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RESEARCH ARTICLE

ROOTALA BAILEYANA SP.NOV. (LYTHRACEAE) FROM KERALA, INDIA.

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Abstract

Rotala baileyana, a new species of Lythraceae, collected from temporary pools on lateritic hills in Kasaragod district of Kerala, India is described and illustrated. It is similar to *R. tulumadensis* but differs by its annual habit, oblong-obovate submerged leaves with entire margin; oblong-obovate aerial leaves with retuse apex and clasping base; 2-6 mm pedicels, absence of bract; triangular-falcate bracteole; presence of nectory gland in the joining of calyx lobes, calyx tube wing with a constriction and projection below the lobes, elliptic-oblong petals with retuse apex; red anther lobes with broad connective.

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Introduction:-

The genus *Rotala* L. (Lythraceae) has more than 55 species and is distributed in tropical and subtropical regions of the world. It shows highest diversity in tropical Asia (Cook, 1979). A total of 31 species are reported so far from India, which includes recently described eleven species from Peninsular India (Yadav *et al.*, 2010; Prasad *et al.*, 2012; Gaikwad *et al.*, 2013; Prasad & Raveendran 2013a,b; Sunil *et al.*, 2013; Anto *et al.*, 2014; Narayanan *et al.*, 2014; Lemiya & Pradeep, 2015; Rijuraj *et al.*, 2017 and Lekhak & Yadav, 2017).

During recent floristic explorations in northern Kerala, we collected an interesting specimen of *Rotala*, from the lateritic plateau in Kasaragod district which is closely related to *R. tulumadensis*. On critical examination with the type of *R. tulumadensis*, it is revealed that the collected specimen was distinct with taxonomically relevant features. Therefore, the *hitherto* unknown taxa of the genus is described and illustrated here as a new species.

***Rotala baileyana* Rogi, Joby, Rameshan, Nisha & I. Antony sp. nov. (Fig. 1 A – K & Fig. 2 B – G) Type:**
 India, Kerala, Kasaragod district, Kayyur, Verikken Para Kulam, 12°15' 48.71"N, 75°10' 53.76"E, 83 m a.s.l., 10 October 2016, Rogi, Joby & Rameshan, 601(holotype: CAL, isotypes: MH, CALI, St. Thomas' College (Autonomous) herbarium, Thrissur, Kerala, India, CMS College Kottayam (Autonomous) herbarium, Kottayam, Kerala).

The new species is different from *R. tulumadensis* by having an annual habit, oblong-obovate submerged leaves with entire margin and stem clasping base; oblong-obovate aerial leaves with retuse apex; 2–6 mm long pedicel, absence of bract; triangular-falcate bracteole; nectary gland in the joining of calyx lobes, calyx tube wing with a constriction and projection below the lobes, petals with retuse apex, red anther lobes with broad connective versus perennial

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habit, 1.0–2.3 × 0.5–1.3 cm elliptic or ovate submerged leaves with rounded base, obtuse or retuse apex and minutely serrate margins, obovate aerial leaves with rounded apex and base, 1–4 mm long pedicel, leaf like bract, subulate bracteole, absence of nectar gland in calyx tube, calyx tube wing without a constriction and projection below the lobes, petal apex obtuse, connective narrow.

Description

Aquatic, annual herb, 30 cm height; Stem cylindrical, minute lines in the internodes Internodes 0.3–1.3 cm, green, slightly reddish, younger branches pinkish red, glabrous, rooting at lower nodes; Leaves dimorphic, decussate. Submerged leaves oblong–obovate 0.4–0.7 × 1.3–1.8 cm, both surface glabrous, reddish tint in upper surface, reddish violet in lower surface, margin entire, base slightly auricled, clasping the stem, apex retuse, lateral veins 5–7 pairs, obscure. Aerial leaves oblong–ovate, 0.5–0.7 × 0.9–1.2 cm, obovate–orbicular, apex retuse; Flowers axillary, solitary, monomorphic, pedicellate; Pedicel 2–6 mm long, glabrous; Bract absent, Bracteole triangular or falcate, rarely subulate, 8–12 white hairs present inside the bracteole, smooth, green; Calyx tube 4 angled, constricted below the apex, constriction with projection, winged on the angles, enlarging in fruit, 4.5 × 3 mm, wings tinted purple–red, translucent; lobes 4, triangular, apex acute, red, nectar glands present in the joining of sepals, not as a continuous ring; Petals 4, 1.5 × 1 mm, elliptic–oblong, rose, margin entire, apex bi-mucronate; Stamens 4, inserted in the middle of calyx tube, episepalous, Filament 1 mm, white, glabrous; Anther lobes red, connective large, broad; Ovary oblong–elliptic, 1.5 × 0.5 mm, glabrous, quadrangular–winged; Stigma capitate, feathery; Capsule oblong, 3 × 1.5 mm, quadrangular–winged, 4 valved, not protruding from the calyx tube; Seeds many, oblong, smooth, minutely striate, green when young, reddish brown when mature.

Etymology

The new species is named after Rev. Benjamin Bailey, the first principal of CMS College, Kottayam, Kerala and the founder of modern English education in Kerala. He is also deemed to be the progenitor of printing and book publishing in Malayalam language by his establishment of Kerala's first printing press. A nonpareil author and translator, his innumerable contributions to language paved a new legacy in the cultural chronicles of Kerala.

Phenology

During the rainy season (June–August) the species remains submerged in the permanent and seasonal lateritic pools. During the winter and early summer (September–February), it produces flowers on the emergent aerial branches. Fruiting is observed in November to March.

Habitat and Ecology

The new species is a short lived annual found in a lateritic lake or depressions on lateritic rocks having a depth of 0.5–1 m. No other species of *Rotala* was noticed in the entire plateau. The associated flora includes *Nymphoides balakrishnanii*, *Nymphoides indica*, *Vallisneria spiralis*, *Marsilea minuta*, *Wiesneria triandra*, *Utricularia reticulata* etc.

Conservation status

R. baileyana is collected only from the type locality and further exploration on distribution is required for analyzing conservation status and endemism. The ecologically significant seasonal laterite pools and temporary lakes are the major source of groundwater recharge, habitat of several species including migratory birds and having rich biodiversity. The lateritic plateau of Kasaragod district has under severe anthropogenic pressure from extensive mining and unscientific applying of herbicides in the adjoining cashew plantations. Most of the seasonal pools and temporary lakes are reclaimed for industrial and other purpose.

Notes

R. baileyana is similar to *R. tulunadensis* and *R. sahyadrica* (Table -1) but can be distinguished by the following key.

Key to the new species and similar species of *Rotala*

- 1a. Flowers sessile, nectar scales present, nectary glands forms a continuous ring.....*sahyadrica*
- 1b. Flowers pedicellate, nectar scales absent, nectary gland not a continuous ring.....2
- 2a. Perennial, leaf margin minutely serrate, aerial leaves rounded at both ends, bract present, bracteole subulate, nectary glands absent in the joining of sepals.....*tulunadensis*

2b. Annual, leaf margin entire, aerial leaf apex retuse, bract absent, bracteole triangular-falcate, nectory glands in the joining of sepals.....*baileyana*

rbcL gene sequence analysis

We analyzed the rbcL sequence by using rbcL-PCR universal primers and automated DNA sequencing was performed on ABI3730xl Genetic Analyzer according to Doyle and Doyle (1990). The newly generated sequence has been submitted to GenBank (accession number MK695164).

Additional specimen examined (paratype): India, Kerala, Kasaragod District, Kayyur, Verikken Para Kulam, 12°15' 48.71"N, 75°10' 53.76"E, 83 m a.s.l., 12 November 2016, Rogi, Joby & Rameshan, 614, Herbarium St Thomas' College (Autonomous), Thrissur, Kerala, India.

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Table 1:-Diagnostic characters of *R. baileyana* and similar species

Characters	<i>Rotala baileyana</i>	<i>R. tulunadensis</i>	<i>R. sahyadrica</i>
Habit	Aquatic, annual herb, 30 cm height	Aquatic perennial spreading herb, 40 cm height	Submerged aquatic annual herb, 30 cm height
Stem	Cylindrical, minute lines in the internodal region, internodes 0.3–1.3 cm, green, slightly reddish, younger branches pinkish red, glabrous, rooting at lower nodes	Cylindrical, branched, creeping and rooting below, floating or erect above.	Obtusely angular below, acutely quadrangular above, erect, rarely branched.
Leaf	Dimorphic, decussate, submerged leaves Oblong–obovate, 0.4–0.7×1.3–1.8 cm, both surface glabrous, reddish tint in upper surface, reddish violet in lower surface, margin entire, base slightly auricled, clasping the stem, apex retuse, lateral veins 5-7 pairs, obscure. Aerial leaves: Oblong–ovate, 0.5–0.7×0.9–1.2cm, obovate-orbicular, apex retuse	Dimorphic, decussate, submerged leaves 1.0–2.3×0.5–1.3 cm, membranous, elliptic or ovate, rounded at base, obtuse or retuse at apex, minutely serrate at margins; lateral veins in 5–7 pairs, obscure; Aerial leaves 5–6×3.0–3.5mm, obovate, rounded at both ends, with veins in 5–6 pairs	Opposite, decussate, sessile, dimorphic, membranous; submerged leaves linear-oblong, rounded at both the ends, 4.0–6.5×0.6–1.0cm, reddish or greenish, entire, with lateral nerves in 3–5 pairs, distinct; aerial leaves obovate orbicular, cordate at base, rounded at apex
Flower	Axillary, solitary, monomorphic, pedicellate	Axillary, solitary, monomorphic, pedicellate	Axillary, solitary, sessile
Pedicel	2–6 mm long, glabrous	1–4 mm long	Absent
Bract	Absent	Leaf like, decreasing in size towards apex, obovate, 2–6×0.5–4.0mm.	Leafy, 0.5–1.5×0.3–1.0cm, reddish, entire
Bracteole	1, Triangular –falcate, subulate, 8–12 white hairs present inside the bracteole, smooth, green	Subulate, ca 1 mm long	2, linear-subulate, 0.7–0.9 mm long, much shorter than the calyx tube, persistent, with 8–12 multicellular, unbranched, 0.2–0.6 mm long, black hairs at the axils
Sepal	Calyx tube 4 angled, 4.5×3mm, constricted below the apex,	Calyx tube 4 angled, 2.5–3.0 mm long, constricted below the	Floral tube sub-cylindric to urceolate, nectar scales present,

	constriction with minute projection, winged on the angles, enlarging in fruit, wings tinted purple-red, translucent; lobes 4, triangular, apex acute, red, nectar glands present in the joining of sepals lobes	apex, with distinct wings on the angles, accrescent, enlarging in fruits up to 4.8 mm long; wings running the whole length of the tube, 0.3–0.4 mm wide, tinged red, translucent; lobes 4, broadly triangular, 0.8–1.0 mm long.	lobes 4, nectary glands form a continuous rim on the calyx tube from where filaments arise.
Petal	4, 1.5×1 mm, elliptic - oblong, rose, margin entire, apex retuse, exerted, pinkish rose	4, ca 1.2×0.8 mm, elliptic to ovate or suborbicular, exerted, rose coloured.	4, 0.9–1.1×0.8–0.9 mm, obovate, obtuse, clawed at base, rosy-white, opposite to the calyx lobes
Stamen	4, inserted in the middle of calyx tube, filaments 1mm, white, glabrous, Anther lobes red, connective broad	4, inserted at about the middle of calyx- the tube; filaments 0.9–1.0 mm long.	4, inserted below the middle of calyx tube, included; filaments narrow towards apex, white
Carpel	Oblong-elliptic, 1.5 × 0.5 mm, glabrous, quadrangular, winged; stigma capitate, feathery.	Ellipsoid, 1.8–2.0 mm long, 4-angled; style short, ca 0.5 mm long; stigma capitate.	Ellipsoid, 1.1–1.3×0.9–1.0 mm, yellowish; style simple, short, persistent in fruit; stigma capitate, minutely pilose, included in calyx tube.
Capsule	Oblong, 3×1.5mm, quadrangular, winged, 4-valved, not protruding from the calyx tube.	Ellipsoid, 4–5×2.5–3.0mm, 4-valved; valves induplicate.	Ellipsoid, 3.00–3.50 ×2.00–2.25mm, slightly protruding from the calyx tube, 4-valved; valves conduplicate, septicidally dehiscent
Seed	Many, 0.6–0.8 mm long, oblong, smooth, minutely striate, green when young, reddish brown when mature.	Many, 0.6–0.7 mm long, ellipsoid, dark brown.	Ovoid-ellipsoid, 0.15–0.19×0.20–0.15 mm, in 2–3 rows in each locule, brownish.

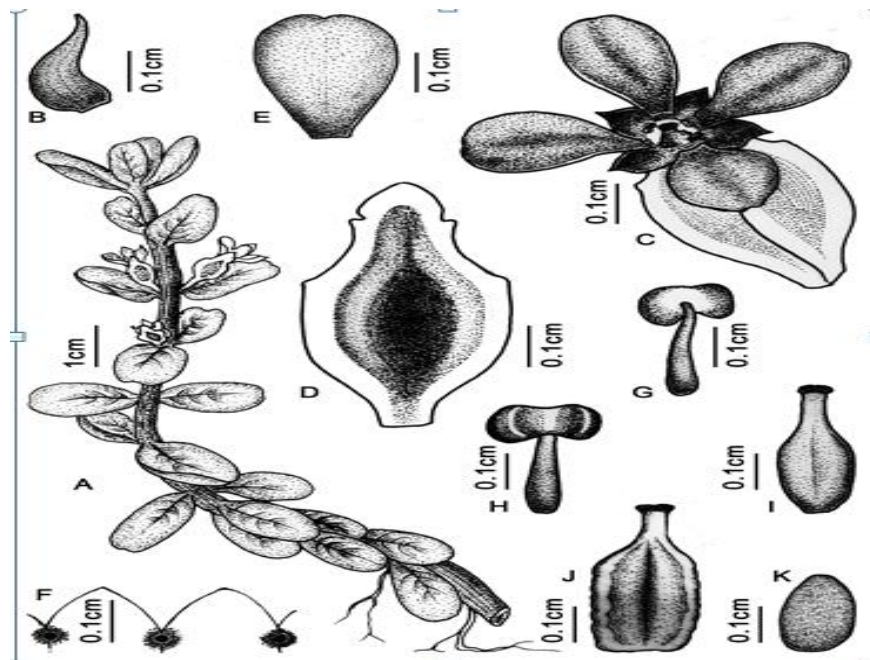


Fig 1:-*Rotala baileyana*. A. Habit, B. Bracteole, C. Flower, D. Persistent calyx tube, E. Petal, F. Glands in the sepals, G & H. Stamens, I. Young pistil, J. Mature capsule, K. Seed (All from Rogi, Joby & Rameshan, 601; drawings by Joby Paul).



Fig 2:-Rotala baileyana. A. Habitat, B. Mature plants with flowering, C. & D. Young plants, E., F. & G. Flowering twigs (Photographs by Rameshan M.).

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