FIRST DESCRIPTION OF FEMALE FLOWERS OF THE DIOECIOUS *ADENIA FRUTICOSA* SUBSP. *TRIFOLIOLATA*

The genus *Adenia* Forssk., with ± 100 Old World species, occurs particularly in tropical and subtropical regions of Africa, Madagascar, Southeast Asia, Malaysia and northern Australia (Feuillet & MacDougal 2007). A significant number of the African taxa are also associated with very arid regions (e.g. Somalia and Namibia) (see Van Wyk & Smith 2001: 157, 158 on the Afro-arid corridor that links northern Namibia to the Horn of Africa). Ten species occur in southern Africa; most are dioecious, with monoecy or polygamy rare (Archer 2000; Feuillet & MacDougal 2007).

Subsequent to publication of the typical subspecies of *Adenia fruticosa* Burtt Davy, sect. *Microblepharis* (Wight & Arn.) Engl. (Burtt Davy 1926), based only on male material, Liebenberg (1939) described the female flowers. The revision of South African adenias by him accommodated a broad concept for *A. fruticosa*, upheld until two further subspecies were distinguished by De Wilde (1971). For the delimitation of *A. fruticosa* Burtt Davy subsp. *simplicifolia* De Wilde, herbarium material of both male and female flowers were available to its author. However, this was not the case for *A. fruticosa* Burtt Davy subsp. *trifoliolata* De Wilde, for which female flowers and fruit were reportedly not seen. De Wilde (1971), nevertheless distinguished this KwaZulu-Natal endemic based on vegetative and male floral characters, and provided a key to this end, which was later reproduced (De Wilde 1976) in slightly modified form. Information on fruits was additionally documented for the *Flora of southern Africa* account (De Wilde 1976), but not of female flowers, which were unavailable at the time. We have been unable to trace the existence of any historical vouchers representing female flowers.

During a field trip to Ulundi in Zululand in August 2008, both male and female plants of this narrowly distributed KwaZulu-Natal endemic were encountered in full and synchronous bloom; as is usual with woody dioecious taxa, female plants were far less prevalent than males in the subpopulation. A female voucher and further male herbarium specimens were gathered, enabling illustration (Figure 21) and completion of the description for *Adenia fruticosa* subsp. *trifoliolata*, including an amplified circumscription of the male element. Female floral characters (Table 3) confirm the distinctions recognized by De Wilde (1971), for flowers of subsp. *trifoliolata* open substantially wider than those of other subspecies, based in part on their somewhat longer sepals. Newly acquired data have enabled the construction of a key for female plants of the three allopatric subspecies, all of which occur within the *FSA* region (Figure 22). *Adenia fruticosa* subsp. *simplicifolia* occurs also in southern and eastern Zimbabwe and neighbouring Mozambique (De Wilde 1971, 2002). The subspecific epithets of two of the three taxa are misnomers: subsp. *simplicifolia* is not always simple-leaved, and subsp. *trifoliolata* may be 5-foliolate. Accordingly, leaf characters are not deemed particularly useful when identifying material.

Field observations have revealed that flowering of both male and female plants of subsp. *trifoliolata* extends, intermittently, from August to December, with fruiting occurring from September onwards.

Key for ♂ plants (from De Wilde 1976)

1a Leaves 3–5-foliolate; petiolule of leaflets 2–5(–7) mm; anthers ± 3.0 mm ..... subsp. *fruticosa*
1b Leaves simple or 3(or 4)-foliolate; leaflets sessile; anthers 4.0–5.5 mm:
  2a Hypanthium broadly cup-shaped, ± 5-saccate, corona hairs 0.5–1.0 mm; disc-glands foliolate ..... subsp. *simplicifolia*
  2b Hypanthium cup-shaped, tapering, not saccate; corona hairs up to 0.5 mm, or partly absent; disc-glands absent ..... subsp. *trifoliolata*

Key for ♀ plants

1a Flowers opening to 12–14 mm; stipe 1.5 mm ... subsp. *trifoliolata*
1b Flowers opening to 6–7 mm; stipe up to 1 mm:
  2a Leaves 3–5-foliolate; petiolule of leaflets 2–5(–7) mm; disc-glands absent; staminodes 3–4 mm ..... subsp. *fruticosa*
  2b Leaves simple or 3-foliolate; leaflets sessile; disc-glands 0.2–0.5 mm; staminodes 2–2.5 mm ..... subsp. *simplicifolia*

FIGURE 21.—*Adenia fruticosa* subsp. *trifoliolata*. A, habit; B, leaf; C, ♂ flower (large form); D, ♂ flower (small form); E, ♂ half-flower diagram; F, petal: reduced lamina with awn; G, connective of ♂ flower (arrowed); H, ♀ inflorescence with leaves; I, ♀ inflorescence structure; J, ♀ flower; K, ♀ half-flower diagram; L, ovule; M, mature fruit. Scale bars: A, M, 10 mm; B–E, H–J, 5 mm; F, G, 2 mm; K, 1 mm; L, 0.2 mm. Artist: Angela Beaumont.

TABLE 3.—Morphological comparison of female flowers of *Adenia fruticosa* subspecies

Character	subsp. *fruticosa* (De Wilde 1976)	subsp. *simplicifolia* (De Wilde 1976)	subsp. *trifoliolata*
Stipe length (mm)	0.5–1.0	0.5–0.75	1.5
Flower opening to (mm)	7	6	12–14
Sepal length (mm)	5–7	5–6	6.0–8.5
Petal length (mm)	3–4	3–4	3–4
Staminode length (mm)	3–4	2.0–2.5	2.25
Staminodes connate for (mm)	1–2	1	1.8
Corona hair length (mm)	0.2	0.5	0.35
Disc glands (mm)	absent	0.2–0.5	0.3
Pistil length (mm)	6.5–8.0	5.0–6.5	8
Gynophore length (mm)	2–3	1.5–2	2
Ovary (mm)	3–4 × 3.0–3.5	1.5–3 × 1.5–2.5	3.75 × 3
Styles connate for (mm)	0.7	0.5–0.7	1
Style arms (mm)	0.5–0.7	0.5–1.0	0.5–1.0
Stigma diameter (mm)	± 1	± 1.5	± 1.6

The following descriptions and general notes for floral characters have been based on Ulundi material.

Description of female flowers

Stipe 1.5 mm long, shorter than in male flowers, articulation not clear; bract at base of stipe heart-shaped with tiny gland at base of lamina, 1 mm long; bracteoles 2, at apex of stipe, triangular, 0.5 mm long. *Hypanthium* cup-shaped, base broadly cuneate to rounded, 2.5–3.0 mm from top of stipe to bases of sepals, 2.8–3.8 mm wide. *Sepals* 5, arrangement quincuncial; innermost 2 sepals oblong, 7.5–8.0 × 2.5–3.0 mm, midvein and immediate parallel, secondary, lateral veins somewhat thicker than rest of lamina, altogether forming a triangular thickened middle region, broadest at sepal base or sinus, narrowest at sepal apex, lamina without ornamentation except at region level with and immediately adjacent to apex of corona bearing some minute fimbriate processes; margins slightly erose or sinuous, or entire basally, erose distally; apex acute, with pronounced beak-like, recurved extension; outermost 3 sepals oblong to slightly oblong-elliptic, 6.0–8.5 × 2.5–3.0 mm, midvein thicker than lateral and immediate parallel, secondary, lateral veins, midvein and immediate secondary veins altogether less thickened than in inner sepals, lamina without ornamentation except at region level with and immediately adjacent to apex of corona bearing some minute fimbriate processes, margins entire basally, slightly sinuous to entire distally. *Disc-glands* minute, 0.3 mm wide, at bases of sepals, level with base of fused part of gynophore-staminode structure. *Petals* 5, shorter than sepals, inserted in sinuses of sepals, linear-lanceolate, 4.5–5.0 × 0.5–0.8 mm, 1–3-nerved; margins entire basally, erose to slightly sinuous distally; base truncate; apex acuminate. *Androecium* of 5 staminodes, bases fused into a tube around gynophore, free parts of staminodes 2.25 mm long; bases broad, 2 mm wide; apex minute with tiny, incurved tip representing vestigial anther. *Corona* comprising ring of 5 vertical connectives, each one between base of petal and inter-staminodal part of androecial column, connectives 0.5 mm long, 0.5 mm wide, (when viewed from above), edges fimbriate. *Gynoecium:* pistil 8 mm long from base of free gynophore to top of stigmatic arms; gynophore 3 mm long from base of fused part with androecial column to base of ovary, free part of gynophore 1.5 mm long; ovary 3.5 mm from base of gynophore to bases of styles, 3 mm diam.; placentation parietal, placentas 3; ovules usually 6 per ovary, 2 per placenta, 0.5 mm long, anatropous, with prominent ridge along length and beak-like apex, funiculus somewhat expanded; styles 3, connate for 0.5 mm, stylar arms 0.7–1.0 mm long, each stylar arm split in 2; stigmas 3, vertical (i.e. parallel with long axis of flower), each connecting the two split stylar arms of each of 3 styles, 1.50 × 1.75 mm, surface papillose, edges laciniate-papillose. *Fruit* subglobose to broadly turbinate, 16.5 × 15 mm, with persistant remnants of perianth. *Seeds* (immature) with pitted testa and swollen funiculus next to base of seed. Figure 21H–M.

Description of male flowers

Hypanthium base to articulation, 1–3 mm long. *Pedicel* 2–7 mm long, 1 or 2 buds along pedicel, buds each with bract and bracteoles, bracts of buds minute, 1.0–1.8 mm long, leaf-like; bracteoles of buds 2, 1 mm long, triangular margins irregular, articulation between base of hypanthium and pedicel distinct; fused portion of bases of sepal lobes cup-shaped in outline, base broadly cuneate to rounded, 2.5–3.5 mm deep (i.e. from point of divergence of sepal lobes to apex of hypanthium), 4.2–6.5 mm wide. *Sepals* quincuncial arrangement, inner 2 sepals oblong, 9.0–12.8 × 3.0–4.8 mm, midveins prominently thickened into a broad-based triangle, narrowing towards apex, margins entire or minutely wavy basally, minutely erose to unevenly serrate distally, apex acute to rounded, tip incurved, beak-like with fimbriae; outer 3 sepals oblong, 10–13 mm × 3.0–4.8 mm, midveins slightly thickened, margins entire to very slightly sinuous throughout, apex acute to rounded. *Petals* usually 5, shorter than sepals, inserted in sinuses of sepal lobes, development variable, linear-lanceolate, 5.0–8.8 × 0.7–2.3 mm; margins slightly serrate to entire basally, erose to unevenly serrate distally; tips acuminate; lamina sometimes partly reduced with awn-like extension of midvein, or lamina absent and petal represented by awn-like structure alone. *Stamens* 5, opposite sepal lobes; filaments broadly triangular, 2.5–4.5 × 0.5–1.0 mm, anther attachment sub-basal; anthers oblong, 3.0–5.0 × 0.5–1.8 mm, bi-thecate, dehiscence introrse, pollen yellow. *Corona* connecting bases of petals to bases of filaments,

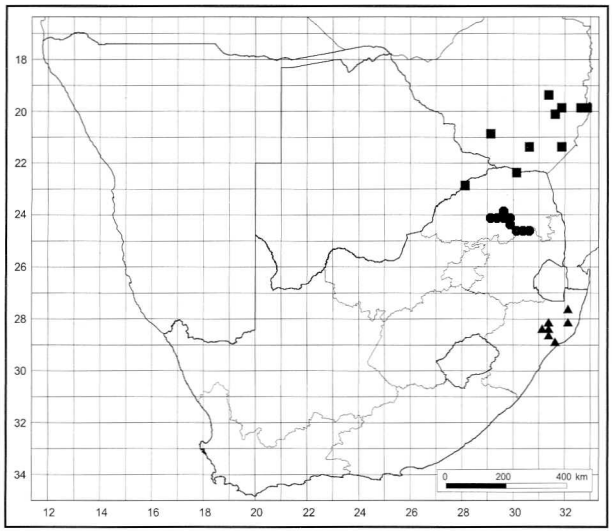

FIGURE 22.—Known distribution of *Adenia fruticosa* based on specimens at NH, NU and PRE and those cited by De Wilde (1971): subsp. *fruticosa*, ●; subsp. *trifoliolata*, ▲; subsp. *simplicifolia*, ■.

outermost (visible) tips of connectives of corona up to 0.5 mm wide, minutely fimbriate, some fimbriae also arising from the inner surfaces of the sepals immediately adjacent to, and level with the tips of the corona arms; pistillode vestigial, up to 1 mm long. Figure 21A–G.

Male flowers produced synchronously on single plants were dimorphic in respect of overall flower size (Figure 21C, D) and variable petal development as described currently. De Wilde (1971) noted that considerable infraspecific variation in both the size of flowers, and their components, is known for *Adenia*. Whereas Liebenberg (1939) related various abnormalities and variations in the flowers of several South African genus members, he did not document male flower dimorphism in *Adenia fruticosa*.

Specimens examined

KWAZULU-NATAL.—2831 (Nkandla): Ondini Historic Reserve, Ulundi, male plant, 513 m, S 28° 18.765', E 31° 27.407', (–AD), 17-08-2008, *J. van Vuuren 1* (NH); Ondini Historic Reserve, Ulundi, female plant, 515 m, S 28° 18.783', E 31° 27. 402', (–AD), 17-08-2008, *J. van Vuuren 2* (NH).

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James van Vuuren of Ulundi kindly brought the existence of a subpopulation of *Adenia fruticosa* subsp. *trifoliolata* to our attention. He subsequently collected voucher material of both sexes, and made observations on the phenology. The use in part of PRECIS data is gratefully acknowledged, kindly supported by Mrs H. Snyman. The staff of the Mary Gunn Library at the National Herbarium in Pretoria generously assisted with sourcing literature.

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N.R. CROUCH*, A. BEAUMONT** and G.F. SMITH***

* Ethnobotany Unit, South African National Biodiversity Institute, P.O. Box 52099, 4007 Berea Road / School of Chemistry, University of KwaZulu-Natal, 4041 Durban. Email: Crouch@sanbi.org (corresponding author).

** School of Biological and Conservation Sciences, University of KwaZulu-Natal, Private Bag X01, 3209 Scottsville. Email: Beaumont@ukzn.ac.za.

*** Research and Scientific Services, South African National Biodiversity Institute, Private Bag X101, 0001 Pretoria / Acocks Chair, Schweickerdt Herbarium, Department of Botany, University of Pretoria, 0002 Pretoria. Email: g.smith@sanbi.org.za.

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