

**Name of applicant: Kooli Kulangara Jeomol**

**Country: India**

**Institution: University of Calicut**

**Project title: Taxonomic revision and micro-morphological studies of the genus *Elatostema* (*Urticaceae*) in India**

### **Introduction**

*Elatostema* J.R.Forster & G.Forster is the second largest and a complex genus of the nettle family *Urticaceae* Juss. The genus belongs to the tribe *Elatostemateae* Gaudich and comprises of *c.* 570 species, distributed in tropical and subtropical Africa, Asia and Oceania (Tseng *et al.* 2019). The majority of the species are distributed in Asia, with Southeast Asia and Southwest China proposed as centres of diversity (Wei *et al.* 2011; Wang 2012, 2014). Wang (2014) recorded 50 species from India, South Nepal and neighboring countries. The members of this genus commonly inhabits moist forest understory, moist slopes, gorges, waterfalls, stream sides and caves (Monro *et al.* 2018).

### **Relevance of the proposed study of *Elatostema* in India**

1. In Indian context, apart from Hooker's (1888) and Fischer's (1928) floristic treatment and two new varietal reports (Henry *et al.* 1964; Bi *et al.* 2011), no detailed taxonomic study of the genus is available. A preliminary study records about 42 species in India, with high diversity and endemics in the northeastern states. Only 7 species (*E. sessile* J.R.Forst. & G.Forst., *E. acuminatum* (Poir.) Brongn., *E. cuneatum* Wight, *E. cuspidatum* Wight, *E. lineolatum* Wight, *E. wightii* Hook.f. and *E. monandrum* (Buch.-Ham. ex D.Don) H.Hara) are reported from other states of India. In addition, a new species *E. agasthyanum* Jeomol & Sunojk. (2019), was recently reported from Kerala. The present study aims at an exhaustive collection and morphological analysis and to prepare a comprehensive taxonomic account of the genus *Elatostema* in India and to resolve all nomenclatural problems and typification in Indian taxa.
2. Since its establishment, the generic delimitation has remained problematic for *Elatostema* and the closely related genera *Elatostematoides* C.B. Rob., *Pellionia* Gaudich. and *Procris* Comm. ex Juss. This is due to high species diversity and the use of homoplastic morphological characters in their taxonomy. All the four genera, *Elatostema*, *Elatostematoides*, *Pellionia*, and *Procris* were treated as distinct genera by Robinson (1910), Schumann and Lauterbach (1900), Wang (1980a, b), Weddell (1869) and Yang *et al.* (1995). Whereas, *Pellionia* and *Procris* were treated at subgeneric level within *Elatostema* by Hallier (1896) and Winkler (1922). *Procris* was treated as a distinct genus and *Pellionia* and *Elatostematoides* as subgenera of *Elatostema* by Schröter (1938) and Schröter and Winkler (1935, 1936). Inter- and infrageneric delimitations of *Elatostema* were attempted by using phylogenetic analyses based on morphological characters (Beaman, 2001; Hadiyah and Conn, 2009; Wu *et al.*, 2015) and DNA sequence data (Hadiyah *et al.*, 2003, 2008; Wu *et al.*, 2013), but relationships remain uncertain. . Tseng *et al.* (2019) reassessed the inter-generic based on morphological and molecular characters. In this analysis, *Elatostema* is resolved as a monophyletic group which includes most of the species of *Pellionia* Gaudich. but excludes *Elatostematoides* C.B.Rob. and *Procris*

Comm. ex Juss. The present study aims to contribute to the better understanding of the intergeneric delimitation.

3. Infrageneric classification of *Elatostema* still remains enigmatic. This is due to two entirely different system for interspecific relationship. Schroter and Winkler (1935, 1936) first proposed four subgenera, namely, subg. *Pellionia*, subg. *Elatostematoides*, subg. *Weddellia* and subg. *Elatostema* (as '*Euelatostema*'). This division was primarily based on the nature of the leaves, stipules, inflorescence and the presence and form of the receptacle. But Wang (1980a) rejected the subgeneric classification of Schroter and Winkler and proposed an infrageneric classification of sections and series based on morphology. At the sectional level, he recognised section *Androsyce*, sect. *Elatostema*, sect. *Laevisperma*, sect. *Pellionioides* and sect. *Weddellia*. Wang used leaf venation, inflorescence and achenes characteristics, but he did not assess the presence or absence of nanophylls. Tseng *et al.* (2019) reassessed the infra-generic classification of the genus, based on morphological and molecular characters. Within *Elatostema*, four major clades were recognized namely, African *Elatostema*, core *Elatostema*, *Pellionia* and *Weddellia*. Hence, at present, the exact systematic placement of the species cannot be ascertained and further studies are required to confirm the infrageneric placement within *Elatostema*. The proposed study attempts to solve confusion in the systematic placement of all the Indian taxa of *Elatostema* and collaborate internationally to devise a more natural infrageneric system.

## Objectives

1. Analyse the species diversity and endemism of *Elatostema* in India and identify the conservation status of various species of *Elatostema* in India using IUCN criteria.
2. To complete the taxonomic account of the genus from India and to resolve nomenclature problems and typification in the Indian species, with descriptions, illustrations, photographs, distribution, and a dichotomous key for identification.
3. To investigate the intergeneric and infrageneric relationships among and within species and related genera using morphological data

## Materials and Methods

1. Field exploration to various parts of India covering all seasons to collect and assess the distributional status of different taxa. Introduction and maintenance of live collections in to Botanical Garden, University of Calicut and preparation of herbarium sheets of voucher specimen of all species collected using conventional techniques.
2. Consultation of herbaria throughout India and abroad.
3. Preparation of data sheets of all taxa studied and identification of all species will be confirmed with types and protologue and the nomenclature will be updated conferring to latest code of nomenclature.
4. Light microscopic and SEM studies for micro-morphologic studies.

## Literature cited

**Beaman, R.S.** (2001) Phylogeny and biogeography of *Elatostema* (Urticaceae) from Mount Kinabalu. Sabah Parks Nat. J. 4: 71–93.

- Bi, H.Y., Yang, Z.R. & Lin, Q.** (2011) New taxa of *Elatostema* (Urticaceae) from Thailand and India. *Bangladesh Journal of Plant Taxonomy* 18(2): 149–152.
- Fischer, C.E.C.** (1928) *Elatostema*. In: Gamble, J.S. (Ed.) *Flora of the Presidency of Madras* Vol. 3. Neeraj Publishing House, Delhi, pp. 1374–1377.
- Hadijah, J.T., Conn, B.J.** (2009) Usefulness of morphological characters for infrageneric classification of *Elatostema* (Urticaceae). *Blumea* 54, 181–191.
- Hallier, H.** (1896) Neue und bemerkenswerte pflanzen aus dem malaiisch-papuanischen inselmeer. *Ann. Jard. Bot. Buitenzorg* 13: 276–326.
- Henry, A.N.** (1964) A new variety of *Elatostema lineolatum* Wight from Agastyamalai hills, Madras state. *Bulletin of the Botanical Survey of India* 6(2–4): 317–318.
- Hooker, J.D.** (1888) Urticaceae. In: Hooker, J.D. (Ed.) *The Flora of British India*, Vol. 5. L. Reeve & Co., London, pp. 477–594.
- Jeomol K.K. & Sunojkumar P.** (2019) *Elatostema agasthyanum*: A new lithophytic species from southern Western Ghats, India. *Phytotaxa* 430(1):03-040.
- Monro, A.K., Bystriakova, N., Fu, L., Wen, F. & Wei, Y.** (2018) Discovery of a diverse cave flora in China. *PloSONE* 13(2): e0190801.
- Robinson, C.B.** (1910) Philippine Urticaceae. *Philippine Journal of Science, Section C, Botany* 5: 465–542.
- Schröter, H. & Winkler, H.** (1935) Monographie der gattung *Elatostema* s.l. Allgemeiner teil. *Repertorium Specierum Novarum Regni Vegetabilis* 83: 1–71.
- Schröter, H. & Winkler, H.** (1936) Monographie der gattung *Elatostema* s.l. Spezieller teil. *Repertorium Specierum Novarum Regni Vegetabilis* 83: 1–237.
- Schumann, K.M., Lauterbach, C.A.G.** (1900) Urticaceae. Die Flora der deutschen Schutzgebiete in der Südsee. Gebrüder Borntraeger, Leipzig, pp. 289–297.
- Tseng, Y.S, Monro, A.K., Wei, Y.G. & Hu, J.M.** (2019) Molecular phylogeny and morphology of *Elatostema* s.l. (Urticaceae): Implications for inter- and infrageneric classifications. *Molecular Phylogenetics and Evolution* 132: 251–264.
- Wang, W.T.** (1980a) Classificatio specierum Sinicarum *Pellioniae* (Urticaceae). *Bulletin of Botanical Laboratory of North-Eastern Forestry Institute, Harbin* 6: 45–66.
- Wang, W.T.** (1980b) Classificatio specierum Sinicarum *Elatostematis* (Urticaceae). *Bulletin of Botanical Laboratory of North-Eastern Forestry Institute, Harbin* 7: 1–96.
- Wang, W.T.** (2012) Nova classification specierum sinicarum *Elatostematis* (Urticaceae). In: Fu, D.Z. (Ed.) *Paper Collection of W.T. Wang*. Higher Education Press, Beijing, 1016–1178.
- Wang, W.T.** (2014) *Elatostema (Urticaceae) in China*. Qingdao publishing house, Qingdao, 393 pp.
- Weddell, H.A.** (1869) Urticaceae. In: De Candolle, A. (Ed.), *Prodomus Systematis naturalis regni vegetabilis*. Masson, Paris, pp. 32–235.
- Wei Y.G., Monro, A.K. & Wang, W.T.** (2011) Additions to the Flora of China: seven new species of *Elatostema* (Urticaceae) from the Karst landscapes of Guangxi and Yunnan. *Phytotaxa* 29: 1–27.
- Winkler, H.** (1922) Die Urticaceen Papuas. *Beitr. Fl. Papuas.* 8: 501–608.
- Wu, Z.Y., Monro, A.K., Milne, R.I., Wang, H., Yi, T.S., Liu, J. & Li, D.Z.** (2013) Molecular phylogeny of the nettle family (Urticaceae) inferred from multiple loci of three genomes and extensive generic sampling. *Molecular Phylogenetics and Evolution* 69: 814–827.
- Yang, Y.P., Shih, B.L. & H.Y. Liu** (1995) A revision of *Elatostema* (Urticaceae) of Taiwan. *Botanical Bulletin of Academia Sinica* 36: 259–278.