

Additional remarks on Ranunculaceae in Taiwan (4) The genus *Cimicifuga* L. ex Wernisch.

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Abstract. The present work is a taxonomic study of *Cimicifuga* L. ex Wernisch. (Ranunculaceae) in Taiwan. The morphological and palynological characters of one species, *C. simplex* (DC.) Wormsk. ex Turcz., are presented. The taxonomic description and a distribution map of this taxon in Taiwan are given.

Keywords: *Cimicifuga*; *Cimicifuga simplex*; Morphology; Palynology; Ranunculaceae; Taiwan; Taxonomy.

Introduction

There are approximately eighteen species of *Cimicifuga* worldwide. The genus *Cimicifuga* was not recorded in the account of Ranunculaceae in the Flora of Taiwan (Liu and Hsieh, 1976). Ou (1976) reported the presence of *Cimicifuga simplex* on Taiwan, based on a herbarium sheet collected as early as 1925 by Japanese botanists from Nantou Hsien. In 1984, the first author of the present paper re-collected *C. simplex* from Taichung Hsien. Subsequently, a few other collections were made of this apparently rare species from the central mountain ranges of this island (see below). In our paper, we present morphological and palynological studies and document the distribution of *C. simplex* in Taiwan. A line drawing is provided to facilitate recognition of this species. Nomenclature of this species follows the treatment of Compton and Jury (1995).

Materials and Methods

The materials were taken from living plants and herbarium collections. Scanning electron photomicrographs were made with a Bausch & Lomb Nanolab 2100 (National Chung-Hsing University, Taichung) and a Hitachi S2300 (Tunghai University, Taichung).

Morphological Characters

Three largest mature leaflets of living specimens collected in the wild were chosen for examination. Herbarium specimens or dehydrated fresh materials were coated with gold for SEM study. The leaf surface, stomatal complex, trichomes, and carpels were observed and described.

Palynological Characters

The anthers were dissected from fresh flowers with a pair of fine forceps and a mounted needle. They were then placed on double-sided cello tape on a stub under a dissecting microscope. The anther fragments were drawn to one side, leaving the pollen grains together in the middle. The pollen grains were coated with gold for about 3 min, then SEM observations were made at magnifications from 3,000 to 15,000.

Results and Discussion

Morphological Characters

The surfaces of the leaflets on the adaxial side can be defined as striate (Figure 1A and B) and smooth (Figure 1C) on the abaxial side. The shape of the stomatal complexes is elliptic and the size is 35.2–44.8 μm long and 29.3–32.8 μm wide. The outer stomatal rim is raised with fine, radiating striations (Figure 1C). The trichomes are linear, filiform simple hairs, with both long and short types, and the surface of the trichomes is finely striate (Figure 1D).

The stomatal complexes are anomocytic in the Ranunculaceae—there are no distinct subsidiary cells—and the genus *Cimicifuga* is hypostomatic, with a high percentage of stomata occurring on the abaxial surface. Sometimes, stomata can be found in reproductive organs, such as the carpel, but there they are smaller (Figure 1E).

Palynological Characters

Grains are tricolpate (Figure 1F and G); the size in polar view is 26.8–29.2 μm long, and in equatorial view is 26.9–27.8 μm long; the apocolpium diameter is 8.4–10.6 μm and colpus width is 3.2–4.5 μm ; the colpus end is acute; the colpus membrane is spinulose. The value of

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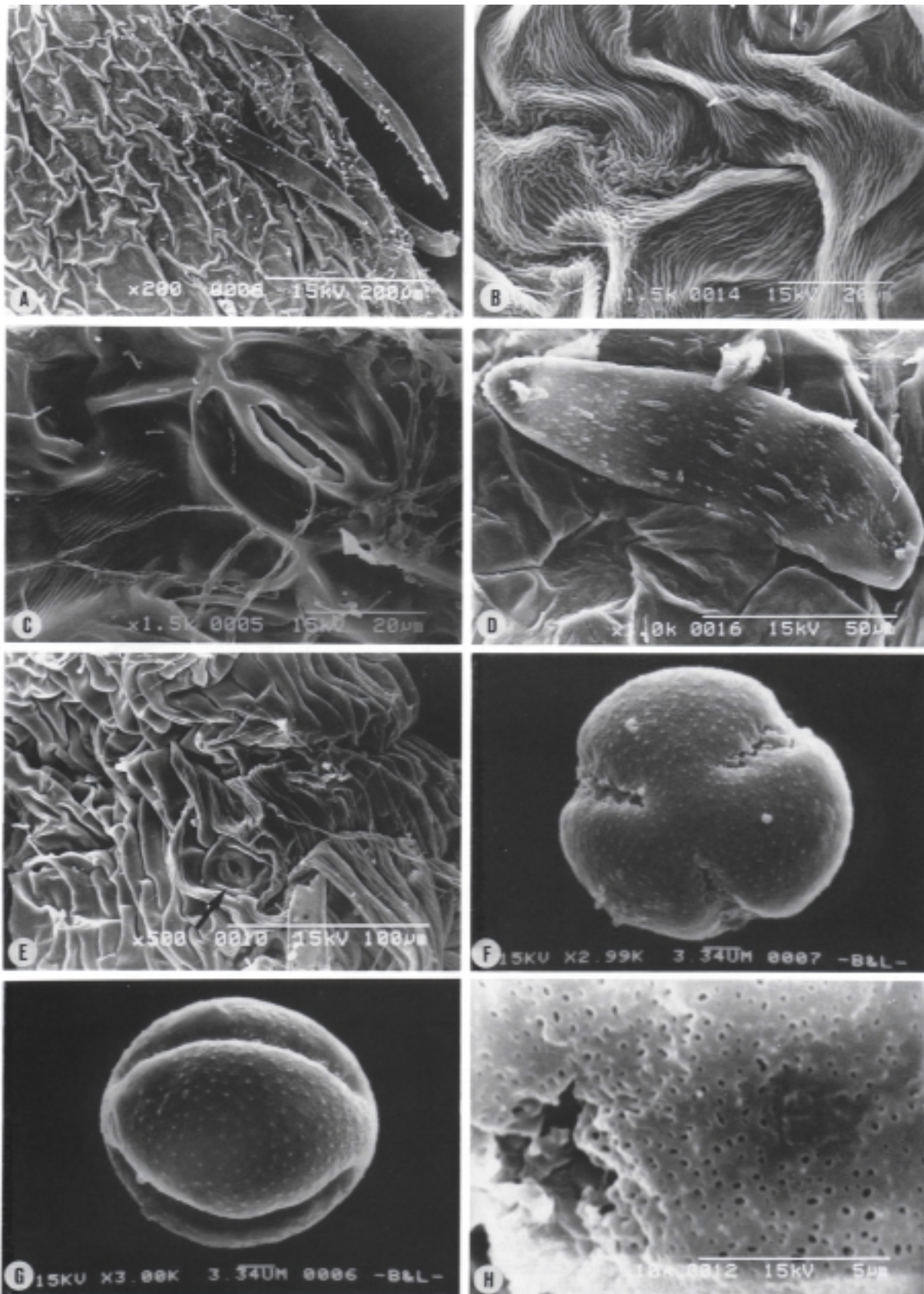


Figure 1. SEM micrographs of *Cimicifuga simplex*. A–C, surface of the leaflets: A and B, adaxial side; C, abaxial side; D, surface of the trichome on the follicle; E, surface of carpel, arrow showing the stoma; F–H, tricolpate pollen grains. F, polar view; G, equatorial view; H, irregular perforation. (All from Yang *et al.* 416)

P.V./E.V is 99.6–105; the shape is oblate spheroidal to prolate spheroidal; irregular perforations are present (Figure 1H); the exine is 1–2 μm thick, sexine and nexine are almost equal to each other.

Kumazawa (1936) divided the family Ranunculaceae into four pollen types, viz., type O, which is inaperturate; type I, which is tricolpate with occasionally 6 to 8 colpi; type II, which is polyaperturate, and type III, which is polyaperturate. The genus *Cimicifuga* has type I pollen, the majority of which are tricolpate. Wang et al. (1993) and Xi and Ning (1993) examined members of tribe Cimicifugeae in China. Wang et al. recognized that pollen grains of *C. simplex* had numerous spines and perforations, and Xi and Ning indicated that all grains in the genus *Cimicifuga* were tricolpate. The second author of the present paper, however, has found species with pantocolpate and pantoporate grains. Xi and Ning's description of *C. simplex* collected in mainland China was similar to that of those collected in Taiwan, except the size in polar view (29.6–34.8 μm) was bigger than that of those in Taiwan.

Taxonomic Treatment

***Cimicifuga simplex* (DC.) Wormsk. ex Turcz., Bull. Soc. Imp. Naturalistes Moscou 15(1): 87. 1842; Komarov, Act. Hort. Petrop. 22: 301. 1903; Sugawara, Ill. Fl. Saghal. 2: 883, t.412. 1939; Hsiao, Fl. Reip. Pop. Sin. 27: 97. 1979.—*Actaea cimicifuga* var. *simplex* DC., Prodr. 1: 64. 1824.—*C. foetida* var. *simplex* (DC.) Regel, Tent. Fl.-Ussur. 13. 1861.—*C. simplex* var. *ramosa* Maxim. ex Franch. & Sav., Enum. Pl. Jap. 1: 13. 1875, nom. illeg.—*Actaea simplex* (DC.) Prantl, Bot. Jahrb. Syst. 9: 246. 1887.—*Thalictrodes simplex* (DC.) Kuntze, Revis. Gen. Pl. 1: 4. 1891.—*C. simplex* (DC.) var. *typica* Nakai, Bot. Mag. (Tokyo) 30: 145. 1916.—*C. ramosa* Nakai, Cat. Sem. Spor. Hort. Bot. Univ. Imp. Tokyo: 15. 1932, nom. illeg.**

***Cimicifuga foetida* var. *intermedia* Regel, Reis. Ostsib. 1(1): 122. 1862.—*C. simplex* var. *intermedia* (Regel) Nakai, Bot. Mag. (Tokyo) 30: 146. 1916.—*C. cimicifuga* var. *intermedia* (Regel) Graebn. & P. Graebn., Syn. Mitteleur. Fl. 5(2): 632. 1926.**

***Cimicifuga ussuriensis* Oett., Trudy Bot. Sada Imp. Yur'evsk. Univ. 6: 138. 1906.**

***Cimicifuga taquetii* H. Lév., Repert. Spec. Nov. Regni Veg. 9(11): 448–449. 1911.**

Figures 2 and 3

A perennial deciduous woody shrub, ca. 100–150 cm tall. Rhizome strong, black. Stem round, shallowly sulcate, glabrous or nearly so below inflorescence. Leaves bi- or tripinnately triternate, chartaceous; petioles ca. 7.5–30 cm long, sparsely pubescent, glabrous or nearly so, with an extended membrane sheathing the base, sparsely pubescent. Leaflets 9–27 or more, terminal leaflet ca. 35–85 mm long, 20–55 mm wide, broadly ovate, ovate, elliptic or obovate; apex acuminate; base obtuse, truncate or acute;

3-lobed; margin serrate or coarsely serrate; glabrous or nearly so on adaxial surface, sparsely pubescent on abaxial surface at least along nerves and margin; mainveins 1–3, nerves flat or sunken on adaxial side and elevated or flat on abaxial side; petiolulate. Inflorescence racemose, usually simple, or with 2 or 3 or more short basal branchlets, terminal or axillary; pedicels ca. 3–8 mm long, elongating after anthesis, ca. 5–13 mm long, alveolulose; bracts chartaceous, glabrous; bracteoles 3, subulate, glabrous. Flowers ca. 5–8 mm diameter, white. Sepals 4, ca. 3.5–5 mm long, 2–3 mm wide, broadly ovate-elliptic, glabrous on both sides except with very sparsely pubescent margins. Stamens numerous, ca. 3.5–7.5(–10) mm long, glabrous; anthers oblong, with lateral longitudinal dehiscence; connective shorter than the pollen sacs; filaments linear, with 1 central nerve. Staminodes 2, rarely 3, ca. 4.6–6.5 mm long, 2–3 mm wide, cupuliform, broadly elliptic or ovate, glabrous on both sides, apex bilobed, nectary at the base, stipe with three nerves. Carpels 2–8, ca. 3–5 mm long, pubescent, except style glabrous; ovaries long stipitate, ca. 0.8–1.5 mm long. Fruits ca. 70–130 mm long, follicles oblong, dark brown, sparsely pubescent; stipes elongating after anthesis, ca. 2–4 mm long. Seeds 4–8, elliptical, brown, ca. 1.3–2 mm long, with extended membranaceous scales from the sides.

Distribution. Distributed around southwest, central and northeast China (Sichuan, Hubei, Shaanxi, Gansu, Inner Mongolia, Hebei, Henan, Liaoning, Jilin, and Heilongjiang provinces), Mongolia, eastern Siberia, Korea and south to Taiwan. In Taiwan, it is represented in the Central Mountains ca. 2,200–3,200 m altitude in open lands or forest margins. Flowering late July to early October; fruiting late August to November.

Additional Specimen Examined. MAINLAND CHINA. JILIN: Mt. Changbaishan, 1800 m, B.B. Wan & Chow 81065 (K). HENAN: Lushi Hsien, Laochungshan, K.M.

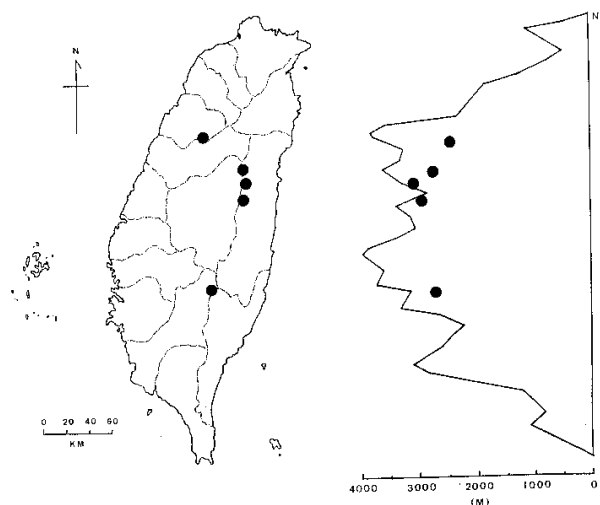


Figure 2. Latitudinal and altitudinal distribution of *Cimicifuga simplex* in Taiwan.

Liou 5350 (K). HUBEI: *A. Henry 6073* (K), *E.H. Wilson 1629* (K), *1675* (K), *2592* (K); Ichang, *A. Henry 4903* (K), *4935* (K). SICHUAN: Omei, Mt Omei, *E.H. Wilson 4713* (K). TAIWAN. MIAOLI HSIEN: Mt. Chungshueshan, 2400 m, *T.C. Huang 10286* (TAI), 2500 m, *T.Y. Yang & Huang et al. 416* (HAST, K, RNG, TAI, TNU, TUNG, National Museum of Natural History, Taichung, Taiwan), *Yang & Yang 5878* (TAI, TUNG, National Museum of Natural History, Taichung, Taiwan). NANTOU HSIEN: Mt. Nenkaochushan, Nov 1925, *Y. Saito & Kikuchi, s.n.*

(TCF). KAOHSIUNG HSIEN: South Cross Highway, *B. & S. Wynn-Jones 343* (priv. herbarium), 2728 m, *B. & S. Wynn-Jones 1486* (priv. herbarium). HUALIEN HSIEN: Mt. Chilaishan, 2870 m, *K.F. Chung 46* (TAI), Mt. Chilaichushan, Nov 1925, *Y. Saito & Kikuchi s.n.* (TCF). KOREA: N. Kankyo, *E.H. Wilson 8984* (K).

Notes. *Cimicifuga simplex* is distinguished by the sometimes simple, elongate terminal raceme on the inflorescence, the white, cupuliform staminodia with deeply bifid

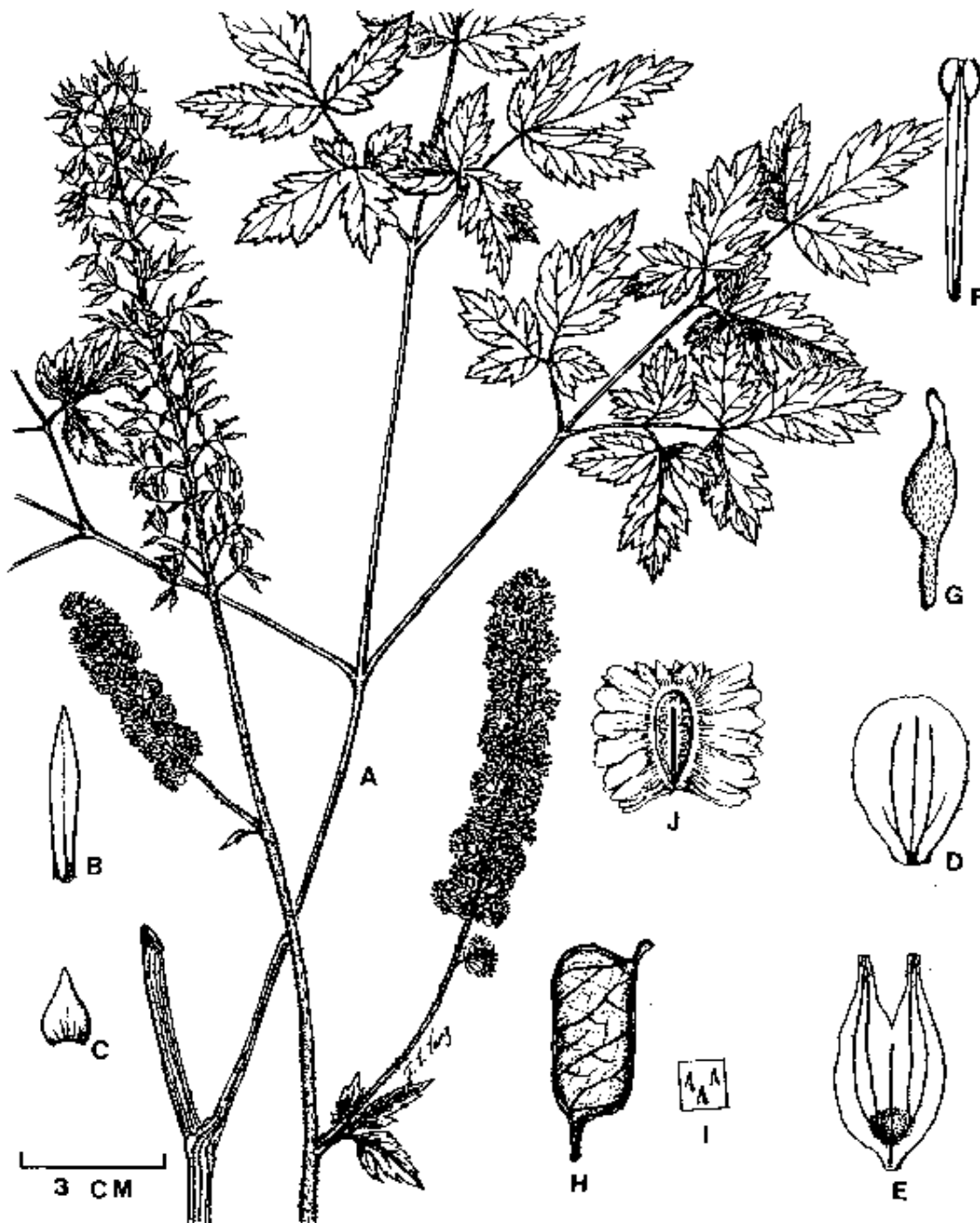


Figure 3. *Cimicifuga simplex* (DC.) Wormsk. ex Turcz. A, habit; B, central bracteole; C, lateral bracteole; D, sepal; E, staminode; F, stamen; G, immature carpel; H, fruit; I, pubescence on the fruit; J, seed.

lobes, the three short deltoid-acute bracteoles subtending the pedicels and long stipitate carpels, which elongate after anthesis. All other Asian species of *Cimicifuga* possess short stipitate carpels, paniculate inflorescence, or if simple, then virgate with entire or emarginate staminode lobes.

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台灣毛茛科植物之新見 (4) 升麻屬

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本文為台灣毛茛科升麻屬 (*Cimicifuga* L. ex Wernisch.) 植物之分類學研究。文中除了對本省產之單穗升麻 (*C. simplex*) 進行形態學及花粉學的觀察，並附其分類描述、繪圖及在台灣之分佈圖。

關鍵詞：升麻屬；單穗升麻；形態學；花粉學；毛茛科；台灣；分類學。