

CALLITRICHACEAE

水马齿科 shui ma chi ke

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Submersed, amphibious, or terrestrial herbs, rooted at nodes when terrestrial or at plant base when aquatic; stem slender. Leaves opposite, decussate, exstipulate, linear or spatulate, notched at apex, entire or very rarely toothed, somewhat congested toward apex of stems reaching water surface, to form a rosette; leaf bases often joined by a ridge of tissue extending across node, always with a midvein, often with a series of secondary veins anastomosing or looped and interconnected; scales (often described as glandular) on stems, leaves, and in leaf axils, with a short stalk and those on stem and leaves with a disk of radiating cells, those in leaf axils fan-shaped. Plants monoecious, or rarely dioecious. Flowers imperfect, minute, axillary, carpellate and staminate sometimes in same axil in various combinations; perianth absent; a subtending pair of bracts present in some species; carpellate flowers bicarpellate, often abaxial to staminate flower, stigmas 2, erect or reflexed, papillate; staminate flowers solitary, filament short or long, anther dehiscing laterally by longitudinal slits; pollen spheroidal, angular, or elongate, with 1 or more leptomata, exine intectate [or absent], sculpturing of pointed or rounded microgemmae or these absent. Fruits schizocarps, separating into 4 nutlets; nutlets dry, winged or not, wings from inner fruit layer.

One genus and ca. 75 species: widely distributed worldwide; eight species (one endemic) in China.

Ming Tien lu. 1980. Callitrichaceae. In: Cheng Mien & Ming Tien lu, eds., Fl. Reipubl. Popularis Sin. 45(1): 11–14.

1. CALLITRICHE Linnaeus, Sp. Pl. 2: 969. 1753.

水马齿属 shui ma chi shu

Morphological characters and geographical distribution are the same as those of the family.

The name *Callitriche stagnalis* Scopoli has been misapplied E of the Ural mountains of Russia. In China it has mainly been applied to *C. fehmedianii*.

In 1966, *Callitriche alata* A. I. Baranov & Skvortsov was described, based on a single specimen. The description is insufficient to separate it from other taxa occurring in the region; few details of reproductive features are provided and could apply to *C. fuscicarpa*, *C. palustris* var. *oryzeterum*, or *C. raveniana*. The details of the holotype are also very sparse, and it is not clear how easy it might be to recognize it if it is represented in other herbaria.

1a. Fruit wingless.

2a. Bracts lacking; fruits expanded at base to form ridge (strumose) 6. *C. peploides*

2b. Bracts present; fruits not expanded at base.

3a. Bracts large and ovate; leaf venation simple 4. *C. palustris*

3b. Bracts as long as fruit but narrow; leaf venation complex 3. *C. fuscicarpa*

1b. Fruit clearly winged.

4a. Fruit widest in upper half, tapering from above midpoint to base.

5a. Bracts lacking; leaves very uniform with 3 main veins 5. *C. japonica*

5b. Bracts present; leaves variable with 1 to many veins 4. *C. palustris*

4b. Fruit widest at or near middle.

6a. Fruit winged only at top 7. *C. glareosa*

6b. Fruit winged all around.

7a. Bracts lacking 1. *C. hermaphroditica*

7b. Bracts present.

8a. Bracts shorter than 0.5 mm; leaves very uniform with 3 main veins 8. *C. raveniana*

8b. Bracts longer than 0.5 mm; leaves variable with 1 to many veins.

9a. Wing of fruit narrower than 1 mm; dry fruits shorter than 1.1 mm 3. *C. fuscicarpa*

9b. Wing of fruit wider than 1 mm; dry fruits longer than 1.3 mm 2. *C. fehmedianii*

1. *Callitriche hermaphroditica* Linnaeus, Cent. Pl. 1: 31. 1755.

线叶水马齿 xian ye shui ma chi

Plants always submerged. Leaf blades all ± lingulate or tapering from base, 5.5–15.3 × 0.6–1.8(–2.2) mm, translucent, slightly to markedly narrower at apex than base, with a single vein. Flowers solitary, a staminate flower or carpellate flower in

1 or both of a pair of axils; bracts lacking; styles 0.6–2.4(–2.5) mm, initially erect, recurved and eventually appearing to emerge below apex of mature fruit; filaments 0.5–0.9 mm, erect, continuing to grow after dehiscence; anthers (0.1–)0.2–0.6 × 0.2–0.7 mm, reniform, translucent; pollen grains colorless, ± circular, 20–30 × 20–30 μm, smooth. Fruits dark brown when mature, 1.2–2.4 × 1.2–2.9(–3) mm, ± as wide as high; mericarps diver-

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gent, such that from above fruit appears crosslike; testa cells in rings; fibrils only in wing cells.

Lakes, still water; 4000–5000 m. NE Nei Mongol, SE Xizang [pan-boreal].

- 1a. Dry fruits 1.2–1.6(–1.7) × 1.2–1.7 mm; wing 0.1–0.4 mm wide 1a. subsp. *hermaphroditica*
 1b. Dry fruits (1.5–)1.6–2.4 × (1.6–)1.7–2.8(–3) mm; wing 0.2–0.7(–0.8) mm wide 1b. subsp. *macrocarpa*

1a. Callitriche hermaphroditica subsp. *hermaphroditica*

线叶水马齿(原亚种) xian ye shui ma chi (yuan ya zhong)

Callitriche autumnalis Linnaeus; *C. bifida* Morong.

Dry fruits 1.2–1.6(–1.7) × 1.2–1.7 mm; wing 0.1–0.4 mm wide.

Lakes, still water. NE Nei Mongol (Da Hinggan Ling) [pan-boreal].

1b. Callitriche hermaphroditica subsp. *macrocarpa* (Hegelmaier) Lansdown, *Watsonia* 26: 106. 2006.

大果水马齿 da guo shui ma chi

Callitriche autumnalis f. *macrocarpa* Hegelmaier, *Verh. Bot. Vereins Prov. Brandenburg* 9: 35. 1867.

Dry fruits (1.5–)1.6–2.4 × (1.6–)1.7–2.8(–3) mm; wing 0.2–0.7(–0.8) mm wide.

Lakes, still water; 4000–5000 m. SE Xizang [pan-boreal].

2. Callitriche fehmedianii Majeed Kak & Javeid, *J. Bombay Nat. Hist. Soc.* 79: 167. 1982.

西南水马齿 xi nan shui ma chi

Plants submerged, with floating rosettes, on wet mud or creeping through and over other plants. Petiole 1.1–5.2 mm; leaf blade spatulate and very broadly expanded, 2.5–9.9(–10) × 0.4–6.7 mm; venation complex, characterized by primary and secondary veins, plus additional loops and anastomosing veins both within and outside secondary veins. Flowers solitary in leaf axils; bracts persistent, sexually dimorphic, those subtending carpellate flowers ca. 0.3 mm and staminate flowers 0.5–1.2 mm; styles shorter than 1.5 mm, persistent, erect to spreading when young, reflexed on mature fruit; filaments shorter than 2 mm, ± erect; anthers ca. 0.5 × 0.6 mm; pollen ovoid-ellipsoid, yellow, 18–21 × 16–20 μm. Fruit 1.3–1.5 × 1.6–1.9 mm, wider than high, dark with paler wing, subsessile or on pedicel shorter than 0.8 mm, broadly winged all round; wing 0.2–0.4 mm at top, 0.2–0.4 mm at side. Fr. Apr–Oct.

Pools, ditches, springs; 1100–3000 m. SE Xizang, C and W Yunnan [Bhutan, India, Indonesia (Sulawesi), Thailand].

3. Callitriche fuscicarpa Lansdown, *Novon* 16: 355. 2006.

褐果水马齿 he guo shui ma chi

Plants submerged or with floating rosettes. Petiole 2.9–5 mm; blade of submerged leaves ± lingulate, 6–9.7 × 0.5–0.8 mm; blade of those toward or at surface expanded, shorter than petiole, spatulate, 3.2–5.2 × 2.3–4.2 mm; venation complex, characterized by primary and secondary veins, plus additional

sometimes branched loops and anastomosing veins outside secondary veins. Flowers solitary in axils or occasionally 2 carpellate flowers opposed by 1 staminate flower; bracts 0.7–1.1 mm, persistent; styles erect to slightly spreading, 0.7–1.2 mm; filaments (0.6–)1.8–2.3 mm, ± straight; anthers ca. 0.3 × 0.3 mm; pollen 20–24 × 15–20 μm, yellow. Fruit 0.7–1.1 × 0.7–1 mm, as long as or slightly longer than wide, dark brown becoming reddish, with faint reticulate pattern, resembling that of fruits of *C. palustris*, subsessile or pedicel shorter than 1 mm; wing poorly developed or up to 0.08 mm at top and side. Fr. Apr–Aug.

Lakes, ponds, swamps, marshes; 1800–3500 m. E Xizang, NW Yunnan [N India, Japan (Hokkaido), Nepal].

4. Callitriche palustris Linnaeus, *Sp. Pl.* 2: 969. 1753.

水马齿 shui ma chi

Plants submerged, with floating rosettes or on wet mud. Blade of lingulate leaves linear to narrowly expanded, (4–)5.6–9.7 × 0.5–1.2 mm, emarginate, with single vein; blade of expanded leaves elliptic to ± orbicular, 3.6–9.9(–10.3) × 1.2–4.3(–4.5) mm; most leaves with tertiary vein, generally also with additional veins arising from secondary veins, either as loops rejoining adjacent secondary veins or as short slightly curved veins pointing ± directly to leaf blade margin. Flowers usually represented by a carpellate flower in each axil or a staminate and carpellate flower in an axil opposed by a single carpellate flower, or more occasionally 1 staminate and up to 3 carpellate flowers opposite a single carpellate flower in an axil; solitary flowers of both sexes may occur with either a shoot or nothing in opposite axil; bracts translucent, whitish, persistent, caducous or lacking; pollen 6–24 × 5–23 μm, probably inaperturate, yellow, ± spherical, exine strongly ornamented, sculpture type a reticulate pattern or muri, lacking supracteal elements. Fruits 0.9–1.4 × 0.8–1.1 mm, sessile, higher than wide; wing 0.05–0.16 mm wide or lacking, when present wider toward apex of fruits.

Lakes, ponds, swamps, marshes, streams, ditches, rice fields; near sea level to 9500 m. Anhui, Fujian, Guangdong, Guizhou, N Heilongjiang, Hubei, Jiangsu, Jiangxi, E Jilin, E Liaoning, E Nei Mongol, Qinghai, Sichuan, Taiwan, SE Xizang, Yunnan, Zhejiang [Bhutan, India, Japan, Kashmir, Korea, Nepal, Russia; Europe, North America].

- 1a. Fruit winged all around, wing wider than 0.1 mm at top 4b. var. *elegans*
 1b. Fruit winged only at top, wing narrower than 0.1 mm.
 2a. Mature fruit blackish; bracts and style caducous 4a. var. *palustris*
 2b. Mature fruit brown; bracts and style persistent 4c. var. *oryzatorum*

4a. Callitriche palustris var. *palustris*

水马齿(原变种) shui ma chi (yuan bian zhong)

Callitriche fallax Petrov; *C. verna* Linnaeus; *C. verna* var. *fallax* (Petrov) H. Hara.

Bracts 0.5–1 mm, falcate, caducous. Fruit 0.9–1.4 × 0.8–1.1 mm, widest above middle; mericarps parallel; mature fruit black, mericarps sharply reticulate, reticulations appearing ±

clearly in vertical rows; wing (0–)0.05–0.16 mm wide, mainly toward apex. Fr. throughout year.

Lakes, ponds, streams, ditches, swamps, marshes; near sea level to 9500 m. Anhui, Fujian, Guangdong, Guizhou, N Heilongjiang, Hubei, Jiangxi, E Jilin, Liaoning, E Nei Mongol, Qinghai, Sichuan, Taiwan, SE Xizang, N Yunnan, Zhejiang [Bhutan, India, Japan, Kashmir, Korea, Nepal, Russia; throughout N part of N Hemisphere; introduced in Australia].

4b. *Callitriche palustris* var. *elegans* (Petrov) Y. L. Chang, Fl. Pl. Herb. Chin. Bor.-Orient. 6: 53. 1977.

东北水马齿 *dong bei shui ma chi*

Callitriche bengalensis Petrov, Izv. Glavn. Bot. Sada S.S.S.R. 27: 358. 1928; *C. elegans* Petrov; *C. verna* subsp. *elegans* Petrov ex Komarov & Alissova; *C. verna* var. *elegans* (Petrov) Kitagawa.

Flowers generally with a carpellate and staminate flower in one of a pair of axils opposed by a single carpellate flower in other axil, very occasionally 2 carpellate flowers and 1 staminate flower in a single axil; bracts caducous, 0.8–1.2 mm, falcate; styles erect to slightly spreading, shorter than 1.5 mm; filaments \pm straight, fugacious, rarely visible in axils below rosettes, shorter than 2.2 mm; anthers ca. 0.4×0.3 mm; pollen yellow, ovoid-ellipsoid, $21\text{--}26 \times 17\text{--}25$ μm . Fruit $1\text{--}1.4 \times 0.7\text{--}1.1$ mm, widest above middle, slightly strumose, black when mature, mericarps sharply reticulate, reticulations appearing \pm clearly in vertical rows; wing less than 0.3 mm wide, mainly toward apex. Fr. throughout year.

Lakes, ponds, streams, ditches, swamps, marshes; near sea level to 5000 m. N Heilongjiang, Hong Kong, Jiangxi, E Jilin, Liaoning (Anshan), E Nei Mongol [Japan, E Russia].

4c. *Callitriche palustris* var. *oryztorum* (Petrov) Lansdown, Novon 16: 359. 2006.

广东水马齿 *guang dong shui ma chi*

Callitriche oryztorum Petrov, Izv. Glavn. Bot. Sada S.S.S.R. 27: 358. 1928.

Flowers with a carpellate and staminate flower in each axil, very occasionally 2 carpellate flowers and 1 staminate flower in a single axil; bracts persistent, broadly ovoid, 0.58–0.9(–1) mm; styles erect to spreading, shorter than 1.7 mm; filaments straight; 1.6–2.7 mm; anthers $0.4\text{--}0.5 \times 0.3\text{--}0.4$ mm. Fruit $0.7\text{--}1 \times 0.6\text{--}0.8$ mm, widest near middle, mature fruit brown, smooth; wing lacking or up to 0.1 mm, only at apex. Fr. Mar–Oct.

Ditches, marshes, rice fields; near sea level to 3300 m. Fujian, Guangdong, Taiwan, Yunnan, Zhejiang [Japan].

5. *Callitriche japonica* Engelmann ex Hegelmaier, Verh. Bot. Vereins Prov. Brandenburg 10: 113. 1868.

日本水马齿 *ri ben shui ma chi*

Callitriche nana B. C. Ho & G. T. P. Vo.

Plants terrestrial on wet soil, riverine mud, or graveled tracks. Petiole 1–1.5 mm; leaf blade expanded, $1.5\text{--}4.5 \times 1\text{--}2.5$ mm, shiny and very neat in appearance; venation simple, generally limited to 1 primary and a pair of secondary veins with

occasional short veins arising within and outside secondary veins. Flowers solitary, most frequently a pair of axils with a carpellate flower opposed by a staminate flower; bracts lacking; styles 0.28–0.33 mm, \pm straight; filament 0.2–0.4 mm, \pm straight; anthers $0.1\text{--}0.2 \times 0.1\text{--}0.3$ mm; pollen ca. 13×15.4 μm . Fruit $0.7\text{--}1 \times 0.7\text{--}1$ mm, brown to blackish when mature, tapering toward base; wing 0.05–0.13 mm at apex, 0.03–0.08 mm at side. Fr. Mar–Aug.

Riverbanks, disturbed ground, roads; near sea level to 2100 m. Fujian, Jiangxi, Taiwan [India, Indonesia, Japan, Thailand].

6. *Callitriche peploides* Nuttall, Trans. Amer. Philos. Soc. 5: 141. 1835.

台湾水马齿 *tai wan shui ma chi*

Plants terrestrial on wet soil or gravel. Leaf blade expanded, spatulate-obovate, $1.4\text{--}2.3 \times 0.4\text{--}0.8$ mm; venation simple, generally limited to 1 primary and a pair of secondary veins. Flowers usually in pairs, a staminate and a carpellate flower opposed by a solitary carpellate flower in a pair of axils; bracts lacking; styles shorter than 0.2 mm, erect or patent, persistent; filaments shorter than 0.2 mm, erect or patent; anthers ca. 1×1 mm, reniform; pollen \pm spherical, yellow. Fruit black when mature, ca. $0.5 \times 0.7\text{--}0.8$ mm, wider than high, a little tapered toward base; wing lacking to narrow throughout, but base of mature fruit expanded to form a protruding ridge (strumose). Fr. Mar–Dec.

Wet mud, tracks, disturbed ground. Taiwan [native to America; introduced in Madagascar and Réunion].

7. *Callitriche glareosa* Lansdown, Novon 16: 355. 2006.

西藏水马齿 *xi zang shui ma chi*

Plants terrestrial on damp gravel. Leaf blade expanded; venation simple, generally limited to 1 primary and a pair of secondary veins. Flowers solitary, most frequently a pair of axils with a carpellate flower opposed by a staminate flower; bracts lacking; style shorter than 0.6 mm, persistent, reflexed; filaments straight, shorter than 0.5 mm; anthers ca. 0.2×0.2 mm; pollen spherical to ellipsoid, yellow, $22\text{--}26 \times 19\text{--}23$ μm . Fruits $0.6\text{--}0.7 \times 0.8\text{--}1$ mm, slightly wider than high, sessile or with pedicel shorter than 0.6 mm, faintly reticulate; mericarps expanded toward base, but not strumose; mature fruit black, winged only at apex; wing 0.05–0.1 mm wide. Fr. Mar–Sep.

Wet soil, gravel tracks; ca. 4400 m. S Xizang [Bhutan].

8. *Callitriche raveniana* Lansdown, Novon 16: 360. 2006.

细苞水马齿 *xi bao shui ma chi*

Plants terrestrial. Petiole 1.3–1.5 mm; leaf blade expanded, $2\text{--}2.5 \times 0.5\text{--}0.8$ mm; venation simple, generally limited to 1 primary and a pair of secondary veins with occasionally few branches arising from secondary veins. Flowers solitary, usually a carpellate and staminate flower in each axil; bracts persistent 0.2–0.3 mm; styles 0.2–0.3 mm; filaments 0.2–0.3 mm; anthers ca. 0.2×0.2 mm; pollen spherical to ellipsoid, yellow, ca. $20 \times 18\text{--}20$ μm . Fruits $0.6\text{--}0.9 \times 0.8\text{--}1.3$ mm, wider than high, sessile to shortly pedunculate, winged throughout; wing 0.07–0.1 mm wide at apex, 0.05–0.08 mm wide at side.

• Streamsides, wet soil, roadsides; near sea level to 300 m. Taiwan.