

Taxonomic Studies on the Asian Species of the Genus *Kalanchoe* (Crassulaceae) 1. *Kalanchoe spathulata* and Its Allied Species

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Differences among *Kalanchoe spathulata* DC., *K. crenata* (Andrews) Haw., *K. integra* (Medik.) Kuntze, *K. deficiens* (Forssk.) Asch. & Schweinf., *K. rosea* C.B. Clarke, *K. laciniata* (L.) DC., and *K. ceratophylla* Haw. are discussed and evaluated. Variations of *Kalanchoe spathulata* DC. and allied species are taxonomically examined. Seven varieties are recognized in *K. spathulata*. Three, var. *baguioensis*, *simlensis*, *staintonii*, are newly described; four new combinations, var. *annamica*, *dixoniana*, *garambiensis*, *schumacheri*, are proposed. A variety of *K. ceratophylla* Haw., var. *indochinensis*, is described.

Key words: Asia, *Kalanchoe*, new names, taxonomy.

During the preparation of a revision of the Asian species of *Kalanchoe* (Crassulaceae) for the flora of Nepal and Thailand, it becomes necessary to publish three new varieties and four new combinations under *Kalanchoe spathulata* DC.

About 70 species and infraspecific taxa of *Kalanchoe* have been described and reported from the Asian region eastward from the Arabian Peninsula. Haworth (1829) published a remarkable account of the genus after de Candolle's synoptical work (1828), which now has only historical significance.

Hamet (1907, 1908) revised the entire genus, however his recognition of *Kalanchoe laciniata* (L.) DC. as a species encompassing a large number of heterogeneous taxa such as *K. spathulata*, *K. integra* and *K. crenata* caused considerable confusion and difficulty for the taxonomy of *Kalanchoe*.

Kalanchoe presents a number of fundamental problems in its classification. Foremost among them is the limited number of characters that can be usefully employed in

the recognition of taxa. Moreover, most previously employed characters show a rather wide range of variation. Due to their preference for habitats such as rock outcrops and gravelly exposed slopes, the species essentially become sporadic in occurrence, and are often further isolated. This leads to difficulties in species delimitation as isolated populations drift towards fixation of different characters. A good example is the case of *Kalanchoe spathulata* DC. and numerous allied taxa. Thus I deal with the taxonomy of this allies.

Kalanchoe spathulata DC. is the most widespread species in the Asian region and has also been known under the name *K. integra* (Medik.) Kuntze (Fig. 1). *Kalanchoe integra* was first described by Medikus as *Cotyledon* in *Historia Commentationes Academiae Electoralis Scientiarum et Elegantiorum Literarum Theodoro-Palatinae* [3: 200] in 1775, based on a living plant cultivated at the garden of the Elector of Mannheim (Hortus Electorali Mannhemi-

ensi). Since the type and any authentic materials do not remain, Tabula 9, an illustration of *Cotyledon integra* should be selected as the lectotype (Wickens 1982). In his description Medikus wrote: "in Catalogo Horti Regii Parisiensis manuscripto speciem hanc jam indicatam invenio, ibique *Cotyledon aegyptica frutescens, foliis subrotundis flore coccineo umbellato* appellatur. Nullibi vero neque delineatam, neque exacte examinatam esse video, novamque speciem esse, non dubito." Fernandes (1980) suspected that Medikus had seen or probably obtained this plant, *Cotyledon integra* (= *K. integra*), from the Royal Garden, (now Jardin Botanique), Paris, through the permission of Bernard de Jussieu and Adanson in 1766. The illustration in Plate 9 resembles *K. deficiens* (Forssk.) Asch. & Schweinf. and *K. spathulata*.

Kalanchoe deficiens, endemic to the Arabian Peninsula, resembles *K. spathulata* but differs in the scarlet, orange-red or pink flowers versus yellow or cream yellow ones. Medikus described *K. integra* (under *Cotyledon*) to have "corollae coccineis (scarlet)." Both the illustration and description of this *Kalanchoe* is considered to be *K. deficiens* as already pointed out by Raadts (1981). During my botanical researches in the Arabian Peninsula I have observed this in the Asir Mountains faced the Red Sea, and confirmed that the colour of *K. deficiens* are stable and no intermediate state between red and yellow. The difference in flower colour is significant in *Kalanchoe* to distinguish the species. *Cotyledon aegyptica* Lam., Encycl. 2: 142 (1786) is the synonymic and illegitimate name for *K. deficiens* (Raadts 1981).

Kalanchoe rosea C. B. Clarke described from Assam is the only Asian species in *K. spathulata*-allies with scarlet or pale pink or orange, fragrant flowers like *K. deficiens*. *Kalanchoe rosea* shares significant features with *K. spathulata*, differing only in the colour and fragrance of flowers.

Kalanchoe crenata (Andrews) Haw., widespread in tropical Africa from South Africa to Arabia and naturalized in tropical America, India and Malesia, is closely related to *K. spathulata*, but differs from it in the glandular-hairy inflorescence-axes, pedicels (and often sepals) and the sepals distinctly connate at the base. The margins of the leaves of *K. spathulata* are entire to slightly dentate or irregularly crenate, and rarely more or less regularly crenulate, and those of *K. crenata* are finely crenate. The leaves below the uppermost ones are deeply trilobed or tripartite in *K. spathulata*, but not lobed nor parted in *K. crenata*.

Kalanchoe spathulata somewhat resembles *K. ceratophylla* Haw. and their ranges partly overlap. Cufodontis (1957, 1965, 1969) and Fernandes (1980) made critical studies of Hamet's *K. laciniata*. Wickens (1982) distinguished the Asian glabrous '*K. laciniata*' from the true *K. laciniata* and applied the name *K. ceratophylla* to it. At least for the eastern and southeastern Asian species, however, it is apparent that none of these treatments have proved entirely satisfactory and more investigations are needed.

Kalanchoe spathulata clearly differs from *K. laciniata* and *K. ceratophylla* by having undivided uppermost leaves, and also by the narrowly ovate to lanceolate leaves with crenate to nearly entire margins. *Kalanchoe laciniata* and *K. ceratophylla* have trilobed uppermost leaves and deeply 3-to 7-lobed or divided cauline leaves. All of these species have similar flowers except the colour and hairiness of the corollas.

Thus, the Asian taxa of *Kalanchoe spathulata*-allies are classified into three species. Seven varieties are recognized in *K. spathulata*, and one variety is described in *K. ceratophylla*. They are distinguished by the following key.

Key to *Kalanchoe spathulata* and allied species and the varieties:

- 1. Leaves irregularly pinnately lobed; lobes usually linear or narrowly oblong-lanceolate
- 2. Plants rather densely papillate
.....*K. laciniata* (not treated here)
- 2. Plants almost glabrous and smooth
.....3) *K. ceratophylla*
- 3. Inflorescences obconical, lateral branchlets not conspicuously elongate
....3a) *K. ceratophylla* var. *ceratophylla*
- 3. Inflorescences conical to spherical, lateral branchlets conspicuously elongate...
...3b) *K. ceratophylla* var. *indochinensis*
- 1. Leaves except for uppermost ones entire to irregularly crenate or finely crenulate, those of uppermost ones sometimes trilobed with ovate or narrowly oblong-ovate lobes
- 2. Flowers scarlet, pale pink or orange, fragrant2) *K. rosea*
- 2. Flowers yellow or cream yellow
.....1) *K. spathulata*
- 3. Inflorescence-axes, pedicels and calyx densely glandular-hairy
- 4. Leaves oblong-obovate, margins finely crenulate; Thailand
.....1d) *K. spathulata* var. *dixoniana*
- 4. Leaves spathulate or narrowly oblong-ovate, margins rather regularly crenulate or minutely serrate; Philippines (Luzon)1c) *K. spathulata* var. *baguioensis* (described here)
- 3. Inflorescence-axes, pedicels and calyx glabrous and smooth
- 4. Leaves less than 10(-13) cm long, margins usually entire or irregularly dissected
- 5. Plants up to 50 cm tall, leaves in lower part long petiolate; Laos, Vietnam and China (Yunnan)
.....1b) *K. spathulata* var. *annamica*
- 5. Plants less than 10 cm tall, leaves in lower part short petiolate; Taiwan
...1e) *K. spathulata* var. *garambiensis*

- 4. Leaves more than 10 cm long, usually with margins regularly crenulate
- 5. Leaves sessile, lamina base long cuneate; India (Himachal Pradesh)....
.....1g) *K. spathulata* var. *simlensis* (described here)
- 5. Leaves petiolate
- 6. Petioles 1/2 or 1/3 length of lamina. [Leaves in lower part narrowly oblong-ovate to narrowly triangular-ovate or widely lanceolate, margins rather regularly crenate to crenulate on upper two thirds]; Himalaya and Assam1h) *K. spathulata* var. *staintonii* (described here)
- 6. Petioles much shorter than 1/3 length of lamina
- 7. Leaves in lower part usually widely elliptic or oblong-ovate, margins nearly entire to irregularly and interruptedly crenate or crenulate; India to Malesia, Thailand, Indo-China, Philippines, China, Taiwan, and S. Japan
...1a) *K. spathulata* var. *spathulata*
- 7. Leaves in lower part oblong, margins rather finely serrate; Java
.....1f) *K. spathulata* var. *shumacheri*

1) ***Kalanchoe spathulata*** DC., Pl. Hist. Succ.: t. 65 (1801); Prodr. 3: 395 (1828). Pers., Synop. Pl. 1: 446 (1805). Haw. in Phil. Mag., N. S. 9: 304 (1829). C.B. Clarke in Hook.f., Fl. Brit. India 2: 414 (1879). Merrill, Enum. Philip. Flow. Pl. 2: 218 (1923). Craib, Fl. Siam. Enum. 1: 587 (1931). Gagnep. in Lecomte, Fl. Ind.-Chin. 2: 701 (1920), pro parte. T.S. Liu & N.J. Chuang in Fl. Taiwan 3: 13 (1977); 2nd ed., 3: 14 (1993). Descoings in Eggli, Ill. Hand. Succ. Pl. Crassulac. 175 (2003). Type: DC., Pl. Hist. Succ.: t. 65 (1801).

Vereia acutiflora Andrews in Bot. Reposit. 9: t. 560 (1809).

Cotyledon spathulata Poir. in Lam.,

Encycl. Suppl. 2: 373 (1811).

Kalanchoe acutifolia (Andrews) Haw. in R. & A. Taylor, Rev. Pl. Succ. 23 (1821).

Kalanchoe varians Haw. in Phil. Mag. N. S. 9: 302 (1829), versim.

Kalanchoe subamplectus Wall., Pl. As. Rar. 2: t. 167 (1831), versim.

Bryophyllum serratum Blanco, Fl. Filip. ed. 2, 220 (1845).

Bryophyllum triangulare Blanco, Fl. Filip. ed. 2, 221 (1845).

Cotyledon nudicaulis Buch.Ham. ex C.B.Clarke in Hook.f., Fl. Brit. Ind. 2: 414 (1879), non Murray.

In *Kalanchoe spathulata*, owing to the wide geographical distribution, the variations in shape, size, and dissection of leaves are extremely wide and show local tendencies. At present seven varieties are recognized in this species which are mostly restricted to narrow geographical areas.

a) var. **spathulata**.

Kalanchoe tashiroi Yamam., Suppl. Icon. Pl. Formos. 2: 25, t. 15 (1926). Liu & Chung in Fl. Taiwan 3: 13 (1977). K.T.Fu & al. in Z.Y.Wu & P.H.Raven, Fl. China 8: 205 (2001). Descoings in Egli, Ill. Hand. Succ. Pl. Crassulac. 177 (2003). Type: Taiwan. Insula Kotosho. Cult. in Horto Botanico Tokyo. Yamamoto (TI).

Kalanchoe integra auct. non (Medik.) Kuntze [Revis. Gen. 1: 229 (1891)]: C.A. Baker in Fl. Mal. ser. 1, 4: 201 (1951), pro parte. Cufod. in Österr. Bot. Zeit. 116: 312 (1909), pro maj. parte. Moran in Walker, Fl. Okinawa: 509 (1976). H.Ohba in Satake & al., Wild Flow. Jap. Herb. 2: 140 (1982). K.T.Fu & al. in Z.Y.Wu & P.H.Raven, Fl. China 8: 205 (2001).

Distr. India to Malesia and S Japan (Ryukyu Islands) through Thailand, Indo-China, China, and Taiwan.

Specimens examined. Ceylon. Sine loc. Thwaites 540 (BM). India. Indes orient. Jacquemont 2445 (P). Punjab, Sutlej Valley, 3000 ft. Cooper 5975 (P).

Assam. Hills east of Kohuna, 3–4000 ft. Kingdon-Ward 11123 (BM). Thailand (Siam). Kao Oktala, Patulung, ca. 200 m. Kerr 15355 (BM, K); Doi Tam Yup, Chiengrai, 480 m. Garrett 259 (BM, L, K); Cheng Mai, Mae Soi Valley. 500 m. Maxwell 90-67 (L). Laos. Tkhepone Kilo 202 route Savannakhet, 400 m. Poilane 11411 (P); Khuang Prov. Poilane 2416 (P). Vietnam. Annam: Prov. Si Zuong Benk, Van Kuan. Pételot 5604 (A, P); Cho Gonk. Pételot 2011 (P); meridional, in montibus Thien Duong. R. P. Bon 4001 (P); meridional, Ngoaithon, in montibus Van Don. R. P. Bon 1293 (P); meridional, Dien Ho, in monte Hang Hoê. R. P. Bon 1268 (P); meridional, Ke Ben. R. P. Bon 9069 (P); Between Pleiku and Bink-Dink, ca. 600 m. Smitinand & E. C. Abbe 6417 (K). Malesia. Lesser Sunda Islands: Alor, Pisigomo-Lantoka, 650 m. O. Jaag 980 (A, BM, L). Lombok: Rindjani-Vulkangebirge, 1925–2000 m. Elbert 2154 (A, L). Central Timor: Soë. M. E. Walsh 304 (BM). Bali: Mt. Prapat Agung, NW Bali, 73 m. Soegeng & Soepadmo 54 (L). Java: sine loc. Zollinger 2911 (BM); sine loc. Koorders 44169β (L); E, Batoc, NW van Malang Pasoeroean. Rant s. n. (L); Besoeki, Balaeran, 1000 ft. Backer 24775 (K); Besoeki, Tdjenplateau by Sempol, 1100 m. Backer 25014 (L); Besoeki, Tdjengan, 1100 m. Koorders 44058β (L); Res. Batavia, Tjikandang, Gaenaeng Parang, 350 m. B. v. d. Brink 4909 (L); G. Parang by Poerwakarta. Backer 13920 (L); Madoera, Tamberae, 50 m. Backer 21183 (L). Celebes: SW, Raelo, 900 m. Bümmemeyes 12509 (L); near Palu. Meijer 9190 (L). Flores: Pakû, 900 m. Schmutz 150 (L); Marggarai, pr. Ruteng, 1–1200 m. Verheyen 506 (L); N dry part near Reo. Kostermans 22215 (L). Philippines. Luzon: Prov. Ilocos Norte, Bangui. Ramos 27431 (K, US); Prov. Bataan, Lamao. Whitford 1131 (K, US); Benguet. Vidal 1667 (K); Prov. Batan, Lamao River, Mt. Mariveles. Whitford 284 (K, US); Prov. Batangas, Bo, Biga. Sulit 1167 (A); loc. cit. Sulit s. n. (US). Palawan: Langen Island, Malapalan Cave. Podzorski SMH1834 (L). China. Sine loc. Lord Macartoney s. n. (BM). Canton et Macao: Gaudichau 255 (P). Yunnan: Men goon. Anderson in 1868 (K); Chu-yuan. Henry 10801 (K); Mengtze. Hancock 171 (NY); loc. cit. Henry 10801 (NY). Amoy. Hance (K). Hainan: sine loc. specialit. Hancock in 1878 (K); Nam Shan Ling, Yaichow. C. L. Tso 23048 (A, K, NY, P); Ue Lung Ling. S. K. Lau 1341 (A, BM, NY, P); Chung Ngo Shan. S. K. Lau 3338 (A, P). Kwangsi: Sui-luk Dist., mts. surrounding Pa Lan Village, SW of Nanning. W. T. Tsang 21813 (A, BM, P). Fukiang: sine loc. specialit. Krone s. n. (P); sine loc. specialit. Fortune 70 (BM); Huighwa Dist. Chung 963 (K); Chuanchow. Mobbs 99 (K); Foochow. T. S. Ging 5517 (BM). Hong Kong. Furet 59 (P). Taiwan. Bunkiko,

1500 m. Faurie 1612 (BM); in petrosis Bankings. Faurie 551 (BM); prov. Koshun, Borg to Kuravi. Wilson 10979 (K); in littore Tamsui. Faurie 552 (BM). Japan. Loo-Choo Island, Shuri. C. Wright 89 (GH, K, P, US); Lutschu, Nopo Kieng. Weyrich in 1834 (K).

Kalanchoe tashiroi approaches *K. crenata* in having ovate to widely ovate leaves with rather regularly crenate margins. I have a suspicion that this is the '*K. crenata*' introduced or naturalized in Orchid Island off Taiwan. No other specimens of *K. spathulata* were collected from the island.

b) var. **annamica** (Gagnep.) H.Ohba, stat. nov.

Kalanchoe annamica Gagnep. in Notul. Syst. 3: 219 (1918); in Lecomte, Fl. Ind.-Chin. 2: 702 (1920). Descoings in Eggi, III. Hand. Succ. Pl. Crassulac. 146 (2003). Type: Indo-Chine [Annam] (= Vietnam): Hue et environs. Eberhardt 1458 (P holo & iso).

Kalanchoe yunnanensis Gagnep. in Lecomte, Notul. Syst. 3: 220 (1918), syn. nov. Type: [China, Yunnan] Mongtze. Tanaut s.n. (P).

Kalanchoe chevalieri Gagnep. in Notul. Syst. 3: 275 (1918); in Lecomte, Fl. Ind.-Chin. 2: 700 (1920). Type: Indo-Chine [Annam] (= Vietnam): Nha-trang et environs. 6 Fevrier 1914. A. Chevalier 30537 (P holo).

Distr. Indo-China (Laos, Vietnam [Annam]) and China (Yunnan).

Specimens examined. Laos. Province de Cammon, villade de Thok. Pételot 4586 (P). Vietnam (Annam). Dalat. Evrard 2206 (P).

This variety is characterized by the petiolate, narrowly ovate to lanceolate or lanceolate-oblong, serrate lower leaves and the linear or narrowly oblong or lanceolate entire or nearly entire upper leaves.

Kalanchoe chevalieri is considered to be conspecific with *K. annamica*, and both represent a geographic variety of *K. spathulata*. The type of *K. yunnanensis* is at fruiting stage, and has petiolate, narrowly ovate to lanceolate leaves 5–10 cm long and 1.5–3.5

cm wide with acute or obtuse-acute apices and rounded bases. The margins of the leaves vary from nearly entire to roughly and irregularly crenulate. The stems, inflorescence-axes and pedicels are glabrous and smooth. Though Fu et al. (2001) considered *K. yunnanensis* to be a synonym of var. *spathulata* (as *K. integra*), this shares significant features with var. *annamica*.

Pételot 4586 and Evrard 2206 are remarkable in that they have tripartite upper leaves, so it might be supposed that they have had a genetic influence from *K. ceratophylla*.

c) var. **baguioensis** H.Ohba, var. nov.

Differt a typo axisibus inflorescentiaequae pedicellis dense vel modice pubescentibus.

Stems up to 40 cm tall, upper part short hirsute. Leaves in lower part spatulate or narrowly oblong-ovate, 4–6 cm long, 1.7–2.5 cm wide, rather regularly crenulate or minutely serrate, apex rounded or obtuse, base widely cuneate, sessile; in upper part narrowly spatulate, narrowly obovate-lanceolate to widely linear, 2–3 cm long, 0.6–1.4 cm wide, entire to remotely and shallowly crenate, apex rounded or obtuse, base cuneate. Inflorescence-axes densely hairy with short-hirsute hairs. Flowers pedicellate, pedicels densely short-hirsute; bracts and bracteoles linear. Flowers 2–2.5 cm long, calyx densely short-hirsute; corolla yellow, short-hirsute on outer surface. Carpels sparse translucent and sometimes with glandular-hairs.

Type: Philippine Isls., Luzon, Prov. Benquet, Baguio. Merrill 11647 (US holo; BM, US, SING iso).

Distr. Philippines (Luzon Island), endemic to Baguio and the vicinity.

Specimens examined. Philippines. Luzon: Prov. Benquet, Baguio. Elmer 6630 (K); loc. cit. Elmer 8353 (K, US); loc. cit. Elmer 4430 (US); loc. cit. Topping 95 (US); loc. cit., Keson Road. Sinclair 9732 (SING, US); loc. cit., Mariveles. Loher 2188 (K, US); loc. cit., Kias Hill. Williams 202 (US); Pauai, Benquet subprovince. M. S. Clemens 9126 A); Mt. Prov., Vicinity of Baguio.

Moran 4835 (US); loc. cit., cult. Univ. Calif. Bot. Gard. Berkely. Acces. no. 55.117-1. Hutchinson s. n. (UA).

This variety is characterized by the dense short-hirsute hairy stem, inflorescence-axes, calyx and corolla. This is known only from Baguio and its vicinity in Luzon Island, the Philippines. Having dense hirsute hairs this approaches to *K. crenata* ranging Africa to the Arabian Peninsula but differs from that by having smaller narrow leaves.

d) var. **dixoniana** (Raym.-Hamet) H. Ohba, stat. nov.

Kalanchoe dixoniana Raym.-Hamet in Kew Bull. 1914: 281 (1914). Gagnep. in Lecomte, Fl. Ind.-Chin. 2: 705 (1920). Craib, Fl. Siam. Enum. 1: 586 (1931). Descoings in Egli, Ill. Hand. Succ. Pl. Crassulac. 154 (2003). Type: Siam. [Payap], Doi Chieng Dao. Kerr 2876 (K holo; BM iso).

Distr. Thailand.

Specimens examined. Thailand. Cult. Hort. Trinity Coll. Dublin. Dixon 12 March 1914 (K).

This, known from only the type collection, is characterized by the rather densely glandular hairy inflorescence-axes (upper part only), pedicels, sepals and corolla tubes and the oblong-obovate, sessile leaves with rather finely crenulate margins and flat narrow bases. These characters of var. *dixoniana* approach those of var. *baguioensis*.

e) var. **garambiensis** (Kudo) H. Ohba, stat. nov.

Kalanchoe garambiensis Kudo in J. Soc. Trop. Agr. Formos. 2: 235 (1930). Liu & Chung in Fl. Taiwan 3: 12 (1977). T.S. Liu & N.J. Chuang in Fl. Taiwan 3: 12 (1977); 2nd ed., 3: 14 (1993). K.T. Fu & al. in Z.Y. Wu & P.H. Raven, Fl. China 8: 205 (2001). Descoings in Egli, Ill. Hand. Succ. Pl. Crassulac. 156 (2003). Type: Taiwan. In rupibus prope Garambi. Kudo & Mori 16132 (TAI, not seen).

Distr. Taiwan (Kaohsiung).

Kalanchoe garambiensis has an extremely dwarf habit reaching only 5 to 8 cm tall. This is known only from limestone crevices on the seashore in the southernmost area of Taiwan. Some specimens of var. *spathulata* which were collected from limestone mountains, e.g., Kerr 15355 (BM), approach to this variety in having a depauperate form with small, lanceolate leaves and short, slender flowering stems.

f) var. **schumacheri** (Koord.) H. Ohba, stat. nov.

Kalanchoe shumacheri Koord. in Bull. Jard. Bot. Buitenz., ser. 3, 1: 180 (1918). Types: Java. East, Prov. Besuki, Idjen-Plateau, auf dem Ridjegan-Rücken, 1000–1500 m. Herb. Kooders, Nos. 20891β, 42909β, 44174β (?BO, not seen).

Kalanchoe integra auct. non (Medik.) Kuntze: C. A. Baker in Steenis, Fl. Mal., ser. 1, 4: 202 (1951), pro parte.

Distr. Java.

Specimens examined. Java. Sine loc. specialit. Unknown collector s. n. (L); sine loc. Horsfield s. n. (K); sine loc. Horsfield in 1802–1818 (K); Besocki, 1–1450 m. Koorder 47704β, 43957β, 44166β & 44324β (L).

This seems to reproduce vegetatively, new plants arising from lateral shoots. The leaves on lateral shoots are rather uniform throughout the stem with trullately ovate lamina of which the distal half is irregularly crenate or serrate and also with long petioles, as illustrated in the Table 14 (especially G) by Koorders (1918).

g) var. **simlensis** H. Ohba, var. nov.

Differt a typo foliis oblanceolatis majoribus haud petiolatis.

Stems up to 80 cm tall, glabrous, base up to 1.3 cm wide. Leaves sessile; those in lower part lanceolate or widely lanceolate, up to 22 cm long, 6.5 cm wide, apex rounded or obtuse, base long attenuate, margins nearly entire to remotely and shallowly crenate; in

upper part oblanceolate to widely oblanceolate, with long attenuate base. Inflorescence and flowers glabrous and smooth.

Type: India. Himal. Bor. Occ. Regio trop. 1-4000 ft. Thomson s.n. (K holo; K, P iso).

Distr. India (Himachal Pradesh).

Specimens examined. India. Himalaya, Barogh. Rich 410 (K). Simla: Nerotegad Valley, Bajii, 4000 ft. Herb. Gamble s. n. (K); Giri, ca. 3000 m. Drummond 1573 (K).

Kalanchoe varians Howarth described from India Orientali might not be distinguishable from this variety. This variety is characterized by the large, oblanceolate sessile leaves.

h) var. **staintonii** H.Ohba, var. nov.

Kalanchoe spathulata auct. non DC.:

Weibel in Candollea 16: 143 (1958), H.Ohba in H.Hara & al., Enum. Flow. Pl. Nepal 2: 159 (1979).

A typo foliis cuneato-vel trianguli-ovatis basi cuneatis, longe petiolatis bene differt.

Stems up to 1.2 m tall, glabrous and smooth, up to 1.5 cm diameter at the base. Leaves glabrous and smooth, conspicuously petiolate; those in lower part with petioles 4-6 cm long up to 25 cm long, 8 cm wide, narrowly oblong-ovate to narrowly triangular-ovate or widely lanceolate, apex rounded, base rounded or widely cuneate, margins rather regularly crenate to crenulate on distal two thirds; leaves in the upper part narrowly ovate to widely lanceolate, conspicuously petiolate, margins crenate to crenulate.

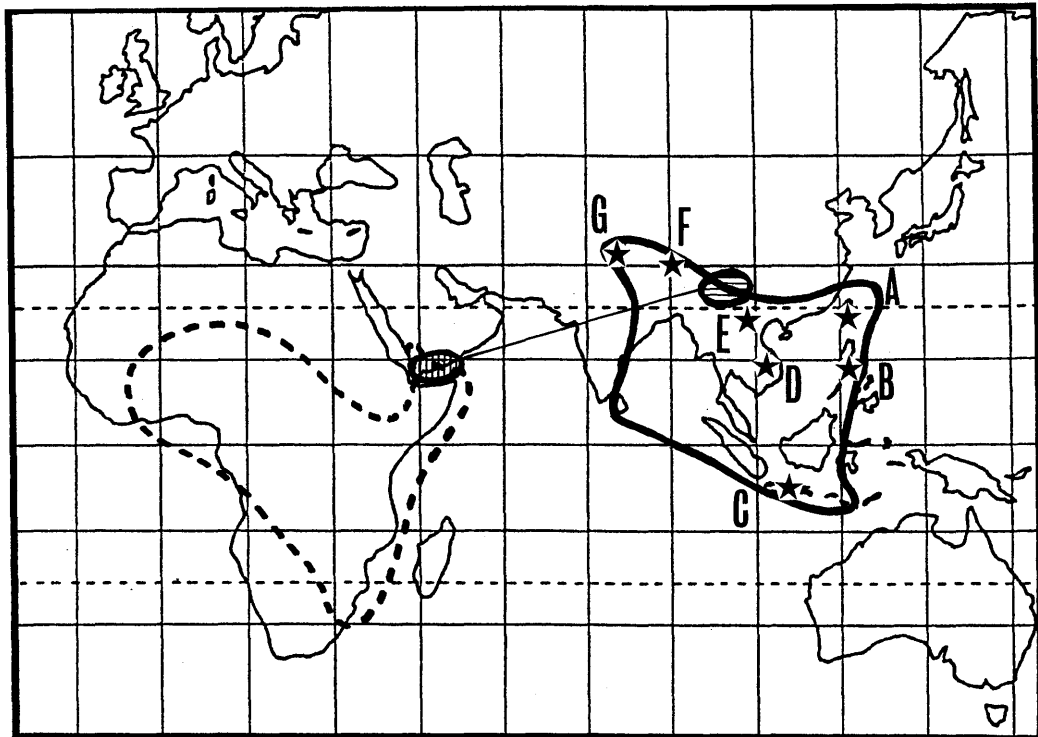


Fig. 1. Distribution of *Kalanchoe spathulata* and its allied taxa. *Kalanchoe spathulata* (solid line), var. *garambiensis* (A), var. *baguioensis* (B), var. *shumacheri* (C), var. *dixoniana* (D), var. *annamica* (E), var. *staintonii* (F), var. *simlensis* (G); *K. crenata* (broken line); *K. deficiens* (solid line with vertical stripes); and *K. rosea* (solid line with horizontal stripes).

Inflorescence and flowers glabrous, smooth. Corolla bright yellow to pale yellow; filaments green; pistils green.

Type: C. Nepal. Dhunche, Trisuli Valley, alt. 5000 ft. (28°8' N, 85°20' E). Stainton 5182 (BM holo).

Distr. Himalaya (Kumaon, Nepal, Sikkim & Bhutan) and Assam.

Specimens examined. NW Himalaya. Dehra Dun. Mackinnon s. n. (BM). Nepal. Karnali Valley, N of Raskot, 3500 ft. Stainton 6164 (BM); Badalkot, Karnali Valley, 4000 ft. Polunin, Sykes & Williams 3963 (BM, KTM); Buri Gandaki River, 22 miles above Arughat Bazar, 5000 ft. Gardner 329 (BM); loc. cit., 8 miles above Arughat bazar, 2000 ft. Gardner 284 (BM); Syabrubesi, 1460 m. Manandar 418 (KTM); Gokarna, 4400 ft. Shrestha 6530 (KTM); Pres de Manebhanjyang, 1700 m. Zimmermann 2055 (BM); Ghatekhundo (Rasuwa), 1880 m. Rajbhandari & Manandar 9297 (KTM); Jandola, Chitawan Dist. Manandar 14113 (KTM); Dhankuta, 1050 m. Pradhan & al. 783 (KTM); Khani Khola, 1400 m. Bhattarai & Kattel 881141 (KTM). Sikkim. Regio trop. Hooker s. n. (K); loc. cit. Hooker & Thomson (K); Teesta. Hooker & Thomson (K); Teesta Valley, 2000 ft. Herb. Treutler 1053 (K); Luner Hills, ca. 3000 ft. Treutler s. n. (K); near Darjeeling. Gamble 2861A (K); Darjeeling, Punkabari, 4000 ft. Clarke 35017 (BM); Kurseong, 3000 ft. Clarke 13861A (BM); Kalimpong, 3000 ft. Clarke 26324 (K, BM). S. Tibet. Chumbi Valley, Chaobari, 3000 ft. Clarke 23752 (K, BM). Bhutan. Sine loc. Griffith 2033 (BM); Ghunkara, 2000 ft. Ludlow, sherriff & Taylor 6288 (BM). Assam. Rupa, 4–5000 ft. Kingdon-Ward 12456 (BM); Salei-But, 3600 ft. Rankin & Pretzlik 075 (BM); Khassia, regio trop. 1–4000 ped. Hooker & Thomson (K, BM, P).

This variety is characterized by the long-petiolate, large leaves with rather regularly crenulate margins and rounded or widely cuneate base. In my observations in Nepal the shape and size, and also the length of petiole and the serration of leaves are constant. It usually grows gregariously on stony, sunny side slopes or river beds.

2) *Kalanchoe rosea* C. B. Clarke in Hook. f., Fl. Brit. India 2: 21 (1879); in J. Linn. Soc. 25: 21 (1889). Lectotype (selected here): India (Assam), Kohima, 5000 ft. C. B.

Clarke 41833A (K). Syntype: India, Assam, Muneypoor, Moa, 5500 ft. C. B. Clarke 41782A (K).

Distr. Endemic to India (Assam).

Specimens examined. India. Assam: Naga Hills, Lhakama, 5500 ft. Bor 47 (K); loc. cit., Khonoma. Kingdon-Ward 7739 (K); loc. cit., Zakhoma, 4–5000 ft. Kingdon-Ward 19028 (BM); Lushai Hills, Sairep, 5000 ft. Parry 480 (K); Kekrima, 5500 ft. Kingdon-Ward 12510 (BM).

The flowers are fragrant with scarlet, pale pink and pale orange corollas. Except for the colour and fragrance of the flowers *Kalanchoe rosea* shares significant features with *K. spathulata*. Further comparative studies, with ample materials, are required.

3) *Kalanchoe ceratophylla* Haw. in R. & A. Taylor, Rev. Pl. Succ. 23 (1821).

a) var. *ceratophylla*: Wickens in Kew Bull. 36: 673 (1982).

Kalanchoe macrosepala Hance in J. Bot. 8: 5 (1870). Type: Hong Kong. Hance 1723 (BM holo).

Kalanchoe gracilis Hance in J. Bot. 8: 6 (1870). Type: Taiwan. Swinhoe. Unknown collector 7578 in 1861 (BM holo).

Kalanchoe takeoi Hayata, Icon. Pl. Formos. 8: 33 (1919). Type: Taiwan. Nantô, Hokusankô. T. Itô s.n. in 1916 (TI holo).

Distr. Himalaya, Thailand, Malesia (Malaya, Sumatra to the Philippines), Indo-China, China, Taiwan, and Mascarenes.

b) var. *indochinensis* H. Ohba, var. nov.

Inflorescentiae ramulis lateralibus multis elongatis ex typo differt.

Stems up to 80 cm tall. Leaves up to 12 cm long, usually with 5 lobes; uppermost leaves linear not divided, 3–5 cm long, 4–5 mm wide. Inflorescences large, with elongate lateral branchlets, conspicuously bracteate; bracts and bracteoles linear, 1–3 cm long. Flowers ca. 2 cm long, corolla yellow, with pedicels up to 1.2 cm long.

Type: Laos. Dok Mien to Luong Prabang. Dr. Spire 878 (P holo, iso).

Distr. Indo-China (Laos and Vietnam).

Specimens examined. Sine loc. Herb. de Dr. Pett-Thouars s. n. (P). Indo-China. sine loc. Dr. Talmy 28 (P). Vietnam. Sud-Vietnam. Tixier s. n. (P). Cochinchina: sine loc. Dr. Thorel 168 (P); sine loc. Dr. Talmy 71 (P); Prov. Bienhoa, Doi Chuachan, 5–800 m. Chevalier 39936 (P). Annam: Nord Roi Zant. Put 2528 (P); Tourane & vicinity. J. & M. S. Clemens 4189 (P); Ca-na pro. Phanrang. Poilane 5850 & 9433 (P); Dalat. Hort. Bot. Paris (P).

Kalanchoe ceratophylla is variable especially in the shape of leaves. This variety, characterized by the inflorescences with many elongate lateral branchlets, is restricted to Indo China (Laos and Vietnam).

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大場秀章：アジア産リュウキュウベンケイソウ属の分類学的研究 1. リュウキュウベンケイソウとその近縁種

リュウキュウベンケイソウ属 (*Kalanchoe*) は、アフリカ、特にマダガスカル島を中心とした熱帯・亜熱帯で多様化したベンケイソウ科の1属で、まだ変異がよく解析されておらず分類法が確定していない。アラビア半島以東のアジア産種についてはこれまで全域を対象とした分類学研究は皆無の状況である。

タイやネパール植物誌のベンケイソウ科を纏める必要があり、これまでリュウキュウベンケイソウとその近縁種について断続的に研究を行ってきた研究の一部をまとめて発表した。

リュウキュウベンケイソウはインド・スリランカ以東のアジア地域に広く分布する (Fig. 1)。その学名には古くから用いられてきた *Kalanchoe spathulata* に替わって、最近では *K. integra* を用いることが多かった。私自身、平凡社刊の「日本の野生植物」や英文版日本植物誌 (Flora of Japan, IIb) でこの見解を採用した。しかるに、改めて Medikus の原記載を読んで、*Kalanchoe integra* が

References (others see the taxonomic treatments)

- Candolle A. P. de 1828. Crassulaceae in Prodrum Systematis Naturalis Regni Vegetabilis. 3: 381–414.
- Cufodontis G. 1957. Erster Versuch einer Entwirrung des Komplex *Kalanchoe laciniata* (L.) DC. Bull. Jard. Bot. Brux. 27: 709–718.
- 1965. The species of *Kalanchoe* occurring in Ethiopia and Somalia Republic. Webbia 19: 711–744.
- 1969. Über *Kalanchoe integra* (Med.) O. Kuntze und ihre Beziehung zu *K. crenata* (Andr.) Haworth. Österr. Bot. Zeit. 116: 312–320.
- Fernandes R. 1980. Notes sur quelques espèces du genre *Kalanchoe* Adans. Bol. Soc. Brot., Sér. 2, 53: 325–442.
- Hamet R. 1907 and 1908. Monographie du genre *Kalanchoe*. Bull. Herb. Boiss. Ser. 2, 7: 869–900 (1907); 8: 17–48 (1908).
- Haworth A. H. 1829. A new account of the genus *Kalanchoe*. Philos. Mag., New. Ser. 9: 301–305.
- Raadts E. 1981. Über zwei arabische *Kalanchoe*-Arten (Crassulaceae). Willdenowia 11: 327–331.
- Wickens 1982. Miscellaneous notes on *Crassula*, *Bryophyllum* and *Kalanchoe*. Studies in the Crassulaceae for the 'Flora of Tropical Africa': III. Kew Bull. 36: 665–674.

紅色の花冠を生じることを知った。またその後サウジアラビアの自生地でもこれを確認した。

リュウキュウベンケイソウ属での花冠の色は種により一定でしかも安定しており、多くの場合、種の識別形質として用いられているものである。また、私自身のサウジアラビアでの観察で、他の形態のよく類似した紅色花の種と黄色花の種で、花色が重要な区別点になることを知った。ベルリンの Raadts は *Kalanchoe integra* をアラビア半島特産の *K. deficiens* の異名としているが、この扱いは適切であると考える。一方、*Kalanchoe spathulata* は、*Kalanchoe crenata* との区別が困難との説もあったが、Fig. 1 に示すように分布域を異にしており、*Kalanchoe spathulata* には *Kalanchoe crenata* の花序枝や花柄などに生じる密生する腺毛がないことや葉の鋸歯などの違いで区別することができる。

リュウキュウベンケイソウの正しい学名は *Kalanchoe spathulata* となる。この種の変異には地方性があり、分布域が限定される7つの変種を区

別した。南西諸島の個体は台湾南部の鶯鑿鼻から記載された var. *garambiensis* に似てくるが、この変種に含まれるかどうかはさらなる研究が必要である。なお、リュウキュウベンケイソウには、私自身これまでリュウキュウベンケイの和名を採用してきたが、植物名であることがよりはっきりするリュウキュウベンケイソウという呼び方を今

後は用いたい。

本論文ではリュウキュウベンケイソウに合計3つの新変種と4つの新組合せ、*Kalanchoe ceratophylla* には var. *indochiensis* という1変種を新たに発表した。各分類群毎に異名とその分布域を示し、多くの分類群では検討した標本を挙げた。

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