



Research note

Taxonomic notes on the genera *Tiliacora* and *Tinospora* (Menispermaceae) in southern Africa



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ABSTRACT

A review of the genera *Tiliacora* and *Tinospora* in southern Africa is presented. One species of *Tiliacora* (*Tiliacora funifera*) and three species of *Tinospora* (*Tinospora caffra*, *Tinospora fragosa* and *Tinospora tenera*) occur in this region. Synonymies, formal descriptions, distribution data and notes on the ecology and known traditional uses of the species in southern Africa are provided as well as a key to distinguish the species of *Tinospora*. *Tiliacora funifera* is a liana with dark green, ovate leaves and ellipsoidal drupes, whereas the *Tinospora* species are lianas with cordate leaves on slender petioles and roundish, fleshy drupes. The three *Tinospora* species in southern Africa differ especially in the shape of the leaf base and the coalescence of the filaments.

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1. Introduction

The Menispermaceae is a family of lianas, or scandent shrubs, in the order Ranunculales (Ortiz et al., 2007) and is a source of the arrow-poison curare (Simpson, 2010). It is regarded as an old family which originated about 105–116 million years ago (Anderson et al., 2005) with the different tribes arising either in the Cretaceous period (145–66 million years ago) or the Palaeocene epoch (66–56 million years ago) (Jacques and Bertolino, 2008).

The family is represented by seven genera and 13 species in southern Africa of which four species (*Antizoma angustifolia* (Burch.) Miers ex Harv., *Antizoma miersiana* Harv., *Cissampelos capensis* L.f and *Tinospora fragosa* (I.Verd.) I.Verd. & Troupin) are endemic to the region (Glen, 2003; Klopper et al., 2006). The family is used in traditional medicine by various cultures in southern Africa (De Wet and Van Wyk, 2008) and *Albertisia delagoensis* (N.E.Br.) Forman is consumed as a leafy vegetable in the northern KwaZulu-Natal region of South Africa (Ntuli et al., 2012). Recently three genera, *Albertisia* Becc., *Cocculus* DC. and *Stephania* Lour., have been revised (De Wet and Van Wyk, 2013; De Wet et al., 2014, 2015) as the last revision on the family in southern Africa was

done in an unpublished thesis by Botha (1975). The current paper will only focus on the two genera *Tiliacora* Colebr. and *Tinospora* Miers occurring in southern Africa and the outstanding genera *Antizoma* Miers and *Cissampelos* L. in this region will follow in a phylogenetic paper.

Tiliacora is a genus of approximately 22 species, of which 20 species are distributed in Africa and two in Southeast Asia (Jordaan, 2000; Klopper et al., 2006; Leistner, 2005). *Tiliacora funifera* (Miers) Oliv. is the only species that occurs in southern Africa (Glen, 2003).

Tiliacora was initially placed in the tribe Tiliacoreae (Miers, 1851), a tribe characterized by hippocrepiform seeds lacking endosperm and large cotyledons. *Tiliacora* however, has endosperm and was moved to the tribe Anomospermeae (Kessler, 1993), although this move is not supported by molecular analysis (Ortiz et al., 2007).

Tinospora is the type genus of the tribe Tinosporeae Hook.f. & Thomson (Forman, 1981), which is characterized by weakly ruminant endosperm and divaricate, foliaceous cotyledons (Leistner, 2005). The genus consists of approximately 30 species distributed throughout the tropical and subtropical regions of Africa, Asia, Australia and the Pacific (Ahmad et al., 2009; Xianrui et al., 2008).

Medicinally, species of *Tiliacora* are used to treat snakebites (Molander et al., 2012), as an antimalarial drug (Phillipson and Wright, 1991) and to treat gastrointestinal and menstrual problems (Burkill, 1997; Oliver-Bever, 1983). Several species of *Tinospora* are used in the treatment of various ailments (Xianrui et al., 2008) and

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the deciduous species are capable of continuing to grow when they break by sending shoots to the ground, which then take root, sometimes from great heights (9 m) (Verdoorn, 1941; Xianrui et al., 2008).

This revision of *Tiliacora* and *Tinospora* includes synonymies and formal description of the species as well as a key to distinguish the *Tinospora* species. The taxon accounts are supplemented with geographical distribution records, notes on the ecology and known traditional uses.

2. Materials and methods

Morphological data were gathered during field trips and from herbarium specimens studied at the following herbaria: BLFU, BM, JRAU, K, NH, NBG, PRE, PRU, S, ZULU. Distribution records and habitat information were obtained from herbarium specimens and observations were made during field trips.

3. Taxonomic treatments

3.1. *Tiliacora*

Colebr. in Trans. Linn. Soc. London 13: 53 (1821), *nomen cons.*, Miers in Ann. Mag. Nat. Hist. 2 (7): 39 (1851); Benth. in Benth. et. Hook f., Gen. Pl. 1: 36 (1862); Oliv. in F.T.A. 1: 43 (1868); Baill., Hist. Pl. 3: 34 (1872); Prantl in Engl. & Prantl, Nat. Pflanzenfam. 3 (2): 85 (1894); Engl., Bot. Jahrb. Syst. 26: 400 (1899); Diels in Engl., Pflanzenz. IV, 46: 59 (1910); Troupin in F.T.E.A.: 7 (1956); in F.Z. 1: 153 (1960); in Mém. Acad. Roy. Sci. Outre-Mer, Cl. Sci. Nat. Méd. 13: 47 (1962); Troupin & Gonç. in Flora de Moçambique 7: 6 (1973); Benv. in Webbia 29: 19 (1975); Forman in Kew Bull. 30: 89 (1975); Kessler in Kubitzki et al., Fam. Gen. Vasc. Pl. 2: 411 (1993); Thulin, Fl. Somalia 1: 26 (1993); Jordaan in Strelitzia 10: 358 (2000); Leistner, Seed Pl. S. Trop. Afr.: 265 (2005). Type: *T. racemosa* Colebr.

Braunea Willd. in Sp. Pl. 4: 638, 797 (1806) *nom. rejic.* Type: *B. menispermoides* Willd. (= *T. racemosa* Colebr.).

Aristega Miers in Ann. Mag. Nat. Hist. 3 (20): 174 (1867). Type: *A. laevifolia* Miers. (= *T. laevifolia* (Miers) Diels).

Glossopholis Pierre in Bull. Mens. Soc. Linn. Paris, sér. 2 (1): 82 (1898). Type: *G. macrophylla* Pierre (= *T. macrophylla* (Pierre) Diels).

Lianas, glabrous. *Leaves* simple, ovate or ovate-lanceolate, entire, penninerved, with nerves prominent below, especially the two lateral basal ones. *Inflorescence* a pseudoraceme of condensed cymules, often cauliflorous, few-flowered, axillary or from old stems, or in axillaria, solitary or 1-flowered cymules; female inflorescence sometimes a spike of solitary flowers. *Male flowers* with 6 to 12 sepals, outer sepals bract-like and smaller than inner sepals; inner sepals obovate or elliptic, ± fleshy or coriaceous; petals 3 or 6; stamens 3 to 9, free or connate; anthers introrse, oblique or longitudinal dehiscence. *Female flowers* similar to male; staminodes absent; carpels 6 to 30, carried on a gynophore. *Fruit* a drupe, ovoid, remains of stigma near the stipe; exocarp glabrescent, smooth or verrucose; endocarp bony, horseshoe-shaped, without prominent ridges or tubercles; condyle narrowly obovate. *Seed* endosperm ruminant, sparse or absent; embryo curved; cotyledons fleshy, appressed, often unequal.

3.1.1. Distribution

Tiliacora is an Old World genus with the majority of the species distributed in tropical Africa. Two species also occur in Southeast Asia (Jordaan, 2000; Klopper et al., 2006; Troupin, 1962).

3.1.2. Diagnostic characters

Tiliacora is characterized by dark green, shiny leaves which are ovate to broadly ovate with a tapering apex (refer to Table 1 for a comparison with the leaves of the other genera). The leaf base is characterized by a reddish pulvinus; a pulvinus also occur in *Cissampelos* and *Stephania* although without specific colouration, as well as in *Tinospora* where it is greenish-yellow. The female flowers of *Tiliacora* have 6 to 30 carpels

borne on gynophores whereas the other genera only have 1 to 5 carpels inserted directly onto the receptacle. Botha (1980) and Jordaan (2000) published keys to distinguish the genera of the southern African Menispermaceae. Keys to distinguish the species of *Tiliacora* were published by Troupin (1956, 1962) and Forman (1975).

3.2. *Tiliacora funifera*

(Miers) Oliv. in F.T.A. 1: 44 (1868); Diels in Engl., Pflanzenz. IV, 46: 64 (1910); Troupin in F.T.E.A.: 9 (1956); Troupin in F.Z. 1: 155 (1960); Troupin in Mém. Acad. Roy. Sci. Outre-Mer, Cl. Sci. Nat. Méd. 13: 58 (1962); Troupin & Gonç. in Flora de Moçambique 7: 6 (1973). *Hypserpa funifera* Miers, Cont. Bot. 3: 104 (1871). *Limacia funifera* (Miers) T. Durand & Schinz, Consp. Fl. Afr. 1(2): 47 (1898). Type: Tanzania. Manganja Hills, Meller s.n. (K!, lecto., designated by Benvenuto, 1975; BM!, B, iso.).

Tiliacora warnecke Engl. ex Diels in Engl., Pflanzenz. IV, 46: 64 (1910). Type: Togo. Lome, Warnecke 221 (B, holo.; BM!, BR, E, K!, P, iso.).

Tiliacora pynaertii De Wild. in Bull. Inst. Roy. Col. Belgique 2: 573 (1931). Type: Democratic Republic of the Congo. Eala, 15 Oct. 1906, Pynaert 615 (BR, holo.; PRE!, iso.).

Tiliacora glycosantha Diels in Notizbl. Bot. Gart. Berlin-Dahlem 11: 622 (1932). Type: Tanganyika, Njombe District, Lupembe, Schlieben 1365 (B, holo.; BR, BM!, iso.).

Tiliacora johannis Exell in J. Bot. 73, Suppl. Polypet. Addend: 7 (1935). Type: Angola. Cabinda, Gossweiler 9046 (BM!, holo.; K!, B, LISJC, iso.).

Robust, woody liana, up to 20 m tall; stem up to 220 mm in diam.; young stems green, glabrous, lenticels prominent, ribbed when dried; older stems brown with callus-like outgrowths. *Leaves* simple, alternate; petiole up to 50 mm long, slightly pubescent to glabrous, pulvinus thickened, sometimes geniculate, with darkish red colour; lamina ovate to broadly ovate, 50–130 × 30–65 mm; apex obtuse to acute or acuminate; base obtuse; dark green and shiny; venation palmate, five veins, middle vein prominent on adaxial side; margin entire; coriaceous; glabrous with veins slightly pilose on abaxial side. *Inflorescence* solitary or 3 to 9 flowered cymules arranged in false racemes, axillary or develops on old stems, peduncle and pedicels puberulent. *Male flowers* sessile or pedicels up to 3 mm long; sepals 9(10) in 3 or 4 whorls, free, sepals of outer whorl bract-like, 0.8–1.5 × 0.8–1.5 mm, triangular to orbicular with median thicken, abaxial side puberulent; sepals of inside whorl 3.5–4 × 1.8–2.3 mm, obovate-elliptic, venation palmate, veins 3, glabrous, straw colour; petals in 2 whorls of 3 each, free, mostly the same size, 1.8–2.7 × 0.7–0.9 mm, or with one or two petals larger, up to 4.2 × 3.5 mm, obovate, clawed, thickened at margins; 6(9) stamens in two whorls, free or slightly united at base, 3–5.9 mm long, filaments exerted, often petal-like; anthers basifix, introrse, longitudinal dehiscence. *Female flowers* sessile or pedicellate, pedicels 0–6.0 mm long; sepals 6 to 9, in 2 whorls, sepals of outer whorl 1.2 mm long, lanceolate to ovate, sepals of inner whorl 4.2–5.5 × 3.1–4.2 mm, suborbicular; petals 6 in 2 whorls, 2.2–2.4 × 1.2–1.3 mm, obovate; carpels 9 to 12, 1.8–2.4 mm long, free, borne on an apparent gynophore. *Fruit* a drupe, 5–7 mm long, ovoid to nearly globose, stipulate, with remains of stigma near stipe, stipe 1.5–3 mm long; exocarp glabrescent; endocarp bony, horseshoe-shaped, laterally somewhat convex, dorsal ridge inconspicuous with many short radially-arranged shallow grooves, lateral surface with a shallow U-shaped furrow bordering on the condyle; condyle narrow or linear. *Seed* with endosperm ruminant; embryo curved; cotyledons fleshy, appressed, often unequal (Figs. 1a, 1b & 2).

3.2.1. Distribution and habitat

T. funifera is distributed from Ghana to Nigeria and across to eastern and southern tropical Africa, including Malawi, Mozambique, Zambia, Angola and Zimbabwe (Leistner, 2005; Thulin, 1993; Troupin, 1956, 1960). In southern Africa it is limited to northern KwaZulu-Natal and Mpumalanga province in South Africa and into Swaziland (Fig. 3). This species grows in regions with high humidity and well-drained

Table 1
Comparison of the characters of the five Menispermaceae genera in southern Africa.

Characters	<i>Albertia</i> Becc.	<i>Antizoma</i> Miers	<i>Cissampelos</i> L.	<i>Cocculus</i> DC.	<i>Stephania</i> Lour.	<i>Tiliacora</i> Colebr.	<i>Tinospora</i> Miers
Leaf shape	Elliptic to broadly oblong	Elongate-oblong, oblanceolate, obovate	Ovate, deltoid, cordiform, reniform	Heteromorphic. Lower branches 3-5-lobed upper branches ovate-oblong	Peltate	Ovate, broadly ovate	Ovate, orbicular cordate,
Leaf apex	Apiculate	Apiculate, obtuse or retuse	Apiculate, obtuse, retuse	Obtuse, rounded	Obtuse, subacute	Acuminate, acute, obtuse	Apiculate, subacuminate, acuminate
Leaf base	Truncate	Truncate, attenuate	Cuneate, truncate, cordate	Truncate, cordate	Rounded	Obtuse	Cordate, obtuse
Leaf margin	Entire	Entire	Entire, undulate, crenate	Entire	Entire	Undulate	Entire to undulate
Leaf colour	Adaxial: dark green. Abaxial: greyish green	Greyish-green or greyish-blue	Greyish-green or shiny light to dark green	Adaxial: dark green. Abaxial: pale green	Adaxial: green. Abaxial: pale green	Shiny dark green	Yellowish-green to pale green
Inflorescence	Cymule	Pseudochasium, dichasium	Pseudochasium, dichasium, raceme	Cymule	Umbelliform cyme	Pseudoraceme of cymules	Raceme
Male flower: sepals	9 in 3 whorls, outside sepals free, inner sepals halfway fused	3–5, free. Female flowers free or slightly or totally connate at edges	4–7, free or connate at base. Female flowers membranous or fleshy	6–9 in 2–3 whorls, free	6–8 in 2–3 whorls, free	9(10) in 3(4) whorls	6(9) s in 2(3) whorls, free or connate at base
Male flower: petals	6 in 2 whorls, inflexed at base	4, fused or unfused. Female flowers free or slightly or totally connate at edges	4, fused. Female flowers free or slightly fused	6, inflexed auricle at the base surrounding the stamens. Female flowers with base much less inflexed	3–4, free	6 in 2 whorls	6 in 2 whorls, free
Male flower: stamens	15–30, synandrium	Synandrium, 4–14 locular	Synandrium, 4–11 locular	6–9, free	2–6, synandrium	6(9) in 2 whorls, free or slightly connate at base	3–6, filaments connate at base, halfway or entirely
Female flower: staminodes	6	Absent	Absent	6	Absent	Absent	6
Female flower: carpel	5(6), hairy	1	1 with style and stigma sometimes divided into 3	3, styles and stigmas bend backwards	1	6–12, carried on a gynophore.	3(4), free.
Endocarp shape	Not horseshoe-shaped	Horseshoe-shaped	Horseshoe-shaped	Horseshoe-shaped	Horseshoe-shaped	Horseshoe-shaped, laterally somewhat convex	Not horseshoe-shaped. Ellipsoidal with base somewhat flattened or ovoid
Endocarp surface	Parchment-like, wrinkled	Dorsal ridge inconspicuous or absent. Radial ridges either flowing into one another, or scale-like and pointing towards condyle, sometimes warty. Lateral girdles adjacent to condyle fairly rough in texture	Dorsal ridge inconspicuous or absent, radial ridges \pm perpendicular to surface of endocarp, or flattened and wrinkled with lateral girdle adjacent to condyle smooth	Dorsal ridge sharp, prominent, lateral ridges inconspicuous and separated from the dorsal ridge by a girdle of irregular ridges	Dorsal ridge conspicuous	Dorsal ridge inconspicuous with many short radially-arranged shallow grooves, lateral surface with a shallow U-shaped furrow bordering on the condyle	Distal and proximal knobs conspicuous or without any distinct knobs or tubercles
Condyle	Absent	Narrowly obovate	Narrowly obovate	Circular	Obovate	Narrow or linear	Elliptic, or 4-lobed



Fig. 1. Photographs of (a–b) *Tiliacora funifera*; (a) ovate, dark green leaves with (b) five prominent yellowish veins on the lamina and the reddish pulvinus; (c–e) *Tinospora* species; (c) *T. caffra*; (d) *T. fragosa* and (e) *T. tenera* (Photographs: B–E. van Wyk).

soil, in lowland and upland rainforest, riverine forest and moist shady places in woodlands.

3.2.2. Phenology

T. funifera produces flowers from late winter to midsummer (August to February).

3.2.3. Etymology and common names

The specific epithet *funifera* means rope-like (Stearn, 1992), referring to the climbing habit of the stems. It is commonly known as the stem-fruit climber or elbow-leaf, or 'stamvrug klimop' (Afrikaans) (Hyde et al., 2014; Kamundi, 2005), and in Zulu as 'umndiza' (De Wet and Van Wyk, 2008).



Fig. 2. *Tiliacora funifera* (a) male inflorescence, *Semei* 3117; (b) male flower, *Semei* 3118; (c) outer sepal, *Semei* 3121; (d) sepal, *Semei* 3119; (e) inner sepal, *Semei* 3121; (f) petal, *Semei* 3118; (g) stamen, *Semei* 3118; (h) fruit, *Greenway* 12133; (i) dorsal view of endocarp, *Greenway* 12133; (j) ventral view of endocarp, *Greenway* 12133; (k) stem, *Wild* 3135; (l–n) variation in leaf shape: (l) leaf, *Correia* 1524; (m) leaf, *Hurter* 5001; (n) leaf, *Winter* 5035. Scale bars (a, h–k) = 4 mm; (b–e, g, l–n) = 1 mm; (f) = 0.7 mm (Photographs: H. de Wet).

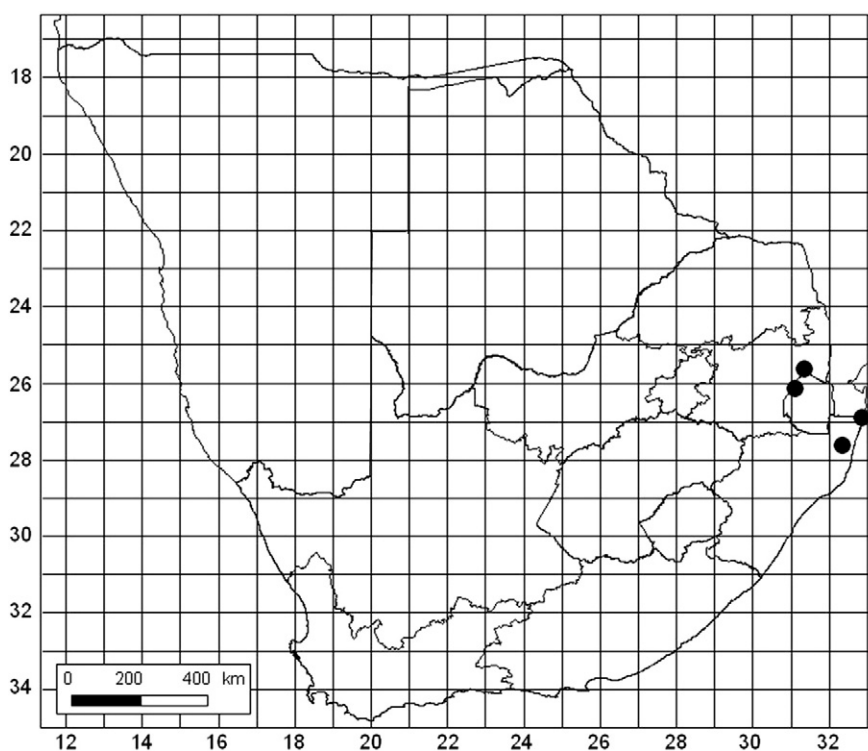


Fig. 3. Known distribution of *Tilacora funifera* in southern Africa.

3.2.4. Traditional uses

In South Africa, the roots of *T. funifera* are mixed with other plants and drunk by women to increase fertility and boiled leaves are used to steam the face to treat facial problems (De Wet and Van Wyk, 2008). In other parts of Africa the stems are debarked and used as binding material (e.g. binding bundles of wood). In the Democratic Republic of Congo the fruits are eaten and in the Congo the sap of the leaves is used in herbal remedies to prevent insanity (Oyen, 2010). In Ghana, *T. funifera* forms part of herbal remedies to treat gastric fever, hernia and menstrual problems (Oyen, 2010).

3.2.5. Additional specimens examined

South Africa. MPUMALANGA: **2531 (Komatipoort)**: Stentor, 16 km SE from Kaapmuiden (–CB), 24 Feb 2001, De Wet & Van Wyk 4063 (ZULU), 5 Aug 1972, Nel 235 (PRE). KWAZULU-NATAL: **2632 (Bela Vista)**: Kosi Bay Nature Reserve (–DD), Botha 314 (PRE), 7 Aug 1974, Botha 899 (BLFU), 24 Sep 1961, Edwards 2552 (PRE); Lake Ndlange, Apiesdraai, Kosi Bay System (–DD), 10 May 1965, Vahrmeijer & Tölken 957 (PRE), 23 Sep 1965, Vahrmeijer 1244 (NH, PRE), Mangesi Forest (–DD), 29 May 1971, Venter 6195 (PRE).

Swaziland. **2631 (Mbabane)**: Malolotja Nature Reserve (–AA), 9 Oct 1994, Van Greunen 639 (PRE).

3.3. *Tinospora*

Miers in Ann. Mag. Nat. Hist., 2 (7): 35, 38 (1851), *nomen cons.*, Benth. in Benth. & Hook f., Gen. Pl. 1: 34 (1862); Miers, Contr. Bot. 3 (1): 30 (1871); Prantl in Engl. & Prantl, Nat. Pflanzenfam. 3 (2): 87 (1894); Engl., Bot. Jahrb. Syst. 26: 402 (1899); Diels in Engl., Pflanzenr. 46: 133 (1910); Troupin in F.T.E.A.: 17 (1956); in F.Z. 1: 159 (1960); in Mém. Acad. Roy. Sci. Outre-Mer, Cl. Sci. Nat. Méd. 13: 191 (1962); Troupin & Gonç. in Flora de Moçambique 7: 13 (1973); Benv. in Webbia 29: 30 (1975); Kessler in Kubitzki et al., Fam. Gen. Vasc. Pl. 2: 413 (1993); Thulin, Fl. Somalia 1: 26 (1993); Jordaan in Strelitzia: 358 (2000); Leistner, Seed Pl. S. Trop. Afr.: 265 (2005). Type species: *T. cordifolia* (Willd.) Miers ex Hook. f. & Thomson.

Campylus Lour., Fl. Cochinch.: 94: 113 (1790) *nom. rejic.* Type: *C. sinensis* Lour. (= *T. sinensis* (Lour.) Merr.).

Desmonema Miers in Ann. Mag. Nat. Hist., 3 (20): 260 (1867) *non* Raf. (1833). Type: *D. caffra* Miers. (= *T. caffra* (Miers) Troupin).

Hypsipodes Miq. in Ann. Mus. Lugd.-Batav. 4: 82 (1868). Type: *H. subcordata* Miq. (= *T. subcordata* (Miq.) Diels).

Fawcettia F.Muell., Fragm. Phyt. Austr. 10: 93 (1877). Type: *F. tinosporoides* F.Muell. (= *T. tinosporoides* (F.Muell.) Forman).

Hyalosepalum Troupin, Bull. Jard. Bot. État Bruxelles 19: 430 (1949). Type: *H. caffrum* Miers. (= *T. caffra* (Miers) Troupin).

Lianes, deciduous, glabrous or verrucose; stems semi-succulent; lenticels prominent. Leaves with petioles up to 150 mm long, simple; lamina cordate, ovoid to orbicular, apex apiculate, acuminate or mucronate, base cordate or obtuse, palmately 5 to 7-veined, margin entire or undulate, coriaceous, glabrous. Inflorescence a 2 to 4-flowered pseudopanicule, pseudoraceme or pseudospike or solitary. Flowers unisexual, dioecious. Male flowers with 6(9) sepals in 2(3) whorls, free or connate at the base, inner ones larger than outer ones; petals 6 in 2 whorls, free; stamens 3(6), filaments connate at the base, or ± to the middle or to the apex; anther with longitudinal dehiscence. Female flowers with sepals and petals similar to male flowers; staminodes 6; carpels 3(4). Fruit a drupe, ellipsoidal, ovoid or bean-shaped; mesocarp pulpy; endocarp ellipsoidal or ovoid, smooth, verrucose or tuberculate. Seed with fleshy endosperm, ruminant, embryo reniform, cotyledons foliaceous, divaricate.

3.3.1. Distribution

Tinospora species are distributed throughout the tropical and subtropical regions of Africa, Madagascar, Asia to Australia and the Pacific islands, (Ahmad et al., 2009; Xianrui et al., 2008).

3.3.2. Diagnostic characters

Tinospora has yellowish-green, ovate to orbicular leaves (refer to Table 1 for a comparison with the leaves of the other genera) with a waxy texture. The pulvinus at the leaf base of the *Tinospora* species is yellowish-green, but of no specific colouration in *Cissampelos* and

Stephania and reddish in *Tiliacora*. *Tinospora* is the only genus of the southern Africa genera with filaments that are connate. Keys to distinguish the Asia, Australia and Pacific species of *Tinospora* were published by Forman (1981) and Xianrui et al. (2008) and a key for the African species by Troupin (1962).

3.3.3. Key to the species of the southern African *Tinospora*

- 1a. Male and female flowers born directly on the main branches and limbs; male flowers with six stamens; filaments connate at base; endocarp smooth; pulvinus reddish when fresh; leaves ovate to deltoid with a deeply cordate base; ..*T. fragosa*
- 1b. Male and female flowers on young branches; male flowers with three or six stamens; filaments connate halfway or entirely; endocarp with distinct distal and proximal knobs; pulvinus yellowish-green when fresh; leaves ovate, ovate-cordate to orbicular with an obtuse to cordate base.....2
- 2a. Bark knobby; male flowers with six stamens; filaments connate \pm halfway; petals of female flowers fleshy, ovate or obovate; drupe ovate; condyle elliptic*T. caffra*
- 2b. Bark striate; male flowers with three stamens; filaments entirely connate; petals of female flowers thin with the margins inflexed, linear; drupe elliptic; condyle with four lobes*T. tenera*

3.4. *Tinospora caffra*

(Miers) Troupin in Bull. Jard. Bot. État Bruxelles 25: 137 (1955); in F.T.E.A.: 19 (1956); in F.Z. 1: 161 (1960); in Mém. Acad. Roy. Sci. Outre-Mer, Cl. Sci. Nat. Méd. 13: 199 (1962); Troupin & Gonç. in Flora de Moçambique 7: 14 (1973); Botha, S. Afr. J. Bot. 46 (1): 26 (1980). *Desmonema caffra* Miers in Ann. Mag. Nat. Hist., 3(20): 261 (1867); Miers, Contr. Bot. 3: 378 (1871); Diels in Engl., Pflanzenz. 46: 156 (1910). *Hyalosepalum caffrum* (Miers) Troupin in Bull. Jard. Bot. État Bruxelles 19: 431 (1949). Type: Natal, Gerrard 1976 (K!, holo.; BM, iso.). *Desmonema mucronulatum* Engl., Bot. Jahrb. Syst. 26: 409 (1899). Type: Tanganyika, Mwanza distr., Kagehi, Fischer 69 (B, lecto. designated by Troupin, 1956).

Desmonema mucronulatum Engl. var. *schweinfurthii* Engl., Bot. Jahrb. Syst. 26: 409 (1899). Type: Sudan, Equatoria Province, Baginze Mountain, Schweinfurth III 80 (B, holo.; K!, iso.).

Desmonema mucronulatum Engl. var. *mildbraedii* Diels in Engl., Pflanzenz. 46: 155 (1910). Type: Congo, Semliki-Ebene, Mildbraed 2743 (B, holo.).

Desmonema pallide-aurantiacum Engl. & Gilg. in Warb., Kunene-Zamb. Exped.: 237 (1903). *Hyalosepalum pallide-aurantiacum* (Engl. & Gilg.) Troupin in Bull. Jard. Bot. État Bruxelles 19: 432 (1949). Type: Angola, Onjimba, Baum 540 (B, holo.; S!, K!, BR, G, iso.).

Desmonema gossweileri Exell, J. Bot. Lon. 70. Suppl. Polypet.: 216 (1932). *Hyalosepalum gossweileri* (Exell) Exell & Mendonça in Consp. Fl. Angol. 1: 357 (1951). Type: Angola, Luanda, Penedo du Bungo, Gossweiler 1485 (BM!, holo.; B, COI, K!, P, iso.).

Desmonema schliebenii Diels in Notizbl. Bot. Gart. Berlin-Dahlem 13: 273 (1938). Type: Tanganyika, Lindi distr., Lake Lutamba, Schlieben 5838 (B!, holo.; S, P, HBG, G, iso.).

Briefly deciduous, lianes; stems semi-succulent, young stems glabrous, older stems verrucose with scaling bark; lenticels prominent; axillary buds tuberculate. Leaves simple, alternate; petioles up to 150 mm long, glabrous, pulvinus extended and somewhat thickened, yellowish green; lamina ovate, ovate-cordate or nearly orbicular, 25–142 \times 15–125 mm; apex abruptly apiculate, mucronate or subacuminate; base cordate to slightly cordate; venation palmate, veins prominent on abaxial side, slightly sunken on adaxial side, 5 to 7 veins; margin entire or slightly undulate; texture coriaceous; yellowish green; glabrous. Male inflorescence up to 30 cm long; racemes with up to four sequentially arranged flowers; bracts linear, up to 1.5 mm long. Male flower with pedicels up to 7 mm long; sepals 6 in 2 whorls, outer ones triangular to subovate, glabrous, fused at the base,

0.6–1.0 \times 0.4–0.7 mm, inner ones oblong to oblanceolate, glabrous, 0.7–1.4 \times 1.0–1.6 mm; petals 6 in 2 whorls, free, outer ones 1.6–2.7 \times 0.6–1.2 mm, inner ones narrower, 1.5–2.7 \times 0.3–0.5 mm; stamens 3, filaments connate to the apex, 1.5–3.0 mm long; anthers basifix, free, longitudinal dehiscence; pollen triporate, spherical, 16–20 μ m in diameter; exine thickness: colpium 2–3 μ m, mesocolpium 1–2 μ m, reticulate, lacunae granular, muri smooth. Female inflorescence up to 40 mm long; racemes, with one flower per bract. Female flower with pedicels up to 2.4 mm long; sepals 6 in 2 whorls, free, outer ones glabrous, triangular with two small appendages at the base, 0.7–0.9 \times 0.8–1.0 mm, inner ones elliptical to ovate, 2.1–3.0 \times 1.8–2.5 mm; petals 6 in 2 whorls, free, inflex margins, linear, 1.4–1.8 \times 0.6–1.2 mm; staminodes 6, linear, 0.4–0.6 \times 0.2–0.3 mm; carpels 3, free, 1.3–1.5 mm long. Fruit a drupe, ovate, 10 \times 6 mm, orange when ripe; mesocarp pulpy; endocarp bony, ellipsoidal with base somewhat flattened, distal and proximal knobs conspicuous; outline of condyle elliptic. Seed with fleshy endosperm, ruminate; embryo reniform; cotyledons foliaceous, divaricate (Figs. 1c & 4).

3.4.1. Diagnostic characters

Tinospora caffra is characterized by ovate leaves with a cordate base (Fig. 4b & 4c) and has the longest petioles (150 mm) of the three *Tinospora* species in southern Africa. The filaments of the three stamens in the male flowers are connate along their entire length (Fig. 4j) and the petals of the female flowers have inflexed margins (Fig. 4i). The fruit is an ovate drupe (Fig. 4l).

3.4.2. Distribution and habitat

Tinospora caffra is widely distributed in the lowland and upland rainforest and deciduous bushland of central and eastern Africa, Mozambique and Zimbabwe (Klopper et al., 2006; Troupin, 1960). In southern Africa, the species occurs in Namibia, Botswana and in the Mpumalanga and KwaZulu-Natal provinces of South Africa (Fig. 5).

3.4.3. Phenology

Tinospora caffra produces flowers from early to late summer (December to February).

3.4.4. Common names

Tinospora caffra is known as the orange grape creeper or the 'oranje-druiveranker' (Afrikaans), and in Zulu it is known as 'isidumuke' (Foden and Potter, 2005a; Pooley, 1998).

3.4.5. Traditional uses

The leaves of *Tinospora caffra* are mixed with those of other plants and sprinkled in the bedroom to relieve sleeping problems; the steam of boiling leaves is inhaled to sooth body aches (De Wet and Van Wyk, 2008). Juices from pounded leaves are applied as an antiseptic to wounds (Oyen, 2008). It is also used to poison fish (Pooley, 1998).

3.4.6. Additional specimens examined

Namibia. **1719 (Rundu)**: Mpreini Missionary (–DC), 29 Nov 1955, De Winter 3750 (PRE).

Botswana. **1821 (Andara)**: Okavango River (–BD), 22 Feb 1983, Smith 4128 (PRE). **1823 (Siambisso)**: Island in the Kwando River (–AB), 29 Jan 1979, Smith 2313 (PRE), 2 Feb 1978, Smith 2346 (PRE).

South Africa. MPUMALANGA: **2530 (Lydenburg)**: Ussitaba Game Farm (–BB), Van Heerden (PRE). **2531 (Komatipoort)**: Skipberg, Kruger National Park (–AB), Botha & Gertenbach 910 (PRE). KWAZULU-NATAL: **2732 (Ubombo)** Pongola Dam wall (–AC), 27 Mar 2001, Van Wyk & De Wet 4074 (ZULU), Manzengwenya (–BD), 28 Mar 1987, Ward 1975 (NH); Mkuze Game Reserve near entrance (–CA), 30 Mar 1977, Van Jaarsveld 2131 (NBG). **2831 (Nkandla)**: University of Zululand Campus (–DB), Feb 1966, Venter 2411 (BLFU); KwaDlangezwa (–DD), 19 Sept 1971, Venter 6426 (ZULU). **2832 (Mtubatuba)**: Hluhluwe Game Reserve (–AA), 10 Dec 1953, Ward 1937 (PRE). **2931 (Stanger)**: Tugela Mouth



Fig. 4. *Tinospora caffra*. (a) Stem, Botha 984; (b) leaf with cordate base, Smith 4128; (c) leaf with slightly cordate base, Botha 984 (d) male inflorescence, Stolz 2448; (e) inflorescence bract, Stolz 2448; (f) male flower, Stolz 2447; (g) female flower, De Winter 3751; (h) sepal, De Winter 3751; (i) petal and staminode (indicated by arrow), De Winter 3751; (j) stamen, Stolz 24450; (k) carpel, De Winter 3751; (l) fruit, Ward 6207; (m) endocarp, Ward 6207. Scale bars (b–c) = 10 mm; (a, d, g, l–m) = 4 mm; (f, h, k) = 1 mm; (e, i–j) = 0.7 mm (Photographs: H. de Wet).

(–BA), 14 Feb 1957, Edwards 1771 (PRE); Haaan Forest, south bank of Umhlanga River (–CA), 23 Jan 1970, Ross & Moll, 2269 (NH, PRE); Umhlanga Rocks (–CC), 7 Mar 1951, Verdoorn 2397 (PRE); Durban Bluff (–CC), 16 Jan 1912, Wood 12114 (NH, PRE), 10 Jun 1967, Strey 7496 (NH, PRE), 31 Dec 1948, Van Hoepen sub PRE 32088 (PRE); Durban Gardens (–CC), 14 Mar 1921, Herb. Stellenbosch 13277 (NH).

3.5. *Tinospora fragosa*

(I. Verd.) I. Verd. & Troupin, Mém. Acad. Roy. Sci. Outre-Mer, Cl. Sci. Nat. Méd 13: 196 (1962); Botha, S. Afr. J. Bot. 46 (1): 26 (1980). *Desmonema fragosum* I. Verd., S. Afr. J. Bot. 7: 209 (1941). Type: Transvaal, Waterpoort, Van der Merwe 1452 (PRE!, lecto., designated by Troupin, 1962; K1, isolecto.).

Deciduous, liane up to 10 m high; stems semi-succulent, up to 50 mm in diam.; lateral branches bear transverse scars of earlier deciduous racemes and leafy shoots; glabrous; lenticels conspicuous; periderm scaling. Leaves simple; alternate; petioles up to 80 mm long, pulvinus yellowish-green, glabrous; lamina ovate to deltoid, 100 × 100 mm; apex acuminate; base deeply cordate; venation palmate, veins 5, prominent on abaxial side; margins entire; texture coriaceous; glabrous; yellowish-green. Inflorescence a raceme, up to 50 mm long, cauliflorous; flowers sequential, in groups of 1 to 3 per bract, with the oldest flower closest to the peduncle; bracts persistent, linear, up to 3.5 mm long. Male flower with pedicels up to 3 mm long; sepals pale green, 6(9) in 2(3) whorls, free, outer ones 3(6), deltoid to ovate, 0.8–1.8 × 0.5–1.4 mm, inner ones, three, ovate to

elliptical, 3.3–3.9 × 2.4–3.0 mm; petals 6 in 2 whorls, free, broad ovate, more or less the same size, 1.6 × 2.1 mm; stamens 6, filaments only connate at the base, longitudinal dehiscence; pollen trisyncolpate, ellipsoidal, 23–29 µm in diameter at polar region, 18–24 µm at equatorial region; exine thickness: colpium 2.5–4.0 µm, mesocolpium 1.5–3.0 µm; surface of mesocolpium reticulated. Female flowers one per bract, receptacle extended, 1.5 mm long, divided into three at the tip; sepals 6(9) in 2(3) whorls, outer whorl(s) with 3 to 6 sepals, ovate or deltoid, base often sagittate, 0.9–3.0 × 0.9–2.1 mm, inner ones, ovate or elliptical, 3.3–3.6 × 2.4–2.9 mm; petals 6 in 2 whorls, free, obovate to pear shape, 1.5–2.0 × 1.0–1.2 mm; staminodes 6, 1.4–2.0 mm long; carpels 3(4), free, 2.4–2.6 mm long, style very short. Fruit a drupe; bean shaped; 8–9 × 5–7 mm; mesocarp pulpy; endocarp bony, smooth, ovoidal without any distinct knobs or tubercles; condyle elliptical. Seed fleshy endosperm, ruminate; embryo reniform; cotyledons foliaceous, divaricate (Figs. 1d & 6).

3.5.1. Diagnostic characters

T. fragosa is the only southern African species of *Tinospora* which develops inflorescences directly on the main branches and limbs (cauliflory). The ovate to deltoid leaves are characterized by a deeply cordate base (Fig. 6c). The flowers in the male inflorescence are arranged sequential in groups of 1–3 per bract, but in *T. caffra* and *T. tenera* there are only a single flower per bract. The filaments of the six stamens in the male flowers are connate at the base (Fig. 6i). The drupe is bean-shaped and the endocarp is smooth, without distinct knobs or tubercles

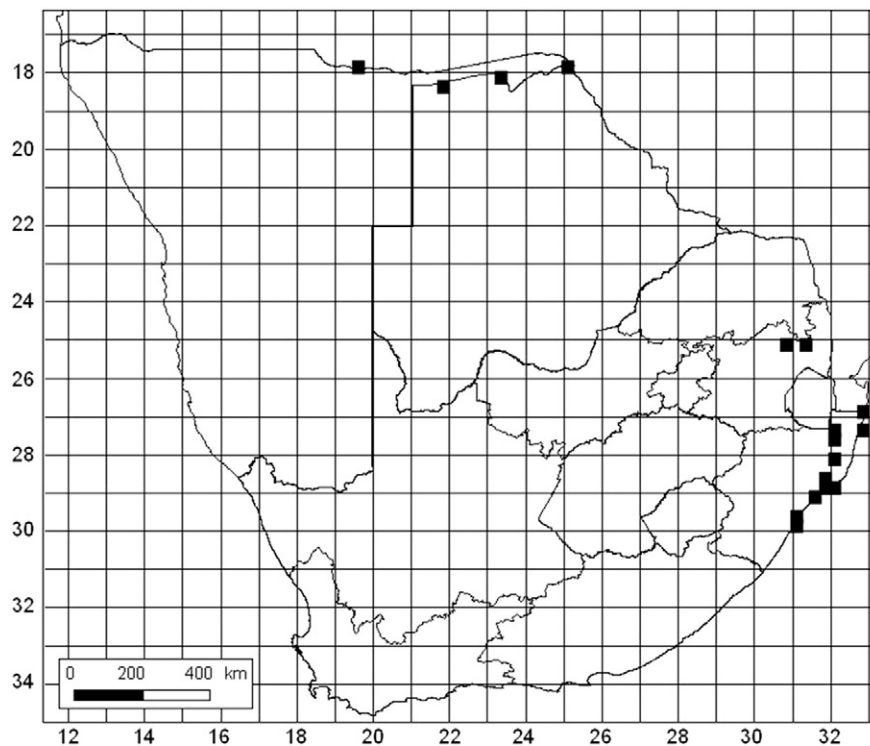


Fig. 5. Known geographical distribution of *Tinospora caffra* in southern Africa.

(Fig. 6k). The endocarp of *T. caffra* and *T. tenera* has distinct distal and proximal knobs (Figs. 4m & 8k).

3.5.2. Distribution and habitat

T. fragosa occurs in northern Namibia and Botswana; South Africa it is confined to the dry subtropical regions of the northern parts of Mpumalanga and Limpopo province (Fig. 7). It also occurs in Zimbabwe (Oyen, 2008). *T. fragosa* grows in dry hot places, especially on dolerite ridges and next to dry river beds, where frost is absent. The plant is a twiner in bushveld vegetation, often growing 10 m or higher.

T. fragosa plants have the ability (when detached from the mother plant) of forming an aerial root which can grow down from 10 m or more above ground before re-rooting and thus re-establishing the plant. In their native dry bushveld habitat, the plants are often disturbed by big game such as kudu and elephants. Instead of dying, the plant simply drops or grows a new “life line”, thus re-establishing itself. The root will only appear during the rainy season and the rest of the plant will remain dormant. This solitary root is initially thin but, once established, soon thickens (Verdoorn, 1941).

3.5.3. Phenology

T. fragosa produces flowers from winter to early summer (July to December). The flowers are conspicuous during this time due to the absence of the leaves.

3.5.4. Common names

T. fragosa is commonly known as the marvel creeper, Moses' staff or Aaron's staff and in Afrikaans as ‘moses-se-kierie’, ‘wonderplant’ or ‘wonderstok’ (Foden and Potter, 2005b; Van Jaarsveld, 2002). In the Lydenburg area it is known as ‘penualleng’ (Verdoorn, 1941) and in the Kwanyama culture as ‘eposa’, ‘omapos’, or ‘omaphsha’ (Rodin, 1985).

3.5.5. Traditional uses

An infusion of the leaves and twigs of *T. fragosa* is applied to anthrax sores and the plant is given as fodder to cattle to prevent anthrax. Twigs are chewed and the sap swallowed to treat cough and sore throats and

stems and leaves are used to prepare a mustard or Turkish bath to soothe rheumatism and body aches. The plant is also grown by Africans in kraals for good luck and to keep out snakes (De Wet and Van Wyk, 2008; Oyen, 2008).

3.5.6. Additional specimens examined

Namibia. **1713 (Swartbooisdrif)**: Kaokoveld, Kunene River area just E of Oonjana (–AB), 20 Jul 1976, *Leistner, Oliver, Steenkamp & Vorster 270* (PRE). **1715 (Ondangwa)**: Oshikango (–BD), Jun 1948, *Loeb 202* (PRE). **1719 (Rundu)**: Mupini Finnish Mission, 16 km W of Rundu (–DC), 29 Nov 1955, *De Winter 3750* (PRE). **1725 (Livingstone)**: Mpilila Island (–CC), 13 Jan 1959, *Killick & Leistner 3339* (PRE).

South Africa. LIMPOPO: **2229 (Waterpoort)**: Messina (Musina), Greefswaldt (–AB), 10 Jan 1973, *PRU Plant Hons. 91* (JRAU); Greefswaldt, Mapungupwe (–AB), 8 Jan 1975, *Eicker & Hons. 187* (PRE, PRU); District Soutpansberg, Farm Breslau 2, along Limpopo River (–AC), 5 Apr 1983, *Straub 178* (PRE); Farm Uitspan, road to Maclontsi (–AC), 15 Mar 1975, *Stephen 1474* (PRE); Dongola Reserve, Banks of Limpopo River (–BA), 15 Mar 1948, *Verdoorn 2271* (PRE); Dongola Reserve, Soutpansberg (–BC), 2 Dec 1942, *Dyer 4321* (PRE), Jul 1940, *Pole Evans 4252* (PRE), 5 Sep 1940, *4253*; Langjan Nature Reserve (–CC), Feb 1975, *Zwanziger 811* (PRE); Njelele River (–CC), 15 May 1973, *Van Graan & Hardy 548* (PRE); Masequas Poort, northern slopes of Soutpansberg (–DD), 15 Sep 1962, *Hardy 984* (PRE); Wyliespoort (–DD), Apr 1941, *Van der Merwe 2151* (PRE), Oct 1940, *Van der Merwe 2185(a)*, 3 Jan 1941, *Van der Merwe 2185(b)*, North side of Wylies Poort, “Fogwell’s Paradise”, Soutpansberg (–DD), 17 Dec 1929, *Gillett 2995* (PRE). **2230 (Musina/Messina)**: Messina (Musina), Zoutpansberg (–AC), *Pole Evans 4253* (PRE); Nwannedi Nature Reserve (–CB), *Van Wyk 3259* (PRE); Mangani, at roadside (–DC), *Mugwedi 1356* (PRE). **2231 (Pafuri)**: 40 km east from Punda Maria (–CB), *Botha 636b* (PRE). **2329 (Polokwane/Pietersburg)**: Pietersburg (Polekwane) district, 4.8 km east from Kalkbank (–CB), 4 Dec 1946, *Codd 2281 A* (PRE). **2330 (Tzaneen)**: Farm Masalol No. 722, east from Merensky Nature Reserve (–DA), *Botha 880* (PRE). **2331 (Phalaborwa)**: Letaba Camp, Kruger National Park (–DC), 4 Nov 1948, *Codd & Dyer 4697* (PRE). **2429**



Fig. 6. *Tinospora fragosa*. (a) Stem, Leistner 270; (b) old stem, Stephen 1475; (c) leaf, Verdoorn 2271; (d) bract subtending a male flower, Leistner 270; (e) male flower, Leistner 270; (f) outer sepal, Leistner 270; (g) inner sepal, Leistner 270; (h) petal, Leistner 270; (i) stamens, Leistner 270; (j) fruit, Strey 3448; (k) endocarp, Strey 3449. Scale bars (c) = 10 mm; (a–b, j–k) = 4 mm; (d–e) = 1 mm; (f–i) = 0.7 mm (Photographs: H. de Wet).

(Zebediela): Monametsi, 50 km from Chunispoort to Burgersfort (–BA), 14 Feb 2001, Van Wyk & De Wet 4060 (ZULU); Potlake Nature Reserve 84 km from Polekwane (–BD), 26 Mar 1979, Mattheé (PRU); Zeekoegat Vodacom cell phone tower, near Sefateng and Atok mine (–BD), 12 Dec 2000, Van Wyk 13604 (PRU). **2430 (Pilgrim's Rest):** Potlake Nature Reserve, next to Olifant River, Burgersfort Polokwane road (–CA), 5 Nov 1999, Siebert 1148 (PRU). MPUMALANGA: **2430 (Pilgrim's Rest):** Lebowa, Croydon 12 farm, top and side of Thagetse Hill (–AC), 17 Aug 1989, Glen 1792 (PRE); Abel Erasmus Pass, opposite waterfall (–BC), 8 Nov 1960, Strey 3448 (PRE); Hoedspruit (–BD), 26 Jul 1978, Botha 2136 (BLFU); 23 Jan 1985, Van Heerden 61 (PRU); Drakensberg side of Olifants River Bridge on Tzaneen and Hoedspruit road (–DD), 30 Mar 1969, Croeser 35 (PRE). **2530 (Lydenburg):** Farm Avontuur (–AB), 12 Nov 1933, Barnard 58 (PRE); Nelspruit (–BD), 15 Nov 1954, Van der Schijff 4040 (PRE). **2531 (Komatipoort):** Crocodile Gorge, road between Nelspruit and Kaapmuiden (–CA), 24 Feb 2001, De Wet & Van Wyk 4069 (ZULU).

3.6. *Tinospora tenera*

Miers, Contr. Bot. 3: 37 (1871); Troupin in F.T.E.A.: 20 (1956); in F. Z. 1: 161 (1960); in Mém. Acad. Roy. Sci. Outre-Mer, Cl. Sci. Nat. Méd. 13: 204 (1962); Troupin & Gonç. in Flora de Moçambique 7: 15 (1973); Botha, S. Afr. J. Bot. 46 (1): 26 (1980). *Desmonema tenerum* (Miers) Diels in Engl., Pflanzenr. 46: 154 (1910). *Hyalosepalum tenerum*

(Miers) Troupin in Bull. Jard. Bot. État Bruxelles 19: 431 (1949). Type: Mozambique, Lower Shire Valley, Kirk s.n. (K!, holo.; BM! iso).

Tinospora stuhlmannii Engl. in Bot. Jahrb. Syst. 26: 404 (1899). Type: Mozambique, Kilimane, Stuhlmann I 742 (HGB, lecto., designated by Troupin, 1956).

Liane; stems semi-succulent, young stems yellow–green, glabrous; older stems verrucose, with lenticels in parallel rows. Leaves simple; alternate; with petiole up to 52 mm long, glabrous, pulvinus geniculate, thickened at petiolar attachment with a distinct reddish colour when fresh; lamina broadly ovate to sub-orbicular, 40–110 × 25–102 mm; apex acuminate, apiculate and sometimes mucronulate; base cordate or obtuse; venation palmate, veins 5, prominent on abaxial side; margins entire to slightly undulate; texture coriaceous; pale green; glabrous. Male inflorescence up to 350 mm long; raceme with four sequential arranged flowers per bract. Male flower with pedicels up to 7 mm long; sepals 6 in 2 whorls, free, outer ones oblong-obovate, 0.6–1.2 × 0.3–0.5 mm, inner ones obovate-spathulate, 1.0–1.2 × 0.9–1.0 mm; petals 6 in 2 whorls, free, all the same size, fleshy, small, obovate, sometimes margins slightly inflexed, petals keeled, 0.8–1.2 × 0.4–0.8 mm; stamens 6, 0.8–1.2 mm long, connate to halfway up; anthers basifix, longitudinal dehiscence; pollen tri-syncolporate, spheroidal, 14–16 µm in diameter; exine thickness: colpium 2–3 µm, mesocolpium 1.2–2 µm; surface reticulate; muri uneven. Female inflorescence up to 80 mm long; raceme with one flower per bract. Female flower with pedicels up to 5 mm long; sepals in 2(3) whorls of 3 each, free, outer ones broadly linear to broadly deltoid, 0.8–1.4 × 0.6–0.7 mm, inner ones broad obovate,

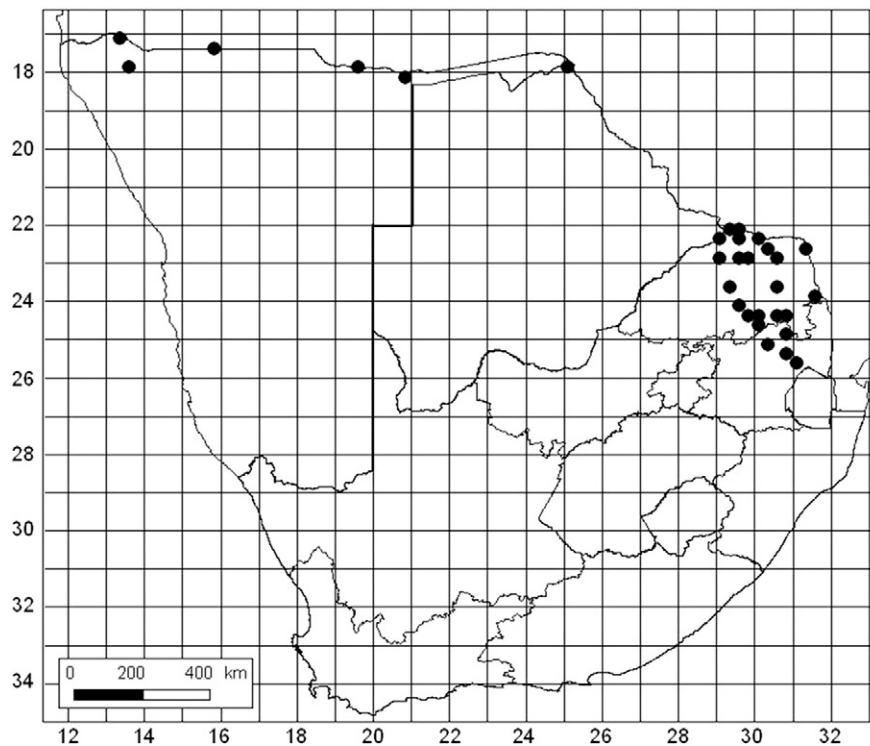


Fig. 7. Known geographical distribution of *Tinospora fragosa* in southern Africa.

2.5–3.3 × 1.4–1.8 mm, sometimes fused in pairs; petals 6 in 2 whorls, all the petals are the same size, free, fleshy, ovate or obovate, 1.5–2.1 × 0.9–1.3 mm; staminodes 6, linear, 0.8–1.0 mm long; carpels 3(4), free, 1.5–1.8 mm long, two stigmas bend outwards. *Fruit* a drupe; ellipsoidal with flattened base; up to 12 × 10 mm; mesocarp pulpy; endocarp bony, more or less ellipsoidal with base somewhat flattened, distal and proximal knobs conspicuous; condyle with four prominent lobes. *Seed* with fleshy endosperm, ruminant; embryo reniform; cotyledons foliaceous, divaricate (Figs. 1e & 8).

3.6.1. Diagnostic characters

T. tenera is characterized by a geniculate pulvinus with a distinct reddish colour when fresh. The pulvinus in *T. caffra* and *T. fragosa* are yellowish-green. The ovate to suborbicular leaves have a cordate (Fig. 8b) or obtuse (Fig. 8c) base and the filaments of the six stamens in the male flowers are only halfway connate (Fig. 8i). The petals in the female flowers are fleshy and the fruit is an ellipsoidal drupe with a flattened base (Fig. 8j). The condyle in *T. caffra* and *T. fragosa* are elliptic but in *T. tenera* it has four lobes.

3.6.2. Distribution and habitat

T. tenera occurs in Tanzania, Mozambique and Zimbabwe (Troupin, 1956, 1960; Troupin and Gonçalves, 1973). In South Africa its distribution is confined to the northern parts of Limpopo province, Mpumalanga, and the northern part of KwaZulu-Natal (Fig. 9). It also occurs in Swaziland (Fig. 9). *T. tenera* grows in humid places and in partial shade.

3.6.3. Phenology

T. tenera flowers in summer (November to February).

3.6.4. Etymology and common names

The specific epithet, *tenera*, means slender (Stearn, 1992) and is known as 'umdlatho' in the Zulu culture (De Wet and Van Wyk, 2008).

3.6.5. Traditional uses

A leaf extract of *T. tenera* is drunk to ease pain in joints. Roots are mixed with leaves to treat influenza and kidney stones and boiled leaves are used to treat venereal sores and skin problems (De Wet and Van Wyk, 2008).

3.6.6. Additional specimens examined

South Africa. LIMPOPO: **2229 (Waterpoort)**: South end of Wylliespoort, Soutpansberg (–DD), 17 Jan 1949, Codd 4826 (PRE); Fogwells Paradise, Wylliespoort (–DD), 17 Dec 1929, Gillet 2995 (BOL). **2230 (Musina/Messina)**: Limpopo River, near Messina (Musina) (–AC), Dec 1928, Hutchinson 2102 (BOL). MPUMALANGA: **2531 (Komatipoort)**: Skip Mountain, Kruger National Park (–AB), 30 Jan 1975, Botha & Gertenbach 910 (PRU), 15 Jan 1953, Van der Schijff 1659 (PRE); 14.4 km SE of Pretoriuskop (–AB), 9 Feb 1949, Codd & De Winter 5151 (PRE), 23 Jan 1954, Van der Schijff 3514 (PRE); Boulders, Kruger National Park (–CB), 26 Mar 1953, Van der Schijff 2522 (PRE); Crocodile Gorge, 28 km from Nelspruit on road to Kaap Muiden (–CA), 4 Apr 1978, Viljoen 2 (NBG, PRE). KWAZULU-NATAL: **2632 (Bela Vista)**: Next to Office in Tembe Elephant Park (–CD), 27 Mar 2001, Van Wyk & De Wet 4076 (ZULU).

Swaziland. **2631 (Mbabane)**: Mlawula Nature Reserve, beside crocodile pool (–BD), 15 Mar 1987, Alward 82 (PRE). **2632 (Bela Vista)**: Mbuluzi, Private Nature Reserve, rapids on Black Mbuluzi River, 4.8 km downstream of Maphiveni Bridge (–AA), 2 Mar 1980, Culverwell 1350 (PRE).

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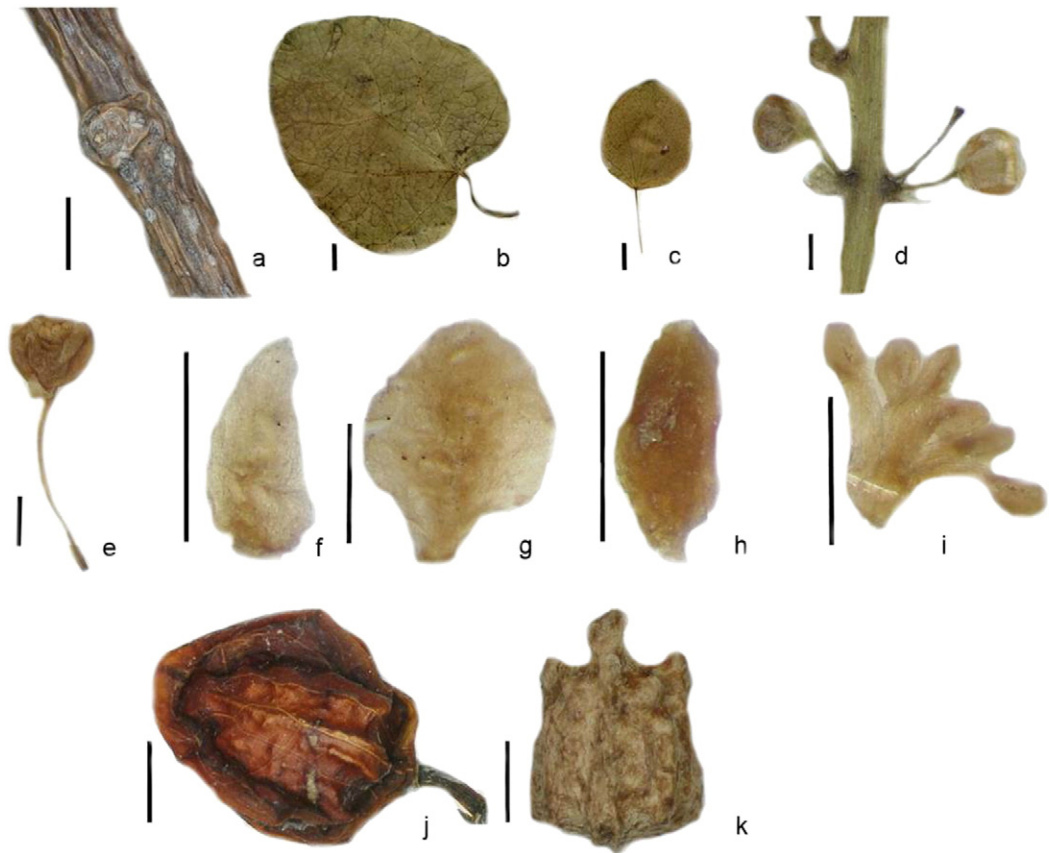


Fig. 8. *Tinospora tenera*. (a) Stem, Codd 5152; (b) leaf with cordate base, Culverwell 135; (c) leaf with obtuse base, Smith 2619; (d) inflorescence, Smith 2619; (e) male flower, Codd 5152; (f) outer sepal, Codd 5152; (g) inner sepal, Codd 5152; (h) petal, Codd 5152; (i) stamen, Codd 5152; (j) fruit, Viljoen 2; (k) endocarp, Viljoen 2. Scale bars (b–c) = 10 mm; (a; j–k) = 4 mm; (d–e) = 1 mm; (f–i) = 0.7 mm (Photographs: H. de Wet).

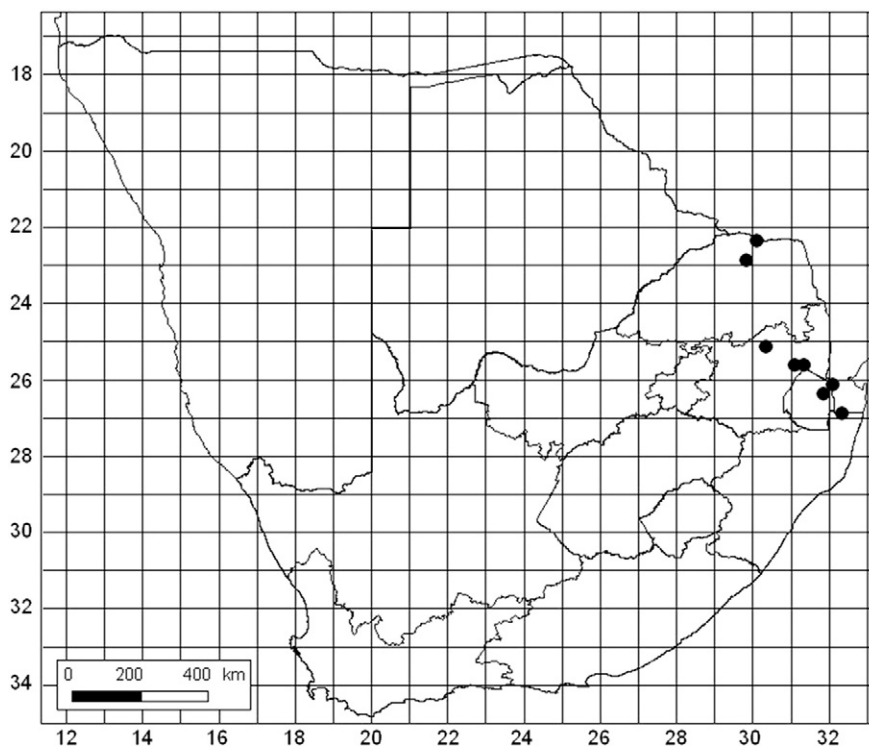


Fig. 9. Known geographical distribution of *Tinospora tenera* in southern Africa.

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