

89. EUTREMA R. Brown, Chlor. Melvill. 9. 1823.

山沸菜属 shan yu cai shu

Wasabia Matsumura.

Herbs perennial, rhizomatous or with a caudex. Trichomes absent or simple. Stems erect, ascending, or decumbent, simple or branched apically. Basal leaves petiolate, rosulate, simple, entire or palmately lobed, palmately veined. Cauline leaves petiolate or sessile and cuneate or auriculate, pinnately or palmately veined, entire, dentate, or crenate; ultimate veins ending or not with apiculate callosities. Racemes ebracteate or rarely bracteate throughout, elongated considerably or not elongated in fruit. Sepals ovate or oblong, base of lateral pair not saccate. Petals white or rarely pink; blade spatulate or rarely obovate, apex obtuse; claw absent. Stamens 6, slightly tetradynamous; filaments slightly dilated at base; anthers ovate or oblong, obtuse at apex. Nectar glands confluent and subtending bases of all stamens; median glands present. Ovules 2–10 per ovary. Fruit dehiscent, siliques or silicles, linear, oblong, ovoid, or lanceolate, terete or slightly 4-angled, sessile or shortly stipitate; valves with an obscure or prominent midvein, smooth or torulose; replum rounded; septum complete or perforated, translucent, veinless; style obsolete or distinct and to 3 mm; stigma capitate, entire. Seeds uniseriate, wingless, oblong, plump; seed coat obscurely reticulate, not mucilaginous when wetted; cotyledons incumbent.

Nine species: primarily C and E Asia and Himalayas, one species extending into North America; seven species (one endemic, one introduced) in China.

1a. Middle and upper cauline leaves sessile, pinnately veined.

2a. Main infructescence 0.2–2(–3.5) cm, often subumbellate; plants 2–15(–25) cm tall; petals 2–3.5 mm; sepals often persistent to fruit maturity 1. *E. heterophyllum*

2b. Main infructescence 10–20(–40) cm tall, lax racemes; plants 30–110 cm tall; petals 4–5 mm; sepals caducous.

3a. Plants glabrous throughout; uppermost leaves cuneate at base; fruit 5–8(–10) mm 2. *E. integrifolium*

3b. Plants sparsely to densely pilose at least along midvein and leaf margin; uppermost leaves auriculate or amplexicaul at base; fruit (8–)12–20(–25) mm 3. *E. himalaicum*

1b. All leaves petiolate, palmately veined.

4a. Fruiting pedicels erect or ascending; ultimate leaf veins not ending in apiculate callosities; fruit lanceolate, ovoid, or oblong, not torulose, often subappressed to rachis, slightly 4-angled 4. *E. deltoideum*

4b. Fruiting pedicels divaricate or reflexed; ultimate leaf veins ending in apiculate callosities; fruit usually linear, torulose, not appressed to rachis, terete.

5a. Rhizomes fleshy; petals 6–8(–9) mm; sepals 3–4 mm; gynophore (1–)2–5 mm; filaments 3.5–5 mm 7. *E. wasabi*

5b. Rhizomes not fleshy; petals 3.5–5(–6) mm; sepals 1.5–2 mm; gynophore absent or obsolete; filaments 1.5–2 mm.

6a. Racemes bracteate throughout 6. *E. tenue*

6b. Racemes ebracteate or only lowermost few flowers bracteate 5. *E. yunnanense*

1. *Eutrema heterophyllum* (W. W. Smith) H. Hara, J. Jap. Bot. 48: 97. 1973.

密序山沸菜 mi xu shan yu cai

Braya heterophylla W. W. Smith, Notes Roy. Bot. Gard. Edinburgh 11: 201. 1919; *Eutrema compactum* O. E.

Schulz; *E. edwardsii* R. Brown var. *heterophyllum* (W. W. Smith) W. T. Wang; *E. obliquum* K. C. Kuan & Z. X. An.

Herbs 2–15(–25) cm tall, glabrous throughout or rarely puberulent, with a caudex and fleshy root. Stems erect, simple, often few from caudex. Basal leaves rosulate, somewhat fleshy; petiole (0.5–)1–5.5(–7.5) cm; leaf blade ovate, suborbicular, lanceolate, or rhombic, (0.3–)0.5–2(–2.5) cm × (2–)4–10(–15) mm, base cordate, truncate, or cuneate, sometimes distinctly oblique, margin entire, apex obtuse or subacute. Middle cauline

leaves lanceolate, ovate, or linear-lanceolate, 0.7–2.5(–3) cm × 2–9 mm, pinnately veined, sessile, base cuneate, margin entire, apex subacute. Infructescence compact, subumbellate or short racemes, little or not expanded in fruit, 0.2–2(–3.5) cm. Fruiting pedicels divaricate or slightly reflexed, 1–4(–5) mm. Sepals ovate, 1.5–2 × ca. 1 mm, persistent through fruit maturity. Petals white, spatulate, 2–3.5 × 1–1.7 mm. Filaments white, 1–2 mm, slightly dilated at base; anthers ovate, 0.2–0.3 mm. Ovules 4–10 per ovary. Fruit linear or oblong, (4–)5–10(–12) × 1.5–2 mm, slightly 4-angled, not torulose; valves cuneate at both ends, with a prominent midvein; gynophore to 0.5 mm; septum mostly perforate; style obsolete to 0.6 mm. Seeds oblong, plump, 1.5–2 × ca. 1 mm. Fl. Jun–Jul, fr. Jul–Aug.

Alpine meadows, scree, grassy slopes, near glaciers, *Kobresia* turf, alpine mats, sandstone ridges; 2500–5400 m. Gansu, Hebei, Qinghai, Shaanxi, Sichuan, Xinjiang, Xizang, Yunnan [Bhutan, Kazakstan, Kyrgyzstan, Nepal, Tajikistan].

The records of *Eutrema edwardsii* R. Brown from China (e.g., in FRPS) and C Asia are based on misidentified plants of *E. heterophyllum*. The former species has lax, racemose infructescences to 18 cm, fruit appressed to the rachis, with erect to erect-ascending fruiting pedicels, and readily caducous sepals. By contrast, *E. heterophyllum* has compact, umbellate or shortly racemose infructescences rarely to 3.5 cm, nonappressed fruit, with divaricate or reflexed fruiting pedicels, and sepals often persisting well after fruit maturity. The record and illustration of *E. edwardsii* from Xinjiang in Fl. Xinjiang. (2(2): 204. 1995) are based on misidentified plants of *Taphrospermum altaicum*.

2. *Eutrema integrifolium* (de Candolle) Bunge, Delect. Seminum Hort. Bot. Dorpat. 1839: 8. 1839.

全缘叶山沸菜 *quan yuan ye shan yu cai*

Cochlearia integrifolia de Candolle, Syst. Nat. 2: 369. 1821; *Eutrema alpestre* Ledebour; *E. alpestre* var. *hissaricum* Lipsky; *E. integrifolium* var. *hissaricum* (Lipsky) O. E. Schulz; *Goldbachia laevigata* de Candolle var. *adscendens* Franchet; *Smelowskia integrifolia* (de Candolle) C. A. Meyer.

Herbs (30–)40–80(–90) cm tall, glabrous throughout; rhizomes short. Stems erect, simple at base, branched above. Basal leaves rosulate, somewhat fleshy; petiole (2.5–)3.5–9(–12) cm; leaf blade ovate, orbicular, or cordate, (1.5–)2–4(–6) × (1.5–) 1.7–3.5(–5.5) cm, base cordate or rounded, margin entire, apex obtuse. Middle cauline leaves lanceolate to oblong-lanceolate, 4–6.5(–8) × 1–2(–3) cm, pinnately veined, sessile, base cuneate, margin entire, apex subacute. Infructescence lax raceme, main branch 10–20 cm. Fruiting pedicels divaricate, (4–)6–13(–18) mm. Sepals ovate, 2–2.5 × 1–1.5 mm, caducous. Petals white, spatulate, 4–5 × 2–3 mm. Filaments white, 1.7–2.5 mm, slightly dilated at base; anthers oblong, 0.6–0.7 mm. Ovules 4 per ovary. Fruit ellipsoid or oblong, 5–8(–10) × 1–2 mm, slightly 4-angled, not torulose; valves cuneate at both ends, with a prominent midvein; gynophore to 0.3 mm; septum complete or rarely perforate; style 0.3–0.6 mm. Seeds oblong, plump, 2–3 × 1–1.5 mm. Fl. May–Jun, fr. Jul–Aug.

Woods, subalpine areas, open slopes; 1200–2400 m. Xinjiang [Kazakstan, Kyrgyzstan, Tajikistan, Uzbekistan].

The records of *Eutrema pseudocordifolium* Popov in FRPS and Fl. Xinjiang. (2(2): 204. 1995) are based on misidentified plants of *E. integrifolium*.

3. *Eutrema himalaicum* J. D. Hooker & Thomson, J. Proc. Linn. Soc., Bot. 5: 164. 1861.

川滇山沸菜 *chuan dian shan yu cai*

Eutrema lancifolium (Franchet) O. E. Schulz; *Goldbachia lancifolia* Franchet; *Hesperis spectabilis* (J. D. Hooker & Thomson ex Fournier) Kuntze; *Sisymbrium hookeri* Fournier; *Sisymbrium spectabile* J. D. Hooker & Thomson ex Fournier.

Herbs 30–80(–110) cm tall, sparsely to densely crisped pilose at least along leaf margin and midvein; rhizomes short. Stems erect, simple at base, branched above.

Basal leaves rosulate, somewhat fleshy; petiole (2.5–)4–12(–17) cm; leaf blade ovate, oblong, or lanceolate, (1–)2–6(–8) × (0.7–)1.5–4 (–5) cm, base cordate or rounded or cuneate, margin entire, apex obtuse or subacute. Middle cauline leaves lanceolate, oblong-lanceolate, or ovate, 3–6(–8) × 0.7–2(–3) cm, pinnately veined, sessile, base rounded or auriculate, margin denticulate or sparsely so near base, apex acuminate or acute. Infructescence lax raceme, main branch 10–25(–40) cm. Fruiting pedicels divaricate, (0.5–)0.7–1.8(–2.2) cm. Sepals ovate, 2–2.5 × 1–1.5 mm, caducous. Petals white, spatulate, 4–5 × 2.5–3 mm. Filaments white, 1.5–2 mm, slightly dilated at base; anthers oblong, ca. 0.5 mm. Ovules 4–8 per ovary. Fruit linear or rarely oblong, (0.8–)1.2–2(–2.5) cm × 1.5–3 mm, slightly 4-angled, subturlose; valves cuneate at both ends, with a prominent midvein; gynophore to 0.5 mm; septum perforated or complete; style 0.5–1 mm. Seeds oblong, plump, 2–3 × 1–1.5 mm. Fl. May–Aug, fr. Jul–Sep. Streamsides, swampy or alpine meadows, among rocks; 3300–4400 m. Sichuan, Xizang, Yunnan [Bhutan, Sikkim].

A critical examination of the types of *Eutrema himalaicum* and *E. lancifolium* shows that they are indistinguishable. The species was recognized in FRPS as *E. lancifolium* and was recorded from Gansu, but the present authors have seen no specimens from that province.

4. *Eutrema deltoideum* (J. D. Hooker & Thomson) O. E. Schulz in Engler, Pflanzenr. 86(IV. 105): 35. 1924.

三角叶山沸菜 *san jiao ye shan yu cai*

Sisymbrium deltoideum J. D. Hooker & Thomson, J. Proc. Linn. Soc., Bot. 5: 163. 1861; *Eutrema deltoideum* var. *grandiflorum* O. E. Schulz; *Hesperis deltoidea* (J. D. Hooker & Thomson) Kuntze.

Herbs (7–)20–75(–110) cm tall, sparsely pilose or glabrous; rhizomes short. Stems erect, simple at base, branched above. Basal leaves rosulate, somewhat fleshy; petiole (1.5–) 3.5–10(–15) cm; leaf blade ovate, deltoid, or oblong, (1–)2–5 (–8) × (0.5–)1–3(–5) cm, base cordate or rounded, margin dentate or rarely subentire, apex obtuse or subacute. Middle cauline leaves with petioles (0.3–)1–2.5(–3.5) cm; leaf blade broadly ovate, ovate-deltoid, or rhomboid, (1.5–)3–6(–10) × (0.3–)2–4.5(–6) cm, palmately veined, base truncate or cordate, margin dentate, apex obtuse or acute. Infructescence lax raceme, main branch 6–15 cm. Fruiting pedicels ascending or suberect, 5–1.2(–15) mm. Sepals ovate, 2–3 × 1.5–2.5 mm, caducous. Petals white or pink, spatulate or obovate, (5–)6–8 × 2.5–4 mm. Filaments white, 1.5–2.5 mm, slightly dilated at base; anthers oblong, 0.5–1 mm. Ovules 2–4 per ovary. Fruit lanceolate, oblong, or ovoid, 7–10 × 2–3 mm, often subappressed to rachis, slightly 4-angled, not torulose; valves with a prominent midvein; gynophore to 1 mm; septum perforated or complete; style obsolete or to 1

mm. Seeds oblong, plump, 2.5–3.5 × 1–1.5 mm. Fl. Jul–Aug, fr. Aug–Sep.

Rock crevices, among shrubs, steep slopes, moist meadows, *Betula-Rhododendron* forests, streambeds; 3600–4700 m. Xizang, Yunnan [Bhutan, Sikkim].

The fruit shape and dimensions given for *Eutrema deltoideum* in all Chinese floras are based on misidentified plants of *E. himalaicum*. *Eutrema deltoideum* var. *grandiflorum* has slightly larger flowers than those of the type, but these represent extremes of a continuous variation. The species was recorded from Sichuan in FRPS and in Fl. Sichuan. (14: 155. 1999), but the present authors have seen no material from that province.

5. *Eutrema yunnanense* Franchet, Pl. Delavay. 61. 1889.

南山沸菜 nan shan yu cai

Eutrema potaninii Komarov; *E. reflexum* T. Y. Cheo; *E. yunnanense* var. *tenerum* O. E. Schulz; *E. yunnanense* var. *yexinicum* Z. X. An; *Wasabia yunnanensis* (Franchet) Nakai.

Herbs (12–)20–60(–110) cm tall, glabrous or sparsely pilose on upper parts; rhizomes not fleshy. Stems erect, simple, often a few from base, rarely branched upward. Basal leaves rosulate; petiole 2–25(–35) cm, dilated at base; leaf blade cordate or reniform, (1–)3–10(–20) × (1.5–)3–10(–20) cm, base cordate, margin dentate, denticulate, repand, or subentire, with distinct apiculate callosities terminating ultimate veins, apex rounded or obtuse. Middle cauline leaves with petioles (0.5–)1–3(–5) cm; leaf blade broadly ovate to ovate-cordate, (1–)2–5(–7) × (0.6–)1–4(–5) cm, palmately veined, base and margin as in basal leaves, apex acute. Infructescence lax raceme, ebracteate or rarely lowermost 1–3 flowers bracteate. Fruiting pedicels reflexed or spreading, slender, 0.6–1.5(–2.5) cm. Sepals ovate, 1.5–2 × 1–1.2 mm, caducous. Petals white, oblong-spatulate, 3.5–5(–6) × 1.5–2.5 mm. Filaments white, 1.5–2 mm; anthers ovate, 0.4–0.5 mm. Ovules 6–10 per ovary. Fruit linear or rarely oblong, (0.5–)0.8–1.5(–2.5) cm × 1.5–2 mm, terete, torulose; valves with an obscure midvein; gynophore absent or obsolete; septum usually complete; style 1–2 mm. Seeds oblong, plump, 2–3 × 1–1.5 mm. Fl. Mar–May, fr. Apr–Jun.

• Hillsides, forest undergrowth, shaded moist pastures, roadsides, among *Rhododendron*; 400–3500 m. Anhui, Gansu, Hebei, Hubei, Hunan, Jiangsu, Jiangxi, Ningxia, Shaanxi, Sichuan, Xizang, Yunnan, Zhejiang.

6. *Eutrema tenue* (Miquel) Makino, Bot. Mag. (Tokyo) 26: 177. 1912.

日本山沸菜 ri ben shan yu cai

Nasturtium tenue Miquel, Ann. Mus. Bot. Lugduno-Batavi 2: 71. 1866; *Cardamine bracteata* S. Moore (1878), not Philippi (1893), nor Suksdorf (1918); *Eutrema bracteatum* (S. Moore) Koidzumi; *E. hederifolium* Franchet & Savatier; *E. thibeticum* Franchet; *E. wasabi* (Siebold) Maximowicz var. *tenue* (Miquel) O. E. Schulz; *Neomartinella guizhouensis* S. Z. He & Y. C. Lan; *Wasabia hederifolia* (Franchet & Savatier) Matsumura.

Herbs 12–35(–55) cm tall, glabrous or retrorsely pilose; rhizomes not fleshy. Stems decumbent, simple, often a few from base. Basal leaves rosulate; petiole 3–8(–10) cm; leaf blade cordate or reniform, 1–3(–5) × 1–3(–6) cm, base cordate, margin dentate, repand, or subentire, with distinct apiculate callosities terminating ultimate veins, apex rounded or obtuse. Middle cauline leaves with petioles 0.7–2.5 cm; leaf blade broadly ovate to ovate-cordate, 0.7–2(–3.5) × 0.8–2 cm, palmately veined, base and margin as in basal leaves, apex acute. Infructescence lax raceme, bracteate throughout. Fruiting pedicels reflexed or spreading, slender, (0.5–)1–2(–2.5) cm. Sepals ovate, 1.5–2 × 1–1.2 mm, caducous. Petals white, oblong-spatulate, 4–5 × 1–1.5 mm. Filaments white, 1.5–2 mm; anthers ovate, 0.3–0.5 mm. Ovules 6–10 per ovary. Fruit linear, (0.8–)1–2 cm × 1.5–2 mm, terete, torulose; valves with an obscure midvein; gynophore absent or obsolete; septum complete; style 0.5–2 mm. Seeds oblong, plump, 2–3 × 1–1.5 mm. Fl. Mar–May, fr. Apr–Jun.

Near sea level to 4000 m. Guizhou, Sichuan, Xizang, Yunnan [Japan].

The record in FRPS of *Eutrema tenue* from Taiwan is based on misidentified plants of *E. wasabi*. Except for having stout styles to 0.7 mm (vs. 1–2 mm), the type of *E. thibeticum* is indistinguishable from that of *E. tenue*.

7. *Eutrema wasabi* (Siebold) Maximowicz, Bull. Acad. Imp. Sci. Saint-Petersbourg, Sér. 3, 17: 283. 1873.

块茎山沸菜 kuai jing shan yu cai

Cochlearia wasabi Siebold, Verh. Batav. Genootsch. Kunst. Wet. 12: 54. 1832; *Alliaria wasabi* (Siebold) Prantl; *Eutrema japonicum* (Miquel) Koidzumi; *E. koreanum* (Nakai) K. Hammer; *E. okinosimense* Takenouchi; *Lunaria japonica* Miquel; *Wasabia japonica* (Miquel) Matsumura; *W. koreana* Nakai; *W. pungens* Matsumura; *W. wasabi* (Siebold) Makino. Herbs 20–60(–75) cm tall, glabrous or sparsely pilose on upper parts; rhizomes fleshy, to 3 cm in diam. Stems erect or decumbent, simple. Basal leaves rosulate; petiole (6–)10–20(–26) cm, dilated at base; leaf blade cordate or reniform, (2.5–)6–15(–20) × (3–)6–18(–22) cm, base cordate, margin dentate, denticulate, shallowly crenate, repand, or subentire, with distinct apiculate callosities terminating ultimate veins, apex rounded or obtuse. Middle cauline leaves with petioles 1–5(–8) cm; leaf blade broadly ovate to ovate-cordate, 1.5–4(–6) × 2–4(–6) cm, palmately veined, base and margin as in basal leaves, apex acute. Infructescence lax raceme, bracteate throughout or basally. Fruiting pedicels ascending or divaricate, slender, 1–3.5(–5) cm. Sepals oblong, 3–4 × 2–2.5 mm, caducous. Petals white, oblong-spatulate, 6–8(–9) × 2–3 mm. Filaments white, 3.5–5 mm; anthers oblong, 0.6–0.8 mm. Ovules 6–8 per ovary. Fruit linear, 1–2 cm × 1.5–2 mm, terete, torulose; valves with an obscure midvein; gynophore (1–)2–5 mm; septum usually complete; style 2–3 mm. Seeds oblong, plump, 2–3 × 1–1.5 mm. Fl. Mar–May, fr. May–Jun.

Flora of China 8: 174–177. 2001.

Cultivated, also naturalized in wet areas along streams in mountains; near sea level to 2500 m. Taiwan [native to Japan, Korea, ?Russia (Far East)].

This species is cultivated for its edible rhizomes, which are the source of the pungent condiment wasabi.

