
A New Species of *Rhodiola* (Crassulaceae) from Western Sichuan, China

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ABSTRACT. *Rhodiola wenchuanensis* Tao Li & Hao Zhang (Crassulaceae) is described and illustrated from Wenchuan County, in western Sichuan Province, China. The new species is related to *R. discolor* (Franch.) S. H. Fu, but differs in having smaller plants with densely puberulent stems and pedicels and sessile leaves. It is characterized by its obviously dentate leaf margins; a petal to stamen length ratio less than or equal to 1; crimson sepals, petals, and ripe fruits; and a carpel that is not developed in the staminate flower. The new species is assigned to series *Bupleuroides* (Frodin) S. H. Fu within section *Rhodiola* L. on the basis of its dioecy and its flowers in terminal corymbs with four or five erect, shortly oblong carpels with the apex not revolute and the base broad.

Key words: China, Crassulaceae, IUCN Red List, *Rhodiola*, sect. *Rhodiola*, Sichuan.

Rhodiola L. (Crassulaceae) consists of 96 species that are distributed mainly in alpine regions throughout the central Himalayan Mountains to the Qinghai-Tibetan Plateau and to the European Alps. Species in the genus are herbaceous perennials of alpine meadows, forests, and mountain glacier habitats. There are 73 species, two subspecies, and seven varieties in China (Fu, 1984). *Rhodiola* plants are mainly distributed in southwestern and northwestern China, with most taxa (32 species and two varieties) located in Tibet, and with 22 species in Sichuan Province (Wu, 1985; Ji et al., 2007). During fieldwork in 2006 and 2007 as part of the floristic survey of *Rhodiola* on the Qinghai-Tibetan Plateau in western Sichuan Province, three populations of an unknown taxon were collected first on Balang Mountain in Wenchuan County and later on Jiajin Mountain in Baoxing County. After comparison with specimens of the closely related species *R. discolor* (Franch.) S. H. Fu in CDBI, CDCM, KUN, LSDC, PE, SM, SZ, and WCU, it was decided to describe this material as a new species.

Rhodiola wenchuanensis Tao Li & Hao Zhang, sp. nov. TYPE: China, Sichuan: Wenchuan Co., Mt.

Balang, 3600–3700 m, 7 July 2006, T. Li 060707 (holotype, WCU). Figure 1.

Haec species quoad rhizomata gracilia et habitum dioecium *Rhodiolae discolori* (Franch.) S. H. Fu affinis, sed ab ea statura brevior, caulibus et pedicellis dense puberulis, foliis sessilibus margine dentatis, petalis staminibus brevioribus vel aequalibus, sepalis petalis et fructibus maturitate carmesinis atque floribus masculinis carpellis carentibus differt.

Perennial herb; rhizomes slender and horizontal, yellowish brown or dark brown, to 7 cm, 0.7–4 mm diam., apex covered with multiple layers of dark red-brown, trilateral, membranous scale leaves; roots very fine, to 5 cm, ca. 0.5 mm diam.; stems 2.5–9 cm tall, ca. 1 mm diam., single or rarely few per plant, erect, green-white, not branching, densely puberulent with unicellular simple trichomes. Leaves alternate, fleshy, ovate-elliptic or ovate, (2–)5–9(–15) × (1.5–)3–5(–6) mm, sessile, glabrous, apex acute or slightly obtuse, sometimes slightly involute, base cordate or rounded, margins obviously bidentate or tridentate in the upper 2/3 on each side, not revolute, adaxial surface dark green, glabrous, abaxial surface jade green, glabrous, the midrib not convex abaxially. Inflorescence a terminal corymb, rarely single, 2- to 16-flowered, dioecious with unisexual flowers, 0.4–1.8 × 0.6–3 cm, with leaflike bracts. Staminate flowers with longer pedicels, 2–9 mm, densely puberulent; sepals 5, crimson, triangular, ca. 0.5 mm; petals 5, crimson, narrowly oblong to oblong, 1.1–1.5 × 0.6–1 mm; stamens 10, filaments red, anthers yellow, rounded, those opposite the petals to 1.5 mm and inserted in the base of petals, when opposite the sepals to 1.8 mm, carpels undeveloped. Pistillate flowers with shorter pedicels, 1–4 mm, densely puberulent; sepals and petals each 5, crimson; sepals triangular, ca. 0.8 mm; petals oblong, ca. 1.2 × 0.3 mm; stamens absent; squamules in the base of carpels 4 or 5, square, ca. 0.5 × 0.5 mm, rounded or emarginate; carpels 4 or 5, oblong, erect, ca. 2.2 × 1 mm, carpels basally connate, each with a short style to 0.6 mm. Follicles erect, ca. 2.5 mm, 0.8–1 mm diam., connective ca. 1.5 mm in base, beak outward-curved, ca. 0.5 mm, crimson at maturity; seeds 7 to 10.

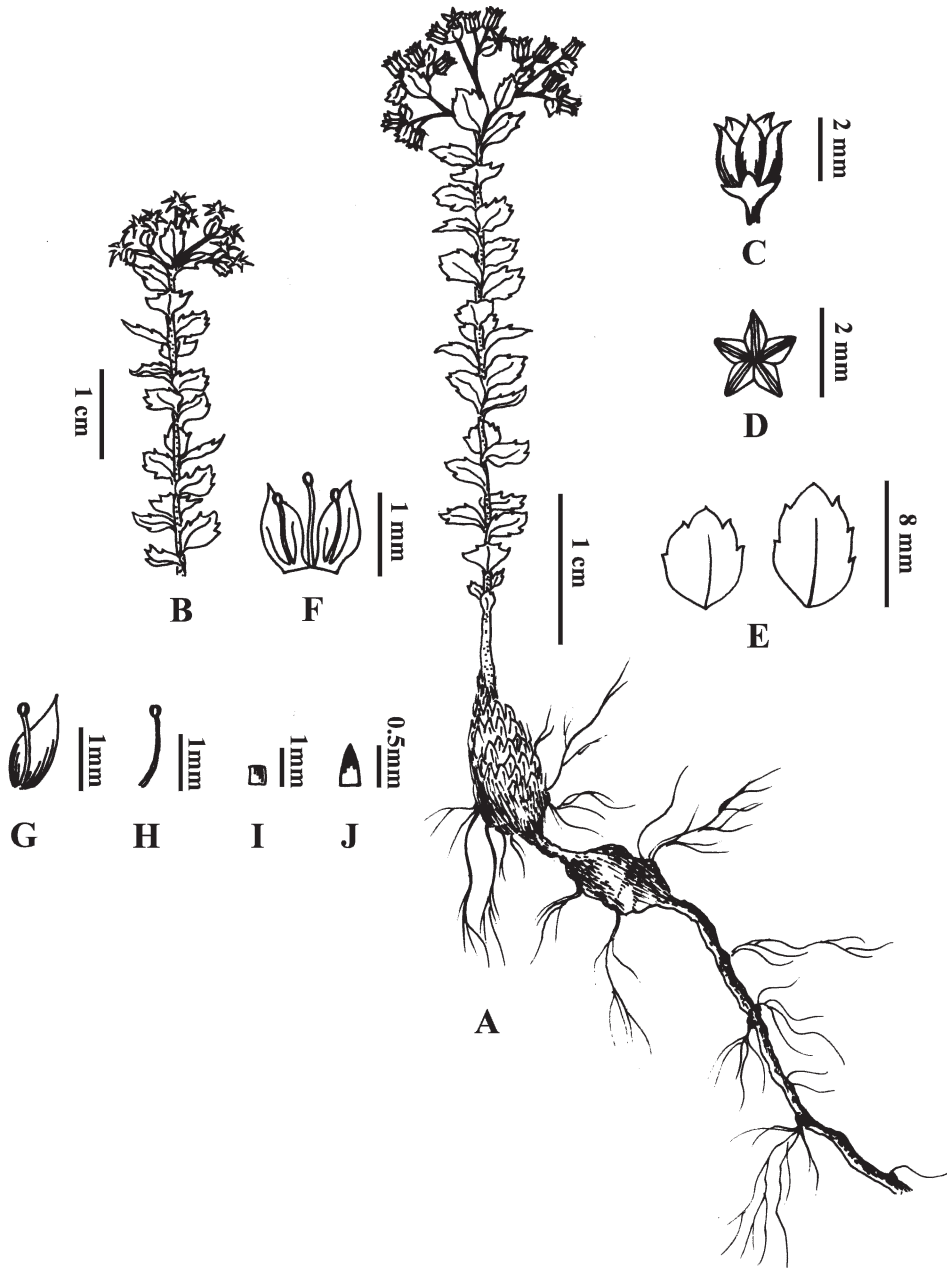


Figure 1. *Rhodiola wenchuanensis* Tao Li & Hao Zhang. —A. Fertile habit (♀). —B. Fertile habit (♂). —C. Fruit. —D. Fruit, viewed from above. —E. Leaves. —F. Partial corolla with three stamens. —G. Partial corolla with one stamen. —H. Stamen. —I. Squamule. —J. Sepal of staminate flower. Drawn from the holotype *T. Li 060707* (WCU).

Distribution and habitat. The new species was found in the Qinghai-Tibetan Plateau on Balang Mountain (Wenchuan County) and Jiajin Mountain (Baoxing County), both in western Sichuan Province, China. In 2006 and 2007, *Rhodiola wenchuanensis* was collected from mountain slopes, grasslands, alpine meadows, and rock crevices, from altitudes

ranging from 3600 to 3700 m. Thus far, three populations totaling about 600 individual plants have been found; of these, ca. 300 individual plants were found at the type locality.

IUCN Red List category. According to the current knowledge of the species, *Rhodiola wenchuanensis* is

Table 1. Morphological comparison of the diagnostic characteristics of *Rhodiola wenchuanensis* with the related species *R. discolor*.

Characters	<i>R. wenchuanensis</i>	<i>R. discolor</i>
Stem	2.5–9 cm high	12–40 cm high
Stem and pedicel	densely puberulent with unicellular simple trichomes	glabrous
Leaf margin	obviously bidentate or tridentate on each side, not revolute	entire or inconspicuous, revolute
Leaf shape	ovate-elliptic or ovate	ovate-lanceolate or linear-lanceolate to ovate
Petiole	absent	present, ca. 1 mm long
Midrib	not convex abaxially	distinctly convex abaxially
Inflorescence	2- to 16-flowered, 0.4–1.8 × 0.6–3 cm	10- to 82-flowered, 3–5 × 5–10 cm
Sepal	crimson (S, P); ca. 0.5 mm (S); ca. 0.8 mm (P)	green (S); green or with pale red (P); 1–2.5 mm (S, P)
Petal	crimson (S, P); 1.1–1.5 × 0.6–1 mm (S); ca. 1.2 × 0.3 mm (P)	pale red, 5–6 × 1.7–2 mm (S); green or with pale red, 3–4 × 0.9–1.2 mm (P)
P:S	≤ 1	2.5–4
Carpel	undeveloped (S)	erect development (S)
Fruit	crimson	green with purplish red at the apex

P, pistillate flower; P:S, length ratio of petal to stamen; S, staminate flower.

restricted to high mountains in western Sichuan Province, where three populations have been discovered in two localities; only one locality is currently within a national conservation area (Wolong National Natural Reserve). The species should be considered Endangered (EN) according to IUCN Red List criteria (IUCN, 2001), because the two localities on the Qinghai-Tibetan Plateau where it has been found are likely to suffer human disturbance due to increasing travel along the roads of Balang Mountain (Wenchuan County) and thriving tourism on Jiajin Mountain (Baoping County). In addition, the species may be affected by excessive grazing on the alpine meadows and by a gradual decline in the areas of available habitat. Strict conservation measures to safeguard the three known populations are urgently needed.

Phenology. Flowering was observed to occur in June and July, with fruiting in July and August.

Etymology. The specific epithet is derived from the type locality in Wenchuan County, Sichuan Province, China.

Affinities. *Rhodiola wenchuanensis* is assigned as a fourth species to *Rhodiola* sect. *Rhodiola* ser. *Bupleuroides* (Frodin) S. H. Fu, with three species previously known worldwide; all four of the species of series *Bupleuroides* are distributed in the Qinghai-Tibetan Plateau in western Sichuan Province, China. Taxa in series *Bupleuroides* have isomorphic, membranous scale leaves; stems single or rarely few per plant; alternate leaves; an inflorescence in a terminal corymb; dioecious plants with unisexual flowers and four or five erect, shortly oblong carpels; and the carpel with an apex that is not revolute, a broad base,

and a length to width ratio of 2:1. Two species previously known for series *Bupleuroides*, *R. purpureoviridis* (Praeger) S. H. Fu and *R. bupleuroides* (Wall. ex Hook. f. & Thomson) S. H. Fu, distinctly differ from *R. wenchuanensis* in the rhizome shape (obconic vs. linear in *R. wenchuanensis*), thickness (ca. 2 cm and ca. 3 cm, respectively, vs. ca. 4 mm diam. in *R. wenchuanensis*), and orientation (erect vs. horizontal in *R. wenchuanensis*); leaf shape (oblong-lanceolate and obovate-rotund, respectively, vs. ovate-elliptic in *R. wenchuanensis*); follicle length (ca. 6 mm and 4–10 mm, respectively, vs. ca. 2.5 mm in *R. wenchuanensis*); plant stature (15–40 cm and 5–60 cm, respectively, vs. 2.5–9 cm in *R. wenchuanensis*); and larger sepals and petals. The most closely related species with a morphology similar to the new taxon appears to be *R. discolor*, also within series *Bupleuroides*, which is sympatric with the new species in Sichuan Province. Both species share slender rhizomes; dioecious plants with the pistillate flowers with four or five erect, shortly oblong carpels with the apex not revolute and base broad; and flowers occurring in terminal corymbs. The new species *R. wenchuanensis* differs from *R. discolor* in its smaller stature (2.5–9 cm vs. 12–40 cm); densely puberulent stems and pedicels (vs. glabrous); the leaf margins obviously dentate and not revolute (vs. entire and revolute); the ratio of petal to stamen length less than or equal to 1 (vs. 2.5–4× longer); the crimson sepals, petals, and ripe fruits (vs. green with purplish red only at the apex); the carpels undeveloped in the staminate flowers (vs. developed); and the sessile leaves (vs. petiole ca. 1 mm long). A detailed comparison of *R. wenchuanensis* and *R. discolor* is provided in Table 1. Through additional fieldwork, we found plants of *R. wenchuanensis* to

have a stable, predictable set of morphological characters that recur in several distinct populations.

Paratypes. CHINA. **Sichuan:** Wenchuan Co., Mt. Balang, 10 July 2006, *T. Li 06071001* (WCU); Baoxing Co., Mt. Jiajin, 15 July 2007, *T. Li 07071501* (WCU).

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