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Cover: The critically endangered *Lilium polyphyllum* in watercolour and acrylics. © Aishwarya S Kumar.

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COMMUNICATION

Notes on *Discospermum sphaerocarpum* Dalzell ex Hook.f., a rare species of Rubiaceae (Ixoroideae: Coffeeae) from southern India

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Abstract: *Discospermum sphaerocarpum* is a rare species in the tribe Coffeeae of the family Rubiaceae and its occurrence on the Madayippara lateritic plateau of the Kannur district of Kerala, southern India is discussed. This plant is endemic to southern India and Sri Lanka. In Kerala, this species was previously recorded from the low-altitude evergreen forests of Thiruvananthapuram district. The present study gives a detailed description, distribution and figures & images illustrating the diagnostic characters of *D. sphaerocarpum* for easy identification and conservation.

Keywords: Conservation, endemism, laterite ecosystems, Madayippara, sacred groves.

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Author contributions: Design of the study, field surveys and communications—CP; Assistance and support in the field surveys—VVD, AKP & KTC; Laboratory studies—CP & VVD; Preparation of the first draft of the manuscript—CP, VVD & AKP; Critical comments for the preparation of the final manuscript—CP, VVD, AKP & KTC; All authors read and approved the final manuscript.

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INTRODUCTION

The genus *Discospermum* Dalzell ex Hook.f. comprises 13 species, mainly shrubs or trees, growing primarily in wet tropical biomes with native ranges from India to the Philippines (POWO 2023). In India, *Discospermum* is represented by three species, *D. sphaerocarpum* Dalzell ex Hook.f., *D. apiocarpum* Dalzell ex Hook.f., and *D. abnorme* (Korth.) S.J. Ali & Robbr. The former two species were reported in southern India and the latter one from Assam. *D. sphaerocarpum* is a medium-sized tree which grows in dry and wet tropical biomes and it is native to southern India and Sri Lanka (POWO 2023).

The genus was originally described by Dalzell in 1850 from Sri Lanka. Later, Hooker (1880) reduced the genus *Discospermum* to a section of *Diplospora*. This synonymy was widely accepted until Ali & Robbrecht (1991) revived *Discospermum*. To resolve the issue of the generic position of asian species classified as *Tricalysia* or *Diplospora*, Ali & Robbrecht (1991) reviewed traits of asian *Diplospora*/*Tricalysia* species, and proved that the Asian species cannot be accommodated within the African genus *Tricalysia*; and *Discospermum*, which was included in the synonymy of *Diplospora* for over a century, was reinstated at generic rank. They found that the two genera differ in placentation, fruit size and fruit wall texture, the number of seeds per locule, seed shape, and exotestal cell anatomy. Using molecular techniques, Arriola et al. (2018) have shown that *Diplospora* and *Discospermum* represent separate lineages in the tribe Coffeeae. Molecular investigations by Tosh et al. (2009) further supported the decision to keep *Diplospora* and *Discospermum* as two distinct genera.

Another much-debated topic was the taxonomic placement of this genus. Initially, *Discospermum* was placed in the tribe Gardenieae. Robbrecht & Puff (1986) emended the circumscription of Gardenieae to include *Tricalysia* and *Diplospora*. Subsequently, Ali & Robbrecht (1991) attributed generic status to *Discospermum,* and included it in the *Gardenieae* subtribe *Diplosporinae*. They stated that *Discospermum* "links the Diplosporinae with the Gardeniinae and supports the rank (subtribe) given to these". Results of the phylogenetic study by Andreasen & Bremer (2000) do not support such a relationship and they concluded that at least some genera of Diplosporinae belong to Coffeeae. In a recent study, Davis et al. (2007) expanded the circumscription of Coffeeae and confirmed the placement of *Discospermum* in this tribe based on plastid sequence data and morphological data set.

Previous reports of the species *Discospermum sphaerocarpum* in India were from the wet and dry evergreen forests from the coast to high altitudes (50–1,000 m) of the Western Ghats regions of Kerala, Tamil Nadu, Karnataka, Goa, and Maharashtra (Singh et al. 2015). Gamble (1921) reported the species from Courtallum of Tinnevelly (Tirunelveli) district of Tamil Nadu; later distribution record extended to Cuddalore and Villupuram districts and Coromandel coast (Narayanasami & Natesan 2020). In Kerala, *D. sphaerocarpum* was earlier reported from the low-elevation evergreen forests of Thiruvananthapuram district (Sasidharan 2004). This species now has been recorded from a totally different habitat close to seashore, the sacred groves of a Lateritic hill of Madayippara at an altitude of less than 50 m in the Kannur district (Pramod & Pradeep 2020, 2021).

During a botanical exploration of the Madayippara lateritic plateau of southern India in 2008, the authors encountered a rare Rubiaceae member in vegetative condition in two patches of vegetation associated with sacred groves. The identity of the species remained a mystery as no flowering was seen in the two populations until early January 2014, when the plant produced a few flower buds which did not open. However, after a gap of five months, following the first summer shower in May, the flowers opened. After critical studies of the specimens, they were referred to Dr. S.E. Dawson, Rubiaceae systematics, Herbarium Royal Botanic Gardens, Kew, and confirmed the identity as *Discospermum sphaerocarpum,* and commented "it is very interesting that it comes from such a different habitat" (Sally Dawson pers. comm. 13.vi.2014). The aforementioned pattern of flowering was repeated in the year 2023 as well. The present paper aims to provide a detailed taxonomy, distribution and conservation status, illustration and photographic images of *D. sphaerocarpum*, for future reference and conservation.

MATERIALS AND METHODS

The present account of the species *Discospermum sphaerocarpum* is based on two populations; one growing in a sacred grove associated with Madayikkavu Thiruvarkkattu Bhagavathi temple and another one in an undisturbed patch of vegetation in a private land near Sree Chalilkkavu Bhagavathi temple (Image 1A,B). The current location is in the northernmost of Kerala, in Madayippara lateritic plateau in the Kannur district, which has a completely different habitat not far separated from the sea coast. Madayippara is one of

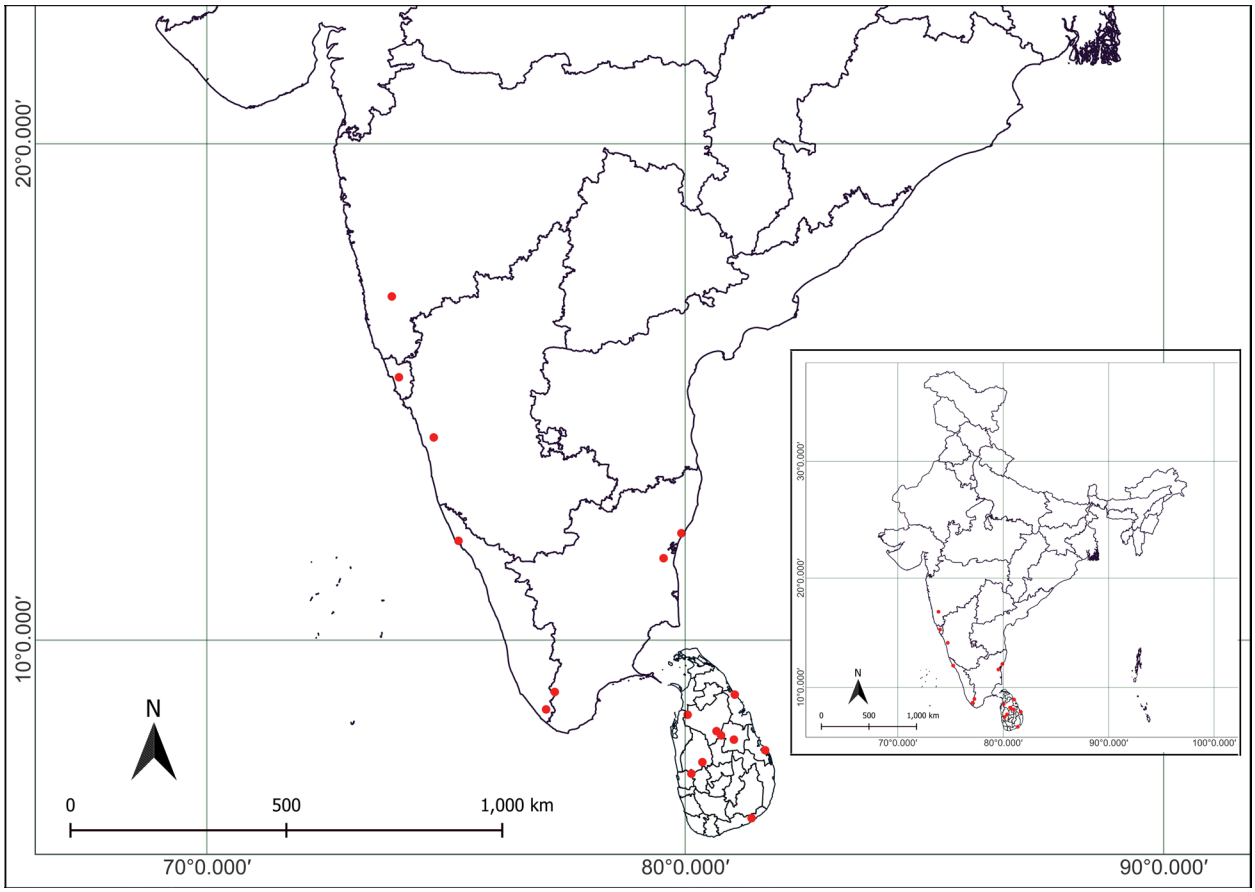

Figure 1. Distribution of *Discospermum sphaerocarpum* Dalzell ex Hook.f.

the most remarkable midland lateritic plateaus in Kerala (Pramod & Pradeep 2020) located in Madayi Panchayath, near Payangadi town, Kannur district, between 12.017–12.050 ^{0}N and 75.233–75.267 ^{0}E, at an altitude of about 50 m and extending an area of 3.65 km^2 on the top (Pramod & Pradeep 2021).

Madayikkavu sacred grove covers an area of about 0.4 ha (Image 1A) with a number of rare and endemic species. A population of *Discospermum spaerocarpum* of seven trees with heights ranging from 5 m–15 m, and 37 saplings was recorded in this location, covering an area of about 0.0014 km^2 between 12.033358–12.033374 ^{0}N and 75.25018–75.250185 ^{0}E. The second population is about 200 m away from Madayikkavu sacred grove, in an undisturbed patch of vegetation in a private-owned land close to Chalilkavu Bhagavathi temple (Image 1B). The population consists of 11 trees ranging in height from 4–20 m, and 15 saplings, covering an area of about 0.0011 km^2, between 12.033386–12.03339 ^{0}N and 75.250229–75.250238 ^{0}E.

Plant materials were collected from the two populations available at Madayippara lateritic plateau for laboratory studies and preparation of voucher specimens. The specimens collected for laboratory studies were worked out using LEICA M80, ZEISS Stemi DV4 and LABOMED CSM2 microscopes. Photographs of the plant specimens and habitats were taken using Nikon Coolpix L110 and Olympus C-7070 cameras. The voucher specimens were prepared following wet method (Fosberg & Sachet 1965) and are deposited at the Calicut University Herbarium (CALI). The distribution status was determined from 'Plants of the World Online' (POWO), pertinent floras and literature; and the distribution map was created using QGIS ver. 3.28.2 (QGIS 2022).

RESULTS AND DISCUSSION

Taxonomic Treatment

Discospermum sphaerocarpum Dalzell ex Hook.f. in Thwaites, Enum. Pl. Zeyl. 158. 1859; Dassan., A Revised Handbook to the Fl. Ceylon 12: 187. 1998; Pramod & Pradeep, A Hillock of Biod. Fl. Madayippara 442. 2020. *Diplospora sphaerocarpa* (Dalzell ex Hook.f.) Hook.f., Fl.

Brit. India 3: 123. 1880; Theodore Cooke, Fl. Bombay 2: 32. 1958. *Tricalysia sphaerocarpa* (Dalzell ex Hook.f.) Gamble, Fl. Madras 620. 1921; R.S. Rao, Fl. Goa, Diu, Daman, Dadra & Nagarhaveli 2: 216. 1986; A.N. Henry et al., Fl. Tamil Nadu, India, 1987; Sasidh., Biod. Doc. Kerala 6. Fl. Pl. 237. 2004.

Lectotype: India, Maharashtra, Bombay, Dalzell, s.n., K000031320 (K, image!).

Discospermum dalzellii Thwaites, Enum. Pl. Zey. 15: 158. 1859. *Diplospora dalzellii* (Thwaites) Hook.f., Fl. Brit. India 3: 123. 1880. *Tricalysia Dalzellii* (Thwaites) Alston in Trimen, Hand-Book. Fl. Ceylon (Suppl. 6.) 151. 1931.

Lectotype: Sri Lanka, *Thwaites G.H.K.,* C.P. 561 (K000031319, K, image!). (Image 1; Figure 2).

Medium-sized trees, up to 20 m tall; bark greyish-brown, smooth; branches terete, compressed towards the apices, glabrous. Leaves simple, opposite, elliptic, 8–15 x 3–6 cm, margins entire, base acute, apex acute-acuminate, glabrous on both sides except domatia, sub-coriaceous, shining above; lateral veins 8–12 pairs, mostly with pubescent domatia in the vein axils beneath; stipules interpetiolar, triangular, aristate, glabrous; petiole 1–1.5 cm long, glabrous. Inflorescence axillary, mostly in the axils of fallen leaves, very short branched fascicled cymes, peduncle short; bracts a pair, ovate, c. 1 mm long, puberulous outside; bracteole 1, oblong, c. 2 mm long, glabrous. Flowers subsessile, c. 5 mm long; calyx cupular, c. 1.5 mm long, lobes 4, subequal, ovate, ciliate, obtuse or shortly retuse at apex, green; tube short; corolla yellowish green, glabrous outside; tube c. 2 mm long, hairy inside; lobes 4, elliptic-oblong, c. 2 mm long, apically notched; stamens 4, filaments short, attached at corolla throat, anthers 1.5–2 mm long; ovary subglobose, ovules many; style c. 2 mm long, glabrous, forked at the apex. Berry subglobose to obovoid, 1–1.5 cm long; calyx persistent forming a crown at the apex of fruit; seeds 8–12, immersed in the well-developed placenta, flat, compressed, reniform, 4–6 × 3–4 mm.

Vernacular names: English: Wild coffee, Tamil: Irrukulimaram, Kannada: Kaadu kafi bija. Sri Lanka: Vella.

Phenology: Since 2008, flowering in this species was observed only twice, in the year 2014 and 2023. The buds appeared in early January, and remained dormant till the middle of May (until heavy summer shower), and the fruits were seen till July.

Distribution and Ecology: The species is endemic to the Western Ghats and Sri Lanka. However, its recent reports from Philippines (Biag & Alejandro 2021) and Bangladesh (Uddin et al. 2023) are doubtful, as its description or voucher specimens were not available for confirmation. In southern India, the species was recorded from the low altitude to high range (50–1,000 m) evergreen forests of the southern Western Ghats (Figure 1) (Gamble 1921; Singh et al. 2015). In Sri Lanka, populations were reported from the dry zone at low altitudes in secondary and rocky areas (Dassanayake 1998). The trees of the population of *Discospermum sphaerocarpum* present in the Madayikkavu sacred grove were seen growing associated with other species such as *Aglaia elaeagnoidea* (A.Juss.) Benth., *Vitex altissima* L.f., *Canthium coromandelicum* (Burm.f.) Alston, *Falconeria insignis* Royle, *Hugonia mystax* L., *Tinospora sinensis* (Lour.) Merr., *Cissus latifolia* Lam., *Tabernaemontana alternifolia* L., *Schleichera oleosa* (Lour.) Oken, *Benkara malabarica* (Lam.) Tirveng., *Getonia floribunda* Roxb., *Glycosmis mauritiana* (Lam.) Tanaka, *Sapindus trifoliatus* L., *Diospyros candolleana* Wight, *Memecylon randerianum* S.M.Almeida & M.R.Almeida, *Strychnos nux-vomica* L., *Dalbergia horrida* (Dennst.) Mabb. var. *horrida*, *Alstonia scholaris* (L.) R.Br., *Croton caudatus* Geiseler, *Grewia nervosa* (Lour.) Panigrahi and *Bridelia stipularis* (L.) Blume.

Similarly, the trees of the population of the species seen in the vegetation patch near Chalilkavu Bhagavathi temple are growing associated with other species such as *Tectona grandis* L.f., *Diospyros candolleana* Wight, *Strychnos nux-vomica* L., *Glycosmis pentaphylla* (Retz.) DC., *Glycosmis mauritiana* (Lam.) Tanaka, *Mallotus philippensis* (Lam.) Müll.-Arg., *Tabernaemontana alternifolia* L., *Bombax ceiba* L., *Caryota urens* L., *Spondias pinnata* (L.f.) Kurz, *Holoptelea integrifolia* (Roxb.) Planch., *Ixora malabarica* (Dennst.) Mabb., *Zingiber zerumbet* (L.) Roscoe ex Sm., *Gomphia serrata* (Gaertn.) Kanis, *Ixora brachiata* Roxb., *Mangifera indica* L., *Grewia nervosa* (Lour.) Panigrahi, *Mitragyna parvifolia* (Roxb.) Korth., *Macaranga peltata* (Roxb.) Müll.-Arg., *Chrysophyllum cainito* L., *Alstonia scholaris* (L.) R.Br. and *Chassalia curviflora* var. *ophioxyloides* (Wall.) Deb & B.Krishna.

Specimens examined: India, Kerala, Kannur district, Madayippara, Madayikkavu, 16.i.2011, C. Pramod 133024; 17.i.2014, C. Pramod 138241; 28.iv.2014, C. Pramod 138276; near Chalilkkavu, 28.iv.2014, C. Pramod 138277; 14.v.2014, C. Pramod 138287; 04.vi.2014, C. Pramod 138293 (CALI [CALI129230, CALI129231, CALI129232, CALI129233, CALI129234, CALI129235, CALI129236, CALI129237, CALI129238, CALI129239, CALI129240, CALI129241, CALI129242, CALI129243, CALI129244, CALI129245]).

Economic importance: The berries are known as wild coffee; the drink made from the roasted and powdered seeds has a coffee flavour. In addition to

Image 1. ***Discospermum sphaerocarpum*** **Dalzell ex Hook.f.: A–B—habitats of populations | C—leafy twig | D—domatia on the abaxial surface of leaf | E—stipule | F—bole | G—twig with flower buds | H—flower buds on a node | I—developing buds | J—flowers | K—mature fruits. © A,B,C,F-K—Pramod C.; D-E—Drisya V.V.**

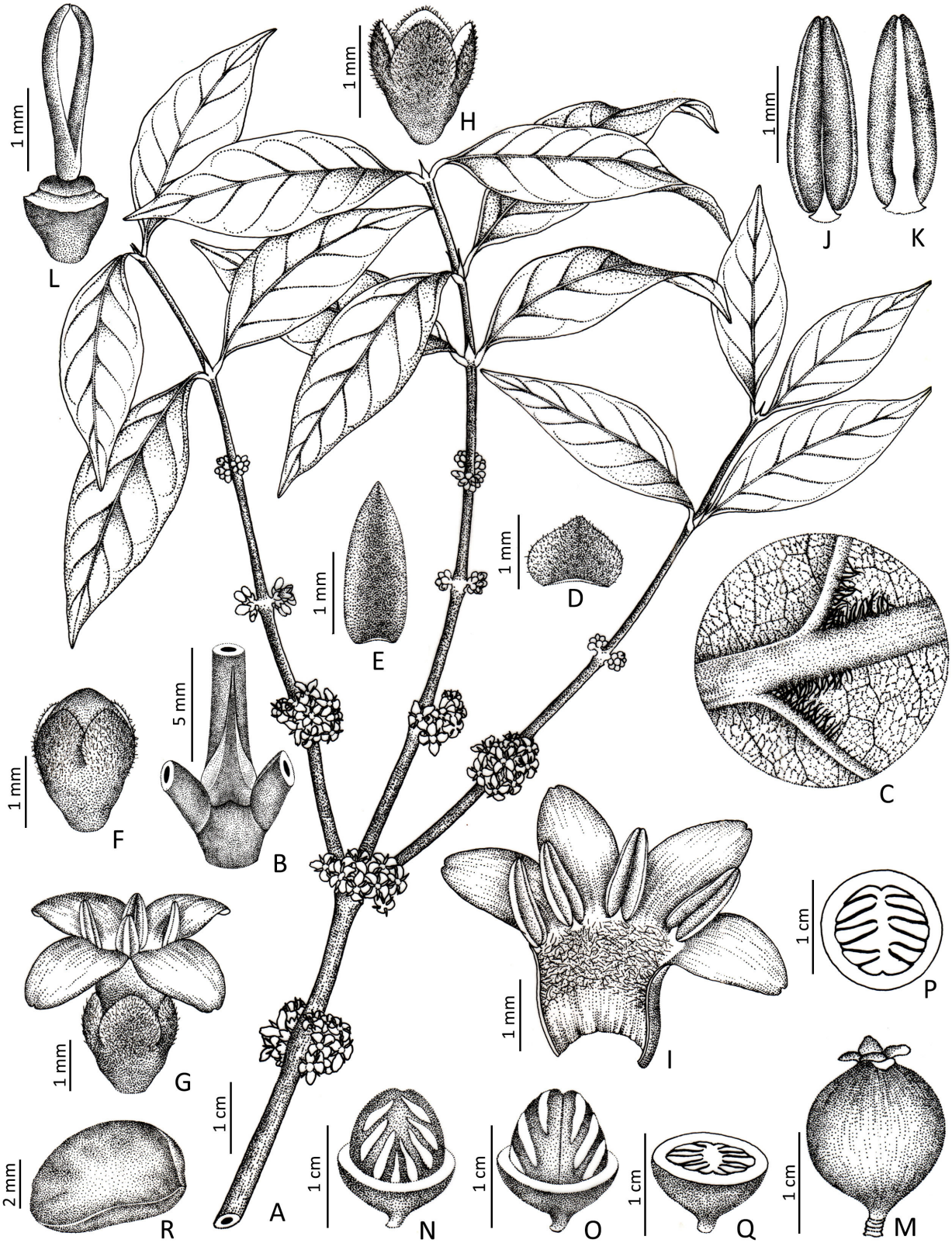

Figure 2. ***Discospermum sphaerocarpum*** **Dalzell ex Hook.f.: A—habit | B—a node showing stipule | C—domatia on the abaxial surface of leaf | D—bract | E—bracteole | F—flower bud | G—flower | H—calyx | I—corolla split opened with attached stamens | J—anther (ventral view) | K—anther (dorsal view) | L—pistil | M—fruit | N–O—fruit with pericarp removed showing seed arrangement | P–Q—lateral section of the fruit | R—seed. Drawn by Drisya V.V., A–L from C. Pramod 138287 | M–Q from C. Pramod 138293.**

this, many alkaloids, astringent, aromatic bodies, fat, sugars and mineral matter are found in seeds (Nadkarni 1976). Being a reservoir of phytochemical components, this plant is used as a potential drug for the treatment of a variety of human illnesses such as depression and diabetes, and also effective as a good antioxidant. Wood is used for making comb.

Conservation: An assessment of tropical dry evergreen forests of Tamil Nadu, recorded that *Discospermum sphaerocarpum* occupies an area of about 10 km^2, has around 500 mature individuals, and is declining at a rate of more than 50% due to the widespread usage of the wood for making comb. No regular flowering and seed set was observed in this species in the current location. There is a serious risk of losing the population in the second location mentioned, the habitat is on a private-owned land, and will be cleared off for construction purposes (Image 1B). *Discospermum* appears to be at a lower level of evolution than *Diplospora* and *Tricalysia* due to its large, dry fruits, frequent well-developed placental extension around the seeds, and radial exotestal cell-thickenings (Ali & Robbrecht 1991). These factors necessitate urgent measures for the conservation of the species and their habitats. In vitro propagation will be useful for the conservation and sustainable utilization of this species.

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