

A REASSESSMENT OF THE STATUS OF THREE TAXA WITHIN THE *RHODODENDRON FORMOSUM* COMPLEX (ERICACEAE: SUBSECT. *MADDENIA*) FROM NORTHEAST INDIA

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A taxonomic investigation of the *Rhododendron formosum* complex in Northeast India was carried out. Both *Rhododendron iteophyllum* Hutch. and *Rhododendron inaequale* Hutch. are reinstated as distinct species using taxonomic characters based on comparing living plants. Detailed taxonomic accounts of *Rhododendron formosum*, *R. iteophyllum* and *R. inaequale* are provided, along with photographic illustrations.

Keywords. *Maddenia*, Northeast India, *Rhododendron formosum* complex, *Rhododendron inaequale*, *Rhododendron iteophyllum*.

INTRODUCTION

Wallich (1832) described *Rhododendron formosum* Wall. based on specimens collected by Smith from the Khasia Hills, Meghalaya, in 1815. Subsequently, Clarke added two varieties of *Rhododendron formosum*, namely var. *salicifolium* C.B. Clarke and var. *inaequale* C.B. Clarke, also from the Khasia Hills (Hooker, 1882). Later, Hutchinson (1919–1921) treated both these varieties as distinct species and named *Rhododendron iteophyllum* Hutch. for *R. formosum* var. *salicifolium* and *Rhododendron inaequale* Hutch. for *R. formosum* var. *inaequale*. He also stated that both taxa deserved closer study and that future collectors in the Khasia Hills would be able to throw further light on their taxonomic status. However, subsequent workers such as Cullen (1980, 2005), Chamberlain *et al.* (1996), Sastry & Hajra (2010) and Bhattacharyya & Sanjappa (2014) treated var. *salicifolium* as conspecific with *Rhododendron formosum* and var. *inaequale* as a distinct variety, while keeping *R. iteophyllum* as a synonym under it (in the absence of a full taxonomic treatment and basing their diagnosis on the width of leaves alone). These various changes have created misconceptions and confusion regarding the identification as well as the numerical diversity of species in the genus *Rhododendron* L.

When Wallich (1832) described *Rhododendron formosum*, he did not mention the presence of hairs on the leaf margins and petioles of the species, but on the specimens

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collected by Griffith (3506, KEW) from Moflong–Myrung road, Khasi Hills, such hairs are a characteristic feature of young leaves (Hutchinson, 1919–1921). Another species, *Rhododendron gibsonii* Paxton, was described based on the collections made in 1837 by J. Gibson from the Summit area of the Khasi Hills (Paxton, 1841). The specimens at Kew show clear gradation in the ciliation of the mature leaves from entirely glabrous to long ciliate, although the young leaves are densely ciliate (Hutchinson, 1919–1921). Later, Hutchinson (1919–1921) placed *Rhododendron gibsonii* under *R. formosum* as conspecific and revised the taxonomic description of *R. formosum*, in which he clearly mentioned the presence of hairs on the leaves.

Most of the above-mentioned works are based on herbarium material, from which the gradation in ciliation cannot be ascertained properly. Moreover, all these taxa were first described from Northeast India. Therefore, an attempt was made to study the *Rhododendron formosum* complex in Northeast India to resolve this taxonomic complexity. The authors conducted an intensive observation of living plants of the *Rhododendron formosum* complex in the Garden of the Botanical Survey of India, the Eastern Regional Centre, Shillong, Summit, Pynursula and Mophlong areas of the Khasi Hills, and in the Umphang area of Jaintia Hills, Meghalaya, over three years. The observations revealed high variability within the complex in the gradation of ciliation of branchlets, petioles, leaf margins and even calyx lobe margins, along with other good taxonomic characters relating to habit, size and shape of leaves, density of scales on corolla and lamina surfaces, and length of flowers, styles and filaments. Therefore, we conclude that Hutchinson was correct to give distinct species rank to both var. *salicifoliaum* and var. *inaequale*. *Rhododendron iteophyllum* is characterised by narrowly obovate to linear-oblong leaves 0.6–1.5 cm broad, sparsely loriform-setose to entirely glabrous (eciliate) young shoots and leaves, a deeply lobed calyx with loriform ciliate margins and an epilose style, whereas *R. inaequale* is characterised by eciliate, obovate to elliptic-oblong leaves (laxly ciliate when young), a broader lamina to 4 cm wide that is not decurrent onto the petiole, style pilose at the base and more or less asymmetrical, larger capsules, to 3 cm long (Table 1).

Here, *Rhododendron iteophyllum* is resurrected and *R. inaequale* is reinstated as a distinct species on the taxonomic evidence. Detailed taxonomic accounts of *Rhododendron formosum*, *R. iteophyllum* and *R. inaequale* are provided, along with photographic illustrations. Scanning electron microscopic images of the scales on the lower lamina surfaces of all three taxa are provided, showing their shape, size and density, these having taxonomic significance.

MATERIALS AND METHODS

Collection, pressing and preparation of herbarium specimens were done according to conventional herbarium techniques (Jain & Rao, 1976). Flowers were preserved in formaldehyde–acetic acid–ethanol solution. Taxonomic measurements and descriptions of each plant part are based on living material. Microscopic details were observed using an Olympus SZ2-ILST stereo-zoom microscope (Olympus, Tokyo, Japan) and a

TABLE 1. Morphological comparisons between *Rhododendron formosum*, *Rhododendron iteophyllum* and *Rhododendron inaequale*

Character	<i>Rhododendron formosum</i>	<i>Rhododendron iteophyllum</i>	<i>Rhododendron inaequale</i>
Habit	Shrubs, to 1 m high	Shrubs, to 0.5–2 m high	Woody shrubs, to 4 m high
Young shoots	Densely loriform-setose	Entirely non-setose to rarely sparingly setose	Sparingly setose
Lamina	Very variable, elliptic to linear-elliptic or linear-obovate to oblanceolate, 4–7.5 × 1–2 cm	Narrowly obovate to linear-oblanceolate, 3.5–12.2 × 0.6–1.5 cm	Obovate to elliptic-oblanceolate, 4.5–11.5 × 2–4 cm
Lamina surface above	Sparsely to densely hairy when both young and old, sparsely lepidote	Non-setose, sparsely lepidote	Non-setose, elepidote when old
Lamina margin	Loriform-setose	Non-setose or laxly loriform-setose only when young	Sparsely loriform-setose when young but soon becoming quite glabrous
Lamina apex	Acute	Subacutely triangular to acuminate	Acute
Base	Attenuate	Attenuate	Subacute-obtuse
Scales	From less than their own diameter to 1.5 times their own diameter apart on lamina surface below, reddish brown, unequal	1.5–3 times their own diameter apart on lamina surface below, golden-brown, ± uniform	1.5–3 times their own diameter apart on lamina surface below, brown, ± uniform
Petiole	0.3–1 cm long, loriform-setose	0.5–1 cm long, non-setose to sparsely loriform-setose only when young	1–1.5 cm long, very laxly loriform-setose when young, soon becoming quite glabrous
Inflorescence	2- or 3(–4)-flowered	2- or 3-flowered	3- to 5-flowered
Flowers	5–7.5 cm long	4.5–9.2 cm long	8–9 cm long
Calyx	Undulate to narrowly 5-lobed	Deeply 5-lobed	Very oblique, undulately lobed
Calyx lobe margin	Eciliate	Densely loriform-ciliate	2 or 3 loriform cilia per tooth
Corolla tube	1.5–2.5 cm long	1.8–2.7 cm long	4–4.3 cm long
Stamens	10	10 or 11	8–10
Style	To 6 cm long, epilose	To 7.5 cm long, epilose	To 7 cm long, pilose to one-quarter of its length from base
Ovary	To 6 mm long, 5- or 6-loculed	To 10 mm long, 6-loculed	To 10 mm long, 6-loculed
Capsules	Symmetrical	Symmetrical	Asymmetrical

Carl Zeiss EVO 18 (special edition) scanning electron microscope (Zeiss, Oberkochen, Germany), and photographed with a Nikon Coolpix P520 (Nikon, Tokyo, Japan). Air-dried specimens (not subjected to critical point drying) were prepared for scanning electron microscopy by gold sputter coating. Voucher specimens have been deposited in the Herbarium of the Botanical Survey of India, Eastern Regional Centre, Shillong (ASSAM).

TAXONOMIC TREATMENT

Key to species

- 1a. Lamina 2–4 cm broad, not decurrent onto petiole; inflorescence 3- to 5-flowered; corolla throughout lepidote outside; style pilose to one-quarter of its length from base; capsules \pm asymmetrical, to 3 cm long _____ **2. R. inaequale**
- 1b. Lamina 0.6–2 cm broad, more or less decurrent onto petiole; inflorescence 2- or 3(–4)-flowered; corolla lepidote only in tube outside and/or sparsely lepidote towards the middle of lobes outside; style epilose; capsules symmetrical, to 2 cm long _____ **2**
- 2a. Plants densely setose on branchlets and leaves; leaves 4.5–7.5 cm long, 1–2 cm broad with acute apex; scales about less than their own diameter to 1.5 times their own diameter apart on lamina surface below; calyx undulate to inconspicuously lobed with eciliate margin _____ **1. R. formosum**
- 2b. Plants entirely non-setose on branchlets and leaves (rarely sparsely ciliate only when young); leaves 3.5–12.2 cm long, 0.6–1.5 cm broad with subacutely triangular to acuminate apex; scales 1.5–3 times their own diameter apart on lamina surface below; calyx deeply lobed with densely loriform ciliate margin _____ **3. R. iteophyllum**

1. *Rhododendron formosum* Wall., Pl. Asiat. Rar. 3: t. 207 (1832); G. Don, Gen. Syst. 3: 845 (1834); DC., Prodr. 7: 721 (1839); Bot. Mag.: t. 4457 (1849); C. B. Clarke in Hook. f., Fl. Brit. Ind. 3: 473 (1882). – Type: India. Assam: Khasi Hills, Moflong–Myrung road, 9 xi 1835, *Griffith* 3506 (topo K). **Figs 1, 2, 7A, B.**

Rhododendron gibsonii Paxton, Paxton's Mag. Bot. 8: t. 217 (1841); Fl. des Series: 1, t. 18 (1845).

Erect shrub, 2–3 m high. *Young shoots* loriform-setose, lepidote. *Leaves* crowded. *Lamina* very variable, elliptic to linear-elliptic or linear-obovate to oblanceolate, 4–7.5 \times 1–2 cm, sparsely to densely hairy and laxly lepidote above, glabrous and densely lepidote beneath, long tapering to the base, acute at apex, margin loriform-setose, dense when young; scales from less than their own diameter to 1.5 times their own diameter apart on lamina surface below, light brown to golden brown, circular, unequal, 169.4–276.7 μm across, rim entire, 55–57 μm broad, central part

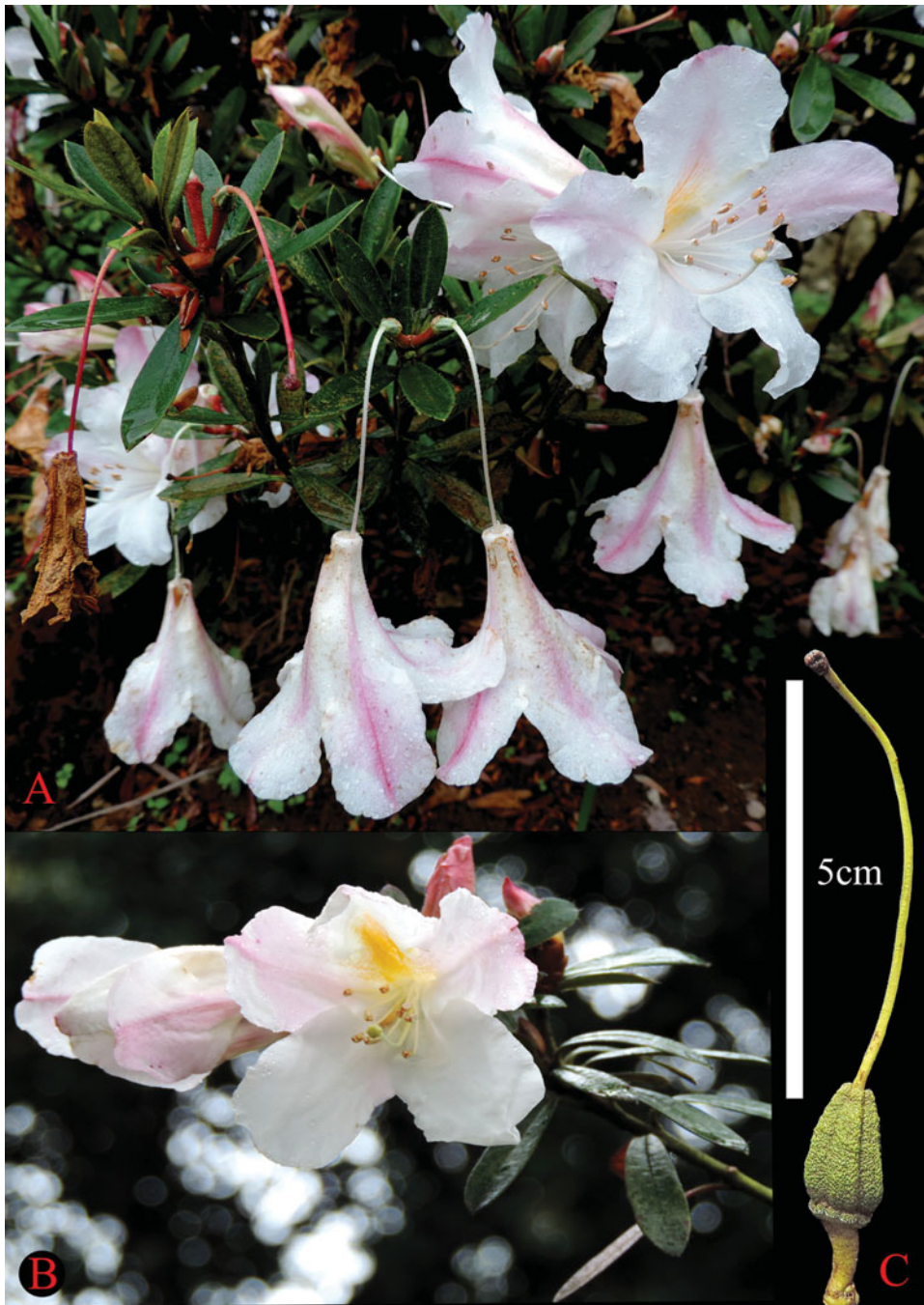


FIG. 1. *Rhododendron formosum* Wall. A and B, habit; C, capsule with persistent style.

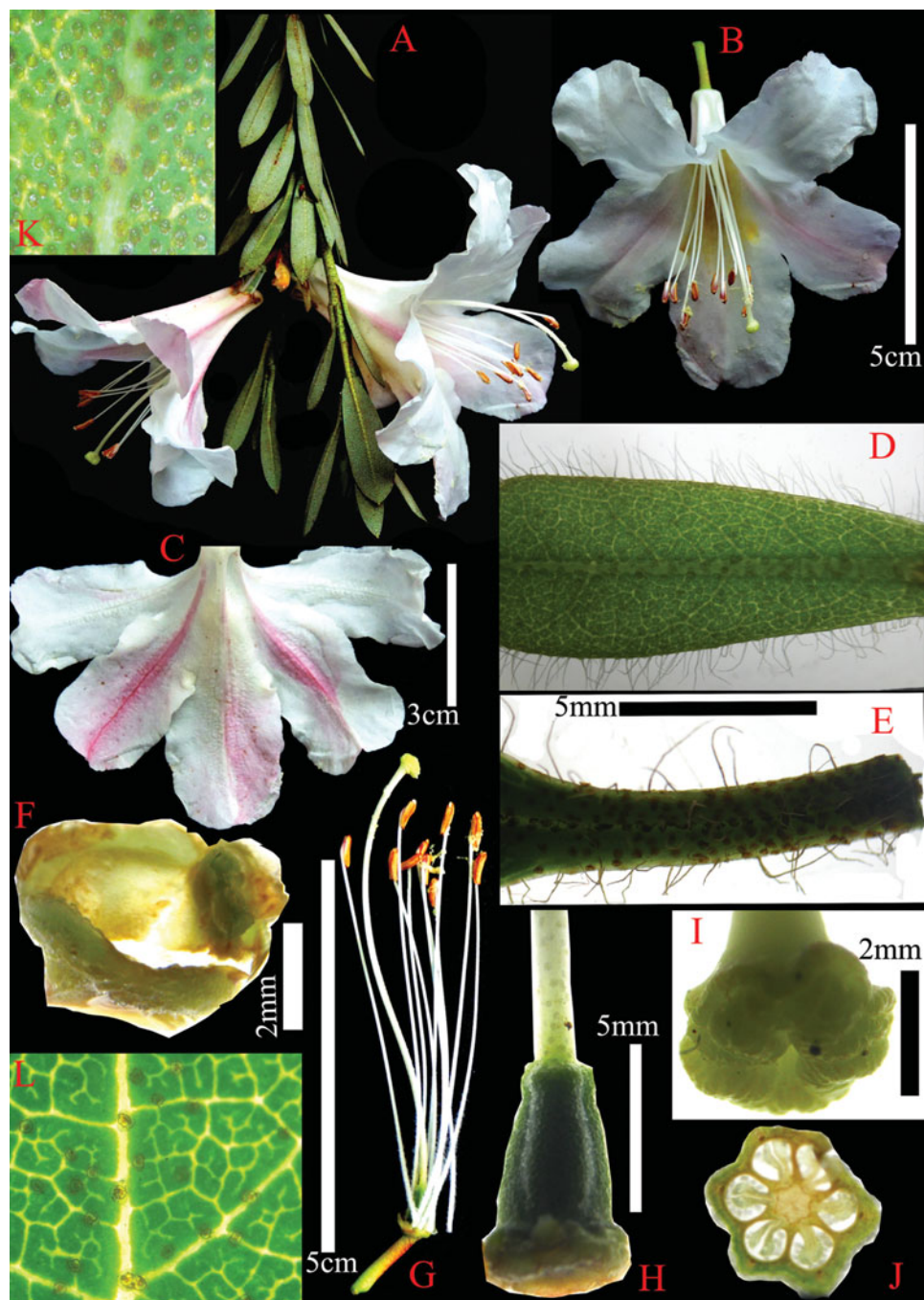


FIG. 2. *Rhododendron formosum* Wall. A, flowering twig; B, flower; C, corolla (dorsal view); D, portion of lamina, showing loriform-setose margins; E, setose petiole; F, calyx; G, stamens and carpel; H, ovary with lower portion of style; I, stigma; J, transverse section of ovary; K, scales on lamina surface below; L, scales on lamina surface above.

swollen, 134–185 μm in diameter; midrib impressed above, prominent beneath, rather sparingly lepidote. *Petiole* 0.3–1 cm long, grooved above, loriform-setose, lepidote. *Inflorescence* terminal, 2- or 3(–4)-flowered; peduncle 0.3–0.5 cm long, glabrous. *Flower* delicately scented, 5–7.5 cm long. *Pedicel* 0.5–1.2 cm long, glabrous, lepidote. *Calyx* disc-like, undulate to narrowly 5-lobed; lobes unequal, ovate-rounded to triangular, 1–1.5 \times 1–1.5 mm, densely lepidote outside, apex acute-rounded, margin eciliate. *Corolla* 3.5–5.5 cm long, widely funnel-campanulate, 5-lobed, white with a yellow blotch at the base on lower petals inside and purplish flushed along 5 external stripes outside; tube 1.5–2.5 cm long, sparsely lepidote, glabrous inside, pilose at the base outside; lobes broadly elliptic, 2.5–3 \times 1.8–3 cm, emarginated at apex, glabrous, lepidote. *Stamens* 10, unequal; filaments 2.8–4.8 cm long, slender, densely pubescent at base up to 3.5 cm from base; anthers linear-oblong, 4–5 mm long, dark purple-brown. *Ovary* cylindrical-ovate, 0.4–0.6 cm long, 5- or 6-loculed, densely lepidote; style impressed, 4.5–6 cm long, whitish, epilose, densely lepidote from base to middle; stigma lobulate, 2–3 mm across. *Capsule* straight, 1.5–2 cm long, about 8 mm thick, strongly ribbed, densely lepidote, with persistent style on central axis.

Phenology. Flowering in March to May and fruiting in May to July.

Distribution. India: Meghalaya.

Altitudinal range of distribution. 1400–2300 m a.s.l.

Specimens examined. INDIA. **Meghalaya:** Khasi Hills, Shillong, Woodland campus, 1441 m, 25°34'46.34"N, 91°53'55.15"E, 21 iv 2015, *A.A. Mao & D.K. Roy* 110465 (ASSAM!); 1451 m, 25°34'45.99"N, 91°53'56.13"E, 21 iv 2015, *A.A. Mao & D.K. Roy* 110466 (ASSAM!); 1470 m, 25°34'44.13"N, 91°53'55.01"E, 21 iv 2015, *A.A. Mao & D.K. Roy* 110467 (ASSAM!); 1469 m, 25°34'44.59"N, 91°53'54.95"E, 21 iv 2015, *A.A. Mao & D.K. Roy* 110468 (ASSAM!).

Additional specimens examined. INDIA. **Meghalaya:** Khasi & Jaintia Hills, Peak Forests, 6 iii 1932, *S.R. Sarma* 13522 (ASSAM!); Shillong, Lake garden, 5 v 1947, *G.K. Deka* 22354 (ASSAM!); Umsaw, *G.K. Deka* 21833 (ASSAM!); Shillong peak, *H. Deka* 18304 (ASSAM!); Mawphlong, 16 iv 1969, *A.S. Rao* 47408 (ASSAM!); Shillong, Woodland compound, 11 iv 1963, *G.K. Deka* 33062 (ASSAM!); Mawphlong, 4 x 1931, *S.R. Sarma* 9539 (ASSAM!); Shillong, Station Nursery, 30 iv 1947, *G.K. Deka* 23405 (ASSAM!); Elephant falls, 6000 ft, 24 v 1914, *U. Kanjilal* 3952 (ASSAM!); Shillong, Phudmari, 5000 ft, 4 vii 1913, *U. Kanjilal* 2245 (ASSAM!); Shillong, 5000 ft, iii 1886, *G. Mann s.n.* (16684, ASSAM!).

2. *Rhododendron inaequale* Hutch., Notes Roy. Bot. Gard. Edinburgh 12: 75–76 (1919).

– Type: India. Meghalaya: Khasi Hills, Myrung, Kollong, 6000 ft, 23 viii 1885, *Clarke* 40025 (holo K). **Figs 3, 4, 7C,D.**

Rhododendron formosum var. *inaequale* (Hutch.) Cullen, Notes Roy. Bot. Gard. Edinburgh 36: 108 (1978).

Rhododendron formosum var. *inaequale* C.B. Clarke in Hook. f., Fl. Brit. Ind. 3: 473 (1882).

Erect woody shrubs, 2–4 m high; branches more or less umbellate. *Young shoots* lepidote, sparingly setose. *Leaves* apically crowded on the branches. *Lamina* obovate



FIG. 3. *Rhododendron inaequale* Hutch. A, habit; B, vegetative twig; C, leaf (dorsal view); D, leaf (ventral view); E, flowering bud; F, flowering twig; G, scales on lamina surface below; H, scales on lamina surface below (close-up view).

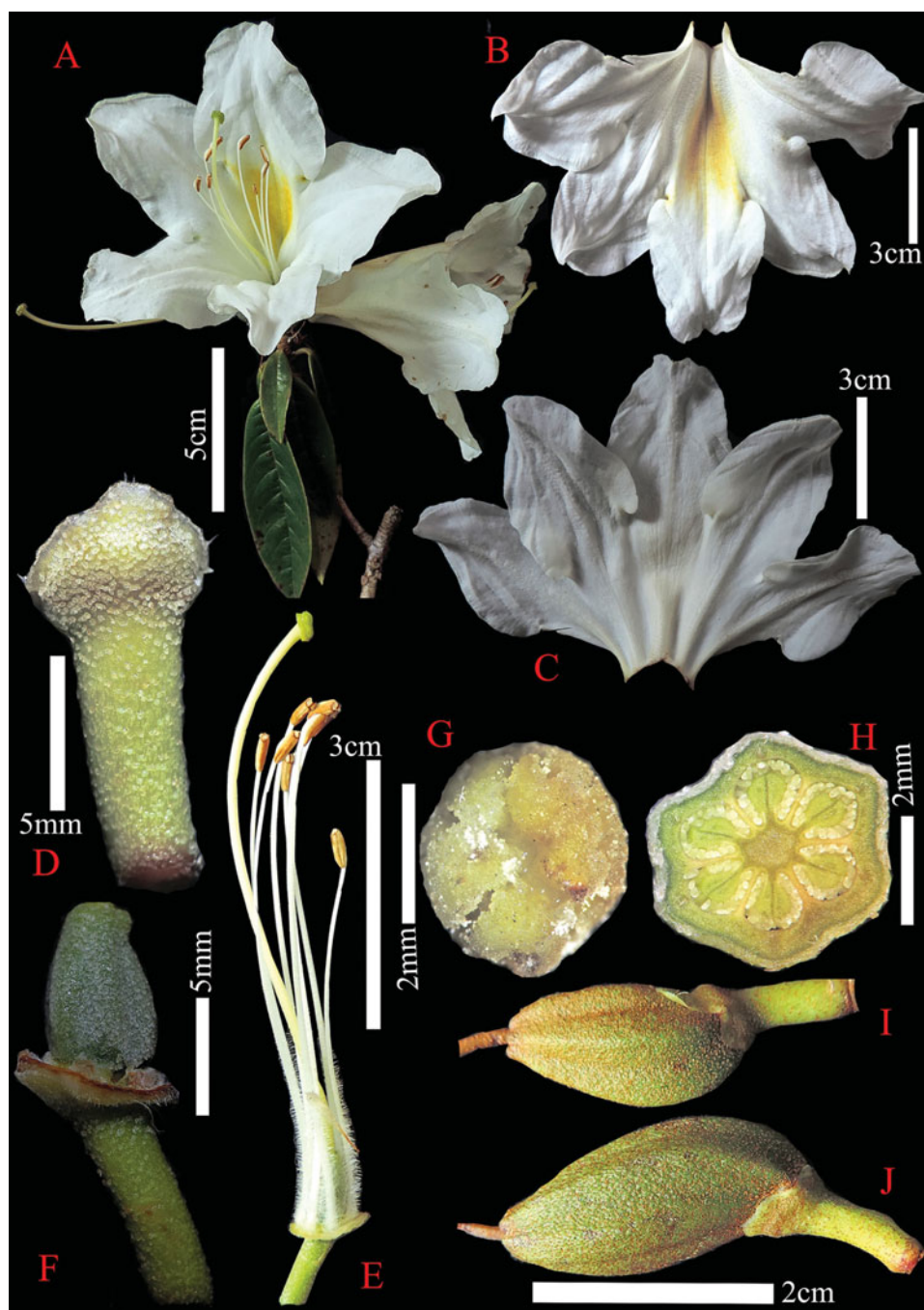


FIG. 4. *Rhododendron inaequale* Hutch. A, flowering twig; B, longitudinal section of corolla (ventral view); C, longitudinal section of corolla (dorsal view); D, pedicel; E, stamens and carpel; F, ovary; G, stigma; H, transverse section of ovary; I and J, capsules.

to elliptic-oblongate, 4.5–11.5 × 2–4 cm, acute at apex, subacute-obtuse at base, at first a little scaly on the upper surface, soon becoming quite glabrous and ciliate at margins when old, lepidote beneath; scales 1.5–3 times their own diameter apart, brown, circular, ± uniform, 212–254.2 μm across, rim entire to undulate, 36–70 μm broad, central part swollen, 110.8–130.8 μm in diameter; midrib impressed above, raised beneath, lepidote; lateral nerves about 6–8 on each side of the midrib. *Petioles* 1–1.5 cm, very laxly loriform-setose when young, soon becoming quite glabrous, lepidote, deeply grooved on the upper side. *Inflorescence* terminal, 3- to 5-flowered. *Flowers* fragrant, 8–9 cm long. *Pedicel* 0.8–1.2 cm long, lepidote. *Calyx* very oblique, undulately lobed, densely lepidote outside, with 2 or 3 loriform cilia at margin of teeth. *Corolla* 7.5–8.5 cm long, 5-lobed, widely open campanulate, white with orange flushing on lower petals inside, laxly scaly all over the outside; tube 4–4.3 cm long, pilose at base outside; lobes broadly elliptic, 3.5–4.2 × 3.3–3.5 cm, emarginate at apex. *Stamens* 8–10, unequal; filaments 4–6 cm long, slender, densely pubescent in lower third; anthers linear-oblong, 4–5 mm long, purple-brown. *Ovary* 6-loculed, cylindrical-ovate, 0.8–1 cm long, densely lepidote; style impressed, 6–7.5 cm long, whitish, sparsely lepidote from base to middle, pilose to one-quarter of its length from base; stigma lobulate, 2–3 mm across, creamy white. *Capsules* ± asymmetrical, 6-valved, 2.5–3 × 1–1.4 cm, densely lepidote with persistent style on central axis.

Phenology. Flowering in March to April and fruiting in May to June.

Distribution. India: Arunachal Pradesh, Manipur, Meghalaya and Nagaland.

Altitudinal range of distribution. 1400–2230 m a.s.l.

Specimens examined. INDIA. **Meghalaya:** East Khasi Hills, Pynursla, 14 ii 2015, *A.A. Mao* 110461 (ASSAM!).

Additional specimens examined. INDIA. **Manipur:** Esii Hills, 2200 m, 12 v 1997, *A.A. Mao* 102432 (ASSAM!); **Meghalaya:** Khasi & Jaintia Hills, Umsong bank, 5500 ft, 17 iv 1914, *U. Kanjilal* 389P (ASSAM!); Mauflong, 4 x 1931, *S.R. Sarma* 9539 (ASSAM!); Dumpep, 29 v 1932, *S.R. Sarma* 13523 (ASSAM!); Wah-Soh-Pho, 5500 ft, 23 ix 1913, *U. Kanjilal* 2631 (ASSAM!); Mawsmai, 26 iii 1960, *D.C. Raju* 21347 (ASSAM!); Shillong, Birla house, 2 vii 1963, *G.K. Deka* 35943 (ASSAM!); Riat Laban, 19 iv 1917, *U. Kanjilal* 7139 (ASSAM!); Peak forest, 19 iv 1931, *S.R. Sarma* 9095 (ASSAM!); Lai-Ling-Kot, 3 x 1930, *S.R. Sarma* 9057 (ASSAM!); Shillong, Um-ja-sai, 5500 ft, 11 iv 1916, *U. Kanjilal* 6998 (ASSAM!); **Nagaland:** Naga Hills, vi 1935, *N.L. Bor* 21244 (ASSAM!); v 1936, *N.L. Bor* 20828 (ASSAM!).

3. *Rhododendron iteophyllum* Hutch., Notes Roy. Bot. Gard. Edinburgh 12: 83–84 (1919). – Type: India. Meghalaya: Khasia Hills, rocks of Bor-Panee, 2000 ft, 24 vii 1850, *Hooker & Thomson s.n.* (syn K). **Figs 5, 6, 7E,F.**

Rhododendron formosum var. *salicifolium* C.B. Clarke in Hook. f., Fl. Brit. Ind. 3: 473 (1882).

Erect shrub, 0.5–2 m high. *Young shoots* non-setose to sparingly setose, green, densely lepidote. *Leaves* narrowly obovate to linear-oblongate, non-setose or sparingly

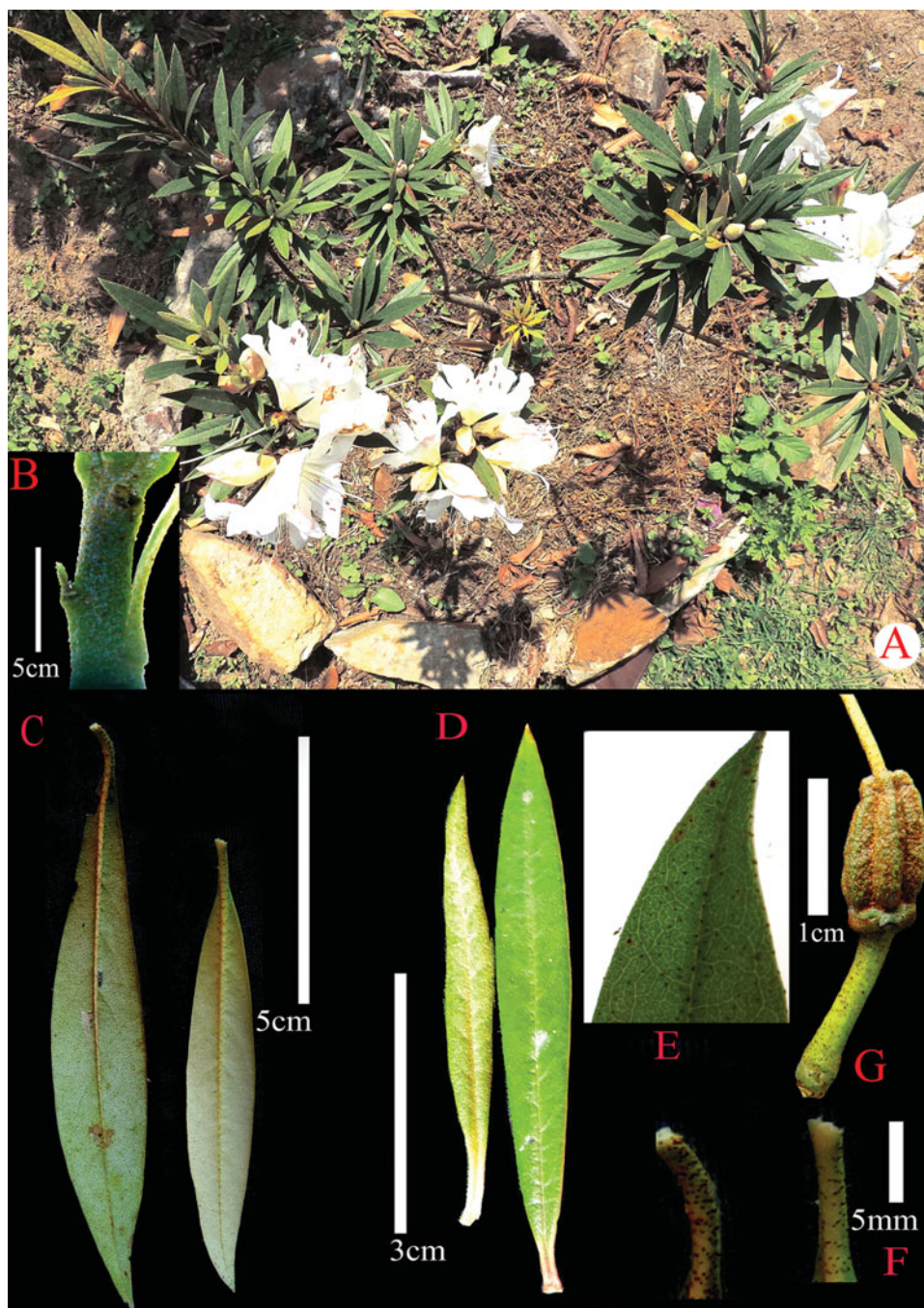


FIG. 5. *Rhododendron iteophyllum* Hutch. A, habit; B, portion of branchlet; C, leaves (ventral view); D, leaves (dorsal view); E, leaf apex; F, petioles; G, capsule.

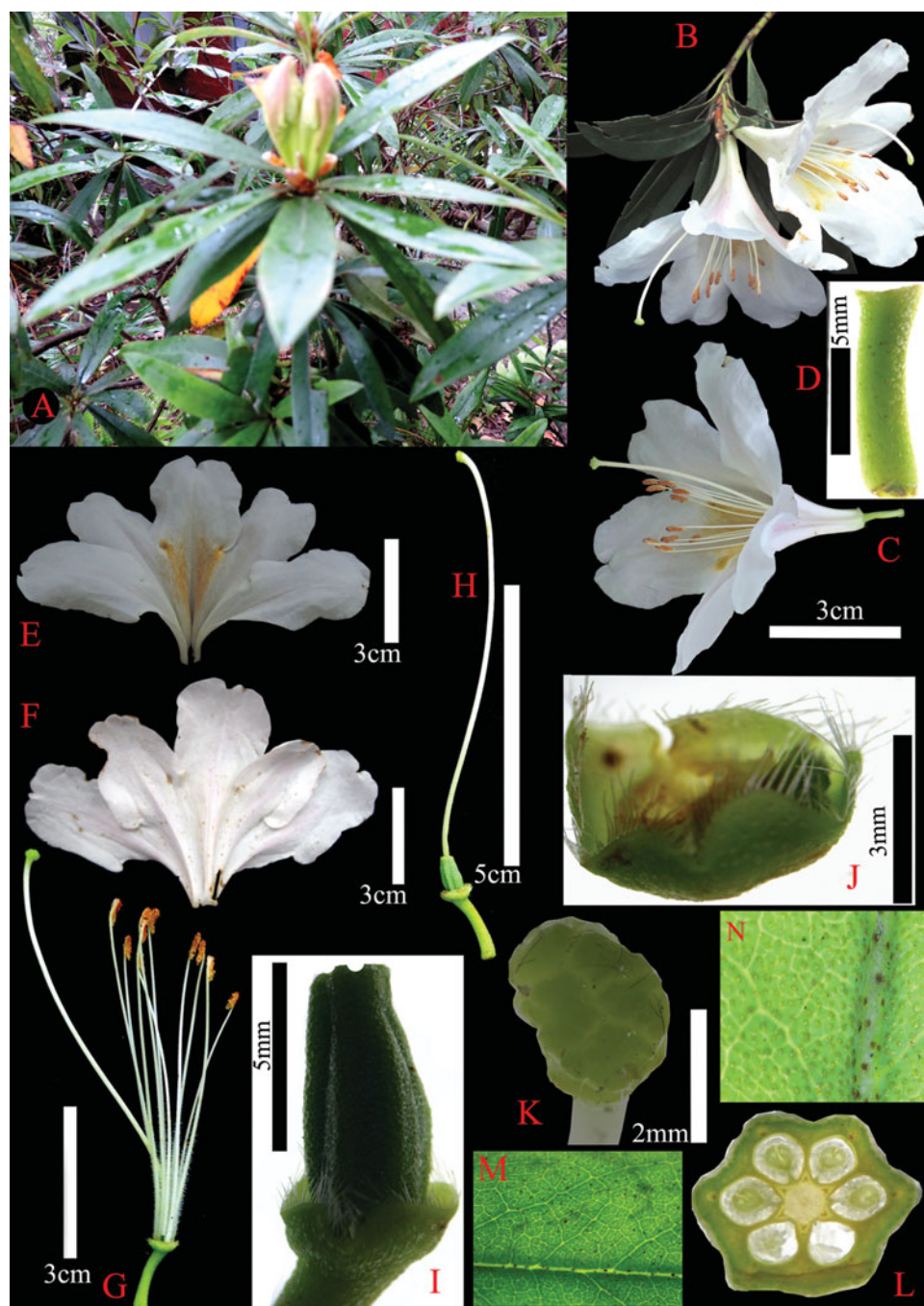


FIG. 6. *Rhododendron iteophyllum* Hutch. A, flowering bud; B, inflorescence; C, flower; D, pedicel; E, longitudinal section of corolla (ventral view); F, longitudinal section of corolla (dorsal view); G, stamens and carpel; H, carpel; I, ovary; J, calyx; K, stigma; L, transverse section of ovary; M, scales on lamina surface above; N, scales on lamina surface below.

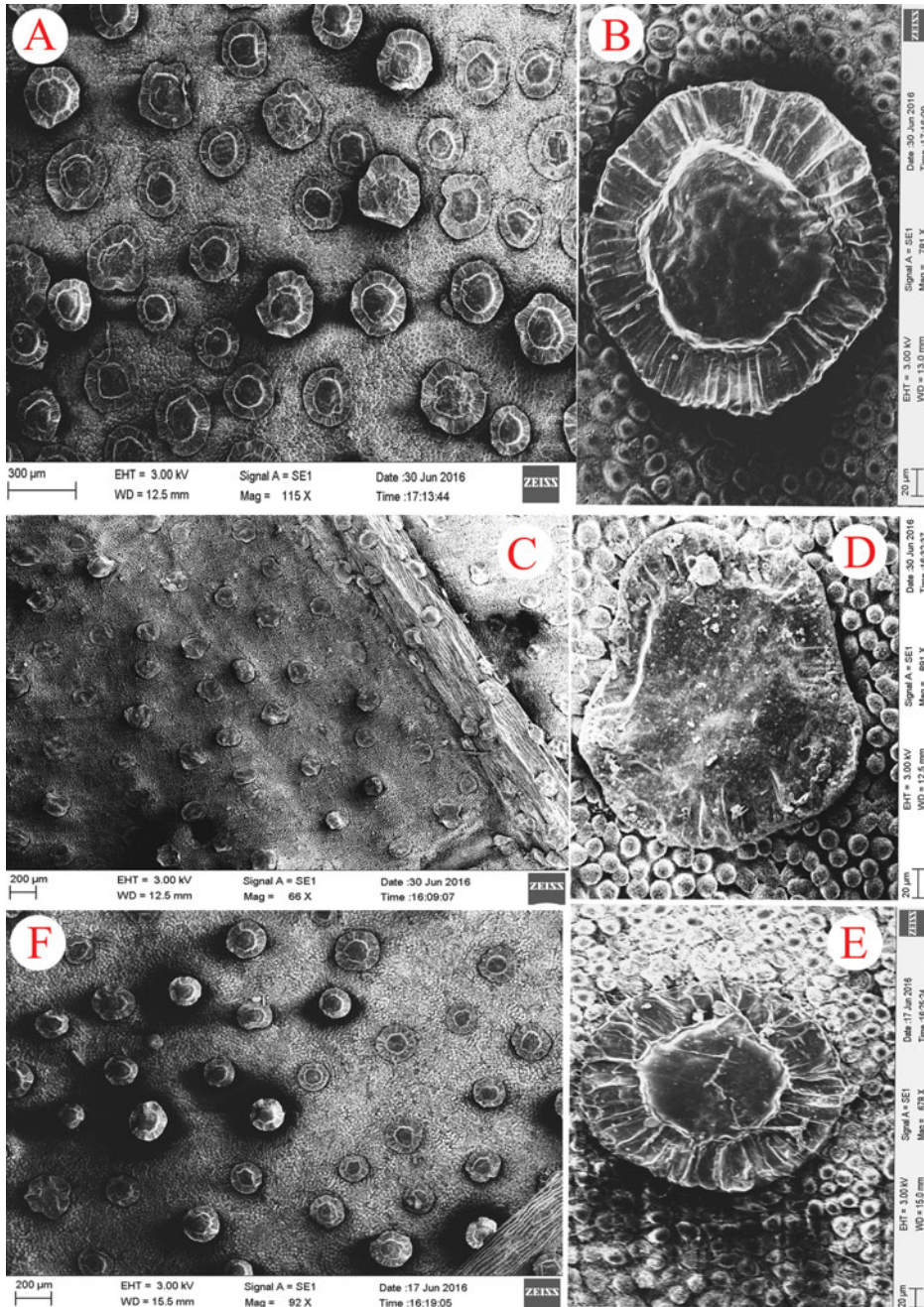


FIG. 7. Scale(s) on lamina surface below. A and B, *Rhododendron formosum* Wall.; C and D, *Rhododendron inaequale* Hutch.; E and F, *Rhododendron iteophyllum* Hutch.

setose only when young, 3.5–12.2 × 0.6–1.5 cm, attenuate at base, subacutely triangular to acuminate at apex, sparsely lepidote above, densely lepidote beneath, margins non-setose; scales 1.5–3 times their own diameter apart on lamina surface below, circular, ± uniform, 150.5–225.5 μm across, golden-brown, rim entire, 65–100 μm broad, central part swollen, 85.5–125.5 μm in diameter; midrib deeply grooved above, raised beneath, lepidote. *Petioles* 0.5–1 cm, grooved, non-setose, lepidote. *Inflorescences* umbellate, terminal, 2- or 3-flowered; bracts golden-brown, glabrous inside, villous outside. *Flowers* strongly sweet-scented, 4.5–9.2 cm long. *Pedicel* 0.5–1.5 cm long, green, lepidote. *Calyx* reddish green, unequally and deeply 5-lobed; lobes oblong-rounded, 1–2.5 × 2–2.5 mm, glabrous and densely lepidote outside, densely loriform ciliate at the margin, apex acute-rounded. *Corolla* open funnel-campanulate, 4–7 cm long, 5-lobed, white with purplish flushing outside and with orange markings on lower petals inside; tube 1.8–2.7 cm long, glabrous inside, lepidote, minutely pilose at base outside; lobes broadly elliptic, 2.2–4 × 1.5–3.5 cm, emarginated at apex, glabrous, sparsely lepidote towards the middle outside, elepidote in inner surfaces. *Stamens* 10–11, unequal, slightly exerted from corolla-tube, shorter than style; filaments 3.5–6.5 cm long, slender, densely pubescent at base to up to 2–3 cm from base; anthers linear-oblong, 3–5 mm long, dark purple-brown. *Ovary* cylindrical-ovate, 5.5–1 cm long, 6-loculed, densely lepidote; style impressed, 4.5–7.5 cm long, whitish, epilose, densely lepidote from base to middle; stigma lobulate, c. 3 mm across. *Capsule* symmetrical, 6-valved, 1–2 cm long, densely lepidote with persistent style on central axis.

Phenology. Flowers from April to May and fruit from June to July.

Distribution. India: Meghalaya.

Altitudinal range of distribution. 890–1500 m a.s.l.

Specimens examined. INDIA. **Meghalaya:** Jaintia Hills, Umphang, c.891 m, 18 iv 2015, A.A. Mao 110462 (ASSAM!); East Khasi Hills, Shillong, Woodland campus, 1466 m, 25°34'44.35"N, 91°53'55.82"E, 21 iv 2015, A.A. Mao & D.K. Roy 110464 (ASSAM!).

Additional specimens examined. INDIA. **Meghalaya:** Khasi & Jaintia Hills, Peak forests, 26 xi 1949, G.K. Deka 22841 (ASSAM!); Myntang valley, 1000 ft, 19 i 1916, U. Kanjilal 6557, 6558 (ASSAM!); Sehra raim, 30 iii 1932, G.K. Deka 13512 (ASSAM!); Mahadew forest, 19 ii 1963, S. Choudhury 31844 (ASSAM!); Jaksem hot spring areas along the river bank, 2 v 1975, G.H. Bhaumik 61877 (ASSAM!).

Potential use. The species is suitable for home gardens, because it does not grow very high and is strongly sweet-scented.

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