

78. TRisetum Persoon, Syn. Pl. 1: 97. 1805.

三毛草属 san mao cao shu

Wu Zhenlan (吴珍兰); Sylvia M. Phillips

Perennials, tufted, sometimes shortly rhizomatous. Leaf blades narrowly to broadly linear, usually flat; ligule membranous. Inflorescence a moderately lax to spikelike panicle, shining. Spikelets with 2 or 3 florets, disarticulating below each floret; rachilla shortly bearded, extended beyond uppermost floret, tipped by a reduced or vestigial floret; glumes lanceolate, unequal or subequal, shorter than spikelet, keeled, herbaceous or membranous, margins broad, hyaline, lower glume 1(–3)-veined, upper glume 3-veined, apex acute or acuminate; floret callus glabrous or shortly bearded; lemmas lanceolate, laterally compressed, membranous to thinly leathery, 5-veined, glabrous, awned from above middle of back, apex 2-toothed, teeth often aristulate; awn geniculate with twisted column or merely outwardly curved; palea hyaline, slightly to distinctly shorter than lemma, gaping free from lemma margins. Ovary glabrous or almost so. Caryopsis with punctiform hilum; endosperm sometimes liquid.

About 70 species: temperate regions of the world except Africa, also on tropical mountains; 12 species (five endemic) in China.

- 1a. Culm below panicle and panicle branches pubescent to tomentose (except *T. altaicum*); panicle contracted to dense and spikelike; plants often less than 50 cm tall.
 - 2a. Culm glabrous; panicle branches smooth, glabrous 1. *T. altaicum*
 - 2b. Culm pubescent to tomentose; panicle branches pubescent.
 - 3a. Plant rhizomatous; culms stout, 2–3 mm thick; panicle scarcely exerted from uppermost leaf sheath 2. *T. kangdingense*
 - 3b. Plant tufted; culms slender, 0.5–2 mm thick; panicle clearly exerted from uppermost leaf sheath.
 - 4a. Palea keels densely ciliate; ovary pilose 5. *T. debile*
 - 4b. Palea keels scabrid; ovary glabrous.
 - 5a. Panicle dense, spikelike, cylindrical to ovoid, 1.5–11 cm; branches erect, appressed; glumes and lemmas lanceolate; anthers 0.7–1.3 mm 3. *T. spicatum*
 - 5b. Panicle contracted but not dense and spikelike, lanceolate to subcylindrical, 5–18 cm; branches usually obvious, slightly spreading; glumes and lemmas narrowly lanceolate; anthers 1.3–1.6 mm ... 4. *T. clarkei*
- 1b. Culm and panicle branches glabrous; panicle lax; plants often more than 40 cm tall.
 - 6a. Floret callus hairy.
 - 7a. Lemmas conspicuously punctate-scabrid; palea 1/2–2/3 lemma length 6. *T. bifidum*
 - 7b. Lemmas smooth; palea subequal to lemma 7. *T. yunnanense*
 - 6b. Floret callus glabrous.
 - 8a. Panicle branches single or paired; awns 9–14 mm, geniculate with twisted column; anthers 1–1.5 mm 8. *T. scitulum*
 - 8b. Panicle branches in whorls of 3–8; awns 4.5–9 mm, recurved or basally slightly twisted; anthers 2–3 mm.
 - 9a. Culm stout, 4–5 mm in diam.; lemmas pale yellowish green, herbaceous with broad hyaline margins 9. *T. henryi*
 - 9b. Culm slender, 1.5–3 mm in diam.; lemmas brown at maturity, firm with narrow margins.
 - 10a. Florets 2–4; lemmas 5–7 mm; awns up to 9 mm, strongly recurved 10. *T. sibiricum*
 - 10b. Florets 1 or 2; lemmas 4.5–5.5 mm; awns up to 6.5 mm, recurved or straight.
 - 11a. Margins of leaf sheaths joined below middle; awns almost straight 11. *T. umbratile*
 - 11b. Margins of leaf sheaths joined to middle or above; awns recurved 12. *T. pauciflorum*

1. *Trisetum altaicum* Roshevitz, Bot. Mater. Gerb. Glavn. Bot. Sada RSFSR 3: 85. 1922.

高山三毛草 gao shan san mao cao

Perennial, loosely tufted, shortly rhizomatous. Culms erect from ascending base, 15–45 cm tall, glabrous, 2–3-noded. Leaf sheaths pilose; leaf blades flat, 10–15 cm, 2–4 mm wide, pilose on both surfaces or only on margins; ligule 2–3 mm. Panicle contracted, fairly dense, linear to narrowly lanceolate-oblong in outline, 4–9 cm, greenish brown tinged violet; branches erect, up to 2.5 cm, smooth or rarely scaberulous. Spikelets 5–7 mm, florets 2 or 3; rachilla hairs 0.5–1 mm; glumes unequal, lower glume 3–4 mm, upper glume 4–5 mm, apex acuminate; lemmas ca. 5 mm, punctately scabrid; awned from slightly above middle to upper 1/3, apex 2-denticulate, teeth mucronate; awn 4–8 mm, recurved, lower part slightly twisted; palea keels scabrid.

Anthers 0.8–1.2 mm. Fl. Jun–Sep. $2n = 14$.

Alpine meadows, among rocks in coniferous forests, grassy mountain slopes; 1900–2800 m. Xinjiang [E Kazakhstan, Mongolia, Russia (Siberia)].

2. *Trisetum kangdingense* (Z. L. Wu) S. M. Phillips & Z. L. Wu, **comb. et stat. nov.**

康定三毛草 kang ding san mao cao

Basionym: *Trisetum clarkei* (J. D. Hooker) R. R. Stewart var. *kangdingense* Z. L. Wu, Acta. Biol. Plateau Sin. 2: 16. 1984 [*“kangdingensis”*].

Perennial with slender rhizomes. Culms usually solitary, erect from ascending base, 40–50 cm tall, 2–3 mm in diam., pubescent below panicle, 2–3-noded. Leaf sheaths longer than internodes, loose, lower sheaths pilose; leaf blades broadly

linear, flat, 7–10 cm, 4–5 mm wide, scaberulous on both surfaces and margins; ligule 1.5–3 mm, truncate, margin ciliate. Panicle scarcely exerted from uppermost leaf sheath, dense, elliptic in outline, lobed, 12–15 cm, pale yellowish; branches erect or slightly spreading, pubescent, densely clothed in branchlets and spikelets, lowest 6–8 cm. Spikelets 5.5–6 mm, florets 3; rachilla hairs ca. 1 mm; glumes slightly unequal, acuminate, lower glume narrowly lanceolate, ca. 5 mm, upper glume narrowly elliptic-oblong, 5.7–5.9 mm; lemma narrowly lanceolate-oblong, 5–5.3 mm, scabrid, awned from upper 1/4, apex entire; awn 3.2–3.4 mm, almost straight, slightly recurved at base, not twisted; palea keels scabrid. Anthers 1–1.1 mm. Fl. Aug.

- Damp ground near water; 3000–3700 m. Qinghai, Sichuan.

The spikelets of this species are the same as those of some forms of *Trisetum spicatum*, but it is excluded from both *T. spicatum* and *T. clarkei* by its strikingly more robust rhizomatous habit and large, dense, scarcely exerted panicles.

3. *Trisetum spicatum* (Linnaeus) K. Richter, Pl. Eur. 1: 59. 1890.

穗三毛 sui san mao

Perennial, densely tufted. Culms erect, 3–60 cm tall, 1–2 mm in diam., pubescent to tomentose especially below panicle, 1–3-noded. Leaf sheaths pubescent; leaf blades flat or rolled, 2–15 cm, 2–4 mm wide, densely to sparsely hairy on both surfaces or only abaxial surface, or glabrous, margins often setose; ligule 1–2 mm. Panicle spikelet-like, dense, linear to ovate or oblong in outline, lower part sometimes interrupted, 1.5–11 cm; branches short, appressed, pubescent to tomentose. Spikelets 4–9 mm, florets 2(or 3); rachilla hairs 1–1.5 mm; glumes subequal or slightly unequal, lower glume 4–8 mm, upper glume 5–9 mm, apex acuminate, occasionally briefly aristulate; lemmas lanceolate, 4–7 mm, scaberulous to pubescent, awned from upper 1/4–1/3, apex usually 2-denticulate, teeth often mucronate, occasionally subentire; awn 2–7 mm, weakly geniculate with loosely twisted column, or recurved at base, or almost straight; palea keels scaberulous. Anthers 0.7–1.3 mm. Fl. and fr. Jun–Sep.

Grassy mountain slopes, alpine meadows, on glacial moraine, among bushes, montane forests; 1900–5600 m. Gansu, Hebei, Heilongjiang, Hubei, Jilin, Liaoning, Nei Mongol, Ningxia, Qinghai, Shaanxi, Shanxi, Sichuan, Taiwan, Xinjiang, Xizang, Yunnan [Afghanistan, Bhutan, N India, Japan, Kazakhstan, Kyrgyzstan, Korea, Mongolia, Nepal, Pakistan, Russia, Tajikistan, Uzbekistan; SW Asia (Caucasus), Australia, Europe, North and South America].

This extremely polymorphic species is one of the most widespread of all flowering plants, being present in arctic and alpine parts of all continents except Africa. A large number of subspecies and varieties has been described, and these are only weakly correlated with geography. In spite of difficulties in applying infraspecific names, it seems unacceptable to include the very large range of forms present in China without subdivision under a single species name. Therefore subspecific names that have previously been applied are maintained here to indicate the main nodes of variation. However, variation is still very imperfectly understood, especially in the Himalayas, and it is not possible to place all specimens within the given subspecies descriptions.

- 1a. Plant up to 50 cm tall; panicle 5–11 cm, linear to narrowly elliptic or oblong,

often interrupted below, pointed at apex, usually greenish or brownish.

- 2a. Lowest lemma 4–5.5 mm, awn 3–5 mm; spikelets usually with 2 florets 3d. subsp. *virescens*
- 2b. Lowest lemma 5–7 mm, awn 5–7 mm; spikelets with 2 or 3 florets 3e. subsp. *alaskanum*
- 1b. Plant up to 30 cm tall; panicle 1.5–5 cm, oblong to ovate, dense, not interrupted, rounded at apex, usually purple or grayish.
 - 3a. Lemmas densely pubescent; plant 3–12 cm tall; leaf blades tomentose 3b. subsp. *tibeticum*
 - 3b. Lemmas scaberulous to puberulous; plant up to 30 cm tall; leaf blades pubescent to glabrous.
 - 4a. Panicle narrowly oblong; awn 4–6 mm 3a. subsp. *spicatum*
 - 4b. Panicle ovate or oblong-ovate; awn 3–4 mm 3c. subsp. *mongolicum*

3a. *Trisetum spicatum* subsp. *spicatum*

穗三毛(原亚种) sui san mao (yuan ya zhong)

Aira spicata Linnaeus, Sp. Pl. 1: 64. 1753; *A. subspicata* Linnaeus, nom. illeg. superfl.; *Trisetum subspicatum* (Linnaeus) P. Beauvois, nom. illeg. superfl.

Plant up to 30 cm tall. Culms, leaf blades, and sheaths nearly glabrous to densely pubescent. Panicle narrowly oblong, 2–4 cm, usually purplish or brownish, dense. Spikelet with 2 florets; lower glume 4–5.5 mm, keel scabrid, upper glume 5–6 mm; lowest lemma 4–5 mm, smooth or scaberulous; awn 4–6 mm, weakly geniculate, twisted below. Fl. and fr. Jun–Sep.

Grassy mountain slopes, alpine meadows; above 1900 m. Gansu, Hebei, Heilongjiang, Hubei, Jilin, Liaoning, Nei Mongol, Ningxia, Qinghai, Shaanxi, Shanxi, Sichuan, Xinjiang [Russia; Europe, North America].

This is a panarctic taxon, extending southward into the mountains of C Asia and W North America. It is not known from the Himalayas.

3b. *Trisetum spicatum* subsp. *tibeticum* (P. C. Kuo & Z. L. Wu) Dickoré, Stapfia 39: 201. 1995.

西藏三毛草 xi zang san mao cao

Trisetum tibeticum P. C. Kuo & Z. L. Wu, Fl. Xizang. 5: 188. 1987.

Plant 3–12 cm. Culms woolly, leaf blades and sheaths tomentose. Panicle ovate to oblong, dense, 1.7–3 cm, usually purplish or brownish. Spikelets with 2 florets; lower glume 4–7 mm, keel sometimes hispid, upper glume 5–7 mm; lowest lemma 4.8–5 mm, densely pubescent, apex 2-denticulate-aristulate; awn 5–5.6 mm, weakly geniculate, twisted below. Fl. and fr. Jun–Sep.

- Among boulders, glacial moraines; 4800–5500 m. Xizang.

Plants from very high altitudes in Xizang are distinguished by their low stature, extremely hairy leaves and culms, and especially by their pubescent lemmas. They grade into subsp. *mongolicum* through

forms with shorter hairs on the lemma back and less densely hairy leaves and culms.

3c. *Trisetum spicatum* subsp. *mongolicum* Hultén ex Veldkamp, Gard. Bull. Singapore 36: 135. 1983.

蒙古穗三毛 meng gu sui san mao

Plant 9–20 cm. Culms pubescent, leaf blades and sheaths glabrous to densely pubescent. Panicle elliptic-oblong to ovate, dense, 1.5–2.5 cm, greenish or brownish, rarely purple. Spikelets with 2 florets, lower glume 4–5.5 mm, upper glume 4.6–6.3 mm; lowest lemma 5–6 mm, scaberulous to shortly pubescent, apex entire or 2-denticulate-aristulate; awn 2–4 mm, straight or outwardly curved at base, not twisted. Fl. and fr. Jun–Sep.

Grassy mountain slopes, alpine meadows, among shrubs; 2000–5200 m. Nei Mongol, Qinghai, Sichuan, Xinjiang, Xizang [Bhutan, India (Sikkim), Kyrgyzstan, Mongolia, Russia (Siberia)].

This is a less hairy form than subsp. *tibeticum*, distinguished also by its relatively short, almost straight awns. Some specimens from above 5000 m in Xizang match subsp. *mongolicum* except for their longer (5–6 mm), twisted awns.

“*Trisetum spicatum* var. *mongolicum* (Hultén) P. C. Kuo & Z. L. Wu,” as given in FRPS (9(3): 140. 1987), was not validly published because “*T. spicatum* subsp. *mongolicum* Hultén” (Svensk Bot. Tidskr. 53: 214. 1959), on which it was based, was also not validly published because no type was indicated.

3d. *Trisetum spicatum* subsp. *virescens* (Regel) Tzvelev, Novosti Sist. Vyssh. Rast. 7: 65. 1971 [“1970”].

喜马拉雅穗三毛 xi ma la ya sui san mao

Avena flavescens var. *virescens* Regel, Bull. Soc. Imp. Naturalistes Moscou 41(2): 299. 1868; *A. virescens* (Regel) Regel; *Trisetum spicatum* subsp. *himalaicum* Hultén ex Veldkamp; *T. virescens* (Regel) Roshevitz (1924), not Nees ex Steudel (1854).

Plant (20–)30–60 cm. Culms pubescent, leaf blades and sheaths densely pubescent to glabrous. Panicle linear to narrowly oblong, often interrupted below, 5–7(–11) cm, green or brownish. Spikelets with 2(–3) florets; lower glume 3.5–4.8 mm, upper glume 4.3–5.6 mm; lowest lemma 4–5.5 mm, scaberulous, apex entire or 2-denticulate; awn 3–5 mm, outwardly curved near base, not twisted.

Alpine grasslands, meadows, often on damp sand or gravel; 3200–5000 m. Qinghai, Sichuan, Xinjiang, Xizang, Yunnan [Bhutan, N India, Kazakhstan, Kyrgyzstan, Nepal, N Pakistan, Tajikistan].

“*Trisetum spicatum* var. *himalaicum* (Hultén) P. C. Kuo & Z. L. Wu,” as given in FRPS (9(3): 141. 1987), was not validly published because “*T. spicatum* subsp. *himalaicum* Hultén” (Svensk Bot. Tidskr. 53: 213. 1959), on which it was based, was also not validly published because no type was indicated.

3e. *Trisetum spicatum* subsp. *alaskanum* (Nash) Hultén, Svensk Bot. Tidskr. 53: 210. 1959.

大花穗三毛 da hua sui san mao

Trisetum alaskanum Nash, Bull. New York Bot. Gard. 2: 155. 1901; *T. formosanum* Honda; *T. spicatum* var. *alaskanum*

(Nash) Malte ex Louis-Marie; *T. spicatum* subsp. *formosanum* (Honda) Veldkamp; *T. spicatum* var. *formosanum* (Honda) Ohwi.

Plant up to 60 cm tall. Culms pubescent, leaf blades and sheaths glabrous or pilose. Panicle linear-elliptic, dense or slightly loose toward base, 5–11 cm, green or brownish. Spikelets with 2 or 3 florets; lower glume 5–8 mm, upper glume 5.5–9 mm; lowest lemma 5–7 mm, scabrid apex acute or 2-dentate; awn 5–7 mm, slightly outwardly curved, not twisted. Fl. and fr. Jun–Sep.

Gravel slopes, alpine meadows; 3800–5600 m. Sichuan, Taiwan, Xizang, Yunnan [Bhutan, India (Sikkim), Japan, Korea, Russia (Far East); North America (Canada, United States)].

This is the most robust member of the complex in China and has the largest spikelets. It has a general distribution along the mountain chains on both sides of the N Pacific, but specimens with these dimensions also occur in the Himalayas, where it intergrades with subsp. *virescens*. Conversely, specimens with the slightly smaller spikelet dimensions of subsp. *virescens* are known from Tianjin.

A robust form from Kashmir with pubescent lemmas has been named *Trisetum spicatum* var. *pubiflorum* (Hackel) L. Liu (*T. pubiflorum* Hackel). This has also been reported from the Hengduan Shan.

4. *Trisetum clarkei* (J. D. Hooker) R. R. Stewart, Brittonia 5: 431. 1945.

长穗三毛草 chang sui san mao cao

Avena clarkei J. D. Hooker, Fl. Brit. India 7: 278. 1896 [“1897”].

Perennial, loosely tufted. Culms erect from ascending base, (30–)50–70 cm tall, 0.5–1 mm in diam., pubescent especially below panicle, 1–3-noded. Leaf sheaths pubescent; leaf blades flat, 5–20 cm, 1.5–2(–4) mm wide, pubescent or scaberulous; ligule 1–2 mm. Panicle contracted, linear to lanceolate in outline, usually slightly loose, at least lower branches obvious, 5–18 cm, brown, green, or yellowish green; branches slender, erect or slightly spreading, pubescent. Spikelets 4–8.5 mm, florets 2 or 3; rachilla hairs ca. 1.5 mm; glumes unequal, narrowly lanceolate, lower glume 4–6 mm, upper glume 5–7.5 mm, apex sharply acute; lemmas narrowly lanceolate, 3.5–7 mm, scabrid, awned from near upper 1/3, apex usually 2-denticulate, teeth mucronate, occasionally subentire; awn strongly recurved at base, 4–8 mm, fine, not twisted; palea keels scabrid. Anthers 1.3–1.6 mm. Fl. Jul–Sep.

Montane forests, among bushes, moist grassy mountainsides; 1900–4300 m. Gansu, Hubei, Qinghai, Shaanxi, Sichuan, Xinjiang, Xizang, Yunnan [E Afghanistan, NW India, Kashmir, Pakistan].

The boundary between *Trisetum spicatum* and *T. clarkei* is obscured by intermediates, which are probably the result of introgression between the two species. *Trisetum clarkei* tends to be a taller, more slender grass, with a slightly looser panicle of narrower spikelets with well-exserted awns.

5. *Trisetum debile* Chrték, Folia Geobot. Phytotax. 25: 334. 1990.

柔弱三毛草 rou ruo san mao cao

Perennial. Culms slender, base ascending, ca. 25 cm tall,

ca. 0.8 mm in diam., glabrous or appressed-pubescent, densely appressed-pilose with longer spreading hairs below panicle, 3-noded. Leaf blades narrowly linear, ca. 4 cm, 1–1.2 mm wide, both surfaces pubescent with scattered longer hairs, convolute toward acuminate apex; ligule ca. 0.7 mm. Panicle lanceolate in outline, dense, ca. 4 cm, with few spikelets; branches short, densely pubescent with scattered longer spreading hairs; pedicels ca. 2 mm. Spikelets 5–6 mm, florets 2, green or straw-colored; rachilla pilose; glumes lanceolate, unequal, scabrid on keel, apex aristulate, lower glume 3–4 mm, 3-veined, upper glume 4–4.5 mm, 5-veined; lemmas 4–4.5 mm, inconspicuously 5-veined, keel scaberulous, awned from upper 1/3, apex 2-toothed; awn 5–7 mm, geniculate or recurved; palea subequal to lemma, keels densely ciliate. Ovary thinly pilose in upper part. Fl. Aug.

- Habitat unknown; ca. 3400 m. NW Yunnan.

This species is known only from the type gathering, which has not been seen.

6. *Trisetum bifidum* (Thunberg) Ohwi, Bot. Mag. (Tokyo) 45: 191. 1931.

三毛草 san mao cao

Bromus bifidus Thunberg in Murray, Syst. Veg., ed. 14, 119. 1784; *Avena bifida* (Thunberg) P. Beauvois; *Trisetum flavescens* (Linnaeus) P. Beauvois var. *bifidum* (Thunberg) Makino; *T. flavescens* var. *macranthum* Hackel; *T. flavescens* var. *papillosum* Hackel.

Perennial, tussocky. Culms erect or geniculate at base, 30–100 cm tall, glabrous, 2–5-noded. Leaf sheaths usually shorter than internodes, glabrous or pilose, margins joined in lower part; leaf blades flat, soft, up to 20 cm, 3–6 mm wide, glabrous or occasionally pilose; ligule 0.5–2 mm. Panicle lax, oblong to lanceolate-oblong in outline, 10–25 cm, often nodding, yellow-green or brown green; branches 2 or 3 at basal node, scaberulous, lowest up to 10 cm. Spikelets 6–8 mm, florets 2 or 3; rachilla hairs 0.2–0.5 mm; glumes unequal, lower glume 2–3.5 mm, upper glume 4–7 mm, apex acuminate; callus pubescent; lemmas 5–7 mm, firm, golden brown, punctate-scabrid, awned from upper 1/4, apex 2-toothed, teeth 1–2 mm, aristulate; awn 7–10 mm, fine, strongly recurved near base, not twisted; palea 1/2(–2/3) length of lemma, keels conspicuously convex, ciliate. Anthers 0.5–1 mm. Fl. Apr–Jun.

Forests, roadsides, moist grassy ditch banks; 500–2500 m. Anhui, Fujian, Gansu, Guangdong, Guangxi, Guizhou, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Shaanxi, Shandong, Sichuan, Taiwan, Xizang, Yunnan, Zhejiang [Japan, Korea, New Guinea].

7. *Trisetum yunnanense* Chrtk, Folia Geobot. Phytotax. 25: 334. 1990.

云南三毛草 yun nan san mao cao

Perennial, tufted, shortly stoloniferous. Culms 26–35 cm tall, ca. 1.5 mm in diam., glabrous, 2–3-noded. Leaf sheaths scabrid, pubescent with longer hairs toward blade; leaf blades linear, gray-green, 4–10 cm, 2–3 mm wide, abaxial surface prominently veined, both surfaces scaberulous, often pilose, margins long ciliate, apex acuminate; ligule 1.5–3 mm, margin ciliate. Panicle lanceolate in outline, fairly dense, 7–9 cm, spikelets many; branches scabrid; pedicels 2–6 mm, scabrid.

Spikelets 6.5–9 mm, florets 3, uppermost reduced, green or violet tinged; rachilla densely pilose; glumes unequal, keel scabrid, margins narrowly hyaline, apex acuminate-aristulate, lower glume lanceolate, 4–5 mm, 1-veined, upper glume elliptic, 5–6.5 mm, 3-veined; callus hairs ca. 0.8 mm; lowest lemma 6.5–7 mm, upper part often violet-colored, keel scabrid, apex 2-toothed; awn 12–16 mm, geniculate or rarely recurved; palea subequal to lemma. Anthers 1.8–2.2 mm. Ovary long-pilose in upper part.

- Dry meadows; ca. 3000 m. Yunnan.

The hairy ovary is unusual in *Trisetum*. The type has not been seen.

8. *Trisetum scitulum* Bor, Kew Bull. [11] 1956: 212. 1956.

优雅三毛草 you ya san mao cao

Avena flavescens J.D. Hooker (1896), not Linnaeus (1753).

Perennial, loosely tufted. Culms erect from geniculate base, 12–80 cm tall, 1.5–2 mm in diam., glabrous, 2–3-noded. Leaf sheaths usually shorter than internodes, glabrous, margins joined near base; leaf blades flat, soft, 10–20 cm, 2–8 mm wide, adaxial surface scattered pilose; ligule 1–4 mm. Panicle lax, lanceolate in outline, 7–15 cm, gray-green, brown or purplish; branches 1–3 at basal node, capillary, flexuous, smooth, glabrous, up to 5 cm. Spikelets 6.5–9 mm, florets 1–3; rachilla filiform, villous; glumes unequal, narrowly lanceolate, lower glume 4.5–5.3 mm, upper glume 6–7.2 mm, apex finely acuminate; callus glabrous; lemmas 6.5–8 mm, firm, golden brown, scaberulous around keel, otherwise smooth, awned from upper 1/4–1/3, apex 2-toothed, teeth 2.5–3 mm, slenderly acuminate-aristulate; awn 9–14 mm, weakly geniculate, column twisted; palea 1/2–2/3 length of lemma, keels slightly convex, scabrid. Anthers 1–1.5 mm. Fl. Jul–Sep.

Alpine scrub, meadows, gravel river banks; 4000–5000 m. Sichuan, Xizang, Yunnan [Bhutan, India (Sikkim), E Nepal].

This is a locally distributed, high-altitude species with a slender habit and large, brown, long-awned spikelets.

9. *Trisetum henryi* Rendle, J. Linn. Soc., Bot. 36: 400. 1904.

湖北三毛草 hu bei san mao cao

Perennial, shortly rhizomatous; roots thick, villous. Culms stout, rooting at lower nodes, ascending, 80–140 cm tall, 4–5 mm in diam., glabrous, 5–9-noded. Leaf sheaths longer than internodes, lower pubescent, usually closed to above middle, upper glabrous, outer margin ciliate; leaf blades broadly linear, 15–35 cm, 5–15 mm wide, scabrid or adaxial surface puberulent, margins stiffly ciliate toward ligule; ligule brown, thick, 1–2 mm. Panicle lax, elliptic to narrowly elliptic-oblong in outline, 10–22 cm, much branched, densely spiculate, silvery yellowish green; branches 4–6 or more at lowest node, smooth, longest 6–8 cm. Spikelets 5–7 mm, florets 2 or 3; rachilla hairs 1–1.2 mm; glumes unequal, lower glume 3–4 mm, upper glume 4–6 mm; callus glabrous; lemmas thinly herbaceous with broad hyaline margins, 5–6 mm, finely scabrid, awned from middle to upper 1/3, apex subentire, 2-mucronate; awn 4.5–6 mm, recurved or with short twisted column; palea 3/4 lemma length,

keels scaberulous. Anthers 2.5–3 mm. Fl. and fr. Jun–Sep.

• Grassy roadsides, damp places in forests; below 2400 m. Anhui, Henan, Hubei, Jiangsu, Jiangxi, Shaanxi, Shanxi (Ruicheng, Yuanqu), SE Sichuan, Zhejiang (Lin'an).

This is the most robust species in China, remarkable for its thick, hairy roots, stout culms, large panicle of pale spikelets, and thin-textured spikelets.

10. *Trisetum sibiricum* Ruprecht, Beitr. Pflanzenk. Russ. Reiches 2: 65. 1845.

西伯利亚三毛草 xi bo li ya san mao cao

Trisetum flavescens (Linnaeus) P. Beauvois subsp. *sibiricum* (Ruprecht) T. Koyama; *T. flavescens* var. *sibiricum* (Ruprecht) Ohwi.

Perennial, loosely tufted, shortly rhizomatous. Culms solitary or few, 50–120 cm tall, 1.5–3 mm in diam., glabrous, 3–4-noded. Leaf sheaths mostly shorter than internodes, glabrous or lower shortly pubescent, margins joined near base; leaf blades broadly linear, 6–20 cm, 4–9 mm wide, glabrous or adaxial surface scattered pilose, ligule 1–2 mm. Panicle lax, narrowly oblong to lanceolate in outline, 10–20 cm, much branched, yellowish brown; branches 3–8 at lowest node, slightly scabrid, up to 6 cm. Spikelets 5–10 mm, florets 2–4; rachilla hairs ca. 1 mm; glumes unequal, lower glume 4–6 mm, upper glume 5–8 mm, apex acuminate; callus glabrous or with few very short hairs; lemmas 5–7 mm, firm, golden brown, finely but densely scabrid, awned from upper 1/3, apex 2-toothed, teeth triangular; awn 5–9 mm, strongly recurved, lower part straight or slightly twisted; palea 3/4 lemma length or longer, keels indistinctly scaberulous. Anthers 2–3 mm. Fl. and fr. Jun–Aug.

Grassy mountain slopes, open forest, marshy places among shrubs; 700–4200 m. Gansu, Hebei, Heilongjiang, Henan, Hubei (Shennongjia), Jilin, Liaoning, Nei Mongol, Ningxia, Qinghai, Shaanxi, Shanxi, Sichuan, Xinjiang, Xizang [Japan, Kazakhstan, Korea, Mongolia, Russia; SW Asia (Caucasus), E Europe, North America (Alaska)].

This species is a good forage grass, closely related to *Trisetum flavescens* (Linnaeus) P. Beauvois from Europe. *Trisetum flavescens* has been introduced into many temperate countries for forage. It can be distinguished from *T. sibiricum* by its pilose lower leaf sheaths, geniculate awn with twisted column, and bearded callus.

11. *Trisetum umbratile* (Kitagawa) Kitagawa, J. Jap. Bot. 31: 302. 1956.

绿穗三毛草 lü sui san mao cao

Trisetum sibiricum Ruprecht var. *umbratile* Kitagawa, Rep. Inst. Sci. Res. Manchoukuo 4: 77. 1940; *T. sibiricum* subsp. *umbratile* (Kitagawa) Tzvelev.

Culms erect, slender, 70–90 cm tall, glabrous. Leaf sheaths equaling or shorter than internodes, glabrous, outer margin ciliate at mouth, margins closed near base; leaf blades linear, 8–30 cm, 2–7 mm wide, scabrid; ligule 1–2 mm. Panicle lax, broadly lanceolate in outline, up to 22 cm, green; branches capillary, smooth in lower part, upper part scabrid. Spikelets 4–5(–6) mm, florets 1 or 2; rachilla hairs ca. 1.4 mm; glumes un-

equal, lower glume oblong-lanceolate, 2.5–4 mm, upper glume oblong, 4–5 mm; lemmas 4.5–5.5 mm, scabrid-papillose, awned from above middle, apex 2-toothed, teeth ca. 1.5 mm, acute; awn up to 6.5 mm, straight or almost so, not twisted; palea keels indistinctly scaberulous. Anthers ca. 2 mm. Fl. and fr. Jul–Sep.

Marshy meadows and in forest. Heilongjiang, Jilin, Liaoning, Nei Mongol (Yakeshi) [Korea, Russia (Ussuri)].

This is a locally distributed variant of *Trisetum sibiricum* with small spikelets and almost straight awns.

12. *Trisetum pauciflorum* Keng, Fl. Tsinling, 1(1): 441. 1976.

贫花三毛草 pin hua san mao cao

Perennial, shortly rhizomatous. Culms erect from ascending base, 50–100 cm tall, 2–2.5 mm in diam., glabrous, 4–7-noded. Leaf sheaths closed up to middle or more, basal sheaths longer than internodes, upper shorter, glabrous, sometimes ciliate at margin and mouth; leaf blades soft, 15–30 cm, 5–8 mm wide, smooth or scabrid; ligule brown, ca. 1 mm. Panicle lax, lanceolate-oblong in outline, ca. 15 cm, much branched with many spikelets, silvery brown or purplish; branches whorled, smooth, up to 5 cm. Spikelets 4.5–5.5 mm, florets 1 or 2;

glumes unequal, lower glume 2.5–3 mm, upper glume 4–4.5 mm; rachilla hairs ca. 1.5 mm; lemmas 4.5–5 mm, scabrid-papillose, awned from upper 1/3, apex subentire; awn 3–4 mm, recurved and slightly twisted near base; palea keels scaberulous. Anthers ca. 2.5 mm. Fl. and fr. Jul–Aug.

- Moist shady places in valleys, woodland margins on mountainsides; 1600–2100 m. Henan, Shaanxi, Sichuan.

This is a little-known variant close to *Trisetum sibiricum* and perhaps does not merit specific rank. It has small spikelets like those of *T. umbratile*, but with recurved awns, and occurs outside the known distribution of that taxon.

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