

## **Kalanchoe darainensis (Crassulaceae), a new species from northeastern Madagascar**

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# Kalanchoe darainensis (Crassulaceae), a new species from northeastern Madagascar

David-Paul Klein, Ronen Shtein, Louis Nusbaumer & Martin W. Callmander

## Abstract

KLEIN, D.-P., R. SHTEIN, L. NUSBAUMER & M.W. CALLMANDER (2021). *Kalanchoe darainensis* (Crassulaceae), a new species from northeastern Madagascar. *Candollea* 76: 117–123. In English, English and French abstracts. DOI: <http://dx.doi.org/10.15553/c2021v761a12>

A new species of small, rosulate and upright-flowered *Kalanchoe* Adans. (Crassulaceae) from northeastern Madagascar is described and illustrated: *Kalanchoe darainensis* D.-P. Klein & Callm. Morphologically, *Kalanchoe darainensis* is most similar to *Kalanchoe blossfeldiana* Poelln. and *Kalanchoe globulifera* H. Perrier which are known from the northwestern Tsaratanana Massif, c. 100 km southwest of Daraina. Detailed notes on the habitat and ecology of *Kalanchoe darainensis* are provided, as well as a short taxonomical overview of allied species of the *Kalanchoe* subg. *Kalanchoe* from Madagascar, including an identification key to those species. Despite its restricted distribution in the protected Antsahabe massif, the new species is preliminary assessed as “Least concern” [LC] using the IUCN Red List Criteria.

## Résumé

KLEIN, D.-P., R. SHTEIN, L. NUSBAUMER & M.W. CALLMANDER (2021). *Kalanchoe darainensis* (Crassulaceae), une nouvelle espèce du nord-est de Madagascar. *Candollea* 76: 117–123. En anglais, résumés anglais et français. DOI: <http://dx.doi.org/10.15553/c2021v761a12>

Une nouvelle espèce de *Kalanchoe* Adans. (Crassulaceae), petite, rosulée et à fleurs dressées du nord-est de Madagascar est décrite et illustrée: *Kalanchoe darainensis* D.-P. Klein et Callm. Morphologiquement, *Kalanchoe darainensis* est plus proche de *Kalanchoe blossfeldiana* Poelln. et *Kalanchoe globulifera* H. Perrier qui sont connues du nord-ouest du massif de Tsaratanana, c. 100 km au sud-ouest de Daraina. Des notes détaillées sur l'habitat et l'écologie de *Kalanchoe darainensis* sont fournies, ainsi qu'un bref aperçu taxonomique des espèces alliées de *Kalanchoe* subg. *Kalanchoe* de Madagascar, y compris une clé d'identification de ces espèces. Malgré sa distribution restreinte dans le massif protégé d'Antsahabe, la nouvelle espèce est préalablement évaluée comme «Préoccupation mineure» [LC] en utilisant les critères de la Liste Rouge de l'IUCN.

## Keywords

CRASSULACEAE – *Kalanchoe* – Madagascar – Daraina – Loky-Manambato – New species

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## Introduction

The genus *Kalanchoe* Adans. (Crassulaceae, *Kalanchooideae*) comprises more than 150 species known to date and occurs in Madagascar, Africa, Arabia and tropical Asia. Currently 80 species and nothospecies are recognized in Madagascar, all but one of which are endemic to the Great Island (MADAGASCAR CATALOGUE, 2021). The genus of *Kalanchoe* consists of three subgenera: the autonymic *Kalanchoe* subg. *Kalanchoe* which is known from Madagascar, Africa, Arabia and Asia, as well as *Kalanchoe* subg. *Bryophyllum* (Salisb.) Koorders and *Kalanchoe* subg. *Kitchingia* (Baker) Gideon F. Sm. & Figueiredo, both endemic to Madagascar (SMITH & FIGUEIREDO, 2018).

*Kalanchoe* subg. *Kalanchoe* includes species that share the following characters: plants annual or perennial, herbaceous or woody-arborescent, calyx unfused for most of its length with a short to indistinct tube, sepal segments often free, usually adpressed to the corolla tube, filaments inserted  $\pm$  above the middle of the corolla tube, rarely below, flowers typically erect, rarely omni-directional or pendent, leaves and inflorescences never bulbiferous, carpels convergent, usually much longer than the styles, scales elongated to linear, with a length/width ratio usually  $> 3$ , anthers included in corolla-tube or very slightly exserted, often dressed with a  $\pm$  spherical connective gland on the anthers (BOITEAU & ALLORGE-BOITEAU, 1995; DESCOINGS, 2003; SMITH & FIGUEIREDO, 2018).

Among the Malagasy representatives of *Kalanchoe* subg. *Kalanchoe*, several morphologically similar species were historically placed in “Group 13” of RAYMOND-HAMET (1907) to so emphasize the morphological similarities they share with species indigenous to mainland Africa, in contrast to similarities shared with other species from Madagascar. These species are *K. boisii* Raym.-Hamet & H. Perrier, *K. briquetii* Raym.-Hamet, *K. chapototii* Raym.-Hamet, *K. globulifera* H. Perrier and *K. globulifera* var. *coccinea* H. Perrier (= *K. blossfeldiana* Poelln.). Later, BOITEAU & ALLORGE-BOITEAU (1995) and ALLORGE-BOITEAU (1996) proposed to further subdivide these species into the two informal groups “Occidentales” and “Globuliferae”, along with *K. aromatica* H. Perrier, *K. bouvetii* Raym.-Hamet & H. Perrier and *K. lanceolata* (Forssk.) Pers. The group “Globuliferae” was defined based on the spherical connective glands (“globules”) on the anthers, whereas species placed in “Occidentales” have terminal inflorescences, are glandular pilose (except *K. blossfeldiana*) and do not have the aforementioned connective glands. However, they added that the latter group “ne présente pas beaucoup d’homogénéité” [do not present much homogeneity] (BOITEAU & ALLORGE-BOITEAU, 1995: 187). They also underlined the morphological affinity of both groups to some continental African species, as opposed to other Malagasy representatives of *Kalanchoe* subg. *Kalanchoe*, such as the species they placed in the informal “Lanigeræ” group.

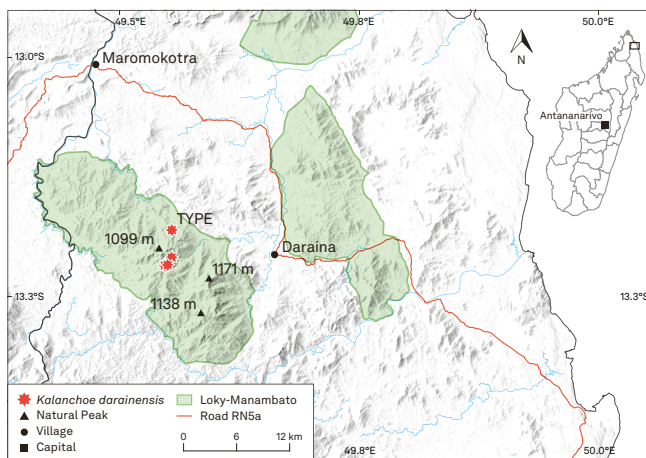


Fig. 1. – Distribution map of *Kalanchoe darainensis* D.-P. Klein & Callm. [map derived from open data sources: <https://earthdata.nasa.gov>, OpenStreetMap® and MOAT & SMITH (2007)]

Excluding *Kalanchoe aromatica* and *K. bouvetii*, that have omnidirectional, zygomorphic flowers and distinct corolla tubes, we consider the species of both informal groups, “Occidentales” and “Globuliferae”, to form a common species group. These are small statured shrubs to medium sized herbs, usually at least partially covered with a glandular indumentum, that have erect, actinomorphic flowers, highly reduced to indistinct calyx tubes, long, deltoid to narrowly lanceolate sepals, apically acute to acuminate and linear to filiform nectary scales. Two further recently described species, *K. antennifera* Desc. and *K. pareikiana* Desc. & Lavranos can also be placed in this species group, based on their morphology. *Kalanchoe antennifera* originates from the vicinity of Antsalova in the Tsingy de Bemahara in western Madagascar (Mangelsdorff, pers. comm.). The precise type locality was unknown to DESCOINGS (2004) who stated “Africa” in the protologue. Moreover, despite its occurrence in Arabia, virtually across continental Africa, and in Madagascar, the exact natural geographical distribution range of *K. lanceolata* remains open to conjecture. *Kalanchoe lanceolata* rather shares character expressions with species of *Kalanchoe* subg. *Kalanchoe* from beyond Madagascar and accordingly we refrain from placing it in this otherwise Malagasy group.

During inventories of the Daraina region (now called Loky-Manambato, see PHILLIPSON et al., 2018), four specimens of small, rosulate, glandular pilose, succulent plants were collected in the massif of Antsahabe (Fig. 1). These specimens have the erect flowers, linear to filiform nectary scales, apically inserted filaments and reduced calyx tube that are found in representatives of *Kalanchoe* subg. *Kalanchoe*, and were all originally determined as representing *K. pumila* Baker. However, *K. pumila* differs from the collected specimens by being taller (20–30 cm) and floury-pruinose, by lacking an indumentum, and by having large, pink-coloured, campanulate corolla tubes (BAKER, 1884; BOITEAU & ALLORGE-BOITEAU,

1995). It is here demonstrated that these collections from the Daraina region are unique among all other known *Kalanchoe* and are described below as a new species: *K. darainensis* D.-P. Klein & Callm. *Kalanchoe darainensis* is most similar to *K. blossfeldiana* and *K. globulifera*, and represents yet another Malagasy member of *Kalanchoe* subg. *Kalanchoe* with strong similarities to continental African species.

### Key to *Kalanchoe darainensis* and allied species

1. Plants perennial, soboliferous; indumentum absent to partial; leaves ovate-oblong, obovate or orbicular, never lobed; flowers golden yellow or scarlet red ..... 2
- 1a. Plants predominantly annual, non-soboliferous; indumentum partial to complete; leaves ovate-lanceolate to linear, often lobed, rarely bi-lobed; flowers whitish to golden yellow ..... 4
2. Flowers yellow, few (7 to 10); leaves sessile; indumentum sparsely glandular, restricted to stem and peduncle ..... *K. globulifera*
- 2a. Flowers scarlet, numerous; leaves petiolate to sessile; indumentum absent or partially densely glandular, restricted to leaves, stem and peduncle ..... 3
3. Indumentum absent; leaf blades ovate-oblong, apically obtuse to acute; inflorescences numerous, terminal and axillary, many-flowered thyrses ..... *K. blossfeldiana*
- 3a. Indumentum densely glandular, restricted to leaves, stem and peduncle; leaf blades ovate, elliptic to orbicular, apically rounded-obtuse; inflorescences single, terminal, many-flowered dichasial cymes ..... *K. darainensis*
4. Sepals and corolla especially thick and fleshy; glandular hair thick-stalked, extends to the upper part of the stem, young leaves, inflorescence, and sepals; flowers whitish cream-yellow ..... *K. pareikiana*
- 4a. Sepals and corolla not thick or fleshy; glandular hair slender-stalked, complete, i.e. extends from the base of the stem to the petals; flowers golden yellow ..... 5
5. Leaves alternate basally, decussate higher up; petals sub-oblong, retuse, i.e. rounded-obtuse and notched; filaments 6.5–8.5 mm in length, free for  $> \frac{1}{3}$  of their length, papillose; anthers fully exerted, wider than long, lacking connective glands ..... *K. briquetii*
- 5a. Leaves decussate; petals ovate, apically acute to acuminate; filaments 10–13 mm in length, free for  $< \frac{1}{10}$  of their length, non-papillose; anthers partially to fully included, longer than wide, dressed with  $\pm$  spherical connective glands ..... 6
6. Plants perennial; leaves 3- to 5-partite, occasionally bi-lobed and petiolulate; leaf or leaflet blades oblong to linear; margins obtusely crenate-sinuate; petals strongly

acuminate with an acumen 3.5–4.5 mm long; styles much longer than carpels ..... *K. chapototii*

- 6a. Plants annual; leaves 1- to 3-partite, if lobed not bi-lobed nor petiolulate; leaf or leaflet blades ovate to lanceolate; margins entire to minutely crenate-sinuate; petals acuminate with an acumen 1.2–2 mm long; styles much shorter than carpels ..... 7
7. Leaves unlobed; leaf or leaflet blades ovate, apically sub-obtuse; styles  $> 2$  times shorter than carpel ..... *K. boisii*
- 7a. Leaves 3-partite; leaf or leaflet blades ovate-lanceolate, apically acuminate-acute; styles  $< 2$  times shorter than carpel ..... *K. antennifera*

### Taxonomy

*Kalanchoe darainensis* D.-P. Klein & Callm., **sp. nov.** (Fig. 2, 3).

**Holotypus:** MADAGASCAR. **Reg. SAVA [Prov. Antsiranana]:** Daraina, forêt d'Antsahabe, [13°13'S 49°33'E], 390 m, 30.IV.2004, fl., *Ranirison* 749 (G [G00028103]!; iso-: TEF image!, P).

*Kalanchoe darainensis* D.-P. Klein & Callm. differs from other representatives of *Kalanchoe* subg. *Kalanchoe* by its dense indumentum of medium to long glandular hairs, covering all parts of the plant except flowers and bracteoles, its basally near-ligneous stems, soboliferous above, developing a single, erect, terminal inflorescence per rosette, rarely two, with a single peduncle each, composed in the apical half of a single node, its indistinct calyx tube, narrowly lanceolate and acute sepals, a corolla tube gradually constricted above to a subcylindrical throat in the apical half, with scarlet red, erect flowers and anthers dressed with flattened spheroid connective glands.

Plants small, perennial, rosulate and succulent, 8.5–13.5 cm high, mostly erect, creeping to decumbent at base, soboliferous, bearing one to few lateral basal shoots, almost entirely densely covered with medium to long glandular hairs. Stems 2.5–3.5 mm in diameter, terete, basally near-ligneous and without indumentum when mature, bearing roots and lateral shoots, densely covered with medium (0.5–1 mm) white-brownish glandular hairs. Leaves opposite, decussate, succulent, light bright green to olive with slightly reddish margins, arising from a rosette bearing up to 6 pairs of leaves, entirely covered with whitish to brownish, medium (0.5 mm) to long (1.9 mm) glandular hairs, long-petiolate to sessile; petioles 1.5–21.5  $\times$  0.5–4 mm, subcylindrical, somewhat flattened above, convex below, broadening towards the leaf base, densely covered with whitish to brownish, short (0.2 mm) to medium (1 mm) glandular hairs. Leaf blades 6–50  $\times$  4–51 mm, ovate, elliptic to orbicular, sometimes wider than long, adaxially canaliculate along the midrib, densely covered with long (up



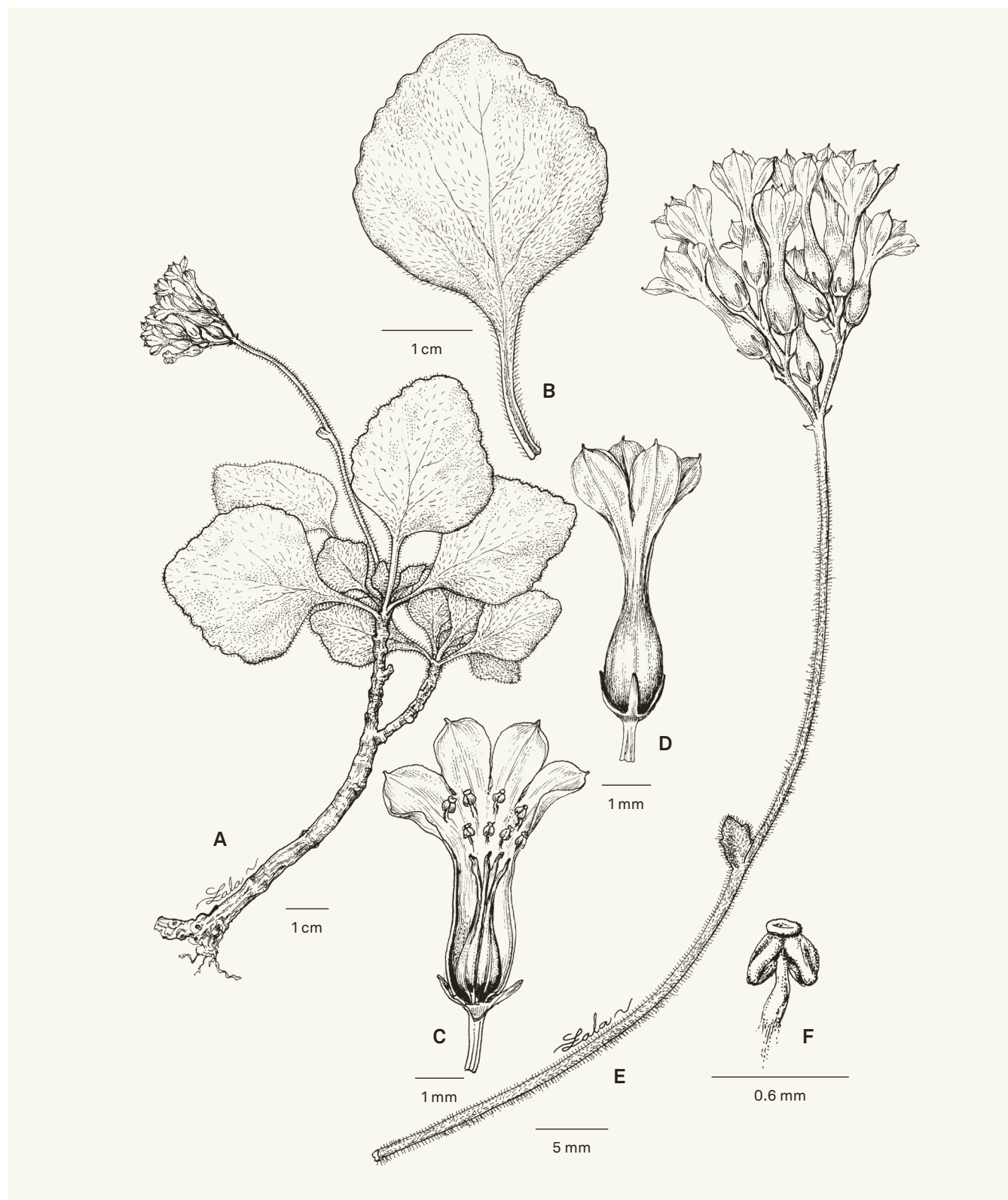
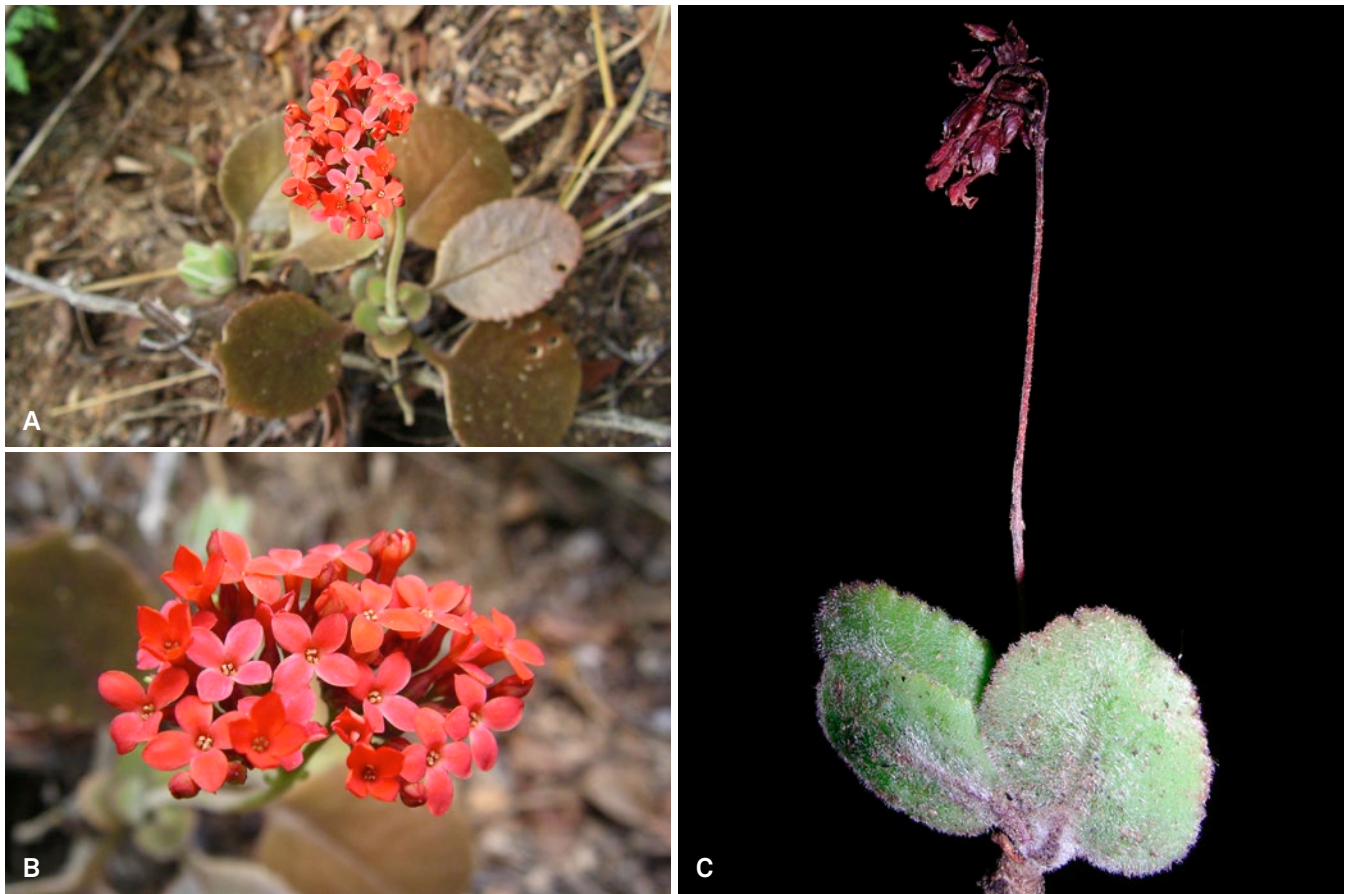


Fig. 2. – *Kalanchoe darainensis* D.-P. Klein & Callm. A. Habit; B. Basal leaf; C. Dissection of corolla, showing androecium and gynoecium; D. Flower; E. Inflorescence; F. Anther with flattened spheroid connective gland.  
 [Ranirison 749, TEF] [Drawings: R.L. Andriamiarisoa]



**Fig. 3.** – *Kalanchoe darainensis* D.-P. Klein & Callm. **A.** Rosulate growth with succulent, bright green to olive leaves; **B.** Terminal, scarlet red and many-flowered dichasial cymes; **C.** Leaves entirely covered with short to long glandular hairs. [A–B: Ranirison 749; C: Callmänder et al. 241] [Photos: A–B: P. Ranirison; C: M. Callmänder]

to 1.9 mm) whitish glandular hairs; tip obtuse-rounded; base obtuse to  $\pm$  rounded or near-truncate, often oblique; margins irregularly wide-sinuate to wide-crenate. *Inflorescences* a few- to many-flowered dichasial cyme with up to 3 secondary branches bearing up to 31 flowers, erect, typically one terminal inflorescence per rosette, rarely two, sparsely covered with medium (up to 0.5 mm) whitish-brownish glandular hairs up to the second node of the inflorescence; peduncle 65–100  $\times$  0.4–1.5 mm, terete, thinning apically, bearing 1–few pairs of peduncular bracts, apical half composed of a single node, densely covered with medium (up to 0.5 mm) whitish-brownish glandular hairs; peduncular bracts 1.6–5  $\times$  0.5–3 mm, borne in the lower third or middle of the peduncle, sessile, densely covered with medium (up to 0.5 mm) whitish-brownish glandular hairs, tip obtuse, base cuneate, margins irregularly sinuate to crenate. *Flowers* 8–10  $\times$  2.5–4 mm, erect. *Bracts* 1.2–1.3  $\times$  0.25–0.4 mm, sessile, lanceolate, slightly incurved, apically acute, sparsely glandular hairy. *Pedicels* 2–2.5  $\times$  0.3–0.7 mm, erect, widening towards the flower. *Bracteoles* 0.8–1.5  $\times$  0.1–0.2 mm, sessile, narrowly lanceolate, incurved, apically acute, glabrous. *Calyx tubes* 0.1–0.2 mm long, indistinct, green. *Sepals*

1–1.9  $\times$  0.20–0.65 mm, free, sometimes slightly adpressed to corolla tube in lower  $\frac{1}{10}$ , narrowly lanceolate, apically acute. *Corolla tubes* 6–8 mm long, at its widest part 1.5–2 mm, scarlet red,  $\pm$  4-angled where it is widest and adpressed against the carpels, gradually constricted above to a subcylindrical throat, very slightly widening towards the petals. *Petals* 2–3.5  $\times$  2 mm, ovate-obovate, apex obtuse, short-mucronate (0.1 mm long). *Stamens* 8, arranged in two rows, 4 stamens each, fused to the corolla tube internally for the most part, free segments short, anthers of upper row at most reaching to slightly exserting the corolla mouth; upper filaments (oppositipetalous) inserted at c. 6.5 mm above corolla base, free for 0.3–0.5 mm; lower filaments (alternipetalous) inserted at c. 5 mm above corolla base, free for 1–1.3 mm. Anthers dull brownish-yellow, each locule (theca) 0.35  $\times$  0.5  $\times$  0.1 mm, elliptic, base emarginate, apex rounded, dressed with a flattened spheroid connective gland; connective gland erythrocyte-shaped, distinctly present only on the upper stamens, 0.3  $\times$  0.3  $\times$  0.05 mm. *Pistils* consisting of 4 carpels; carpels 4.5–6  $\times$  1–1.4 mm, greatest width towards the middle, convergent; styles 1.2–1.5 mm long; stigmas very slightly capitate. *Scales* 2.2–2.5  $\times$  0.2 mm, long and thin,

flattened, adpressed to carpel, whitish, ligulate / strap-shaped, apex truncate to rounded. *Seeds* 0.5 × 0.15 mm, brown, longitudinally furrowed (striate).

*Distribution, ecology and phenology.* – *Kalanchoe darainensis* is known only from the Antsahabe forest in the Loky-Manambato region (Daraina) in northeastern Madagascar (Fig. 1). Being situated between the Eastern humid and the Western dry phytogeographical domains, with elevation levels partially resembling those of the Central domain, this area comprises particularly diverse vegetation types (RANIRISON et al., 2018). Only four individuals of the new species were found among all the localities visited during a vegetation study, which included more than 54,000 records of plant occurrences in the 10 main forest areas of that region (NUSBAUMER, 2011). These individuals were observed at elevations between 390 and 900 m where the annual mean precipitation reaches 1400–1450 mm and annual mean temperatures vary from 17.5–21° C, depending on the elevation level (NUSBAUMER, 2011). *Kalanchoe darainensis* grows on the lower slopes of rocky outcrops on raw mineral soils (lithic erosion soils on leucocratic granite or skeletal soils on cristalin domes) in rupicolous vegetation mainly surrounded by primary mesophilous and ombrophilous forest (RANIRISON et al., 2018), but also by matrix habitats on a ridge covered with sparse vegetation with a low canopy. The rupicolous vegetation reaches heights of 1 m with occasionally emerging treelets up to 4–5(–8) m tall. The most frequently recorded species occurring with *K. darainensis* include: *Artabotrys darainensis* Deroin & L. Gaut. (*Annonaceae*), *Aulotandra trigonocarpa* H. Perrier (*Zingiberaceae*), *Chasechloa humbertiana* A. Camus (*Poaceae*), *Doryopteris cordifolia* (Baker) Diels (*Pteridaceae*), *Dracaena reflexa* var. *linearifolia* Baker (*Asparagaceae*), *Emilia humifusa* DC. (*Asteraceae*), *Eugenia viguieriana* H. Perrier (*Myrtaceae*), *Pandanus* cf. *grallatus* B.C. Stone (*Pandanaceae*) and *Xerophyta* sp. (*Velloziaceae*).

Other species of *Kalanchoe* collected in the Loky Manambato region include *K. aff. miniata* Hilsenb. & Bojer ex Tul.,

*K. maromokotrensis* Desc. & Rebmman, *K. pinnata* (Lam.) Pers. and *K. porphyrocalyx* (Baker) Baill.

*Kalanchoe darainensis* was collected in flowers between April and October.

*Conservation status.* – While *Kalanchoe darainensis* is known only from four collections representing four locations (sensu IUCN, 2012), it is situated within a large block of forest in the Loky-Manambato protected area. No future decline is expected in terms of Area of Occupancy (AOO), Extent of Occurrence (EOO), or quality of habitat. We therefore assign a preliminary risk of extinction status of “Least concern” [LC] using the IUCN Red List Categories and Criteria (IUCN, 2012).

*Notes.* – *Kalanchoe darainensis* is morphologically most similar to *K. blossfeldiana* and *K. globulifera* (Table 1). The two latter species are restricted to the high-altitude humid forests of the Tsaratanana mountain range, c. 100 km south-west from Daraina. Like *K. darainensis*, these species are perennial, small-sized, soboliferous, rosulate plants with simple leaves and a subcylindrical corolla-throat. *Kalanchoe blossfeldiana* and *K. darainensis* share the same flower characters, i.e. the scarlet red flower color and the petals being ovate-obovate, with an obtuse, mucronate apex. *Kalanchoe globulifera* and *K. darainensis* both produce few- to many-flowered dichasial cymes, are at least partially glandular pilose and are dressed with connective glands on the anthers. Among the northern representatives of *Kalanchoe* subg. *Kalanchoe* in Madagascar, a scarlet red flower color is unique to *K. blossfeldiana* and *K. darainensis*.

*Additional specimens examined.* – MADAGASCAR. Reg. SAVA [Prov. Antsiranana]: Daraina, massif d’Antsahabe, 13°13’S 49°33’E, 620 m, 16.X.2004, Callmander et al. 241 (G, K, MO, P, TEF); *ibid. loco*, 13°13’S 49°33’E, 900 m, 6.XII.2004, Gautier & Nusbaumer LG 4843 (G, K, MO, P, TEF); *ibid. loco*, 13°13’S 49°33’E, 560 m, 3.XI.2005 Razafitsalama et al. 771 (MO, P, TAN).

Table 1. – Diagnostic characters distinguishing *Kalanchoe darainensis* D.-P. Klein & Callm. from *K. blossfeldiana* Poelln. and *K. globulifera* H. Perrier.

	<i>K. darainensis</i>	<i>K. blossfeldiana</i>	<i>K. globulifera</i>
Habit height [cm]	8–13.5	9–30	6.5–9(–22.5)
Indumentum	dense, partial, glandular	absent	sparse, partial, glandular
Leaf blade shape	ovate, elliptic to orbicular	ovate-oblong	obovate-orbicular
Leaf blade tip	rounded to obtuse	obtuse to acute	rounded
Type of inflorescence	terminal, few- to many-flowered dichasial cymes	terminal and axillary, many-flowered thyrses	terminal, few- to many-flowered dichasial cymes
Number of inflorescences	typically 1	numerous	1 to few
Flower colour	scarlet red	scarlet red	golden yellow
Calyx tube [mm]	indistinct, 0.1–0.2	short, 1	short, 0.5



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