

Kappia lobulata (Apocynaceae, Periplocoideae), a new genus from South Africa

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Abstract

Kappia, a new genus from the Fish River Valley in the Eastern Cape Province, South Africa is presented. At first described as *Raphionacme lobulata* Venter and R.L.Verh. [Venter, H.J.T., Verhoeven, R.L. 1988. *Raphionacme lobulata* (Periplocoaceae), a new species from the eastern Cape Province, South Africa. South African Journal of Botany 54, 603–606.] based on a single specimen collected in 1936, recently discovered plants of this species proved it to be a new genus. In habit *Kappia* resembles *Baseonema* Schltr. and Rendle, *Batesanthus* N.E.Br., *Mondia* Skeels and *Stomatostemma* N.E.Br. However, as far as floral structure is concerned, *Kappia* reveals more affinity with *Raphionacme* Harv. DNA sequence data show *Kappia* to be distinct from *Batesanthus*, *Mondia* and *Raphionacme* Harv. and weakly supported as a sister to *Stomatostemma*.

1. Introduction

In 1936, the late RA Dyer, collected a plant near the confluence of the Fish and Kap Rivers not far from Ndlambe (Port Alfred) in the Eastern Cape Province. Although this plant belonged to the subfamily Periplocoideae (Apocynaceae), it was clearly undescribed. Venter and Verhoeven (1988) named it *Raphionacme lobulata* Venter and R.L.Verh. Subsequently the first author searched for this plant at the original locality but was unsuccessful and the description thus depended on the incomplete material of RA Dyer. Atypical characteristics present in *R. lobulata* have remained problematic. The forest habitat, the climbing habit, the leaf morphology, the peculiar interpetiolar stipules, and the hairiness of the inner petal surfaces are atypical but the flower morphology compares well with *Raphionacme* Harv.

In January 2003, Tony Dold of the Selmar Schonland Herbarium and second author of the present article, searched for and rediscovered *R. lobulata* in the Kap Nature Reserve, not far from the site of the original collection. Complete specimens, with flowers and fruit were collected. These complete collections convinced the first author that this species does not belong to *Raphionacme*. A search through other genera in the Periplocoideae indicated a likeness to *Batesanthus* N.E.Br. and *Baseonema* Schltr. and Rendle from tropical Africa, *Mondia* Skeels, widely distributed over subtropical and tropical Africa, and to *Stomatostemma* N.E.Br., widely distributed over subtropical southern Africa. However, none of these genera could satisfactorily accommodate *R. lobulata* and a new genus name, *Kappia*, is therefore coined for it. *Kappia* is derived from the name of the Reserve in which the plant was found and to which the genus may be endemic.

2. Material and methods

The external morphology of the new genus was studied from herbarium specimens and spirit material with an Olympus Stereo Microscope. Pollen was acetolysed (Erdtman, 1960), mounted in glycerine jelly and sealed with paraffin wax for the light microscope study and measurements. Pollen was, furthermore, acetolysed, air-dried on stubs, coated with gold and examined with a Jeol Winsem 6400 microscope at 5 kV. The pollen translators were mounted on stubs, coated with gold and examined with the same electron microscope. Pollen fixed in FAA was treated after the method of Spurr (1969), stained with uranyl acetate, followed by lead citrate, and was examined with a Philips CM100 transmission electron microscope at 60 kV.

Nuclear ribosomal DNA of *K. lobulata* was sequenced by Ionta and Judd and included in a phylogenetic analysis of the subfamily Periplocoideae (Apocynaceae). Details of that study will be published at a later date. Pairwise base differences (after adjusting for gaps/ambiguities) between ITS sequences of *R. lobulata* and other Periplocoideae were estimated using PAUP* 4.0b10 (Swofford, 1999).

Kappia Venter, A.P.Dold and R.L.Verh. **gen. nov.**

Kappia manifestat affinitatem *Batesantho* et *Baseonemae* habitu scandendi et carnosis interpetiolaribus stipulis, sed differt corolla. In *Batesantho* et *Baseonema* tubus corollae reflexus est et annulus coronalis sine lobis. *Kappia* habet infundibuliformem corollae tubum magnopere auctis coronae lobis carentibus annulum. *Raphionacme* manifestat affinitatem *Kappiae* morphologia florali, sed lobi corollae habent glabras superficies interiores.

Liana radice tuberibus, volubilibus caulibus, carnosis sub-sphaericis stipulis interpetiolaribus, infundibuliformi corollae tubo, hirsutis corollae lobis, obcordatis carnosis coronae lobis conjunctis corollae lobi basibus, magnis loriformibus nectariis supra nectaris saccos; pollen tetradibus 4–8 poris per granum.

TYPE: — *Kappia lobulata* (Venter and R.L.Verh.) Venter and A.P.Dold (*Raphionacme lobulata* Venter and R.L.Verh.).

Liana. *Roots* tuberous. *Leaves* with fleshy sub-spherical interpetiolar stipules. *Inflorescence* multi-flowered. *Corolla* tube funnel-shaped, corolla lobes glabrous outside, hirsute inside. *Corona* inserted in the corolla mouth, 5-lobed; lobes broadly obcordate, distally minutely hirsute, laterally fused to corolla lobes. *Stamens* arising from fleshy staminal feet, anthers fused to style-head, pollen in tetrads, grains 4–8-porate. *Interstaminal nectaries* arise near the base of the corolla tube, strap-shaped above nectar pouches. *Style-head* and anthers protruding from corolla mouth, pollen translators spatulate.

Kappia lobulata (Venter and R.L.Verh.) Venter, A.P.Dold and R.L.Verh. **comb. nov.**

Raphionacme lobulata Venter and R.L.Verh. in South African Journal of Botany 54, 603–606 (1988). TYPE: — Eastern Cape Province, Bathurst District, Fish River Mouth near Kap River, *Dyer 3381* (PRE!, holo.; GRA!, PRE!, iso.).

Perennial liana. *Roots* slender, with up to 15 succulent tubers strung along the roots; tubers sub-spherical, 50–200 mm diameter, greyish outside, flesh opaque white, latex white. *Stems* up to 12 m long, up to 15 mm diameter, twining; young bark pale mauve, old bark mottled grey. *Leaves* simple, opposite, glabrous, petiolate; petiole glossy, deep maroon, 8–12 mm long, grooved, with reddish prickles in the groove; interpetiolar stipules fleshy, sub-spherical, dentate; blade ovate to elliptic, coriaceous, 60–70 × 20–35 mm, adaxial surface glossy, dark green, veins sunken, reticulate, abaxial surface pale green, veins raised, margin entire, undulate, revolute, apex acute to acuminate and recurved, base obtuse to rounded, sometimes with reddish prickles. *Inflorescence* cymose, monochasial branches up to 10-flowered, glabrous; peduncles 5–15 mm long, pedicels 4–5 mm long; bracts triangular, margins membranous, often ciliate. *Flowers* actinomorphic, bisexual, pentamerous. *Sepals* free, broadly triangular, 2–3 × 2 mm, margins membranous to ciliate, apex acute. *Corolla* funnel-shaped, 6–10 mm long, semi-succulent; tube 2–3 mm long, glabrous; lobes ovate, 4–7 × 3–5 mm, apex acute, outside glabrous, apple green flushed pale maroon towards the base, inside apple green, hirsute, hairs white. *Coronal* columns 5, arising at the corolla mouth, laterally fused to the inner base of adjacent corolla lobes, yellow, fleshy; lobes from apices of coronal columns, broadly obcordate, 0.5–1.0 × 2 mm, yellow-green, tinged pale maroon, minutely hirsute on distal surface. *Stamens* directly below corona lobes; filaments fused to inner base of coronal columns, linear, ± 0.5 mm long; anthers fused to style-head, angular-ovate, ± 1 mm long, lower half infertile with basal callosities, upper half fertile, apical connectives triangular, fused into a dome-shaped cover over style-head; pollen in decussate tetrads, average 49.3 × 45.6 µm; single grains 4–8-porate; pores round with inner pore edge often irregular; exine smooth with distal tectum subtended by granular stratum. *Nectaries* inserted below and alternate to stamens, strap-shaped and erect around style, ± 1 mm long, nectar pouches below nectaries vertically fused with bases of adjacent coronal columns. *Pistil*: ovaries 2, semi-inferior, ± 0.5 mm long; style terete, dilating towards apex, ± 1.5 mm long; style-head broadly angular ovate, ± 0.5 × 1.0–1.5 mm; pollen translators embedded in the upper surface of the style-head, spatulate with broad ovate receptacle, stipe short, viscidium ovate, 795–830 × 414–440 µm. *Fruit* paired, 45° divergent follicles, occasionally single and erect; follicles narrowly ellipsoid with rounded and retuse apices, 65–80 × 23–25 mm, smooth, glossy green becoming longitudinally wrinkled and pale straw coloured when ripe, adaxial surface centrally longitudinally grooved and occasionally warty on distal keel. *Seeds* oblong-obovate, flattened, concavo-convex, 10–13 × 3–5 mm, yellow-brown becoming dark brown, rugulose with dark central ridge along the inner surface, margins erose, comose; coma white, spreading, 20–30 mm long (Fig. 1, Fig. 2, Fig. 3, Fig. 4 and Fig. 5).



Fig. 1. *Kappia lobulata*, roots and tubers (photo by AP Dold).



Fig. 2. *Kappia lobulata*, plant climbing on the stem of *Zanthoxylum capense* (photo by AP Dold).



Fig. 3. *Kappia lobulata* flower as seen from above (photo by AP Dold).

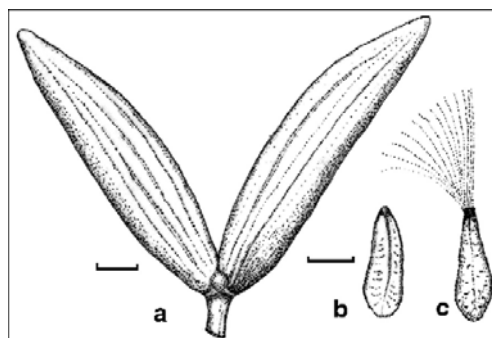


Fig. 4. *Kappia lobulata*, a: fruit with paired follicles; b: seed ventral surface; c: seed dorsal surface and proximal coma. Scale bars: a=10 mm; b, c=5 mm (Sketch by AP Dold from Dold 4461).

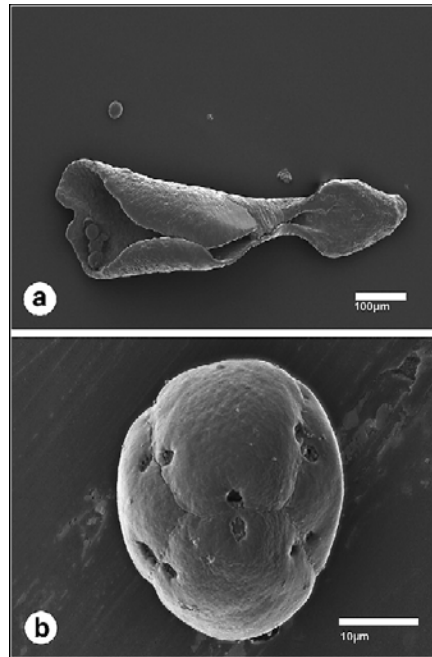


Fig. 5. *Kappia lobulata*, a: pollen translator and b: decussate pollen tetrad (micrographs by RL Verhoeven from Dold 4461). Scale bars: a=100 μm , b=10 μm .

3. Distribution and ecology

Dold 4461 was collected in riverine forest on the eastern bank of the Kap River, about halfway between Port Elizabeth and East London (Fig. 6). *Dyer 3381* may have been collected in an outlier of this population on the ecotone with Valley Thicket at the confluence of the Kap and Fish Rivers.

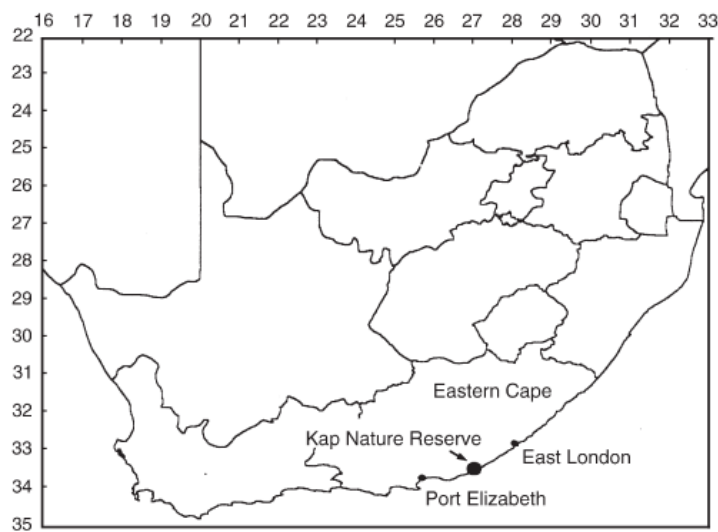


Fig. 6. Known distribution of *Kappia lobulata*.

Cloete (1994) describes the Kap River forest as a unique coastal forest type with strong affinity to the Amatola afro-montane forests. This forest, in the Albany Centre of Endemism (Van Wyk and Smith, 2001), has a significant number of rare and endangered plant species and is the southernmost limit for a number of Tongaland–Pondoland species and the northernmost limit for several Cape elements. Emergent tree species in this forest include *Podocarpus falcatus* (Thunb.) R.Br. ex Mirb., *Ficus sur* Forssk., *Calodendrum capense* (L.f.) Thunb. and *Sideroxylon inerme* L. Understory trees include *Croton rivularis* Müll.Arg., *Acalypha glabrata* Thunb. and *Mimusops obovata*

Sond. Some forest floor species are *Gnidia subcordata* (Meisn.) Engl., *Ecbolium flanaganii* C.B. Clarke and *Streptocarpus rexii* (Bowie ex Hook.) Lindl.. Although extremely localised in the forest *K. lobulata* is fairly common climbing in trees to a height of 12 m where it flowers in January.

4. Conservation status

Venter and Verhoeven (1988) suggested that *K. lobulata* may have disappeared from its natural habitat as a result of human influence on the vegetation, however, the vegetation type remains extensive and impenetrable in the vicinity. If the species is localised in riverine forest logging may have had a detrimental impact. The species is localised but fairly common in the Kap River Reserve which was established in 1989 by the Algoa Regional Service Council (Dold, 2001) and is currently managed by the Ndlambe (Port Alfred) Municipality. Based on the new IUCN categories (IUCN, 2000), Victor (2002) applied a status of “Vulnerable (VUD2)” to *K. lobulata* [= *R. lobulata*] and this status remains unchanged despite the rediscovery of the species. However, the description of the habitat as an urban environment (Victor, 2002) is incorrect as the species occurs in a protected area surrounded by farmland.

5. Specimens examined

EASTERN CAPE. — 3327 (Peddie): Kap River Reserve (-AC), 12/01/2003, *Dold 4461* (GRA); Bathurst District, Fish River mouth near Kap River (-AC), *Dyer 3381*, 21/01/1936 (PRE x2, GRA).

6. Discussion

Vegetatively, *Kappia*, *Batesanthus* and *Baseonema* are climbers, exhibiting very similar fleshy sub-spherical interpetiolar stipules that are unusual in the Periplocoideae. The flowers of all three have well developed corolla tubes, but in *Baseonema* and *Batesanthus* the tube is widely campanulate and reflexed with a coronal ridge on the fold, while in *Kappia* this tube is funnel-shaped and lacks a coronal ridge. In *Batesanthus* and *Baseonema*, with the exception of one species, no corona lobes exist, while in *Kappia* these lobes are well developed. In *Batesanthus* pollen tetrads with 4–6-porate grains occur (Taoana, 2001). *Baseonema* has tetrads with 8–16-porate pollen grains, a condition confined to *Baseonema* (Taoana, 2001), *Raphionacme* (*Raphionacme haeneliae* Venter and R.L. Verh. being an exception (Venter and Verhoeven, 1996)) and *Schlechterella* K.Schum. Although unusual *Schlechterella* has its tetrads grouped into pollinia (Verhoeven and Venter, 1988 and

Verhoeven and Venter, 1998). Venter and Verhoeven (1988) regarded the *K. lobulata* [= *R. lobulata*] pollen grains as 8-porate and thus similar to those found in *Raphionacme*, Dold 4461 revealed that the pores may be as few as 4 or 6 per grain. It is a pity that nothing is known about the root systems of *Batesanthus* and *Baseonema* to compare with the interesting stringed root tubers of *K. lobulata*. Both *Batesanthus* and *Baseonema* are from tropical Africa and are thus separated by a few thousand kilometres from *Kappia*.

Vegetatively, *K. lobulata* also strongly resembles *Stomatostemma monteiroae* (Oliv.) N.E.Br., but differs in stipules which are fleshy sub-spherical teeth in *Kappia* and simple ridges in *Stomatostemma*. Both species are woody perennial lianas, their leaves are similar in shape and texture, and both have similar peculiar strings of more or less spherical root tubers. The second author made an interesting observation that the *K. lobulata* tubers, when exposed above ground level in the field, give rise to a secondary vegetative growth. This phenomenon was not observed by the first author when examining the root tubers of *Stomatostemma* in the field (Venter 10456 (BLFU)), and was not reported by Meve and Liede (2004).

The flowers of *Stomatostemma* (Venter and Verhoeven, 1993) and *Kappia* are conspicuously different. The corolla lobes of *S. monteiroae* (and also *S. pendulina*) are glabrous inside, and the match-stick corona lobes arise from the petal sinuses, these clearly separated from the stamens which, as in *Cryptolepis* R.Br., arise from the bottom of the corolla tube. In contrast, the corolla lobes of *K. lobulata* are hirsute on their insides, and the broadly obcordate corona lobes, together with the stamens, arise at the corolla mouth. The follicles of *Stomatostemma* and *Kappia* are different, not only in shape (Venter and Verhoeven, 1993), but also in their fusion. In *Stomatostemma* the fruit follicles are completely fused until the seed is shed (communication by P. Winter, South African National Biodiversity Institute, Pretoria, and field observation by the first author), while in *Kappia* the follicles are free and divergent.

Stomatostemma is widely distributed across subtropical southern Africa and thus not so completely separated from *Kappia* as *Batesanthus* and *Baseonema*. Recently, a seemingly new periplocacious species was discovered by Ernst van Jaarsveld of Kirstenbosch Botanical Garden, Cape Town, which resembles *K. lobulata* in its climbing habit and strings of root tubers, but no flowers were found. This may well prove to be related to *Kappia* once its flowers are found.

Mondia Skeels also reveals an affinity to *Kappia*, particularly with regards to its large interstipular fringes and massive corona lobes, but its root tubers are long and cylindrical and its corolla is rotate with glabrous lobes.

With regards to the presence of root tubers, corolla structure, the position of the corona lobes, stamens, interstaminal nectary lobes and nectary pouches *Kappia* shows a strong affinity to *Raphionacme*. However, in *Raphionacme* usually only one, mostly turnip-shaped tuber occurs per plant, the corolla lobes have glabrous inner surfaces, and the pollen grains have 8 or more pores.

Inclusion of *K. lobulata* in a recent phylogenetic analysis of ribosomal DNA sequence data (Ionta and Judd, unpublished) confirmed its difference from the *Raphionacme* species, and weakly suggested it to be a sister to *Stomatostemma* (59% bootstrap support). Inspection of pairwise base differences (after adjusting for gaps/ambiguities)

between the ITS sequences of *K. lobulata* and other Periplocoideae revealed that *K. lobulata* differed from *Raphionacme* sampled by 3.69–4.14% base pairs or less. ITS sequences of *S. monteiroae* and *S. pendulina* differ by only 2.81%. *K. lobulata* differs from these taxa by 3.10 and 3.84%, respectively. As mentioned, *K. lobulata* is weakly supported as a sister to *Stomatostemma*, and these taxa also share certain vegetative features, as shown above. However, pairwise base differences of ribosomal DNA for *K. lobulata* show slightly more divergence from *S. pendulina* (3.84%) than from some *Raphionacme* species (*Raphionacme galpinii* Schltr.; 3.69%); these results coupled with numerous morphological differences between *K. lobulata* and *Stomatostemma*, as indicated above, support its recognition as a genus separate from *Stomatostemma*.

Meve and Liede (2004), in a DNA sequence study of tuberous Periplocoideae, showed that the African tuberous genera comprise two groups, a *Mondia/Stomatostemma* clade and a *Raphionacme* clade. Compared with the above ITS sequences of *Kappia*, *Stomatostemma* and *Raphionacme*, it seems likely that, *Kappia* belongs to the *Mondia/Stomatostemma* clade.

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