

Three new species of *Asarum* (section *Heterotropa*) from Taiwan

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ABSTRACT. Three new species of *Asarum* L. sect. *Heterotropa*: *A. chatiense* C. T. Lu & J. C. Wang, *A. tawushanense* C. T. Lu & J. C. Wang, and *A. villisepalum* C. T. Lu & J. C. Wang, from Taiwan are described and illustrated. The somatic chromosome number and micromorphology of pollen grains of all of them were also examined. The somatic chromosome number in all three species is $2n=24$. The tectum of the pollen is rugulate-perforate with large supratectate warts in *A. tawushanense* and *A. villisepalum* but composed of perforated subunits in *A. chatiense*. *Asarum chatiense* and *A. villisepalum* are similar to *A. macranthum* Hook f. in gross morphology, but differ in floral morphology. *Asarum chatiense* has greenish yellow flowers, a longer cylindrical calyx tube and the apex of the styles is bilobed. *Asarum villisepalum* is distinguished by dark maroon flowers, the densely white villous adaxial surface of the calyx lobes, and the internal surface of the calyx tube with 12 and 24 longitudinal ridges on the upper and lower part respectively. *Asarum tawushanense* resembles *A. hypogynum* Hayata, but is distinguishable in having a short cylindrical calyx tube and smaller dark purple flowers. Descriptions, illustration and a synoptic key are provided for comparison with other species of *Asarum* in Taiwan.

Keywords: *Asarum*; Aristolochiaceae; Chromosome number; *Heterotropa*; Pollen; Taiwan.

INTRODUCTION

Asarum L., s.l., (Aristolochiaceae), contains about 90 species distributed in the north temperate zone, with the center of diversity in eastern Asia (Huang et al., 2003). *Asarum* is often split into several genera; *Heterotropa* Morren & Decne., *Hexastylis* Raf., *Asiasarum* Maekawa, *Japonasarum* Nakai, and *Geotaenium* Maekawa. The study by Kelly (1998) supported recognition of two subgenera, *Asarum* and *Heterotropa*, and that treatment is adopted here (1998).

Most species of *Asarum* are low-growing, rhizomatous herbs in shaded, moist, broadleaved forests. The floral characteristics are diverse, but the extremely conservative gross morphology of the species has resulted in confusion. Floral characters are difficult to determine in dried specimens. Since Hayata's (1915) pioneering work, the treatments of *Asarum* in Taiwan have been incongruous, with from 5 to 13 species being recognized (Lai, 1973; Wu et al., 1974; Liu and Lai, 1976; Maekawa, 1978; Cheng and Yang, 1983, 1988; Huang et al., 1995; Huang, 1996; Lu, 2001; Huang et al., 2003). Recently, Huang et al. (1995) critically revised *Asarum* on the bases

of morphology, pollen features, and karyotype. They recognized six species, including two new species, *A. crassusepalum* S. F. Huang, T. H. Hsieh & T. C. Huang and *A. taipingshanense* S. F. Huang, T. H. Hsieh & T. C. Huang. They (Huang et al., 1995) treated several of Hayata's species as synonyms of the very variable *A. macranthum* Hook f. within which three morphologically distinguishable populations have been described. Most recently, *Asarum* of Taiwan was revised again (Lu, 2001) based on comparative morphology, palynology, cytology and molecular evidence to elucidate the taxonomy and phylogeny of the genus. The present paper describes three new species that were overlooked or were previously misidentified as *A. macranthum*. The morphological terms used in this paper follow Sugawara (1987) and Huang et al. (1995).

MATERIALS AND METHODS

Materials used in this study were collected from the field throughout Taiwan. Living material was cultivated in the greenhouse, Department of Life Sciences, National Taiwan Normal University. Most plants were pressed and dried and the specimens are deposited in the TNU Herbarium. Voucher specimens for pollen and chromosome observations are also preserved at TNU.

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Pollen grains for scanning electron microscopic (SEM) study were collected from fresh anthers and prepared by the method proposed by Erdtman (1952). The acetolyzed grains were dehydrated through an ethanol series, critical point dried, coated with gold, and examined with a Hitachi SM 2400 scanning electron microscope (SEM).

Root tips for cytological study were pretreated with 0.1% colchicines for 3-4 hours at room temperature and fixed in a 3:1 mixture of 99.5% ethyl alcohol and acetic acid for 1 day. After maceration with 5% pectinase, the root tips were squashed in an acetic orcein solution.

NEW SPECIES

1. *Asarum chatiense* C. T. Lu & J. C. Wang, sp. nov.—TYPE: Taipei County: Sanhsia Town, Mt. Peichatienshan, en route from entrance to shelter, elev. ca. 600-950 m, *C. T. Lu 571* (holotype: TNU; isotype: TNU). 插天山細辛 (Figures 1, 4A-D)

Diagnosis. Affine *A. macrantho*, *sed calycis tubo longius anguste cylindricus, extus dilute purpureo-virescente, intus purpureus, irregularis tessellatus, calycis lobis flavo-virescentibus, non valde undulatis, stylis apice bilobis et stigmatibus extrorsus, differt.*

Herbs, perennial. Plants forming clumps. Adventitious roots few, glabrous. Rhizomes glabrous, repent, clustered at nodes. Leaves long petiolate; petiole ca. 10-30 cm long, adaxially hairy, grooved, purple; blade triangular-oblong to triangular-ovate, 8-16 cm long, 6-10 cm wide, base cordate and 2 lobed, lobes 2-3.5 cm long, 3-5 cm wide, apex acute; upper surface usually dark green, glabrous, with white blotches, lower surface pale green; young leaves adaxially and on margin usually with short hairs. Flowering branch with 2 or 3 cataphylls at base, cataphylls ca. 2 cm long, ovate, both surfaces glabrous, margin hairy. Flowers solitary, yellowish green, axillary, decumbent on ground; pedicel glabrous, 1-1.5 cm long; calyx tube ca. 12-15 mm long, basally ca. 7 mm wide, apically ca. 7-8.5 mm wide, glabrous outside, irregularly tessellated inside, longitudinal ridges 12-15; lobes 3, shorter than calyx tube; calyx tube opening 3-5 mm in diam.; orifice ring ca. 5-10 mm wide; calyx lobes spreading obliquely, triangular to ovate, 10 mm long, 10 mm wide, abaxially glabrous, with short hairs adaxially; lamellate appendage present between orifice and calyx lobes; stamens 12, in 2 whorls, 2-2.5 mm long, filament short, anthers extrorse, 1.2-1.5 mm long, apex of connectives rounded; ovary superior, locules 6, fused; styles 6, free; styles half as long as calyx tube, apex of stylar protuberance 2 lobed; stigma elliptic, extrorse; ovules 8-10 per locule. Somatic chromosome number $2n = 24$ (Figure 6A).

Additional specimens examined. **TAIPEI COUNTY.** Sanhsia Town: Mt. Peichatienshan, en route from entrance to shelter, elev. ca. 600-950 m, *C.C. Liao et al. 354* (HAST), elev. ca. 950-1,150 m, *C.C. Liao et al. 369* (HAST), *C.T. Lu 150* (TNU), *570* (TNU), *571* (TNU), *572* (TNU), Mt. Peicha, elev. ca. 1,200-1,400 m, *L.W.*

Wu 6 (TNU); Wulai Township: Neitung logged trail, *C.T. Lu 1068* (TNU). **ILAN COUNTY.** Chiaoohsi Township: Shengmushanchung National Forest trail, en route from Bridge Tungtienchiao to Shengmu Lodge, elev. ca. 400-900 m, *C.T. Lu 868* (TNU).

Distribution and habitat. Endemic to Taiwan. *Asarum chatiense* occurs in semishaded, moist, broadleaved forests in low mountains in the northern part of the Hsuehshan mountain range from Chiaoohsi and Wulai Township to Sanhsia Town (Figure 7).

Phenology. Flowering February-April.

Etymology. The specific epithet is derived from the name of the location where the type specimen was collected.

Pollen morphology. Pollen suboblate, with 4 or 5 colpi, ca. $35.6 \mu\text{m} \times 41.0 \mu\text{m}$ (P×E), exine granulate, tectum with perforated subunits (Figures 5C, D).

The use of pollen surface structure for the identification of subgenera and species was analyzed by Mi and Yang (1991). Two major patterns, inaperaturate and 4-6 colpoidate, generally characterize subgenera *Asarum* and *Heterotropa*, respectively. Huang et al. (1995) prepared a key based on pollen features to distinguish the species of *Asarum* in Taiwan. Morphologically, *A. chatiense* is similar to *A. macranthum*, but the granulate exine with tectum composed of perforated subunits of the pollen of the former differs from the latter, which has large suprategate warts on the exine (Figure 5A). Palynologically, *A. chatiense* is more similar to *A. hypogynum* Hayata (Figure 5B) than to *A. macranthum*.

Morphological Notes. *Asarum chatiense* on Mt. Peichatienshan was previously misidentified as *A. macranthum*. *Asarum chatiense* has yellowish green flowers, with a long, narrow cylindrical tube with a purple, irregularly tessellated internal surface and bilobed stylar protuberances (Figures 4A-D). To determine more clearly the differences in the calyx tube morphology more clearly, we measured 9 flowers of *A. chatiense* and 46 flowers of *A. macranthum* and calculated the length/width ratio of calyx tube. The results (Figure 8) show significant differences ($p < 0.001$) between them in the shape of the calyx tube. Addition, the two taxa differ in pollen morphology, as mentioned above (Figure 5A, C, D).

2. *Asarum tawushanense* C. T. Lu & J. C. Wang, sp. nov. —TYPE: Pingtung County: Taiwu Township, Tawushan Nature Reserve, around Kuaiku Lodge, mixed coniferous-broadleaved forest on mountain slopes, *C. T. Lu et al. 218* (holotype and isotype: TNU). 大武山細辛 (Figures 2, 4E-H)

Diagnosis. Affine *A. hypogyno*, *sed floris parvi circ. 2-3 cm in diametrum, calycis tubo brevi cylindricus, ad collum constrictus sed haud elongatus, calycis lobis atro-purpureis, basi circum orem intus supra lamellaris appendices, purpureo-rubellus, differt.*

Herbs, perennial. Plants forming extensive

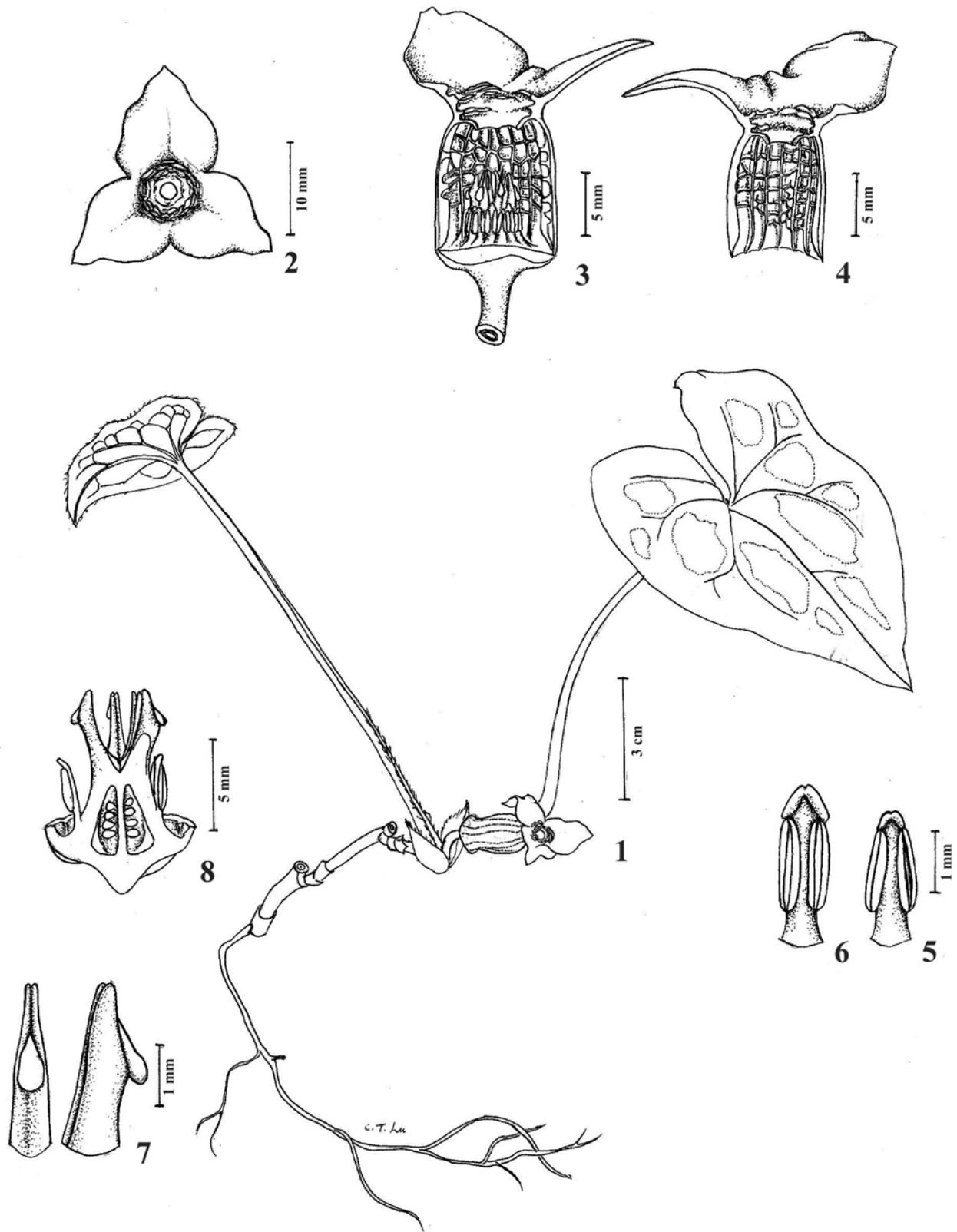


Figure 1. *Asarum chatiense* C. T. Lu & J. C. Wang. 1, Habit; 2, Flower, front view; 3, Dissected flower; 4, Dissected calyx tube showing inner tessellated ridge; 5, Stamen, outer whorl; 6, Stamen, inner whorl; 7, Style and stigma; 8, Dissected ovary.

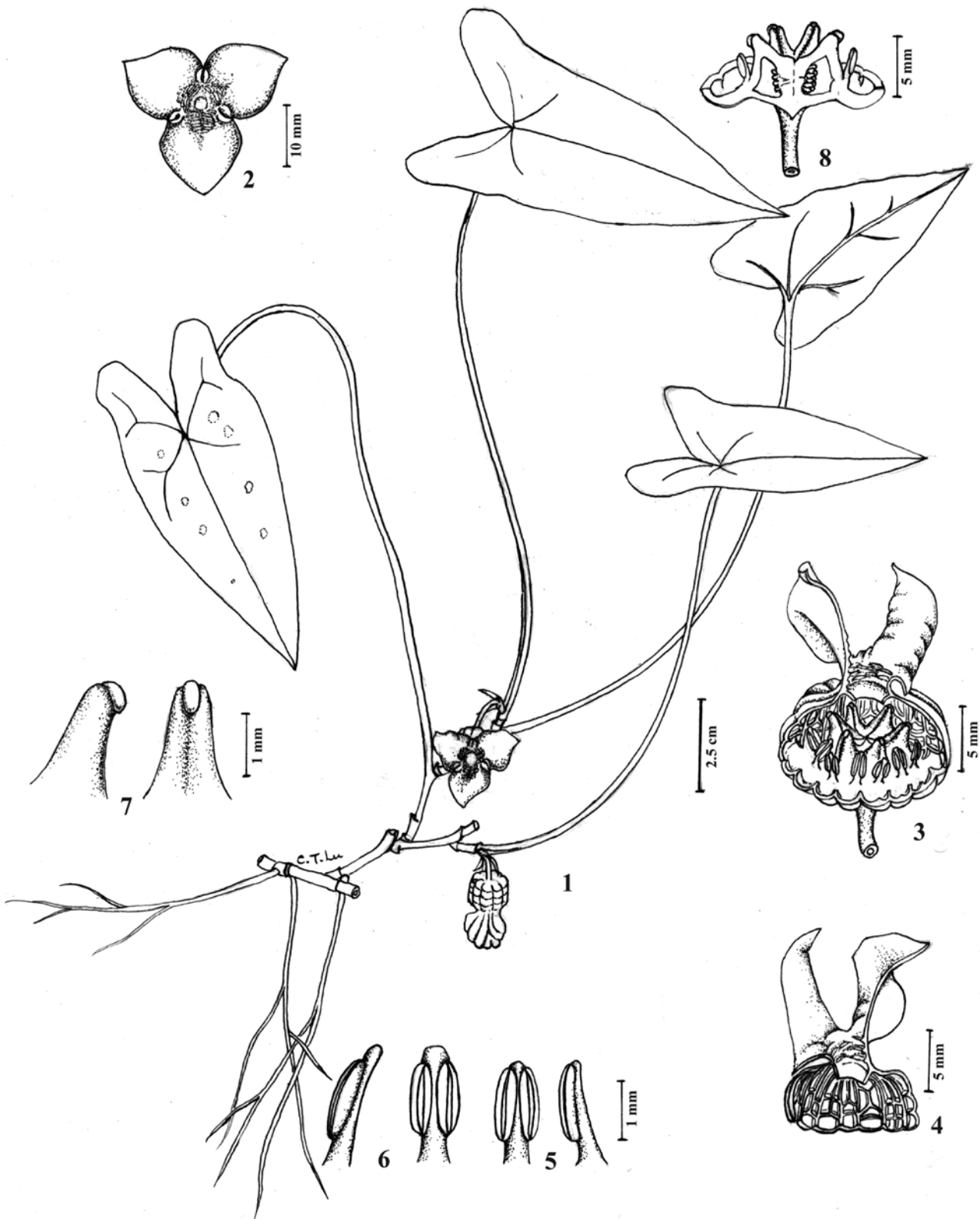


Figure 2. *Asarum tawushanianum* C. T. Lu & J. C. Wang. 1, Habit; 2, Flower, front view; 3, Dissected flower; 4, Dissected calyx tube showing inner tessellated ridge; 5, Stamens, outer whorl; 6, Stamens, inner whorl; 7, Style and stigma; 8, Dissected ovary.

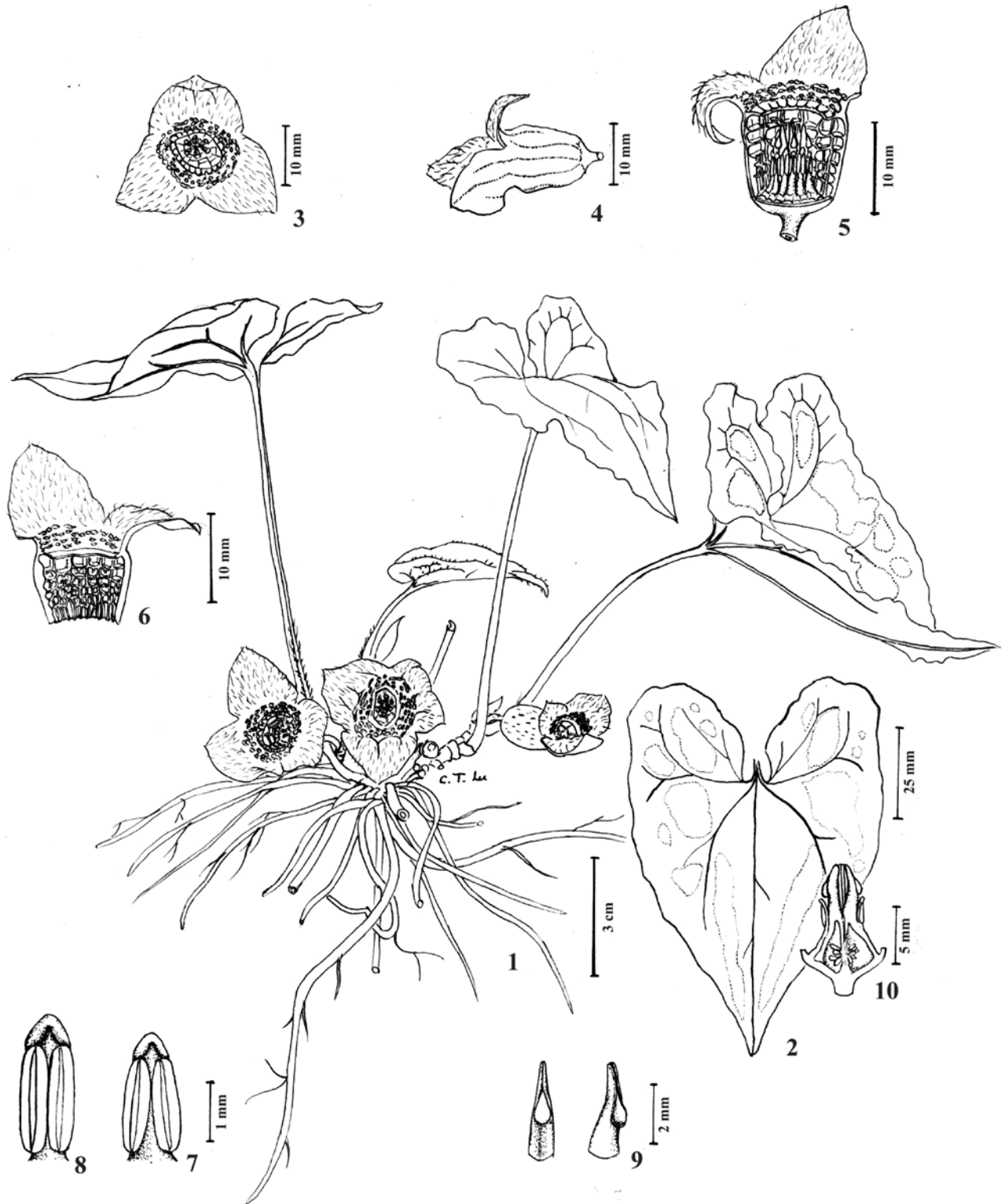


Figure 3. *Asarum villisepalum* C. T. Lu & J. C. Wang. 1, Habit; 2, Leaf; 3, Flower, front view; 4, Flower, lateral view; 5, Dissected flower; 6, Dissected calyx tube, showing inner tessellated ridge; 7, Stamens, outer whorl; 8, Stamens, inner whorl; 9, Style and stigma; 10, Dissected ovary.

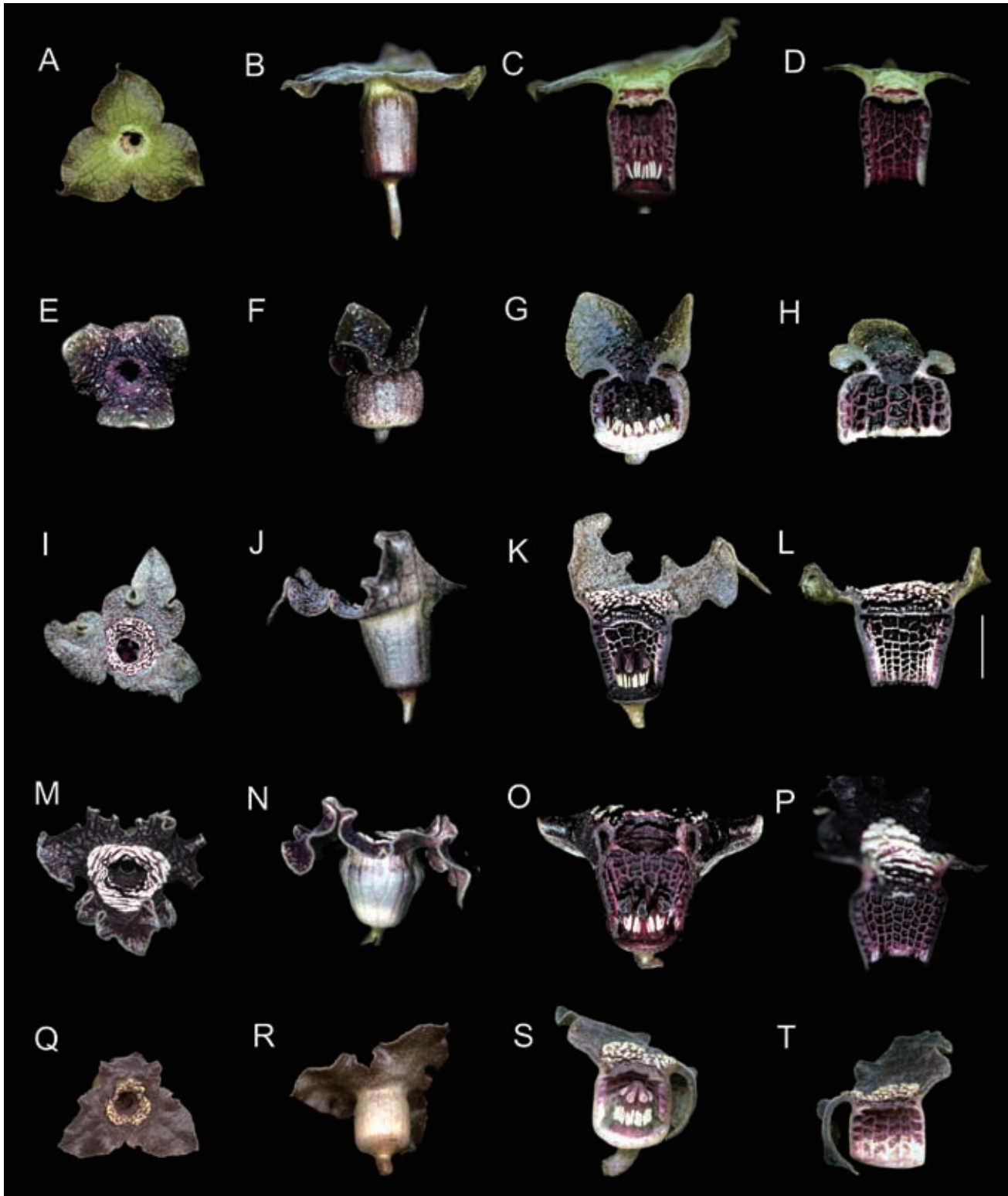


Figure 4. Floral characters of *Asarum chatiense* (A-D), *A. tawushense* (E-H), *A. villisepalum* (I-L), *A. macranthum* (M-P), and *A. albomaculatum* (Q-T). Bar = 10 mm. Notice (1) coloration of calyx lobes: yellowish green in *A. chatiense* (A), purple reddish in others (E, I, M, Q), and adaxial surface of calyx lobes with white villi in *A. villisepalum* (I); (2) shape of calyx tube: long cylindrical in *A. chatiense* (B), obconic in *A. villisepalum* (J), urceolate in *A. macranthum* (N), shortly cylindrical in *A. tawushense* (F) and *A. albomaculatum* (R); (3) pistil characters: lateral stigma with horn-like stylar protuberance in *A. chatiense* (C), *A. villisepalum* (K), and *A. albomaculatum* (S), terminal or subterminal stigma without horn-like stylar protuberance in *A. tawushense* (G) and *A. macranthum* (O); (4) number of longitudinal ridges: 24 in *A. macranthum* (P), 24 in lower part, 12 in upper part in *A. villisepalum* (L), 10 to 12 in *A. albomaculatum* (T), more than 12 but less than 24 in *A. chatiense* (D) and *A. tawushense* (H).

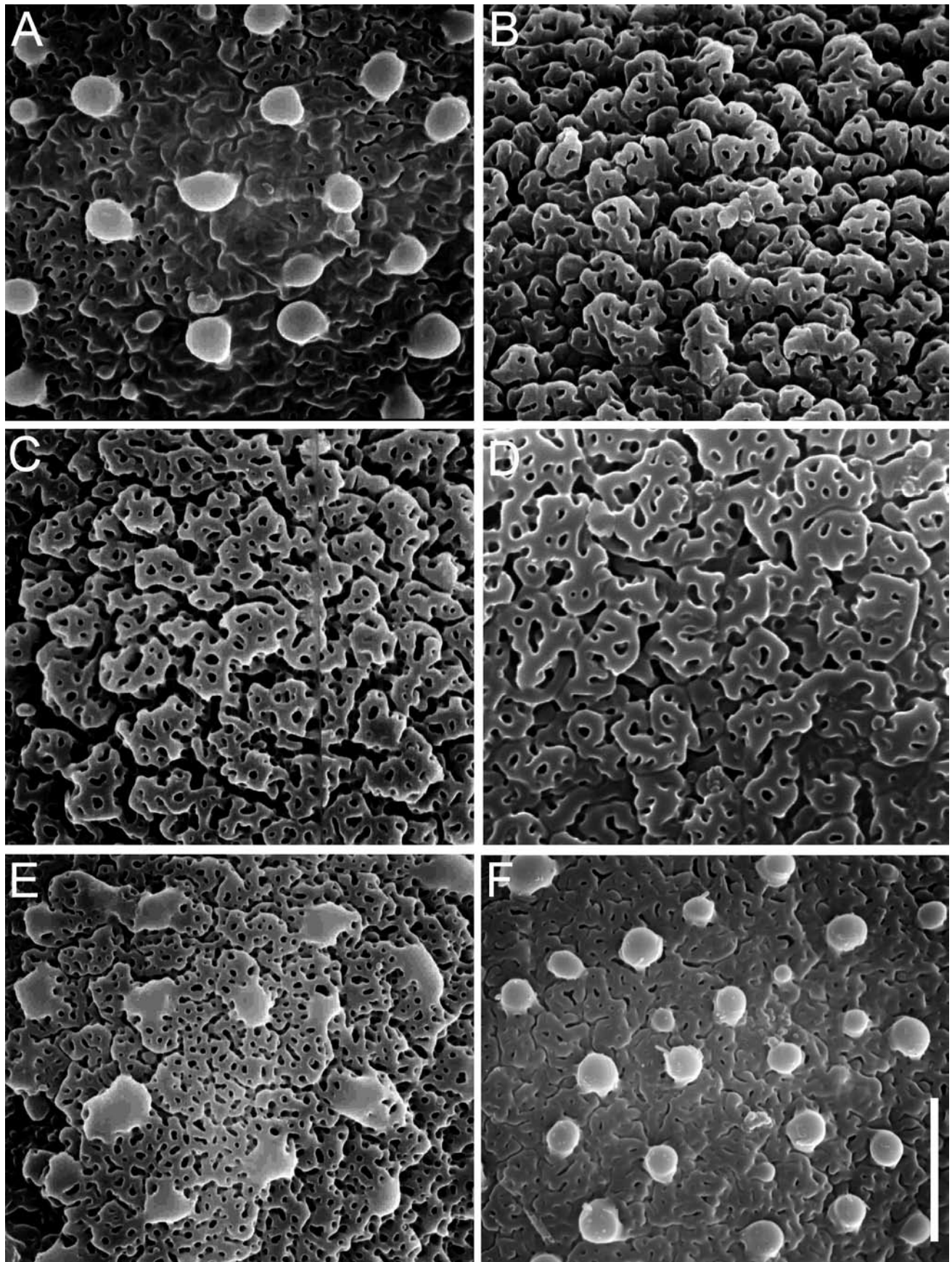


Figure 5. Micromorphology of pollen exine of *Asarum*. A, *A. macranthum*; B, *A. hypogynum*; C-D, *A. chatiense*; E, *A. tawushanense*; F, *A. villisepalum*. Bar = 3 μ m.

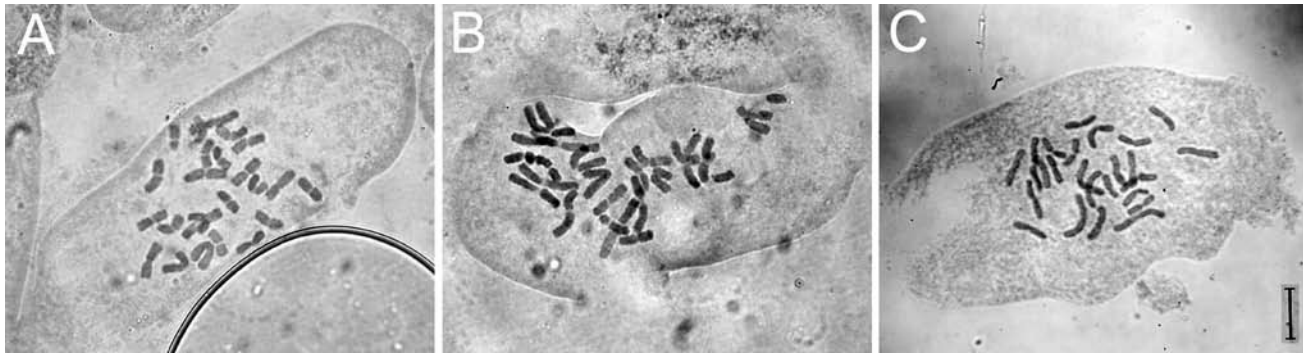


Figure 6. Somatic chromosome number of *Asarum*. A, *A. chatiense* ($2n = 24$); B, *A. tawushanense* ($2n = 24$); C, *A. villisepalum* ($2n = 24$). Bar = 10 μ m.

groundcover. Adventitious roots few, glabrous, as thick as rhizome. Rhizomes glabrous, repent, elongate; annual vegetative branches with 2-4 cataphylls at base, cataphylls membranous, hyaline, sessile, oblong, both surfaces glabrous, margin hairy, apex obtuse. Leaves long petiolate; petiole ca. 16 cm long, glabrous adaxially, grooved, dark brown or purple; blade triangular-oblong to triangular-ovate, 8.5-12 cm long, 5-6 cm wide, base cordate, basal lobes 2, 3-4 cm long, 2.5-3 cm wide, apex acuminate; upper surface usually dark green, lustrous, glabrous, with white spots, lower surface pale green; young leaves adaxially and margin with short hairs. Flowering branches with 2-4 cataphylls at base; cataphylls ovate, glabrous on both surfaces, margin hairy. Flowers solitary, axillary, dark purple, decumbent on ground; pedicel glabrous, 1-2 cm long; calyx tube shortly cylindrical, 8-10 mm long, 12-15 mm wide, glabrous outside, reticulate, ridged inside, longitudinal ridges 12-15; calyx lobes 3, spreading obliquely, triangular to ovate, ca. 10 mm long, 10-15 mm wide, adaxially with glands and hairs, abaxially glabrous; lamellate appendage reddish purple, between orifice and calyx lobes; calyx tube opening less than 3 mm in diam., throat constricted but not elongated; orifice ring well developed; stamens 12, in 2 whorls, 2-2.5 mm long, filaments short, anthers extrorse, ca. 1.5 mm long, apex of connectives rounded; ovary superior, locules 6, fused; styles 6, free; stylar protuberance absent; stigma elliptic, extrorse, terminal; ovules 10 per locule. Capsule fleshy, calyx tube persistent. Seeds ellipsoid, brown, ventrally with fleshy elaiosome. Somatic chromosome number $2n = 24$ (Figure 6B).

Additional specimens examined. **PINGTUNG COUNTY.** Taiwu Township, Mt. Peitawushan, Kuaiku Lodge, elev. ca. 2,000 m, *C.I Peng 10619* (HAST), elev. ca. 2,000 m, *C.I Peng 13285* (HAST), Tawushan Nature Reserve, elev. ca. 1,880 m, *S.H. Wu & C.I. Hu 1432b* (HAST), elev. ca. 2,200 m, *C.T. Lu et al. 218* (TNU); Wutai Township, on the way to Mt. Tawushan, between mountain-hiking entrance and Kuaiku Lodge, elev. ca. 1,600-2,000 m, *C.H. Chen et al. 516* (HAST), 609 (HAST), 611 (HAST), elev. ca. 1,500-2,100 m, *J.C. Wang et al. 9051* (TNU, TAI), en route to Mt. Tawushan, elev. ca. 1,600-2,100 m, *T.C. Huang et al. 13628A* (TAI),

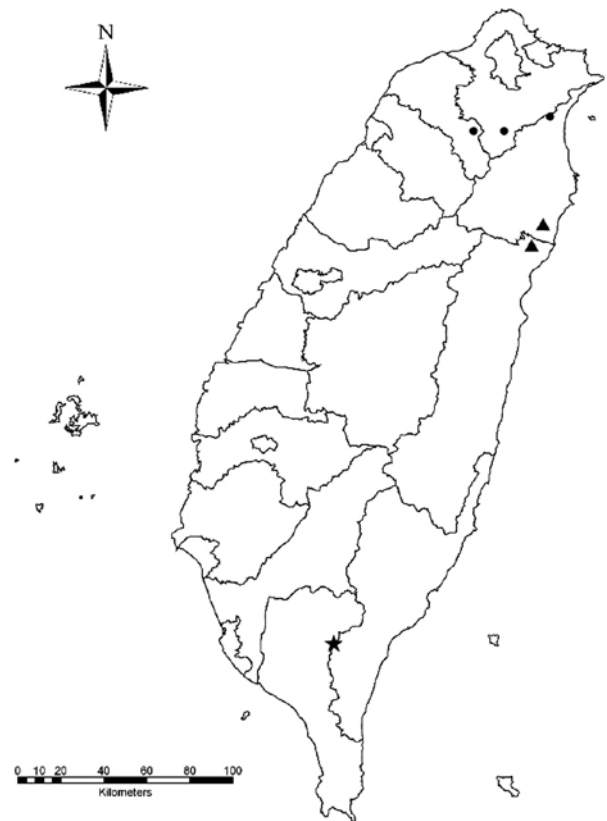


Figure 7. Geographic distribution of *Asarum chatiense* (●), *A. tawushanense* (★) and *A. villisepalum* (▲).

Kuaiku Lodge, elev. ca. 2,200 m, *M.J. Wu 1850* (TAI).

Distribution and habitat. Endemic to Taiwan. Currently known only from Tawushan Nature Reserve around Kuaiku Lodge at high elevations in southern Taiwan (Figure 7). *Asarum tawushanense* inhabits heavily shaded, moist mixed coniferous-broadleaved forests on mountain slopes.

Phenology. Flowering April to May.

Etymology. The specific epithet is derived from the name of the location where the type specimen was collected.

Pollen morphology. The pollen grains of *Asarum tawushanianum* are oblate spheroid with 4-6 colpi, $33.6 \mu\text{m} \times 37.8 \mu\text{m}$ (P×E), tectum rugulate-perforate with large irregular suprategate warts (Figure 5E). Pollen of *A. tawushanianum* resembles the pollen of *A. macranthum* even though in gross morphology the plants are more similar to *A. hypogynum*.

Morphological Notes. Huang et al. (1995) treated *Asarum tawushanianum* as a high-altitude form of *Asarum macranthum* restricted to the south-central mountain range. They believed it to be similar to *A. albomaculatum* Hayata and to *A. hypogynum* in appearance. The vegetative characters *A. macranthum*, such as the green leaves with adaxial white blotches, and paler abaxially. The indistinct leaf venation is the same as in *A. albomaculatum*. The flowers arising from young leaves or directly from branches and the styles lacking a protuberance resemble *A. hypogynum*. Vegetative morphology and floral characters show this taxon to be more similar to *A. hypogynum* than to *A. macranthum* or *A. albomaculatum* (Figures 4M-T). *Asarum tawushanianum* differs from *A. hypogynum* in having smaller flowers, (ca. 2-3 cm in diam. versus ca. 5 cm in the latter), shortly cylindrical calyx tube, throat constricted but not elongated and calyx lobes totally dark purple with a reddish purple lamellate appendage at the base (which is white in the latter).

3. *Asarum villisepalum* C. T. Lu & J. C. Wang, sp. nov.—

TYPE: Ilan County: Nanao Township, Shenmihu Nature Preserve, virgin broadleaved forest dominated by *Machilus*, *Castanopsis* and *Cyclobalanopsis*, with abundant epiphytic ferns and orchids, on somewhat exposed site by a trail, elev. ca. 1,000-1,150 m, C.T. Lu 579 (holotype: TNU; isotype: TNU). 神秘湖細辛 (Figures 3, 4I-L)

Diagnosis. *Affine A. macrantho, sed foliis margine undulatis, floris atro-maroon, calycis lobis supra villosis, calycis tubo intus elevato-reticulatus, albus, supra 1/2 longitudinalibus 12 infra 1/2 longitudinalibus 24, stylis apice bilobis, cornuatus et stigmatibus lateralis, differt.*

Perennial herbs. Plants forming clumps. Adventitious roots glabrous, as thick as rhizome. Rhizomes glabrous, suberect; annual vegetative branch with 2 cataphylls at base; cataphylls membranous, hyaline, sessile, oblong, both surfaces glabrous, margin hairy, apex obtuse. Leaves long petiolate; petiole ca. 9-15 cm, adaxially hairy, grooved, dark purple; blade triangular-oblong to triangular-ovate, 10-14 cm long, 7-13 cm wide, margin undulate, base cordate, basal lobes 2, 3-4 cm long, 3-4 cm wide, apex acute to acuminate; upper surface usually dark green, glabrous, with white blotches, lower surface pale green; young leaves adaxially and margin usually with short hairs. Flowering branches with 2 cataphylls at base, cataphylls ovate, glabrous on both surfaces, margin hairy. Flowers solitary, axillary, dark maroon, decumbent on ground; pedicel glabrous, ca. 1 cm long; calyx tube obconic, 10-14 mm long, basally 7-8 mm wide, apically

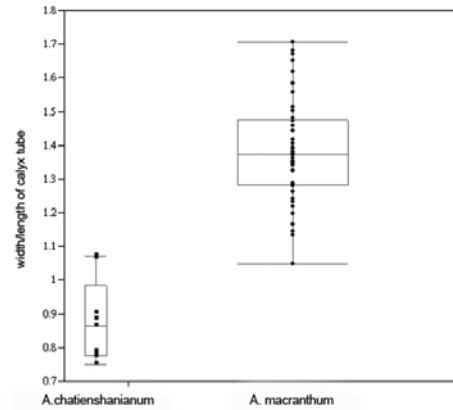


Figure 8. Length/width ratio of calyx tube of *A. chatiense* (■, sample size = 9) and *A. macranthum* (●, sample size = 46), showing significant difference in this character (t test, $p < 0.001$). (box presents sample size).

11-14 mm wide, glabrous outside; calyx lobes 3, spreading obliquely, usually not undulate, triangular to ovate, 8-15 mm long, 11-15 mm wide, abaxially glabrous, adaxially white villous; tubercles between orifice and calyx lobes white; inside reticulate ridged, longitudinal ridges 24 basally, 12 apically; calyx tube opening less than 8 mm in diam.; orifice ring ca. 1 mm wide; stamens 12, in 2 whorls, 2-2.5 mm long, filaments short, anthers extrorse, ca. 1.5 mm long, apex of connective rounded; ovary semi-inferior, locules 6, fused; styles 6, free; stylar protuberances 2 lobed, apex horn-like; styles equal to or slightly shorter than calyx tube; stigma elliptic or lachrymiform, lateral on style; ovules 8 per locule. Somatic chromosome number $2n = 24$ (Figure 6C).

Additional specimens examined. ILAN COUNTY: Nanao Township, Chinyang Nanao Broadleaved Forest Preserve, elev. ca. 1,100 m, C.I Peng et al. 13812 (HAST), 13813 (HAST); Shenmihu Nature Preserve Area, elev. ca. 1,000-1,150 m, C.C. Liao et al. 1758 (HAST), C.T. Lu 579 (TNU), Lake Shenmihu, elev. ca. 1,000 m, S.F. Huang et al. 5200 (TAI), en route from Shenmihu control station to Shenmihu broadleaved forest, elev. ca. 1,355-1,030 m, T.Y. Liu et al. 139 (HAST, TNU), elev. ca. 1,260-1,200 m, T.Y. Liu et al. 169 (HAST, TNU), Chinyang Village, Lake Shenmihu, elev. ca. 1,000-1,100 m, C.H. Chen et al. 665 (HAST, TNU); Mt. Fanpaoshan, en route from hiking entrance to ridge of mountain, elev. ca. 1,500 m, C.C. Liao & C.C. Chen 1799 (HAST). **HUALIEN COUNTY.** Hsiulin Township, Hoping logged trail 28-32 K, S.C. Liu 2619 (TNU).

Distribution and habitat. Endemic to Taiwan, only in Shenmihu Nature Preserve Area, ca. 1,000 m and Hoping logged trail (Figure 7). *Asarum villisepalum* occurs in heavily shaded, moist, broadleaved forests on mountain slopes.

Phenology. Flowering from March to May.

Etymology. The specific epithet refers to the dense white hairs on the upper surface of the calyx lobes.

Pollen morphology. The pollen of *Asarum villisepalum* is suboblate with 4-6 colpi, $36.5 \mu\text{m} \times 42.5 \mu\text{m}$ (P×E), tectum rugulato-perforate with median suprategate warts (Figure 5F).

Morphological Notes. Huang et al. (1995) regarded *Asarum villisepalum* as represent infraspecific variation in *Asarum macranthum*, due to their similarity in gross morphology. Our detailed comparison revealed that *A. villisepalum* differs from *A. macranthum* as follows: leaf

margins undulate, adaxial surface of calyx lobes with long white villi, calyx tube reticulate, ridged inside, longitudinal ridges 12 apically, 24 basally (Figure 4L), and apex of stylar protuberance bilobed and horn-like. The dark maroon flowers of *A. villisepalum* are also different from those of *A. macranthum*, which has the tube white outside (Figure 4N). Additionally, the ridges inside the calyx tube are white instead of purple in *A. macranthum* (Figure 4L).

Key to the taxa of Taiwanese *Asarum*

1. Leaves membranous, both surfaces hairy, without white spot or blotch on upper surface; rhizomes hairy; roots more slender than rhizome; ovary inferior, hairy; calyx tube without an orifice rim; styles fused to form a stylar column.
 2. Current year's stem suberect, with 2, nearly opposite leaves; leaves usually triangular to ovate; apex of calyx lobes caudate; filaments longer than anthers *A. caudigerum*
 2. Current year's stem repent, with 1-3 alternate leaves; leaves usually ovate; apex of calyx lobes round; filaments shorter than anthers *A. epigynum*
1. Leaves coriaceous, glabrous or hairy along veins and margin, usually with white spots or blotches on upper surface; rhizomes glabrous; roots equal to or slightly less than rhizomes in diam.; ovary superior or half-inferior, glabrous; calyx tube with an orifice rim; styles free.
 3. Leaves glabrous or scarcely hairy on veins on upper surface; stylar protuberance entire; throat of tube severely constricted below calyx lobes.
 4. Plants robust; leaves to 30 cm long; flowers ca. 5 cm in diam.; calyx lobes brownish purple, margin usually green or yellow *A. hypogynum*
 4. Plants slender; leaves less than 15 cm long; flowers ca. 2-3 cm in diam.; calyx lobes dark purple, margin dark purple *A. tawushanianum*
 3. Leaves usually hairy on veins and margin; stylar protuberance bifid;; throat of tube usually slightly constricted below calyx lobes.
 5. Veinlets on lower surface of leaves indistinct (Figure 9B); calyx tube cylindrical, longitudinal ridges inside tube 12 or less; stigma round or lachrymiform, lateral on style; stylar protuberances horn-like at apex of style.
 6. Plant body robust; annual vegetative branches close together; leaves usually triangular-cordate, apex acuminate *A. albomaculatum*
 6. Plant body slender; annual vegetative branches far apart; leaves triangular to sagittate, apex acute to acuminate or triangular-oblong and apex obtuse.
 7. Blade triangular to sagittate, apex acute to acuminate; base of calyx lobes with lamellate tubercle *A. crassusepalum*
 7. Blade triangular to triangular-oblong, apex obtuse; base of calyx lobes without tubercles *A. taipingshanianum*
 5. Veinlets on lower surface of leaves distinct (Figure 9A); calyx tube urceolate, cylindrical or obconic, longitudinal ridges inside tube more than 12; stigma hook-like or lachrymiform, terminal, subterminal or lateral on style; stylar protuberance winged on both margins or horn-like at apex of style.
 8. Calyx tube urceolate, with 24 longitudinal ridges inside tube; stigma hook-like, terminal or sub-terminal on style; stylar protuberance winged on both margins at apex of style *A. macranthum*
 8. Calyx tube cylindrical or obconic, with more than 12 but less than 24 longitudinal ridges inside tube; stigma lachrymiform, lateral on style; stylar protuberance horn-like at apex of style.
 9. Flowers green or yellowish green; calyx lobes spreading, flat, adaxial surface pubescence; calyx tube narrowly cylindrical, with more than 12 but less than 24 longitudinal ridges inside tube *A. chatiensehanianum*
 9. Flowers maroon; calyx lobes spreading, undulate, adaxial surface white villous; calyx tube obconic, inner wall apically with 12 longitudinal ridges, basally with 24 longitudinal ridges *A. villisepalum*

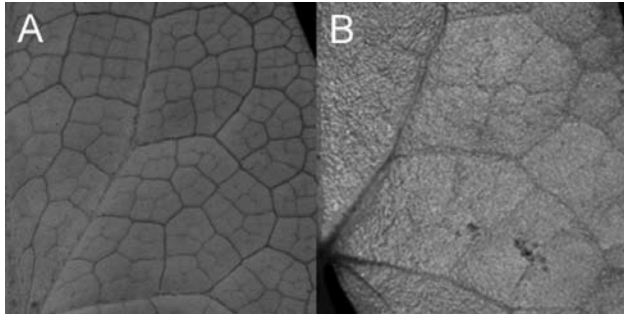


Figure 9. Venation of lower surface of leaves of *A. macranthum* (A) and *A. albomaculatum* (B) showing distinct and indistinct veinlets.

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台灣產細辛屬杜蘅組三個新種

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本文報導台灣產細辛屬杜蘅組植物 (*Asarum* sect. *Heterotropa*) 的三個新種：插天山細辛 (*A. chatiense*)、大武山細辛 (*A. tawushanense*) 及神秘湖細辛 (*A. villisepalum*)。除新種特徵描述外並提供手繪圖與彩色照片以資辨識。文中並檢視此三個新種的體染色體數目及花粉粒表面的微細構造。其中體染色體數目三種均為 $2n = 24$ ，而花粉粒的外壁除插天山細辛為由穿孔的小單元所組成外，其餘兩種皆為條紋狀穿孔且其上具有大型瘤突。在形態上，插天山細辛與神秘湖細辛與大花細辛 (*A. macranthum*) 在植物體外形上相似，但是可由花部特徵加以區分：插天山細辛具有黃綠色的花，萼筒為長圓柱形，且花柱具有二裂的角狀附屬物；神秘湖細辛的花為褐紫紅色，萼裂片上覆有白色長柔毛，萼筒內壁上半部具有 12 條縱向隆起，而下半部則有 24 條。大武山細辛則與下花細辛 (*A. hypogynum*) 較為相似，然而，可由其壓扁狀圓柱形的萼筒與花較小且呈紫紅色，而與之區別。文末附上台灣產細辛屬植物所有分類群的檢索表，供物種間比較及鑑定之用。

關鍵詞： 細辛屬；馬兜鈴科；染色體數目；杜蘅組；花粉；台灣。