A taxonomic revision of the *Boehmeria spicata* complex (Urticaceae) in Korea

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ABSTRACT: Seven species and two varieties belonging to the genus *Boehmeria* Jacq. (Urticaceae) are known to be distributed in Korea. Among them, *B. spicata*, *B. tricuspis*, and *B. tricuspis* var. *unicuspis* were subjected to an external morphological study. Among the individuals believed to exhibit variations in the leaf shape, *B. gracilis* and *B. silvestrii* were newly recognized. Unlike related taxa, *B. gracilis* has middle leaves with an elliptic, broadly elliptic, ovate, or broadly depressed ovate shape, a regular and serrulate-dentate margin, and an unlobed and short caudate or cuspidate apex. *Boehmeria silvestrii* has middle leaves with 5-angled ovate, orbicular ovate or broadly ovate shapes, and 3- or 5-lobed and caudate apices. Therefore, we assigned the corresponding names ‘Top-geo-buk-kko-ri’ and ‘Cham-geo-buk-kko-ri’. Meanwhile, the *B. spicata* complex (*B. gracilis*, *B. silvestrii*, *B. spicata*, and *B. tricuspis* var. *unicuspis*) is very closely related in terms of the morphological characters, whereas *B. tricuspis* exhibits no relationship. Furthermore, because the scientific name and type specimen of *B. tricuspis* var. *unicuspis* (Pul-geo-buk-kko-ri) are problematic, the correct name *B. paraspicata* Nakai and corresponding holotype are presented. Additionally, lectotypes of *B. gracilis* and *B. silvestrii* are newly designated here. A taxonomic treatment, descriptions, a key, photographs, type specimens, and leaf variation images of the *B. spicata* complex are provided in this study.

Keywords: *Boehmeria*, *B. gracilis*, *B. paraspicata*, *B. silvestrii*, *B. spicata*, lectotypification

The genus *Boehmeria* Jacq. is one of the largest genera belonging to the family Urticaceae (Gaudichaud, 1830; Weddell, 1856, 1869; Wilmot-Dear and Friis, 2013). The genus is composed of approximately 100–150 species and is distributed in the tropics and subtropics (East Africa, Indian Ocean Islands, East to West Asia, Oceania, Pacific Ocean Islands, and North to South America). In particular, many species are distributed from the Himalayas to Indochina (Weddell, 1856; Blume, 1857; Jackson, 1895; Pinner and Bence, 1987; Ilvessalo-Pfäffli, 1995; Wilmot-Dear and Friis, 1996, 2013; Kozłowski, 2012). Approximately 44–75 species of this genus are distributed in Asia (Yahara, 1981; Zhao et al., 2003; Pierozzi et al., 2008). In Korea, seven species and two varieties of this genus are distributed (Liang, 2009; Kim, 2018). Among them, *B. spicata*

(Thunb.) Thunb., *B. tricuspis* (Hance) Makino, and *B. tricuspis* var. *unicuspis* Makino are the most confusing, as the boundary of the leaf variation is unclear.

Meanwhile, *B. tricuspis* is generally confused with *B. silvestrii* (Pamp.) W. T. Wang because the apex of the leaf is similar to a 3-lobed shape (Makino, 1940, 1961, 1989; Ohwi, 1953, 1965; Kitamura and Murata, 1961; Im, 1996; Lee, 1996a, 1996b; Lee, 2003; Tateishi, 2006; Liang, 2009; Wilmot-Dear and Friis, 2013). The distribution of *B. silvestrii* in Korea was mentioned for the first time by Makino (1989).

Boehmeria gracilis C. H. Wright is also known to be distributed in Korea (Makino, 1989), and it is often confused with *B. spicata* and *B. tricuspis* var. *unicuspis*. In China, Chen et al. (2003) considered *B. gracilis* and *B. tricuspis* var.

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Table 1. Comparison of the *Boehmeria spicata* and the related taxa recognized in Korea, China, and Japan.

Taxa	Korea				China			Japan			
	Lee (1996a, 1996b)	Lee (2003)	Lee (2006)	Kim (2018)	Chen et al. (2003)	Wang (2016)	Kitamura and Murata (1961)	Makino (1961)	Ohwi (1965)	Makino (1989)	Tateishi (2006)
<i>B. gracilis</i>						●				●	●
<i>B. spicata</i>	●	●	●	●	●	●	●	●	●	●	●
<i>B. tricuspis</i> var. <i>unicuspis</i>	●	●	●	●			●	●	●		

unicuspis as synonyms of *B. spicata*. However, Wang (2016) recently recognized *B. gracilis* and *B. spicata* as independent species and treated *B. tricuspis* var. *unicuspis* as a synonym of *B. gracilis*. In Japan, *B. spicata* and *B. tricuspis* var. *unicuspis* were treated as different taxa (Kitamura and Murata, 1961; Makino, 1961; Ohwi, 1965). Later, Makino (1989) recognized *B. tricuspis* var. *unicuspis* as *B. gracilis* and considered *B. gracilis* and *B. spicata* as independent species. Tateishi (2006) also treated *B. gracilis* and *B. spicata* as independent species. In Korea, *B. spicata* and *B. tricuspis* var. *unicuspis* are recognized as independent taxa (Table 1; Lee, 1996a, 1996b; Lee, 2003; Lee, 2006; Kim, 2018).

Thus, the purpose of this study is to examine the identities of *B. silvestrii* and *B. gracilis* by comparing them with *B. spicata* and related taxa. *Boehmeria gracilis*, *B. silvestrii*, *B. spicata*, and *B. tricuspis* var. *unicuspis* are very closely related in terms of the morphological characters, whereas *B. tricuspis* exhibits no relationship, as noted above. They have common characters as a subshrub or small shrub, a sparsely strigillose or subglabrous plant, with a convex midvein of the leaf on the adaxial surface, a cleft perianth of the male flower, an unbranched pistillate inflorescence, and an irregular strigillose perianth tube of the achene throughout the surface. Accordingly, they are recognized as the *B. spicata* complex. The situation is taxonomically very confusing due to leaf variations and no distinct difference in the reproductive characters.

Therefore, a taxonomic treatment, descriptions, a key, photographs, type specimens, and leaf variation images are presented based on the original descriptions, type specimens, and morphological characters.

Materials and Methods

The literature was reviewed and fieldwork was conducted from 2016 to 2020 in Korea. Voucher specimens were deposited in the herbarium of Andong National University (ANH) (Appendix 1). Herbarium specimens of KB, KH, TI, and WFRC and specimen images of BM, FI, GH, K, LD,

LINN, MNHN, P, PE, and UPS were also examined. The qualitative and quantitative morphological characters of the vegetative organs (e.g., habit type, plant hair, leaf shape) and reproductive organs (e.g., inflorescence shape, male flower shape, achene hair) were observed with a microscope (AX-70, Olympus, Tokyo, Japan; DP2-BSW, Olympus) and with a digital caliper (CD-15CPX, Mitutoyo, Kawasaki, Japan).

Taxonomic Treatment

1. *Boehmeria gracilis* C. H. Wright, J. Linn. Soc., Bot. 26: 485, 1899.—TYPE: China. Hubei, Patung, Ichang, May 1888, *A. Henry* 4692 (lectotype: K, photo!, designated here, see Fig. 1A); Hubei, 1885–1888, *A. Henry* 4692 (syntype: GH, photo!); Hubei, Patung, Ichang, May 1888, *A. Henry* 4728 (syntype: K, photo!); Hubei, Changlo, Mar 1889, *A. Henry* 6258 (syntype: K, photo!).

B. tricuspis var. *unicuspis* Makino, Ill. Fl. Nippon. 641, 1940, *nom. nud.*; *B. tricuspis* var. *unicuspis* Makino ex Ohwi, Fl. Jap. 441, 1953.

Korean name: Top-geo-buk-kko-ri (톱거북꼬리, new common name).

Habits subshrub, monoecious or dioecious. **Stems** erect, 0.5–1.3 m tall, 1.5–3.2 mm in diam., a few branched from the base, red or green, sparsely strigillose or subglabrous. **Leaves** opposite, pairs subequal in size; stipules lanceolate, 7.2–12.6 mm long, 1.9–2.9 mm wide, yellow green, sparsely pubescent along midvein on abaxial surface; petioles 1.1–9.0 cm long, 0.6–1.9 mm in diam., red or green, sparsely strigillose or subglabrous; middle leaf blades elliptic, broadly elliptic, ovate or broadly depressed ovate, 3.8–13.7 cm long, 3.3–10.6 cm wide, base cuneate, broadly cuneate or subtruncate, margin serrulate-dentate, gradually subequal distally, teeth 7–15 on each side, narrowly triangular to triangular, 4.3–6.6 mm long, 5.6–9.3 mm wide, apex unlobed, short caudate or cuspidate, adaxial surface green, sparsely strigillose, densely cystoliths punctiform, midvein convex, abaxial surface yellow green, sparsely strigillose with uncinat hair or subglabrous along

Fig. 1. Types of the *Boehmeria spicata* complex. **A.** *B. gracilis* (lectotype: A. Henry, 4692, K, designated here). **B.** *B. paraspicata* (holotype: T. Nakai s.n., TI). **C.** *B. silvestrii* (lectotype: P. C. Silvestri 4070, FI, designated here). **D.** *B. spicata* (lectotype: C. P. Thunberg 22115, UPS).

veins and veinlets, often thin membranous or chartaceous. **Inflorescences** axillary; staminate inflorescences unbranched or branched in proximal axils, 15.5–17.2 cm long, rachis 1.0–1.3 mm in diam.; pistillate inflorescences unbranched in distal axils, 7.7–18.1 cm long, rachis 0.3–0.5 mm in diam., loosely glomerules at flowering, relatively densely glomerules at fruiting. **Flowers** unisexual; male flowers 4-merous, rarely 3- or 5-merous, 3.1–4.9 mm in diam.; pedicels 0.2–1.2 mm long, red or green; perianth lobes cleft near to the middle, convex, elliptic, 0.9–1.2 mm long, 1.0–1.2 mm wide, red or yellow green, strigillose in outside; filaments 4, rarely 3 or 5, linear, inflexed, 3.1–4.9 mm long, white; anthers basifixed, 0.8–1.2 mm long, 0.8–1.2 mm wide, white; ovaries rudimentary, clavate; female flowers 3.6–4.0 mm long, sessile; perianth tubes obovoid, 1.0–1.4 mm long, 0.7–1.6 mm wide, red or yellow green, strigillose with uncinat hair; necks 2-toothed; styles 1, linear, plumose, 1.9–3.3 mm long, red or white; stamens absent. **Achenes** rhomboid or obovoid, compressed, 1.4–3.5 mm long, 0.9–2.8 mm wide, base cuneate, irregular strigillose with uncinat hair throughout the surface. **Seeds** subcircular, 0.7–1.3 mm long, 0.6–1.0 mm wide; wings rhomboid, obovoid or broadly obovoid, 1.2–1.4 mm long, 1.0–1.1 mm wide.

Chromosome number: $2n = 28$ (Yahara, 1983).

Phenology: Flowering July to September, Fruiting September to November.

Distribution: Korea (all provinces except Jeju and Ulleungdo Islands), China, Japan.

Taxonomic note: This taxon has slight similarity to *B. spicata* but was announced as a new species due to the ovate shape of the leaf and the regular, serrate margin of the leaf by C. H. Wright (Forbes and Hemsley, 1899). Later, Tateishi (2006) and Wang (2016) treated *B. tricuspis* var. *unicuspis* as a synonym of *B. gracilis*. Chen et al. (2003) and Wilmot-Dear and Friis (2013) considered *B. gracilis* and *B. tricuspis* var. *unicuspis* as continuous variations of *B. spicata* (Jom-kkae-ip-na-mu). Therefore, *B. gracilis*, *B. spicata*, and *B. tricuspis* var. *unicuspis* are often confused with each other. However, Yahara (1983, 1986) and Wang (1981, 2016) recognized *B. gracilis* as an independent species because it is distinguished from *B. spicata* by the habit, shape, size, margin, and hair of the leaf, as well as the rachis hair of the inflorescence.

Meanwhile, Makino (1940) first published *B. tricuspis* var. *unicuspis* based on the red petiole, red inflorescence, and caudate or non-caudate apex of the leaf. In the description, it is written as ‘Marubaakaso’ in Japanese, which means a form of *B. tricuspis* with a round shape of the leaf. Subsequently, Makino (1989) recognized *B. gracilis* with the Japanese name

‘Kusakoakaso.’ In the literature, *B. tricuspis* var. *unicuspis* was omitted and *B. tricuspis* was renamed *B. silvestrii*, but the description and the illustrated image of *B. silvestrii* were identical to *B. tricuspis* described by Makino (1940). Therefore, *B. tricuspis* var. *unicuspis* published by Makino is presumed to be *B. gracilis*, which often has red petioles, a red inflorescence, a round-shaped leaf, and regular teeth. Consequently, *B. tricuspis* var. *unicuspis* is treated as a taxonomic synonym in this study.

Because *B. gracilis* is a subshrub with middle leaves that have elliptic, broadly elliptic, ovate, or broadly depressed ovate shapes, a subequal size of the teeth and a serrulate-dentate margin of the leaf, as well as a short caudate or cuspidate apex of the leaf, it can be distinguished from *B. spicata* (Figs. 2, 3, and Table 2). Therefore, it is named ‘Top-geo-buk-kko-ri’ based on the subequal size of the teeth and the serrulate-dentate margin of the leaf.

2. *Boehmeria paraspicata* Nakai, Veg. Mt. Apoi 19, 1930; *B. tricuspis* (Hance) Makino var. *paraspicata* (Nakai) Hara, Bot. Mag. (Tokyo) 48: 812, 1934; *Durretia paraspicata* (Nakai) Nakai, Bull. Natl. Sci. Mus. Tokyo 31: 42, 1952, *nom. illeg.*; *B. tricuspis* subsp. *paraspicata* (Nakai) Kitamura, Col. Ill. Herb. Pl. Jap. 2: 340, 1961.—TYPE: Japan. Hokkaido, Prov. Hidaka, Mt. Apoi, Aug 1928, *T. Nakai s.n.* (holotype: TI!, see Fig. 1B).

B. paraspicata Nakai ex Satake, J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot. 4: 483, 1936, *nom. illeg.*—TYPE: Japan. Hokkaido, Prov. Isikari, Kanayama, Aug 1916, *G. Koidzumi s.n.* (holotype: TI, photo!).

B. paraspicata Nakai f. *viridis* Satake, J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot. 4: 485, 1936.—Type: Japan. Honshu, Prov. Sagami, Mt. Zinba, 19 Jul 1931, *K. Hisauchi s.n.* (holotype: TI, photo!).

Korean name: Pul-geo-buk-kko-ri (풀거북꼬리).

Habits subshrub, monoecious or dioecious. **Stems** erect, 0.8–1.1 m tall, 1.8–4.1 mm in diam., a few branched from the base, green or red, sparsely strigillose or subglabrous. **Leaves** opposite, pairs subequal in size; stipules lanceolate, 8.2–14.7 mm long, 1.4–3.5 mm wide, yellow green, sparsely pubescent along midvein on abaxial surface; petioles 3.8–12.1 cm long, 0.8–1.7 mm in diam., green or red, sparsely strigillose or subglabrous; middle leaf blades ovate to broadly ovate, 9.0–19.1 cm long, 7.4–16.2 cm wide, base broadly cuneate, margin serrate-dentate, gradually larger distally, teeth 6–14 on each side, narrowly triangular to triangular, 6.4–9.9 mm long, 7.2–10.6 mm wide, apex unlobed, caudate or narrowly acute, adaxial surface green, sparsely strigillose, densely cystoliths

Fig. 2. Photographs of *Boehmeria gracilis*. **A.** Habit. **B.** Underground structure. **C.** Base stem. **D.** Middle stem. **E.** Adaxial surface of stipule. **F.** Abaxial surface of stipule. **G.** Middle leaf. **H.** Adaxial surface of leaf. **I.** Abaxial surface of leaf. **J.** Staminate inflorescence (left: unbranched, right: branched). **K.** Bud of male flower. **L.** Male flower. **M, N.** Pistillate inflorescence at flowering. **O.** Female flower. **P.** Pistillate inflorescence at fruiting. **Q.** Achene. **R.** Seeds.

Fig. 3. Middle leaf variations of the *Boehmeria spicata* complex. A. *B. gracilis*. B. *B. paraspicata*. C. *B. silvestrii*. D. *B. spicata*.

punctiform, midvein convex, abaxial surface yellow green, sparsely strigillose with uncinat hair or subglabrous along veins and veinlets, often thin membranous or chartaceous.

Inflorescences axillary; staminate inflorescences unbranched or rarely branched in proximal axils, 5.9–28.5 cm long, rachis 0.2–1.1 mm in diam.; pistillate inflorescences unbranched in distal axils, 9.4–23.7 cm long, rachis 0.3–0.9 mm in diam., loosely glomerules at flowering, relatively densely glomerules at fruiting. **Flowers** unisexual; male flowers 4-merous, rarely 5-merous, 4.0–5.2 mm in diam.; pedicels 0.2–1.6 mm long, green or red; perianth lobes cleft near to the middle, convex, elliptic, 0.9–1.2 mm long, 0.9–1.1 mm wide, yellow green or red, strigillose in outside; filaments 4, rarely 5, linear, inflexed, 1.7–2.2 mm long, white; anthers basifixed, 0.7–1.0 mm long, 0.7–0.9 mm wide, white; ovaries rudimentary, clavate; female flowers 2.6–3.3 mm long, sessile; perianth tubes obovoid, 1.3–1.7 mm long, 0.6–1.0 mm wide, yellow green or red, strigillose

with uncinat hair; necks 2-toothed; styles 1, linear, plumose, 0.8–2.0 mm long, white or red; stamens absent. **Achenes** rhomboid or obovoid, compressed, 2.5–4.0 mm long, 2.2–3.3 mm wide, base cuneate, irregular strigillose with uncinat hair throughout the surface. **Seeds** elliptic or subcircular, 1.0–1.7 mm long, 0.8–1.6 mm wide; wings rhomboid-obovoid or broadly obovoid, 0.7–1.0 mm long, 0.6–0.8 mm wide.

Chromosome number: $2n = 28$ (Okabe, 1963; Yahara, 1983).

Phenology: Flowering July to September, Fruiting September to November.

Distribution: Korea (all provinces), China, Japan.

Taxonomic note: Nakai (1930) first reported a new species, *B. paraspicata* Nakai. This name was accompanied by a Japanese diagnosis without a type specimen in the flora of Mt. Apoi in Prov. Hidaka on Hokkaido. Later, Satake (1936) recognized *B. paraspicata* as a *nomen nudum*, and he

Table 2. Comparison of the key morphological characters of the *Boehmeria spicata* complex.

Character	<i>B. gracilis</i>	<i>B. paraspicata</i>	<i>B. silvestrii</i>	<i>B. spicata</i>
Plant, habit	Subshrub	Subshrub	Subshrub	Small shrub
Stem, no. of branches	A few	A few	A few	Many
Stipule, shape	Lanceolate	Lanceolate	Narrowly lanceolate	Narrowly lanceolate
Middle leaf blade				
Shape	Elliptic, broadly elliptic, ovate or broadly depressed ovate	Ovate to broadly ovate	5-angled ovate, orbicular ovate or broadly ovate	Rhombic to rhombic ovate
Length (cm)	3.8 (10.4) 13.7	9.0 (11.7) 19.1	8.6 (11.0) 13.6	5.7 (7.5) 10.5
Width (cm)	3.3 (7.4) 10.6	7.4 (9.5) 16.2	8.1 (9.7) 13.1	3.5 (4.5) 6.8
Base	Cuneate, broadly cuneate or subtruncate	Broadly cuneate	Broadly cuneate or subtruncate	Cuneate or broadly cuneate
Margin	Serrulate-dentate	Serrate-dentate	Serrate-dentate	Serrate-dentate
No. of teeth on each side	7 (12) 15	6 (10) 14	7 (9) 11	4 (7) 9
Size of teeth	Subequal	Unequal	Unequal	Unequal
Lobed of apex	Unlobed	Unlobed	3- or 5- lobed	Unlobed
Apex	Short caudate or cuspidate	Caudate or narrowly acute	3- or 5-caudate	Caudate or narrowly acute

Bold letters indicate key character.

republished it with an accompanying Latin description and a specimen collected from Mt. Kanayama in Prov. Isikari on Hokkaido in August 1916 by G. Koidzumi (in TI herbarium). Among the examined specimens, there was a specimen that was assumed to have been collected when Nakai published *B. paraspicata*. Nakai's specimen and Koidzumi's specimen allowed confirmation that the characters of the habit, stem, leaf, and inflorescence are identical. Furthermore, in 1928, before the announcement of the new species, the specimen was annotated as '*B. paraspicata* Nakai'. Moreover, the collection site and the collector were in good agreement with the protologue of Nakai (Fig. 1B). As a result, Satake (1936) knew that there was an original material of Nakai, but he recognized the specimen of Koidzumi collected earlier as the type specimen. However, the specimen of Nakai has priority because *B. paraspicata* is not a name based on the specimen of Koidzumi. Thus, *B. paraspicata* Nakai ex Satake, published based on the Koidzumi's specimen, is a later homonym of *B. paraspicata* Nakai according to Art. 53.1 of the Shenzhen code (Turland et al., 2018), and *B. paraspicata* Nakai was validly published according to Art. 38.1 of the Shenzhen code (Turland et al., 2018). Therefore, we present a holotype to avoid confusion regarding the type specimen (Fig. 1B).

This taxon is clearly distinguished from *B. silvestrii* by the unlobed apex of the leaf and from *B. gracilis* based on the

broadly ovate shape of the middle leaf, the serrate-dentate margin of the leaf, the gradually larger teeth distal of the leaf, and the caudate or narrowly acute apex of the leaf (Figs. 3, 4, and Table 2).

3. *Boehmeria silvestrii* (Pamp.) W. T. Wang, Acta Phytotax. Sin. 20: 204, 1982; *B. platanifolia* (Franch. & Sav. ex Maxim.) C. H. Wright var. *silvestrii* Pamp., Nuovo Giorn. Bot. Ital. n. s. 22: 278, 1915; *B. japonica* (L. f.) Miq. var. *silvestrii* (Pamp.) Friis & Wilmot-Dear, Blumea. 58: 191, 2013.—TYPE: China. Hubei, 1912, *P. C. Silvestri* 4070 (lectotype: FI, photo!, designated here, see Fig. 1C), 4070a (isolectotype: FI, photo!, designated here).

Korean name: Cham-geo-buk-kko-ri (참거북꼬리, new common name).

Habits subshrub, monoecious or dioecious. **Stems** erect, 0.8–1.4 m tall, 1.9–3.6 mm in diam., a few branched from the base, green or red, sparsely strigillose or subglabrous. **Leaves** opposite, pairs subequal in size; stipules narrowly lanceolate, 8.6–13.1 mm long, 1.7–3.2 mm wide, yellow green, sparsely pubescent along midvein on abaxial surface; petioles 4.3–13.2 cm long, 0.9–1.5 mm in diam., green or red, sparsely strigillose or subglabrous; middle leaf blades 5-angled ovate, orbicular ovate or broadly ovate, 8.6–13.6 cm long, 8.1–13.1 cm wide,

Fig. 4. Photographs of *Boehmeria paraspicata*. **A.** Habit. **B.** Underground structure. **C.** Base stem. **D.** Middle stem. **E.** Adaxial surface of stipule. **F.** Abaxial surface of stipule. **G.** Middle leaf. **H.** Adaxial surface of leaf. **I.** Abaxial surface of leaf. **J.** Staminate inflorescence. **K.** Bud of male flower. **L.** Male flower. **M, N.** Pistillate inflorescence at flowering. **O.** Female flower. **P.** Pistillate inflorescence at fruiting. **Q.** Achene. **R.** Seeds.

base broadly cuneate or subtruncate, margin serrate-dentate, gradually larger distally, teeth 7–11 on each side, narrowly triangular to triangular, 4.6–8.6 mm long, 6.4–10.5 mm wide, apex 3- or 5-caudate, adaxial surface green, sparsely strigillose or subglabrous, densely cystoliths punctiform, midvein convex, abaxial surface yellow green, sparsely strigillose with uncinat hair or subglabrous along veins and veinlets, often thin membranous or chartaceous. **Inflorescences** axillary; staminate inflorescences unbranched or rarely branched in proximal axils, 9.6–15.6 cm long, rachis 0.3–0.7 mm in diam.; pistillate inflorescences unbranched in distal axils, 11.2–22.2 cm long, rachis 0.3–0.5 mm in diam., loosely glomerules at flowering, relatively densely glomerules at fruiting. **Flowers** unisexual; male flowers 4-merous, 3.4–4.3 mm in diam.; pedicels 0.2–1.1 mm long, green or red; perianth lobes cleft near to the middle, convex, elliptic, 0.8–1.0 mm long, 0.8–0.9 mm wide, yellow green or red, strigillose in outside; filaments 4, linear, inflexed, 1.3–1.8 mm long, white; anthers basifixed, 0.6–0.9 mm long, 0.8–0.9 mm wide, white; ovaries rudimentary, clavate; female flowers 3.3–4.4 mm long, sessile; perianth tubes obovoid or rhomboid, 1.0–1.2 mm long, 0.7–1.5 mm wide, yellow green or red, strigillose with uncinat hair; necks 2-toothed; styles 1, linear, plumose, 0.9–1.5 mm long, white or red; stamens absent. **Achenes** rhomboid or obovoid, compressed, 3.1–4.5 mm long, 2.0–2.8 mm wide, base cuneate, irregular strigillose with uncinat hair throughout the surface. **Seeds** elliptic or subcircular, 0.8–1.1 mm long, 0.6–0.9 mm wide; wings obovoid or obdeltoid, 1.3–2.0 mm long, 0.8–1.3 mm wide.

Chromosome number: $2n = 42$ (Okabe, 1963).

Phenology: Flowering June to September, Fruiting September to November.

Distribution: Korea (all provinces except Jeju Island), China, Japan.

Taxonomic note: *Boehmeria silvestrii* and *B. tricuspis* are often misidentified and confused with each other because the apex of the leaf has a 3-lobed shape. Therefore, most studies in the literature confused these two with each other (Makino, 1940, 1961, 1989; Ohwi, 1953, 1965; Kitamura and Murata, 1961; Im, 1996; Lee, 1996a, 1996b; Lee, 2003; Tateishi, 2006; Liang, 2009; Wilmot-Dear and Friis, 2013; Kim, 2018). *Boehmeria silvestrii* is clearly distinguished from *B. tricuspis* as it is subshrubs with sparsely strigillose or subglabrous stems, sparsely strigillose leaves, a lobed perianth of the male flower, an unbranched pistillate inflorescence, and an irregular strigillose achene (Figs. 5, 6). It was newly named ‘Cham-geobuk-kko-ri’ to avoid confusion with *B. tricuspis*. This taxon has a 3- or 5-lobed leaf apex, unlike other taxa of the *B. spicata* complex (Figs. 3, 5, and Table 2).

4. *Boehmeria spicata* (Thunb.) Thunb., Trans. Linn. Soc. Lond. 2: 330, 1794; *Urtica spicata* Thunb., Syst. Veg., ed. 14, 850, 1784, *pro part.*; *Durretia spicata* (Thunb.) Nakai, Bull. Natl. Sci. Mus. Tokyo. 31: 42, 1952, *nom. illeg.*—TYPE: Japan. 1984, *C. P. Thunberg 22115* (lectotype: UPS, photo!, designated by Yahara, J. Jap. Bot. 59: 130, 1984, see Fig. 1D).

B. spicata var. *tenera* Blume, Mus. Bot. 2: 220, 1857; *B. japonica* (L. f.) Miq. var. *tenera* (Blume) Friis & Wilmot-Dear, Blumea. 58: 193, 2013.—TYPE: Japan. *Unknown collector s.n., Lugd.-Bat. 908.186-164* (holotype: L).

B. spicata var. *akari* Blume, Mus. Bot. 2: 220, 1857.—TYPE: Japan. *Unknown collector s.n., Lugd.-Bat. 908.186-156* (holotype: L).

B. spicata var. *microphylla* Nakai ex Satake, J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot. 4: 483, 1936.—TYPE: Japan. Honshu, Prov. Izu, Mt. Amagi, 26 Jun 1931, *T. Nakai s.n.* (holotype: TI, photo!).

Korean name: Jom-kkae-ip-na-mu (쭝개잎나무).

Habits small shrub, monoecious or dioecious. **Stems** erect, 0.6–2.5 m tall, 1.2–3.0 mm in diam., many branched from the base, brown, often densely black pubescent, barks peeled off; branches green or red, sparsely strigillose or subglabrous. **Leaves** opposite, pairs subequal in size; stipules narrowly lanceolate, 3.9–7.0 mm long, 1.1–1.9 mm wide, yellow green, sparsely pubescent along midvein on abaxial surface; petioles 2.2–7.5 cm long, 0.5–1.0 mm in diam., green or red, sparsely strigillose; middle leaf blades rhombic to rhombic ovate, 5.7–10.5 cm long, 3.5–6.8 cm wide, base cuneate or sometimes broadly cuneate, margin serrate-dentate, gradually larger distally, teeth 4–9 on each side, narrowly triangular, 3.8–10.0 mm long, 4.9–10.5 mm wide, apex unlobed, caudate or narrowly acute, adaxial surface green, sparsely strigillose, densely cystoliths punctiform, midvein convex, abaxial surface yellow green, often sparsely strigillose with uncinat hair or subglabrous along veins and veinlets, often chartaceous. **Inflorescences** axillary; staminate inflorescences unbranched or rarely branched in proximal axils, 4.6–15.7 cm long, rachis 0.2–0.7 mm in diam.; pistillate inflorescences unbranched in distal axils, 7.7–21.4 cm long, rachis 0.3–0.5 mm in diam., loosely glomerules at flowering and fruiting. **Flowers** unisexual; male flowers 4-merous, 3.7–4.5 mm in diam.; pedicels 0.3–0.7 mm long, green or red; perianth lobes cleft near to the middle, convex, elliptic, 0.7–0.9 mm long, 1.0–1.1 mm wide, yellow green or red, strigillose in outside; filaments 4, linear, inflexed, 1.6–1.9 mm long, white; anthers basifixed, 0.8–1.1 mm long, 0.8–1.0 mm wide, white; ovaries rudimentary, clavate; female flowers 3.4–5.1 mm long, sessile; perianth tubes

Fig. 5. Photographs of *Boehmeria silvestrii*. **A.** Habit. **B.** Underground structure. **C.** Base stem. **D.** Middle stem. **E.** Adaxial surface of stipule. **F.** Abaxial surface of stipule. **G.** Middle leaf. **H.** Adaxial surface of leaf. **I.** Abaxial surface of leaf. **J.** Staminate inflorescence. **K.** Bud of male flower. **L.** Male flower. **M, N.** Pistillate inflorescence at flowering. **O.** Female flower. **P.** Pistillate inflorescence at fruiting. **Q.** Achene. **R.** Seeds.

Fig. 6. Comparative photographs of *Boehmeria silvestrii* and *B. tricuspis*. A–G. *B. silvestrii*. H–N. *B. tricuspis*. A, H. Base stem. B, I. Middle stem. C, J. Middle leaf. D, K. Staminate inflorescence. E, L. Male flower. F, M. Pistillate inflorescence. G, N. Achene.

Fig. 7. Photographs of *Boehmeria spicata*. **A.** Habit. **B.** Underground structure. **C.** Base stem. **D.** Branch. **E.** Adaxial surface of stipule. **F.** Abaxial surface of stipule. **G.** Middle leaf. **H.** Adaxial surface of leaf. **I.** Abaxial surface of leaf. **J.** Staminate inflorescence. **K.** Bud of male flower. **L.** Male flower. **M, N.** Pistillate inflorescence at flowering. **O.** Female flower. **P.** Pistillate inflorescence at fruiting. **Q.** Achene. **R.** Seeds.

obovoid, 1.1–2.1 mm long, 0.6–1.3 mm wide, yellow green or red, strigillose with uncinat hair; necks 2-toothed; styles 1, linear, plumose, 1.1–1.9 mm long, white or red; stamens absent. **Achenes** rhomboid or obovoid, compressed, 2.4–3.3 mm long, 2.0–2.6 mm wide, base cuneate, irregular strigillose with uncinat hair throughout the surface. **Seeds** elliptic or subcircular, 0.8–0.9 mm long, 0.5–0.6 mm wide; wings rhomboid-obovoid or broadly obovoid, 1.2–1.5 mm long, 0.9–1.2 mm wide.

Chromosome number: $2n = 28, 42$ (Okabe, 1963; Yahara, 1983, 1984).

Phenology: Flowering July to September, Fruiting September to November.

Distribution: Korea (all provinces), China, Japan.

Taxonomic note: This taxon is distinguished from related taxa as it is a subshrub with many branching stems at the base, peeled bark, a densely black pubescent woody stem, and a rhombic to rhombic ovate middle leaf (Figs. 3, 7, and Table 2). In addition, it is often confused with *B. paraspicata*, but it is different in terms of the habit, leaf shape, and leaf size.

Key to the *Boehmeria spicata* complex and the related taxa in Korea

1. Habits subshrub or small shrub; plants sparsely strigillose or subglabrous; midvein of leaves convex on the adaxial surface; perianth of male flowers cleft; pistillate inflorescences unbranched; perianth tube of achenes irregular strigillose throughout the surface
2. Habits subshrub with woody stem only at base; woody stems glabrous; stems a few branched; middle leaf blades not rhombic to rhombic ovate
3. Leaf apexes unlobed
 4. Middle leaf blades elliptic, broadly elliptic, ovate, or broadly depressed ovate, margin serrulate-dentate, teeth subequal distally, apex short caudate or cuspidate 1. *B. gracilis* 톱거북꼬리
 4. Middle leaf blades ovate to broadly ovate, margin serrate-dentate, teeth gradually larger distally, apex caudate or narrowly acute 2. *B. paraspicata* 풀거북꼬리
3. Leaf apexes 3- or 5-lobed 3. *B. silvestrii* 참거북꼬리
2. Habits small shrub with woody stem throughout; woody stems often densely black pubescent; stems many-branched; middle leaf blades rhombic to rhombic ovate 4. *B. spicata* 좀깨잎나무
1. Habits perennial herb; plants densely pubescent or

strigose; midvein of leaves compressed on the adaxial surface; perianth of male flowers parted; pistillate inflorescences usually branched; perianth tube of achenes strigose on apical part 5. *B. tricuspis* 거북꼬리

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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notype and evolution in *Boehmeria* Jacq. Plant Fiber and Products 25: 209–212.**Appendix 1.** Specimens examined for the *Boehmeria spicata* complex in this study.**1. *Boehmeria gracilis*.** CHINA. Guizhou: Jiangkou Xian, Heiwan River, 27 Aug 1986, *W. T. Wang & C. J. Chen* 557 (TI).JAPAN. Honshu: Kanagawa Pref., Sagami, Bijosani, 1931, *K. Hisauchi s.n.* (TI); Nagano Pref., Koshibu-yu, 4 Aug 1966, *M. Furuse* 44326 (TI); Nagano Pref., Minamisaku-gun, 11 Aug 1978, *J. Murata & H. Ohba* 5196 (TI); Nagano Pref., Minamisaku-gun, Mt. Sekibutsu, 11 Aug 1978, *J. Murata & H. Ohba* 5263 (TI); ?, 29 Jul 1939, ? *s.n.* (TI); ?, 30 Aug 1935, ? *s.n.* (TI).KOREA. Chungcheongbuk-do: Danyang-gun, Sobaeksan Mt., ? *KOSPVP0000178316* (KB); Danyang-gun, Sobaeksan Mt., Cheondong Rest Area, 26 Jun 2020, *H. J. Jo et al.* *HJ200626-002* (ANH); Jecheon-si, Deokdong Valley, 29 Aug 2019, *H. J. Jo et al.* *HJ190829-005* (ANH); Chungcheongnam-do: Cheonan-si, Gwangdeoksan Mt., 12 Sep 2016, *H. J. 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Jo et al.* *HJ190821-005* (ANH); Yeongcheon-si, Bohyeonsan Mt., 9 Jul 2019, *H. J. Jo et al.* *HJ190709-001, 002* (ANH); Yeongyang-gun, Irwolsan Mt., 23 Jul 2016, *H. J. Jo et al.* *HJ160723-001-003* (ANH); Yeongyang-gun, Irwolsan Mt., 26 Sep 2017, *H. J. Jo et al.* *HJ170926-003* (ANH); Yeongyang-gun, Ulyeonsan Mt., 18 Aug 2002, *G. Y. Chung et al.* *ANH020818-001* (ANH). Gyeongsangnam-do: Hapcheon-gun, Gaya-myeon, Gayasan Mt., 1983, *Y. M. Kim & S. K. Kim* *KNKA200005123029* (KH); Sancheong-gun, Jirisan Mt., 25 Aug 2009, *H. I. Chun et al.* *KOSPVP0000177403* (KB). Hamgyungbuk-do: Bolsang-gun, Sansa-myeon, 1 Aug 1939, *T. Nakai s.n.* (TI). Jeollabuk-do: Jangsu-gun, Jangansan Mt., Deoksan Valley, 17 Aug 2016, *H. J. Jo et al.* *HJ160817-002* (ANH); Jinan-gun, Unjangsan Mt., 9 Sep 2017, *H. J. Jo et al.* *HJ170909-001-003, 005* (ANH); Muju-gun, Deokyusan Mt., 4 Aug 1974, *J. S. Chang* 2711 (KH); Sunchang-gun, Gangcheonsan Mt., 8 Jul 2019, *H. J. 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