

Notes on the genus *Trachyandra* (Asphodelaceae: Asphodeloideae) 1: A review of the *T. thyrsoidea* group (Section *Trachyandra*), including three new species from the Northern Cape

J.S. Boatwright^{a,b,*}, J.C. Manning^a

^a Compton Herbarium, South African National Biodiversity Institute, Private Bag X7, Claremont 7735, South Africa

^b Department of Botany, University of Cape Town, Private Bag, 7700, Rondebosch, South Africa

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Abstract

Three new species of the genus *Trachyandra* are described, *T. hantamensis* Boatwr. & J.C.Manning, *T. kamiesbergensis* Boatwr. & J.C. Manning and *T. sanguinorhiza* Boatwr. & J.C.Manning. These species form part of a group of morphologically similar species referred to here as the *T. thyrsoidea* group and are distinguished by their generally small stature, filiform leaves (except for *T. tortilis*), and simple or shortly branched racemes of patent flowers with maculate tepals. Many of the species in the group have roots that contain abundant anthraquinones, visible as a red substance below the outer skin of the roots, and which is soluble in alcohol, thus often staining herbarium papers purple. A synopsis of the eight species that comprise the *T. thyrsoidea* group is presented, with maps of each species and illustrations of those described as new.

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1. Introduction

The genus *Trachyandra* Kunth comprises ±55 species widely distributed through Africa and Madagascar, with all but a handful of species concentrated in southern Africa (Thulin, 1995; Smith and Van Wyk, 1998). The South African species were last revised by Obermeyer (1962), with four additional species described since then (Manning, 1990; Perry, 1990; Manning and Goldblatt, 2007). The genus is largely centred in the Greater Cape Region of South Africa where some 36 species are found (Goldblatt and Manning, 2000; Snijman et al., 2008).

Examination of recent herbarium collections has revealed the existence of several additional unnamed species, mainly from the Succulent Karoo Biome. Three of these species are described here. They form part of an informal group of eight

morphologically similar species in section *Trachyandra*, here called the *Trachyandra thyrsoidea* group. The group is distinguished by the generally small stature, filiform leaves (except *T. tortilis*), and simple or shortly branched racemes of patent flowers with maculate tepals. Many of the species in the group have roots that contain abundant deposits of an orange or red substance below the outer skin of the roots. A synopsis of all eight members recognised in the group is presented.

2. Materials and methods

Morphological characters of the eight species were studied using herbarium material in the main winter rainfall collections, namely from NBG (including SAM and STE), PRE and BOL, supplemented with selected online specimens from B and K (abbreviations according to Holmgren et al., 1990). Some of the species, especially those described as new, were also studied in the field. Data on the distribution of the various species are presented as maps. These data were gathered from herbarium material, field notes, as well as from Leistner and Morris (1976). Drawings were done using a stereoscope (WILD M4A) with a

* Corresponding author. Compton Herbarium, South African National Biodiversity Institute, Private Bag X7, Claremont 7735, South Africa.

E-mail address: S.Boatwright@sanbi.org.za (J.S. Boatwright).

camera lucida attachment. Author citations are given in the taxonomic section and not repeated elsewhere.

3. Results and discussion

3.1. Vegetative morphology

The eight species of the *Trachyandra thyrsoides* group are usually small in stature, generally less than 300 mm in height. Their roots vary from spreading-wiry and swollen towards the tips to thickened and \pm fused into a swollen, tuber- or bulb-like structure. Most species reproduce vegetatively by occasional branching of the rhizome, thus either solitary or forming small clumps but *T. prolifera* is distinctly stoloniferous, producing new plants along the length of the roots. The roots of *T. hantamensis*, *T. kamiesbergensis*, *T. karrooica*, *T. prolifera* and *T. sanguinorhiza* develop a layer of red or orange tissue in the outer cortex immediately beneath a hard, brown outer skin. This substance is soluble in ethanol and then results in conspicuous purple stains on herbarium mounting boards. The roots of the Asphodelaceae are known to contain a mixture of anthraquinones, among them the red pigment chryslandicin, which has been isolated from the roots of *Bulbine* Wolf and *Kniphofia* Moench species (Dagne and Yenesew, 1994; Van Wyk et al., 1995). The root chemistry of *Trachyandra*, however, is not known and studies are necessary to ascertain the identity of the red substance in the root tissue.

The leaves of all species in the group are filiform or linear, except in some forms of *Trachyandra tortilis* in which they are linear to lanceolate. The tips of the leaves are curled or loosely coiled in *T. sanguinorhiza*, while the leaves are helically coiled or sinuously folded in *T. tortilis* and *T. zebrina*. In *T. tortilis* the leaves are usually transversely plicate and folded like a concertina, rather than being coiled as in *T. zebrina*. The leaves of all the species are hirsute or hispid to muricate. The membranous cataphylls that surround the shoots as well as the leaf and scape bases are especially long in *T. tortilis* and *T. zebrina*, forming a tube around the leaf tuft. The cataphylls of *T. zebrina* bear characteristic transverse brown stripes.

3.2. Reproductive morphology

The inflorescences of species of the *Trachyandra thyrsoides* group are either simple or shortly branched racemes, sometimes forming very compact panicles. Accessory branches (secondary branches developing alongside the main branches) are lacking except in robust plants of the paniculate species, *T. thyrsoides* and *T. tortilis*, which sometimes develop a few accessory branches.

Most of the other species of section *Trachyandra*, notably the so-called tumble-weeds, develop well branched panicles with many accessory branches. Exceptions are members of two other informal groups, the *T. ciliata* group and the *T. hispida* group, which have simple, often congested racemes (Boatwright and Manning, in prep.). The species of these groups differ in several respects from those of the *T. thyrsoides* group, most notably in

that their roots never have red inner tissues, and in their mostly broader leaves. The tepals in the *T. hispida* group are immaculate.

The bracts of *Trachyandra hantamensis*, *T. thyrsoides*, *T. tortilis*, *T. sanguinorhiza* and *T. zebrina* are conspicuous, white and membranous with ciliate margins that are also often dentate. *Trachyandra kamiesbergensis*, *T. karrooica* and *T. prolifera* usually have \pm inconspicuous, papery bracts with entire margins. The peduncles are glabrous, shortly pubescent, hispid or hirsute.

The tepals are white to pinkish with pinkish-brown midribs and conspicuous yellowish or greenish spots (maculae) near the base. They are usually pilose on the abaxial midrib. The flowers are patent and not nodding as in many other species in the genus and the tepals are mostly spreading and not reflexed, with the exception of *T. kamiesbergensis*. The pedicels of *T. karrooica* are exceptionally long (up to 40 mm long), while those of *T. tortilis* are recurved when in fruit.

The tips of the styles of *Trachyandra hantamensis*, *T. thyrsoides*, *T. sanguinorhiza*, *T. tortilis* and *T. zebrina* are distally upcurved, a character that is unique in the genus. All the other species have straight or weakly declinate styles without recurved tips.

The capsules of the species in the *Trachyandra thyrsoides* group are globose to obovoid or ellipsoid, sometimes elongate in *T. tortilis*, and are glabrous in all the species, except in *T. zebrina* where they are hispid. The seeds are angular, keeled and almost entirely enveloped by a sarcostesta that is diagnostic for the family. This gives the mature seeds a dull grey to black (rarely ochraceous) coloration and is also verrucose with wart-like protuberances that are visible as white spots. These are idioblasts containing raphide crystals.

4. Taxonomy

4.1. Key to the species of the *Trachyandra thyrsoides* group

- 1a. Style recurved apically; bracts membranous with ciliate margins (except occasionally in *T. hantamensis*); flowers white or often with a pinkish tinge.....2
 - 2a. Leaves straight or curled apically.....3
 - 3a. Roots white, free and finger-like, swollen distally.....6. *T. thyrsoides*
 - 3b. Roots brown with red inner tissue, usually \pm fused and bulbous or tuberous.....4
 - 4a. Leaves curled apically; pedicels 3–6 mm long; restricted to the Klein-Roggeveld.....5. *T. sanguinorhiza*
 - 4b. Leaves straight; pedicels 8–15 mm long; restricted to the Nieuwoudtville area.....1. *T. hantamensis*
 - 2b. Leaves spirally coiled or transversely plicate through their entire length.....5
 - 5a. Cataphylls with brown transverse stripes; fruiting pedicels suberect; capsules hispid.....8. *T. zebrina*
 - 5b. Cataphylls without stripes; fruiting pedicels decurved; capsules glabrous.....7. *T. tortilis*
- 1b. Style straight; bracts papery, margins entire; flowers white.....6

6a. Roots branching and stoloniferous; racemes simple and few-flowered; flowers large, up to 30 mm diam.; restricted to the Bokkeveld Plateau.....4. *T. prolifera*

6b. Roots fused into elongate tubers, not stoloniferous; racemes branched, with many flowers; flowers less than 22 mm diam.....7

7a. Pedicels long, up to 40 mm long; flowering in autumn, March–April; widespread but absent from Kamiesberg.....3. *T. karrooica*

7b. Pedicels short, up to 10 mm long; flowering in spring, July–September; restricted to the Kamiesberg.....2. *T. kamiesbergensis*

4.2. Synopsis of species

4.2.1. *Trachyandra hantamensis* Boatwr. & J.C.Manning, sp. nov., *Trachyandra sanguinorhiza* Boatwr. & J.C. Manning radicibus ruberis bulbosis, bracteis membranaceis ciliatis et stylis sursum curvatis similis, sed foliis rectis hirsutis, pedunculo hirsuto et pedicellis longioribus (8–15 mm longis) differt. *T. sanguinorhiza* folia crispa ad apicem et muricata, pedunculus breviter pubescens et pedicelli breviores (3–6 mm longi) differt.

Type: Northern Cape, near Nieuwoudtville, September 1930, *Bolus 19605* (BOL, holo.).

Deciduous geophyte, 120–300 mm high; plants clump-forming or roots stoloniferous. *Rhizome* short, vertical; roots swollen, fused above with rhizome, split below into elongate tubers or thinner and wiry, firm-textured, bright red internally with flaking, dark brown, leathery periderm, lanate distally, staining purple when pressed. *Cataphylls* surrounding shoots as well as leaf- and scape-bases, papery, white tinged red, 5–15 mm long. *Leaves* 10–35, erect, filiform, 60–150 × 0.5–1.0 mm, muricate or hirsute, straight. *Inflorescence* a simple raceme or with 2 or 3 branches, peduncle erect, terete, 2–3 mm diam. at base, hirsute; bracts ovate-acuminate, white, membranous, 5–10 × 2–3 mm, ciliate; pedicels erect, 8–15 mm long at anthesis, ultimately 10–20 mm long in fruit. *Flowers* patent, cream with brown midribs and paired maculae near base; tepals spreading but suberect and weakly clawed in basal ±1 mm, outer elliptical, 7–8 × 1.5–2.0 mm, inner obovate, 7–8 × 2–3 mm. *Stamens* weakly dimorphic, suberect but sometimes upcurved apically; filaments filiform, white, outer ±5 mm long, inner ±6 mm long, weakly retrorsely scabrid; anthers yellow, 0.5–1.0 mm long. *Ovary* globose, ±1.5–2.0 mm long, brownish, with ±4 ovules per locule; style upcurved apically, filiform, ±5–6 mm long, white. *Capsule* globose, 4–6 × 3–4 mm, light brown. *Seeds* angular, ±1–2 × 1.0–1.5 × 1 mm, black or greyish-black, surface verrucose with wart-like idioblasts (sometimes visible as white spots) containing raphide crystals (Fig. 1). *Flowering time*: August–September.

4.2.1.1. *Diagnostic characters and relationships.* *Trachyandra hantamensis* resembles *T. sanguinorhiza* in its often bulbous red roots, membranous, ciliate bracts and upcurved styles. It differs in its straight, hirsute leaves, hirsute peduncle, and longer pedicels, 8–15 mm long. In *T. sanguinorhiza* the leaves are

muricate and curled at the tips, the peduncle is shortly pubescent, and the pedicels are 3–6 mm long. The two species occupy complimentary ranges, with *T. hantamensis* restricted to the Bokkeveld Plateau and *T. sanguinorhiza* to the Klein–Roggeveld.

Obermeyer (1962) included material of this species under *T. patens* Oberm., but noted that it was anomalous in its roots that stained the mounting paper purple and in the few-branched racemes.

4.2.1.2. *Distribution and habitat.* *Trachyandra hantamensis* occurs on tillite or clay soils between Loeriesfontein and Nieuwoudtville (Fig. 2) as a component of Nieuwoudtville Shale Renosterveld, which is known for its rich geophytic flora, especially in wetter places (Rebello et al., 2006).

4.2.1.3. Additional specimens examined.

–3019 (Loeriesfontein) ±5 km west of Loeriesfontein (–CD), 14 September 2007, *Snijman 2175* (NBG).

–3118 (Vanrhynsdorp) Wolwepunt, Bokkeveld Mountains on Farm Perdekraal (–BB), 7 August 1983, *Van Wyk 1287* (NBG).

–3119 (Calvinia) 5.1 km along Theunisdrift road from turn-off near Grasberg (–AA), 9 October 2009, *Boatwright & Bergh 321* (NBG), 21 August 1986, *Perry & Snijman 3471* (NBG); on road to Loeriesfontein ±20 km north of Nieuwoudtville (–AA), 9 October 2009, *Boatwright & Bergh 323* (NBG).

4.2.2. *Trachyandra kamiesbergensis* Boatwr. & J.C.Manning, sp. nov., *Trachyandrae karrooica* Oberm. radicibus ruberis tuberosis, foliis linearibus, stylis rectis et capsulis globosis similis, sed propter florentem tempore veris, foliis ciliatis, basibus pedunculorum glabrosis vel ciliatis et pedicellis brevioribus (ad 10 mm longis) differt. *Trachyandra karrooica* autumnis florens et folia glabra vel hispida, bases pedunculorum breviter pubescentes et pediculos longos habet (ad 40 mm longis).

Type: Northern Cape, Kamiesberg Mountains, Farm Damsland, ±north of ruined homestead [3018 AC; 30°24′05.8″ S; 18°06′15.8″ E], 29 October 2007, *Snijman 2209* (NBG, holo.).

Deciduous geophyte, 140–200 mm high. *Rhizome* short, vertical; roots swollen, fused above with rhizome, split below into elongate tubers tapering to wiry roots, firm-textured, bright red with flaking, dark brown and leathery periderm, staining purple when pressed. *Cataphylls* surrounding shoots as well as leaf- and scape-bases, papery, white tinged red, 10–30 mm long. *Leaves* 5–10, erect, linear-canaliculate, flushed pink basally, 100–150 × 1–2 mm, ciliate. *Inflorescence* racemose with 1 or 2 branches, peduncle suberect, often slightly curved, terete, 1–2 mm diam. at base, puberulous, glabrescent; bracts ovate-acuminate, white, 3–7 × 1.5–2.5 mm, glabrous; pedicels suberect, 6–10 mm long, ultimately ±10–12 mm long. *Flowers* patent, white with brown midribs and paired greenish maculae near base, opening late afternoon, unscented; tepals suberect and weakly clawed in basal ±1 mm,

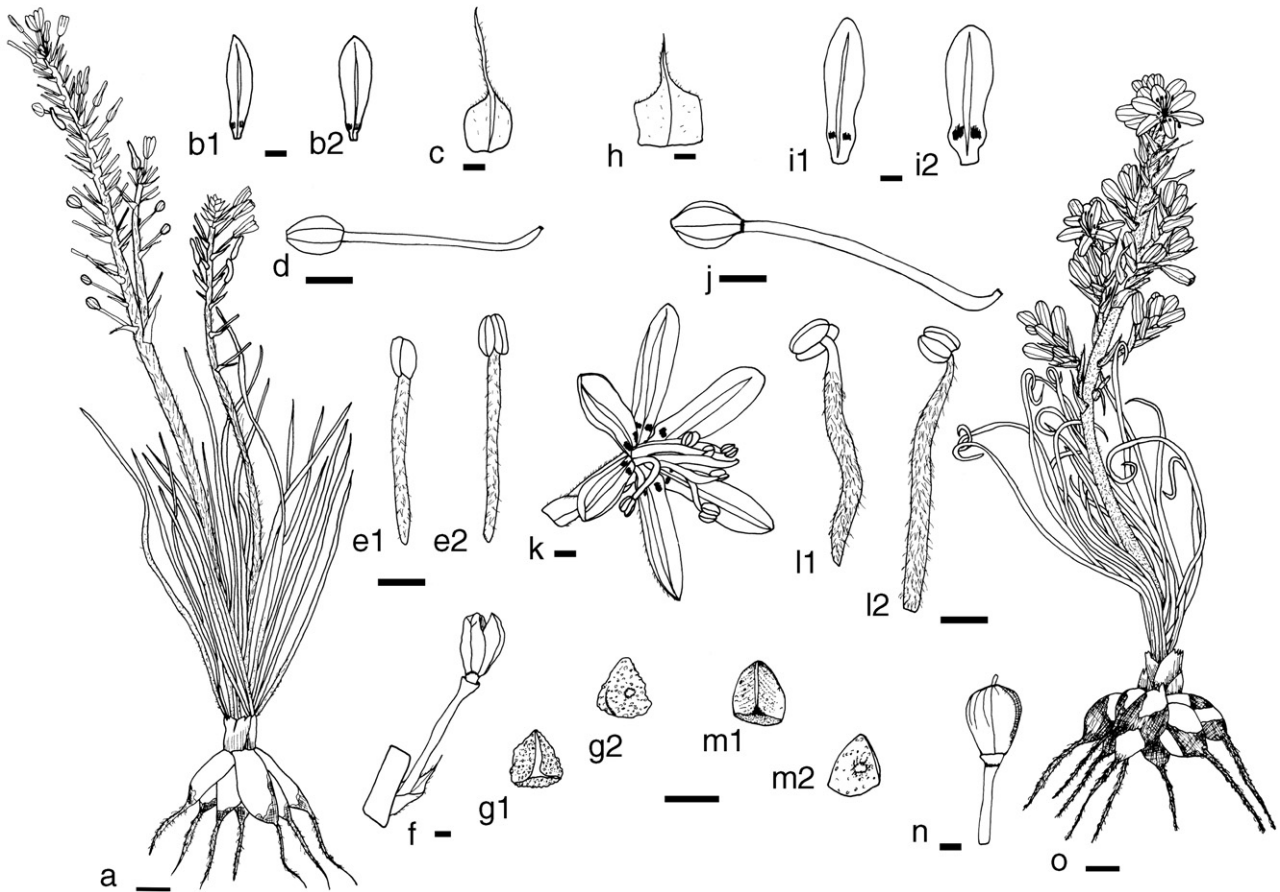


Fig. 1. Morphology of *Trachyandra hantamensis* (a–g) and *T. sanguinorhiza* (h–o). (a) whole plant; (b1) outer tepal; (b2) inner tepal; (c) bract; (d) gynoecium; (e1) outer stamen; (e2) inner stamen; (f) capsule; (g1) seed in ventral view; (g2) seed in dorsal view; (h) bract; (i1) outer tepal; (i2) inner tepal; (j) gynoecium; (k) flower; (l1) outer stamen; (l2) inner stamen; (m1) seed in ventral view; (m2) seed in dorsal view; (n) capsule; (o) whole plant. Voucher specimens: (a–e) *Bolus 19605* (BOL); (f–g) *Boatwright & Bergh 321* (NBG); (h–o) *Boatwright & Magee 302* (NBG). Scale bars: (a, o) 1 cm; (b–n) 1 mm.

spreading-recurved above, outer elliptical, 6–8 × 1.5–2.0 mm, inner narrowly obovate, 6–8 × 2–3 mm. *Stamens* dimorphic, suberect below but sometimes apically upcurved and lowermost filament declinate; filaments filiform, white, outer ± 5 mm long, inner ± 6 mm long, retrorsely scabrid but basal third of inner filaments patently scabrid; anthers yellow, 1.0–1.5 mm long. *Ovary* globose, ± 1.0–1.5 mm long, brownish, with ± 4 ovules per locule; style weakly decurved, filiform, ± 4–5 mm long, white. *Capsule* globose to obovoid, 3–4 × 3–4 mm, light brown. *Seeds* angular, ± 2 × 1 × 1 mm, black, surface verrucose with wart-like idioblasts (sometimes visible as white spots) containing raphide crystals (Fig. 3). *Flowering time*: October–November.

4.2.2.1. Diagnostic characters and relationships. *Trachyandra kamiesbergensis* is similar to *T. karrooica* in its fused, tuberous roots with red flesh, its linear leaves, ± straight style and globose capsules, but differs in having the leaves and peduncle puberulous, shorter pedicels (up to 12 mm long), and in flowering in spring. *Trachyandra karrooica* has glabrous or hispid leaves and a shortly pubescent peduncle, pedicels up to 40 mm long, and flowers in autumn.

4.2.2.2. Distribution and habitat. *Trachyandra kamiesbergensis* appears to be endemic to the Kamiesberg in central Namaqualand, where it occurs on well-drained sandy soil or stony granite soil (Fig. 2), in Namaqualand Granite Renoster-veld (Rebello et al., 2006).

4.2.2.3. Additional specimens examined.

–3018 (Kamiesberg) right of second gate on Farm Damsland in the Kamiesberg, behind small ruin among grass, 30°24' 10.6" S, 18°06'23.0" E (–AC), 13 October 2009, *Boatwright & Bergh 343* (NBG); Farm Welkom, at edge of kloof on road to Doringkraal (–AC), 18 November 1995, *Goldblatt & Manning 10421* (NBG).

4.2.3. *Trachyandra karrooica* Oberm. in *Bothalia* 7: 748 (1962). Type: Northern Cape, 17 miles [27.35 km] west of Richmond [3123 BD], 25 March 1952, *Acocks 16341* (PRE!, holo.; BM, photo!, BOL!, PRE!, iso.).

Deciduous geophyte, 50–200 mm high. *Rhizome* short, vertical; roots swollen, fused above with rhizome, split below

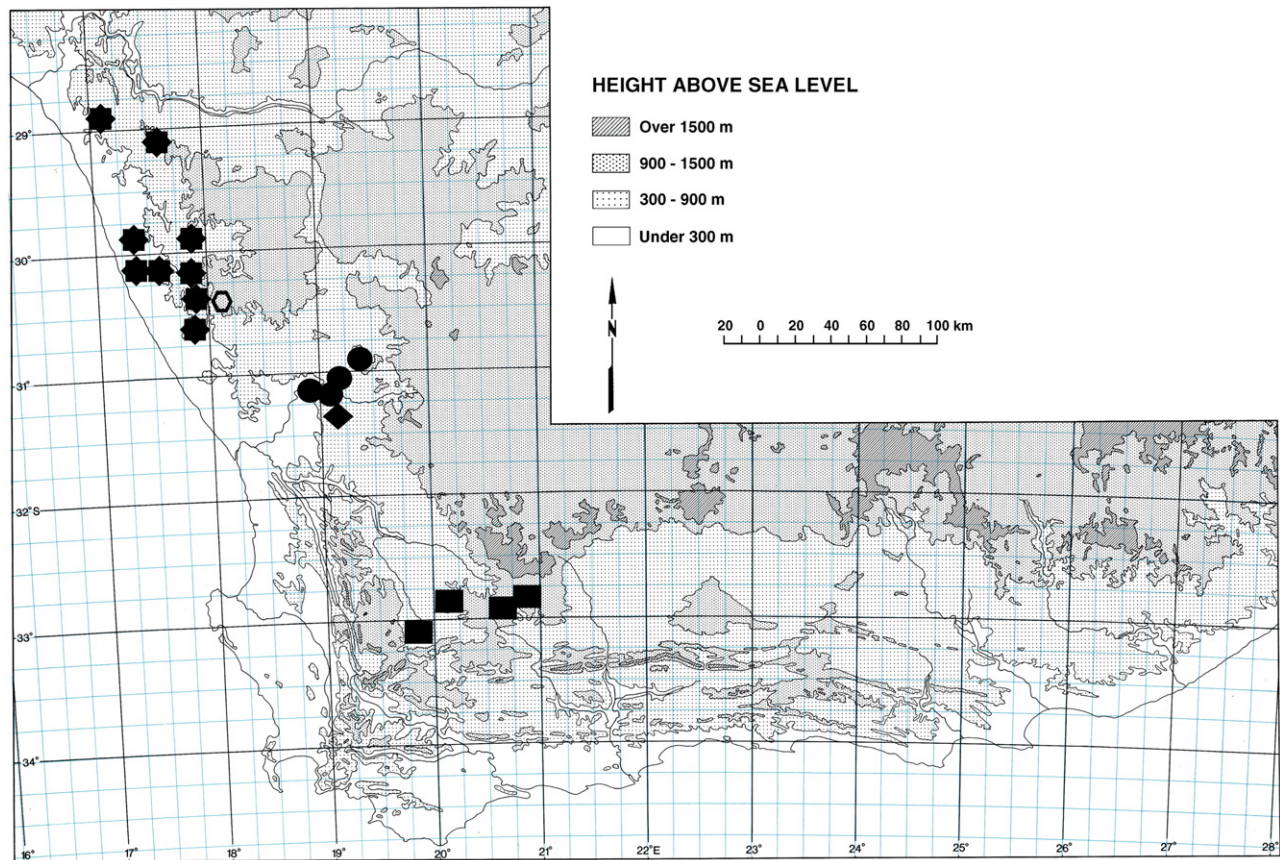


Fig. 2. Known geographical distribution of *Trachyanandra hantamensis* (circles), *T. kamiesbergensis* (hexagon), *T. prolifera* (diamond), *T. sanguinorhiza* (squares) and *T. zebrina* (stars).

into elongate to obovoid tubers tapering to wiry roots, firm-textured, bright red with flaking, dark brown, leathery periderm, staining purple when pressed. *Cataphylls* surrounding shoots as well as leaf- and scape-bases, papery, white tinged red, 5–18 mm long. *Leaves* 3–7, erect or deflexed to one side, linear-canaliculate, flushed pink basally, 40–160 × 1–3 mm, glabrous, muricate or hirsute. *Inflorescence* racemose with 1–3 branches, peduncle suberect, often slightly curved, terete, 1–2 mm diam. at base, shortly pubescent; bracts ovate-acuminate, white, papery, 2–4 × 1–2 mm, glabrous; pedicels patent, 10–20 mm long at anthesis, ultimately ±15–40 mm long in fruit. *Flowers* patent, white with brown midribs and paired yellow maculae near base, opening late afternoon, faintly sweet scented; tepals spreading but suberect and weakly clawed in basal ±1 mm, outer elliptical, 8–10 × 1–2 mm, inner narrowly obovate, 8–10 × 2–3 mm. *Stamens* dimorphic, suberect; filaments filiform, white, outer ±6 mm long, inner ±7 mm long, retrorsely scabrid but basal third of outer filaments sometimes glabrous; anthers yellow, 1.0–1.5 mm long. *Ovary* globose, ±1.0–1.5 mm long, brownish, with ±6 ovules per locule; style weakly decurved, filiform, ±7–8 mm long, white. *Capsule* globose to obovoid, 2–4 × 2–4 mm, light brown. *Seeds* angular, ±1.5–2 × 1.0–1.5 × 1.0–1.5 mm, black, surface verrucose with wart-like idioblasts (sometimes visible as white spots) containing raphide crystals. *Flowering time*: February–April. Two collections were in flower in October.

4.2.3.1. Diagnostic characters and relationships. *Trachyanandra karrooica* is similar to *T. kamiesbergensis* and *T. prolifera* in the roots that have a red inner tissue and in its straight styles, but differs from both of these in the extremely long pedicels (up to 40 mm long), and from the latter in its smaller flowers (up to 22 mm in diameter) and non-vegetatively reproducing roots. *Trachyanandra prolifera* and *T. karrooica* are both autumn-flowering.

4.2.3.2. Distribution and habitat. This species is widely distributed and has been collected in Namibia east of Henties Bay and in South Africa from Cornellsberg through the Namaqualand and central Northern Cape east to Willowmore (Fig. 4). It has been collected on rocky, sandy and clay soil. Obermeyer (1962) included *Merxmüller 1719* collected in Namibia under this species. This extreme outlying population could be the result of the species being poorly represented in herbarium records for that area or possibly that it is poorly collected in these regions since it flowers in autumn when many botanists are not in the field.

4.2.3.3. Additional specimens examined.

- 2214 (Swakopmund) 35 miles [56.32 km] east of Henties Bay (–BB), 20 February 1958, *Merxmüller 1719* (PRE).
- 2817 (Vioolsdrif) Cornellsberg (–CA), without date, *Williamson 3419* (NBG).

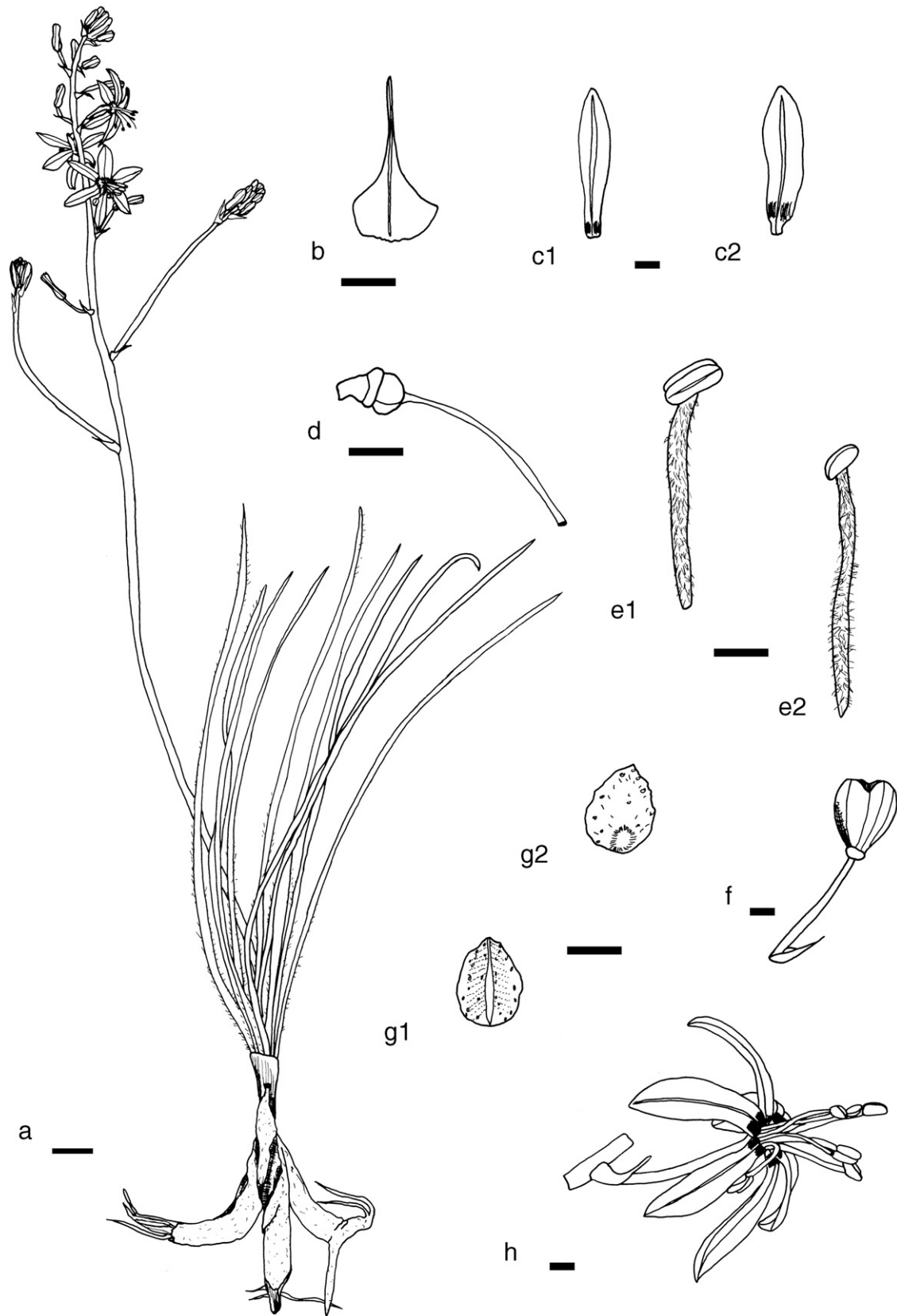


Fig. 3. Morphology of *Trachyandra kamiesbergensis*. (a) whole plant; (b) bract; (c1) outer tepal; (c2) inner tepal; (d) gynoecium; (e1) outer stamen; (e2) inner stamen; (f) capsule; (g1) seed in ventral view; (g2) seed in dorsal view; (h) flower. Voucher specimen: (a–h) *Boatwright & Bergh 343* (NBG). Scale bars: (a) 1 cm; (b–h) 1 mm.

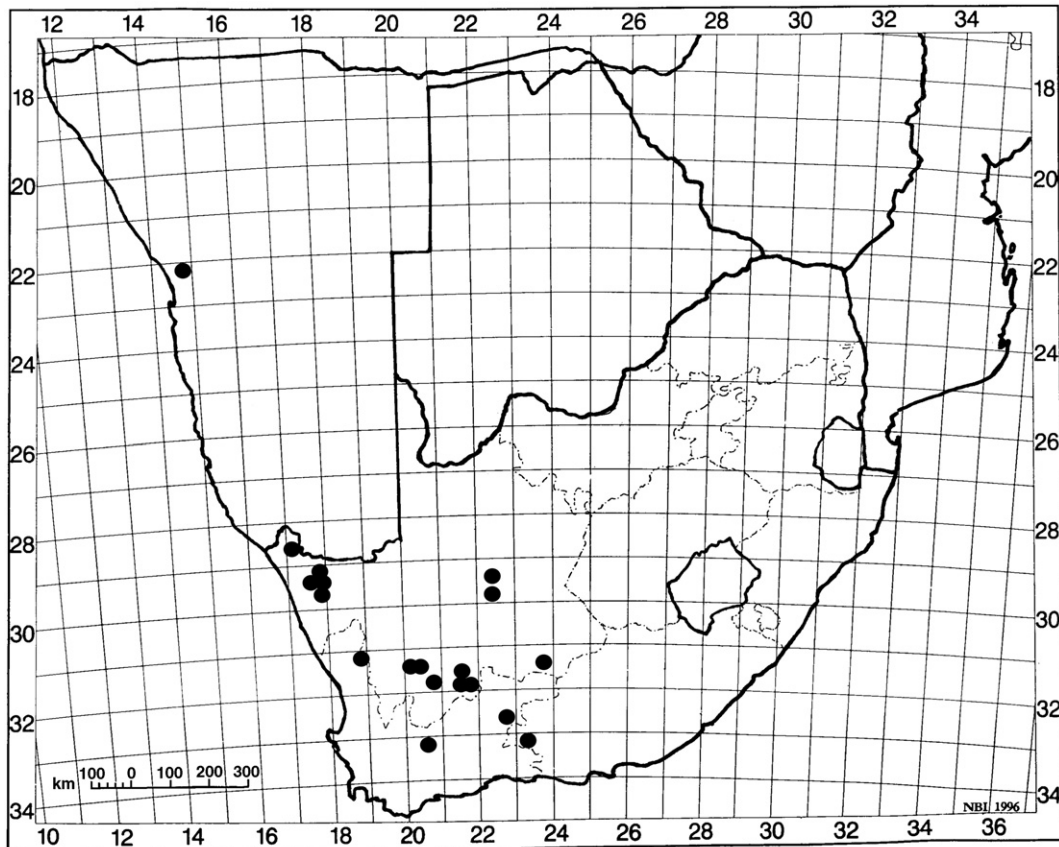


Fig. 4. Known geographical distribution of *Trachyandra karrooica*.

- 2917 (Springbok) north of Jakkalswater (–BB), March 1995, *Williamson & Williamson 5414* (NBG); base of Konkyp (–BB), 20 March 1995, *Williamson & Williamson 5531* (NBG); 2 km north-west of Springbok towards Steinkopf (–BC), without date, *Snijman 1129* (NBG); Steinkopf, Eenriet (–BD), 2 April 1953, *Herre 3355* (BOL); 5 miles [8.05 km] west of Springbok (–DB), 3 April 1963, *Nordenstam 1885* (NBG).
- 2922 (Prieska) Boorwater (–AD), 14 April 2003, *Bruyns 9433* (NBG); Volstruisbult (–CD), 20 March 1921, *Bryant J256* (PRE).
- 3118 (Vanrhynsdorp) Knersvlakte, Farm Klipgat Zuid 90, along Gemsbok River road (–BB), 23 April 2001, *Snijman 1801* (NBG).
- 3120 (Williston) 36 km along main Brandvlei road from Calvinia to Williston road (–AC), 24 March 1988, *Perry 3598* (NBG 2 sheets, PRE); 1 km along Kootjieskolk turn-off from Calvinia to Williston road (–AD), 24 March 1988, *Perry 3597* (NBG), 15 March 2010, *Boatwright & Magee 421* (NBG); 56 miles [90.10 km] west of Fraserburg (–DD), 18 March 1948, *Acocks 14153* (PRE).
- 3121 (Fraserburg) 103 km Carnarvon to Fraserburg, 8 km south of Farm Stofkraal (–DA), 17 April 1991, *Perry & Bruyns 3813* (NBG); Fraserburg (–DC), 11 February 1930, *Nel s.n. sub STE15833* (NBG); Fraserburg to Loxton road about 6 km beyond the Carnarvon turn-off (–DD), 8 September 1991, *Perry & Bruyns 3881* (NBG).
- 3222 (Beaufort West) Farm Rystkuil in vicinity of old uranium mine (–DB), 8 October 1983, *Retief & Reid 232* (PRE).
- 3320 (Montagu) Whitehills, near railway line (–BA), 22 September 1986, *Perry 3517* (NBG, 2 sheets).
- 3323 (Willowmore) Blydeberg, on Farm Kruidfontein (–AB), August 1928, *Marloth 13194* (PRE).
- Precise locality unknown: Swellendam, October 1917, *Marloth 8608* (PRE).
- 4.2.4. *Trachyandra prolifera* P.L.Perry in S. African J. Bot. 56: 257 (1990). Type: Northern Cape, Nieuwoudtville, Farm Glen Lyon [3119 AC], 4 April 1986 (flower), 4 June 1986 (leaf), *Snijman 869* (NBG!, holo.; NBG!, iso.).
- Deciduous geophyte, 100–200 mm high, roots stoloniferous and plants growing in clumps. *Rhizome* short, vertical; roots swollen, fused above with rhizome, split below into spreading roots or elongate tubers tapering to wiry roots, firm-textured, bright red with flaking, dark brown, leathery periderm, staining purple when pressed. *Cataphylls* surrounding shoots as well as leaf- and scape-bases, papery, white, 6–10 mm long. *Leaves* 3–8, erect, filiform, terete, flushed pink basally, 80–200 × 1.0–1.5 mm, glabrous. *Inflorescence* a simple raceme, peduncle erect, terete, 0.5–1.0 mm diam. at base, shortly pubescent at base and

becoming glabrescent above; bracts ovate-acuminate, white, papery, 3–4 × 1–2 mm, with denticulate margins; pedicels erect, 4–8 mm long at anthesis (fruiting material not seen). *Flowers* patent, white with brown midribs and paired yellow maculae near base, opening midday (in cultivation, see Perry, 1990), sweet scented; tepals spreading but suberect and weakly clawed in basal ±1 mm, outer elliptical, 12–14 × 1.5–2.0 mm, inner narrowly obovate, 12–14 × 2.5–3.0 mm. *Stamens* dimorphic, suberect below but sometimes apically upcurved; filaments filiform, white, outer ±8 mm long, inner ±10 mm long, retrorsely scabrid but basal third of inner filaments patently scabrid; anthers yellow, 1.0–1.5 mm long. *Ovary* globose, ±1.5 mm long, brownish, number of ovules unknown; style weakly decurved, filiform, ±10 mm long, white. *Capsule* unknown. *Seeds* unknown. *Flowering time*: March–April.

4.2.4.1. Diagnostic characters and relationships. This species is similar to *Trachyandra karrooica* in that both species are autumn-flowering and have roots with red inner tissues. *Trachyandra prolifera* differs in the roots that are spreading and which can reproduce vegetatively, shorter pedicels (up to 8 mm long) and larger flowers which are up to 30 mm in diameter (those of *T. karrooica* up to 22 mm in diameter).

4.2.4.2. Distribution and habitat. *Trachyandra prolifera* is restricted to the Bokkeveld Plateau around Nieuwoudtville (Fig. 2) where it occurs in red clay soils on dolerite (Perry, 1990).

4.2.4.3. Additional specimens examined.

–3119 (Calvinia) Nieuwoudtville Wild Flower Reserve (–AC), 19 April 1983, Perry & Snijman 2048 (NBG); Farm Glen Lyon (–AC), 20 March 1987, Perry 3461 (NBG, 2 sheets).

4.2.5. *Trachyandra sanguinorhiza* Boatwr. & J.C. Manning, sp. nov., *Trachyandrae thyrsoideae* (Bak.) Oberm. bracteis membranaceis ciliatis et stylis sursum curvatis similis, sed radicibus bulbosis cum contextis interioribus sanguineis, foliis muricatis et pedunculo breviter pubescenti differt. *T. thyrsoidea* radices digitiformes et tumidae ad apices sine contextis interioribus ruberis et folia pedunculique hispida vel hirsuta differt.

Type: Western Cape, just after gate to De Hoop Farm on road to Komsberg Pass [3220 DC; 32°49'33.2" S, 20°41'37.0" E], 3 September 2009, Boatwright & Magee 302 (NBG, holo.; BOL, K, iso.).

Deciduous geophyte, 100–220 (–350) mm high. *Rhizome* short, vertical; roots swollen, fused above with rhizome, split below into turbinate tubers which taper to a wiry root, firm-textured, bright red with flaking, dark brown, leathery rind, lanate distally, staining purple when pressed. *Cataphylls* surrounding shoots as well as leaf- and scape-bases, papery, white tinged red, 10–25 mm long. *Leaves* 4–20, erect, filiform, bases pink, 80–240 × 0.5–1.0 mm, muricate, curled apically. *Inflorescence* a simple raceme or with 1 or 2 basal branches, peduncle suberect,

often slightly curved, terete, 2–3 mm diam. at base, shortly pubescent; bracts ovate-acuminate, white, membranous, 6–8 × 3–4 mm, ciliate; pedicels erect in bud, 3–6 mm long at anthesis, ultimately ±7–8 mm long in fruit, pilose. *Flowers* patent, pinkish-white with pinkish-brown midribs and paired greenish maculae near base, opening mid-morning and fading late afternoon, with a musky fragrance (sweet scented like Rève d'or rose, Marloth 10399, PRE); tepals spreading but suberect and weakly clawed in basal ±1 mm, outer elliptical, 8–10 × 1.5–2.0 mm, inner obovate, 8–9 × 2–3 mm. *Stamens* weakly dimorphic, suberect below but anthers sometimes upcurved and lower two filaments declinate; filaments filiform, white, outer ±6 mm long, inner ±7 mm long, distal two thirds retrorsely scabrid but basal third patent-scabrid, inner filaments with patent marginal scabrae longer, thus scabrid-ciliate in lower third; anthers yellow, 1.0–1.5 mm long. *Ovary* globose, ±1.0–1.5 mm long, brownish, with ±8 ovules per locule; style upcurved apically, filiform, ±5–6 mm long, white. *Capsule* globose to obovoid, 3–5 × 3–5 mm wide, light brown. *Seeds* angular, ±2 × 2 × 1 mm, black, surface verrucose with wart-like protuberances (which are sometimes visible as white spots) containing raphide crystals (Fig. 1). *Flowering time*: August–September.

4.2.5.1. Diagnostic characters and relationships. *Trachyandra sanguinorhiza* is similar to *T. thyrsoidea* in its membranous bracts and upcurved styles, but the roots differ in that they are bulbous and have red inner tissues. In *T. thyrsoidea* the roots are white, finger-like and swollen towards the ends. Obermeyer (1962) included material of this new taxon under *T. patens* Oberm. but did, however, note the simple racemes and purple-staining, bulbous roots, two of the most important distinguishing characters of this species. Snijman et al. (2008) also noted the distinctiveness of this species and list it as *Trachyandra* sp. A. in their treatment of the flora of the Namaqualand–Namib Succulent Karoo and surrounding areas.

4.2.5.2. Distribution and habitat. *Trachyandra sanguinorhiza* occurs on sandy loam or rocky flats in the Klein–Roggeveld (Fig. 2) in Central Mountain Shale Renosterveld which sustains a rich geophytic flora in the wetter habitats (Rebello et al., 2006).

4.2.5.3. Additional specimens examined.

–3319 (Worcester) bank above (north) Doorn River, on Ceres–Sutherland road (–BB), 14 August 1985, Hilton–Taylor & Midgley 3 (NBG).

–3220 (Sutherland) Thuys Hoogte, Koedoes Mountains (–CC), 5 September 1916, Levyns 1566 (BOL); flats before Komsberg Pass, 32°45'45.1" S 20°42'59.8" E (–DC), 3 September 2009, Boatwright & Magee 305 (NBG); on main road from Sutherland to Matjiesfontein ca. 70 km from Matjiesfontein, 32°53'15.5" S 20°33'39.1" E (–DC), 4 September 2009, Boatwright & Magee 306 (NBG); rocky flats ca. 70 km south of Sutherland below Komsberg Pass (–DC), 31 August 1993, Goldblatt & Manning 9670 (NBG); 20 miles

[32.18 km] south–south–west of foot of Komsberg Pass (–DC), 15 September 1955, *Leistner 268* (PRE); turn-off to the farm De Plaat (–DC), 14 September 1986, *Fellingham 1183* (NBG, PRE); Klein Roggeveld, farm De Hoop, 32°48'912"S 20°42'050"E (–DC), 14 September 2004, *Snijman 1940* (NBG); Farm De Plaat, Blinkhuis River (–DD), 7 September 1988, *Fellingham 1424a* (NBG).

Precise locality unknown: without locality, without date, *Marloth 8670* (PRE); Klein Roggeveld, September 1921, *Marloth 10399* (PRE).

4.2.6. *Trachyandra thyrsoidea* (Bak.) Oberm. in *Bothalia* 7: 744 (1962). *Anthericum thyrsoideum* Bak. in *J. Bot. Lond.*: 139 (1872); *Fl. Cap.* 6: 393 (1897). Type: Western Cape, Yuk River Hoogte [3220 CC], 19 July 1811, *Burchell 1231* (K, photo!, holo.).

Deciduous geophyte, 80–260 mm high. *Rhizome* short, vertical; roots swollen, fused above with rhizome, split below into finger-like, wiry roots that are swollen towards the tips, firm-textured, white with smooth periderm, not staining purple when pressed. *Cataphylls* surrounding shoots as well as leaf- and scape-bases, papery, white, 10–30 mm long. *Leaves* 4–12, erect, linear-canaliculate, white basally, 80–260 × 2–3 mm, hirsute. *Inflorescence* racemose or paniculate with 3 or many branches, peduncle suberect, often slightly curved, semi-terete, 3–6 mm diam. at base, hirsute; bracts ovate-acuminate, white, membranous, 8–10 × 2–4 mm, ciliate; pedicels erect, ±5–10 mm long at anthesis, ultimately ±8–15 mm long in fruit. *Flowers* patent, pinkish-white with pinkish brown midribs and paired yellow maculae near base, opening mid-morning and fading late afternoon, unscented; tepals spreading but suberect and weakly clawed in basal ±1 mm, outer elliptical, 7–9 × 1.5–2.0 mm, inner narrowly obovate, 7–9 × 2.5–3.0 mm. *Stamens* dimorphic, suberect below but sometimes apically upcurved and lowermost filament declinate; filaments filiform, white, outer ±4 mm long, inner ±5 mm long, retrorsely scabrid but basal third of inner filaments patently scabrid; anthers yellow, 0.5–1.0 mm long. *Ovary* globose, ±1.0–1.5 mm long, brownish, with ±10–12 ovules per locule; style upcurved apically, filiform, ±4–5 mm long, white. *Capsule* globose, 5–6 × 4–5 mm, light brown. *Seeds* angular, ±1.5–2.0 × 1.0–1.5 × 1.0–1.5 mm, black, surface verrucose with wart-like idioblasts (sometimes visible as white spots) containing raphide crystals. *Flowering time*: July–September.

4.2.6.1. *Diagnostic characters and relationships.* This species is similar to *Trachyandra sanguinorhiza* in the large, papery bracts and simple to somewhat branched racemes with pinkish flowers, but differs in the many finger-like roots that are sometimes swollen towards the tips, but never bulbous or purple staining.

4.2.6.2. *Distribution and habitat.* *Trachyandra thyrsoidea* occurs around the Matjiesfontein, Laingsburg and Oudtshoorn areas in rocky, well-drained soil (Fig. 5).

4.2.6.3. Additional specimens examined.

–3220 (Sutherland) 2 km from Klein–Roggeveld via Komsberg turn-off on the way down the Pass (–DA), 5 September 1986, *Cloete & Haselau 227* (NBG); just after Farm De Plaat, 32°48'08"S 20°42'45.1"E (–DC), 3 September 2009, *Boatwright & Magee 304* (NBG); 33 km from Matjiesfontein turn-off towards Sutherland (–DC), 16 September 1991, *Perry 3896* (NBG).

–3320 (Montagu) Karoo Garden, Whitehill (–BA), 12 August 1929, *Compton 3496* (BOL, NBG); Whitehill Ridge (–BA), 20 August 1931, *Compton 373* (BOL), 8 August 1927, *Compton 3228* (BOL, NBG), 18 August 1941, *Compton 11250* (NBG), 17 August 1942, *Compton 13397* (NBG); Matjiesfontein (–BA), without date, *Beattie s.n.* (BOL); 18 July 1974, *Goldblatt 2117* (NBG).

–3321 (Ladismith) Gamka Poort Nature Reserve, at Doringkraal (–BC), 20 August 1991, *Kroon 9* (PRE).

–3322 (Oudtshoorn) west of Prince Albert (–AA), 29 July 1986, *Bayer 5226* (NBG).

4.2.7. *Trachyandra tortilis* (Bak.) Oberm. in *Bothalia* 7: 745 (1962); Bond and Goldblatt, *J. S. Afr.* 13: 36 (1984); Goldblatt and Manning, *Cape Pl.*: 74 (2000); Van Jaarsveld in *Cactus and Succulent Journal* 63: 196 (1991). *Anthericum tortile* Bak. in *Bull. Herb. Boiss. Ser. 2*, 4: 996 (1904). Type: Western Cape, Tulbagh, Saron [3319 AA], 17 August 1894, *Schlechter 4846* (Z, photo!, holo.; BOL!, iso.).

Anthericum salteri Leighton in *Flow. Pl. of Africa* 18: t. 687 (1938). Type: Northern Cape, Springbok [2917 DB], 14 June 1931, *Salter 966* (BOL!, holo.).

Anthericum oocarpum Schltr. ex Poelln. in *Bol. Soc. Brut.* 16, 2: 75 (1942). Type: Western Cape, Zuurfontein [3218 AB], 14 August 1896, *Schlechter 8525* (B, photo!, holo.).

Deciduous geophyte, 90–260 mm high. *Rhizome* short, vertical; roots swollen, fused above with rhizome, split below into obovoid tubers tapering to wiry, lanate roots or some of the roots thin, wiry and swollen at the tips, firm-textured, dark brown with a leathery periderm, not staining purple when pressed. *Cataphylls* surrounding shoots as well as leaf- and scape-bases, papery, white, 6–30 mm long. *Leaves* 3–10, erect, linear to lanceolate, transversely plicate or coiled through several turns, rarely straight, 50–200 × 2–15 mm, glabrous with muricate margins or entire surface muricate, often glaucous. *Inflorescence* paniculate with many, divaricate branches, peduncle suberect, often slightly curved, terete, 3–6 mm diam. at base, glabrous or scabrid; bracts ovate, white, membranous, 1.5–5.0 × 2–3 mm, ciliate; pedicels suberect, recurved in fruit, 3–8 mm long at anthesis, ultimately ±4–10 mm long in fruit. *Flowers* patent, white or pale pink with brown or greyish midribs and paired yellow maculae near base, opening late afternoon, sweetly scented; tepals spreading but suberect and weakly clawed in basal ±1 mm, outer elliptical, 8–11 × 1.5–2.0 mm, inner narrowly obovate, 8–11 × 2–3 mm. *Stamens* dimorphic, suberect below but sometimes apically upcurved and lowermost filaments declinate;

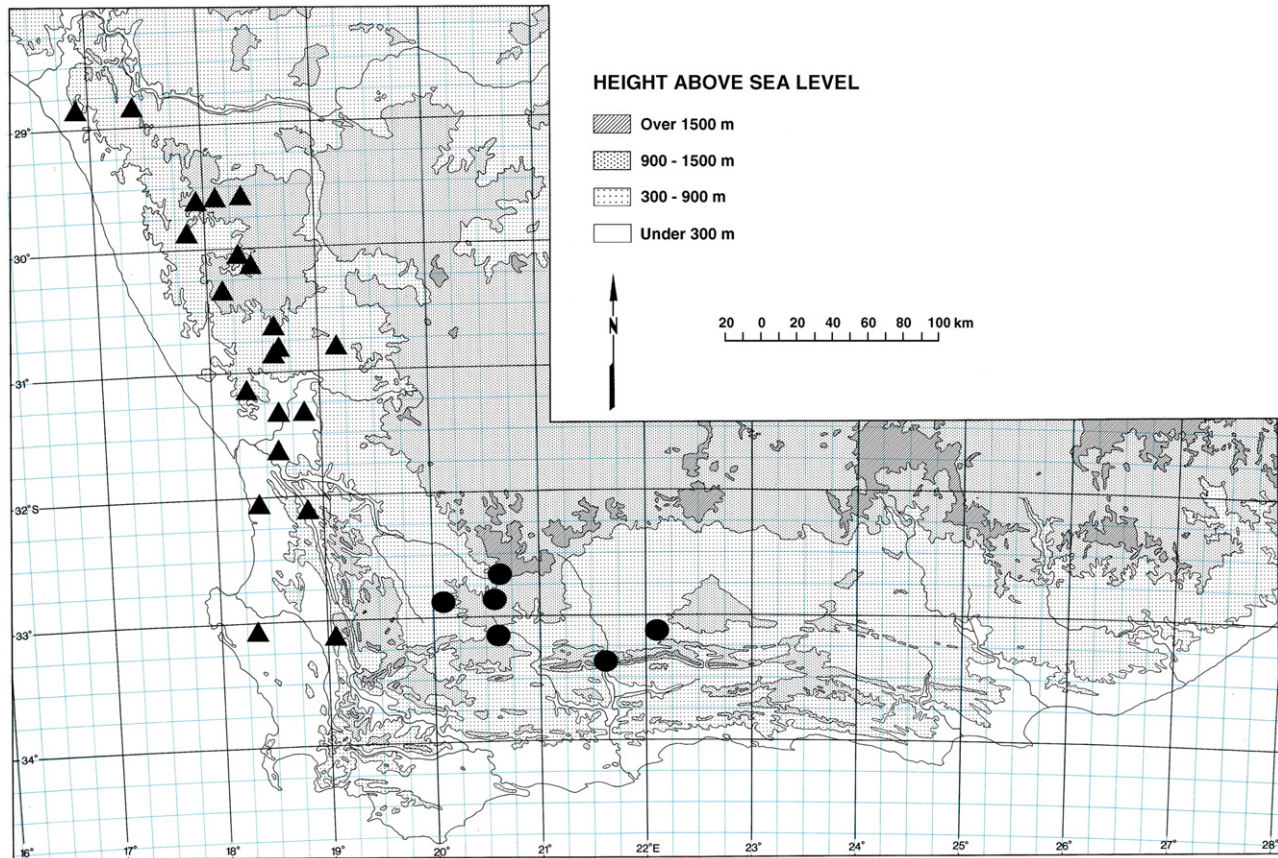


Fig. 5. Known geographical distribution of *Tracyandra thyrsoidea* (circles) and *T. tortilis* (triangles).

filaments filiform, white, outer ± 6 mm long, inner ± 7 mm long, retrorsely to patently scabrid but basal third of inner filaments often glabrous; anthers yellow, 1.0–1.5 mm long. *Ovary* elliptic, ± 1.0 –1.5 mm long, brownish, with ± 10 ovules per locule; style upcurved apically, filiform, ± 5 –6 mm long, white. *Capsule* ellipsoid, 4–8 \times 2.5–4.0 mm, light brown. *Seeds* angular, ± 1.5 –2.0 \times 1.0–1.5 \times 1 mm, grey-black to ochraceous, surface verrucose with wart-like idioblasts (sometimes visible as white spots) containing raphide crystals. *Flowering time*: May–September.

4.2.7.1. Diagnostic characters and relationships. This species is similar to *Trachyandra zebrina* in the usually coiled leaves, large cataphylls (up to 30 mm long) and upcurved styles, but differs in that the cataphylls are not striped (transversely striped in *T. zebrina*), the leaves are transversely plicate (spirally coiled in *T. zebrina*), and the fruiting pedicels recurved. It is very appealing to succulent growers and also easily cultivated (Van Jaarsveld, 1991).

4.2.7.2. Distribution and habitat. *Trachyandra tortilis* occurs from Kuboes in the Richtersveld through the higher-lying parts of Namaqualand and across the Knersvlakte to Vredendal, with outlying collections further to the south from near Clanwilliam, Hopefield and Saron. The species occurs on well-drained rocky or clay soil, riverbeds or quartz patches (Fig. 5).

4.2.7.3. Additional specimens examined.

- 2816 (Oranjemund) Kubus hills, along Holgat River west of Lekkersing–Kubus road (–DD), 8 July 2007, *Bruyns 10826* (NBG).
- 2817 (Vioolsdrif) 6 km south of Eksteenfontein (–CC), 7 August 2000, *Bruyns 8288* (NBG).
- 2917 (Springbok) Hester Malan Nature Reserve (–DB), without date, *Le Roux 2768* (BOL), 10 July 1975, *Rosch & Le Roux 1233* (PRE); 2 miles [3.22 km] east of Springbok (–DB), 26 July 1950, *Lewis 3303* (NBG); Mesklip (–DD), 24 August 1941, *Barker 1882* (NBG), 24 August 1941, *Esterhuysen 5953* (BOL, PRE).
- 2918 (Gamoep) 23 miles [37 km] east–north–east of Springbok (–CA), 26 May 1961, *Leistner 2540* (PRE 2 sheets); Areb, ca. 30 miles [48.27 km] north–east of Springbok (–CB), 25 August 1954, *Lewis 4400* (NBG).
- 3018 (Kamiesberg) ca. 5 km south–south–west of Rooifontein (–AB), 12 August 1991, *Perry 3854* (NBG); Stofkloof (–AB), without date, *Schelppe 8224* (NBG); eastern Kamiesberg between Die Kruis and Witwater, 30°23.213'S 18°13.525'E (–AC), 8 September 2006, *Snijman 2086* (NBG); hills west of Kliprand (–DA), 15 August 1992, *Bruyns 5301* (BOL); Warmviool (–DC), 16 August 1992, *Bruyns 5310* (BOL); Rietkloof,

- 30°54'50"S 18°37'24"E (–DC), 20 August 1999, *Desmet 126* (NBG).
- 3019 (Loeriesfontein) 35.7 km from Loeriesfontein towards Lospersplaas (–CC), 18 May 1993, *Snijman 1298a* (NBG).
- 3118 (Vanrhynsdorp) Nuwerus (–AB), 28 August 1941, *Esterhuysen 5982* (BOL, NBG, PRE); 5 miles [8.05 km] south of Nuwerus (–AB), 3 August 1956, *Hall s.n.* (NBG); between the Sout and Vars Rivers, (–AC), 17 August 1965, *Barker 10385* (NBG); Farm Quaggaskop (–BC), 5 September 1986, *Hilton–Taylor 1504* (NBG), 20 August 1986, *Perry 3495* (NBG); ca. 1 km south of southern entrance gate to Douse-the-Glim (–BD), 27 August 2001, *Snijman 1827* (NBG); along road from Grootdrif towards Gemsbokrivier on the farm Elandsfootpath River, 31°25'20.1"S 18°54'55.1"E (–BD), 19 July 2005, *Snijman 1989* (NBG); 9 miles [14.48 km] east of Vredendal (–DA), 31 August 1970, *Hall 3800* (PRE).
- 3218 (Clanwilliam) Clanwilliam (–BB), July 1941, *Leipoldt 4455* (BOL, NBG).
- 3318 (Cape Town) Hopefield (–AB), September 1905, *Bohus 12871a* (PRE).
- Precise locality unknown: Knersvlakte, 14 September 1964, *Hall 2839* (NBG); Vanrhynsdorp, salt pan, July 1941, *Leipoldt 3889* (BOL).

4.2.8. *Trachyanandra zebrina* (Schltr. ex Poelln.) Oberm. in *Bothalia* 7: 746 (1962). *Anthericum zebrinum* Schltr. ex. Poelln. in *Bot. Soc. Brot.* 16, 2: 66 (1942). Type: Northern Cape, Brakdam [3017 BD], 8 September 1897, *Schlechter 11128* (B, photo!, holo.; BM, photo!, GRA, K, photo!, L, 2 sheets, photos!, NBG!, PRE!, S, photo!, WAG, photo!, iso.).

Deciduous geophyte, 80–250 mm high. *Rhizome* short, vertical; roots swollen, fused above with rhizome, split below into obovoid tubers tapering to wiry, lanate roots or some of the roots thin, wiry and swollen at the tips, firm-textured, dark brown with a leathery periderm, not staining purple when pressed. *Cataphylls* surrounding shoots as well as leaf- and scape-bases, papery, white with distinctive brown transverse stripes, 12–35 mm long. *Leaves* 2–10, erect, filiform to linear, spirally coiled through several turns, rarely straight, 80–220 × 1–5 mm, glabrous, muricate or hirsute. *Inflorescence* racemose with 1 or many branches, peduncle suberect, often slightly curved, terete, 1–3 mm diam. at base, shortly pubescent to hirsute; bracts ovate-acuminate, white, membranous, 3–5 × 1.5–3.0 mm, ciliate; pedicels suberect, hispid, 2–5 mm long at anthesis, ultimately ± 5–10 mm long in fruit. *Flowers* patent, white or pale pink or brown with brown midribs and paired light yellow maculae near base; tepals spreading but suberect and weakly clawed in basal ± 1 mm, hispid dorsally, outer elliptical, 8–10 × 1.5–2.0 mm, inner narrowly obovate, 8–10 × 2–3 mm. *Stamens* dimorphic, suberect below but sometimes apically upcurved; filaments filiform, white, outer ± 7 mm long, inner ± 8 mm long, retrorsely to patently scabrid but basal third of inner filaments often glabrous; anthers yellow, 1.0–1.5 mm

long. *Ovary* globose to elliptic, ± 1.0–1.5 mm long, brownish, with ± 8 ovules per locule; style upcurved apically, filiform, ± 4–5 mm long, white. *Capsule* globose, 3–5 × 3–5 mm, light brown, hispid. *Seeds* angular, ± 1.5–2 × 1.0–1.5 × 1.0–1.5 mm, grey-black to ochraceous, surface verrucose with wart-like idioblasts (sometimes visible as white spots) containing raphide crystals. *Flowering time*: May–September.

4.2.8.1. *Diagnostic characters and relationships.* *Trachyanandra zebrina* is similar to *T. tortilis* in the spirally coiled leaves and upcurved styles, but differs in its striped cataphylls, upright fruiting pedicels and hispid capsules.

4.2.8.2. *Distribution and habitat.* The species occurs through central Namqualand from Springbok to Garies on granitic, sandy or stony, often clay soil or quartz patches (Fig. 2).

4.2.8.3. *Additional specimens examined.*

- 2817 (Vioolsdrif) Karrachab Pass between Springbok and Kubus (–CC), 23 July 1937, *Verdoorn 1823* (PRE).
- 2917 (Springbok) Steinkopf, Anenous Pass (–BA), 23 August 1983, *Van Wyk 6255* (PRE); close to Komaggas (–CD), 23 August 1981, *Van Berkel 365* (NBG); 27 miles [43.44 km] south of Springbok (–DD), 27 July 1950, *Lewis 3309* (NBG).
- 3017 (Hondeklipbaai) Riethuis (–AB), 11 July 1989, *Bruyns 3859* (BOL); on a quartz pebble patch roadside on the Koingnaas/Rietvlei road (–AB), 15 July 1998, *Pater-son–Jones 825* (NBG); 8 km south-west of Soebatsfontein on road to Wallekraal (–BA), 13 August 1982, *Le Roux 2911* (NBG); 15 miles [24.14 km] north of Kamieskroon (–BB), 25 July 1950, *Barker 6223* (NBG); Darter's grave, 15 km south of Kamieskroon (–BB), 6 September 1950, *Hall 127* (NBG); 10 km along road from Wallekraal to Sanniesaam (–BC), 29 June 1995, *Manning 2124* (NBG); Brakdam (–BD), 24 August 1941, *Esterhuysen 5678* (BOL 2 sheets, NBG, PRE); 6 miles [9.65 km] north–north-west of Garies (–DB), 19 July 1957, *Acocks 19314* (PRE); Garies (–DB), 22 May 1984, *Bayer 4663* (NBG), 27 August 1958, *Theron 1265* (PRE).

Precise locality unknown: without locality, without date, *Spright 8037* (BOL).

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References

- Dagne, E., Yenesew, A., 1994. Anthraquinones and chemotaxonomy of the Asphodelaceae. *Pure and Applied Chemistry* 66, 2395–2398.
- Goldblatt, P., Manning, J.C., 2000. Cape Plants: a conspectus of the Cape flora of South Africa. *Strelitzia* 9. National Botanical Institute of South Africa, Pretoria, and Missouri Botanical Garden, St. Louis.
- Holmgren, P.K., Holmgren, N.H., Barnett, L.C., 1990. Index Herbariorum 1: the Herbaria of the world, *Regnum Vegetabile* 120, Eighth edition.
- Leistner, O.A., Morris, J.W., 1976. South African place names. *Annals of the Cape Provincial Museums* 12, 1–565.
- Manning, J.C., 1990. A new species of *Trachyandra* section *Liriothamnus* (Asphodelaceae) from the Richtersveld. *South African Journal of Botany* 56, 1–5.
- Manning, J.C., Goldblatt, P., 2007. *Trachyandra arenicola* and *T. montana*, two new species from South Africa. *Bothalia* 37, 26–31.
- Obermeyer, A.A., 1962. A revision of the South African species of *Anthericum*, *Chlorophytum* and *Trachyandra*. *Bothalia* 7, 669–767.
- Perry, P.L., 1990. A new species of *Trachyandra* section *Trachyandra* (Asphodelaceae) from the Western Cape. *South African Journal of Botany* 56, 257–260.
- Rebello, A.G., Boucher, C., Helme, N., Mucina, L., Rutherford, M.C., 2006. Fynbos Biome. In: Mucina, L., Rutherford, M.C. (Eds.), *Vegetation of South Africa, Lesotho and Swaziland*, *Strelitzia* 19. South African National Biodiversity Institute, Pretoria, pp. 176–190.
- Smith, G.F., Van Wyk, B.-E., 1998. Asphodelaceae. In: Kubitzki, K. (Ed.), *The families and genera of vascular plants*, Vol. 3. Springer, Berlin, pp. 130–140.
- Snijman, D.A., Manning, J.C., Goldblatt, P., Fish, L., Duncan, G.D., Archer, C., Roux, J.P., Kurzweil, H., Linder, H.P., Verboom, G.A., Klopper, R.R., Smith, G.F., 2008. Monocotyledons, ferns and quillworts of the Namaqualand-Namib Succulent Karoo, Tanqua-southern Great Karoo and Western Mountain Karoo, southern Africa. [September 2008. <http://www.sanbi.org/frames/posafam.htm/>].
- Thulin, M., 1995. *Trachyandra triquetra* (Asphodelaceae), a new species from the Horn of Africa. *Nordic Journal of Botany* 15, 571–573.
- Van Jaarsveld, E., 1991. The subfamily Asphodeloideae with specific reference to *Trachyandra tortilis*. *Cactus and Succulent Journal* 63, 196–199.
- Van Wyk, B.-E., Yenesew, A., Dagne, E., 1995. Chemotaxonomic significance of anthraquinones in the roots of Asphodeloideae (Asphodelaceae). *Biochemical Systematics and Ecology* 23, 277–281.