




## ***Kalanchoe torrejaczii* (Crassulaceae subfam. Kalanchooideae), a new species in *K.* subg. *Bryophyllum* from the Namorona River valley, Madagascar**

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### Abstract

*Kalanchoe torrejaczii* (Crassulaceae subfam. Kalanchooideae) is described as a new phyllo-bulbiliferous species. It occurs in the Namorona River valley, near Ranomafana, southern Madagascar. Differences between *K. torrejaczii* and the partially sympatric *K. laxiflora* are discussed and the new species is contrasted with representatives of the *K. rosei* complex with which it shares some similarities. *Kalanchoe torrejaczii* is the most northern pink-flowered species among other such species that belong to the recently described *K.* sect. *Invasores*, to which *K. laxiflora* and representatives of the *K. rosei* complex also belong.

**Keywords:** *Kalanchoe*, new species, phyllo-bulbiliferous, Ranomafana

### Introduction

With some 80 of the *ca.* 180 known species of *Kalanchoe* Adanson (1763: 248) indigenous to Madagascar, this island is a present-day centre of species diversity for the genus. *Kalanchoe torrejaczii* Shtein & Gideon F.Sm. (Crassulaceae subfam. Kalanchooideae) (Fig. 1), a new species of phyllo-bulbiliferous *Kalanchoe*, is described from the Namorona River valley, near Ranomafana, southern Madagascar. It differs from the closely related and partially sympatric *K. laxiflora* Baker (1887: 472) by having truncate, at most shallowly auriculate, never peltate, narrower leaves that are sometimes basally lobed; by having a barely stipitate, large, vibrant pink corolla that is at least as wide as the calyx where it is inflated; and by the generally green foliage that is only marked along the less distinctly crenate margins. Similarities with representatives of the *K. rosei* Raymond-Hamet & Perrier de la Bâthie (1914: 132) complex are discussed.

### Material and methods

The description is based on detailed morphological studies of material of *K. torrejaczii*, as well as of individuals of material with which it shares some characters and could be confused (see ‘Discussion’). Measurements were taken using a ruler, except for floral measurements below 4 mm, which were taken using hand-held magnifying equipment. The new species was compared to other representatives of *K.* subg. *Bryophyllum*, with character information for these species obtained from living material and herbarium collections, especially those held at Herb. P.

The infrageneric classification of *Kalanchoe* followed here recognises four subgenera, i.e., the autonymic one, as well as *K.* subg. *Bryophyllum* (Salisbury 1805: t. 3) Koorders (1918: 170), *K.* subg. *Kitchingia* (Baker 1881: 268) Smith & Figueiredo (2018: 169), and *K.* subg. *Fernandesiae* Smith (2020a: 5). Within *K.* subg. *Bryophyllum*, we recognise *K.* sect. *Invasores* Shtein & Smith (2021: 105), to which *K. torrejaczii* belongs, as discussed below.

Authors of the taxa cited follow IPNI (2020+), but in the notation required by *Phytotaxa*, and herbarium codes follow Thiers (2020 [continuously updated]). Nomenclatural matters accord with the Shenzhen Code (Turland *et al.* 2018).



**FIGURE 1.** *Kalanchoe torrejaczii* (R. Shtein 580). A. Pink-flowered, terminal inflorescences. B. Basal leaves and suffrutescent stem. C. Apical leaves of a plant in vegetative growth. D. Minutely and broadly auriculate leaf blade base, lacking any crenation or dentation. Photographs: Ronen Shtein.

## Nomenclature

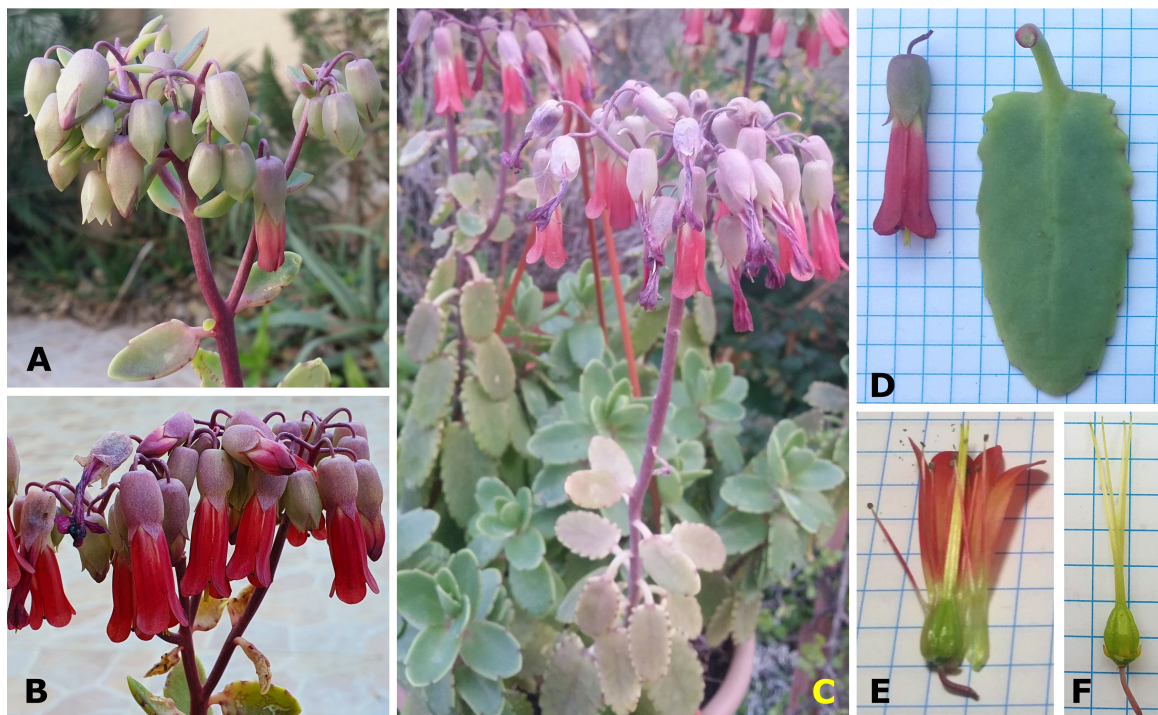
*Kalanchoe torrejaczii* Shtein & Gideon F.Sm. *sp. nov.* (Figs 1, 2).

**Type:**—MADAGASCAR. Vatovavy-Fitovinany region, Namorona River valley, along the north side of the road RN 25, about 6 km west of Ranomafana, just east of Vorondolo, southeastern Madagascar, in shade at the bottom of a cliff over which water flowed, collected on 26 June 2011 by Aldo Torrebruno & Joël Jacq *s.n.*, plants cultivated in Israel and prepared on 20 April 2020, R. Shtein 580 [TELA904] (holotype TELA); R. Shtein 580 [TELA905, TELA921] (isotypes TELA).

**Diagnosis:**—*Kalanchoe torrejaczii* differs from all other representatives of *K.* subg. *Bryophyllum* by having mostly erect, suffrutescent stems; by having induced-bulbiliferous leaves that are narrowly ovate-elliptic to oblong, distinctly truncate and often shallowly auriculate basally; by the corolla being predominantly pink, indistinctly short-stipitate, and 2.5× longer than the calyx; by the free sepal segments being as long as wide or wider; by the calyx tube being only slightly longer than wide; and by having nectar scales that are somewhat wider than long.

**Description:**—Plants perennial, entirely glabrous, sometimes slightly glaucescent throughout (in direct sun), often branched, basally generally erect to decumbent, about 0.6–0.8 m tall when in flower. Stem 5.0–7.5 mm in diam., 3–5 mm towards inflorescence, suffrutescent, green to brown basally, purple in distal half, cylindrical, often developing aerial roots; leaf scars rounded-crescentiform, conspicuous, slightly protruding, not connate; internodes 1.0–2.5 cm long. Leaves opposite, decussate, distinctly petiolate, succulent, sometimes trilobate; petiole 0.8–2.5 cm long, 3 mm in diameter, cylindrical, slender, sometimes slightly widened distally, green to purple; blade 3.6–5.5 × 2.2–3.5 cm, uniformly green to green-brown, narrowly ovate-elliptic to oblong, ± flat, often slightly concave above and convex below, not guttered, abaxial surface indistinctly coloured, widest basally or rarely medially, if lobed, lobes

obtuse and shallow; *margins* green to green-brown, subentire to entirely irregularly bluntly crenate-serrate, blotched red to dark purple between crenations, within blotches marked by pale organogenic and/or embryogenic notches prior to bulbil production or bulbils proper; *crenations* 0.5–3 × 3–7 mm, increasing in width medially, increasing in acuity and frequency basally and apically, blunt to indistinct; *bulbil production* stress-induced, possible at each marginal leaf notch, but most common in apical ½; *base* ± truncate, proximal end entire, sometimes broadly auriculate, auricles absent or shallow, < 1 mm long; *apex* obtuse to rounded. *Inflorescence* a corymbiform cyme, not leafed at anthesis, non-bulbiliferous, i.e., does not form dense bulbil clusters, but may form few, large, discrete plantlets post-flowering, dense, terminal, 9–15 cm wide; *peduncle* single, cylindrical, 9–12 cm long, 3–5 mm in diameter, nodes few and long; *peduncular bracts* ± 2.5 × ± 1.5 cm, entire, petiolate, truncate, leaf-like, wilting soon; *floral bracts* ± 9 × ± 3 mm, sessile, attenuate, narrowly oblong, entire or few-dentate apically, wilting soon; *pedicels* 6–13 mm long, curved, cylindrical, tapering towards the flowers from 1.0–1.8 mm to ± 0.5–0.7 mm in diam., purple. *Flowers* numerous, pendent, campanulate. *Calyx* 12–14 × 7–8 mm, green-grey to purple, free sepal segments especially infused with purple, succulent, thick, campanulate-urceolate, rarely slightly 4-angled, basally ± flat, widest in apical ¼ just above point of sepal fusion, then constricted where sepals fuse; *tube* 8–10 mm long; *free sepal segments* 4–5 mm long, widest at base at 5–6 mm, ovate to deltoid, apiculate, adpressed to corolla to slightly spreading. *Corolla* 31–34 mm long, uniformly vibrant pink, green where obscured by calyx, barely stipitate, *stipe* ± 0.5 × ± 2.5 mm; *tube* 23–25 mm long, especially basally ± 4-angled, basally adpressed around and above carpels, up to 5.5 mm wide, then diminishing to 3.0–3.5 mm wide at its thinnest, then gradually inflating to base of petals where it is very slightly constricted at width of 6.0–6.5 mm, widest in apical ⅓ at width of 6.5–7.0 mm; *lobes* 7.5–9.0 × 4–5 [at base] mm, widest at 5–6 mm at ⅓ from tip, oblong-obovate, apically rounded, very slightly apiculate, usually spreading. *Stamens* 8, inserted low down in corolla tube, at ± level of carpels, almost exserted, visible between, and reaching distal ⅓ of petals; *filaments* of two similar lengths, adpressed, protruding inside base of corolla, free for ± 20–23 mm, thin, dull green basally and apically, strongly infused with purple-pink elsewhere; *anthers* ± 0.8–1.2 × 1.0 mm, dark grey, ovate-cordate, ± as long as wide; *pollen* dark grey-violet. *Pistil* consisting of 4 carpels; *carpels* ± 6.5–7.5 × 2.0–2.5 mm, convergent, fused at base, free above, uniformly dark green, narrowly ovate to almost conical, widest in lower ⅓, cuneate towards styles; *styles* ± 24–26 mm long, uniformly yellowish green; *stigmas* very minutely capitate, dark green; *scales* ± 2.0 × 2.5 mm, yellow-green, free, broadly trapezoidal, slightly wider than long, thickened basally, tapering apically in thickness and width, incurved, upper corners obtusely truncate-rounded. *Follicles* not seen. *Seeds* not seen. *Chromosome number*: 2*n* = unknown.



**FIGURE 2.** *Kalanchoe torrejaczii* (R. Shtein 580). Detail of the flowers and inflorescence. A. Deltoid-tipped buds. B. Flowers at anthesis, grown in full sun, showing the large corolla that dilates in the apical ¾. C. Inflorescences with some wilted flowers and peduncles that become devoid of bracts during anthesis. D–F. Details of a flower and the abaxial leaf blade surface, as well as a corolla, and pistil, respectively—all not to scale, grid segment in each element represents 5 mm. Photographs: Ronen Shtein.

**Eponymy:**—*Kalanchoe torrefracqii* jointly honours Aldo Torrebruno and Joël Jacq, both of France, who together discovered the species during a field trip through the Namorona River valley, in close proximity to the RN 25, west of Ranomafana, Madagascar (Fig. 3).

Mr Joël Jacq (born 1948) is a self-taught horticulturalist who has been passionate about nature from an early age. His father was a meteorologist, and as a result of his assignments, the family lived in the tropics, mostly in West Africa, and sometimes in very remote areas for 18 years. With his three brothers he spent his childhood discovering the forests, the plains, and the rivers where his family was based. He collects orchids and tropical plants, many of them having been sourced during his travels. Now retired, his daughter, Hélène, is carrying on the family's interest in nature.

Mr Aldo Torrebruno (born 1964) is a recently retired electrician who specialised in industrial facilities, transformers, and networks. He is the son and grandson of farmers and began collecting plants in 1983 when he experienced a lack of greenery in a new, urban-based life. After having collected *Maranta* Linnaeus (1753: 2, arrowroot family), orchids, and cacti, he specialised in *Sansevieria* Thunberg (1794: 65), *nom. cons.* He enjoys travelling and all his trips have a botanical goal, especially to explore for or research a plant that has not been collected for decades.

Messrs Torrebruno and Jacq have been friends with Mr Philippe Richaud, a cactus and succulent nurseryman in France, for over 25 years. Being aware of Mr Richaud's passion for *Kalanchoe* and recognising that *K. torrefracqii* differs from *K. laxiflora*, material was later given to Mr Richaud as "*Kalanchoe* sp."; Mr Richaud brought it to our attention for identification.



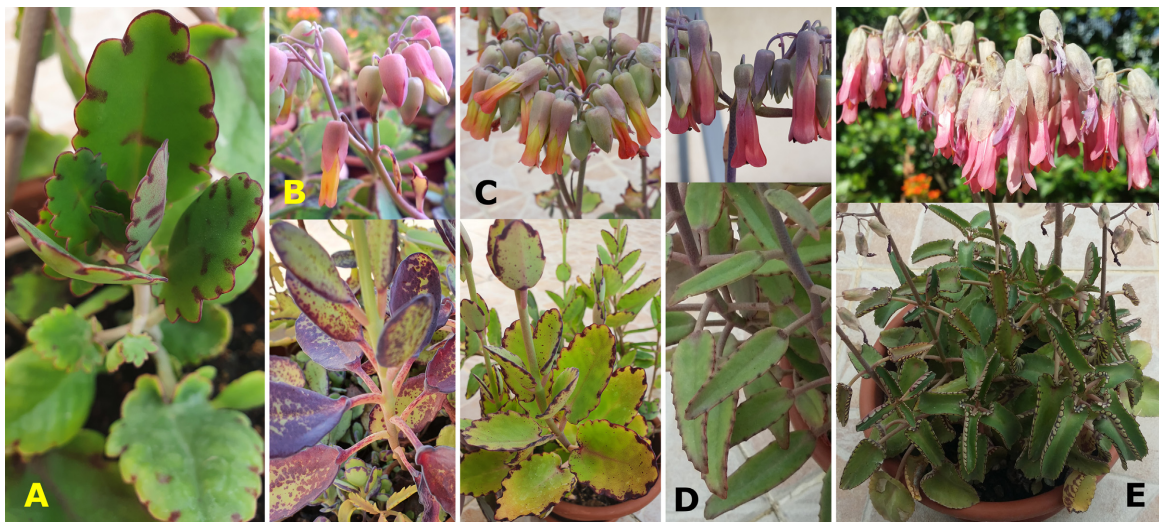
**FIGURE 3.** The Namorona River valley in the vicinity of Vorondolo and the Ranomafana National Park, Madagascar. The type locality of *Kalanchoe torrefracqii* is close by. Photographs: Joël Jacq.

## Discussion

*Kalanchoe torrefracqii* occurs sympatrically with several other pendant-flowered kalanchoes in the tropical rainforest of Ranomafana. These include *K. peltata* (Baker 1883: 140) Baillon (1885: 468) var. *peltata*, *K. gracilipes* Baillon (1885: 469) var. *gracilipes*, *K. laxiflora*, *K. miniata* Hils. & Bojer ex Tulasne (1857: 149) cf. var. *andringitrensis* (Perrier de la Bâthie 1924: 22) Perrier de la Bâthie (1928: 19), and *K. porphyrocalyx* (Baker 1883: 142) Baillon (1885: 469). Out of these species, only *K. torrefracqii* and *K. laxiflora* belong to *K.* [subg. *Bryophyllum*] sect. *Invasores*. This is indicated by their ability to produce bulbils on the leaf margins when under stress (see Garcês *et al.* 2007 for a discussion of this reproductive ability); as well as nectary scales that are  $\leq 2\times$  longer than wide; convergent carpels; and a calyx and corolla that are fused for most of their length. *Kalanchoe torrefracqii* is therefore not particularly closely related to *K.*

*peltata*, *K. gracilipes*, *K. miniata*, or *K. porphyrocalyx* (Descoings 2006, Smith & Figueiredo 2018); the former two being completely non-bulbiliferous and having divergent carpels, and therefore placed in their own subgenus, *K. subg. Kitchingia*; while the latter species, traditionally placed in *K. subg. Bryophyllum* also do not produce bulbils on their leaf blade margins, though in the case of *K. miniata*, produce dense inflorescence bulbil clusters, an unrelated trait (see Shtein & Smith 2021).

Within this group, *K. torrejacqii* is most similar to the orange-flowered *K. laxiflora* that occurs in central- to south-east Madagascar, from around Antananarivo to Ranomafana and possibly in the Andringitra regions (Fig. 4A). Both species are basally suffrutescent; have nectary scales that are wider than long; apically rounded leaves; often elliptic-oblong leaf blades; a campanulate-urceolate and succulent calyx that is relatively large and wide (almost as wide as long); and free sepal segments that are about as long as wide. However, the corolla of *K. laxiflora* is orange and  $< 2\times$  longer than the calyx (compared to pink and  $2.5\times$  longer than the calyx in *K. torrejacqii*) and often distinctly narrower than the calyx. While the corolla in the type material of *K. laxiflora*, based on the protologue description of the name, is strongly stipitate with an ampulliform stipe much longer than wide, other forms of *K. laxiflora* and *K. torrejacqii* are indistinctly short-stipitate with the stipe being much wider than long. *Kalanchoe torrejacqii* further differs from *K. laxiflora* by the base of the leaf blade being  $\pm$  truncate, with an entire proximal end and at most broadly and barely auriculate, as compared to the base of the leaf blades of *K. laxiflora* being strongly auriculate and crenate-serrate to distinctly peltate; by the obtuse to rounded rather than rounded leaf apex; by the bluntly crenate-serrate to subentire rather than deeply crenate leaf margins; and by the leaf blade being widest in the basal  $\frac{1}{2}$  rather than the apical  $\frac{1}{2}$ ; and by the dark grey-violet, rather than yellow, pollen (Fig. 4A–C). Finally, unlike *K. laxiflora*, the leaf blades of *K. torrejacqii* are sometimes obscurely basally lobed, and lack abaxial or adaxial markings, except on the margins and above the point of petiole insertion (Table 1).



**FIGURE 4.** Species closely related to *Kalanchoe torrejacqii*. A. Obscurely maculate and distinctly auriculate-peltate clone of *K. laxiflora* occurring in a region close to the type locality of *K. torrejacqii*. B. Conspicuously maculate, oblong-leaved clone of *K. laxiflora* with distinctively rectangular auricles (below) and barely spreading, narrow corollae, with subacute petals (above). C. Suborbicular, auriculate-peltate clone of *K. laxiflora* (below) with large flowers and rounded petals (above). D. Simple-, non-peltate-leaved *Kalanchoe* often attributed to *K. rosei* var. *rosei*, showing lanceolate leaves (below), pink flowers, and a small calyx tube (above). E. *K. peltigera* showing deeply peltate leaves (below), and flimsy-textured calyx and pink corolla (above). Photographs: Ronen Shtein.

*Kalanchoe torrejacqii* bears some resemblance to representatives of the *K. rosei* species complex (Fig. 4D–E), which occur further south, around Benenitra, Tsivory, and Behara. This manifests chiefly through the vibrant pink colour of its corolla, its darker violet pollen colour, as well as in the distinctly petiolate leaf blades that are much longer than wide. From *K. rosei* var. *rosei*, as well as *K. peltigera* Descoings (2005: 6), *K. torrejacqii* differs by having no abaxial leaf markings; by having a leaf blade base that is truncate and proximally entire rather than deeply peltate and crenate-dentate; by having  $\pm$  flat rather than distinctly guttered leaves; by having a thick rather than flimsy calyx texture; by having a much shorter corolla stipe; and by having apically rounded petals. Furthermore, the leaves of *K. torrejacqii* are much less often lobed and at most indistinctly so, in comparison to those of *K. rosei* var. *rosei* and *K. peltigera* (Table 1).

**TABLE 1.** Comparison of selected characters of *Kalanchoe torreyacqii*, *K. laxiflora*, *K. rosei*, and *K. peltigera*.

#	Character	<i>K. laxiflora</i>	<i>K. torreyacqii</i>	Non-peltate and unlobed-leaved <i>K. rosei</i>	<i>K. rosei</i> var. <i>rosei</i> and <i>K. peltigera</i>
A.	Vegetative				
1.	Leaf blade	± Flat	± Flat	± Flat	Distinctly guttered
2.	Leaf blade base	At least strongly auriculate, typically peltate	Truncate, entire at proximal end, up to broadly auriculate	Rounded-truncate, up to minutely auriculate or obscurely peltate	At least strongly auriculate, typically deeply peltate
3.	Leaf blade markings	Various	Margins	Abaxial, margins	Abaxial, margins
4.	Leaf blade lobes (presence/absence)	Absent	Usually absent; rarely obscurely present	Usually absent; rarely obscurely present	Present, up to 5(–7)
5.	Leaf blade and lobe (if present) shape	Obovate- elliptic to oblong or suborbicular	Narrowly ovate-elliptic to oblong	Ovate-lanceolate	Narrowly lanceolate or ovate-oblong to elliptic
6.	Leaf blade and lobe (if present) apex	Rounded	Obtuse to rounded	Acute	Acute to rounded
B.	Reproductive				
7.	Calyx texture	Succulent	Succulent	Succulent	Flimsy
8.	Calyx:corolla ratio	≤ 1:2	1:2–1:3	1:3–1:4	1:2–1:3
9.	Free sepal segment:calyx tube ratio	≤ 1:2	± 1:2	± 1:1	≤ 1:2
10.	Free sepal segment shape	Ovate deltoid	Ovate deltoid	Lanceolate	Ovate deltoid
11.	Corolla colour	Orange	Pink	Pink	Pink
12.	Petal lobe shape	Ovate to obovate-deltoid	Ovate or obovate	Ovate or obovate	Ovate- or obovate-deltoid
13.	Petal lobe apex	Rounded to subacute, slightly apiculate	Rounded, barely apiculate	Rounded, barely apiculate	Subacute, slightly apiculate
14.	Corolla stipe	Short to long	Short	Absent	Mid-length
15.	Scales length:width ratio	± 0.6–0.8	± 0.6–0.8	± 1.3–1.6	± 1.3–1.6

From non-peltate and unlobed-leaved plants that are often referred to *K. rosei* var. *rosei*, *K. torreyacqii* differs by having no abaxial leaf markings; by the obtuse rather than acute leaf apex; by the oblong-elliptic rather than lanceolate leaves; by having a larger calyx tube that is not fully adpressed against the corolla base; by the corolla being 2.5× longer than the calyx rather than 3–4× longer; by having sepals that are deltoid and as long as wide or wider, rather than lanceolate and much longer than wide; and by having a short corolla stipe.

Overall, *K. torreyacqii* presents vegetative and reproductive morphologies that are intermediate between those of the pink-flowered representatives of the *K. rosei* species complex and the orange-flowered *K. laxiflora* (Fig. 4). *Kalanchoe torreyacqii* is the most northern pink-flowered species among other such species that belong to *K. sect. Invasores*, i.e., the informal groups “Suffrutescentes” or “Bulbiliferae” recognized by Boiteau & Allorge-Boiteau (1995: 16 [page unnumbered]), i.e., *K. rosei*, *K. peltigera*, *K. diagremontiana* Raymond-Hamet & Perrier de la Bâthie (1914: 128), *K. laetivirens* Descouings (1997: 85) (treated as *K. ×laetivirens* by Smith 2020b: 105), and *K. sanctula* Descouings (1997: 87).

We have considered the possibility that *K. torreyacqii* represents a hybrid, of which one parent would be the sympatric *K. laxiflora*. However, we do not regard such an interpretation as plausible, as, with the exception of *K. torreyacqii*, no pink-flowered representatives of *K. sect. Invasores*, for example *K. rosei* or *K. peltigera*, occur anywhere in the vicinity of the tropical rainforest of Ranomafana. Bar *K. torreyacqii*, the northernmost occurring pink-flowered representatives of *K. sect. Invasores* are *K. daigremontiana*, *K. laetivirens*, *K. rosei*, and *K. peltigera*, from the Isalo, Onilahy, and Tsivory regions. Moreover, *K. torreyacqii* in cultivation is fertile at least to some extent and hybridises readily with other representatives of *K. sect. Invasores*, as is common in this clade. Note specifically that

many *Kalanchoe* species that propagate via bulbils, though not of hybrid origin, do suffer from reduced fertility and malformed pollen (Garcês *et al.* 2007, Shtein & Smith 2021). Furthermore, several hybrids recognised in *Kalanchoe*, such as *K. ×gunniae* Smith & Figueiredo in Smith *et al.* (2019: 147) and what we have observed for *K. 'Rauhii'*, a horticultural trade hybrid attributed to *K. rosei* by (Shaw 2008: 25), seed viability can be as high as 100%. Thus, reduced fertility and malformed pollen are not useful indicators of hybrid status in this clade, nor in the genus.

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