The *Rhynchosia totta* complex (Phaseoleae, Fabaceae) in Southern Africa, including the description of a new variety and new species

**Background:** The *Rhynchosia totta* complex is one of three taxonomically complicated African groups in the genus *Rhynchosia*. Numerous southern African species and infraspecific taxa (at least 19 names, 17 species and 2 varieties) have been described by various authors in the past, but were later reduced into synonymy with *R. totta*. Currently, only the typical variety is recognised in Southern Africa.

**Objectives:** To investigate and update the circumscription of the taxa within the *R. totta* complex in southern Africa and to update their synonymies and distribution ranges.

**Methods:** Specimens of *R. totta* at GRA, JRAU, K, NH and PRE were studied and compared, and measurements of characters recorded. Populations were also observed during field studies.

**Results:** The examination of numerous specimens, as well as field investigations, has prompted the recognition of four varieties (one described here as new: *R. totta var. longicalyx*) and a new species (*R. pedunculata*) in southern Africa.

**Conclusions:** A great variation in leaf structure and vestiture occurs within the *R. totta* complex, with the extreme forms easily recognisable. However, the total number of varieties are limited to four ([*R. totta* vars. *totta*, *longicalyx*, *rigidula* and *venulosafra*] and a new species described to accommodate specimens with a distinctly prostrate habit and upwardly directed leaves.

**Introduction**

*Rhynchosia* Lour. is a member of the Fabaceae (Leguminosae) subfamily Papilionoideae (Faboideae) tribe Phaseoleae (Lackey 1981). Within the tribe Phaseoleae, taxonomic studies have been completed for a number of southern African genera, for example, *Dipogon* Liebm. (Stirton 1981a), *Macrotyloma* (Wight & Arn.) Verdc. (Verdcourt, Hooker & Halliday 1982), *Bolusafra* Kuntze (Moteetee & Van Wyk 2006), *Dolichos* L. (Moteetee & Van Wyk 2012a), *Sphenostylis* E.Mey. (Moteetee & Van Wyk 2012b), *Ophestria* H.M.L.Forbes (Moteetee & Van Wyk 2012c), and *Canavalia* DC. (Moteetee 2016), while studies on other genera are ongoing. Of particular interest is the genus *Rhynchosia* in which taxonomic research is ongoing and several new species have already been described (Boatwright & Moteetee 2014; Germishuizen 1998, 2006, 2011; Moteetee, Boatwright & Jaca 2012, 2014). With approximately 230 species (Schrire 2005), *Rhynchosia* is the largest genus in the subtribe Cajaninae with the majority of species widely distributed across Africa. Some of the species are also found in warm temperate and tropical regions of Asia, Australia and America. It is closely related to *Eriosema* (DC.) Desv. within the Phaseoleae. Cajaninae is characterised by the presence of vesicular glands and bulbous-based hairs (Lackey 1981). It comprises eight genera, of which only four occur in southern Africa; that is, *Bolusafra*, *Cajanina* DC. (write out cultivated species), *Eriosema* and *Rhynchosia*. Comprehensive taxonomic studies of the South African species of the genus *Eriosema* are yet to be published; however, a number of studies have been published by Stirton (1977, 1981b, 1981c, 1994).

*Rhynchosia totta* (Thunb.) DC. was first described by Thunberg (1800) in his *Prodromus Plantarum Capensium as Glycine totta* Thunb. (1800). De Candolle (1825) later transferred it to *Rhynchosia*. This species is commonly known as the yellow carpet bean and is widely distributed from South Africa northwards to Somalia (Verdcourt 1971). Its place of origin has been suggested to be South Africa. However, molecular studies are needed to prove this. Thunberg (1800) described this species as having trifoliolate leaves with reticulate, ovate and ciliate leaflets. More detailed descriptions of *R. totta* are given by De Candolle (1825), Harvey (1862), and Verdcourt, Pope & Polhill (2001), who...
have described it as a climbing, twining, ascending perennial herb with a tuberous rootstock and slender stems, with glabrescent to densely pubescent trifoliolate leaves, oblong-lanceolate leaflets acute at the apex, glabrescent to silky pubescent with prominent, reticulate venation, and flowers flushed reddish that are either solitary or a few arranged in very lax inflorescences.

Baker (1923) divided the species into seven variants mainly based on leaf shape and structure, as well as stem and/or leaf vestiture, but other characters such as petiole length and flower size were applied inconsistently. These are *Rhynchosia totta* var. *brevipetiolata* Baker f. (stem pilose or tomentose, petioles short), *R. totta* var. *fenchelii* Schinz (stem grey puberulous, leaves trifoliolate), *R. totta* var. *graciliflora* Harms ex Baker f. (R. graciliflora Harms) (leaves trifoliolate, linear-lanceolate, pubescent or nearly glabrous), *R. totta* var. *namaensis* Schinz (leaves trifoliolate, leaflets lanceolate or ovate-lanceolate, grey puberulous), *R. totta* var. *pilosa* Harv. (stem patently pilose, leaves trifoliolate, leaflets of the lower ovate-oblong, upper linear) and *R. totta* var. *unifoliolata* Burtt Davy (leaves unifoliolate or trifoliolate, leaflets ovate, petiole short).

Having studied *Rhynchosia* species occurring in East Africa, Verdcourt (1971) remarked that ‘three groups stand out for their difficulty, so far as Africa is concerned’. The three groups in question are: 1) the *Rhynchosia minima* (L.) DC. group, 2) the *R. viscosa* (Roth) DC. group, and 3) the *R. totta* (Thunb.) DC group. The *R. viscosa* group does not occur in South Africa, while the other two are more widely distributed in southern and tropical Africa. The *R. totta* group is centred in South Africa but extends through most of southern Africa (Figure 1) and north-eastwards through East Africa as far as Somalia. Numerous South African species and infraspecific taxa in this group (herein referred to as a complex) have been described giving ‘the impression that work on the group has been uninspired and that every small variant has been given a name, as the simplest way out of the particular author’s immediate difficulty’ (Verdcourt 1971). There are at least 17 specific and 2 varietal names that have been reduced into synonymy with *R. totta* over the years, possibly due to the immense variation in leaf shape and vestiture encountered across a wide distribution area. According to Verdcourt (1971), there are two extremes in East Africa (which also extend to southern Africa): there are variants with slender stems and glabrescent leaflets on the one hand (which he

Source: Compiled by M.M. le Roux, original map based on GTOPO30 global digital elevation model

**FIGURE 1:** Combined distribution of *Rhynchosia totta* and its four varieties in southern Africa.
TABLE 1: Historical overview of the development of the concept of the Rhynchosia totta complex.

<table>
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<td>Series 25</td>
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<tr>
<td>Rhynchosia totta (Thunb.) DC.</td>
<td>R. totta</td>
<td>R. totta</td>
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<tr>
<td>var. totta</td>
<td>var. totta</td>
<td>var. totta (synonyms as in Verdcourt (1971) and Verdcourt, Pope, &amp; Polhill (2001), excluding R. rigidula but including those listed below)</td>
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<tr>
<td>var. brevipebillata Baker f.</td>
<td>[=R. humidis Eckl. &amp; Zeyh.]</td>
<td>[=var. unbiflora]</td>
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<tr>
<td>var. fencheli Schinz</td>
<td>[=R. rigidula]</td>
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<tr>
<td>var. gracitoflora Harms ex Baker f.</td>
<td>[=Copitina paniculata E.Mey.]</td>
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<td>var. namaeniensis Schinz</td>
<td>[=R. paniculata (E.Mey) Steud.]</td>
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<tr>
<td>var. pilosa (E.Mey) Baker f</td>
<td>[=C. pilosum E.Mey.]</td>
<td>var. longicalyx A.Moteetee &amp; M.M.le Roux</td>
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<tr>
<td>var. unifoliolata Burtt Davy</td>
<td>[=R. pilosa (E.Mey) Steud.]</td>
<td>var. rigidula (DC.) Moteetee &amp; M.M.le Roux</td>
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<tr>
<td>R. longiflora Schinz</td>
<td>[=var. pilosa]</td>
<td>var. namaeniensis [=R. longicalyx]</td>
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<td>Series 26</td>
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<td>[Series 26]</td>
<td>[=R. nervosa Benth. ex Harv. &amp; Sond. var. petiolaris Burtt Davy]</td>
<td>var. venulosa (synonyms as in Verdcourt (1971), and Verdcourt, Pope, &amp; Polhill (2001)) and those listed below)</td>
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<tr>
<td>R. elegantisima Schinz</td>
<td>var. venulosa (Hiern) Verdc.</td>
<td>[var. fencheli]</td>
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<td>Series 27</td>
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<td>(=Series 27)</td>
<td>[=R. falciculata Bak.]</td>
<td>var. elongatifolia Verdc.</td>
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<tr>
<td>R. venulosa (Hiern) K. Schum.</td>
<td>[=R. hirsuta Schinz, non illegit.]</td>
<td>R. pedunculata M.M.le Roux &amp; A. Moteetee</td>
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<tr>
<td>R. pedunculata f.</td>
<td>[=R. venulosa]</td>
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<tr>
<td>Series 29</td>
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<tr>
<td>R. rigidula DC.</td>
<td>[=R. elegantisima]</td>
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<td></td>
<td>[=R. cinnamomea Schinz]</td>
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<td>[=R. remotu Corrath]</td>
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<tr>
<td></td>
<td>[=R. mollis Burtt Davy, non illegit.]</td>
<td>var. elongatifolia Verdc.</td>
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attributes to the typical variant) and those with thicker stems and pubescent to densely velvety leaflets on the other [R. totta var. venulosa (Hiern) Verdc. – which was recognised as a species by Baker (1923)], with several intermediates between these two. He further recognised R. totta var. elongatifolia Verdc. (Verdcourt 1971; Verdcourt et al. 2001). The development of the concept of the R. totta complex is summarised in Table 1. According to the latest checklist of southern African plants (Germishuizen and Meyer 2003), only the typical variant is currently recognised.

Here, we present results of a taxonomic study of the R. totta complex, including correct synonymy and distribution ranges of the taxa of southern Africa. We further describe a new species and a new variety.

Research method and design

Plant material representative of both R. totta and R. capensis (Burm.f.) Schinz was studied from herbarium specimens housed at GRA, JRAU, K, NH and PRE, and during field excursions. Rhynchosia capensis is the closest relative to R. totta (see the discussion under ‘Diagnostic characters and relationships’ of R. totta). Herbarium acronyms are listed according to Thiers (2011). Both Baker (1923) and Verdcourt (1971) mentioned the variation in leaf structure (number and shape of leaflets) and vestiture; therefore, these were examined as well as other characters such as habit, petiole length, floral and fruit morphology. Flowers were rehydrated in boiling water and dissected under a binocular stereomicroscope.

Representative specimens examined are arranged according to the quarter-degree grid reference system (Edwards & Leistner 1971; Leistner & Morris 1976). This system is used to map distribution data of each taxon, whereby the basic unit is the one-degree square of latitude and longitude, designated by a degree reference number (i.e. degrees of latitude and longitude of the north-west corner) and the district name of that square. Some types of specimens were examined online in the JSTOR (2015) database.

Results

The examination of 562 specimens labelled as R. totta at the National Herbarium in Pretoria (PRE), and those housed in GRA, JRAU, K and NH, as well as observations made during field trips, have revealed great morphological variation. Rhynchosia totta is a scrambling perennial herb, although some of the varieties tend to be woody, particularly those occurring farther north in southern Africa. The herbaceous nature can potentially be the result of stems dying back (or burning down) during winter, corresponding to typical environmental circumstances found in grasslands (fire and frost during the winter season) but with the underground, robust tuber remaining undamaged, giving rise to new stems and foliage in spring. Leaves are usually leathery with distinct reticulate venation.

We here recognise four varieties (R. totta var. totta, longicalyx Moteetee & M.M.le Roux, rigidula (DC.) Moteetee & M.M.le Roux and venulosa (Hiern) Verdc.) in southern Africa. The newly described R. totta var. longicalyx is distinguished by the larger flowers (12 mm – 14 mm long) and elongate, narrowly linear calyx lobes. We also recognise a new species, R. pedunculata M.M.le Roux & Moteetee, characterised by its elongated peduncles and prostrate habit.

Key to the Rhynchosia totta complex and related species

1A. Habit distinctly prostrate, stems never twining; leaflets directed upwards ... R. pedunculata

Rhynchosia unifoliolata Burtt Davy, Man. Flow. Pl. Transvaal: 49 (1932), syn. nov. Rhynchosia totta var. unifoliolata (Burtt Davy) Baker f. in Bothalia 1: 131 (1923). Type: South Africa, Mpumalanga, 2629 (Bethal), ‘Ermelo’, (–DB), without date, Burtt Davy 17403 (K, lecto.), designated here, see taxonomic note (iii)). [Syntype: South Africa, Mpumalanga, 2729 (Volksrust), ‘Hoogeveld near Paardekopberg’ (–BA), without date, Rehmann 6836 (specimen not seen)]

Rhynchosia totta var. graciliflora Harms ex Baker f. in Bothalia 1: 131 (1923), syn. nov. Type: South Africa, Mpumalanga, 2530 (Lydenburg), ‘Lydenburg’, (–AB), Nov 1895, Wilms 367 (Z, lecto.), designated here; K, isoleceto., see taxonomic note (iv)).

Description

Vigorous, slender, spreading, twining or climbing herb arising from a woody rootstock. Stems: densely puberulous with short, brownish or grey hairs when young, often glabrescent. Leaves: pinnately trifoliolate or unifoliolate, leaflets linear, narrowly to broadly elliptic or ovate, sometimes asymmetrical, 15–80(100) × 3(6)–25(30) mm, glandular, hispidulous-pubescent or villous to glabrescent above, sparsely- to densely-pubescent below, emarginate or mucronate; stipules small, ovate-lanceolate or elliptic-ovate 3–6 × 0.5–2.0 mm, striated; petiole 3(6)–40 mm long. Inflorescences: mostly 1–4-flowered (rarely 5-flowered) in axillary racemes or sessile, 15–125 mm long, sometimes occurring in pairs. Flowers: 5–18 mm long, yellow; bracts lanceolate, 1.5–3.0 × 0.2–1.0 mm; bracteoles absent. Calyx: bilabiate, usually half the length of the corolla to almost as long as the corolla, vexillary lobes connate for 0.2–0.8 (–1.5) mm above the calyx tube, those of the lower lip unequal, oblong-elliptic, carinal lobe longer than lateral lobes, 5–12 mm long, lateral lobes 3–10 mm long. Corolla: persistent; standard yellow or yellow and veined red, suborbicular, reflexed backwards, 5–15 × 4–7 mm, slightly emarginate, glabrous, with two callosities on claws; wings oblong, sometimes slightly narrower and shorter than keel, 4–8 × 1–2 mm, spurred at base, without sculpturing; keel obtuse, 4–10 × 2–4 mm, pocketed. Androecium: diadelphous with nine filaments fused, vexillary stamen free to the base; anthers monomorphic, dorsifixed. Ovary: narrowly oblong-elliptic, stipitate, pubescent, 2-ovuled; style curved upwards, glabrous. Fruit: narrowly oblong, laterally compressed, 15–20(25) × 4–8 mm, densely pilose, glandular, 2-seeded. Seeds: depressed-globular, 3–5 × 1–3 mm, brown, black or mottled brown (Figures 2, 3). Flowering time: (Aug) Sep to Apr (May).

Distribution and ecology

Rhynchosia totta is widespread in southern Africa, but is centred mainly in South Africa, from which it extends north through Botswana, Zimbabwe and Mozambique, westwards to Namibia and Angola, eastwards through Zambia, and
Source: M.M. le Roux

(a), Twining branch with pinnately trifoliolate, greyish-pubescent leaves; (b), Typical fruit; (c–d), Trailing, spreading habit; (e), Flower with wings almost equal in length to the keel; (f), Pinnately trifoliolate leaf with inflorescence, showing the long length of the peduncle in comparison to the leaves; (g), Prostrate, trailing habit with leaves notably upright.

a–c, Rhynchosia totta var. venulosa. d, Rhynchosia totta var. totta. e–g, Rhynchosia pedunculata.

FIGURE 2: Diagnostic features of Rhynchosia totta var. venulosa and totta and R. pedunculata.
across East Africa as far as Somalia (Verdcourt, Pope & Polhill 2001). In South Africa, it occurs widely in all provinces, except in the Western Cape province and is only sparsely distributed in the Northern Cape province (Figure 1). It grows in sandy soil in grasslands, burnt hillides, rocky outcrops, near streams, and on roadside embankments.

Taxonomic notes

(i) Some of Drège’s syntypes of Copisma tottum, C. paniculatum, and C. pilosum could not be found in any of the probable herbaria (B, P, UPS, W). If they were ever deposited in B, they were most probably destroyed during World War II. (ii) The K specimen of R. nervosa var. petiolata is selected because it is a better-looking specimen with multiple fruits. (iii) The K specimen of R. totta var. unifoliolata is chosen as lectotype because it is the only one available. (iv) The Z specimen of R. totta var. graciliflora is chosen as lectotype because it has both flowers and a fruit and it represents best the twining nature of the taxon.

Diagnostic characters and relationships

Rhynchosia totta resembles R. capensis in its growth form (spreading, twining or climbing herb arising from a woody rootstock), but tends to be more hairy (R. capensis tends to be glabrous or minutely downy), has leaflet margins that are not revolute (leaf margins slightly revolute in R. capensis), and peduncles that are usually laxly 1–4-flowered or sometimes 5-flowered (1–6-flowered, flowers concentrated at the tips of peduncles in R. capensis). According to Harvey (1862), R. capensis also differs from R. totta in having large resinous glands. However, glands do occur in R. totta, but they are much denser in R. capensis.

R. totta var. totta

Description

Leaves: unifoliolate or trifoliolate, leaflets linear-lanceolate, lanceolate, elliptic or ovate, 16–35(45) × 3–11(20) mm, sparsely pubescent above, densely pubescent below; stipules lanceolate, 3–6(8) × 1–2 mm; petiole (6)10–25 mm long.

Inflorescences: 1–3-flowered axillary racemes, occasionally branched, 10–40 mm long, pubescent-glabrescent. Flowers: yellow, 6–10 mm long; bracts 1.0–1.5 × ± 0.2 mm. Calyx: tube 2–3 mm long, upper lobes 3–5 mm long, lateral lobes 2–4 mm long, carinal lobe 5–6 mm. Standard: 6–8 × 4–5 mm; wings 4–5 × 1–2 mm; keel 5–6 × 2–3 mm. Fruits: 15–20 × 5–6 mm, pubescent. Seeds: brown or black, 2–4 × 1–3 mm (Figure 2d and Figure 3).

Distribution and ecology

This variety is widely distributed in South Africa (across the Eastern Cape, Free State, Gauteng, KwaZulu-Natal, Limpopo, Mpumalanga and North-West provinces), Swaziland and Lesotho (Figure 4), with two specimens found on the border of the Northern Cape province. Specimens from the latter province are sterile and could not be identified with confidence as they share similarities in appearance with R. totta var. rigidula. It grows on sandy soil in grasslands, rocky outcrops, open woodlands and forest margins.

Diagnostic characters and relationships

Rhynchosia totta var. totta differs from var. rigidula in the herbaceous habit, long rachises and leafy, glabrescent leaves (woody with short rachises and often slightly silver-felted leaves that are not leathery are found in R. totta var. rigidula). This variety also resembles the new species, R. pedunculata, but differs in the trailing, twining or spreading habit and inflorescences that are not distinctly longer than the leaves or leaves orientated horizontally (prostrate habit with inflorescences much longer than the leaves and invariably standing upright in R. pedunculata). The typical variety includes those taxa with a woody base and herbaceous stems, and unifoliolate or trifoliolate leaves with leaflets that are ovate to lanceolate in shape. There are some specimens with long petioles and linear-lanceolate leaflets (formerly R. totta var. graciliflora), but, given the lack of any other morphological features to distinguish these collections from the typical form, the variant is included in R. totta var. totta.
Additional specimens seen

Pretoia, (–CA), 4400 ft, Nov 1934, L.C.C. Liebenberg 3205 (K); Suidfcronehillen in Magaliesberg, (–CA), 14 Nov 1969, B.J. Coetzee 17 (PRE); veld opposite Dutch Reformed Church in Doornpoort, (–CA), 3 Oct 2003, S.P. Bester 4236 (PRE); 24 my buite Pretoria op Hartbeespoortdam pad [24 mi outside Pretoria on the Hartebeespoort Dam road], (–CA), Feb 1961, H.P. van der Schiff 5297 (PRE); between Pienaars River Dam and entrance to Roodeplaat Research Station, (–CB), 3 Oct 1971, B. Clarke 228 (PRE); Pretoria, Doornpoort, new extension, (–CB), 9 Jan 2004, S.P. Bester 4615 (PRE); Pretoria National Botanical Gardens, (–CB), Nov 1974, P. Drijfhout 940 (PRE); Roodeplaatdam Natuurreservaat hek S [Roodeplaat Nature Reserve, gate S], (–CB), 13 Nov 1979, N. van Rooyen 2094 (PRE); Pretoria, Doornkloof, (–CC), Dec 1935, M.C. Gillett 1082 (PRE); Pretoria, Faerie Glen, langs Morelettaaspruit [Pretoria, Faerie Glen, next to Moreletta stream], (–CD), 26 Aug 1978, A.E. van Wyk 2378 (PRE); Van Riebeek nature reserve [Van Riebeek Nature Reserve], (–CD), 5000 ft, 17 Oct 1968, P.D.F. Kok 2729 (JRAU); Premier Mine, Pretoria, (–DA), 5000 ft, 1919, F.A. Rogers 23506 (K); 2627 (Potchefstroom): Northcliff, vacant plot between Weltevrede Road and Amanda Avenue, (–BB), 1600 m, 12 Sep 1998, R.A. Reddy, K.B. Reddy & P. Reddy 1371 (PRE); op kaal erwe h/v Monkor- en Jukskievlei en omgewing in Kelland, Johannesburg [on empty yards c/o Monkor and Juksie drives and in area of Kelland, Johannesburg], (–BB), Oct 1976, L.C.C. Liebenberg 3831 (K); Sasol Game Park, (–BB), 14 Dec 1985, F.A. van Wyk 2358 (JRAU); Pretoria National Botanical Gardens, (–BB), 9 Jan 2004, B.-E. van Wyk 1819 (JRAU); Davel, Leeuwkuil, (–BC), 2 Dec 1911, J.P. Coetzee 2204 (PRE); 2727 (Withbark): Mapocho Cave, Roossenekal, ca. 7 km NE of Roossenekal, (–BB), 1587 m, 18 Jan 2005, M.K. Maseroxumule 214 (PRE); Middelburg, Tautesberg, (–BB), 9 Nov 1933, R.G.N. Young A 184 (PRE); ca. 16 km W of Witbank, next to the N4, (–CC), 18 Dec 2003, T. Nkoni 79 (PRE), 2530 (Lydenburg): 16 mi SE of Lydenburg, (–AC), 11 Aug 1966, G.D. Morris 35 (PRE); Dullstroom Caravan Park, in cut grass W of centre of ablution blocks, (–AC), 6 Apr 1994, P.M. Burgoyne 2389 (PRE); Dullstroom, Farm Tonteldoos, (–AC), 2090 m, 8 Mar 1988, P.M. Burgoyne 177 (PRE); Schoemanskloof, Belfast, (–AD), 14 Nov 1933, R.G.N. Young A349 (PRE); Schoemanskloof, W end, (–AD), 14 Nov 1933, R.G.N. Young A 340 (PRE); De Kuilen Farm, ca. 9 mi SE of Lydenburg, (–BA), 5500 ft, 2 Nov 1975, P.J. Anderson A 58 (PRE); Sabie, Relevé no. GB 81089, (–BB), 14 Dec 1981, G.B. Deall 1327 (PRE); Weltevrede Farm 268 JT, opposite Weltevrede school, (–BC), 5 Feb 1979, S.P. Fourie 3189 (PRE); 58080 (PRE); Dullstroom on the road to Machadodorp, Elands Valley Farm, (–CA), 5 Nov 2001, A.J. Hankey 1346 (PRE); Mac-Mac Nature Reserve, (–CA), 7 Mar 1979, J.P. Kluge 1787 (PRE); 10 km from Machadodorp on road to Badplaas, (–CB), 7 Mar 1989, G. Germishuizen 5011 (PRE); Uitkomst Farm, 18 km from Machadodorp on road to Badplaas, (–CD), 5 Mar 1986, G. Germishuizen 3805 (PRE); 8 km from Badplaas on road to Barberton, (–DC), 5 Mar 1986, G. Germishuizen 3833 (PRE). 2531 (Komatipoort): Kruger National Park, Shabin, (–AA), 20 Nov 1952, H.P. van der Schaff 1384 (PRE); Kruger National Park, Mshahalong spruit [Kruger National Park, Mshahalong stream], (–AB), 11 Nov 1952, H.P. van der Schaff 1265 (PRE); Kangwane, Songimvelo Game Reserve, near camp for training field wardens, (–CC), 10 Dec 1992, G. Germishuizen 5841 (PRE); lower slopes on Saddleback Hill, (–CC), Oct 1890, E.E. Galpin 1108 (K), 1108a (K, PRE); 4 km from Barberton on road to Kaapmuiden, (–CC), 10 Mar 1989, G. Germishuizen 5118 (PRE); 4 km from Barberton on road to Nelspruit, (–CC), 13 Aug 1985, G. Germishuizen 3223 (PRE). 2629 (Bethal): Ca. 0.5 km before ‘Skuwekop’ turn-off on Bethal- Hendrina road, (–AD), 21 Feb 1986, B.-E. van Wyk 1819 (JRAU); Davel, Leeuwwkuil, (–BC), 2 Dec 1911, W. Wayland s.n. (PRE 6745) (PRE); Ermelo, Spitskop, (–BD), Dec 1915, R. Pott-Leendertz 5276 (PRE 15069) (PRE); Standerton, (–CC), Jan 1912, R. Leendertz s.n. (PRE 11108) (PRE); Nooitgedacht 10, (–DB), 21 Dec 1927, P.E. Potter 1740 (PRE); Nooitgedacht 10, Ermelo, (–DB), 28 Jan 1928, M. Henrici 1757 (PRE). 2630 (Colorado): 25 km from Carolina, (–AA), 12 Feb 1986, B.-E. van Wyk 1833 (JRAU); 13 km from Jessievale on road to Osheo, (–BA), 9 Mar 1989, G. Germishuizen 5071 (PRE); 50 km from Chrissiesmeer on road to Lochiel, (–BA), 6 Mar 1986, G. Germishuizen 3892 (PRE); Ermelo, Athole Pasture Reserve street, (–CB), 8 Apr 1938, J.H. Peller 137 (PRE); Amersfoort area, Kalkoenkranz, Elandsberg Farm, (–CC), 6 Nov 1984, B.J. Turner 333 (PRE); S of Panbult at Jagdrift Farm, (–CD), 1550 m, 9 Mar 1993, J.P. Coetzee 2204 (PRE); 21 km from Panbult to Amersfoort, (–CD), 12 Jan 1984, G. Germishuizen 2982 (PRE). 2729 (Volksrust): Koppieskraal Farm, Amersfoort area, (–BB), 7 Mar 1986, B.J. Turner 1066 (PRE). 2730 (Vryheid): Amersfoort area, Latemanek, Langberg Farm, (–AA), 1951 m, 18 Feb 1986, B.J. Turner 874 (PRE); Zomershoek Farm, Latemanek, (–AA), 17 Feb 1986, B.J. Turner 858 (PRE); Wakkerstroom, (–AC), 1829 m, 5 Feb 1994, P.P. Swartz 51/84W (PRE).

FREE STATE.—2727 (Kroonstad): Just outside Heilbron on road to Kroonstad, (–BD), 13 Mar 1987, G. Germishuizen 4482 (PRE); Bulfontein, Viljoensdrift, (–BD), 4 May 1912, D. Odendaal s.n. (PRE 56343) (PRE). 2728 (Frankfort): 20 km from Frankfort on road to Vrede near slow-moving stream, (–BC), 9 Mar 1987, G. Germishuizen 4343 (PRE); Farm Modus Vivendi, E of Petrus Steyn, (–CA), 25 Jan 1988, M. Crosby 472 (PRE); 38 km N van Bethlehem of R26 route, kop links van pad [38 km N of Bethlehem on route R26, hill left of road], (–CC), 14 Dec 1985, B.-E. van Wyk 1549 (JRAU). 2729 (Volksrust): 42 km SE of Vrede, Farm Driekop, area between Spitzkop and Aasvoëlkop, (–CB), 2000 m, 4 Feb 1987, L. Smook 6413 (PRE); 13 km from Verkykerskop on road to Memel, (–CD),

R. totta var. longicalyx


Description

Leaves: trifoliolate, leaflets ovate to lanceolate, 35–50 mm × 12–25 mm, pubescent-villous above and below; stipules narrowly lanceolate, 3.5–5 × 0.5–1.0 mm; petiole 12–25 mm long. Inflorescences: 2–5-flowered axillary racemes, 18–55 mm long, villous to pubescent. Flowers: light yellow with red veins, 12–14 mm long; bracts ca. 2 × 1 mm. Calyx: tube 3–4 mm long, upper lobes 5–8 mm long, lateral lobes 5–10 mm long, carinal lobe 10–12 mm long. Standard: 8.15–5.6 mm; wings 4–6 × 1–2 mm; keel 5–10 × 3–4 mm. Fruits: 18–25 × 5–8 mm, pubescent. Seeds: brown or black, 3–4 × ca. 2 (Figure 3).

Distribution and ecology

In southern Africa, this variety mostly has a northern distribution occurring from KwaZulu-Natal province north and westwards to the Northern Cape province, Botswana and Namibia (Figure 5). The distribution may stretch into Mozambique and Zimbabwe, but no specimens in PRE were found for these areas. It is common in sandveld and brown sandy loam.

Diagnostic characters and relationships

This variety is close to R. totta var. venulosa, but differs in having relatively large flowers (12–14 mm long), elongated, linear and narrow calyx lobes and often strongly asymmetrical lanceolate-ovate leaves. In R. totta var. venulosa, the flowers are 6–10 mm long, the calyx lobes are narrowly deltoid and the leaves are less strongly asymmetrical and lanceolate in shape.
Additional specimens seen

2320 (Urwi): 5 km NNW of Dondong borehole, (–AD), 12 Feb 1977, C. Skarpe S-141 (PRE).
2425 (Waterpoort): ca. 5 km from Pontdrif on road to Alldays, at picnic spot, (–AA), 22 Mar 2003, M. Jordaan 4057 (PRE); Langjan Nature Reserve, (–CC), 2600 ft, Dec 1974, S. Zwanziger 410 (PRE); Wyllies Poort, Kidsgrove, 739 MS, (–DD), 3600 ft, 11 Jan 1986, P. Raal & G. Raal 739 (PRE).
2327 (Ellisras): 50 km to Swartwater from Ellisras, (–CB), 21 Mar 2003, M. Jordaan 4054 (PRE); 9 mi from Ellisras on road to Thabazimbi, (–DC), 24 Apr 1971, B. Clarke 199 (PRE).
2328 (Naboomspruit): Naboomfontein, (–BC), 1290 m, 23 Jan 1894, F.R.R. Schlechter 4299 (PRE); Naboomspruit, Waterberg, (–DA), 8 Feb 1919, E.E. Galpin M 95 (PRE).
2329 (Pietersburg): 40 km from Louis Trichard on southern Vivo road en route to Lesheba Farm, (–BA), 25 Mar 1994, H. Joffe 1067 (PRE).
2428 (Nylstroom): Naboomfontein [Naboomspruit], (–BC), 1290 m, 23 Jan 1894, F.R.R. Schlechter 4299 (PRE); Naboomspruit, Waterberg, (–DA), 8 Feb 1919, E.E. Galpin M 95 (PRE).
2429 (Zebediela): Pietersburg area, Atok Mine, ca. 22 km SE of Atok near Matsatsana school, (–BD), 1007 m, 15 Nov 1999, P.M. Burgoyne 7643 (PRE).

Source: Compiled by M.M. le Roux, original map based on GTOPO30 global digital elevation model

FIGURE 5: Distribution of Rhynchosia totta var. longicalyx in southern Africa.

SOUTH AFRICA. LIMPOPO.—2229 (Waterpoort): ca. 5 km from Pontdrif on road to Alldays, at picnic spot, (–AA), 22 Mar 2003, M. Jordaan 4057 (PRE); Langjan Nature Reserve, (–CC), 2600 ft, Dec 1974, S. Zwanziger 410 (PRE); Wyllies Poort, Kidsgrove, 739 MS, (–DD), 3600 ft, 11 Jan 1986, P. Raal & G. Raal 739 (PRE).
2331 (Pafuri): Zoutpansberg, Kruger National Park, Punda Maria, (–CA), Nov 1932, H. Lang s.n. (PRE 32347) (PRE).
2327 (Ellisras): 50 km to Swartwater from Ellisras, (–CB), 21 Mar 2003, M. Jordaan 4054 (PRE); 9 mi from Ellisras on road to Thabazimbi, (–DC), 24 Apr 1971, B. Clarke 199 (PRE).
2328 (Baltimore): Morgenzon Farm 138 LR, Ga-Mathula Hill, (–AD), 13 May 1986, S. Venter 11883 (PRE).


NORTHERN CAPE.—2723 (Kuruman): 2 mi S of bed of Kuruman River, 78 mi NW of Kuruman, (–AA), 3400 ft, 5 Apr 1961, O.A. Leisner 2217 (K, PRE).

R. totta var. rigidula

(DC.) Moteetee & M.M.le Roux, stat. nov. Rhynchosia rigidula DC., Prodr. 2: 388 (1825); Eckl. & Zeyh., Enum. 2: 235 (1836); Baker f. in Bothalia 1: 133 (1923). Type: South Africa, Western Cape, ‘ad Cap. B.-Spei’, without date, Burchell 2587 (G-DC-microfiche, holo.!).


Description

Leaflets: trifoliolate, leaflets lanceolate to elliptic, 22–40 × 3–7 mm, sparsely pubescent above, densely pubescent below; stipules lanceolate, 2–3 × 0.5–1.0 mm; petiole 3–8 mm long. Inflorescences: 1–3-flowered axillary racemes, sometimes in pairs, 13–16 mm long, reddish brown pubescent. Flowers: yellow, 9–18 mm long; bracts 1.5–3.0 × 0.5–1.0 mm. Calyx: tube 3–5 mm long, upper lobes 2–4 mm long, lateral lobes 3–4 mm long, carinal lobe 4–6 mm long. Standard: 9–12 × 4–7 mm, wings 5×–1×2 mm; keel 6–10 × 3–4 mm. Fruits: 20–25 × 5–8 mm, villous-pubescent. Seeds: brown mottled black, ca. 5 × 3 mm.

Distribution and ecology

This variety has a northern distribution extending from the central parts of the Northern Cape into KwaZulu-Natal province as well as Swaziland into Botswana, Namibia and farther northwards (Figure 6). It grows in stony hills, well-drained, red-brown sand and banded ironstone rock.

Diagnostic characters and relationships

Rhynchosia totta var. rigidula closely resembles R. totta var. venulosa, but differs in its symmetrical lateral leaflet bases (versus leaflet bases strongly asymmetrical in the latter), shorter peduncles (versus up to 16 mm long, opposed to 125 mm long), the relatively larger flowers (up to 18 mm long versus up to 10 mm long), and calyx that is half the length of the flower (versus calyx sometimes as long as the flower). Rhynchosia totta var. rigidula is also similar to the typical variety, but differs in its woody habit, greyish-felted, soft-textured leaves and brown mottled black seeds (versus herbaceous habit, glabrescent, leathery leaves and brown seeds in R. totta var. totta).

Additional specimens seen


2719 (Tranental): At Karasberg, Krai Kluft River bed, (–AD), 23 Dec 1912, **Pearson 8286** (K); Karasberg, Numdis, (–AD), Jan 1974, **W.P. Auret 5597** (PRE). 2818 (Warmbad): Kopie near curving of the Kalkfontein railway track, (–BB), 3300–3600 ft, 2 Feb 1909, **H.H.W. Pearson s.n.** (K).

SOUTH AFRICA. LIMPOPO.—

2228 (Maasstroom): Maasstroom, (–CB), 1 May 1961, **R.G. Strey & H.-J.E. Schlieben 8663** (PRE). 2229 (Waterpoort): Breslau 2 mi S of farm, (–AC), 1800 ft, 24 May 2001, **C.C. Straub 929** (PRE); Breslau 2 mi S of farm (near Pontdrift), (–AC), 26 Jul 2000, **C.C. Straub 855** (PRE); Waterpoort, ongeveer 10 km NO van Alldays op plaas Ceon [Waterpoort, ca. 10 km NE from Alldays on Ceon Farm], (–CA), 25 Mar 1978, **N. Grobbelaar 2438** (PRE). 2230 (Messina): Messina, near the town, (–AC), 29 May 1927, **R.G.N. Young 26490** (PRE); 12.1 mi from Tshipise on road to Messina, (–AC), 21 Apr 1971, **B. Clarke 178** (PRE); Messina, 9 km from Zebediela on road to Immerpan, (–CC), 2 Feb 1919, **F.A. Rogers 22555** (K, PRE). 2231 (Pafuri): Kruger National Park, Punda Maria, (–CA), 15 Oct 1952, **H.P. van der Schijff 944** (PRE), 1700 ft, 16 May 1949, **L.E.W. Codd & B. de Winter 5523** (PRE). 2327 (Ellisras): Ellisras, Mokolo River, Zwartkoek 597 LQ Farm, (–DD), 900 m, 1979, **S.P. Fourie 203** (PRE). 2329 (Pietersburg): Soutpansberg, Llewellyn 35 Farm, (–AB), 1640 m, 4 Jul 1985, **S. Venter 10734** (PRE). 2330 (Tzaneen): Zoutpansberg, 2 mi from Mashangani, (–AC), Jul 1916, **H.G. Breijer s.n.** (PRE 16021) (PRE). 2427 (Thabazimbi): Geelhoutbos Farm of Mr Van Heerden, (–BC), 10 May 1977, **G. Germishuizen 298** (K); Thabazimbi, Kransberg, lower plateau, (–BC), 1275 m, 12 Mar 1980, **R.H. Westfall 966** (PRE). 2428 (Nylstroom): Waterberg near Visgat, (–AA), 1 May 1961, **R.G. Strey & H.-J.E. Schlieben 8667** (K); Vaalwater, Buffelsfontein, Welgevonden, (–AC), 17 May 2000, **G.J. Bredenkamp & S.J. Siebert 1649** (PRE); Heuningfontein, Ratelhoek Farm, (–AD), 1480 m, 9 Dec 1985, **R.H. Westfall 2065** (PRE); sowat 10 mi N van Warmbad op pad na Nylstroom [ca. 10 mi N of Warmbad on road to Nylstroom], (–CD), Feb 1968, **N. Grobbelaar 2409** (PRE). 2429 (Zebediela): Zebediela, 9 km from Zebediela on road to Immerpan, (–AC), 2 Apr 1972, **B. Clarke 384** (PRE); between grass valley and Stavoren Tin Mine, (–CA), 19 Jan 1955, **B. de Winter 2301** (K, PRE); Lebowa, Arabie, Camp A2, ca. 300 m S of primary school, (–CD), 16 Nov 1981, **W.N. Ellery 327** (PRE). 2430 (Pilgrim’s Rest): **tussen Mica en Phalaborwa** [between Mica and Phalaborwa].

Source: Compiled by M.M. le Roux, original map based on GTOPO30 global digital elevation model

**FIGURE 6:** Distribution of *Rhynchosia tota var. rigidula* in southern Africa.
Phalaborwa], (–BB), 14 Apr 1964, N. Grobbelaar 338 (PRE); 4 km from Gravelotte on road to Mica, (–BB), 7 Nov 1985, G. Germishuizen 3471 (PRE); Hoedspruit, Lissabata Private Nature Reserve, (–BC), 500 m, 1 Jan 1987, F. van Heerden 711 (PRE); Simoari, Ga-mabins, (–BC), 630 m, 27 Nov 1981, S. Venter 7270 (PRE). \(2431\) (Acorndhoek): Sheila 10 KU, 14 km S of Phalaborwa, (–AA), 19 Sep 1984, I.M. Retief 194 (K, PRE).


Gauteng.—\(2528\) ( Pretoria): Moloto, 10 mi from Moloto on road to Groblersdal, (–BC), 21 Apr 1969, 2531 (Pretoria): Moloto, 10 mi from Moloto on road to Groblersdal, (–BC), 21 Apr 1969, N. Grobbelaar 122/54 (PRE); Bestwood Farm, (–BB), 12 Nov 1987, D.M. Green 452 (PRE).


R. totta var. venulosa


Description

Leaves: trifoliolate, leaflets lanceolate, 26–100 × (3)9–30 mm, pubescent above, pubescent to densely velvety below; giving a greyish appearance; stipules lanceolate, 4–6 × 0.5–1.0 mm; petiole 23–40 mm long. Inflorescences: 2–4-flowered axillary
racemes, 30–125 mm long, villous-pubescent. Flowers: yellow with red veins, 6–10 mm long; bracts ca. 3 × 0.2 mm. Calyx: tube 2–3 mm long, upper lobes 2–4 mm long, lateral lobes 3–4 mm long, carinal lobe 4–6 mm long. Standard: 5–8 × 4–6 mm; wings 4–5 × 1–2 mm; keel 4–6 × 2–3 mm. Fruits: pubescent, 18–25 × 5–8 mm. Seeds: brown or black, 3–4 × ca. 2 mm (Figure 2a–c).

Distribution and ecology
Rhynchosia totta var. venulosa is widely distributed throughout southern and East Africa up to Ethiopia. In South Africa, it occurs in Limpopo, North-West, Gauteng, Mpumalanga, KwaZulu-Natal, and Eastern Cape provinces (Figure 7). It grows on heavy alluvium and sandy soils in floodplain grasslands, Acacia thickets and wooded grasslands.

Taxonomic notes
(v) The specimen in K is chosen as lectotype because it is the only one available. It is also possible that Burtt Davy based the description of this species on this specimen since he was based there at the time of writing his book.

Diagnostic characters and relationships
This variety differs from the typical variety in having thicker, hairier stems with a tendency of becoming woody, with pubescent to densely velvety leaflets that often have very prominent venation, and the strongly asymmetrical lateral leaflets.

Additional specimens seen

NORTH-WEST.—2527 (Rustenburg): Bophuthatswana, Pilanesberg Game Reserve, near Saulspoort End, (–AA), 3 Jan 1988, G. Germishuizen 4979 (PRE); kopie, near Rustenburg, (–CA), 6 Feb 1929, J. Hutchinson 2936 (K, PRE); Tierkloof, (–CA), 14 Mar 1976, G.K. Theron 522 (K, PRE); Magaliesberg, Jacksonsituin, (–DA), 19 Sep 1957, D.R.J. van Vuuren 291 (PRE).

GAUTENG.—2528 ( Pretoria): Soutpan, (–CA), 15 May 1956, L. Vari 1750 (PRE); 38 km NE of Pretoria on road past Rooodeplaat Dam, (–CD), May 1975, T.H. Arnold 900 (PRE).


**Rhynchosia pedunculata**


**Description**

Prostrate herb arising from a woody rootstock. **Stems:** pubescent-glabrescent. **Leaves:** pinnately trifoliate, leaflets lanceolate-elliptic, slightly asymmetrical, mucronate, 26–100 × (39)–30 mm, pubescent to glabrescent above and beneath, mucronate; stipules small, lanceolate, 2–6(7) × 0.5–1.0 mm, striated; petiole (5)10–25(34) mm long. **Inflorescences:** (1)2–4-flowered axillary racemes, (30)45–125 mm long, striated; petiole (5)10–25(34) mm long. **Flowers:** 6–10 mm long, yellow with red veins, 6–10 mm long; bracts lanceolate, ca. 3 × 0.5 mm, bracteoles absent. **Calyx:** bilabiata, usually half the length of the corolla, lobes of upper lip connate almost to half the length of the lobes, those of the lower lip approximately equal, oblong-acuminate, carinal lobe longer than lateral lobes, tube 13.5–36.0 mm long, upper lobes 2–3 mm long, lower lobe 3–6 mm long, lateral lobes
2–3 mm long. Corolla: persistent, standard yellow, ovate-oblong, reflexed backwards, 7–9 × 4–5 mm, slightly emarginate, glabrous, with no callosities on the claws; wings oblong-obovate, narrower and approximately as long as keel, 7–8 × 2–3 mm, spurred at base, without sculpturing; keel somewhat rostrate, 7–8 × 2–3 mm, pocketed. Androecium: diadelphous with nine filaments fused, vexillary stamen free to the base; anthers monomorphic, dorsifixed.

Ovary: narrowly oblong-elliptic, subsessile, pubescent, 2-ovuled; style strongly curved upwards, glabrous.

Fruit: narrowly oblong-elliptic, laterally compressed, 14–23 × 4–6 mm, pubescent, glandular, (1)2-seeded. Seeds: smooth, ca. 1.5 × 0.5 mm, uniformly brown (Figures 2e–g and Figure 8).

Flowering time: Oct to Mar (Apr).

Distribution and ecology
A South African endemic, with populations found in the Free State, Gauteng, KwaZulu-Natal, Mpumalanga and North-West provinces (Figure 9). It grows in grassland areas on black turf or loamy soil on dolomite or quartzite.

Diagnostic characters and relationships
Rhynchosia pedunculata is closely related to R. totta, but differs in the prostrate habit (never twining), upright leaves, long peduncles that extend beyond the leaves, and wing petals approximately equal in length to the keel. Rhynchosia totta is a trailing, climbing and twining species with leaves not distinctly erect and the peduncles not distinctly longer than the leaves (peduncles might be longer when multi-flowered), and wing petals slightly shorter and narrower than the keel.

Additional specimens seen


MPUMALANGA.—2629 (Bethal): Ermelo, (–DB), 10 Feb 1910, R. Leendersz. s.n. (TRV 7811) (PRE); Amersfoort area, Uitspanning, Rolfontein Farm, (–DD), 1640 m, 13 Mar 1986, B.J. Turner 978 (PRE).

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Competing interests
The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

Authors’ contributions
A.N.M. and M.M.L.R. contributed equally to this article in conceptualisation and execution of the study. A.N.M. compiled the initial manuscript, while M.M.L.R. contributed the specimens examined sections and figures. Both authors were equally involved in the editing process.

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FIGURE 9: Distribution of Rhynchosia pedunculata.

Source: Compiled by M.M. le Roux, original map based on GTOPO30 global digital elevation model

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