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Aconitum shennongjiaense (Ranunculaceae), a new species from Hubei, China

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ABSTRACT. *Aconitum shennongjiaense* Q. Gao & Q. E. Yang, a new species of the Ranunculaceae from Shennongjia, northwestern Hubei, China, is described and illustrated. The new species is similar to *A. kirinense* Nakai in having yellow flowers and cylindrical helmets, but differs by the inflorescence axis and the pedicels densely golden villous with rough-surfaced patent hairs, the helmet higher and narrower, the spur of petals longer and obviously recurved or circinate, the ovary densely golden villous with rough-surfaced ascending hairs, and the seeds brown, obovoid, transversely lamellate, not alate. The chromosome number of the new species was counted to be $2n = 16$, and the karyotype was formulated as $2n = 2$ m + 6 sm + 8 st. A color plate, line drawings, distribution map, and SEM microphotographs of the pubescence of pedicels, of lateral sepals and of ovaries are given for the new species.

Keywords: *Aconitum barbatum*; *Aconitum kirinense*; *Aconitum shennongjiaense*; *Aconitum wangyedianense*; Chromosome number; Karyotype; New species; Taxonomy.

INTRODUCTION

When examining the specimens of *Aconitum* L. subgenus *Lycoctonum* (DC.) Peterm. (Ranunculaceae) for the first author's Ph.D. project on the systematics and evolution of this subgenus, a gathering, *Shennongjia Plant Expedition 22332* (PE), made from the Shennongjia Nature Reserve, northwestern Hubei, China, caught our attention. The two sheets of the gathering, both in fruit, had been previously identified as *A. kirinense* Nakai var. *australe* W. T. Wang. Upon closer examination, we found that the plant was strikingly different from the three varieties under *A. kirinense*, var. *kirinense*, var. *australe*, and var. *heterophyllum* W. T. Wang, by the inflorescence axis and the pedicels all densely golden villous with patent hairs. In the three varieties of *A. kirinense*, the inflorescence axis and pedicels are white strigose with curved hairs. In July 2006, we made a field trip to the Shennongjia Nature Reserve and successfully found a flowering population of the plant under question. The population was found to be similar to *A. kirinense* in having yellow flowers and cylindrical helmets, but differs by the inflorescence axis and pedicels densely golden villous with rough-surfaced patent hairs, the helmet higher and narrower, the spur of petals longer and obviously recurved or circinate, the ovary densely golden villous with rough-surfaced ascending hairs, and the seeds brown, obovoid, transversely lamellate, not alate, and thus represents a hitherto undescribed species.

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NEW SPECIES

Aconitum shennongjiaense Q. Gao & Q. E. Yang, sp. nov.—TYPE: CHINA. Hubei Province, Shennongjia Nature Reserve, elev. 1,650 m, on grassy slope along evergreen broad-leaved forest margin in a ravine, abundant, 29 July 2006, *Qi Gao & Y. S Chen 62* (holotype: PE). 神農架烏頭 Figures 1-3

Aconitum shennongjiaense simile A. kirinensi Nakai floribus flavis et casside cylindrica, sed a quo differt axe inflorescentiae et pedicellis dense patenterque aureo-villosis, villis superfacie scabridis, casside altiore et angustiore, 2.0-2.5 cm longa, prope medium 2.6-3.6 mm crassa, calcari petali 1.5-2-plo longiore quam labio, distincte recurvato vel circinato, ovariis dense aureo-villosis, villis ascendentibus, seminibus obovoideis, transverse lamellatis exalatis.

Herbs perennial, ca. 2 m tall. *Rhizomes* slender, fascicled and terete, up to ca. 11 cm long, 6-10 mm in diameter. *Stem* erect and branched, densely golden villous with rough-surfaced patent hairs. *Basal leaves* 2-4, and proximal cauline leaves long petiolate; petiole 12-27 cm long, densely golden villous with rough-surfaced

Figure 1. Photograph of the holotype of *Aconitum shennongjiaense* Q. Gao & Q. E. Yang (*Qi Gao & You-sheng Chen 62*, PE).

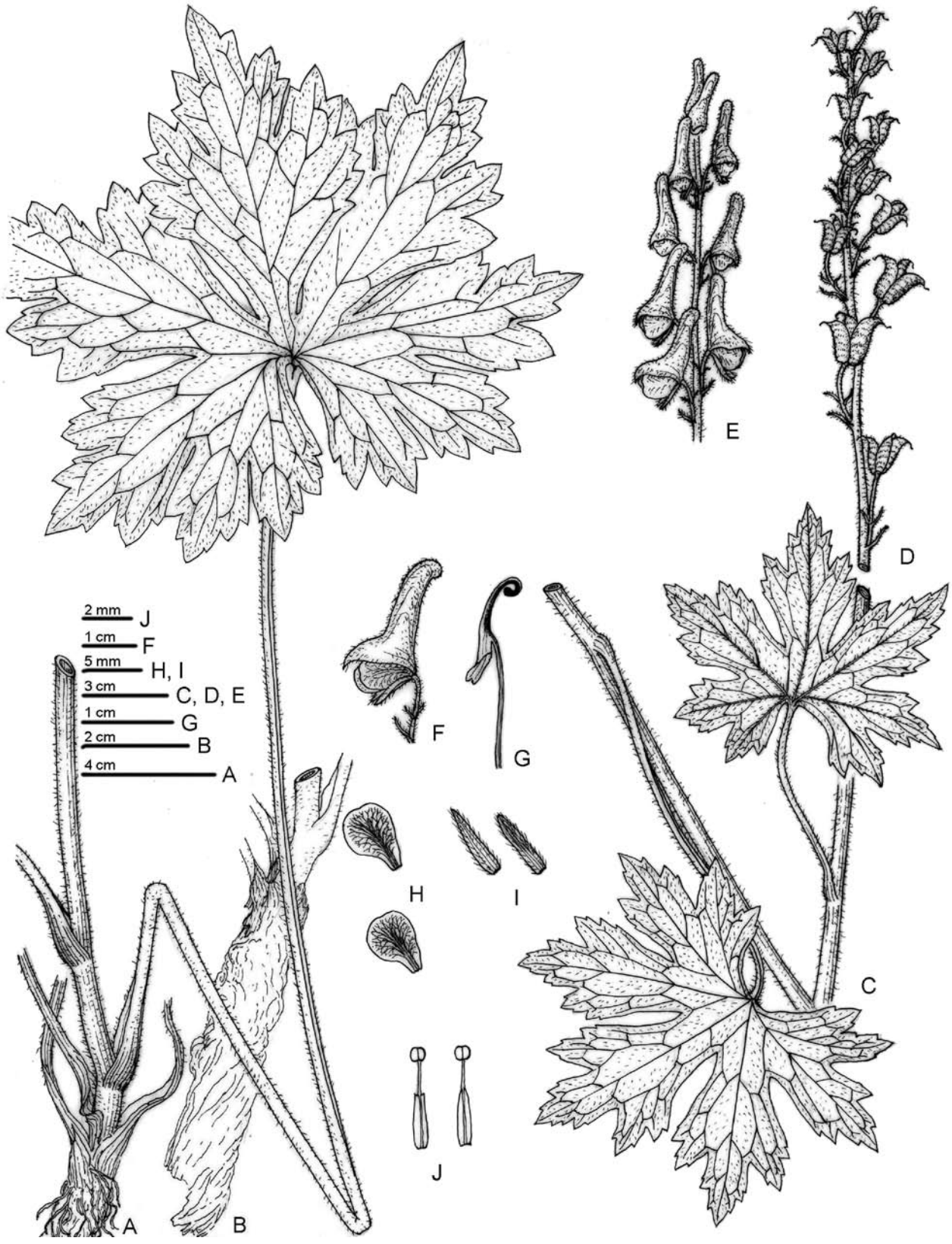

Figure 2. *Aconitum shennongjiaense* Q. Gao & Q. E. Yang. A, Lower part of plant and basal leaf; B, Rhizome; C, Upper part of plant; D, Infructescence; E, Inflorescence; F, Flower; G, Petal; H, Lateral sepals; I, Lower sepals; J, Stamens. All from *Qi Gao & You-sheng Chen 62* (PE).

patent hairs; leaf blade reniform-pentagonal, 7-14 cm long, 11-22 cm wide, densely golden villous with rough-surfaced patent hairs on both sides, 3-parted; central lobe indistinctly 3-parted or toothed with blunt mucronulate or sometimes acute teeth; lateral lobes unequally 3-fid below middle. *Inflorescences* terminal and axillary, racemose, 10-20 cm long, flowers 10-20; rachis and pedicels densely golden villous with rough-surfaced patent hairs; proximal bracts leaflike, others linear, 3-4 mm long. Pedicels 0.6-2.9 cm long, with 2 bracteoles at middle or above; bracteoles linear, 3-4 mm long. *Flowers* bisexual, zygomorphic; sepals 5, yellowish-green or yellow, densely golden villous with rough-surfaced patent hairs outside; lower sepals 2, one lanceolate and one oblong, ca. 8 mm

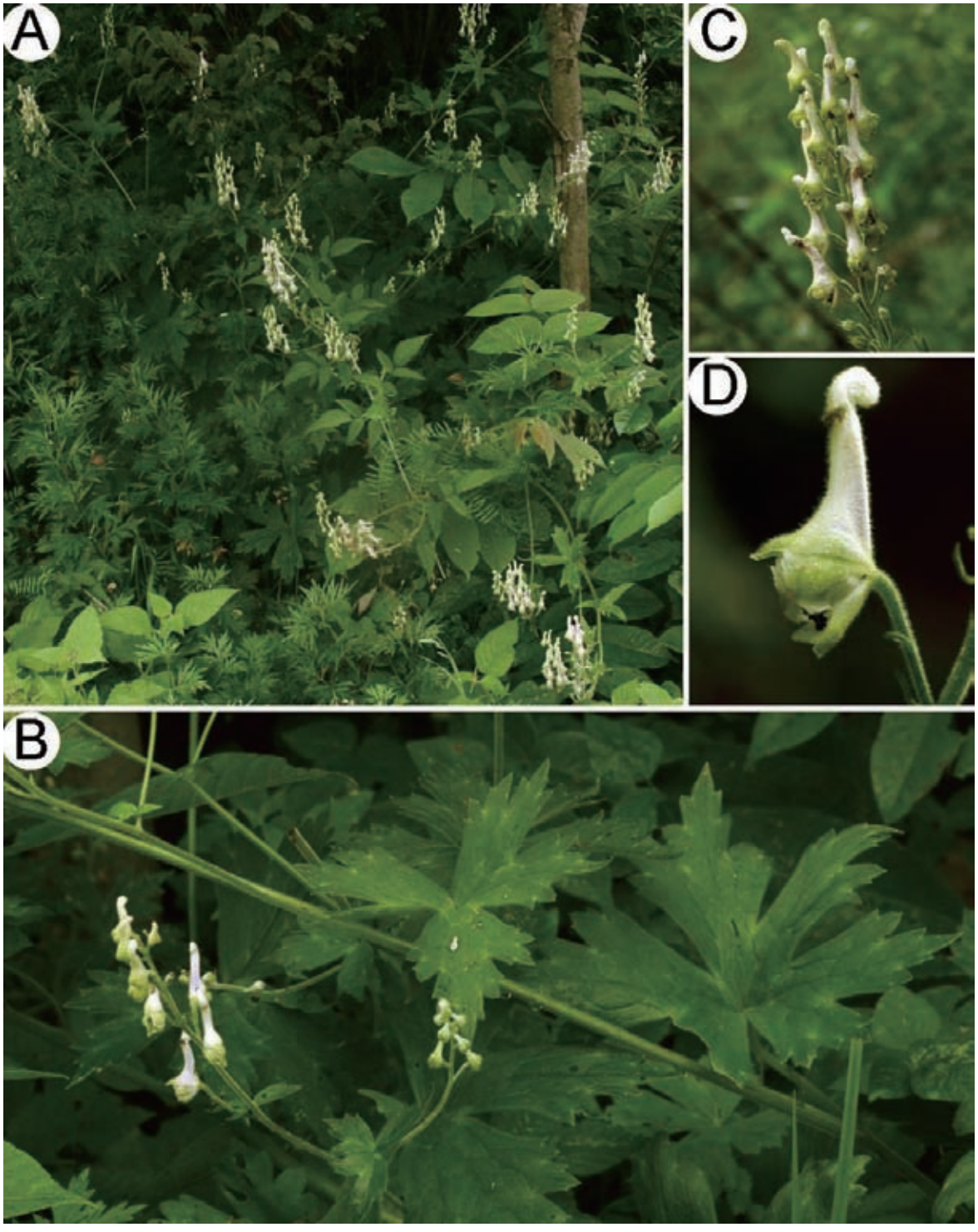

Figure 3. *Aconitum shennongjiaense* Q. Gao & Q. E. Yang. A, Habitat; B, Habit; C, Inflorescence; D, Flower. All from *Qi Gao* & *You-sheng Chen 62* (PE).

long; lateral sepals 2, broadly obovate, ca. 8 mm long; helmet cylindrical, 2.0-2.5 cm high, middle 2.6-3.6 mm in diameter, erect or slightly curved, clearly beaked, lower margin 0.7-1.4 cm long. Petals glabrous; spur recurved or circinate, 1.5-2 times as long as lip. Stamens glabrous; filaments usually entire, rarely 2-denticulate. *Carpels* 3; ovary densely golden villous with rough-surfaced ascending hairs. *Follicles* 1.1-1.8 cm long. *Seeds* numerous, brown, obovoid, ca. 3 mm long, shallowly lamellate, not alate. Somatic chromosome number, $2n = 16$ (Figure 8).

Additional specimens examined. **CHINA.** Hubei Province, Shennongjia Nature Reserve, Songluo, 19 August 1976, *Shennongjia Pl. Exped. 22332* (PE).

Ecology. On grassy slope along evergreen broad-leaved forest margin in a ravine, elev. 1,650 m.

Distribution. Northwestern Hubei, China (Figure 7), rare, currently only known from two localities in Shennongjia Nature Reserve.

Etymology. The specific epithet is derived from the type locality, Shennongjia Nature Reserve, northwestern Hubei Province, China.

Phenology. Flowering in July; fruiting from July to August.

Chromosome cytology. For chromosome observation, actively growing root tips were pretreated in 0.1% colchicine for 2.5 h at room temperature and then fixed in Carnoy I (3 ethanol:1glacial acetic acid). They were macerated in 1:1 mixture of 1 N HCL and 45% acetic acid at 60°C for 4 min, and stained and squashed in 1% aceto-orcein.

Karyotype formula was based on measurements of metaphase chromosomes taken from photographs. The symbols used to describe the karyotypes followed Levan et al. (1964): m = median centrometric chromosome with arm ratio of 1.0-1.7; sm = submedian centromeric chromosome with arm ratio of 1.7-3.0; st = subterminal centromeric chromosome with arm ratio of 3.0-7.0.

The chromosomes of *Aconitum shennongjiaense* were counted to be $2n = 16$ (Figure 8) and the karyotype was formulated as $2n = 2$ m + 6 sm + 8 st (Figure 8). The new species is not essentially different from its allied species *A. kirinense* in chromosome number and morphology. In fact, the karyotypes of all the diploid species with available karyotypic data in the subgenus, such as *A. alboviolaceum* Kom., *A. finetianum* Hand.-Mazz., *A. longecassidatum* Nakai, *A. sinomontanum* Nakai, *A. leucostomum* Vorosch., *A. monticola* Steinb., *A. scaposum* Franch., *A. septentrionale* Koelle, *A. umbrosum* (Korsh.) Kom., and *A. barbatum* Pers., are very similar to each other, commonly consisting of one pair of m chromosomes, three pairs of sm chromosomes and four pairs of st chromosomes (Sakai, 1933; Shang and Lee, 1984; Yang et al., 1993; Yang, 1996, 2001; Yuan and Yang, 2006; Gao and Yang, unpublished).

Notes. *Aconitum shennongjiaense* is similar to *A. kirinense* in having yellow flowers and cylindrical helmets, differing in the inflorescence axis and the pedicels densely golden villous with rough-surfaced patent hairs (Figure 5C, E, G) (vs. strigose with rough-surfaced curved hairs, Figure 5D, F, H); the helmet 2.0-2.5 cm high (vs. 1.6-2.1 cm), 2.6-3.6 mm broad (vs. 3.0-5.0 mm); the abaxial side of lateral sepal densely golden villous with rough-surfaced patent hairs (Figure 5A) (vs. strigose with rough-surfaced curved hairs, Figure 5B); the spur of petals recurved or circinate, 1.5-2 times as long as lip (Figure 4A) (vs. erect or slightly recurved, subequaling or slightly shorter than lip, Figure 4E); the ovary densely villous with rough-surfaced ascending hairs (Figure 4C, D) (vs. densely villous with rough-surfaced appressed hairs, Figure 4G,

Figure 4. Comparison of petals, seeds, carpels, and ovary pubescence of *Aconitum shennongjiaense* Q. Gao & Q. E. Yang (A-D) and *Aconitum kirinense* Nakai var. *australe* W. T. Wang (E-H). A, E, Petals; B, F, Seeds; C, G, Carpels; D, H, Scanning electron micrographs of ovary pubescence. A-D from *Qi Gao & You-sheng Chen 62* (PE); E-H from *Qi Gao 88* (PE).

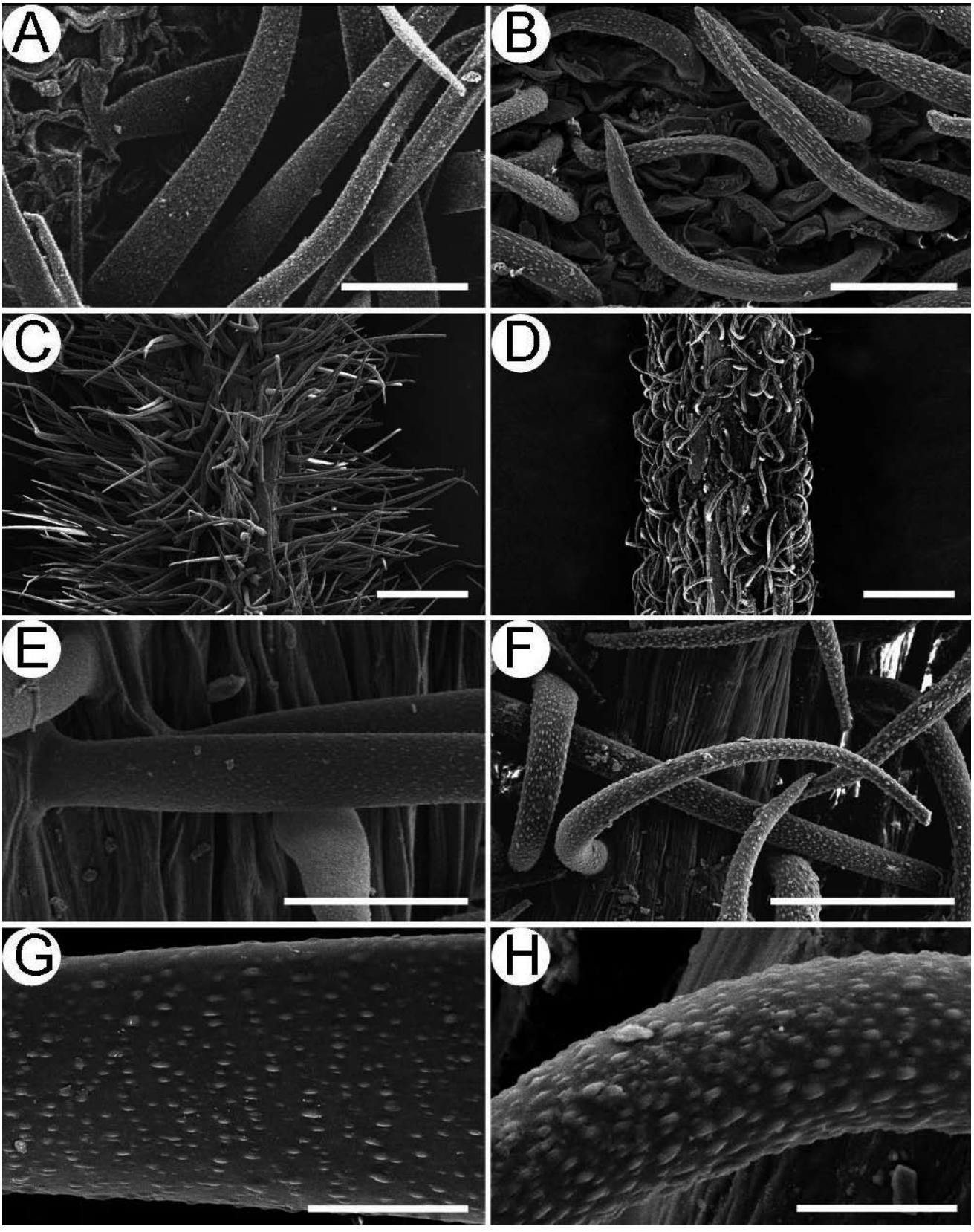

Figure 5. Comparison of hair morphology of *Aconitum shennongjiaense* Q. Gao & Q. E. Yang (A, C, E, G) and *A. kirinense* Nakai var. a*ustrale* W. T. Wang (B, D, F, H). A, Rough-surfaced patent hairs on the abaxial side of lateral sepal; B, Rough-surfaced curved and appressed hairs on the abaxial side of lateral sepal; C, E, G, Rough-surfaced patent hairs on pedicel; D, F, H, Rough-surfaced curved and appressed hairs on pedicel. Scale bar = 100 μm (A, B, E, F); 500 μm (C, D); 20 μm (G, H). A, C, E, G from *Qi Gao & You-sheng Chen 62* (PE); B, D, F, H from *Qi Gao 88* (PE).

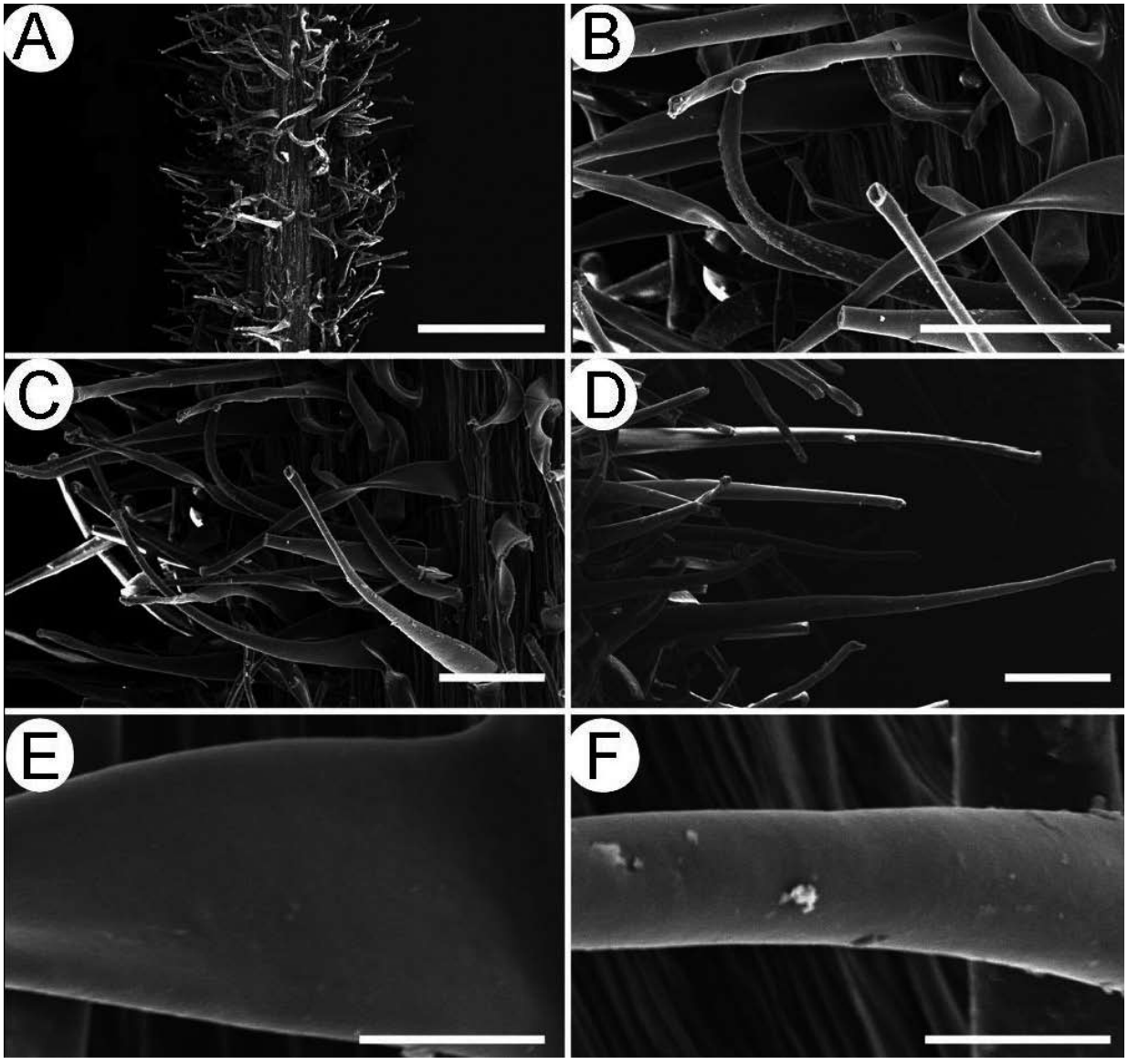

Figure 6. Scanning electron micrographs of pedicel pubescence of *Aconitum wangyedianense* Y. Z. Zhao. A, Pedicel pubescence; B, Mixture of rough-surfaced curved hairs and smooth-surfaced glandular hairs; C, E, Smooth-surfaced glandular hairs; D, F, Smooth-surfaced patent hairs. Scale bar = 500 μm (A); 100 μm (B-D); 20 μm (E, F). All from *Xi-ting Lei & Wen-sheng Yang 89* (PE).

H); the seeds brown and obovoid without transverse membranous wings (Figure 4B) (vs. white and triangular-pyramidal obviously with transverse membranous wings, Figure 4F).

Aconitum shennongjiaense is also similar to *A. barbatum*, a species itself most closely similar to *A. kirinense* in all characters but the degree of leaf division (Tamura and Lauener, 1979). Although Tamura and Lauener (1979) accepted that *A. kirinense* can be distinguished from *A. barbatum* by having less deeply divided leaves, they pointed out that there are specimens intermediate between the two species. In fact, Handel-Mazzetti (1939) once reduced *A. kirinense* to *A. barbatum*. The relationship between the two species needs a further study.

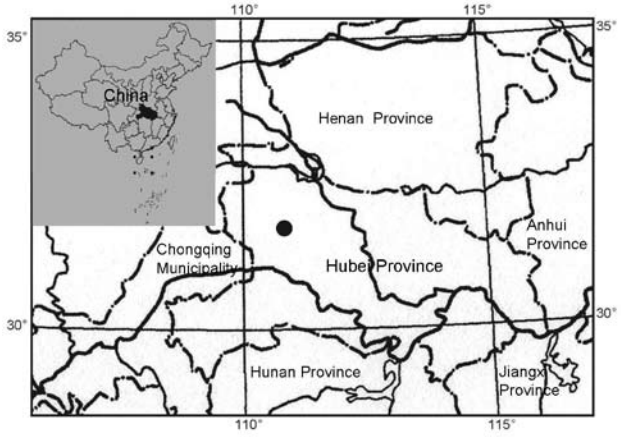

Figure 7. Distribution of *Aconitum shennongjiaense* Q. Gao & Q. E. Yang (circle) in Hubei, China.

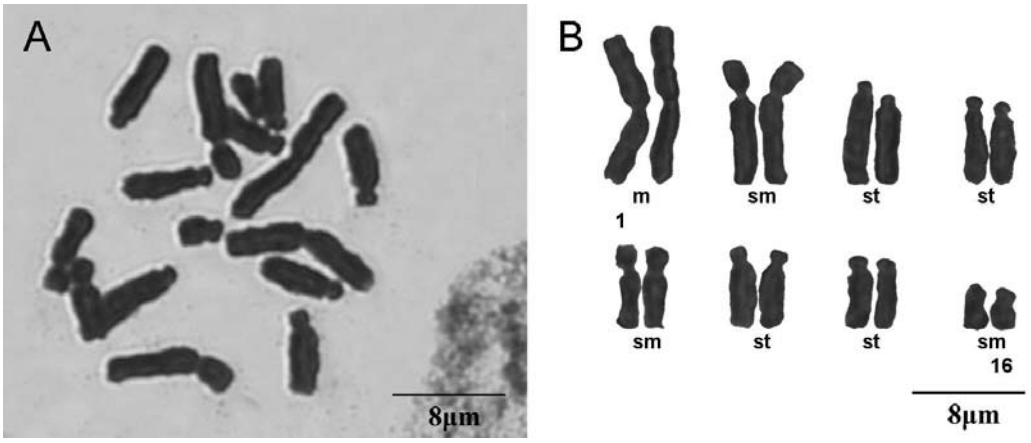

Figure 8. Somatic chromosomes at mitotic metaphase in *Aconitum shennongjiaense* Q. Gao & Q. E. Yang. A, Photomicrograph of metaphase chromosome, 2*n* = 16; B, Karyotype, 2*n* = 2 m + 6 sm + 8 st. All from *Q. Gao & You-sheng Chen 62* (PE).

In the yellow-flowered and cylindrical-helmeted Chinese species of *Aconitum* subgenus *Lycoctonum*, *A. wangyedianense* Y. Z. Zhao, a species occurring in Inner Mongol, was described to have pedicels covered with short yellowish patent hairs. As shown in Figure 6, the pedicels of *A. wangyedianense* are predominantly covered with smooth-surfaced glandular hairs, mixed with a few smooth-surfaced patent hairs and rough-surfaced curved hairs. Furthermore, *A. wangyedianense* is also different from *A. shennongjiaense* by having glabrous ovary. It should be noted that, as pointed out by Li and Kadota (2001), *A. wangyedianense* is currently only known from its type material and may be conspecific with *A. monticola* Steinb., so further study is necessary to determine its identity.

Interestingly, the pedicels of *Aconitum mashikense* Kadota, a Japanese species described by Kadota (2001), were also reported to be golden villous with rough-surfaced patent hairs only. Kadota (2001) pointed out that this species is the only representative with such pedicel pubescence in the genus *Aconitum* from East Asia. Our new species, *Aconitum shennongjiaense*, represents the second species with such pedicel pubescence in this genus from the region.

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中國湖北產烏頭屬一新種：神農架烏頭

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本文描述了中國湖北西北部產烏頭屬一新種 : 神農架烏頭（*Aconitum shennongjiaense* Q. Gao & Q. E. Yang）。本新種與吉林烏頭（*A. kirinense* Nakai）相似，花黃色，盔圓筒形，但花序軸和花梗密被開展的金黃色粗糙長柔毛、盔較細高、花瓣較長且明顯後彎或拳卷，子房密被上升的金黃色粗糙長柔毛，以及種子褐色、倒卵形、有橫皺但無翅而明顯有別。其體細胞染色體數目爲 $2n = 16$，核型爲 $2n = 2\ m + 6\ sm + 8\ st$。本文提供了神農架烏頭的彩色圖版、線繪圖、地理分佈圖以及花梗毛被、側萼片毛被和子房毛被的電顯圖。

關鍵詞 ： 細葉黃烏頭 ； 吉林烏頭 ； 神農架烏頭 ； 旺業甸烏頭 ； 染色體數目 ； 核型 ； 新種 ； 分類學。