



FLORAL AND POLLEN MORPHOLOGY OF *POGOSTEMON STRIGOSUS* BENTH. AND *POGOSTEMON QUADRIFOLIUS* (BENTH.) F. MUELL (LAMIACEAE) - FROM ASSAM, NORTH EAST INDIA

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Abstract

Floral and pollen morphology of *Pogostemon strigosus* and *Pogostemon quadrifolius* from Assam were studied by Light Microscope and Scanning Electron Microscope. A detailed taxonomic treatment of both the species were tabulated along with micrographs and live photographs were provided. The results of the paper furnish empirical basis for identification of both the species.

Key words : Lamiaceae, *Pogostemon strigosus*, *Pogostemon quadrifolius*, floral morphology, Pollen.

Introduction

Pogostemon Desfontaines belong to the tribe Pogostemoneae (Lamiaceae). The genus is distinguished from other genus of Lamiaceae bearing exserted stamens with moniliform hairs (Hasskarl 1842, Kuntze 1891, Press 1982, Bhatti & Ingrouille, 1997). It is one of the largest genus of the tribe *Pogostemoneae*. According to Bhatti and Ingrouille (1997), the highest species diversity was found in the India subcontinent. The genus is mostly distributed in the Southeast Asian countries, Northern Australia, Japan and the Korea.

Pogostemon strigosus (Benth.) and *Pogostemon quadrifolius* (Benth) F. Muell (Lamiaceae) were collected during the floristic survey of Assam. Both the species were annual herbs. The aerial parts of both the plant covered with densely pubescent hairs. The filaments of stamen are clearly hairy towards the middle called as moniliform hairs. (Benham, 1836, Hooker 1885 & Mukerjee, 1940).

Key to the species

◆ Floral characters

- 1a. Inflorescence single terminal spike; 4-8 cm × 5-8 mm,

Flower white..... *Pogostemon strigosus*

1b. Inflorescence branched; each branched terminated by a spike 8-12 cm×9mm,

Flower purplish..... *Pogostemon quadrifolius*

◆ Pollen characters

1a. Pollen size, P 19.8 μm × E 14.6 μm

..... *Pogostemon strigosus*.

1b. Pollen size, P 18.7 μm × E 13.9 μm

..... *Pogostemon quadrifolius*.

Materials and Methods

To work out on the present study and to bring out the taxonomic account, extensive field survey was carried out by visiting various areas of Assam. During field survey specimen was collected in their flowering stages. Spot photographs were taken. Permanent pollen slides were prepared by acetolysis method followed by procedure of Erdtman (1952) with modification of Nair (1970). In this manuscript, an attempt has been made to provide complete information on floral and pollen morphology of both the species by light microscope and scanning electron microscopy (SEM). The specimens were identified with the help of relevant literatures and herbaria. (ASSAM, CAL, GUBH, BSI, Eastern Circle, Shillong). In

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determining names of taxa, effort has been made to give upto date nomenclature by consulting various states, national and international literatures and verified by online database of Plant list for Angiosperm version 1.1 www.plant.List.

Results

A detail floral morphology and pollen description of both the taxa were recorded. The floral photograph of *Pogostemon strigosus* (Benth.) and *Pogostemon quadrifolius* Benth. were shown in Plate 1. The light microscopy and scanning electron microscopy micrographs of *Pogostemon strigosus* (Benth.) Kuntze and *Pogostemon quadrifolius* Benth. were also provided.

Pogostemon strigosus Benth

Habitat: Rocky dry shady areas.

Flowering: March-September

Synonyms: *Dysophylla strigosa* Benth.

Exsiccatae: Assam, Karbi- Anglong (Baithalango) Chayanika Bordoloi 18400, dated 03-12-2017. (GUBH).

Global distribution: INDIA (Assam, Khasia Hills, Jowai, Dawki, Jaintia hills, Nongkrem, Cherrapunji), Bangladesh, Myanmar.

Pogostemon quadrifolius (Benth.) F. Muell

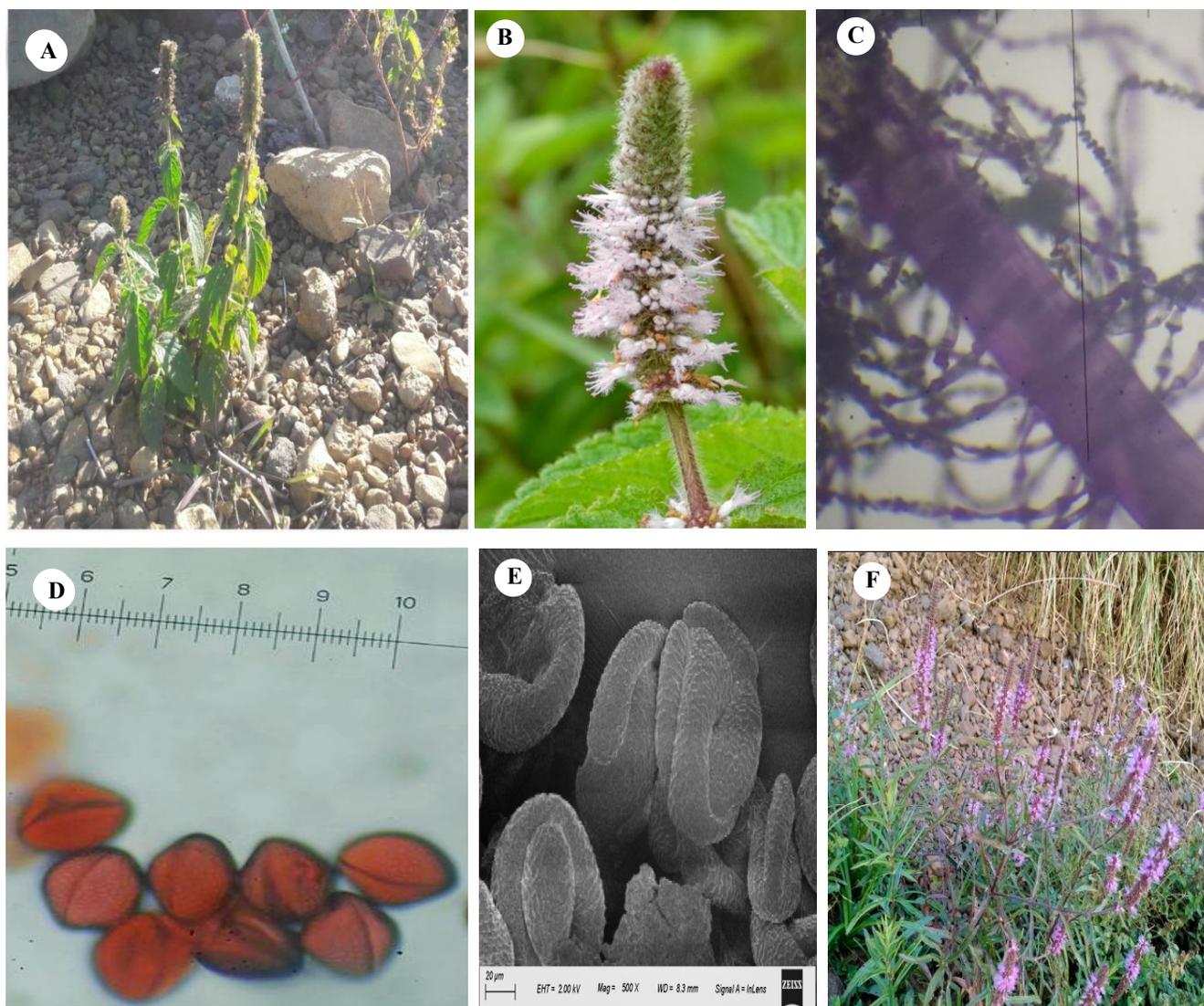
Habitat: It mostly grows near water and hilly region and edges of forests.

Flowering: From August to November.

Synonyms: *P. stellatus* (Lour) Kuntz; *Anuragia quadrifolia* (Benth.) Raizada; *Dysophylla quadrifolia*; *Dysophylla rupestris* Dalzell; *Eusteralis quadrifolia* (Benth.) Panigrahi.

Exsiccatae: Assam, Dhubri (Dhaphdhepi), Chayanika Bordoloi, 12443 dated 10/09/2016 (GUBH).

Global distribution: India, (Assam, Khasi & Garo



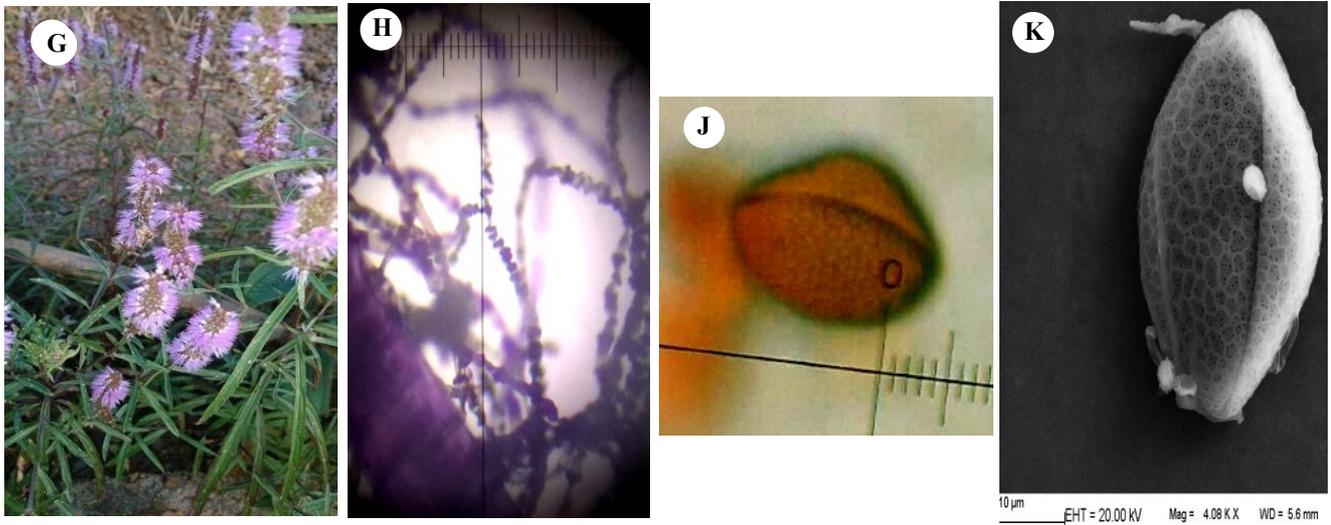


Plate 1. *Pogostemon strigosus* A. Habit; B. Inflorescence; C. stamen bearded with moniliform hairs (Under Microscope). D & E Pollen (LM & SEM);

Pogostemon quadrifolius F. Habit; G. stamen bearded with moniliform hairs (Under Microscope).D & E Pollen (LM & SEM);

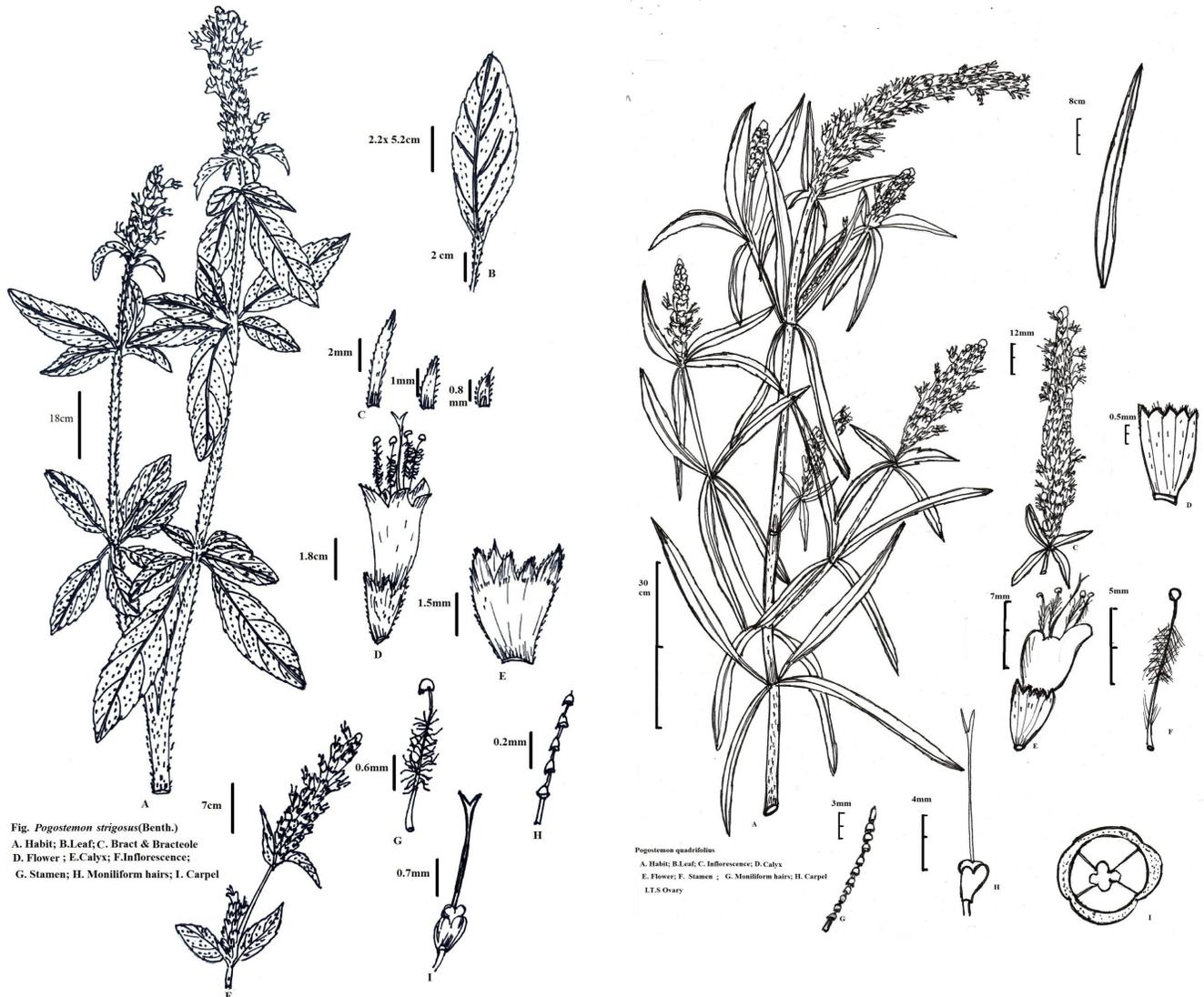


Fig. *Pogostemon strigosus*(Benth.)
A. Habit; B. Leaf; C. Bract & Bracteole
D. Flower; E. Calyx; F. Inflorescence;
G. Stamen; H. Moniliform hairs; I. Carpel

Pogostemon quadrifolius
A. Habit; B. Leaf; C. Inflorescence; D. Calyx
E. Flower; F. Stamen; G. Moniliform hairs; H. Carpel
I. L.S. Ovary

hills, Kerala, Bangladesh, China.

Taxonomic treatment and Description of floral morphology

***Pogostemon strigosus* (Benth.)** in A. DC., Prodr. 12:155(1848); *Dysophylla strigosa* Benth. in Wall., Pl. asiat. rar., 1:30 (1830); Bhatti & Ingrouille. Bull. Nat. Hist. Lond. (Bot.) 27(2). 107: 1997.

Flower in verticillasters in terminal unbranched spike, Raceme simple, 4-8cm long and 5-8 mm wide, with sub sessile flower, Bracts and bracteoles clavate-linear, ciliated, 0.2-0.5 mm long. flower 1.2-1.8 cm long, calyx longer than bract, tubular, teeth 5, triangular, sub-equal, ciliated outside, 5-veined, campanulate, 1.2-1.8mm long; corolla white, 0.9 mm-2.5mm long; tube exserted, hairy outside, 4-lobed sub equal, stamen 4, filaments 0.6 mm, long, inserted at the middle of corolla tube, bearded at the middle of filaments, exerted, upper part of filaments violet in colour, middle densely covered with \pm 0.2 mm long moniliform hairs, glabrous towards tip and base; anthers rounded, broad, dark black colour; carpel \pm 0.7 mm long, violet toward tip, base white, stigma bifid, equal, lobes 0.4mm long. (Fig. 1: Plate 1)

***Pogostemon quadrifolius* (Benth.) F. Muell.**, Fragm.5: 200.1866; *Eusteralis quadrifolia* (Benth.) Raizada, Suppl. Duth. Fl. Upp. Gang. Plain 218.1976; *Dysophylla quadrifolia* Benth, in Wall., Pl. Asiat. Rar. 1:30.1830; Hook, f., Fl. Brit. India. 4: 639.1885; *Dysophylla quadrifolia* Benth, Prain, Bengal Pl. 2:635, 1903; Gamble, Fl. Pres. Madras 1137 (795).1924; *Dysophylla quadrifolia* Benth. Kanjilal *et al.*, Fl. Ass. 3:513.1939; Subram., Fl. Thenmala Div. 290.1995; Bhatti & Ingrouille. Bull. Nat. Hist. Lond. (Bot.) 27(2).110:1997; *Eusteralis quadrifolia* (Benth) Panigrahi, Phytologia 32:378; Manila & Sivar., Fl. Calicut 238; Ansari, Fl, Kasaragod Div 304.198 5; Babu, Fl, Malappuram Dist 641.1991; Mohanan & Sivad., Fl. Agasthyamala 531.2002.

Annual aromatic herb, spike 8-12 mm long, compact, terminal, flowers sessile. Each branched terminated by a spike, hairy; calyx densely hairy and glandular outside, 5-teeth, 0.5-1.5mm, triangular, margin ciliated; corolla purplish, 7 mm long, glabrous inside, glandular outside, 4-lobed unequal, exserted ; stamen 4, erect, much exserted, 5 mm long, much bearded with moniliform hairs that exserted outside, 3mm, unilocular anthers; style 5mm long, stigma bifid, lobes equal. (Fig. 2: Plate 1)

Description of pollen morphology

The pollen grain of *Pogostemon strigosus* and *Pogostemon quadrifolius* were radially symmetrical and

isopolar. Apertures tricolporate. Colpi usually narrow, long and sunken, colpus membrane covered with granules or crustate elements. Exine appeared as reticulate with sculpturing, microechinate surface pattern and tectate optical section. Pollen size, P 19.8 μm \times E 14.6 μm (*Pogostemon strigosus*) and P 18.7 μm \times E 13.9 μm (*Pogostemon quadrifolius*). Shape in equatorial view prolate and polar view concave to triangular. (Plate1)

Discussion

Pogostemon strigosus and *Pogostemon quadrifolius* were newly recorded species for the flora of Assam. Both the species were not reported earlier in the *Flora of Assam* (Kanjilal *et al.*, 1939). Detailed study of both the species were not worked out till date in Assam. However, both the species were reported from Khasi & Garo hills, Jowai, Dawki, Jaintia hills, Nongkrem, Cherrapunji from North East India (Mao *et al.*). The pollen attributes were potentially useful for both species identification and phylogenetic implication (Abdel Khalik, 2016) 'Morphologically pollen grain are among the most conservative and constant structures and features of the spore coat that provide a tool for identification of genus or even species' (Harris, 1955).

References

- Bhatti, G.R. and M. Ingrouille (1997). Systematics of *Pogostemon* (Labiatae). *Bull. Nat. Hist. Mus. London. Botany Series*, **27(2)**: 77-147.
- Doan, T. (1936). Labiatae. In. H. Lecomte, (ed.) *Flore Générale de l'Indo-Chine. Masson, Paris*, **4(8&9)**: 915-1046.
- Engler, A. and L. Diels (1936). Syllabus der Pflanzenfamilien ed.11. Berlin, Borntraeger. pp. 419.
- Erdtman, G. (1945). Pollen morphology and plant taxonomy. IV. Labiatae, Verbenaceae and Avicenniaceae. *Svensk. bot. Tidskr.*, **39(3)**: 279-285.
- Erdtman, G. (1951). On the '*Tricolporites protrudens* problem'. *Svensk bot. Tidskr.*, **45**: 355.
- Erdtman, G. (1952). Pollen morphology and plant taxonomy. Angiosperms. (An introduction to Palynology) Vol.1. Almqvist and Wiksell. Stockholm.
- Harris, W.F. (1955). A Manual of the spores of New Zealand Pteridophyta. *New Zeal. Dep. Sci. Indust. Res.*, **116**:1-186.
- Hasskarl, J.K. (1842). Plantarum genera *et* species novae aut reformatae javenses. *Flora*, **25(2)**: 1-32.
- Harley, R.M., S. Atkins, A.L. Budantsev., R. Grayer (2004). Labiatae. In: Kubitzki, K. & Kadereit, J.W. (Eds.) *The families and genera of vascular plants. Springer*, Berlin & Heidelberg., **7**: 167-275.
- Hooker, J.D. (1885). *The Flora of British India*. L. Reeve & Co. Ltd., London. **4**: 604-705.
- Kanjilal, U. N., P.C Kanjilal., A. Das and R.N. De (1939). *Flora of*

- Assam*. Assam Govt. Press, Shillong: **3**: 509-516.
- Kuntze, O. Labiatae (1891). In: *Revisio. Generum Plantarum*, Arthur Felix, Leipzig, **2**: 511-531.
- Khalik, A.K. (2016). A systematic revision of the genus *Plectranthus* L. (Lamiaceae) in Saudi Arabia based on Morphological, Palynological and Micromorphological characters of trichomes. *American J. Plant Sciences*, **7(1)**:1429-1444.
- Li, H.W. and I.C. Hedge (1994). *Pogostemon* and *Dysophylla*. In Wu, Z.Y. & Raven, P.H. (Eds.) *Flora of China*: Science Press, Beijing & Missouri Botanical Garden Press, St. Louis, **17**: 260-266.
- Mao, A.A., B.K. Sinha., D.Verma and N. Sarma (2016) Checklist of Flora of Meghalaya. 1st ed. State Biodiversity Board, Meghalaya. B.S.I. Shillong, **1**:1-273.
- Miquel, F.A.W. (1856). *Flora van Nederlandsch Indië*, C. G. van der Post, Amsterdam, **2**: 103.
- Mukerjee, S.K. (1940). A Revision of the Labiatae of the Indian Empire. *Rec. Bot. Surv. India*, **14(1)**: 1-228.
- Nair, P. K.K. (1970a). Pollen morphology of Angiosperms – A historical and phylogenetic study. Vikas Publishing House. Delhi.
- Press, J.R. (1982). Taxonomic studies in the Labiatae, tribe Pogostemoneae. *Bulletin of the British Museum (Natural History)*, Botany, **10**: 1-89.
- Panigrahi, G. (1984). Nomenclatural notes on *Pogostemon* Desf. (Lamiaceae). *Taxon, International Association for Plant Taxonomy* (IAPT), Vienna, Austria, **33(1)**: 102.
- Wu, C.Y. and Y.C. Huang (1977). *Pogostemon* and *Dysophylla*. In: Wu, C.Y. & Li, H.W. (Eds.) *Flora Reipublicae Popularis Sinicae*. Science Press, Beijing, **66**: 366-387.
- Yao, Gang., Yun Fei Deng., Xue Jun Ge (2015). A Taxonomic revision of *Pogostemon* (Lamiaceae) from China. *Phytotaxa*. China, **200 (1)** : 1-67.