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Collaborative Activity 1

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SHORT COMMUNICATION

Salvia roborwoskii Maxim. — an addition to flora of Western Himalaya, India

Partha Lodh[1]*, V. Sampath Kumar[2], Sobhan Kr. Mukherjee[3] and Sankar Narayan Sinha[3]
[1]Department of Botany, Govt. General Degree College at Kaliganj, Debagram, Nadia - 741137, West Bengal
[2]Botanical Survey of India, Southern Regional Centre, T.N.A.U. Campus, Lawley Road (P.O.), Coimbatore - 641003, Tamil Nadu
[3]Department of Botany, University of Kalyani, Kalyani - 741235, West Bengal

*Author for correspondence: partha.presi09@gmail.com

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ABSTRACT

The species *Salvia roborowskii* Maxim. (Lamiaceae) was previously known in India from Sikkim Himalaya is reported here as an addition to the flora of Western Himalaya. A brief description along with illustration of floral parts, which was lacking in earlier literaturehas been provided.

KEYWORDS
Salvia roborowskii, new record, Western Himalaya, India

Introduction

The genus *Salvia* L. (Lamiacaeae), represented by about 980 species, is chiefly tropical to temperate in distribution, Sub-cosmopolitan, absent only in Australia and New Zealand with an exception of one species (Harley *et al.*, 2004; Walker *et al.*, 2004; Mabberley, 2008; Gonzalez-Gallegos, 2014; Hu*et. al.*, 2018). In India the genus is represented by ca 25 species of which majority of them are distributed in the Himalayas (Sampath Kumar and Murthy, 2004; Sampath Kumar, 2014). During the revisionary study of the genus in India, the authors came across two specimens collected from Vasudhara, Garhwal Himalaya at an altitude of 3500m, deposited at BSD, identified as *Salvia nubicola* Sweet and at CAL, kept in unidentified folder. Subsequent studies revealed that these specimens are *Salvia roborowskii* Maxim., which was previously reported from Central and Eastern Himalayas in Indian region (Mukerjee, 1940; Li and Hedge, 1994; Clemens, 1999; Singh *et al.*, 2019). The present report of this species is an addition to the flora of Western Himalaya. A detailed illustration of this species was also lacking in the literature. Therefore, in the present paper a brief description and illustrations of dissected parts, distribution along with other relevant information has been provided.

Taxonomic Account

Salvia roborowskii Maxim., Bull. Acad. Imp. Sci. Saint-Petersbourg, Ser. 3, 27: 527. 1881; Mukerjee, Rec. Bot. Surv. India 14(1): 112. 1940; H.W. Li and I.C. Hedge in C.Y. Wu and P.H. Raven, Fl. China 17: 212. 1994; R.A. Clement in A.J.C. Grierson and D.G. Long, Fl. Bhutan 2(2): 974. 1999. (Fig. 1)

Annual or biennial erect herb, 20–50 (–70) cm high; stem simple or branched, slender, dark greenish often black along edges, hirsute with glutinous hairy throughout, hairs glandular and eglandular. Leaves ramal, opposite decussate, petiolate; lamina triangular or sometimes slightly sagittate, 3–8 × 2–5 cm, truncate or rarely slightly cordate at base, acute-obtuse at apex, margins crenate, membranous, rugulose, adaxially sparsely pubescent, abaxially adpressedly strigose along veins; lateral nerves (4–) 5–6 pairs; petioles 1–6 (–7) cm long, longer in lower leaves. Inflorescence axillary or terminal, verticillasters in racemes or sometimes in panicles with 4–6 flowers per each verticils, verticils (3–) 3.5–5.0 cm apart, successively distant in basal parts; bracts 3–4 × (1)1.5–2.0 mm, subsessile, lanceolate-elliptic, shorter than calyx, acute-acuminate, margins slightly undulate, ciliate, villous hairy intermixed with sessile glands. Flowers pale yellow, 15–18 (–20) mm, shortly pedicellate; pedicels 2–3 mm long, glandular. Calyx 8–11 mm long, tubular, fruiting calyx dilated, 12–13 cm long, glandular hirsute with sessile oil glands, markedly striated, dark green; upper lip 3–3.5 × 4–4.5 mm, entire, triangular, apex mucronate or slightly disappearing 3-mucronate, prominently 3-nerved, nerves black, sparsely glandular hairy along nerves; lower lip almost equal to upper lip, 2.5–3.5 × 3–4 mm, deeply 2-cleft upto half, lobes deltoid-triangular, aristate in both lobes, prominently 6-nerved, adpressedly glandular hairy along veins. Corolla 14–17 mm, bilabiate; tube 9–12 mm long, slightly exserted, abaxially inflated; upper lip hooded, straight, apex retuse; lower lip 3-lobed, reflexed, median one larger, ovate, entire; lateral lobes smaller, rounded, entire; sparsely pilose outside, incompletely pilose annulate inside. Stamens 2, filaments longer than connective, connective arcuate, joint articulated, upper arm subequal or sometimes slightly shorter than lower arm, upper arm with fertile anther,1–1.5 mm long, oblong, straight-slightly recurved, lower arm with shorter deformed anther like, subspheroidial, most often pelleniferous, punctate, ca 0.5 mm, coherent; staminodes 2 on upper lip, minute. Gynoecium without prominent gynobasic disc, styles 12–15 mm long, stigma unequally bifid. Mericarps dark brownish or yellowish, obovoid, slightly trigonous, 3 (–3.5) × 2 (–2.2) mm, smooth.

Flowering and Fruiting: July to October.
Distribution: INDIA: Uttarakhand (reported during this study), Sikkim; NEPAL, BHUTAN, CHINA). (Fig. 2)
Habitat: Slightly rare, grows in moist areas especially near streams or springs between 3200 and 4300 m altitude.
IUCN Category: Not Evaluated (NE).

Specimens Examined: INDIA. Sikkim: Thangu, 4267m, 3 Nov 1909, *Lepcha Collector* 2830 (CAL!); without precise locality, *s.coll., s.n.* Acc.

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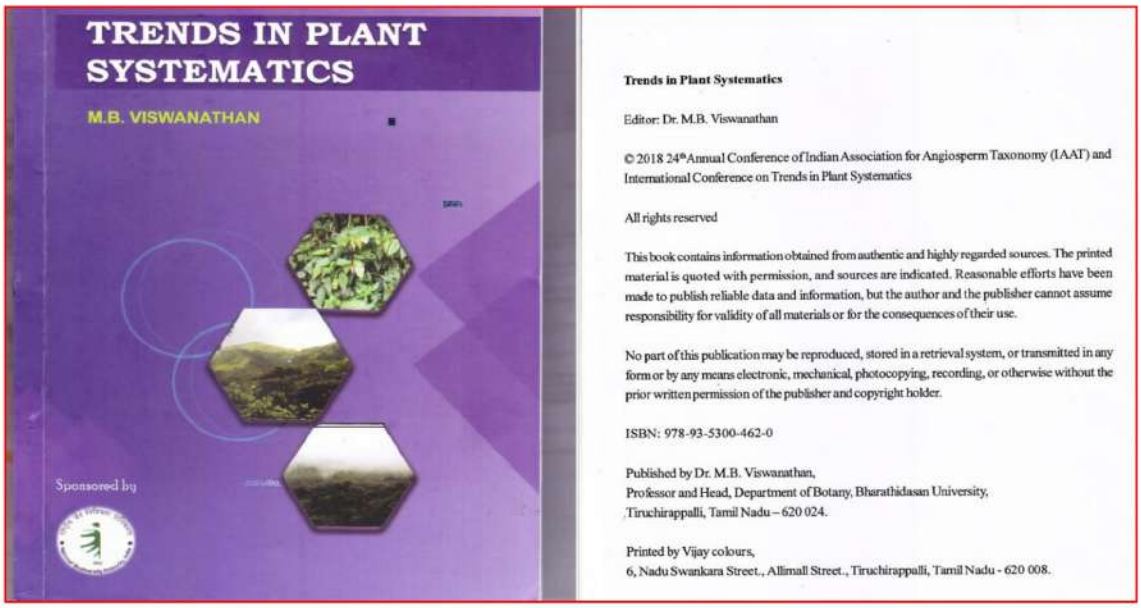
Collaborative Activity 2



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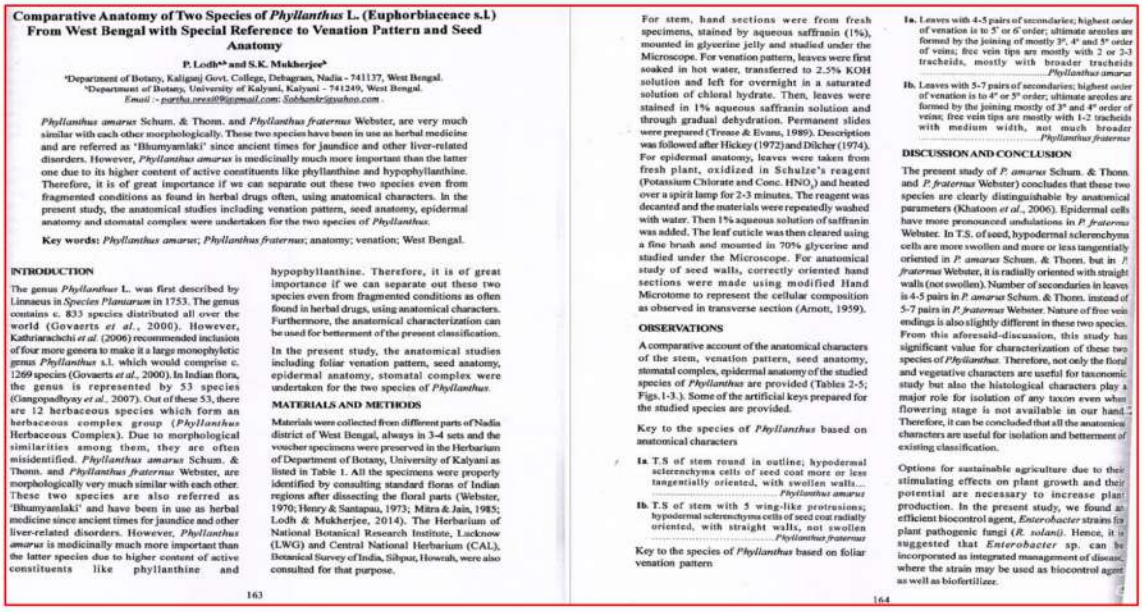

Comparative Anatomy of Two Species of *Phyllanthus* L. (Euphorbiaceae s.l) From West Bengal with Special Reference to Venation Pattern and Seed Anatomy

P. Lodh[a*] and S.K. Mukherjee[b]

[a]Department of Botany, Kaliganj Govt. College, Debagram, Nadia - 741137, West Bengal.
[b]Department of Botany, University of Kalyani, Kalyani - 741249, West Bengal.
Email :- partha.nrest@gmail.com; Sobhankrg@yahoo.com .

Phyllanthus amarus Schum. & Thonn. and *Phyllanthus fraternus* Webster, are very much similar with each other morphologically. These two species have been in use as herbal medicine and are referred as "Bhumyamlaki" since ancient times for jaundice and other liver-related disorders. However, *Phyllanthus amarus* is medicinally much more important than the latter one due to its higher content of active constituents like phyllanthine and hypophyllanthine. Therefore, it is of great importance if we can separate out these two species even from fragmented conditions as found in herbal drugs often, using anatomical characters. In the present study, the anatomical studies including venation pattern, seed anatomy, epidermal anatomy and stomatal complex were undertaken for the two species of *Phyllanthus*.

Key words: *Phyllanthus amarus*; *Phyllanthus fraternus*; anatomy; venation; West Bengal.

INTRODUCTION

The genus *Phyllanthus* L. was first described by Linnaeus in *Species Plantarum* in 1753. The genus contains c. 833 species distributed all over the world (Govaerts *et al.*, 2000). However, Kathriarachchi *et al.* (2006) recommended inclusion of four more genera to make it a large monophyletic genus *Phyllanthus* s.l. which would comprise c. 1269 species (Govaerts *et al.*, 2000). In Indian flora, the genus is represented by 53 species (Sangupodiyay *et al.*, 2007). Out of these 53, there are 12 herbaceous species which form an herbaceous complex group (*Phyllanthus* Herbaceous Complex). Due to morphological similarities among them, they are often misidentified. *Phyllanthus amarus* Schum. & Thonn. and *Phyllanthus fraternus* Webster, are morphologically very much similar with each other. These two species are also referred as "Bhumyamlaki" and have been in use as herbal medicine since ancient times for jaundice and other liver-related disorders. However, *Phyllanthus amarus* is medicinally much more important than the latter species due to higher content of active constituents like phyllanthine and hypophyllanthine. Therefore, it is of great importance if we can separate out these two species even from fragmented conditions as often found in herbal drugs, using anatomical characters. Furthermore, the anatomical characterization can be used for betterment of the present classification.

In the present study, the anatomical studies including foliar venation pattern, seed anatomy, epidermal anatomy, stomatal complex were undertaken for the two species of *Phyllanthus*.

MATERIALS AND METHODS

Materials were collected from different parts of Nadia district of West Bengal, always in 3-4 sets and the voucher specimens were preserved in the Herbarium of Department of Botany, University of Kalyani as listed in Table 1. All the specimens were properly identified by consulting standard floras of Indian regions after dissecting the floral parts (Webster, 1970; Henry & Santapau, 1973; Mitra & Jain, 1985; Lodh & Mukherjee, 2014). The Herbarium of National Botanical Research Institute, Lucknow (LWG) and Central National Herbarium (CAL), Botanical Survey of India, Sibpur, Howrah, were also consulted for that purpose.

For stem, hand sections were from fresh specimens, stained by aqueous saffranin (1%), mounted in glycerine jelly and studied under the Microscope. For venation pattern, leaves were first soaked in hot water, transferred to 2.5% KOH solution and left for overnight in a saturated solution of chloral hydrate. Then, leaves were stained in 1% aqueous saffranin solution and through gradual dehydration. Permanent slides were prepared (Trease & Evans, 1989). Description was followed after Hickey (1972) and Dilcher (1974). For epidermal anatomy, leaves were taken from fresh plant, oxidized in Schulze's reagent (Potassium Chlorate and Conc. HNO_3) and heated over a spirit lamp for 2-3 minutes. The reagent was decanted and the materials were repeatedly washed with water. Then 1% aqueous solution of saffranin was added. The leaf cuticle was then cleared using a fine brush and mounted in 70% glycerine and studied under the Microscope. For anatomical study of seed walls, correctly oriented hand sections were made using modified Hand Microtome to represent the cellular composition as observed in transverse section (Arnott, 1959).

OBSERVATIONS

A comparative account of the anatomical characters of the stem, venation pattern, seed anatomy, stomatal complex, epidermal anatomy of the studied species of *Phyllanthus* are provided (Tables 2–5; Figs. 1-3.). Some of the artificial keys prepared for the studied species are provided.

Key to the species of *Phyllanthus* based on anatomical characters

1a. T.S of stem round in outline; hypodermal sclerenchyma cells of seed coat more or less tangentially oriented, with swollen walls.... ..... *Phyllanthus amarus*

1b. T.S of stem with 5 wing-like protrusions; hypodermal sclerenchyma cells of seed coat radially oriented, with straight walls, not swollen ..... *Phyllanthus fraternus*

Key to the species of *Phyllanthus* based on foliar venation pattern

1a. Leaves with 4-5 pairs of secondaries; highest order of venation is to 5° or 6° order; ultimate areoles are formed by the joining of mostly 3°, 4° and 5° order of veins; free vein tips are mostly with 2 or 2-3 tracheids, mostly with broader tracheids ..... *Phyllanthus amarus*

1b. Leaves with 5-7 pairs of secondaries; highest order of venation is to 4° or 5° order; ultimate areoles are formed by the joining mostly of 3° and 4° order of veins; free vein tips are mostly with 1-2 tracheids with medium width, not much broader ..... *Phyllanthus fraternus*

DISCUSSION AND CONCLUSION

The present study of *P. amarus* Schum. & Thonn. and *P. fraternus* Webster) concludes that these two species are clearly distinguishable by anatomical parameters (Khatoon *et al.*, 2006). Epidermal cells have more pronounced undulations in *P. fraternus* Webster. In T.S. of seed, hypodermal sclerenchyma cells are more swollen and more or less tangentially oriented in *P. amarus* Schum. & Thonn. but in *P. fraternus* Webster, it is radially oriented with straight walls (not swollen). Number of secondaries in leaves is 4-5 pairs in *P. amarus* Schum. & Thonn. instead of 5-7 pairs in *P. fraternus* Webster. Nature of free vein endings is also slightly different in these two species. From this aforesaid-discussion, this study has significant value for characterization of these two species of *Phyllanthus*. Therefore, not only the floral and vegetative characters are useful for taxonomic study but also the histological characters play a major role for isolation of any taxon even when flowering stage is not available in our hand. Therefore, it can be concluded that all the anatomical characters are useful for isolation and betterment of existing classification.

Options for sustainable agriculture due to their stimulating effects on plant growth and their potential are necessary to increase plant production. In the present study, we found an efficient biocontrol agent, *Enterobacter* strains for plant pathogenic fungi (*R. solani*). Hence, it is suggested that *Enterobacter* sp. can be incorporated as integrated management of disease, where the strain may be used as biocontrol agent as well as biofertilizer.

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