A revision of the genus *Gueldenstaedtia* (Fabaceae)

Xiang-yun Zhu

Institute of Botany, The Chinese Academy of Sciences, 20 Nanxincun, Xiangshan, Beijing 100093, China (e-mail: xiangyunzhu@ns.ibcas.ac.cn)

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This paper provides a taxonomic revision of *Gueldenstaedtia* (Fabaceae). Four species and one form are recognized. The revision is based on herbarium material and includes pollen and seed morphological observations. I treat the genus as distinct from the closely related *Tibetia* based on pollen and seed morphology, other morphological characters and chromosome data. A number of names in *Gueldenstaedtia* are reduced to synonyms. A key to all species of the genus is provided. For each taxon, its description, ecology, phenology, notes and an illustration and distribution map are also provided.

Key words: Fabaceae, *Gueldenstaedtia*, taxonomy

**Introduction**

*Gueldenstaedtia* (Fabaceae) is a papilionoid legume genus in the Astragalinae subtribe of the tribe Galegeae. Close relatives include *Astragalus, Oxytropis, Biserrula* and *Alhagi* (Polhill 1981). Polhill (1994) proposed a classification system of Fabaceae, in which *Halimodendron, Caragana, Calopha, Spongiocarpella, Chesneya, Astragalus, Astrakantha, Oxytropis, Neodielsia* and *Gueldenstaedtia* were included in the subtribe Astragalinae. The temperate Asian genus *Gueldenstaedtia* formerly comprised 12 species, including one subspecies and two forms (Wu 1991, Cui 1998). Mabberley’s (1997) circumscription of *Gueldenstaedtia* (including *Tibetia*) covered 14 species distributed from Sino-Himalaya to Siberia and confined to Asia, especially to China. The demarcation of *Gueldenstaedtia* and *Tibetia* is a point of dispute. They are treated either as two distinct genera (Tsui 1979, Cui 1998, Wu 1999) or a single genus (Yakovlev 1980, Li & Ni 1985, Grierson & Long 1987, Mabberley 1997). In the course of a taxonomic revision of the genus *Gueldenstaedtia*, I studied herbarium specimens from the main distribution areas. My observations of morphological characters, pollen and seed morphology clarified the delimitation of *Gueldenstaedtia* and *Tibetia* as separate genera (Zhu & Wen 2004) — a conclusion supported by the chromosome data of Ni et al. (2002) and Yang (2002). In this revision, four species and one form are recognized in *Gueldenstaedtia*. For each taxon, its description, ecology, phenology and further notes are provided along with illustrations and distribution maps.

**Taxonomic history**

*Gueldenstaedtia* was established in Fischer (1823) and named in honour of the Russian naturalist Anton Johann von Gueldenstaedt. *Gueldenstaedtia pauciflora* (Pall.) Fisch. was
chosen as the lectotype by Fischer, but is now a synonym of *G. verna* (Georgi) Boriss. In his original paper, only two species, *G. monophylla* Fisch. and *G. pauciflora* (Pall.) Fisch., were recognized. Kitagawa (1936) pointed out that *Gueldenstaedtia* Necker was a synonym of *Gueldenstaedtia* Fisch. and considered that it should be replaced by *Amblytropis* Kitagawa. Ali (1962–1963) proposed conserving the generic name *Gueldenstaedtia* Fisch. In view of the uncertain nomenclatural status of the names in Neck-er’s *Species Naturales*, the International Con-gress of Montreal made a decision against the acceptance of Necker’s name (Rickett & Stafleu 1959) and maintained the name *Gueldenstaed-tia* Fisch. for the genus. This is in accordance with ICBN (Greuter et al. 2000). Jacot (1927) adopted *Gueldenstaedtia* as one genus and did not propose a subdivision, but Ali (1962–1963) proposed two subgenera: subg. *Gueldenstaed-tia* and subg. *Tibetia* Ali. Tsui (1979) separated *Tibetia* from *Gueldenstaedtia*, raised it to the generic level and amended the circumscription of *Gueldenstaedtia*. Therefore, the correct cita-tion for this genus is *Gueldenstaedtia* Fisch. *emend.* Tsui. The separation of *Tibetia* from *Gueldenstaedtia* remains controversial (Grierson & Long 1987, Mabberley 1997, Cui 1998).

**Relationship between *Gueldenstaedtia* and *Tibetia***

The two genera belong to the subtribe Astragaliinae of the tribe Galegeae (Fabaceae sub-family Papilionoideae). They are closely related to *Astragalus, Oxytropis, Biserrula* and *Alhagi* (Polhill 1981). While there is considerable variation in many pollen-morphological characters throughout Papilionoideae, their taxonomic value is also variable (Ferguson & Skvarla 1981). Zhu and Ohashi (2000) reported that the pollen mor-phology of *Astragalus* and *Oxytropis* is similar in shape, size and endoaperture characteristics. The pollen grains of *Alhagi* are 3-colporate, mostly spheroidal, with long colpi, without constriction and slightly protruding at the equator, as reported by Ohashi (1971) and Choi and Ohashi (1996). Differences in pollen grains between *Guelden-staedtia* and *Tibetia* are discussed in Zhu and Wen (2004) and can be summarized as follows. *Gueldenstaedtia*: pollen grains 3-colporate, psi-late, and spheroidal, sometimes subprolate, prolate or oblong; *Tibetia*: pollen grains 3 and 4-colporate, perforate, spheroidal, sometimes sub-prolate or prolate. These data combined with the basic chromosome number *x* = 7 for *Guelden-staedtia* (Yang 2002) and *x* = 8 for *Tibetia* (Ni et al. 2002) support the separation of these two genera. This is also consistent with some morphological differences; in *Gueldenstaedtia* the two upper calyx lobes are free, the stipules are free and adnate to petiole, and in *Tibetia* the two upper lobes of calyx are connate, and the stipules are connate and opposite to the leaves.

**Taxonomy**

*Gueldenstaedtia* Fisch. *emend.* Tsui


*Type:* *Gueldenstaedtia verna* (Georgi) Boriss.

Perennial herbs. Roots thick and woody, cylindrical. Stem almost absent, or very short, with many branches. Leaves with many leaflets, rarely unifoliolate; stipules adnate to petioles, broadly to narrowly triangular, membranous, persistent, lateral, not leaf-opposed; petioles sessile, leaflets entire, ovate, lanceolate, elliptic, oblong, linear or sub-circular. Racemes with 3–8 flowers, flower pedicellate, bracteate, purple, pink or yellow; bracteoles 2; calyx campanulate, densely appressed with long white hairs, sometimes with black hairs, rarely glabrous, 5-lobed, upper 2 lobes longer and wider than lower 3 lobes; standard ovate or sub-round, tapering to claw at base, emarginate at apex; wings oblique obovate, slightly shorter than standard; keel-petals blunt at apex, ovate, very small, 1/2 as long as wing-petals. Stamens diadelphous (9 + 1); ovary tubular, sessile, pilose or glabrous, style incurved, stigma blunt, cylindrical. Pods cylindrical unilocular, dehiscent along both sutures, with many seeds; seeds reniform, sometimes with a depression. Flowering May to June, fruiting July to September.


**Gueldenstaedtia** includes four species and one form mainly occurring in Asia.

### Key to the species of Gueldenstaedtia

1. Leaves simple or sometimes 2- or 3-lobed ........................................... *G. monophylla*

1. Leaves imparipinnate, leaflets rarely 3, 4 or 5 .............. 2

2. Leaflets widely elliptical to round ........ *G. tibbangensis*

2. Leaflets elliptical to oblong-elliptical, ovate to lanceolate or linear ................................................................. 3

3. Branches elongate, usually ca. 5.0 cm long, lignified; standard acute at apex; wings semilunate ....... *G. henryi*

3. Branches short, usually less than 5 cm long, non-lignified; standard round at apex; wings obovate .............. 4

4. Flowers purple, violet, or pink .................................. *G. verna*

4. Flowers white .................................................. *G. verna f. alba*

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**Gueldenstaedtia monophylla** Fisch. (Fig. 1)

Mém. Soc. Nat. Moscon. 6: 171. 1823. — **Type**: Russia. Altai Mts., 1820 Fischer 57 (holotype LE!, isotype PE!).

Perennial herb, 5–15 cm tall. Stem short. Leaf solitary, rarely 2- or 3-lobed; leaflets round, reniform, or orbicular, broad or sometimes slightly notched at base, obtuse to short-pointed at apex, sometimes 2- or 3-lobed, with appressed sericeous hairs, 1–3.5 cm long, 1.5–4.5 cm wide. Stipules lanceolate, 3–5 cm long, with appressed hairs, ciliate, connate at base; leaves with hairs, petiole 2–6 cm long; peduncles numerous, slender, sericeous, 3–13 cm long; racemes with 2–6 flowers, pedicels 1–2 mm long, or subsessile; bracts filiform, 2–5 mm long, bracteoles filiform, shorter than calyx tube; calyx broadly campanulate, sericeous, 5–6 mm long, 5–lobed, teeth lanceolate, 2/3 of tube; corolla violet; standard broadly obovate, entire or slightly emarginate at apex, 12–14 mm long, claw broad and short; wings 10–12 mm long, as long as standard, oblong, obtuse at apex, claw 1–1.5 mm long; keel-petals ca. 4 mm long, whitish, lamina incurved, as long as filiform claw; stamens diadelphous (9 + 1), shorter than keel-petals; ovary obovate, hairy; petals curved, glabrous, ca. 1 mm long; stigma thick; pods linear-cylindric, ca. 2.5 cm long, 3.5–5 mm wide, appressed-pubescent. Seeds reniform, irregularly circle reticulate.

**Distribution**: Russia, Mongolia (Fig. 2).

**Habitat ecology**: Rocks, dry stony and gravelly slopes.

**Phenology**: Flowering from May to July, fruiting from June to August.

This species is readily distinguished from the congeners by its solitary leaf. *Gueldenstaedtia monophylla* has been recorded from the Altai mountain area of Xinjiang in China, but I have not seen collections from that area. The distribution map (Fig. 2) combines my observations with those of Yakovlev (1980) and Kurbatski (1994).

**Additional specimens examined. — Mongolia.** Alashan Gobi, s.coll. (LE). **Russia.** Altai, s.coll. 575 (K); Altai, Bunge s.n. (K); Altai, Prescott s.n. (K); In superistibus apricis fl. Katanga, Bunge s.n. (K); Altai, 1835 s.coll. (K); Southern

**Gueldenstaedtia taihangensis** Tsui (Fig. 3)


Perennial herb. Roots deep, thick at upper part. Stem with many branches. Leaves 3–13 cm long, imparipinnate, petiole thin, sulcate, with appressed hairs; leaflets 2–6 pairs, widely ovate to sub-circular, elliptic to ovate, 5–10 mm long, 3–8 mm wide, truncate, obtuse, mucronulate or lobed at apex, round at base, glabrous on upper side, sometimes pubescent on both sides, entire, petiole ca. 0.5 mm long. Stipules 2–5 mm long, adnate to the petiole, lanceolate, with densely appressed hairs. Racemes with 1–6 flowers, pedicels thin, sulcate, bracts, bracteoles, peduncle, pedicel and calyx with appressed long hairs. Bracts linear or triangular, 4–5 mm long, bracteoles similar to bracts, narrowly triangular, ca. 3 mm, adnate to the base pedicel, pedicel ca. 1 mm long. Calyx campanulate, 5–7 mm long, 2.5–3 mm wide, appressed with hairs, 5-lobed, unequal, upper 2 lobes triangular, 3–3.5 mm long, 2.5–3 mm wide. Flowers violet, standard obovate or oblong, ca. 11 mm long, 6–7 mm wide, round or retuse at apex, tapering to base, wings obovate, 7–9 mm long, ca. 3 mm wide, claw ca. 1.5 mm long, keel-petals shorter than wings, 3–5 mm long, ca. 1.5 mm wide, lamina ovate, claw linear, ca. 1.5 mm long, ariculate, ovary cylindrical or oblong, pubescent, style short, incurved, glabrous. Pods cylindrical, pubescent, 10–17 mm long, 3–4 mm wide. Seeds reniform, with circular depression.

**DISTRIBUTION**: China (Hebei, Shanxi and Guangxi) (Fig. 4).

**ECOLOGY**: On roadside verges, hilly slopes or open, sandy areas, alt. 950 to 1150 m.

**PHENOLOGY**: Flowering from March to July, fruiting September.

The shape of leaflets in this species varies from elliptical to round, but they are distinctly different from the other species. Its distribution is disjunct, being known from Hebei, Shanxi and Guangxi.

Gueldenstaedtia henryi Ulbr. (Fig. 5)


Perennial herb. Roots thick and woody, cylindrical, sometimes with adventitious root. Stem with branches, ca. 5 cm long, lignified. Leaves, 2–9 cm long, imparipinnate, pubescent or subglabrous; leaflets 5–7 pairs, oblong or obovate, 3–10 mm long, 2–5 mm wide, round or emarginate at apex, with clear apicule, glabrous on upper side, pubescent on lower side; stipules, 3–5 mm long, free from petioles at apex, broadly triangular, petioles short to sessile. Racemes with 4–5 flowers, peduncle longer than 10 cm long, pubescent or glabrous; bracts narrowly lanceolate, ca. 3.5 mm, pedicel ca. 3 mm long; bracteoles linear, ca. 2.5 mm long; calyx campanulate, ca. 6 mm long, with appressed hairs, upper 2 lobes longer and wider than the lower 3 lobes, narrowly triangular, ca. 4 mm long, ca. 1.5 mm wide, low 3 lobes lanceolate, ca. 2.5 mm long; standard widely obovate, ca. 14 mm long, ca. 8 mm wide, acute or retuse at apex, tapering to claw until the base; wings ellipsoid-semilunar, ca. 11.5 mm long, ca. 3.5 mm wide, claw very short; keel-petals ca. 5.5 mm long, ca. 2.5 mm wide, claw ca. 2 mm long; ovary oblong, pubescent; pods ca. 1.5 cm long, pubescent. Seeds reniform.

Distribution: China (Hubei, Sichuan) (Fig. 6).

Ecology: On grassland, alt. 120 m.

Phenology: Flowering May to July, fruiting June to August.

Gueldenstaedtia henryi is close to G. verna, but the main difference is that the former has a standard acute at apex and the latter, rounded. The pollen grains of G. henryi differ from those of the other species in having wide colpi. Thus I treat this as a distinct species.

Additional specimens examined: — China. Hubei: Ba Dong, alt. 120 m, 1939 T. P. Wang 10864 (PE); Ichang, s.coll. 1130 (K).

Gueldenstaedtia verna (Georgi) Boriss. (Fig. 7)

Spisok Rast. Gerb. Fl. SSSR 12: 122. 1953. — Astragalus
**G. verna** Georgi, Reise Russisch. Reich. 1: 226. 1775. — **Type:** Siberia, Georgi (LE!).

**Astragalus biflorus** Pall., auct. non L., Reise 3: 206. 1773.


**G. pauciflora** (Pall.) Fisch. var. **subglabrata** DC., Prodr. 2: 307. 1825. — **Type:** “In pratis udis circa Ircutiam” (LE!).


**G. mirpourensis** Benth. ex Baker, Fl. Brit. Ind. 2: 118. 1879. — **Type:** “Upper gangetic plain at Mirpour, Jacquemont, Hazara”, *Dr. Stewart* (K!).


**G. giraldii** Harms subsp. **glaabra** Jacot, J. North China Br. Roy. As. Soc. 58: 113. 1927, syn. nov. — **Type:** “Tsina” (NY!).


**G. giraldii** Harms subsp. **glaabra** Jacot, J. North China Br. Roy. As. Soc. 58: 113. 1927, syn. nov. — **Type:** “Tsina” (NY!).


**Amblytropis brachytera** var. **elongata** Péi & Shieb, Key to Spermatophyta of S Jiangsu Province: 140. 1958, nom. nud.

Perennial herb. Roots thick and woody, cylindrical. Stem almost absent, with persistent stipules. Plants with appressed hairs or glabrous. Leaves imparipinnate, 2–23 cm long, young
leaves with long hairs, mature leaves with sparse appressed hairs or glabrous, petiole sulcate, slender, with white appressed hairs, leaflets 2–10 pairs, elliptical to lanceolate, ovate to widely ovate, apical leaflet sometimes obovate, ovate to elliptic, widely elliptic to widely obovate, blunt and apiculate at apex, sometimes young leaflets ovate and mature leaflets linear, 2–4.5 cm long, 1–10 mm wide, apiculate, acute, blunt, emarginated or retuse, pubescent or sometimes glabrous on both surfaces, rounded at base. Racemes with 2–8 flowers, peduncle sulcate, hairy, slightly longer than leaves before blooming, much longer than leaves after blooming. Pedicel slender, sulcate, 1–3 mm long, bracts triangular-linear, narrowly triangular, lanceolate, subulate, 2–4 mm long, bracteoles linear, 1/2 as long as calyx. Calyx campanulate, 5–8 mm long, with long appressed white hairs, 5-lobed, lanceolate, upper 2 lobes equal to calyx, low 3 lobes shorter than calyx. Corolla violet, purple, and pink, standard ovate or sub-round, ovate, widely ovate or obovate, 9–13.5 mm long, 4.5–8 mm wide, emarginated at apex, tapering to claw at base; wings oblique obovate, 6–11 mm long, 1.7–3.5 mm wide, claw linear, 1.8–2 mm long, auriculate; keel-petals 4.2–7 mm long, 1–2 mm wide, oblique obovate, ovate, obovate, acuminate at apex, claw linear, 1.8–2.5 mm long; ovary tubular, cylindrical, oblong, elliptic, with densely appressed hairs, style glabrous, incurved, stigma round. Pods cylindrical, narrowly ovate, tubular, unilocular, 1.2–2 cm long, diameter 3–4 mm, with long hairs, when mature dehiscent along both sutures, with many seeds; seeds reniform or cylindric-reniform or triangular-reniform, with mark.

**Distribution:** China (Beijing, Gansu, Hebei, Henan, Hubei, Jiangsu, Jiangxi, Jilin, Heilongjiang, Liaoning, Nei Menggu, Ningxia, Shaanxi, Shandong, Shanxi, Tianjin, Yunnan), Korea, Mongolia, Russia (Fig. 8).

**Ecology:** Roadside, grasslands and terraced fields, alt. from 80 to 2600 m.

**Phenology:** Flowering March to June, fruiting May to November.

*Gueldenstaedtia verna* is variable in morphology and has a wide north–south distribution. Cui (1998) considered it to be different from *G. gracilis* and *G. stenophylla* in the shape of the leaflets and standard-petal. However, our observations of wild populations revealed continuous variation in leaflet shape. Both these characters show variation within populations as well as in a single specimen (e.g. in specimens s.coll. 4116 and Abbe E. Licent 3675). Plant height was treated as the main character for distinguishing *G. verna* from *G. delevayi* and *G. gracilis* by Cui (1998). Based on the specimens examined, height varies considerably in different localities and is clearly an environmentally induced character. The name *G. delevayi* has been applied to small plants. *Gueldenstaedtia harmsii* is characterized by long peduncles and many flowers per raceme and can be considered to represent one extreme of the variation seen in *G. verna*. Two specimens (Guan K. J. and Chen Y. L. 64) from one locality were identified as *G. maritima* and *G. multiflora* by different scholars. Of them, *G. maritima* has glabrous morphological organs, an abnormal fascies in *G. verna*. This shows that glabrous and pubescent organs coexist in one population, and are thus unstable characters. I include *G. multiflora* in *G. verna* because the number of flowers per raceme is variable. The former species sometimes shows appressed, dense hairs and specimens with only one to two flowers.

*Gueldenstaedtia verna* and *G. stenophylla* are identical except for some minor leaf shape differences, and *G. pauciflora* appears to be merely another variation of *G. verna*. Flower size among *G. verna*, *G. multiflora*, and *G. stenophylla* is identical. The pollen morphology supports that *G. gansuensis*, *G. gracilis*, *G. mul-
Gueldenstaedtia tiflora, G. stenophylla, and G. verna should be reduced to one species, consistent with macro-morphological characters such as leaf shape and plant height variation.

Additional selected specimens examined (total = 291):

f. alba (H.P. Tsui) P.C. Li


Distribution: China (Beijing, Shandong) (Fig. 9).

Ecology. On sunny and dry slopes, alt. from 150 m to 2600 m.

Phenology. Flowering May.

The form has been placed in various species. It is easily distinguished by the white flowers.

Additional specimens examined: — China. Beijing, on
sunny slope, Shisanling, alt. 150 m, Beijing Normal University 00239 (BNU); on grassland of Sanzhan, 1957 s.coll., 051 (PE).

**Excluded taxa and names**


*Gueldenstaedia australis* Leveille, Cat. Pl. Yunnan.: 30270105). The author thanks Dr. Y. Roskov for providing literature, Dr. de L. Rico Arce for helpful suggestions, Mr. Y. Cui, H. B. for parts of drawings and Drs. de L. Rico Arce, G. P. Lewis and B. Schrire for their help while visiting Kew. I am grateful to Gregory Kenicer for correcting the English in the manuscript.

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