–13 mm, darkly lined vertically on locules and septa; style \pm 2 mm long, branches \pm 12 mm long, crests \pm linear, 8–12 mm long. *Capsules* \pm cylindric, (15–)20–24 \times 2 mm. *Seeds* 0.8–1.5 mm diam., golden brown, shortly winged on angles. *Chromosome number* unknown. *Flowering time*: mid-Aug.–mid-Sept. Figure 12.

Distribution: restricted to the Western Cape lowlands between Voëlvlei and Strand and locally in the upper Breede River Valley between Wolseley and Botha, *Moraea ogamana* occurs in waterlogged stony ground

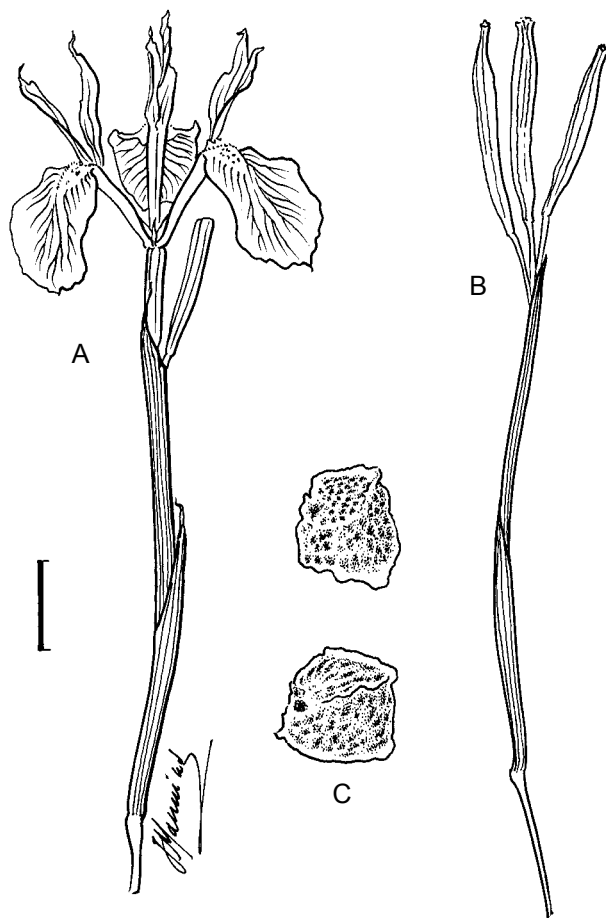


FIGURE 12.—*Moraea ogamana*, Goldblatt & Manning 13520. A, flowering stem; B, capsules; C, seeds. Scale bar: 10 mm. Artist: John Manning.

(Figure 11). Judging by the few collections, the species is rare. With rapid agricultural development in lowland Western Cape *M. ogamana* must be regarded as endangered, although its existence is secure in the Elandsberg Nature Reserve at Bo-Hermon immediately south of Voëlvlei, a small part of its once much wider range.

Diagnosis: the narrow, linear-cylindric ovary 10–13 mm long, often partly included in the spathes, and pale blue flower with outer tepal limbs with yellow nectar guides and dark radiating venation immediately set *Moraea ogamana* apart in the *M. tripetala* complex. Associated with these features are the short stature, rarely exceeding 180 mm, fairly small corms, 7–12 mm diam., with wiry, black tunic fibres and a relatively short leaf, usually shorter than, but occasionally exceeding the stem. Unlike most populations of *M. tripetala* in the Western Cape forelands, which have orange-red pollen, the pollen of *M. ogamana* is white. An additional, but somewhat trivial distinction is the style crests, up to 12 mm, which are unusually long for the relatively small flowers. More importantly, almost all specimens we have seen have a single, small cormlet in the foliage leaf axil. This modest level of vegetative reproduction results in plants sometimes growing in small clumps of three or four individuals. Correlated with the long, angular ovary, the capsules are \pm cylindric and normally 20–24 mm long. Capsules of *M. tripetala* are ellipsoid-oblong and only 10–14 mm long. The species is named in honour of Ms Naoka Ogama of Japan for her generous donation to the study of southern African Iridaceae.

Representative specimens

WESTERN CAPE.—3318 (Cape Town): between Paarl and Pont, (–DB), *Drège s.n.* (S); near Groenfontein, Klappmuts, level wet area, (–DD), 15 Sept. 1983, *Van Zyl 3515* (NBG, PRE); damp place near Bottelary Road, (–DD), 9 Sept. 1934, *Acocks 2157* (S). 3319 (Worcester): Bo-Hermon, Elandsberg Farm, seasonally wet alluvial fynbos, (–AC), 20 Oct. 2010 (fr.), *Manning 3307* (MO, NBG); between Bain's Kloof and Wolseley, wet sandy flats, (–AC), 24 Aug. 1974, *Goldblatt 2428* (MO); Worcester, Botha's Halt, (–CB), 14 Sept. 1928, *Gillet 293* (NBG). 3420 (Simonstown): Harmony Reserve, Strand, (–BB), 28 Aug. 2000, *Runnalls 1041* (NBG).

8. *Moraea amabilis* Diels in *Botanische Jahrbücher der Systematik* 44: 118 (1910). Type: [Northern Cape], Bokkeveld, Calvinia, Oorlogskloof, 13 Sept. 1900, *Diels 626* (B, lecto.!, designated by Goldblatt: 751 (1976), as holotype).

Plants 150–250 mm high, growing in clonal colonies. *Corm* mostly 7–12 mm diam., with tunics of pale, medium to fairly coarse fibres (rarely soft relatively fine fibres), often replaced annually by two daughter corms. *Stem* simple or 1(2)-branched, glabrous or velvety, sometimes with cormlets in below-ground axils, enclosed at base by brown cataphylls, occasionally accumulating in a collar of fine fibres around base. *Foliage leaf* solitary, linear, channeled, usually broadly so, 2–5 mm wide, abaxial surface often velvety-pilose; cauline sheathing leaves \pm 40–52 mm long, glabrous or velvety, green with dry apices. *Rhipidia* several-flowered; spathes green, dry and attenuate above, becoming dry entirely, glabrous or velvety, inner mostly 45–55 mm long, outer \pm half to two thirds as long as inner. *Flowers* mostly purple or violet to dark blue (rarely pink, dull yellow or buff-brown), nectar guides velvety, white

speckled with purple or dark blue, often with larger dark mark at base, often slightly scented of honey or vanilla, outer tepals 20–31 mm long, claws pale mauve often with darker central line and spotted purple-black, 10–12 mm long, velvety, limbs \pm broadly lanceolate, (9–)11–18 \times 10–14 mm, apex obtuse-apiculate, inner tepals erect, hair-like, acute, 1.5–2.5 mm long. *Stamens* with filaments \pm free, 3.5–6.0 mm long; anthers 4.5–7.0(–8.0) mm long, pollen white (often red in west of range, rarely pale blue). *Ovary* exerted from spathes, 6.0–9.5 mm long, flushed red; style vestigial, < 0.5 mm long, branches \pm 10 mm long; crests linear, erect or arching inward, 6–9 mm long. *Capsules* narrowly ellipsoid, 11–16 mm long, sometimes with thickened apical rim. *Seeds* 1.7–2.0 \times \pm 1 mm, facets with spongy edges and prominent spongy micropylar crest. *Chromosome number* $2n = 12$ (Table 1). *Flowering time*: mostly Sept.–mid-Oct. Figure 13.

Distribution: relatively widespread, *Moraea amabilis* extends from the Olifants River Valley to the Bokkeveld Escarpment and in an arc across the northern edge of the Roggeveld Escarpment and south through the Roggeveld and Klein Roggeveld to Worcester and the western end of the Little Karoo (Figure 11). Plants grow in light clay soils or in sandy loam. Locally in the Bokkeveld Mtns and Gifberg, plants grow in shallow sandy ground on sandstone pavement where they are usually dwarfed, we assume because of the shallow, nutrient poor soil. In the west of its range plants flower from late August to mid-September, but at higher elevations to the east, plants bloom from mid September into October, sometimes as late as the end of that month.

Diagnosis: *Moraea amabilis* is recognized in the *Moraea tripetala* complex by the virtually free filaments (united for < 4 mm) and inner tepals reduced to hair-like cusps up to 2.5 mm long, and by the distinctive mode of vegetative reproduction in which the parent corm is replaced annually by two new corms. Plants also often have a cormlet in the leaf axil and as a result form clonal colonies. This unusual characteristic is only evident if the plants are carefully extracted from the ground (see Figure 14A). The species is most likely to be confused with *M. grandis*, which also has virtually free filaments but that species is larger in all features, notably the ovary, 6–9 mm long in *M. amabilis* vs. 10–12(–15) mm in *M. grandis*, and anthers 4.5–7.0(–8.0) mm and up to half again as long as the filaments vs. 9–11 mm long and twice as long as the filaments in *M. grandis*. The corms of *M. amabilis* have pale (rarely dark) brown, coarsely fibrous tunics with prominent vertical elements in contrast to the finer tunic fibres in *M. grandis*. Apart from smaller flowers, *M. amabilis* often has white pollen in contrast to the consistently bright red-orange pollen of *M. grandis* (Table 2).

Capsules of *Moraea amabilis*, typically 11–16 mm long, contain relatively small, sharply angular seeds, \pm 2 mm at longest axis, with a prominent, pale, spongy micropylar crest (Figure 14D). In contrast, capsules of *M. grandis* are significantly larger, up to 19 mm long, have a thickened apical ridge and the large, dark brown seeds are up to 3 mm long (Figure 15D). A velvety to pilose pubescence is universal on the leaves, stem and

spathes of western Karoo populations of *M. amabilis* but those from the Bokkeveld Mtns, Gifberg and Cedarberg–Olifants River Mtns usually have smooth leaves although some notable exceptions include *Goldblatt & Porter 13522* from Kransvlei and *Levy's 10155* from Paleisheuvel. We place only moderate confidence in the pubescence character as some other members of the *M. tripetala* complex occasionally have hairy leaves (notably *M. mutila*), but we have seen no collections of *M. grandis* with hairy leaves. On the dolerite flats near Farm Keiskie, southeast of Calvinia, plants of *M. grandis* (*Goldblatt et al. 13366*) were entirely hairless, whereas *M. amabilis* growing nearby had pubescent leaves, stems and sheathing leaves (*Goldblatt et al. 13365*). The possibility that *M. amabilis* and *M. grandis* hybridize in the Nieuwoudtville area where the two co-occur is discussed briefly under the latter species.

Plants from near Worcester match *Moraea amabilis* vegetatively, notably in their corm tunics and velvety leaves and stems but have unusual, buff-yellow, or dusty pink flowers (e.g. *Goldblatt 4089*). Plants from the Rabiesberg, not far distant, also have velvety stems and leaves and were described as having brown (we assume buff-brown) flowers. These colour variants are unique for the *M. tripetala* complex.

Moraea amabilis was described by Friedrich Diels in 1910 based on plants he had collected in September 1900 when he lived in Calvinia. Goldblatt (1976b) erroneously designated *Diels 626* as the holotype, overlooking the second collection cited in the protologue, *Diels 1169* (incidentally no longer extant). The so-called holotype becomes the lectotype. Treated merely as a variant morph of *M. tripetala* by Goldblatt (1976b), we now regard *M. amabilis* as one of the most distinctive members of the *M. tripetala* complex in its habit of often producing two new corms in place of the single parent corm. Flowers of the type, evidently somewhat shrunken, have tepal claws 10–12 mm long and limbs \pm 12–14 \times 11 mm, an ovary \pm 7 mm long, and the stamens have filaments \pm 3.5 mm and anthers 5–6 mm long. Leaves and corms are lacking, but as these were described they were presumably present in the syntype, now lost, *Diels 1169*. The extant type material most closely matches the morph from the sandstone pavement in the Bokkeveld Mtns close to the edge of the escarpment.

Representative specimens

NORTHERN CAPE.—**3119** (Calvinia): between Oorlogskloof and Papkuilsfontein, (–AC), Sept. 1939, *Leipoldt 3059* (BOL), *Leipoldt 3002* (BOL, PRE); Oorlogskloof Nature Reserve, sandstone pavement near entrance, burned last summer, (–AC), 13 Sept. 2010, *Goldblatt & Porter 13532* (MO, NBG, PRE); 0.5 km S of top of Vanrhyn's Pass, (–AC), 29 Aug. 1974 *Goldblatt 2471* (MO); 15 km SSW of Nieuwoudtville, Oorlogskloof Nature Reserve, (–AC), 31 Aug. 1995, *Pretorius 259* (NBG, PRE); Lokenburg, rugged TMS, (–CA), 28 July 1956, *Acocks 18900* (K, PRE); Farm Keiskie, dolerite flats SE of Keiskie-se-Poort, plants hairy (co-blooming with *M. grandis*), (–DB), 16 Sept. 2009, *Goldblatt, Manning & Porter 13365* (MO, NBG). **3120** (Williston): \pm 70 km SE of Calvinia to Middelpoort on Blomfontein road, (–CC), 26 Oct. 1976, *Goldblatt 4381* (MO, PRE). **3220** (Sutherland): Roggeveld, Soekop, Rooipunt Camp, (–AA), 17 Sept. 2004, *Rosch 253* (NBG); Roggeveld Plateau, Farm Blesfontein, sandy flats, (–AD), 4 Nov. 2011, *Goldblatt & Porter 13720* (MO, NBG); Smoushoogte, slopes above road (visited by *Rediviva macgregorii*), (–DC), 17 Sept. 1993, *Steiner 2710* (MO, NBG); top of Verlaten Kloof, (–DC), 28 Oct. 1982, *Bayer 3276* (NBG); Moordenaars Karoo on road to farm Meintjiesplaas, shaded S slope above stream, (–DC), 30 Sept.



FIGURE 13.—*Moraea amabilis*, Goldblatt & Porter 13461. A, flowering stems and corm; B, inner perianth whorl plus filaments and style; C, capsules; D, seeds. Scale bar: A, C, 10 mm; B, D, 2 mm. Artist: John Manning.

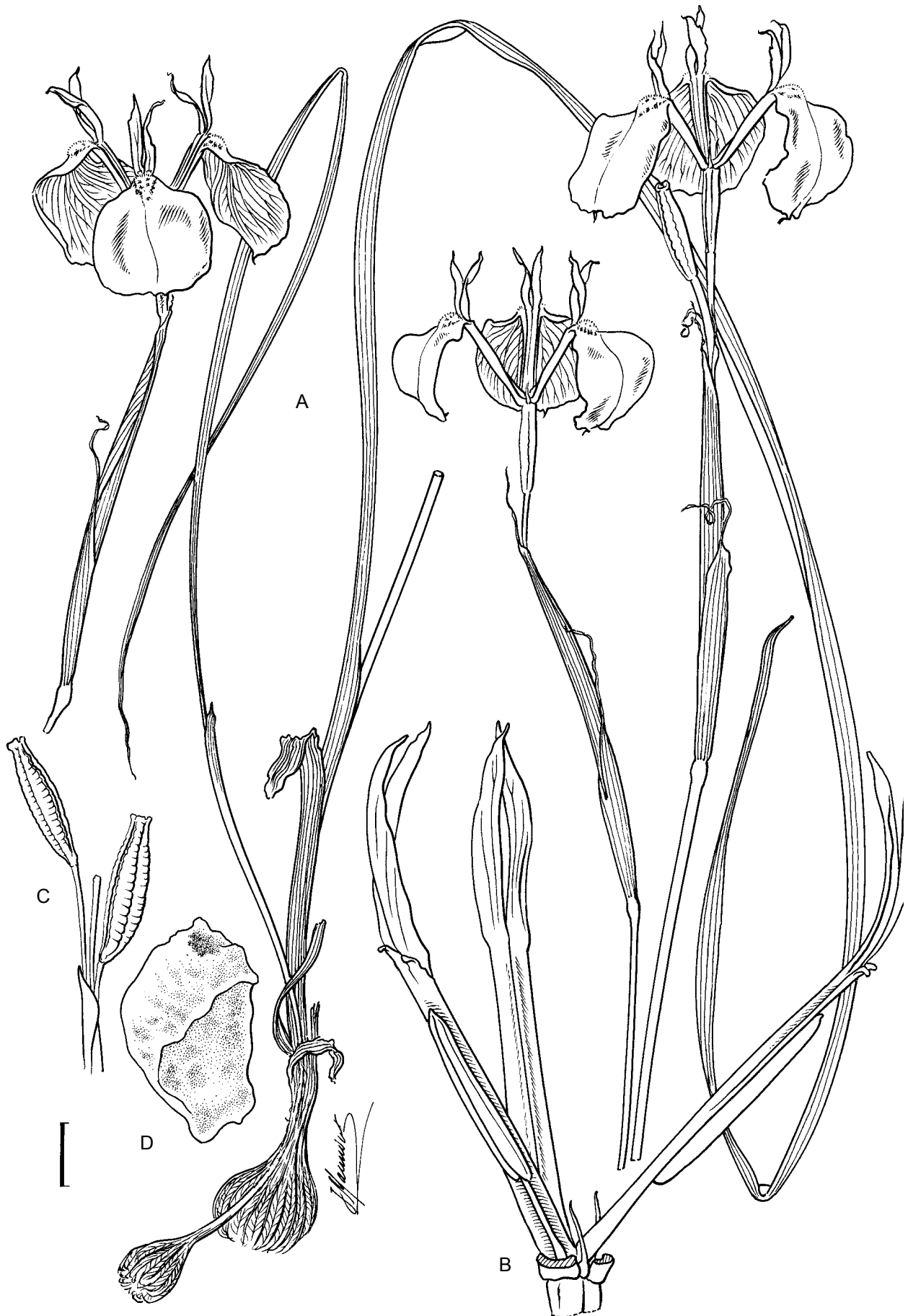


FIGURE 14.—*Moraea grandis*, Goldblatt & Manning 13658. A, flowering stems and corm; B, inner perianth whorl plus filaments and style; C, capsules; D, seeds. Scale bar: A, C, 10 mm; B, D, 2 mm. Artist: John Manning.

TABLE 2.—Comparison of taxonomically important features in *Moraea amabilis* and *M. grandis*. Filaments are virtually free or basally united for less than 0.4 mm in all specimens of both species examined.

Species	Ovary/ capsule (mm)	Outer tepals (mm)		Inner tepal (mm)	Filaments (mm)	Anthers (mm)	Leaf width (mm)	Inner spathe (mm)
		Limb	Claw					
<i>grandis</i>	(10–)12–15/ 16–19	18–23 × 15–20	12–18	1.5–3.0	4.5–5.5	8–11 orange-red,	3.0–5.5	50–80
<i>amabilis</i>	6.0–9.5/ 11–16	11–18 × 8–14	10–14	1.5–2.5	3.5–6.0	4.5–8.0 white or red (blue)	2–5	45–55

2004, *Goldblatt & Porter 12656* (MO); Klein Roggeveld, (–DC), Oct. 1920, *Marloth 9595* (PRE), *9602* (PRE).

WESTERN CAPE.—**3118** (Vanrhynsdorp): Gifberg, plateau, (–DB), 23 Aug. 1984, *Goldblatt 7230* (MO), 13 Sept. 2010 (fr.), *Goldblatt & Porter 13524* (MO, NBG), 23 Jun. 1913, *Phillips 7524* (K); Bulhoek, (–BD), 2 Aug. 1896, *Schlechter 8382* (MO, PRE); top of Nardouw Pass, (–BD), 13 Aug. 1976, *Goldblatt 3853* (MO). **3218** (Clanwilliam): Clanwilliam, at turnoff to Boskloof, (–BB), 29 Aug. 1974, *Goldblatt 2457* (MO, PRE), 11 Sept. 2010 (fr.), *Goldblatt & Porter 13522A* (MO, NBG); W slopes of Pakhuis Pass, 10 km from Clanwilliam, (–BB), [?date], *Nordenstam & Lundgren 1325* (MO, S); sandy slopes near Paleisheuvel, (–BC), 5 Sept. 1954, *Levyns 10155* (BOL). **3219** (Wuppertal): Klipfonteinrand, (–AA), 20 Aug. 1974, *Nordenstam & Lundgren 1347* (MO, S). **3220** (Sutherland): Koedoes Mtns, rocky gully above stream, (–CC), 14 Sept. 2009, *Goldblatt, Manning & Porter 13327* (NBG, MO); 70 km S of Sutherland to Matjiesfontein, (–DC), 30 Oct. 1974 (late fl. & fr.), *Goldblatt 3222* (MO); N of Farms Fortuin and Nuwerus at Komsberg turnoff from Sutherland road (co-blooming with *M. cuspidata*), (–DC), 28 Sept. 2009, *Goldblatt & Porter 13461* (MO). 3319 (Worcester): Rabiesberg, Montagu, (flowers brown), ex hort. Kirstenbosch, (–CA), July 1940, *Van der Gaast s.n.* (Nat. Bot. Gard. 2673/35 in NBG); Rabiesberg, lower slopes, flowers pink, (–CA), 27 Sept. 1935, *Lewis s.n.* (BOL 21733, K); foot of Fonteintjiesberg, Farm Onse Rug, clay soil, flowers pink or buff, (–CB), 12 Sept. 1976, *Goldblatt 4089* (K, MO, PRE). 3320 (Montagu): Memorial Hill, rocky slope above cemetery, (–AB), 29 Sept. 2009, *Goldblatt & Porter 13467* (MO); S-facing bank of stream opposite Pietermeintjies Siding, (–AC), 23 Sept. 1976, *Goldblatt 4175* (MO, PRE); Op-de-Tradouw, Barrydale to Montagu, (–DC), *Goldblatt 4185* (MO).

9. *Moraea grandis* Goldblatt & J.C.Manning, sp. nov.

TYPE.—Northern Cape, 3119 (Calvinia): Wild Flower Reserve at Nieuwoudtville, edge of shrubs near top of dolerite slope, scented of vanilla, (–AC), 22 Sept. 2011, *Goldblatt & Manning 13658* (NBG, holo.; MO, PRE, iso.).

Plants 200–400 mm high, usually in small colonies. *Corm* mostly 10–15 mm diam, with tunics of light (rarely dark brown), relatively fine, firm or soft fibres, rarely accumulating in a thick mass; often producing two new corms to replace parent corm. *Stem* glabrous, rarely velvety to pilose, simple or 1(2)-branched, base sheathed by dry light brown cataphylls, these usually persisting as collar of fine fibres around base; usually producing one or more cormlets in leaf or cataphyll axils. *Foliage leaf* solitary, shallowly channelled, usually exceeding stem and up to twice as long, 3.5–5.5 mm wide, glabrous; cauline sheathing leaves green or becoming dry from tips, long-attenuate, 55–70 mm long. *Rhipidia* several flowered; spathes green with dry, attenuate tips, glabrous, inner 55–80 mm long, outer ± half as long as inner. *Flowers* pale blue to pale violet or light purple, nectar guides small, triangular, yellow (rarely cream) on a white background and edged dark blue, short-velvety (rarely glabrous), scented of vanilla,

outer tepals 30–40 mm long, claws 12–18 mm long, velvety, limbs ± orbicular, widest above middle, usually ± as wide as long, 15–20(–23) × 15–20 mm, plane, obtuse-apiculate, spreading at 45–60°, inner tepals hair-like, erect, 1.5–3.5 mm long. *Stamens* with filaments ± free or united < 0.2 mm, 4.0–5.5 mm long; anthers 8–11 mm long, usually not reaching stigma lobes, pollen orange-red. *Ovary* (10–)12–15 mm long, slightly narrowed below apex; style vestigial, < 0.4 mm long, branches ± 15 mm, crests linear, 8–12 mm long. *Capsules* 16–19 mm long, narrowly ovoid-oblong with thickened rim. *Seeds* relatively large, 2–3 × 1.8–2.3 mm, facets rounded, angles with wing-like ridges. *Chromosome number* 2n = 12 (Table 1). *Flowering time*: mainly late Aug.–late Sept. Figure 14.

Distribution: restricted to the northern end of the western (winter rainfall) Karoo, *Moraea grandis* extends from the Langberg west of Loeriesfontein through the higher country between Loeriesfontein and Calvinia and along the Bokkeveld Plateau to the northern end of the Roggeveld Escarpment (Figure 15). Plants favour heavier soils and are most often found in heavy red clay among dolerite rocks but also grow on lighter soils derived from tillite and shale.

Diagnosis: the most striking of the species of the *Moraea tripetala* complex, *M. grandis* has relatively large corms up to 15 mm diam, with tunics usually of fine, soft (rarely firm) fibres, and the largest flowers in the alliance. The outer tepals are 30–40 mm long (Table 2) and have ± orbicular limbs 18–23 × 15–20 mm, thus almost as wide as long, and have unusually small nectar guides, usually yellow (sometimes cream) on a white background, minutely spotted with dark blue, and usually edged with a darker colour than the rest of the tepal limb. The limbs are also widest in the upper third

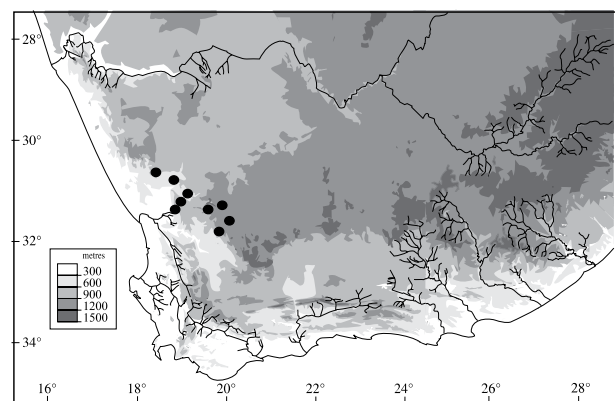


FIGURE 15.—Distribution of *Moraea grandis*, ●.

and usually have an abrupt, comma-like tip. The flowers have a pleasant, vanilla-like odour. Like its relative, *M. amabilis*, it typically grows in colonies resulting from vegetative reproduction by axillary cormlets and the sometimes replacement of the parent corm by two daughter corms. It also resembles *M. amabilis* in having virtually free filaments (united for < 0.2 mm), but the anthers, 8–11 mm long, are at least twice as long as the filaments and sometimes 2.5 × as long, easily the largest in the *M. tripetala* complex. The pollen is consistently bright orange-red, not unusual for the entire group, and contrasting with the white pollen in most western Karoo populations of *M. amabilis*, which has smaller anthers 4.5–7.0 mm long and ± as long as or up to 1.5 × as long as the filaments.

Moraea grandis sometimes grows in close proximity to *M. amabilis*, and the two can be seen flowering together on the farm Keiskie south of Calvinia. Difficulty in distinguishing the two in the immediate vicinity of Nieuwoudtville is probably the result of hybridization and introgression between the two species, which share the same large-bodied bees as pollinators.

Moraea grandis has been illustrated in several wild flower volumes notably in the *Nieuwoudtville, Bokkeveld Plateau and Hantam* wildflower guide (Manning & Goldblatt 1997: 69) and *The color encyclopedia of Cape bulbs* (Manning *et al.* 2002: 19, 307). The photographs show the distinctive, broad outer tepal limbs oriented almost vertically in fully open flowers.

Representative specimens

NORTHERN CAPE.—**3018** (Kamiesberg): Langberg, wet gully on shale, (–DB), 5 Sept. 2006, *Goldblatt & Porter 12765* (MO, NBG). **3019** (Loeriesfontein): slopes of Kubiskou Mtn, clay ground, (–CC), 6 Sept. 2006, *Goldblatt & Porter 12783* (MO); ± 8 km W of Loeriesfontein, slate hills, (–CD), 12 Sept. 1976, *Thompson 2883* (NBG, PRE). **3119** (Calvinia): Nieuwoudtville, Farm Glenlyon, (–AC), 2 Sept. 1959, *Hardy 73* (PRE); 3 miles [4.5 km], W of Nieuwoudtville, (–AC), 28 Aug. 1950, *Lewis 2274* (PRE); Glen Lyon; 2 mi. S of Nieuwoudtville, red clay flats. Flowers blue. Fairly frequent in between bulbinellas and rhenosterbos, (–AC), 11 Sept. 1974, *Oliver & Mauve 42* (K, PRE); foot of Vanrhyns Pass, (–AC), 16 Oct. 1974 (fr.), *Goldblatt 3098* (MO); Calvinia District, 8 km on Rietfontein road, W of Calvinia–Loeriesfontein road, (–AD), 25 August 1976, *Goldblatt 3948* (MO, PRE); Langfontein ± 3 km to Kotzeskolk, (–BB), 2 Sept. 1986, *Burger & Louw 184* (NBG); Farm Perdekraal, S slope on dolerite, (–BC), 12 Sept. 1981, *Goldblatt 6247* (MO); Hantamsberg, upper slopes NW of Calvinia, (–BC), 16 Sept. 1980, *Goldblatt 1980* (MO); road to Toring, 4.1 km N of Loeriesfontein–Calvinia road, dolerite slope with heavy red clay, (–BD), 21 Sept. 2011, *Goldblatt & Manning 13655* (MO, NBG); Bloukrans Pass, near summit in wet gully, (–DA), 31 Aug. 1981, *Snijman 622* (NBG, PRE); Farm Keiskie, dolerite flats SE of Keiskie-se-Poort (co-blooming with *M. amabilis*), (–DB), 16 Sept. 2009, *Goldblatt, Manning & Porter 13366* (MO, NBG).

ACKNOWLEDGEMENTS

We thank Elizabeth Parker and Lendon Porter for their assistance and companionship in the field; Koos Claassens of Jacobsbaai for help in investigating the status of *M. hainebachiana*; Mary Stiffler, Research Librarian, Missouri Botanical Garden, for help with literature searches; Roy Gereau, Missouri Botanical Garden, for assistance with nomenclatural questions; and Clare Archer for lists of exsiccatae from the PRE collection. Rhoda McMaster provided the initial stimulus for this

study by questioning the range of seed types in plants then treated as *Moraea tripetala*. Collecting permits were provided by the Nature Conservation authorities of Northern Cape and Western Cape, South Africa. Field work was funded in part by the Mellon Foundation and the B.A. Krukoff Fund, Missouri Botanical Garden.

We acknowledge the generous donation of the Hainebach family of Camps Bay, Cape Town, for conservation of the Cape Flora. Their contribution is remembered in the name *Moraea hainebachiana*. We are also delighted to recognize the valuable support towards our research provided by Ms Naoko Ogama, Miyagi prefecture, Japan, by commemorating her in the name *Moraea ogamana*.

REFERENCES

- BAKER, J.G. 1896. Iridaceae in W. T. Thiselton-Dyer, *Flora capensis* 6: 7–171. Reeve & Co., London.
- BAKER, J.G. 1904. Beiträge zur Kenntnis der Afrikanischen-Flora. XVI. Iridaceae. *Bulletin de l'Herbier Boissier* ser. 2, 4: 1003–1007.
- BAKER, J.G. 1906. II.—Diagnoses Africanæ, XVI. Royal Botanic Gardens, Kew. *Bulletin of Miscellaneous Information* 1906: 15–30.
- BOLUS, H. & WOLLEY DOD, F. 1903. List of the flowering plants of the Cape Peninsula. *Transactions of the South African Philosophical Society* 14.
- BRUMMITT, R.K. & POWELL, C.E. 1992. *Authors of plant names*. Royal Botanic Gardens, Kew.
- DE CANDOLLE, A.P. 1804. Mémoire sur le *Viesseuxia*, genre de la famille des Iridées. *Annales du Muséum National d'Histoire Naturelle* 2: 136–141.
- DIELS, L. 1910. Formationen und Florenelemente im nordwestlichen Kapland. *Botanische Jahrbücher für Systematik* 44: 92–124.
- DIETRICH, A.G. 1833. *Species plantarum* edn. 6, 2. Nauck, Berlin.
- ECKLON, C.F. 1827. *Topographisches Verzeichniss der Pflanzensammlung von C.F. Ecklon*. Reiseverein, Esslingen.
- GOLDBLATT, P. 1971. Cytological and morphological studies in the southern African Iridaceae. *Journal of South African Botany* 37: 317–460.
- GOLDBLATT, P. 1976a. Evolution, cytology and subgeneric classification in *Moraea* (Iridaceae). *Annals of the Missouri Botanical Garden* 63: 1–23.
- GOLDBLATT, P. 1976b. The genus *Moraea* in the winter-rainfall region of southern Africa. *Annals of the Missouri Botanical Garden* 63: 657–786. 1976.
- GOLDBLATT, P. 1986a. The *Moraes* of southern Africa. *Annals of Kirstenbosch Botanical Garden* 14: 1–224.
- GOLDBLATT, P. 1986b. Convergent evolution of the *Homeria* flower type in six new species of *Moraea* (Iridaceae) in southern Africa. *Annals of the Missouri Botanical Garden* 73: 102–116.
- GOLDBLATT, P. 1998. Reduction of *Barnardiella*, *Galaxia*, *Gynandriis*, *Hexaglottis*, *Homeria* and *Roggeveldia* in *Moraea* (Iridaceae: Irideae). *Novon* 8: 371–377.
- GOLDBLATT, P. & MANNING, J.C. 2009. New species of *Moraea* (Iridaceae: Iridoideae), with range extensions and miscellaneous notes for southern African species. *Bothalia* 39: 1–10.
- GOLDBLATT, P. & MANNING, J.C. 2010. *Moraea intermedia* and *M. vuvuzela* (Iridaceae: Iridoideae), two new species from western South Africa, and some nomenclatural changes and range extensions in the genus. *Bothalia* 40: 146–153.
- GOLDBLATT, P., MANNING, J.C. & BERNHARDT, P. 2005. Pollination mechanisms in the African genus *Moraea* (Iridaceae: Iridoideae): floral divergence and adaptation for pollen vector variability. *Adansonia* 27: 21–46.
- GOLDBLATT, P. & TAKEI, M. 1993. Chromosome cytology of the African genus *Lapeirousia* (Iridaceae: Ixioidae). *Annals of the Missouri Botanical Garden* 80: 961–973.
- GUNN, M.D. & CODD, L.E. 1981. *Botanical exploration of southern Africa*. Balkema, Cape Town.
- HOLMGREN, P.K., HOLMGREN, N.H. & BARNETT, L.C. 1990. *Index Herbariorum. Part. 1: The Herbaria of the World*. New York Botanical Garden, New York.

- KER GAWLER, J. 1803. *Moraea tripetala*. *Curtis's Botanical Magazine* 19: t. 702.
- KLATT, F.W. 1866. Revisio Iridearum (Conclusio). *Linnaea* 34: 537–689.
- KLATT, F.W. 1894. Iridaceae. Pp. 143–230 in T. Durand & H. Schinz, *Conspectus Florae Africae* 5. De Mat, Brussels.
- LEWIS, G.J. 1941. Iridaceae. New genera and species and miscellaneous notes. *Journal of South African Botany* 7: 19–59.
- LEWIS, G.J. 1950. Iridaceae. Pp. 217–265 in R.A. Adamson & T.M. Salter, *Flora of the Cape Peninsula*. Juta. Cape Town.
- LINNAEUS, C. fil. 1782 [as 1781]. *Supplementum plantarum*. Orphanotropheus, Brunswick.
- MANNING, J.C. & GOLDBLATT, P. 1997. Nieuwoudtville, Bokkeveld Plateau and Hantam. *South African Wild Flower Guide* 9. Botanical Society of S. Africa, Cape Town.
- MANNING, J.C., GOLDBLATT, P. & SNIJMAN, D. 2002. *The color encyclopedia of Cape bulbs*. Timber Press, Portland, OR.
- MAYTHAM KIDD, M. 1950. *Wild flowers of the Cape Peninsula*. Oxford University Press, Cape Town.
- NORDENSTAM, R.B. 1972. Types of Ecklon's 'Topographisches Verzeichniss' in the Swedish Museum of Natural History in Stockholm. *Journal of South African Botany* 38: 277–298.
- ROEMER, J.J. & SCHULTES, J.A. 1817. *Systema vegetabilium secundum* 1. Cotta, Stuttgart.
- THUNBERG, C.P. 1782. *Dissertatio de Iride*. Edman, Uppsala.
- VOIGT, J.O. 1845. *Hortus suburbanus calcuttensis*. Bishop's College Press, Calcutta.