

8. **ROOTALA** Linnaeus, Mant. Pl. 2: 143, 175. 1771.

节节菜属 *jie jie cai shu*

Qin Haining (覃海宁); Shirley Graham

Herbs, annual or perennial, aquatic, amphibious, or terrestrial, often anthocyanic with age. Stems glabrous, simple or branched, commonly 4-angled or 4-winged. Leaves decussate or whorled, sessile or subsessile; bracts of inflorescences like foliage leaves or smaller and different in shape. Flowers actinomorphic, monomorphic [or dimorphic], (3 or)4(–6)-merous, solitary, sessile or shortly pedicellate, in axils of bracts on main stem, on spikelike lateral branchlets, or in terminal spikes. Floral tube campanulate or urceolate, generally globose in fruit; bracteoles 2, at base of floral tube; sepals 3–6, ca. 1/3 length of floral tube or less, deltate; epicalyx alternating with sepals or absent. Petals 3–6, pink-purple to whitish. Stamens 1–6, opposite the sepals. Ovary 2–4-loculed; style long or short; stigma capitate, rarely more massive, discoid. Capsule finely transversely striate (10 × magnification), hyaline, septicidally dehiscent, 2–4-valved. Seeds numerous, brown or reddish brown, ovoid to ellipsoidal, concave-convex, less than 1 mm.

About 46 species: tropical and temperate regions of the world; ten species (one endemic, one naturalized) in China.

An additional species, *Rotala hippuris* Makino (Bot. Mag. (Tokyo) 12: 81. 1898), a popular aquarium plant considered endemic to Japan, is found in ornamental ponds in Taiwan. It was reported (Liu et al., Man. Taiwan Vasc. Pl. 3: 241. 2000) from ponds at Taoyuan, Taiwan. Whether it is native, naturalized, or cultivated there was not stated.

See also Cook, A revision of the genus *Rotala* (Lythraceae) (Boissiera 29: 1–156. 1979).

- 1a. Leaves whorled.
 - 2a. Flowers in terminal racemes, pedicellate; petals present; stamens 4; aerial leaves 3–12-whorled, submerged leaves more numerous 1. *R. wallichii*
 - 2b. Flowers solitary, axillary, sessile; petals absent; stamens (1 or)2 or 3(or 4); aerial and submerged leaves 3–5[–8]-whorled 2. *R. mexicana*
- 1b. Leaves decussate.
 - 3a. Stipulelike outgrowths present at nodes; sepals 6 3. *R. hexandra*
 - 3b. Stipulelike outgrowths absent at nodes; sepals 3–5.
 - 4a. Flowers in 1 or more densely flowered terminal spikes; stigma massive, discoid; foliage leaves obovate-elliptic to orbicular or elliptic 4. *R. rotundifolia*
 - 4b. Flowers in axillary spikes (lateral branchlets) or sessile in bracts on main stem; stigma capitate to punctiform; foliage leaves various.
 - 5a. Leaf margin translucent to opaque white cartilaginous; capsules 2-valved 5. *R. indica*
 - 5b. Leaf margin green, membranous; capsules 3- or 4-valved.
 - 6a. Stems broadly 4-winged, wings running to or onto leaves; bracts of inflorescence distinctly smaller than foliage leaves; flowers in axillary spikes or less often sessile on main stem.
 - 7a. Stem wings running onto the leaves; flowers in axillary spikes; sepals 4; epicalyx segments between sepals absent 6. *R. cordata*
 - 7b. Stem wings running to the leaves; flowers in axillary spikes or sessile on main stem; sepals 5; epicalyx segments between sepals setiform, ca. 1/2 as long as floral tube or longer 7. *R. densiflora*
 - 6b. Stems terete or 4-angled, not distinctly winged; bracts of inflorescence like foliage leaves; flowers sessile on main stem.
 - 8a. Stamens 5; capsule 3-valved, well exerted from floral tube, red at apex 8. *R. rosea*
 - 8b. Stamens 4; capsule 4-valved, included in or slightly exerted from floral tube, golden brown.
 - 9a. Leaves oblanceolate, narrowly oblanceolate, or elliptic, apex obtuse; capsule slightly exerted from floral tube 9. *R. ramosior*
 - 9b. Leaves obovate-oblong, apex acute or subacute; capsule included in floral tube 10. *R. taiwaniana*

1. ***Rotala wallichii*** (J. D. Hooker) Koehne, Bot. Jahrb. Syst. 1: 154. 1880.

瓦氏节节菜 *wa shi jie jie cai*

Hydrolythrum wallichii J. D. Hooker in Bentham & J. D. Hooker, Gen. Pl. 1: 777. 1867; *Ammannia myriophylloides* Dunn; *A. wallichii* (J. D. Hooker) S. Kurz.

Herbs, perennial, to 30 cm, aquatic with emergent inflorescence, amphibious, or terrestrial. Stem solitary, rarely branched, slender. Leaves whorled; aerial leaves 3–12-whorled, linear to oblong, apex obtuse or 2-cleft; submerged leaves typically more numerous, filiform, distinctly longer than aerial leaves, 1.5–2.5 cm, apex 2-cleft. Bracts much reduced in inflorescence, oblong or ovate, 2–3 mm. Flowers 5–8-whorled per node, shortly pedicellate in a bracteate raceme; bracteoles short, less than 1/2

length of floral tube. Floral tube 4-merous, campanulate, translucent, ca. 1.5 mm; sepals 4; epicalyx absent. Petals 4, showy, light red or pink, orbicular, longer than floral tube. Stamens 4; anthers reaching margin of floral tube. Ovary globose, ca. 1 mm in diam.; style included, shorter than ovary. Capsules globose, ca. 1 mm in diam., 2-valved. Seeds ca. 0.7 mm. Fl. and fr. autumn and winter.

Ponds, wet places. Guangdong, Taiwan (Pingdong) [India, Indonesia, Malaysia, Myanmar, Thailand, Vietnam].

2. *Rotala mexicana* Chamisso & Schlechtendal, *Linnaea* 5: 567. 1830.

轮叶节节菜 lun ye jie jie cai

Ammannia mexicana (Chamisso & Schlechtendal) Bailon; *Hypobrichia spruceana* Benth; *Rotala mexicana* var. *spruceana* (Benth) Koehne; *R. pusilla* Tulasne; *R. verticillaris* Linnaeus var. *spruceana* (Benth) Hiern.

Herbs, annual, aquatic, amphibious, or terrestrial. Stem 3–10 cm, creeping, floating, or erect and ascending, branching. Leaves 3–5(–8)-whorled; aerial leaves narrowly lanceolate to broadly linear [or ovate], 5–10 × 1.5–2 mm, base narrow, apex truncate and often 2-cleft; submerged leaves linear, to 15 × 0.5 mm. Flowers solitary, sessile, axillary; bracteoles linear, ca. as long as floral tube. Floral tube (3 or)4(or 5)-merous, campanulate, translucent, ca. 0.5 mm; sepals (3 or)4(or 5); epicalyx absent. Petals absent. Stamens (1 or)2 or 3(or 4), included. Ovary subglobose; style included, much shorter than ovary. Capsule ca. 1 mm in diam., (2 or)3-valved. Seeds ca. 0.3 mm. Fl. Sep–Dec.

Common in paddy fields and wet places. Henan, Jiangsu, Shanxi, Taiwan (Xinzhu), Zhejiang [tropics and warm-temperate regions of the world].

3. *Rotala hexandra* Wallich ex Koehne, *Bot. Jahrb. Syst.* 1: 167. 1880.

六蕊节节菜 liu rui jie jie cai

Rotala kainantensis Masamune.

Herbs, annual, amphibious, to 40 cm. Stem ultimately erect, distinctly 4-winged. Leaves decussate, lanceolate to oblong, 1–3 cm, base cuneate to cordate or auriculate, apex obtuse. Bracts like foliage leaves; stipular growths present on nodes near leaf bases, to 2 mm. Flowers solitary, shortly pedicellate, axillary. Floral tube 6-merous, campanulate, ca. 2 mm, distinctly ribbed; sepals 6; epicalyx absent; bracteoles linear, less than 1/2 as long as floral tube. Petals 6, ca. 1 mm, surpassing sepals. Stamens 6, nearly free from tube at base of ovary; anthers exerted. Ovary globose, 4-loculed; style exerted. Capsule subglobose, ca. 1.5 mm in diam., slightly exerted, possibly irregularly dehiscent. Seeds 0.6–1 mm. Fl. and fr. Jul–Dec.

Hainan [Indonesia, Myanmar, Philippines].

4. *Rotala rotundifolia* (Buchanan-Hamilton ex Roxburgh) Koehne, *Bot. Jahrb. Syst.* 1: 175. 1880.

圆叶节节菜 yuan ye jie jie cai

Ammannia rotundifolia Buchanan-Hamilton ex Roxburgh, *Fl. Ind.* 1: 446. 1820; *A. subspicata* Benth.

Herbs, perennial or possibly annual, to 30 cm. Stem creeping or floating, red-tinged; internodes of basal stem portion usually much longer than subtending leaves. Leaves decussate, obovate-elliptic to orbicular or elliptic, 5–13 × 3.5–15 mm, base obtuse, apex obtuse. Bracts distinctly smaller than foliage leaves, ca. 3 × 1.5 mm, ca. equal to floral tube. Flowers in 1–8 terminal, emergent spikes; spikes 1–4(–8) cm, lax in fruit; bracteoles slightly shorter than sepals, scarious. Floral tube 4-merous, campanulate, 1–1.5 mm; sepals 4; epicalyx absent. Petals 4, bright rose, surpassing sepals. Stamens 4; anthers reaching margin of floral tube. Ovary pyriform to globose; style included, shorter than ovary; stigma discoid, ca. 0.3 mm in diam. Capsules globose, ca. 1.5 mm in diam., 4-valved. Seeds ca. 0.5 mm. Fl. and fr. Nov–Jun. $2n = 16^*$, 28, 30.

Marshes, streamsides, paddy fields, mountains; below 2700 m. Fujian, Guangdong, Guangxi, Guizhou, Hainan, Hubei, Hunan, Jiangxi, Shandong, Sichuan, Taiwan, Yunnan, Zhejiang [Bangladesh, Bhutan, India, Japan, Laos, Myanmar, Nepal, Thailand, Vietnam].

5. *Rotala indica* (Willdenow) Koehne, *Bot. Jahrb. Syst.* 1: 172. 1880.

节节菜 jie jie cai

Peplis indica Willdenow, *Sp. Pl.* 2: 244. 1799; *Ameletia indica* (Willdenow) Candolle; *A. uliginosa* Miquel; *Rotala densiflora* (Roth) Koehne var. *formosana* Hayata; *R. elatinomorpha* Makino; *R. indica* var. *koreana* Nakai; *R. indica* var. *uliginosa* (Miquel) Koehne; *R. koreana* (Nakai) Mori; *R. uliginosa* (Miquel) Nakai.

Herbs, annual, terrestrial or amphibious, to ca. 40 cm. Stem creeping and branched at base, ascending, or erect, terete to weakly 4-angled. Leaves decussate, obovate-elliptic or obovate-oblong, 5–17 × 3–8 mm, base cuneate, margin translucent to opaque, white cartilaginous, apex obtuse. Bracts like foliage leaves or distinctly smaller on axillary spikes. Flowers in axillary spikes or sessile in bracts on main stem; bracteoles linear, reaching sepals or longer. Floral tube 4-merous, pink-red at anthesis, narrowly to broadly campanulate, 1.5–2.5 mm, 4-angled; sepals 4, lanceolate-deltate; epicalyx absent. Petals 4, pink, minute to ca. 1/2 as long as sepals. Stamens 4; anthers reaching sinus of sepals. Ovary ellipsoidal; style ca. 1/2 as long as ovary, slightly exerted. Capsule ellipsoidal, ca. 1 mm in diam., slightly exerted, 2-valved. Seeds ca. 0.4 mm. Fl. Sep–Oct, fr. Oct–Apr. $2n = 32^*$.

Wet places, paddy fields. Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangsu, Jiangxi, Shanxi, Sichuan, Taiwan, Yunnan, Zhejiang [Bhutan, Cambodia, India, Indonesia, Japan, Korea, Laos, Malaysia, Myanmar, Nepal, Philippines, Sri Lanka, Thailand, Vietnam; C Asia; introduced in rice fields in Africa (Congo), Europe (Italy, Portugal), and North America (United States)].

The species is closely associated with rice cultivation. There are unbranched plants with flowers sessile at nodes of the main stem that do not form lateral spikelike inflorescences. Cook (1979) found that although the unbranched form was sometimes genetically fixed, in many geographically scattered populations it was not fixed but ecologically

induced as a result of crowded growing conditions.

6. *Rotala cordata* Koehne, Bot. Jahrb. Syst. 1: 172. 1880.

异叶节节菜 yi ye jie jie cai

Rotala diversifolia Koehne.

Herbs, annual, terrestrial or amphibious, 8–30 cm. Stem branched, 4-winged; wings white, broad, extending into margins of leaves and bracts. Leaves decussate, narrowly oblong to lanceolate, 8–25 × 3–8 mm, base broad, cordate, clasping, apex obtuse. Bracts lanceolate to oblong, smaller on lateral inflorescences, 4–6 mm × 1.5–2 mm. Flowers solitary, subsessile, in bracts of axillary spikes; bracteoles minute, at base of floral tube, scarious. Floral tube 4-merous, broadly campanulate, 1–2 mm; sepals 4, pink-tinged, deltate, ca. 1/3 as long as floral tube, acuminate; epicalyx absent. Petals 4, obovate. Stamens 4, anthers reaching margin of floral tube. Ovary globose; style exerted. Capsules globose, ca. 1.5 mm in diam., 3-valved. Seeds ca. 0.5 mm. Fl. Nov.

Wet places by water. Guangxi, Hainan [NE India (Darjeeling), Laos, Thailand, Vietnam].

7. *Rotala densiflora* (Roth) Koehne, Bot. Jahrb. Syst. 1: 164. 1880.

密花节节菜 mi hua jie jie cai

Ammannia densiflora Roth in Roemer & Schultes, Syst. Veg. 3: 304. 1818; *Rotala densiflora* subsp. *uliginosa* (Roth) Koehne; *Sellowia uliginosa* Roth.

Herbs, annual, terrestrial or amphibious, 7–10[–40] cm. Stem usually creeping, sparsely to densely branched, 4-winged, wings not running into leaves. Leaves decussate, often alternate toward stem apex, narrowly elliptic, linear-lanceolate, oblong, or ovate, [2–]12–30 × 1.5–5 mm, base cordate to obtuse, apex obtuse, acute, or acuminate. Bracts of stem and lower branches like foliage leaves; bracts of axillary branchlets much smaller and broadly ovate, clasping. Flowers solitary in axils on main stem or in axillary spikes; bracteoles pink, lanceolate, equaling to surpassing floral tube. Floral tube (4 or)5-merous, campanulate, 1–2 mm; sepals (3–)5; epicalyx segments present between sepals, setiform, ca. 1/2 as long as to longer than sepals. Petals (4 or)5, bright pink or white, equal to or surpassing sepals, persistent. Stamens (3–)5; anthers reaching margin of floral tube. Ovary globose; style shorter than ovary, slightly exerted. Capsules subglobose, ca. 1.5 mm in diam., included, 3-valved. Seeds ca. 0.5 mm. Fl. and fr. Aug.

Wet places. Guangdong, Jiangsu [India, Indonesia (Kalimantan), Nepal, Pakistan, Sri Lanka; C Asia, Australia].

The habit varies considerably depending on whether the flowers are sessile at nodes of the main stem or develop in the axils of lateral branchlets. If branchlets occur, the stem leaves are much larger than the bracts of the branchlets.

8. *Rotala rosea* (Poir.) C. D. K. Cook ex H. Hara, Enum. Fl. Pl. Nepal 2: 173. 1979.

五蕊节节菜 wu rui jie jie cai

Ammannia rosea Poir., Encycl., Suppl. 1: 329. 1810; *A. leptopetala* Blume; *A. littorea* Miquel; *A. pentandra* Roxburgh; *Rotala leptopetala* (Blume) Koehne; *R. littorea* (Miquel) Nakai; *R. pentandra* (Roxburgh) Blatter & Hallberg.

Herbs, annual, terrestrial or amphibious, 8–30 cm. Stems ascending or erect, mostly unbranched. Leaves decussate, linear-lanceolate to lanceolate-oblong, 7–30 × 3–5 mm, base obtuse [to cuneate], apex obtuse to retuse. Bracts similar to foliage leaves, longer than flowers. Flowers 5-merous, solitary, sessile, axillary on main stem and branches; bracteoles linear, slightly shorter than floral tube. Floral tube campanulate, 1–1.5 mm; sepals (4 or)5, very short, ca. 0.25 mm, apex acuminate; epicalyx segments setiform, equaling sepals. Petals (absent to)5, ca. 0.25 mm, not persistent. Stamens 5; anthers reaching margin of floral tube. Ovary globose; shorter than ovary. Capsules globose, ca. 2 mm in diam., well exerted from floral tube, apex red, 3-valved.

Seeds ca. 0.3 mm. Fl. and fr. Aug–Oct in temperate regions, throughout year in tropical regions.

Paddy fields, wet places; lowlands. Fujian, Guangxi, Guizhou, Hainan, Jiangsu, Yunnan; naturalized in Taiwan (Nantou) [Bangladesh, Indonesia, Myanmar, Malaysia, Philippines, Thailand, Vietnam].

9. *Rotala ramosior* (Linnaeus) Koehne in Martius, Fl. Bras. 13(2): 194. 1877.

美洲节节菜 mei zhou jie jie cai

Ammannia ramosior Linnaeus, Sp. Pl. 1: 120. 1753; *A. monoflora* Blanco.

Herbs, annual, terrestrial or amphibious, to 20[–55] cm. Stem erect or ascending, usually branched, weakly 4-angled. Leaves decussate, oblanceolate, narrowly oblanceolate, or elliptic, 1–2.5[–5] × 0.5[–1] cm, base attenuate, apex obtuse. Bracts like foliage leaves. Flowers 4-merous, solitary, sessile, axillary on main stem and branches; bracteoles 1–2.5 mm, less than 1/2 as long as floral tube [or exceeding floral tube]. Floral tube green, tinged with red, narrowly campanulate to subglobose, 2–5 mm; sepals 4, shallowly deltate; epicalyx segments apiculate to deltate, ca. as long as or longer than sepals. Petals absent to 4, pale pink, minute to equaling sepals, caducous. Stamens 4; anthers included. Ovary globose; style shorter than ovary. Capsules globose, 2–3 mm in diam., (3 or)4-valved, slightly exserted from floral tube. Seeds ca. 0.5 mm. Fl. Jul–Sep, fr. Aug–Oct. $2n = 16, 32$.

Recently naturalized in paddy fields. Taiwan [native to North America].

10. *Rotala taiwaniana* Y. C. Liu & F. Y. Lu, Quart. J. Chin. For. est. 12(4): 86. 1979.

台湾节节菜 tai wan jie jie cai

Herbs, annual, terrestrial or amphibious, 15–20 cm. Stem procumbent at base; branches ascending, weakly 4-angled. Leaves decussate, obovate-oblong, 1.8–2.6 × 0.2–0.4 cm, base attenuate, apex acute or subacute. Bracts narrowly lanceolate, 6–7 mm. Flowers 4-merous, solitary, sessile, axillary on main stem and branches; bracteoles undescribed. Floral tube tubular-campanulate, ca. 3 mm; sepals 4, narrowly deltate; epicalyx segments deltate, ca. 1/2 as long as sepals. Petals 4, whitish, equaling sepals. Stamens 4; anthers included. Ovary obovoid; style ca. 0.4 mm. Capsules ovoid, tuberculate, included in floral tube. Seeds semiovoid, pale brown. Fl. undescribed, fr. Dec.

- Drained paddy fields, wet places. E Taiwan (Hualian).

This species is known only from the type (*F. Y. Lu & C. H. Ou 5511*, holotype NCUF, isotype TPCA).

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