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A REVISION OF EVODIELLA (RUTACEAE)

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SUMMARY

Evodiella B.L. v.d. Linden (Rutaceae) from New Guinea and Queensland has two species: *Ev. muelleri* (Engl.) B.L. v.d. Linden with three formae: forma *dinggi* Veldk. & Rouwenhorst, forma nova, forma *kanange* Veldk. & Rouwenhorst, forma nova, and forma *muelleri*, and *Ev. velutina* Veldk., spec. nov., from the Eastern Highlands.

INTRODUCTION

Evodiella B.L. v.d. Linden is a neglected genus of the Rutaceae. It occurs in Papua New Guinea and in Queensland and has generally been said to contain three species. Some time ago Dr. J. Sterly, Hamburg, pointed out that the Papuans in the Chimbu area recognized two 'species' and he asked the attention of the Rijksherbarium to their differences.

The following observations are primarily based on the ample material available in L, Sterly's collections in HBG and on a brief examination of the specimens in K by the first author during a visit there. Comparison with some critical specimens were hampered by the fact that some of the material present in L and U was out on loan to Dr. T.G. Hartley, Canberra, who was engaged in a revision of *Euodia* Forst. f., but who failed to respond to letters.

Evodiella is clearly related to *Acronychia* Forst. f. and *Euodia* ('*Evodia*' in most literature). Van der Linden (1959) has given a tabular survey of the differences which was largely followed by Hartley (1974), so it seems superfluous to reproduce it here. In short, *Evodiella* is especially distinct by its fruit which is fairly large with the four carpels more or less connate at the base. During maturation the latter strongly enlarge upward and become quite columnar, but leave deep elongated furrows between them, whereby they seem to have dehisced at an early stage of development. They remain connate at their very tips until the fruit finally does dehisce, but inside they almost immediately have formed an open longitudinal slit invisible from the outside until after dehiscence. When the upper parts of the carpels separate, they appear as 'valves' of an apparently 4-locular quadrangular capsule. The hairy endocarp turns outward along the edges, giving a curious rim- or wing-like aspect to them. The 'valves' split into two in the upper fifth or so ('loculicidally dehiscent', Hartley)

exposing the inner part of the endocarp. This is not very well shown in Lauterbach's picture of it (1918, copied by Engler, 1931) although the general shape is correct. The fruit depicted by Engler (1896, 1931) is not of *Evodiella* at all, but of a true *Euodia*, probably *Eu. elleryana* F.v.M., about which later. In *Evodiella* the lower part is inflated whereby a kind of 4-locular 'basal chamber' is formed in which the seeds hang down freely. The latter are oblong-ovoid to cylindric with at first a reddish brown and dull, finally a dark bronze coloured and slightly shiny, wrinkled testa.

Euodia, on the contrary, has rather small fruits, the 'valves' separate to their bases spreading horizontally without forming a 'basal chamber', but tightly clasp the globose to broadly ellipsoid, black, shiny, smooth seeds. This is also what Engler's plates referred to above showed.

Acronychia has drupaceous fruits. The 'valves' do not separate although there may be adaxial slits, there is no 'basal chamber' and the dull, smooth seeds are tightly clasped.

Whether the characters thus offered by fruits and seeds will eventually turn out to be adequate enough to distinguish the genera is thrown into doubt by a few specimens in L which could not be placed satisfactorily. In *NGF 22179 (Gillison)* and *Pullen 6733* the fruits have 'valves' that spread out from about halfway their lengths; the basal parts are connate into a massive structure without the development of 'chambers'. The seeds are similar to those of *Euodia*, so at present we have assumed that they represent a species of that genus, which in the absence of a revision has remained unknown to us. In *NGF 44421 (Streimann & Kairo)* the fruits are similar to those of *Evodiella*, but much smaller, more of the size of typical *Euodia* fruits and although fully ripe still somewhat puberulous. The 'basal chamber' is small but present and the seeds are also similar to those of *Evodiella*. This collection then might represent an aberrant form or an extreme one that at present cannot readily be linked to the remainder of the material.

Van der Linden said in his generic diagnosis that the filaments would be hairy at the base, but in his description of *Euodia muelleri* he stated that they would be glabrous. Hartley gives us glabrous filaments as a diagnostic character but in fact they are always hairy at least at their base and often so up to halfway their lengths.

INTERSPECIFIC RELATIONSHIPS AND TYPIFICATIONS

Van der Linden distinguished three species which will here be treated in the chronological order of their publication.

Von Mueller (1875) identified a Dallachy collection from Queensland with *Euodia accedens* Blume. Apparently at the time of collecting or soon afterwards, a mix-up was made with the fruits of an *Euodia*, most likely *Eu. elleryana*, for these were depicted by Engler (1896, 1931). The duplicate sheet in K is accompanied by a satchel with such fruits. The specimen itself, however, has typical *Evodiella* fruits still attached to it (see also Francis, 1931, who considered the species to be an *Acronychia*). The flowers are also those of *Evodiella*. The specimen in L, which we unfortunately could not study, may assumed to be uncontaminated, at least Van der Linden made

no remark about *Euodia* fruits. Contrary to his remarks the isotype in K had filaments with hairy bases, as was to be expected.

Von Mueller compared his specimen with a plate given by Miquel (1867) and a specimen from Ceram. Unfortunately, this material was also out on loan to Hartley, but this lack was not important as our genus occurs in Papua New Guinea and Queensland, only.

Engler (1896), without giving any further reasons, correctly regarded Von Mueller's material as representative of a distinct species, *Euodia muelleri* Engl.

Van der Linden had to base his concept of *Evodiella cauliflora* (Lauterb.) B.L. v.d. Linden on Lauterbach's original description and plate (Lauterbach, 1918, who considered the species to belong to *Acronychia*). The plate fairly well agrees with other specimens seen by us but some dimensions in Lauterbach's description are conflicting as was already observed by Van der Linden: filaments 6 mm long, anthers 1.1 mm, style 3 mm. Lauterbach somehow has made an error of about a factor 2. This occasionally happens when one has a ruler provided with both centimetre and inch scales: 1 line = 1/12 inch = 2.1 mm.

Evodiella hooglandii B.L. v.d. Linden was based on only three specimens.

Many more collections have now been brought in and it has become clear that the characters used by Van der Linden to delimit his species do not distinguish them. We agree with him, though, that three taxa are present. As they differ by some weak characters only, with intermediate states being present, we prefer to regard them as formae. Two of these agree with the 'species' distinguished by Sterly's collectors, who are therefore vindicated. It is well-known that in the field with whole plants being available, differences between apparent taxa may be more obvious than in the herbarium specimens with which Von Mueller, Engler, Francis, Van der Linden and we by necessity had to work.

In the next discussion we will use the native Chimbu names 'dinggi' and 'kanange' for the two non-typical forms.

Sterly's collectors said that dinggi would grow in the forest and kanange outside it, that the leaves would be the same, but that the flowers would be different.

As far as we can see, there are indeed no differences in the leaves.

If we assume that with 'flowers' the Papuans meant 'inflorescences', then there is indeed some difference in their position, in the amount of flowers, in the length of the peduncle and especially in the length of the pedicels (see diagram 1). 'Typical' representatives of dinggi have inflorescences in the axils of the leaves of last season's growth or on the younger branches and are poor and lax because of the presence of relatively long peduncles (8–32(–47) mm long, average 17.4 mm), long pedicels (5–13 mm long, average 8.0 mm) and few flowers. The inflorescences of 'typical' kanange, on the other hand, are on the thicker, older branches or are even cauliflorous. They appear much denser because of the presence of relatively short peduncles (2–23 mm long, average 10.3 mm), short pedicels (3.5–6.5 mm long, average 5.2 mm) and many flowers.

Table 1.
Statistical analysis of some characters of *Evodiella muelleri* (Engl.) B.L.v.d. Linden forma *dinggi* Veldk. & Rouwenhorst and forma *kanange* Veldk. & Rouwenhorst.

	'dinggi'				'kanange'			
	altitude (m)	height (m)	peduncle (mm)	pedicel (mm)	altitude (m)	height (m)	peduncle (mm)	pedicel (mm)
N	46	42	46	46	28	15	28	29
average	2761.3	9.1	17.4	8.0	1560.9	7.3	10.3	5.2
1.96 × st.dev.	853.7	11.8	14.7	3.8	1092.0	5.0	11.5	1.7
lowest	1800	2	8	5	610	3	2	3.5
highest	3505	30.1	47	13	2590	12.2	23	6.5

correlation factor

altitude/pedicel length	(N = 44):	0.0013	(no corr.)	(N = 28):	0.0910	(no corr.)
altitude/height	(N = 41):	-0.1999	(no corr.)	(N = 15):	-0.1475	(no corr.)*
pedicel/height	(N = 39):	0.2601	(no corr.)	(N = 15):	-0.5440	(corr. at 2.5%)*

F-values (5%) for dinggi/kanange:

	expected	found	conclusion
altitude ($\varphi_1 = 45, \varphi_2 = 27$)	1.8–1.84	1.660	not significantly different
height ($\varphi_1 = 40, \varphi_2 = 14$)	2.27	3.950	significantly different*
peduncles ($\varphi_1 = 45, \varphi_2 = 27$)	1.8–1.84	1.611	not significantly different
pedicels ($\varphi_1 = 45, \varphi_2 = 28$)	1.78–1.81	5.018	significantly different

* Without four exceptionally large trees (30.1 m for dinggi, 21.3, 24.4 and 27.4 m for kanange). When these are included the correlation coefficients for altitude and height of dinggi becomes -0.2309 (N = 42, no corr.), for kanange 0.3772 (18, no corr.), for pedicel and height for dinggi 0.2355 (40, no corr.) and kanange -0.0944 (18, no corr.); the F = 1.360 ($\varphi_1 = 41, \varphi_2 = 17$, expected F = 2.08–2.11) and the difference is not significant.

There are also some differences in the texture and shape of the dried fruits which are difficult to express in words. In dinggi they seem to be less fleshy or woody and less rotund than in kanange.

Whether there are ecological differences as well, as suggested by Sterly's spokesmen, is difficult to assess from the field labels. At least in altitude there is a difference, dinggi being found between 1950 and 3505 m altitude (average 2716 m) and kanange

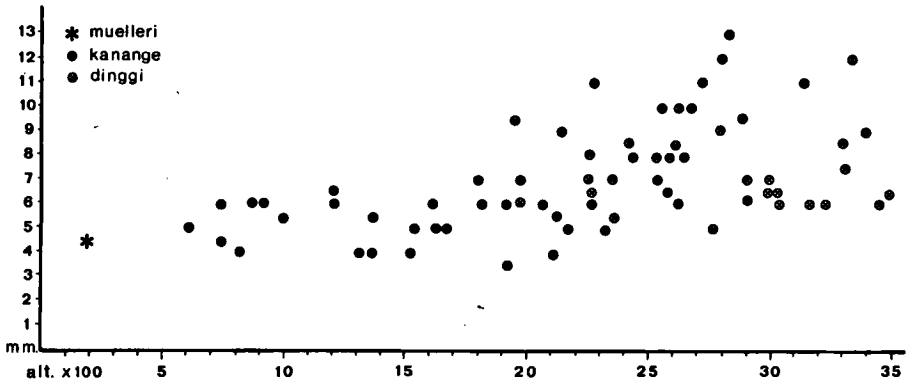

Diagram 1. *Evodiella muelleri* (Engl.) B.L. v.d. Linden. The altitude against the average length of the pedicels (5 measurements per specimen, whenever possible).

growing between 610 and 2590 m (average 1560 m) (see table 1 and diagram 1). It might therefore be possible that dinggi appears to grow more in the forest than kanange, because at higher altitudes the forest generally has been less cut down than at lower altitudes, which kanange favours.

There is a slight difference in distribution: dinggi is not known from the Sepik, Morobe and Northern Districts, while kanange has not been seen from the Southern Highlands and Milne Bay Districts.

Dinggi is apparently a higher plant, up to c. 21 m tall (average 8.6 m), while kanange is more often recorded as a shrub or treelet, up to c. 12.2 m tall (average 7.3 m). Occasional collections of kanange are of some exceptionally tall trees: *Carr 15515* (21.3 m), *NGF 35704 (Kairo & Streimann)* (24.4 m), and especially *NGF 45574 (Foreman & Wardle)* (27.4 m), the latter found far above the normal altitude of the forma (2590 m). For dinggi some exceptional collections have also been made: *NGF 34616 (Croft & Lelean)* was found at only 1800 m, but it has the 'typical' dinggi inflorescences, while here, too, one collection of a much taller tree was present: *Saunders 999* (30.1 m). The duplicate in L of *Pullen 567* (23.8 m) is sterile and cannot be assigned. As far as the altitude is concerned it is most likely a dinggi.

Statistical variance analyses on the size of the plant (when the exceptional tall ones mentioned above were omitted) and the length of the pedicels showed that significant differences do indeed exist (see table 1) and although none of the characters has a discrete variation, their cumulative effect suggests that two taxa are present. There is an almost zero correlation between the altitude and the length of the pedicel (see table 1), but in a scatter diagram (diagram 1) their values clearly pull the taxa apart. Neither is there a correlation between the altitude and the size of the plant. In dinggi there is also no correlation between the length of the pedicel and the size of the plant, but in kanange smaller trees appear to have a tendency for longer pedicels when the exceptionally tall ones are excluded. When these are included there is no correlation again.

Most of the specimens belonging to dinggi have usually been identified as *Evodiella hooglandii*, while kanange is found under either *Ev. cauliflora* or *Ev. muelleri.*

In New Guinea the fruits at maturity are usually completely glabrous. In a few specimens, however, they turned out to be persistently hairy. These collections were remarkable also for having been found between sealevel and c. 200 m in the Gulf and Central Districts, much lower than any other *Evodiella* collection known. The fruits of the type of the species, *Dallachy s.n.*, from Queensland, have been described as being 'fulvous pubescent' (Francis, 1931) or 'densely hairy' (Van der Linden, 1959). Other mature fruiting specimens from Australia also had a more or less persistent, very thin indument. Because there were only a few specimens available, from both New Guinea and Australia, the possible variability is still badly understood. It therefore seemed most prudent for the present to regard these specimens as all belonging to the forma *muelleri*. We have seen no specimens with both fruits and flowers, but *Craven & Schodde 980* found at low altitude (200 m) seems most likely to be a flowering representative and has thus been included here causing the single 'star' in diagram 1.

Even more pubescent are two collections from the Kainantu/Aiyura area (Eastern Highlands) where the leaves, sepals, petals and fruits are densely velvety hairy. A closer inspection showed other differences as well which convinced us that these specimens represented a very local, undescribed species, *Evodiella velutina* Veldk.

ACKNOWLEDGEMENTS

This study was started during an advanced course in Angiosperm taxonomy at the Rijksherbarium, Leiden, by the second author. The first author, who supervised this study, continued the research. We would like to thank Dr. J. Sterly, Hamburg, for bringing the subject to our attention, Dr. D.G. Frodin, then at Port Moresby, for his welcome information on the material present in UPNG, and Dr. C. Kalkman, Dr. W. Vink and Dr. W. J. J. O. de Wilde, Leiden, for their instructive assistance. This revision was based on the material present in L, on that loaned from HBG and seen in K (by JFV). We are most grateful to the Directors and Keepers of these Institutes for their cooperation. Some additional information on the Kew specimens was later kindly provided by Dr. W. R. Barker, Adelaide, during his visit to Kew. Mr. J.J.A.M. Wessendorp, Leiden, prepared diagram 1.

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EVODIELLA

Evodiella B.L.v.d. Linden, Nova Guinea n.s. 10 (1959) 145; Hartley, Lloydia 36 (1973) 259; J. Arn. Arb. 55 (1974) 469, 470; v. Royen, Alp. Fl. New Guinea 3 (1982) 2325. – Type: *Evodiella hooglandii* B.L.v.d. Linden [= *E. muelleri* (Engl.) B.L.v.d. Linden forma *dinggi* Veldk. & Rouwenhorst].

Shrubs or trees, growing with flushes. *Leaves* decussate, (1–)3-foliolate, leaflets papyraceous to coriaceous, minutely translucent-glandular-dotted, pale to dark green, nerves in 9–15 pairs anastomosing with loops. *Thyrses* axillary, ramiflorous, or cauliflorous. Bracts minute, triangular. *Flowers* bisexual, protandrous (see note), 4-merous. Flowers with simple, woolly hairs up to 1 mm long. *Sepals* imbricate, 4. *Petals* imbricate, 4, apex acuminate with a small pointed appendage. *Stamens* 4, alternipetalous; filaments filiform, apex geniculate; anthers dorsoversatile, dehiscing introrsely with two longitudinal slits. Disk intra-staminal. *Ovary* 4-locular, carpels slightly connate at least at base. Ovules 2 per carpel, epitropous, axillary, serial, the upper ascending, the lower pendulous. *Fruit* capsular, leathery to woody, consisting of a basal, permanently 4-locular 'chamber' and 4 free lobes ('valves') which very early in maturation have adaxial slits, at maturity the 'valves' become free, split apically extrorsely, whereby they become 2-lobed exposing the hairy endocarp, the latter also exserted along their margins. *Seeds* up to 8, oblong-ovoid to cylindric, testa at first reddish brown and dull, later bronze coloured and slightly shiny, wrinkled.

Distribution. Two species in Papua New Guinea and Queensland.

Phytochemistry. Hartley (1973) noted the absence of alkaloids in the bark and leaves.

Note. Flowers protandrous, remaining closed during anthesis with the anthers protruding from between their bases and later, terminally, the style.

KEY TO THE TAXA

1. Younger branches, undersurface of the leaflets, outside of sepals and petals velutinous. Petioles stout, 1–2 cm long. Leaflets elliptic to oblong, coriaceous. Sepals ovate, without a pale, scarious margin. Fruit puberulous; 1500–1650 m altitude **2. Evodiella velutina**

1. Younger branches, undersurface of the leaflets glabrous, outside of sepals at most very minutely puberulous, petals outside glabrous. Petioles slender, 2.5–6.5 cm long. Leaflets oblong to lanceolate, apex long acuminate to caudate. Sepals hemiorbicular to ovate, with a pale, scarious margin. Fruit usually glabrous, exceptionally puberulous, then plants from low altitude (0–820 m) **1. Evodiella muelleri**

2. Mature fruits puberulous; 0–200 m in Port Moresby area, 730–820 m in Australia. – Inflorescence on the older branches to cauliflorous, many-flowered, compound, dense. Peduncles 7–25 mm long, pedicels 3–5(–6) mm long **1a. forma muelleri**

2. Mature fruits glabrous; 610–3505 m altitude; New Guinea.

3. Shrub, treelet or tree, 2–21(–30.5) m tall. Inflorescences axillary on the younger branches, few-flowered, fairly simple. Peduncles 8–32(–47) mm long, pedicels 5–13 mm long; (1850–)1910–3500 m altitude . . . **1b.** forma **dinggi**
3. Shrub or treelet, 3–12.2(–27.4) m tall. Inflorescences on the older branches to cauliflorous, few- to many-flowered, usually amply compound and dense. Peduncles 2–23 mm long, pedicels 3.5–6.5 mm long; 610–2590 m altitude **1c.** forma **kanange**

1. Evodiella muelleri (Engl.) B.L.v.d. Linden

For literature, see under the formae.

Shrubs to trees, 2–30 m tall, glabrous. Branches terete, brown to blackish with usually linear lenticels. Petioles terete, (0.1–)1.5–4.5(–9.5) cm by (0.5–)1–2 mm diameter. *Leaflets* papyraceous (i.s.), oblong to lanceolate, base cuneate, apex cuspidate to caudate, acumen up to 2 cm long, nerves in 9–15 pairs; lateral leaflets (3.5–)5.5–8(–9) by 2–4(–6) cm; terminal leaflets (5–)7–10(–15) by (2–)2.5–4(–6.5) cm. *Thyrses* patent to pendulous, sometimes racemoid; (partial) peduncles 0.2–4.7 cm by 0.5–2 mm diameter; pedicels 3.5–13 by 0.2–0.7 mm diameter. *Flowers* 7–9 mm diameter. *Sepals* hemi-circular to ovate, 2–3(–4) by 1.5–3(–4) mm, apex rounded to obtuse, outside glabrous or finely ciliolate, inside glabrous or sparsely pubescent at base. *Petals* elliptic, (4–)6–8(–11) by (2.5–)3.5–4.5(–5.5) mm, pale brown (i.s.), outside glabrous or with some minute cilia, inside hirsute at least at base and on midrib. *Filaments* (0.7–)1.1–1.6(–2.1) cm long, densely pubescent at base to halfway. Anthers c. 2.2 mm long. Disk round to 4-lobed, lobes alternating with the stamens, or more-lobed and irregular, 4.5–6.5 mm diameter, c. 1 mm thick, fleshy, densely pubescent. *Ovary* immersed into the disk, densely pubescent; carpels with a rib-shaped to slightly winged, c. 1 mm wide, 0.2 mm thick abaxial ridge. Style filiform, (0.5–)0.9–1.6(–2) cm long, glabrous to sparsely pubescent at base. *Fruit* (1.1–)2–3 by 1.2–2.5 cm diameter, carpels usually connate in about the lower third, rarely up to the upper fourth, soon glabrescent, endocarp inside densely pubescent. *Seeds* up to 8, oblong-ovoid, c. 5 by 3 mm diameter.

Uses. Sterly (1978/79) cites for '*E. hooglandii*' a mixture of the formae *dinggi* and *kanange*: 'dinggi is also the name of a bracelet. Leaves given together with sweet potatoes to pigs with bronchopneumonia. The juice services as a medicine against malaria.'

a. forma muelleri

Evodiella muelleri (Engl.) B.L.v.d. Linden, Nova Guinea n.s. 10 (1959) 147. – *Euodia accedens* auct. non Blume: F.v.M., Fragm. Phyt. Austr. 9 (1875) 102; Bailey, Queensl. Fl. 1 (1899) 201, excl. syn. – *Euodia muelleri* Engl. in E. & P., Nat. Pfl. Fam. III, 4 (1896) 121, f. 69G & H; ibid., ed. 2, 19a (1931) 228, f. 96G & H. – *Acronychia muelleri* Francis, Kew Bull. (1931) 190. – Type: *Dallachy s.n.* (B, holo, lost; L, MEL, n.v.; K), Australia, Queensland, Rockingham Bay.

Small to fair-sized trees, 4–24.5 m tall. Inflorescences on the older branches to cauliflorous, many-flowered, amply compound and dense. Peduncles 7–25 mm long (average 14.3 mm), pedicels 3–5(–6) mm long. Mature fruits puberulous to pubescent.

Distribution. Papua New Guinea: Gulf (1 specimen), Central (4); Australia: Queensland (Cook Dist.) (5).

Ecology. Wet sclerophyll hill forest, mixed savannah woodland, on granite, roadside; altitude 0–200 m in Papua New Guinea, 730–820 m in Queensland.

Collector's notes. Tree. Crown well-formed. Bark greyish brown, slightly furrowed, brownish white; inner bark pale cream brown, greenish yellow, yellowish brown; wood straw, creamy white, heart not strongly differentiated, yellowish brown. Leaves above dull midgreen, below paler. Flowers on the branches below the leaves. Petals mauve pink. Fruit green, drying brownish, verrucose, somewhat speckled by darker, round oil dots, strong citrus smell.

Notes. This forma is still not very well known as only a few, usually incomplete specimens were available. In general it looks like a larger-sized forma *kanange* with hairy fruits growing at low altitude, at least in Papua New Guinea.

A single flowering specimen, *Craven & Schodde 980*, has been included here because of the low altitude of its provenance (200 m).

b. forma **dinggi** Veldk. & Rouwenhorst, *forma & stat. nov.*

Evodiella hooglandii B.L.v.d. Linden, Nova Guinea n.s. 10 (1959) 145, f. 1a–e; Borgmann, Zeitschr. Bot. 52 (1964) 134; Hartley, Lloydia 36 (1973) 259, pro *Hartley 13215*; Sterly, Ethnomed. 5 (1978/79) 396, pro *Sterly 71-255*; v. Royen, Alp. Fl. New Guinea 3 (1982) 2325, f. 693. – Type: *Pullen 287* (L, holo; CANB, LAE, n.v.), New Guinea, Chimbu Dist., Kuaki R. near Toromambuna Mission, 2680 m, 11 Aug. 1957.

Shrubs, treelets or trees, 2–18.6(–30.5, see note) m tall. Inflorescences axillary on the younger branches, few-flowered, fairly simple. Peduncles 8–32(–47) mm long (average 17.4 mm), pedicels 5–13 mm long (average 8 mm). Mature fruits glabrous.

Distribution. Papua New Guinea: Enga (8 coll.), W. Highlands (11), Chimbu (18), E. Highlands (10), S. Highlands (4, all from Mt Giluwe), Central (4), Milne Bay (2). Not known from the Sepik, Morobe and Northern Districts.

Ecology. Subalpine shrubbery, mixed montane forest, in the subcanopy of *Nothofagus, Podocarpus, Libocedrus, Phyllocladus* and Lauraceous forest, moist, mossy forest, secondary forest, forest edge, *Miscanthus* grassland; altitude (1800–) 1910–3505 m.

Chromosome number. 2n = 36 (Borgmann, 1964, based on *Borgmann 163*).

Collector's notes. Bushy, thickly foliaged treelet to tree. All parts aromatic. Bark light grey brown with widely spaced longitudinal fissures or polygonal cracks, an anastomosing network, pusticular, pale brown with purple longitudinal lenticels in longitudinal rows, brown and grey streaked, pink brown, brown, dark

brown; underbark green, greenish white, greenish yellow, greenish orange, straw, white and orange, streaked with red, white with brown patches; inner bark yellow green, sweet smelling. Wood white, whitish cream, straw, pale brown, yellow, with concentric wavy orange lines in transverse section, soft. Sap somewhat mucilaginous (*Brass 30130*, but *NGF 28284*: 'exudate absent'). Leaves bright yellow green when young, above green, dull green, glossy, below yellow green, pale green with oil glands, leathery, aromatic when crushed. Pedicels red. Sepals yellow green, green, red, purplish. Petals pink, pink outside and white inside, vivid pink, creamy red, orange red, red, crimson, pale purple at base, darker to apex. Stamens long-exserted. Filaments white, pink, crimson after anthesis. Anthers yellow, pale brown when young, wine red, purplish red, purple black when old. Style white, crimson after anthesis; stigma green, yellow. Ovary dark green. Disk white. Fruits green, red-tinged, shiny dirty pink, yellow tinged, orange, deep red, fleshy, dehiscent in the upper half when ripe (except apically: *van Balgooy 533*), aromatic-glandular. Seeds black.

Uses. Planted on ceremonial dancing grounds. Flowers have a symbolic significance during ceremonies in the Goroka area. Leaves eaten as medicine (Pengagl). Sterly (in litt.) said that a decoction of the leaves is used externally against malaria and also as a pig's medicine (voucher *Sterly 71-255*). Wood may be used as timber. As birds feed on the flowers bird hunters erect a shelter nearby (Sterly, in litt.). See also under the species. 'Dinggi' is also a Chimbu word for bracelet, which may indicate the use of the flowers.

Vernacular names. Ala kumba (Kaugel), averini (Fiyugi), diling (Wahgi, Minj), dinakiss, dinikis (Goroka, Asaro, Kefamo, Dunantina), various forms of dinggi (Chimbu), kaima (Togoba), kidji, kilch (Hagen, Togoba), kumb (Enga, Poio), kumbe (Hagen, Tomba), liok, para (Enga), olei (Okapa), titiku (Waria, Garaina), ump (Mendi).

Note. An exceptionally tall tree is represented by *Saunders 999*: 30.1 m. The duplicate in L of *Pullen 567* (23.8 m) is sterile and cannot be assigned. It possibly belongs to this forma because of the altitude at which is was found (2375 m).

c. forma **kanange** Veldk. & Rouwenhorst, *forma nov.*

Acronychia cauliflora Lauterb., Bot. Jahrb. 55 (1918) 253, f. 5; Engl. in E. & P., Nat. Pfl. Fam. ed. 2, 19a (1931) 310, f. 141. – *Evodiella cauliflora* B.L.v.d. Linden, Nova Guinea n.s. 10 (1959) 147. – Syntypes: *Ledermann 11269, 11281* (B, lost), New Guinea, E. Sepik Dist., Mt Hunstein, 1300 m, 3 March 1913.

Evodiella hooglandii auct. non B.L.v.d. Linden: Hartley, Lloydia 36 (1973) 259, pro *Hartley 12456, 12605*; Sterly, Ethnomed. 5 (1978/79) 396, pro *Sterly 75-350.*

Evodiella sp.: Hartley, Lloydia 36 (1973) 259.

Frutex aut arbusculum, rare arbor, 3–12.2(–27.4) m alta, inflorescentiis ramis vetustioribus insidentibus aut caulifloris plerumque multifloris ramosis densisque, pedunculis 2–23 mm longis (10.3 mm in medio), pedicellis 3.5–6.5 mm longis (5.2 mm in medio), fructibus maturis glabris, inter 610 et 2590 m altitudinem (1560 m in medio) crescentibus. – Typus: *Sterly 80-290* (L, holo; A, CANB, K), Papua New Guinea, Chimbu Dist., Gembbogl Subdist., Chimbu Valley, Yononggo, 2075 m, 5 Oct. 1980.

Shrubs or treelets, 3–12.2(–27.4, see note) m tall. Inflorescences on the older branches to cauliflorous, usually many-flowered, usually amply compound and dense. Peduncles 2–23 mm long (average 10.3 mm), pedicels 3.5–6.5 mm long (average 5.2 mm). Mature fruits glabrous.

Distribution. Papua New Guinea: E. Sepik (2 specimens), Enga (1), W. Highlands (4), Chimbu (8), E. Highlands (3), Morobe (14!), Central (7), Northern (1). Not known from the S. Highlands and Milne Bay Districts.

Ecology. *Castanopsis, Nothofagus, Phyllocladus* forest, in second storey, forest edge, between coniferous forest and treefern grassland, streamside, dry marginal scrub, secondary forest, secondary grasslands, planted in house and garden areas; altitude 610–2590 m.

Collector's notes. Shrub, small to large tree. No buttresses. Crown slight. Branches slender. Outer bark grey, grey brown, pale brown, with darker patches, smooth or with shallow vertical cracks, peeling off in small, irregular flakes, roughened; under bark green, green yellow, red; inner bark brittle, cream, straw, pale brown, with darker brown streaks due to fibres, doughy scent; wood white, soft, moderately hard, heavy, with pores in a wavy band. Leaves membranous, venation not prominent, above pale to midgreen, below paler, aromatic when crushed, usually trifoliolate. Flowers axillary below the leaves or cauliflorous on the old wood. Sepals pale green, deep pink, purplish. Petals pink, rose lilac, reddish violet. Filaments exserted between the petals, yellowish white, crimson after anthesis. Anthers red, purple. Style yellowish white, crimson after anthesis, stigma yellow. Ovary pale green. Fruits whitish, green, orange brown, flesh white, with strong lemon scent, taste bitter, like tangerines. Seeds greenish white (unripe?).

Uses. Planted at ceremonial dancing grounds. Flowers have symbolic significance at ceremonial occasions. Mature trees used for timber. Crushed leaves are eaten in case of intestinal complaints (voucher *Sterly 71-266*). See also under the previous forma and the species.

Vernacular names. Dinggi (!), kaficinam (Kainantu), kanange (Chimbu), ket (Waria), kilch (Hagen), kilt (Medlpa), liok (Enga), titiku (Garaina). Sterly (in litt.) mentioned irula kanage from Sinasina; this probably refers to *Hide 63* (n.v.), but the name was not mentioned by Sterly (1978/79).

Notes. Exceptionally tall trees are represented by *Carr 15515* (21.3 m), *NGF 35704 (Kairo & Streimann)* (24.4 m), and especially *NGF 45574 (Foreman & Wardle)* (27.4 m) which was found at 2590 m, far above the highest altitude of the rest of the forma, 2285 m (*NGF 11348*).

2. Evodiella velutina Veldk., *spec. nov.*

Evodiella muelleri auct. non B.L. v.d. Linden: Hartley, Lloydia 36 (1973) 259.

A *Evodiella muelleri* (Engl.) B.L. v.d. Linden in ramulis, foliis, sepalis petalisque velutinis, petiolis crassioribus brevioribusque, foliolis ellipticis ad oblongis coreaceis, sepalis ovatis sine marginibis scariosis, fructibus puberulis differt. – Typus: *NGF 24712 (Womersley)* (L, holo; LAE, n.v.), New Guinea, E. Highlands, Aiyura, Norikori swamp, 6°20′S, 145°55′E, 1650 m, 25 May 1966.

Treelets, 3.5–6 m high, at least the younger branches cinnamon-velvety, glabrescent. Petioles rather stout, 1–2 cm by 1.5–2 mm diam. *Leaflets* coriaceous, elliptic to oblong, base cuneate, apex abruptly acuminate, acumen up to c. 7 mm long, dirty green (i.s.), coriaceous, nerves in 10–14 pairs, velvety on both sides, the upper surface soon glabrescent; lateral leaflets 5.6–7.6 by 2.7–4 cm; terminal leaflets 7–9.5 by 4–5 cm. *Thyrses* axillary, few-flowered, rather compact, erecto-patent to pendulous; axes velvety; partial peduncles up to 8 by 1.2 mm diameter; pedicels 4–5 mm long. Bracts triangular, minute, velvety. *Sepals* ovate, 3–3.5 by 3–3.5 mm, margins not scarious, rounded to obtuse, velvety outside, glabrous, shiny inside, fleshy. *Petals* oblong, 6.5–7 by 2.5–3 mm, apex incurved, acutish with a small pointed appendage inside, yellowish brown (i.s.), margins whitish, rather thin, glabrous, outside velvety, inside at base hirsute, in the upper half with 3 hairy lines. *Filaments* filiform, c. 1.35 cm long, pubescent in the lower 0.3–0.5th. Anthers 2.2–2.5 mm long, purple. Disk annular, obscured by the indument. *Ovary* subglobose, densely villose. Style filiform, c. 1.2 cm long, hairy in the lower 0.6th. *Fruit* woody, 1.8–2 by 1.2–1.3 cm diameter, velutinous, carpels connate in the lower half, splitting again at the apex, endocarp densely puberulous. *Seeds* (1 seen) ± cylindric, c. 4 by 2.5 mm.

Distribution. Papua New Guinea, E. Highlands (Aiyura, Akuna, 2 miles S. of Kainantu).

Ecology. Streambank, *Castanopsis* forest, 1525–1650 m altitude.

Collector's notes. Small tree, branching freely, bole c. 1.2 m long, 15 cm diameter. Bark grey, finely fissured, underbark green, 2.5 mm thick. Wood white. Leaves grey green, tomentose. Sepals green. Petals pink. Stamens pink, anthers dark red. Fruit quadrangular, covered with oil dots.

Vernacular name. Agin-nimya (Kamona).

IDENTIFICATION LIST

Only numbered collections have been included. Abbreviations:

d = *Ev. muelleri* (Engl.) B.L. v.d. Linden forma *dinggi* Veldk. & Rouwenhorst
i = *Ev. muelleri* (Engl.) B.L. v.d. Linden intermediary forms
k = *Ev. muelleri* (Engl.) B.L. v.d. Linden forma *kanange* Veldk. & Rouwenhorst
m = *Ev. muelleri* (Engl.) B.L. v.d. Linden forma *muelleri*
s = *Ev. muelleri* (Engl.) B.L. v.d. Linden sterile collections
v = *Ev. velutina* Veldk.

ANU 921 (Walker): i; 2618 (Flenley): d; 2731 (id.): d; 6498 (Wheeler): k; 15147 (Smith): d.
van Balgooy 504: d; 533: d – Borgmann 163: d – Bowers 835: d – Brass 22870: d?; 30130: d; 30214: d; 30397: d?; 30961: d; 31752: d.
Carr 11563: m; 13420: k; 13828: k; 14842: k; 15515: k – Clemens 7237: k; 8500a: k? – Craven & Schodde 980: m.
Grubb & Edwards 56: d.
Hartley 9704: k; 12456: k; 12605: d; 12930: v; 13215: d – Hoogland 9620: k – Hoogland & Pullen 5524: d; 5835: d; 6144: d – Hoogland & Schodde 6935: d; 7086: d; 7556: d.
LAE 55574 (Stevens & Veldkamp): d; 60924 (Croft et al.): d; 61978 (id.): i; 74361 (Kerenga & Umba): d; 74403 (Kerenga & Croft): d – Ledermann 11269: (k); 11281: (k).

NGF 4382 (Womersley): d; 5294 (Floyd et al.): k; 6788 (Womersley & Floyd): k; 6904 (id.): d; 7142 (Grey & McDonald): m; 8497 (Womersley & Millar): k; 9579 (White): d; 9613 (Ross): k; 10757 (McVeagh): k; 11189 (Havel & Kairo): k; 11348 (Womersley): k; 14118 (id.): k; 14435 (Millar): k; 14691 (Millar & van Royen): d; 15385 (Womersley): k; 17158 (Vagi): k; 18171 (van Royen): d; 18507 (Millar & van Royen): k; 19926 (Sayers & Millar): d; 20199 (van Royen): d; 20345 (id.): k; 23167 (Millar): d; 24712 (Womersley): v; 25126 (Gillison): d; 28284 (Frodin): d; 28326 (id.): d; 34616 (Croft & Lelean): d; 35704 (Kairo & Streimann): k?; 35749 (id.): d; 38359 (Millar): k; 39592 (Vanderberg): d; 39639 (id.): d; 40279 (Coode et al.): d: 40723 (Millar): d; 44421 (Streimann & Kairo): k?; 45574 (Foreman & Wardle): k?; 46394 (Lelean): k; 46404 (Womersley): k; 47130 (Johns & Noble): d; 48034 (Foreman et al.): d; 48398 (Foreman & Lelean): d.

Philipson & Philipson 3390: d – Pullen 287: d; 567: d?.

Robbins 394: d.

Sanderson 46: m – Saunders 785: d; 875: d?; 999: d – Schodde 1711: d – Smith 03357: m; 14360: m – Sterley 71-255: d; 71-266: d; 75-350: k; 80-290: k; 1609: k.

UPNG 451 (Gebo & Pulu): m?; 3249 (Vinas & Naoni): m.

Vink 17203: d; 17227: d?.