



Note

Supplementary descriptions of inflorescence and achene of four species of *Elatostema* (Urticaceae) from China

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ABSTRACT: The inflorescences and achenes provide valuable taxonomic characters for the genus *Elatostema* (Urticaceae). To fill the significant gaps in our understanding of these structures, we conducted extensive field investigations to collect infructescences and achenes of four understudied species: *E. omeiense*, *E. oligotrichum*, *E. pseudoficoides*, and *E. subcuspidatum*. Our detailed morphological analysis, employing high-resolution techniques, revealed key differences between these species and their close relatives. These findings strengthen our knowledge on their species delimitation and contribute to a more precise identification and classification of *Elatostema* species, which is essential for their conservation.

KEY WORDS: *Elatostema*, infructescences, species delimitation, morphological characters.

INTRODUCTION

Elatostema J.R.Forst. & G.Forst. (Urticaceae) is a genus of several hundred herbaceous and sub-shrubby species that thrive in the deep shade of forests, gorges, stream banks, and caves (Wang, 2014; Fu *et al.*, 2017). Widely distributed across tropical and subtropical Africa, Madagascar, Asia, Australasia, and Oceania, *Elatostema* is particularly diverse in China, with at least 280 species, especially on karst landforms (Wang, 2014; Fu *et al.*, 2019a).

Recent phylogenetic analyses indicate that *Elatostema* forms a monophyletic group encompassing taxa previously classified within *Pellionia* Gaudich., while excluding those traditionally assigned to *Elatostematoides* C.B.Rob., *Procris* Comm. ex Juss., and *Pellionia repens* (Lour.) Merr. (Tseng *et al.*, 2019). The redefined *Elatostema* is comprised of four distinct clades: core *Elatostema*, *Pellionia*, *Weddellia*, and African *Elatostema*. Among these, the core *Elatostema* clade is the largest and most widespread, encompassing species primarily from China, Southeast Asia, and Oceania. However, due to their morphological similarities, including tiny, congested flowers and reduced tepals, the classification within this clade remains unresolved (Fu *et al.*, 2014a).

While the inflorescence and achene offer valuable taxonomic characters (Wang, 2010; Tseng *et al.*, 2019; Xin *et al.*, 2023), significant gaps exist in our knowledge of these structures, especially for Chinese species. Despite extensive research efforts (Wu *et al.*, 2012a,b; Fu *et al.*, 2014b, 2017; Chen *et al.*, 2017; Fu *et al.*, 2019b), information on pistillate inflorescences (21%), staminate inflorescences (29%), and achenes (44%) remains limited

(Xin *et al.*, 2023).

During our 2023 field investigations in Chongqing and Sichuan, China, we collected infructescences including mature achenes from four *Elatostema* species: *Elatostema oligotrichum* W.T.Wang, *E. omeiense* W.T.Wang, *E. pseudoficoides* W.T.Wang, and *E. subcuspidatum* W.T.Wang. A comprehensive literature review confirmed that female inflorescence and/or achene had not been previously described (Lin *et al.*, 2003; Wu *et al.*, 2012a, 2012b; Fu *et al.*, 2014b; Wang, 2014; Chen *et al.*, 2017; Fu *et al.*, 2017). By providing detailed descriptions of these morphological features, we aim to contribute to the accurate identification, classification, and conservation of *Elatostema* species.

MATERIALS AND METHODS

For this study, we conducted field investigations covering the entire natural range of the three narrowly distributed *Elatostema* species: *E. oligotrichum*, *E. subcuspidatum*, and *E. omeiense*. *E. oligotrichum* and *E. subcuspidatum* (with infructescences) were collected from their respective single known localities (their type localities). *E. omeiense* was collected from a similar habitat on Jinfo Mountain, Nanchuan, representing one of its two known localities. *E. pseudoficoides*, widespread in Southwest China (Wang, 2014), was also collected from its type locality. All specimens were deposited at the herbarium of the Guangxi Institute of Botany (IBK). Mature infructescences, including achenes, were carefully dissected from herbarium specimens of the four species. Morphological characters were observed using a camera (Canon R5) paired with a high-magnification objective lens (Mitutoyo). An automatic stepping guide



was employed to capture several images, which were then processed to create high-definition photos through depth of field synthesis. Achene morphology was further examined using scanning electron microscopy (SEM). Achene materials were collected from specimens, air-dried, mounted on stubs with double-sided adhesive tape, and sputter-coated with gold prior to imaging. At least five achenes per specimen were measured. Detailed illustrations were created based on the photographs.

TAXONOMIC DISCUSSION

Elatostema oligotrichum W.T.Wang in Bull. Bot. Res., Harbin 37(5): 643. 2017.

Figs. 1A–C, 2A, E & 3C

Type: CHINA. Chongqing: Jiangjin District, Simian Mountain, Wolonggou, on shady wet stony cliff, 1009 m, 9 March 2016, Z.Y. Liu, J. Zhang *et al.* S-0112 (holotype: PE!); same locality, Simian Mountain, Qianshayan, under broad-leaved forest, 1020m, 11 March 2016, Z.Y. Liu, M.X. Lin *et al.* S-0628 (paratype, PE!)

Description: Achenes 30–60 per infructescence, 0.70–1.00 × 0.37–0.48 mm, length: width ratio = 1.71–2.08, ellipsoid, tuberculate, pale brown.

Specimens examined: CHINA. Chongqing: Jiangjin District, Simian Mountain, Dawopu, N 106°21.05' E 28°34.82', 1095 m, 08 May 2023, F. Chen & C. Xiong XC20230508-05 (IBK!).

Notes: *Elatostema oligotrichum* was originally described as distinct from its closely related species, *E. nasutum*, based on morphological differences. These differences include leaf size, the nature of bract and bracteole appendages, the density of stigmatic hairs (Wang, 2017). Our supplementary description of achene morphology further highlights a difference between the two species. *E. oligotrichum* possesses a tuberculate achene surface, whereas *E. nasutum* exhibits longitudinal ridges.

Elatostema omeiense W.T.Wang in Bull. Bot. Lab. N. E. Forest. Inst., Harbin 1980(7): 79. 1980.

Figs. 1D–F, 2B, F & 3A–B

Type: CHINA. Sichuan: Emeishan City, Emei Mountain, Hongchunping, 2 April 1941, W.P. Fang 16053 (holotype: S)

Description: Pistillate infructescences, axillary, subsessile, involucre receptaculate, bracteolate; receptaculate involucre 0.6–0.8 × 1–1.2 cm, rectangular, green, deeply divided into two lobes, each lobe further divided into 2–3 lobes, glabrous, outer major bracts 2, ovate, ca 3 × 2 mm, apex corniculate, marginal minor bracts 40–60, subequal, triangular, 0.6–0.8 × 0.2–0.3 mm; bracteoles subequal, ca. 0.6 × 0.1 mm, lanceolate-linear, membranous, apex sparsely ciliate, pistillate flower not seen. Achenes 150–300 per infructescence, 0.66–0.97 × 0.33–0.39 mm, length: width ratio 1.94–2.85, narrow ellipsoid, longitudinally 5–7-ribbed with wings, pale green.

Specimens examined: CHINA. Chongqing: Nanchuan

District, Jinpo Mountain, Huangniya, N 107°5.68' E 29°0.27', 1127 m, 30 April 2023, S.R. Yi & C. Xiong XC20230430-16 (IBK!).

Notes: *Elatostema omeiense* was originally described as distinct from its closely related species, *E. dissectum*, by having minor leaf size, strigulose, minor cystolith and five-parted male flower (Wang, 1980). Wang (2014) described the female receptacle of *E. omeiense* as rounded, while our observations indicate a disc-shaped receptacle, further distinguishing it from *E. dissectum*. In addition, our supplementary description of achene morphology elucidates that *E. omeiense* possesses a smaller achene with fewer ribs in comparison to *E. dissectum*.

Elatostema pseudoficoides W.T.Wang in Bull. Bot. Lab. N. E. Forest. Inst., Harbin 1980(7): 85. 1980.

Figs. 1G–I, 2C, G & 3F

Type: CHINA. Sichuan: Emeishan City, Emei Mountain, Jiulao Cave, 1700 m, 18 August 1957, K.H. Yang 56703 (holotype: PE!; isotype: NAS!)

Description: Achenes 30–80 per infructescence, 0.48–0.58 × 0.24–0.26 mm, length: width ratio = 1.89–2.42, ellipsoid, longitudinally 2–4-ribbed, between each pair of ribs sparsely tuberculate, pale brown.

Specimens examined: CHINA. Sichuan: Emeishan City, Emei Mountain, Jiulao Cave, N 103°21.48' E 29°32.85', 1835 m, 22 November 2023, XC20231122-12 (IBK!).

Notes: *Elatostema pseudoficoides* was originally described as distinct from its closely related species, *E. nanchuanense* by its glabrous stem, larger leaves, and the retention of green color upon drying (Wang, 1980). Our supplementary description of achene morphology further underscores a key difference between the two species. *E. pseudoficoides* possesses a smaller achene longitudinal ridges and tubercles, while *E. nanchuanense* exhibits a larger achene with only longitudinal ridges.

Elatostema subcuspidatum W.T.Wang in Bull. Bot. Res., Harbin 4(3): 115. 1984.

Figs. 1J–L, 2D, H & 3D–E

Type: CHINA. Chongqing: Nanchuan District, Jinpo Mountain, Delong, near Xiaomiping, 1600 m, 30 August 1983, Z.Y. Liu, 4387 (holotype: PE!)

Description: Pistillate infructescences, axillary, paired, subsessile, involucre receptaculate, bracteolate; receptaculate involucre, 0.9–1.2 × 1–1.4 cm, ellipsoidal-discoid, white-green, weakly divided into two lobes, hirsute outside, bracts connate, the basal two oblong, 4–6 × 4–5 mm, with a subulate horn-like projection, marginal bracts 20–30, subequal, puberulous, triangular, 1–2 × 0.2–0.3 mm; bracteoles subequal, ca. 1–1.5 × 0.2 mm, lanceolate-oblong, membranous, apex ciliate, pistillate flower not seen. Achenes 40–100 per infructescence, 0.87–1.06 × 0.42–0.50 mm, length: width ratio 1.89–2.43, ellipsoid, longitudinally 10–15-ribbed, reddish brown.

Specimens examined: CHINA. Chongqing: Nanchuan District, Jinpo Mountain, Shuiyuan Village, N 107°16.29' E 29°0.39', 1121 m, 16 November 2023, F. Chen & C. Xiong XC20231116-03 (IBK!).

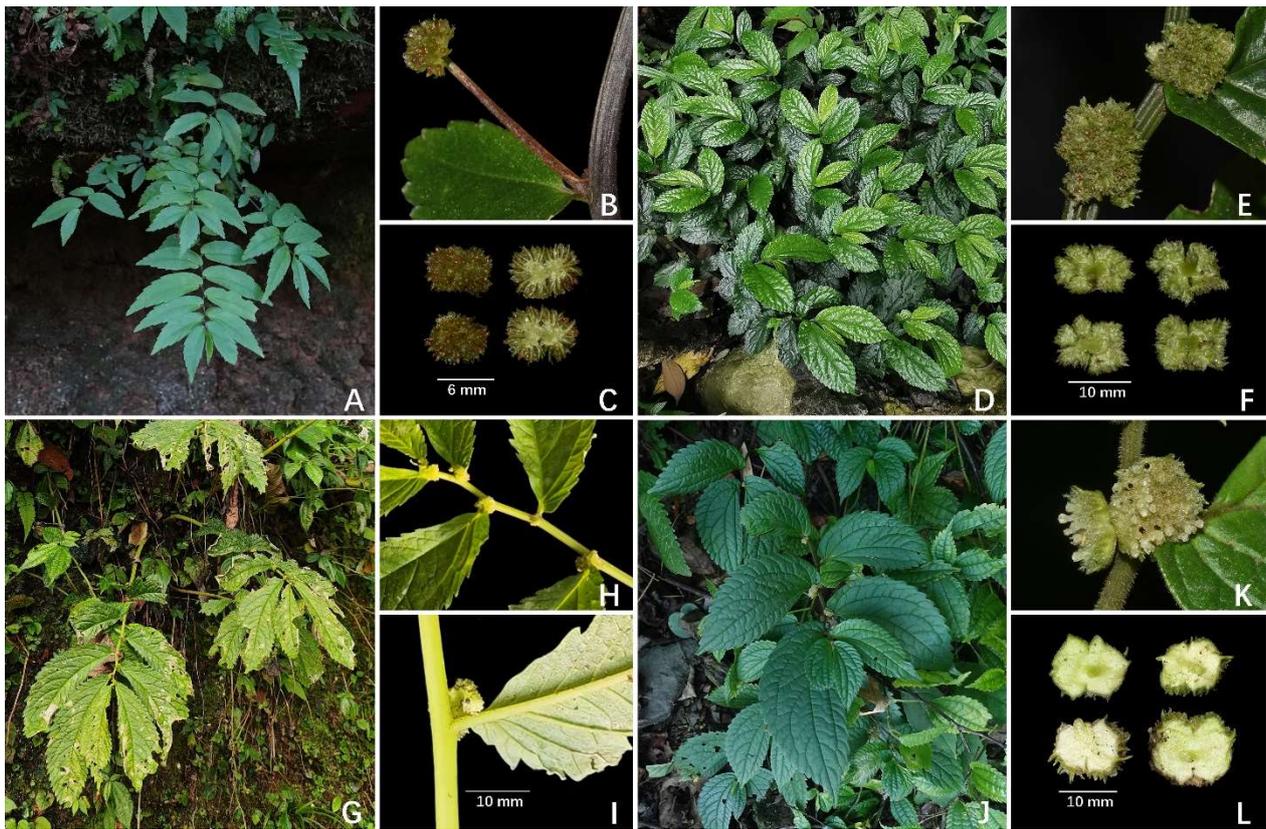


Fig. 1. Photographs of four *Elatostema* species. **A–C.** *E. oligotrichum* W.T.Wang, **D–F.** *E. omeiense* W.T. Wang, **G–I.** *E. pseudoficoides* W.T.Wang, **J–L.** *E. subcuspidatum* W.T.Wang. **A, D, G, J.** habit; **B, E, H, K.** Pistillate inflorescences with mature achenes; **C, F, I, L.** Pistillate inflorescences viewed from below. (Photographs of A and J by Feng Chen; others by Chi Xiong)

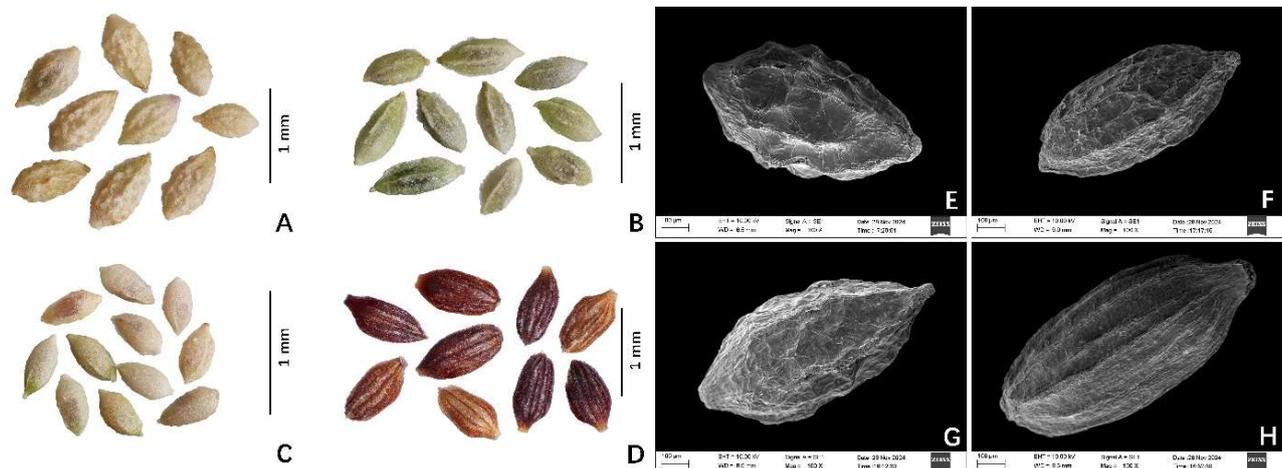


Fig. 2. Photographs of achenes of four *Elatostema* species. **A.** LM of *E. oligotrichum* W.T.Wang, **B.** LM of *E. omeiense* W.T. Wang, **C.** LM of *E. pseudoficoides* W.T.Wang, **D.** LM of *E. subcuspidatum* W.T.Wang, **E.** SEM of *E. oligotrichum* W.T.Wang, **F.** SEM of *E. omeiense* W.T. Wang, **G.** SEM of *E. pseudoficoides* W.T.Wang, **H.** SEM of *E. subcuspidatum* W.T.Wang. (Photographs of A–D by Yu-Jing Wei, E–H by Bing Li)

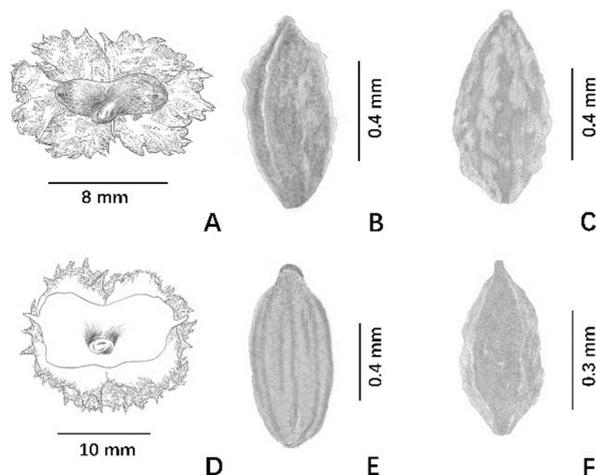


Fig. 3. Illustrations of four *Elatostema* species. *E. omeiense* W.T.Wang. **A.** Pistillate infructescence viewed from below, **B.** achene; *E. oligotrichum* W.T.Wang, **C.** achene; *E. subcuspidatum* W.T.Wang. **D.** Pistillate infructescence viewed from below, **E.** achene; *E. pseudoficoides* W.T.Wang, **F.** achene. (Illustrations by Jing Wei)

Notes: *Elatostema subcuspidatum* was originally described as distinct from its closely related species, *E. cuspidatum*, based on several morphological features, such as plant color, stem and leaf hairiness, and male bract appendages (Wang, 1984). Our comparative study further revealed a morphological difference of achene between *E. subcuspidatum* and *E. cuspidatum*. *E. subcuspidatum* possesses 10–15 ribs on its achenes, a greater number than that observed in *E. cuspidatum*.

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LITERATURE CITED

- Chen, X.-Q., Fu, L.-F., Wen, F., Li, S., Liu, Y., Wei, Y.-G. 2017 Supplementary description of achenes of *Elatostema* (Urticaceae). *Guihaia* **37**(7): 849–854.
- Fu, L.-F., Do, V. T., Wen, F., He, C.-X. 2014a *Elatostema arcuatobracteatum* (Urticaceae), a new species from Vietnam. *Phytotaxa* **174**(2): 111–115.
- Fu, L.-F., Huang, S.-L., Liu, Y., Do, V. T., Wen, F., Wei, Y.-G. 2014b A newly recorded species of *Elatostema* (Urticaceae) from Vietnam. *Taiwania* **59**(3): 281–286.
- Fu, L.-F., Monro, A. K., Huang, S.-L., Wen, F., Wei, Y.-G. 2017 *Elatostema tiechangense* (Urticaceae), a new cave-dwelling species from Yunnan, China. *Phytotaxa* **292**(1): 85–90.
- Fu, L.-F., Monro, A.K., Do, V. T., Nuraliev, M. S., Averyanov, L. V., Wen, F., Xin, Z.-B., Maisak, T. V., Kuznetsov, A. N., Kuznetsova, S. P., Nguyen, K. S., Wei, Y.-G. 2019a Checklist to the *Elatostema* (Urticaceae) of Vietnam including 19 new records, ten new combinations, two new names and four new synonyms. *PeerJ* **7**: e6188.
- Fu, L.-F., Xin, Z.-B., Monro, A.K., Wen, F., Li, S., Wei, Y.-G. 2019b Supplementary descriptions of inflorescence and achene of two species of *Elatostema* (Urticaceae) from China. *Taiwania* **64**(2): 198–201.
- Lin, Q., Friis, I., Wilmot-Deary, M. C. 2003 *Elatostema*. In: Wu, Z.-Y. & Raven, P. H. [eds.], *Flora of China*, vol. 5: 76–189. Science Press, Beijing and Missouri Botanical Garden Press, St. Louis, Missouri.
- Tseng, Y.-H., 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. *Mol. Phylogenet. Evol.* **132**: 251–264.
- Wang, W.-T. 1980 Classification specierum sinicarum *Elatostematis* (Urticaceae). *Bull. Bot. Lab. N. E. Forest. Inst., Harbin* **7**: 1–96.
- Wang, W.-T. 1984 Two new species of *Elatostema* (Urticaceae) from Sichuan. *Bull. Bot. Res., Harbin* **4**(3): 113–117.
- Wang, W.-T. 2010 Morphology of the bracts of *Elatostema* (Urticaceae) and the evolutionary trends in them. *Guihaia* **30**(5): 571–583.
- Wang, W.-T. 2014 *Elatostema* (Urticaceae) in China. Qingdao: Qingdao Press.
- Wang, W.-T. 2017 One new species of *Pellionia* and two new species of *Elatostema* (Urticaceae) from Chongqing. *Bull. Bot. Res., Harbin* **37**(5): 641–644.
- Wu, Z.-Y., Wang, H., Li, D.-Z. 2012a Supplementary description of inflorescences of three species in *Elatostema* (Urticaceae). *Plant Diversity and Resour.* **34**(1): 13–16.
- Wu, Z.-Y., Wang, H., Li, D.-Z. 2012b Supplementary description of achenes of seven species in *Elatostema* (Urticaceae). *Guihaia* **32**(5): 603–606.
- Xin, Z.-B., Monro, A.K., Wang, R.-F., Fu, L.-F. 2023 An integrative approach to species delimitation sinks three Chinese limestone karst *Elatostema* (Urticaceae) species. *PhytoKeys* **236**: 83–96.