

3. TETRADIUM Loureiro, Fl. Cochinch. 1: 91. 1790.

四数花属 *si shu hua shu*

Zhang Dianxiang (张奠湘); Thomas G. Hartley

Boymia A. Jussieu; *Megabotrya* Hance ex Walpers; *Philagonia* Blume.

Shrubs or trees, evergreen or deciduous, dioecious or rarely polygamo-dioecious. Axillary buds exposed. Leaves opposite, odd-pinnate (occasional leaves even-pinnate); lateral leaflet blades often \pm inequilateral, especially at base. Inflorescences terminal or terminal and axillary, thyriform. Sepals 4 or 5, basally connate. Petals 4 or 5, narrowly imbricate in bud. Stamens 4 or 5, distinct. Male flowers: stamens to $1.5 \times$ as long as petals; disk conic to cylindric or occasionally barrel-shaped; gynoecium rudimentary, of 4 or 5 basally connate, divergent, and fingerlike carpels. Female flowers: stamens rudimentary, ligulate, much shorter than petals or sometimes lacking; disk pulvinate to barrel-shaped; gynoecium 4- or 5-carpelled; ovaries basally connate, otherwise contiguous, each with 1 or 2 ovules; style apical, of 4 or 5 \pm contiguous styler elements; stigma peltate. Fruit of 1–5 basally connate follicles with abortive carpels, if any, persistent; outer part of pericarp (exocarp and mesocarp) dry or \pm fleshy; endocarp cartilaginous. Seeds remaining attached in dehiscent fruit; seed coat (except in *Tetradium daniellii* and *T. calcicola*) with thick inner layer of dense black sclerenchyma and spongy outer layer bounded externally by a shiny black or reddish pellicle; endosperm copious; embryo straight; cotyledons broadly elliptic, \pm flattened; hypocotyl superior.

Nine species: E, S, and SE Asia; seven species (one endemic) in China.

Euodia lvi H. Léveillé (Bull. Géogr. Bot. 24: 142. 1914) is a synonym of *Miliusa sinensis* Finett & Gagnepain in the Annonaceae (see Fl. China 7).

Euodia chaffanjonii H. Léveillé (Repert. Spec. Nov. Regni Veg. 13: 265. 1914) is a synonym of *Euscaphis japonica* (Thunberg) Dippel in the Staphyleaceae (see p. 498).

Euodia was long confused with *Tetradium* and *Melicope*. *Euodia* comprises seven species native to NE Australia, New Guinea, and SW Pacific islands.

1a. Plants flowering.

2a. Flowers 4(or 5)-merous.

3a. Leaflet blade secondary veins 13–22 on each side of midvein, margin crenulate or rarely entire; ovules 2 per carpel, subcollateral 1. *T. fraxinifolium*

3b. Leaflet blade secondary veins 11–14 on each side of midvein, margin entire; ovules 2 per carpel, collateral 5. *T. trichotomum*

2b. Flowers (4 or)5-merous.

4a. Ovules 1 per carpel; leaflet blades abaxially finely papillate 7. *T. austrosinense*

4b. Ovules 2 per carpel; leaflet blades not abaxially papillate.

5a. Ovules superposed.

6a. Petals white or whitish, drying whitish or pale brown, outside glabrous; leaflet blade margins subentire to crenulate 2. *T. daniellii*

6b. Petals purple, drying dull purplish red, outside sparsely to \pm densely appressed pubescent; leaflet blade margins entire 3. *T. calcicola*

5b. Ovules collateral or subcollateral.

7a. Sepals ca. 0.5 mm; leaflet blades abaxially usually glaucous, reticulate veinlets dense and clearly defined 4. *T. glabrifolium*

7b. Sepals 0.5–1.2 mm; leaflet blades abaxially rarely slightly glaucous, reticulate veinlets \pm loose and \pm inconspicuous 6. *T. ruticarpum*

1b. Plants fruiting.

8a. Fruit (including abortive carpels, if any) 4(or 5)-carpelled.

9a. Seeds 2 per follicle, subtrigonal, attached in dehiscent follicle to a fleshy funiculate aril 1. *T. fraxinifolium*

9b. Seeds 1 per follicle, paired with an abortive seed, subglobose to broadly ovoid, attached in dehiscent follicle to an axile strip of pergamentaceous pericarp tissue 5. *T. trichotomum*

8b. Fruit (including abortive carpels, if any) (4 or)5-carpelled.

10a. Fruit follicles 2-seeded.

11a. Fruit follicles 5–11 mm, sparsely to densely spreading pubescent, apex beaked 2. *T. daniellii*

11b. Fruit follicles ca. 5 mm, sparsely to densely appressed pubescent laterally, otherwise glabrate, apex not beaked 3. *T. calcicola*

- 10b. Fruit follicles 1-seeded.
 12a. Seed not paired with an abortive seed; follicles ca. 3.5 mm 7. *T. austrosinense*
 12b. Seed paired with an abortive seed; follicles 3.5–6 mm.
 13a. Fruit follicles trigonous, sparsely to densely appressed pubescent laterally, glabrous
 abaxially, endocarp sparsely to ± densely pubescent 4. *T. glabrifolium*
 13b. Fruit follicles subglobose, glabrous or sometimes with sparse trichomes laterally and/or
 abaxially, endocarp glabrous 6. *T. ruticarpum*

1. *Tetradium fraxinifolium* (Hooker) T. G. Hartley, Gard. Bull. Singapore 34: 102. 1981.

无腺吴茛 *wu xian wu yu*

Philagonia fraxinifolia Hooker, Icon. Pl. t. 710. 1845; *Euodia fraxinifolia* (Hooker) Benth; *E. impellucida* Handel-Mazzetti; *E. impellucida* var. *macrococca* C. C. Huang; *E. poilanei* Guillaumin; *E. subtrigonosperma* C. C. Huang.

Trees to 12 m tall. Leaves 23–67 cm, 5–15-foliolate; leaflet blades lanceolate or occasionally ovate, elliptic-oblong, or elliptic, 9–25 × 3.5–8.5 cm, abaxially often glaucous and sometimes subpapillate, secondary veins 13–22 on each side of midvein, reticulate veinlets abaxially usually inconspicuous, base in lateral leaflets rounded to narrowly cuneate and in terminal leaflet cuneate, margin crenulate or rarely entire, apex acuminate. Inflorescences 7–24 cm. Flowers 4(or 5)-merous. Sepals 0.5–1.5 mm. Petals green to pale yellow but drying brown, 3.5–6.5 mm, outside glabrous, inside glabrous to villous. Ovary glabrous or appressed pubescent; ovules 2 per carpel, subcollateral. Fruit (including abortive carpels, if any) usually 4-carpelled; follicles compressed subglobose, 5.5–10 mm, glabrous to sparsely pubescent, apex not beaked; endocarp glabrous or sparsely pubescent. Seeds 2 per follicle, subtrigonous, 4–5 mm, attached in dehisced follicle to a fleshy funiculate aril; seed coat with thick inner layer of dense black sclerenchyma and spongy outer layer bounded externally by a reddish brown to brownish black shiny pellicle. Fl. May and Nov, fr. Jul–Nov.

Forests, thickets; 700–3000 m. SE Xizang, Yunnan [Bhutan, India, Myanmar, Nepal, Thailand, N Vietnam].

2. *Tetradium daniellii* (Bennett) T. G. Hartley, Gard. Bull. Singapore 34: 105. 1981.

臭檀吴茛 *chou tan wu yu*

Zanthoxylum daniellii Bennett, Ann. Mag. Nat. Hist., ser. 3, 10: 201. 1862; *Ampacus daniellii* (Bennett) Kuntze; *Euodia baberi* Rehder & E. H. Wilson, p.p. as to *E. H. Wilson 1164* p.p. Jul 1908 (see also synonymy of *Tetradium ruticarpum*); *E. daniellii* (Bennett) Hemsley; *E. daniellii* var. *delavayi* (Dode) C. C. Huang; *E. daniellii* var. *henryi* (Dode) C. C. Huang; *E. daniellii* var. *hupehensis* (Dode) C. C. Huang; *E. daniellii* var. *labordei* (Dode) C. C. Huang; *E. daniellii* var. *villicarpa* (Rehder & E. H. Wilson) C. C. Huang; *E. delavayi* Dode; *E. henryi* Dode; *E. henryi* var. *villicarpa* Rehder & E. H. Wilson; *E. hupehensis* Dode; *E. labordei* Dode; *E. sutchuenensis* Dode, p.p. as to *R. P. Farges 1284* p.p. (see also synonymy of *Phellodendron chinense* var. *chinense*); *E. velutina* Rehder &

E. H. Wilson; *E. vestita* W. W. Smith; *Z. bretschnideri* Maximowicz.

Shrubs or trees, to 20 m tall. Leaves 15–44 cm, 5–9(or 11)-foliolate; leaflet blades broadly ovate to lanceolate or rarely elliptic or elliptic-oblong, 5–18.5 × 2.5–10.5 cm, abaxially sometimes ± glaucous and not papillate, secondary veins 7–14 on each side of midvein, reticulate veinlets abaxially usually inconspicuous, base in lateral leaflets narrowly cuneate, subtruncate, subrounded, or subcordate and in terminal leaflet narrowly cuneate, cuneate, or occasionally rounded, margin subentire to crenulate, apex acuminate. Inflorescences 3.5–19 cm. Flowers (4 or)5-merous. Sepals 0.5–1.5 mm. Petals white or whitish but drying whitish or pale brown, (2.5–)3–5 mm, outside glabrous, inside sparsely or sometimes densely pubescent or villous. Ovary pubescent between carpels, otherwise ± densely pubescent to glabrous; ovules 2 per carpel, superposed. Fruit (including abortive carpels, if any) usually 5-carpelled; follicles narrowly pyriform, 5–11 mm, sparsely to ± densely spreading pubescent, apex beaked; endocarp glabrous. Seeds 2 per follicle, superposed, black, ovoid to ellipsoid, shiny, attached in dehisced fruit to axile strip of pergamentaceous pericarp tissue; basal seed sterile, usually 1.5–3.5 mm, containing what appears to be endosperm but no embryo; apical seed fertile, 2.5–4 mm; seed coat sclerenchymatous, lacking spongy tissue, in fertile seed thick and resistant to breakage, in sterile seed thin and brittle. Fl. Jun–Aug, fr. Aug–Nov. $2n = 76, 78$.

Forests, forest margins, open slopes; near sea level to 3200 m. Anhui, S Gansu, Guizhou, Hebei, Henan, Hubei, Jiangsu, Liaoning, S Ningxia, E Qinghai, Shaanxi, Shandong, Shanxi, Sichuan, SE Xizang, Yunnan [Korea].

3. *Tetradium calcicola* (Chun ex C. C. Huang) T. G. Hartley, Gard. Bull. Singapore 34: 108. 1981.

石山吴茛 *shi shan wu yu*

Euodia calcicola Chun ex C. C. Huang, Acta Phytotax. Sin. 6: 120. 1957.

Shrubs or trees, to 15 m tall. Leaves 9–19 cm, 5-foliolate; leaflet blades ovate to elliptic, 5–9.5 × 2.3–4.5 cm, abaxially ± glaucous and not papillate, secondary veins 10–14 on each side of midvein, reticulate veinlets abaxially usually inconspicuous, base in lateral leaflets and in terminal leaflet obtuse to rounded, margin entire, apex acuminate. Inflorescences 5.5–13 cm. Flowers 5-merous. Sepals 0.7–1 mm. Petals purple but drying dull purplish red, 3–4 mm, outside sparsely to ± densely appressed pubescent, inside villous. Ovary sparsely to ± densely appressed pubescent; ovules 2 per carpel, superposed. Fruit (including abortive carpels, if any) 5-carpelled;

follicles pyriform, ca. 5 mm, laterally densely appressed pubescent, otherwise glabrate, apex not beaked; endocarp glabrous. Seeds 2 per follicle, superposed, black, ellipsoid, shiny, attached in dehisced fruit to axile strip of pergamentaceous pericarp tissue; basal seed sterile, ca. 2 mm, containing what appears to be endosperm but no embryo; apical seed fertile, ca. 3 mm; seed coat sclerenchymatous, lacking spongy tissue, in sterile seed thin and brittle, in fertile seed thick and resistant to breakage. Fl. Jun–Sep, fr. Sep–Dec.

• Forests, thickets; 600–800 m. N and W Guangxi, S Guizhou, SE Yunnan.

4. *Tetradium glabrifolium* (Champion ex Benth) T. G. Hartley, Gard. Bull. Singapore 34: 109. 1981.

棘叶吴萸 lian ye wu yu

Boymia glabrifolia Champion ex Benth, Hooker's J. Bot. Kew Gard. Misc. 3: 330. 1851; *Ampacus meliifolia* (Hance ex Walpers) Kuntze; *Euodia ailantifolia* Pierre; *E. balansae* Dode; *E. fargesii* Dode; *E. glabrifolia* (Champion ex Benth) C. C. Huang; *E. glauca* Miquel; *E. meliifolia* (Hance ex Walpers) Benth; *E. taiwanensis* T. Yamazaki; *E. yunnanensis* C. C. Huang; *Eurycoma dubia* Elmer; *Megabotrya meliifolia* Hance ex Walpers; *Phellodendron burkillii* Steenis; *Tetradium glabrifolium* var. *glaucum* (Miquel) T. Yamazaki; *T. taiwanense* (T. Yamazaki) T. Yamazaki.

Shrubs or trees, to 20 m tall. Leaves 14–38 cm, (3 or)5–19-foliolate; leaflet blades broadly ovate to lanceolate or less often elliptic or elliptic-oblong, 4–15 × 1.7–6 cm, abaxially usually glaucous and not papillate, secondary veins 8–18 on each side of midvein, reticulate veinlets abaxially clearly defined and dense, base in lateral leaflets narrowly cuneate to subrounded to subtruncate and in terminal leaflet narrowly cuneate to cuneate, margin entire or ± crenulate, apex acuminate. Inflorescences 9–19 cm. Flowers (4 or)5-merous. Sepals ca. 0.5 mm. Petals green, yellow, or white but drying whitish to brown, 2.7–4 mm, outside glabrous or sometimes with sparse appressed trichomes, inside nearly glabrous to villous. Ovary ± densely pubescent between carpels, otherwise finely pubescent toward apex or glabrous; ovules 2 per carpel, collateral or subcollateral. Fruit (including abortive carpels, if any) usually 5-carpelled; follicles trigonous, 3.5–5 mm, laterally sparsely to densely appressed pubescent, otherwise glabrous, apex not beaked; endocarp sparsely to ± densely pubescent. Seeds 1 per follicle but paired with an abortive seed, subglobose to ovoid to broadly ellipsoid, 2.5–4 mm, attached in dehisced follicle to axile strip of pergamentaceous pericarp tissue; seed coat with thick inner layer of dense black sclerenchyma and spongy outer layer bounded externally by a shiny black pellicle. Fl. Jun–Sep, fr. Sep–Dec.

Forests, thickets, open places; near sea level to 1200 m. Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hainan, Henan, Hubei, Hunan, Jiangxi, S Shaanxi, Sichuan, Taiwan, Yunnan, Zhejiang [Bhutan, India, Indonesia, Japan (including Ryukyu Islands), Malaysia, Myanmar, Philippines, Thailand, Vietnam].

5. *Tetradium trichotomum* Loureiro, Fl. Cochinch. 1: 91. 1790.

牛科吴萸 niu dou wu yu

Ampacus trichotoma (Loureiro) Kuntze; *Brucea trichotoma* (Loureiro) Sprengel; *Euodia colorata* Dunn; *E. hainanensis* Merrill; *E. lenticellata* C. C. Huang; *E. trichotoma* (Loureiro) Elmer; *E. trichotoma* var. *pubescens* C. C. Huang; *E. viridans* Drake.

Shrubs or trees, to 8 m tall. Leaves 12–37 cm, (3 or)5–11(or 13)-foliolate; leaflet blades elliptic-oblong, lanceolate, or occasionally ovate, 3–16 × 3–5 cm, abaxially neither glaucous nor papillate, secondary veins 11–14 on each side of midvein, reticulate veinlets abaxially inconspicuous, margin entire, base in lateral leaflets subrounded to cuneate and in terminal leaflet cuneate, apex acuminate. Inflorescences 5–30 cm. Flowers 4(or 5)-merous. Sepals 0.5–1 mm. Petals green, yellow, or white but drying brown to whitish, 3–4 mm, outside glabrous, inside glabrous or sparsely villosulous. Ovary glabrous or with a few short trichomes between carpels toward base; ovules 2 per carpel, collateral. Fruit (including abortive carpels, if any) usually 4-carpelled; follicles subglobose to obovoid, 4–7 mm, glabrous or laterally with sparse pubescence toward base, apex not beaked; endocarp glabrous. Seeds 1 per follicle but paired with an abortive seed, subglobose to broadly ovoid, 3.7–6 mm, attached in dehisced follicle to axile strip of pergamentaceous pericarp tissue; seed coat with thick inner layer of dense black sclerenchyma and spongy outer layer bounded externally by a shiny black pellicle. Fl. Apr–Aug, fr. Sep–Nov.

Forests, thickets; 300–1900 m. SE Guangdong, Guangxi, S Guizhou, Hainan, Hubei, Shaanxi, S Sichuan, Yunnan [Laos, Thailand, N Vietnam].

6. *Tetradium ruticarpum* (A. Jussieu) T. G. Hartley, Gard. Bull. Singapore 34: 116. 1981.

吴茱萸 wu zhu yu

Boymia ruticarpa A. Jussieu, Mém. Mus. Hist. Nat. 12: 507. 1825; *Ampacus ruticarpa* (A. Jussieu) Kuntze; *Euodia baberi* Rehder & E. H. Wilson, p.p. as to *E. H. Wilson 1164* p.p. Oct 1908 (see also synonymy of *Tetradium daniellii*); *E. bodinieri* Dode; *E. compacta* Handel-Mazzetti; *E. compacta* var. *meionocarpa* Handel-Mazzetti; *E. hirsutifolia* Hayata; *E. officinalis* Dode; *E. rugosa* Rehder & E. H. Wilson; *E. ruticarpa* (A. Jussieu) Benth; *E. ruticarpa* var. *bodinieri* (Dode) C. C. Huang; *E. ruticarpa* var. *officinalis* (Dode) C. C. Huang.

Shrubs or trees, to 9 m tall. Leaves 15–40 cm, (3 or)5–13(or 15)-foliolate; leaflet blades elliptic to ovate or sometimes lanceolate, oblanceolate, or obovate, 4.5–17 × 2–8 cm, abaxially rarely slightly glaucous and not papillate, secondary veins 9–17 on each side of midvein, reticulate veinlets abaxially ± inconspicuous and ± loose, base in lateral leaflets obtuse to narrowly cuneate or sometimes rounded to cuneate or rarely attenuate, margin entire or irregularly crenulate, apex acuminate. Inflorescences 2.5–18 cm. Flowers (4 or)5-merous. Sepals 0.5–1.2 mm. Petals green, yellow, or white but drying brown to whitish, 3–5 mm, outside glabrous or with sparse short trichomes, inside nearly glabrous to villous. Ovary

Fl. China 11: 66–70. 2008.

glabrous or with sparse trichomes; ovules 2 per carpel, collateral or subcollateral. Fruit (including abortive carpels, if any) usually 5-carpelled; follicles subglobose, 3.5–6 mm, glabrous or sometimes with sparse trichomes, apex not beaked; endocarp glabrous. Seeds 1 per follicle but paired with an abortive seed, ovoid or sometimes ellipsoid or subglobose, 3.5–5.5 mm, attached in dehisced follicle to axile strip of pergamentaceous pericarp tissue; seed coat with thick inner layer of dense black sclerenchyma and spongy outer layer bounded externally by a shiny black pellicle. Fl. Apr–Jun, fr. Aug–Nov.

Forests, thickets, open places; 100–3000 m. Anhui, Fujian, S Gansu, Guangdong, Guangxi, Guizhou, Hebei, S Henan, Hubei, Hunan, S Jiangsu, Jiangxi, S Shaanxi, Sichuan, Yunnan, Zhejiang [Bhutan, NE India, Myanmar, Nepal].

7. **Tetradium austrosinense** (Handel-Mazzetti) T. G. Hartley, Gard. Bull. Singapore 34: 120. 1981.

华南吴萸 hua nan wu yu

Euodia austrosinensis Handel-Mazzetti, Sinensia 5: 1. 1934.

Trees to 20 m tall. Leaves 20–35 cm, 7–11-foliolate; leaflet blades broadly elliptic or sometimes ovate, lanceolate, obovate, or oblanceolate, 5.5–14.5(–17) × 2.5–7(–8.5) cm, abaxially glaucous and finely papillate, secondary veins 9–12 on each side of midvein, reticulate veinlets abaxially usually ± conspicuous and ± loose, base in lateral leaflets obtuse to nearly rounded and in terminal leaflet cuneate, margin entire, apex acuminate. Inflorescences 11–18 cm. Flowers (4 or)5-merous. Sepals ca. 0.5 mm. Petals green to greenish yellow but drying brown, 2.5–3 mm, outside glabrous to sparsely puberulent, inside sparsely to densely villous. Ovary glabrous; ovules 1 per carpel. Fruit (including abortive carpels, if any) usually 5-carpelled; follicles trigonous to subtrigonous, ca. 3.5 mm, glabrous or rarely with a few scattered trichomes, apex not beaked; endocarp glabrous. Seeds 1 per follicle and not paired with an abortive seed, ellipsoid to subreniform, 2.3–2.5 mm, attached in dehisced follicle to axile strip of pergamentaceous pericarp tissue; seed coat with thick inner layer of dense black sclerenchyma and spongy outer

layer bounded externally by a shiny black pellicle. Fl. Jun–Jul, fr. Sep–Nov.

Forests; 300–1500 m. Guangdong, Guangxi, S Yunnan [N Vietnam].

Fl. China 11: 66–70. 2008.