

**JUGLANDACEAE**

胡桃科 hu tao ke

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Trees or rarely shrubs, deciduous, semievergreen, or evergreen, monoecious or rarely dioecious; bark tight (or exfoliating). Branchlets with solid or chambered pith. Terminal buds subglobose or ovoid to oblong, naked or with scales. Stipules absent. Leaves alternate (or opposite), odd- or even-pinnate, sometimes trifoliolate, rarely simple; leaflets with glandular, peltate scales, often resinous and aromatic, particularly conspicuous abaxially on young leaves and twigs, margin serrate or rarely entire. Inflorescences pendulous or sometimes erect, lateral or terminal, on reduced shoots arising on branchlets of previous year (old growth) or on current year's growth (new growth), of several types: androgynous panicle with male, lateral spikes and female, central spike; androgynous panicle with male, mainly lateral spikes and female, central spike male at apex; cluster of male spikes and solitary female spike; or solitary male and female spikes. Flowers unisexual, anemophilous, rarely entomophilous. Male flowers subtended by an entire or 3-lobed bract; bracteoles 2 or absent; sepals 0–4, adnate to receptacle when present; stamens 3–40(–100), inserted on receptacle; filaments short to nearly absent, free or united at base; anthers glabrous or pubescent, 2-loculed, dehiscent longitudinally. Female flowers with an entire or 3-lobed bracts; bracteoles 2 or 3 (or absent); sepals 0–4, adnate to ovary, free at apex; gynoecium of 2 carpels united into an inferior ovary, 1-loculed, but at base 2–4(–8)-loculed; style 1, short or elongate, rarely absent; stigmas 2, carinal or commissural, sometimes 4-lobed, plumose or fleshy; ovule 1, orthotropous. Fruiting spike elongate, and pendulous or short and erect, rarely conelike. Fruit a drupelike nut, 2–4(–8)-chambered at base, with a dehiscent or indehiscent husk, or a 2- or 3-winged or disc-winged nutlet. Seed solitary, without endosperm. Cotyledons 4-lobed, much contorted. Germination hypogeal or epigeal.  $2n = (28), 32, (64)$ .

Nine genera and 60 or more species: mostly in temperate and subtropical regions of the N hemisphere; seven genera (one endemic) and 20 species (seven endemic, one introduced) in China.

Kuang Ko-zen & Lu An-ming. 1979. Juglandaceae. In: Kuang Ko-zen & Li Pei-chun, eds., Fl. Reipubl. Popularis Sin. 21: 6–44.

- 1a. Flowering spikes of both sexes erect; fruiting spike conelike, bracts persistent, overlapping; fruit a minute,  
2-winged nutlet; leaves odd-pinnate ..... 1. *Platycarya*
- 1b. Male flowering spikes pendulous, female spike erect; fruiting spike not conelike; bracts dispersed with nuts or nutlets; fruit a small, 2- or 3-winged nutlet or a medium to large, drupelike nut with a husk; leaves odd- or even-pinnate.
- 2a. Fruiting bract 3-lobed, expanded into membranous, pinnately veined wings subtending nutlet; lateral bracteoles fused, forming a small, anterior rim or well-developed prophyll; leaves even-pinnate 2. *Engelhardia*
- 2b. Fruiting bract entire, inconspicuous; lateral bracteoles expanded into 2 small wings on nutlet, fused into disc wing, or fused with sepals to form husk; leaves odd-pinnate.
- 3a. Branchlets with solid pith; male spikes in clusters of 3 or 5–8; drupelike nuts with a 4–9-valved, dehiscent husk.
- 4a. Leaflet margin entire; male spikes in clusters of 5–8; stamens 5–15; husk strongly keeled, splitting into 4–9 segments; nuts with attenuate apex ..... 6. *Annamocarya*
- 4b. Leaflet margin serrate; male spikes in clusters of 3; stamens 3–7; husk not keeled, occasionally with small flanges, splitting into 4 segments; nuts rarely with prominent, attenuate apex ..... 7. *Carya*
- 3b. Branchlets with chambered pith; male spikes solitary or in clusters of 3–5; disc- or 2-winged nutlets or drupelike nuts with an indehiscent or irregularly dehiscent husk.
- 5a. Fruit a large, drupelike nut, indehiscent or with an irregularly dehiscent husk; germination hypogeal; female spike usually less than 10-flowered, erect ..... 5. *Juglans*
- 5b. Fruit a small, winged nutlet, indehiscent; germination epigeal; female spike 10- to numerous flowered, pendulous.
- 6a. Fruit a disc-winged nutlet; male spikes in clusters of 3–5 ..... 3. *Cyclocarya*
- 6b. Fruit a 2-winged nutlet; male spike solitary ..... 4. *Pterocarya*

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1. **PLATYCARYA** Siebold & Zuccarini, Abh. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. 3: 741. 1843.

化香树属 hua xiang shu shu

*Fortunaea* Lindley.

Trees or occasionally shrubs, deciduous, monoecious. Branchlets with solid pith. Terminal buds subglobose to ovoid, with broad, overlapping scales. Leaves odd-pinnate, rarely simple; leaflets (1–)7–15(–23), margin serrate. Inflorescences terminal on new growth, erect at apex of leafy branchlets, an androgynous panicle of male and female spikes, with mainly lateral spikes male, central spike female but male at apex, or occasionally panicle becoming wholly male when female spike aborts. Flowers entomophilous. Male flowers with an entire bract; bracteoles absent; sepals absent; stamens 4–15, anthers glabrous. Female flowers subtended by an entire bract, ± free from ovary; bracteoles 2, adnate to ovary; sepals 2, adnate to bracteoles; style absent; stigmas carinal, 2-lobed, short, minutely plumose. Fruiting spike short, conelike, erect, with rigid, persistent bracts. Fruit a small, flattened, narrowly 2-winged nutlet, 2-chambered at base. Germination epigeal.

One species: China, Japan, Korea, Vietnam.

1. **Platycarya strobilacea** Siebold & Zuccarini, Abh. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. 3: 742. 1843.

化香树 hua xiang shu

*Fortunaea chinensis* Lindley; *Platycarya kwangtungensis* Chun; *P. longipes* Wu; *P. simplicifolia* G. R. Long; *P. simplicifolia* var. *ternata* G. R. Long; *P. sinensis* Mottet; *P. strobilacea* var. *kawakamii* Hayata. Trees or shrubs to 15 m tall. Leaves (6–)8–30 cm; petiole 1.2–9.2 cm, glabrous; rachis glabrous; leaflets 1–15(–23); lateral leaflets sessile, blade ovate-lanceolate to narrowly elliptic-lanceolate, 3–11 × 1.5–3.5 cm, abaxially glabrous, except for dense cluster of hairs at base and along midvein abaxially, base oblique to cuneate; terminal leaflet with petiolule 0.6–3.5 cm, base rounded or broadly cuneate. Androgynous spike 2–10 cm; central spike female in basal 1–3 cm, male in

apical 1–3.4 cm, or sometimes absent. Male spikes 2–15 cm; bracts ovate, 2–3 mm, apex acute to acuminate. Female flowers with bract straight or reflexed. Fruiting spike ovoid-ellipsoid or ellipsoid-cylindric to subglobose, 2.5–5 × (1.2–)2–3 cm; bracts lanceolate, 4–10 × 2–3 mm. Nutlets suborbicular to obovate, 3–6 × 3–6 mm. Fl. May–Jul, fr. Jul–Oct.  $2n = 28$ .

Mixed forests on mountain slopes, sometimes on limestone; 400–1400(–2200) m. Anhui, Fujian, S Gansu, Guangdong, Guangxi, Guizhou, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Shaanxi, Shandong, Sichuan, Yunnan, Zhejiang [Japan, Korea, Vietnam].

Two variants, *Platycarya longipes* and *Platycarya simplicifolia*, restricted to limestone formations, were recognized in earlier treatments; however, sterile specimens of the former intergrade with *P. strobilacea*, and the latter is clearly a mutant anomaly.

2. **ENGELHARDIA** Leschenault ex Blume, Bijdr. 10: 528. 1825.

黄杞属 huang qi shu

*Pterilema* Reinwardt.

Trees deciduous, semievergreen or evergreen, monoecious or rarely dioecious. Branchlets with solid pith. Terminal buds oblong, naked. Leaves even-pinnate, rarely odd-pinnate; leaflets 2–14, margin entire or serrate. Inflorescences lateral or terminal on old or new growth: male and female spikes in androgynous panicles or separate; male spikes solitary or clustered, pendulous; female spike many flowered, erect or recurved in fruit. Flowers anemophilous. Male flowers with a 3-lobed bract; bracteoles 2, rarely absent; sepals 1–4, rarely absent; stamens 3–15, anthers glabrous or pubescent. Female flowers subtended by an enlarged, 3-lobed bract; bracteoles 2, united, reduced to a low rim or forming a conspicuous, anterior prophyll, adnate to base of ovary; sepals 4, adnate to ovary, free at apex; style absent or elongate; stigmas carinal or commissural, 2-lobed, with 2 or 4 plumose branches, or short and 4-lobed. Fruiting spike elongate, pendulous. Fruit a 3-winged nutlet, (2–)4-chambered at base. Germination epigeal.

About seven species: S and SE Asia, N India; four species (one endemic) in China.

The number of species of *Engelhardia* is open to question: more than ten have been recognized in SE Asia. The taxonomy of the genus suffers from a lack of good specimens from throughout its range.

- 1a. Plants monoecious, semievergreen or evergreen; leaflet margin entire; inflorescences terminal on new growth; male flowers shortly stalked, receptacle orbicular, stamens (10–)12, enclosed in 4-hooded floral parts, anthers glabrous; female flowers stalked, style absent, stigmas carinal, short, 4-lobed; nutlets glabrous ..... 1. *E. roxburghiana*
- 1b. Plants monoecious or dioecious, evergreen or deciduous; leaflet margin serrate or entire; inflorescences lateral on old growth; male flowers sessile, receptacle elongate, stamens 4–13, not enclosed, anthers pubescent; female flowers ± sessile, style present, stigmas commissural, elongate, with 2 or 4 plumose branches; nutlets pubescent.

- 2a. Leaflets with glandular scales inconspicuous abaxially, margin entire; petiole 2.5–11.5 cm ..... 4. *E. spicata*  
 2b. Leaflets with glandular scales conspicuous abaxially, margin serrate or entire; petiole 1–7 cm.  
 3a. Petiole 1–2 cm, pubescent; leaflets pubescent abaxially, margin serrate or entire; nutlets globose, ca. 3 mm  
 in diam., central wing 2–2.5 cm ..... 2. *E. serrata*  
 3b. Petiole 4.5–7 cm, glabrous or pubescent; leaflets glabrous to slightly pubescent along midvein  
 abaxially, margin serrate; nutlets obovoid, 5–7 mm in diam., central wing 5–6 cm ..... 3. *E. hainanensis*

**1. Engelhardia roxburghiana** Wallich, Pl. Asiat. Rar. 2: 85. 1831.

黄杞 huang qi

*Alfaropsis roxburghiana* (Wallich) Iljinskaja;  
*Engelhardia chrysolepis* Hance; *E. fenzelii* Merrill; *E. formosana* Hayata; *E. roxburghiana* f. *brevialata* W. E. Manning; *E. spicata* Leschenault var. *formosana* Hayata; *E. unijuga* Chun ex P. Y. Chen.

Trees to 30 m tall. Leaves even-pinnate, 1–25 cm; petiole 1–8 cm, glabrous; rachis glabrous; leaflets 2–10, entire, petiolule 2–15 mm, blade elliptic-lanceolate to long elliptic, 4.5–14 × 1.5–5 cm, abaxially glabrous or puberulent, base oblique, apex acuminate or shortly acuminate. Nutlets globose, 3–5 mm, glabrous; wings glabrous, middle wing 1.5–5 cm, lateral wings 0.7–2.7 cm. Fl. Feb–Aug, fr. Jan–Dec.  $2n = 32$ .

Mixed broad-leaved or evergreen forests on loam, or on steep, dry slopes with sandy soil; 200–1500 m. Fujian, Guangdong, Guangxi, Guizhou, Hainan, Hubei, Hunan, Jiangxi, Sichuan, Taiwan, Yunnan, Zhejiang [Cambodia, Indonesia, Laos, Myanmar, E Pakistan, Thailand, Vietnam].

This species is widely distributed and highly variable, but the leaves, flowers, and nutlets are quite distinctive. Vegetative material can usually be distinguished by its entire, leathery, evergreen leaflets that are glabrous but coated with yellowish, peltate scales abaxially.

**2. Engelhardia serrata** Blume var. **cambodica** W. E. Manning, Bull. Torrey Bot. Club 93: 47. 1966.

齿叶黄杞 chi ye huang qi

Trees to 12 m tall. Leaves even-pinnate, rarely odd-pinnate, 15–25 cm; petiole 1–2 cm, tomentose; rachis tomentose; leaflets 6–14, sessile to shortly petiolulate, blade elliptic or elliptic-lanceolate, (2–)6–13 × (1.5–)2.5–4.5 cm, abaxially tomentose, base broadly cuneate to obtuse, margin irregularly serrate or entire, apex acute or shortly acuminate. Nutlets globose, ca. 3 mm, hispid; wings hispid at base, middle wing 2–2.5 cm, lateral wings ca. 1.3 cm. Fl. Feb, fr. Apr.

Forests on mountain slopes; 700–1000 m. SW Yunnan [Cambodia, India, Laos, Myanmar, Thailand, Vietnam].

According to W. E. Manning (Bull. Torrey Bot. Club 93: 34–52. 1966), this taxon displays a degree of intermediacy between *Engelhardia serrata* var. *serrata*, from Indonesia and the Philippines, and *E. spicata* var. *colebrookeana*, a taxon that also has golden yellow scales intermixed with hairs abaxially on the leaflets.

**3. Engelhardia hainanensis** Chen, Acta Phytotax. Sin. 19(2): 251. 1981.

海南黄杞 hai nan huang qi

Trees to 30 m tall. Leaves even-pinnate, 15–23 cm; petiole 4.8–7 cm, pubescent or glabrescent; rachis pubescent; leaflets 6–10, petiolule 2–3 mm, blade

oblong-ovate or oblong-elliptic, 5–10.5 × 2.5–4 cm, abaxially pubescent along midvein and with scattered hairs in vein axils, base oblique, subobtusate or subcordate, margin serrate, apex acuminate. Nutlets obovoid, 8–10 × 5–7 mm, hispid; wings hispid at base, middle wing 5–6 cm, lateral wings 2.5–2.8 cm. Fr. Dec–Jan.

• Forests in valleys. SW Hainan (Dongfang: Jianfeng Ling).

**4. Engelhardia spicata** Leschenault ex Blume, Bijdr. 10: 528. 1825.

云南黄杞 yun nan huang qi

Trees to 20 m tall. Leaves even-pinnate, rarely odd-pinnate, 15–35 cm; petiole 2.5–11.5 cm, glabrous or pubescent; rachis glabrous or pubescent; leaflets 4–14, entire, sessile or petiolulate, blade elliptic, elliptic-lanceolate, or elliptic-ovate, 7–15 × 2–7 cm, abaxially glabrous or pubescent, base broadly cuneate, apex shortly acuminate. Nutlets globose or ovoid, 3–6 mm, hispid; wings hispid at base, middle wing 2.5–3.5 cm, lateral wings ca. 1.5–2 cm. Fl. Nov–Apr, fr. Jan–Aug(–Nov).  $2n = 32$ .

Forests on mountain slopes or in valleys; near sea level to 2100 m. Guangdong, Guangxi, Guizhou, Hainan, Xizang, Yunnan [Bhutan, India, Indonesia, Laos, W Malaysia, Myanmar, Nepal, Pakistan, Philippines, Sikkim, Thailand, Vietnam].

- 1a. Leaflets strongly petiolulate, abaxially glabrous; fruiting spike long, (22–)30–45(–60) cm ..... 4a. var. *spicata*  
 1b. Leaflets sessile or petiolulate, abaxially pubescent; fruiting spike short, 13–30(–40) cm.  
 2a. Leaflets sessile or shortly petiolulate, abaxially slightly pubescent, apex acuminate ..... 4b. var. *aceriflora*  
 2b. Leaflets petiolulate or rarely sessile, abaxially tomentose, apex obtuse or acute ..... 4c. var. *colebrookeana*

**4a. Engelhardia spicata** var. **spicata**

云南黄杞(原变种) yun nan huang qi (yuan bian zhong)

Trees to 20 m tall. Leaves 25–35 cm; petiole 3.5–11.5 cm, glabrous to tomentose; rachis glabrous to tomentose; leaflets (4–)8–14, petiolule 2–10 mm, blade elliptic to elliptic-lanceolate, 7–15 × 2–5 cm, abaxially glabrous except for slight pubescence along midvein and in secondary vein axils, base broadly cuneate, apex obtuse or sometimes acute. Fruiting spike (22–) 30–45(–60) cm, glabrous. Nutlets globose, ca. 3.5 mm, hispid; wings hispid at base, middle wing 2.5–3.5 cm, lateral wings ca. 1.5 cm. Fl. Nov, fr. Jan–Feb.  $2n = 32$ .

Mixed forests on mountain slopes; 500–2100 m. Guangxi, Xizang, Yunnan [Bhutan, India, Indonesia, Laos, W Malaysia, Nepal, Pakistan, Philippines, Sikkim, Thailand, Vietnam].

**4b. *Engelhardia spicata* var. *aceriflora*** (Reinwardt) Koorders & Valeton, Bijdr. Boomsort. Java 5: 167. 1900.

爪哇黄杞 *zhao wa huang qi*

*Pterilema aceriflorum* Reinwardt, Sylloge Plant. Nov. Soc. Rotisb. 2: 13. 1826; *Engelhardia aceriflora* (Reinwardt) Blume.

Trees to 10 m tall. Leaves 8–15 cm; petiole 4.5–9 cm, glabrous to puberulent; rachis usually slightly pubescent; leaflets 4–10, petiolule sessile to 5 mm, blade narrowly elliptic to ovate-elliptic, 8–15 × 3–6 cm, abaxially puberulent or glabrous, base oblique, obtuse, apex acuminate. Fruiting spike 15–30(–40) cm, tomentose. Nutlets ovoid, ca. 6 mm, hispid; wings hispid at base, middle wing 3–3.8 cm, lateral wings 1.5–1.8 cm. Fl. Mar, fr. Apr–May, Nov.  $2n = 32$ .

Forests on mountain slopes; 1500–1700 m. Yunnan [India, Indonesia, Myanmar, Nepal, Philippines, Thailand, Vietnam].

**4c. *Engelhardia spicata* var. *colebrookeana*** (Lindley) Koorders & Valeton, Bijdr. Boomsort. Java 5: 169. 1900.

毛叶黄杞 *mao ye huang qi*

*Engelhardia colebrookeana* Lindley in Wallich, Pl. Asiat. Rar. 3: 4. 1832; *E. esquirolii* H. Léveillé; *E. pterococca* Roxburgh ex Kuntze var. *colebrookeana* (Lindley) Kuntze; *E. spicata* var. *integra* (Kurz) Grierson & Long; *E. villosa* Kurz var. *integra* Kurz.

Trees to 7(–20) m tall. Leaves 15–25 cm; petiole 2–6 cm; petiole and rachis tomentose, rarely glabrescent; leaflets 4–10, petiolule to 1 cm or leaflets rarely sessile, blade broadly elliptic-ovate or broadly elliptic-obovate to long elliptic, 7–15 × 3–7 cm, abaxially tomentose or rarely glabrescent, base oblique, broadly cuneate or rounded, apex obtuse or sometimes acute. Fruiting spike 13–18 cm, densely pubescent. Nutlets globose, 4–6 mm, hispid; wings hispid at base, middle wing 1.9–3 cm, lateral wings 1–1.5 cm. Fl. Jan–Apr, fr. Mar–Aug(–Oct).  $2n = 32$ .

Open forests on mountain slopes or in valleys; near sea level to 1400(–2000) m. Guangdong, Guangxi, Guizhou, Hainan, Xizang, Yunnan [India, Myanmar, Nepal, Philippines, Sikkim, Thailand, Vietnam].

### 3. CYCLOCARYA Iljinskaya, Trudy Bot. Inst. Akad. Nauk S.S.S.R., ser. 1, Fl. Sist. Vyssh. Rast. 10: 115. 1953.

青钱柳属 *qing qian liu shu*

*Pterocarya* sect. *Cycloptera* Franchet.

Trees deciduous, monoecious. Branchlets with chambered pith. Terminal buds oblong, naked. Leaves odd-pinnate; leaflets (5 or)7 or 9(or 11), margin serrate. Inflorescences lateral or terminal on old or new growth, pendulous; male and female inflorescences separate: male spikes in clusters of 3–5, lateral on old growth; female spike solitary, terminal on new growth. Flowers anemophilous. Male flowers with an entire bract; bracteoles 2; sepals 2; stamens 20–31, anthers pubescent. Female flowers subtended by a small, entire bract, adnate to bracteoles and virtually submerged in wing complex; bracteoles 2, united and adnate to ovary; sepals 4, adnate to ovary, free at apex; style short; stigmas commissural, 2-lobed, plumose. Fruiting spike elongate, pendulous. Fruit a disc-winged nutlet, 2–4-chambered at base. Germination most likely hypogeal.

• One species: China.

This taxon is sometimes treated as a section or subgenus of *Pterocarya*, but generic rank seems preferable, based on the fossil record and several distinctive features, including clusters of male spikes (vs. solitary), low pollen pore number (3–5 vs. 4–9), bract fused with bracteoles (vs. not fused), commissural stigmas (vs. carinal), and disc-winged nutlets (vs. 2-winged).

**1. *Cyclocarya paliurus*** (Batalin) Iljinskaya, Trudy Bot. Inst. Akad. Nauk S.S.S.R., ser. 1, Fl. Sist. Vyssh. Rast. 10: 115. 1953.

青钱柳 *qing qian liu*

*Pterocarya paliurus* Batalin, Trudy Imp. S.-Peterburgsk. Bot. Sada 13: 101. 1893; *Cyclocarya paliurus* var. *micropaliurus* (Tsoong) P. S. Hsu & al.; *P. micropaliurus* Tsoong.

Trees to 30 m tall. Leaves 20–25 cm; petiole 2.5–5 cm, tomentose or sometimes glabrescent; rachis tomentose; leaflets (5 or)7 or 9(or 11); lateral leaflets sessile or

petiolule to 2 mm, blade elliptic-ovate to broadly lanceolate, 5–14 × 2–6 cm, abaxially pubescent along midvein and secondary veins, base oblique, broadly cuneate to subrounded, apex obtuse or acute, rarely acuminate; terminal petiolule 1–15 mm. Fruiting spike 25–30 cm, axis glabrous or pubescent. Nutlets compressed globose, ca. 7 mm; disc wing leathery, orbicular to ovate, 2.5–6 cm. Fl. May–Jun, fr. Jul–Sep.

• Moist forests on mountains; 400–2500 m. Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hainan, Hubei, Hunan, Jiangsu, Jiangxi, Sichuan, Taiwan, SE Yunnan, Zhejiang.

### 4. PTEROCARYA Kunth, Ann. Sci. Nat. (Paris) 2: 345. 1824.

枫杨属 *feng yang shu*

Trees deciduous, monoecious. Branchlets with chambered pith. Terminal buds oblong, naked, or with 2–4 overlapping scales. Leaves odd- or even-pinnate; leaflets 5–21(–25), margin serrate. Inflorescences lateral or

terminal on old or new growth, pendulous; male and female inflorescences separate: male spike solitary, lateral on old growth or at base of new growth; female spike terminal on new growth. Male flowers with an entire bract; bracteoles 2; sepals 4; stamens 5–18, anthers glabrous or pubescent. Female flowers with a small, entire bract, adnate to ovary but nearly free at base; bracteoles 2, adnate to ovary but nearly free above bract on posterior side; sepals 4, adnate to ovary, free at apex; style short; stigmas carinal, 2-lobed, plumose. Fruiting spike elongate, pendulous. Fruit a 2-winged nutlet, 4-chambered at base. Germination epigeal.

Six species: E and SW Asia; five species (two endemic) in China.

- 1a. Terminal buds with 2–4 caducous scales; branchlets with narrow bands of bud-scale scars; male spike lateral at base of new growth; bract of female flowers ca. 3 mm, densely tomentose; nutlets without lacunae in wall.  
 2a. Leaflets 11–21; axis of fruiting spike pubescent; nutlets glabrous, wings semiorbicular, 1.3–2.1 × 0.9–1.8 cm ..... 4. *P. rhoifolia*  
 2b. Leaflets 7–13; axis of fruiting spike glabrous or pubescent; nutlets glabrous or pubescent, wings orbicular-ovate to elliptic-rhomboid, 1–3 × 1–2 cm ..... 5. *P. macroptera*  
 1b. Terminal buds naked; branchlets without bud-scale scars; male spike lateral on old growth or scattered on new growth; bracts of female flowers less than 2 mm, glabrous or puberulent; nutlets with large lacunae in wall.  
 3a. Leaflets 5–11(–15); rachis wingless; nutlet wings broad, elliptic-ovate ..... 1. *P. hupehensis*  
 3b. Leaflets usually 6–21(–25); rachis winged or not; nutlet wings narrow, linear or oblong-linear.  
 4a. Rachis usually winged, at least in part; leaflets elliptic or elliptic-lanceolate, 6–12 × 2–3 cm, apex obtuse to acute ..... 2. *P. stenoptera*  
 4b. Rachis wingless; leaflets ovate or elliptic-ovate, 9–17 × 3–7 cm, apex acute to acuminate 3. *P. tonkinensis*

**1. *Pterocarya hupehensis*** Skan in F. B. Forbes & Hemsley, J. Linn. Soc., Bot. 26: 493. 1899.

湖北枫杨 hu bei feng yang

*Pterocarya sprengeri* Pampanini.

Trees to 20 m tall. Leaves odd-pinnate, (18–)20–25 cm; petiole 5–7 cm, glabrous; rachis wingless, glabrous; leaflets 5–11(–15), petiolule to 2 mm, blade long elliptic to ovate-elliptic, 8–12 × 3.5–5 cm, abaxially glabrous except for hairs along midvein, in dense clusters in axils, and scattered along secondary veins, base subrounded, oblique, apex shortly acuminate. Fruiting spike 30–45 cm, axis glabrous or slightly pubescent. Nutlets subglobose, slightly ribbed, 7–8 mm, glabrous; wings broad, elliptic-ovate, 1–1.5 × 1.2–1.5 cm. Fl. Apr–May, fr. Aug.

• Streambanks in moist forests; 700–2000 m. N Guizhou, W Hubei (Changyang Xian), S Shaanxi, W Sichuan.

**2. *Pterocarya stenoptera*** C. de Candolle, Ann. Sci. Nat., Bot., sér. 4, 18: 34. 1862.

枫杨 feng yang

*Acer mairei* H. Léveillé; *Pterocarya chinensis* Lavallée; *P. esquirolii* H. Léveillé; *P. japonica* Lavallée; *P. laevigata* Lavallée; *P. stenoptera* var. *brevialata* Pampanini; *P. stenoptera* var. *kouitchensis* Franchet; *P. stenoptera* var. *sinensis* Graebner.

Trees to 30 m tall. Leaves even-pinnate, rarely odd-pinnate, 8–16(–25) cm; petiole 2–6.5 cm, sparsely pubescent; rachis often winged or sometimes only ridged or sulcate on some leaves, sparsely pubescent to tomentose; leaflets (6–)11–21(–25), sessile, long elliptic to elliptic-lanceolate, 8–12 × 2–3 cm, abaxially

slightly pubescent, base oblique, cuneate or broadly cuneate, apex obtuse or acute. Fruiting spike 20–45 cm, axis pubescent at first but becoming nearly glabrous. Nutlets long ellipsoid, 6–7 mm, slightly pubescent to glabrescent; wings linear, 1.2–2.5 × 3–6 mm. Fl. Apr–May, fr. Aug–Sep.  $2n = 32$ .

Forests on mountain slopes or riverbanks; near sea level to 1500 m. Anhui, Fujian, Gansu, Guangdong, Guangxi, Guizhou, Hainan, Hebei, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Liaoning, Shaanxi, Shandong, Shanxi, Sichuan, Taiwan, Yunnan, Zhejiang [Japan, Korea].

Widely cultivated as a shade tree.

**3. *Pterocarya tonkinensis*** (Franchet) Dode, Bull. Soc. Dendrol. France 70: 67. 1929.

越南枫杨 yue nan feng yang

*Pterocarya stenoptera* C. de Candolle var. *tonkinensis* Franchet, J. Bot. (Morot) 12: 318. 1898.

Trees to 30 m tall. Leaves even-pinnate, rarely odd-pinnate, 18 cm or more; petiole 4.5–7 cm, glabrescent; rachis wingless, sometimes ridged or sulcate, pubescent or glabrescent; leaflets 6–14, sessile, ovate or elliptic-ovate, 9–17 × 3–7 cm, abaxially glabrous except for hairs along midvein and secondary veins, base oblique, rounded or broadly cuneate, apex acute to acuminate. Fruiting spike 13–30 cm. Nutlets rhomboid, 6–7 mm, glabrous; wings linear, 1–1.7 cm × 2–6 mm. Fl. Mar, fr. May–Oct.

Wet areas along mountain streams; 200–1200 m. S Yunnan [Laos, Vietnam].

Shares many features with *Pterocarya stenoptera*, but lacks wings on the rachis and has a more southerly distribution with earlier flowering

and fruiting. Transitional forms occur where the ranges of two species overlap.

**4. *Pterocarya rhoifolia*** Siebold & Zuccarini, Fl. Jap. 141. 1845.

水胡桃 shui hu tao

*Pterocarya sorbifolia* Siebold & Zuccarini.

Trees to 30 m tall. Leaves odd-pinnate, 20–25(–40) cm; petiole 3–7 cm, pubescent; rachis wingless, pubescent; leaflets (7–)11–21; lateral leaflets with petiolule ca. 1.5 mm, blade ovate-oblong to broadly oblanceolate, 6–12 × 1.5–4 cm, abaxially woolly pubescent along midvein and secondary veins, base oblique, rounded or broadly cuneate, apex acuminate; terminal petiolule 1.5–2 cm. Fruiting spike 20–30(–49) cm, axis pubescent. Nutlets 8–9 mm, base rounded, apex obtusely conical, glabrous; wings semiorbicular, ca. 1.3–2.1 × 0.9–1.8 cm. Fl. May, fr. Jun–Jul.

Wet areas along riverbanks and mountain streams. E Shandong (Lao Shan) [Japan].

**5. *Pterocarya macroptera*** Batalin, Trudy Imp. S.-Peterburgsk. Bot. Sada 13: 100. 1893.

甘肃枫杨 gan su feng yang

Trees to 25 m tall. Leaves odd-pinnate, 23–45 cm; petiole 2–13 cm, tomentose; rachis wingless, tomentose; leaflets (5 or) 7–13; lateral leaflets sessile or petiolule to 2 mm, blade ovate, elliptic, or long elliptic, 9–19 × 3–6 cm, abaxially pubescent, base oblique, cordate, apex acuminate; terminal petiolule 1–2.5 cm. Fruiting spike 45–60(–70) cm, axis glabrous or tomentose.

Nutlets 7–9 mm, base rounded, apex broadly conical, glabrous or pubescent; wings orbicular-ovate to elliptic-rhomboid, 1–3 × 1–2(–2.5) cm. Fl. Apr–Jun, fr. Jul–Sep.

• Forests in valleys, along mountain streams, slopes; 1100–3500 m. SE Gansu, W Hubei, Shaanxi, Sichuan, Xizang, NW Yunnan, Zhejiang.

1a. Petiole 2–6 cm; axis of fruiting spike glabrous; nutlets glabrous or nearly so 5c. var. *insignis*

1b. Petiole 4–13 cm; axis of fruiting spike pubescent; nutlets pubescent.

2a. Petiole 4–8 cm; nutlet wings elliptic-rhomboid, 2–3 × ca. 2 cm 5a. var. *macroptera*

2b. Petiole 5–13 cm; nutlet wings orbicular-ovate to elliptic, 1–2.5 × 1–1.3 cm ..... 5b. var. *delavayi*

**5a. *Pterocarya macroptera* var. *macroptera***

甘肃枫杨(原变种) gan su feng yang (yuan bian zhong)

Trees to 15 m tall. Leaves 23–30(–43) cm; petiole 4–8 cm; leaflets 7–13, lateral leaflets elliptic or long elliptic, 9–18 × 3–6 cm, base oblique, cordate, apex acuminate. Fruiting spike 45–60(–70) cm, axis tomentose. Nutlets 7–9 mm, tomentose; wings elliptic-rhomboid, 2–3 × ca. 2(–2.5) cm. Fl. May–Jun, fr. Jul–Aug.

• Forests in valleys, along mountain streams; 1600–3500 m. SE Gansu, S Shaanxi, NE Sichuan.

**5b. *Pterocarya macroptera* var. *delavayi*** (Franchet) W. E. Manning, Bull. Torrey Bot. Club 102: 165. 1975.

云南枫杨 yun nan feng yang

*Pterocarya delavayi* Franchet, J. Bot. (Morot) 12: 317. 1898; *P. forrestii* W. W. Smith.

Trees to 15 m tall. Leaves 20–45 cm; petiole 5–13 cm; leaflets 7–13, lateral ones elliptic or elliptic-ovate to elliptic-lanceolate, 7–19 × 3–6 cm, base oblique, slightly cordate or broadly cuneate, apex acute or acuminate. Fruiting spike 50–60 cm, axis tomentose. Nutlets ca. 8 mm, tomentose; wings orbicular-ovate to elliptic, 1–2.5 × 1–1.3 cm. Fl. Apr–Jun, fr. Jul–Aug.

• Forests on mountain slopes; 1900–3300 m. W Hubei, W Sichuan, Xizang, NW Yunnan.

**5c. *Pterocarya macroptera* var. *insignis*** (Rehder & E. H. Wilson) W. E. Manning, Bull. Torrey Bot. Club 102: 165. 1975.

华西枫杨 hua xi feng yang

*Pterocarya insignis* Rehder & E. H. Wilson in Sargent, Pl. Wilson. 3: 183. 1916.

Trees to 25 m tall. Leaves (20–)30–45 cm; petiole 2–6 cm; leaflets (5 or)7–13, lateral ones ovate to long elliptic, 14–16 × 4–5 cm, base oblique, rounded, apex acuminate. Fruiting spike to 45 cm, axis glabrous or nearly so. Nutlets ca. 8 mm, glabrous; wings orbicular-ovate, 1.5(–2) × 2(–2.5) cm. Fl. May–Jun, fr. Aug–Sep.

• Forests on mountain slopes; 1100–2700 m. W Hubei, Shaanxi, Sichuan, NW Yunnan, Zhejiang.

**5. JUGLANS** Linnaeus, Sp. Pl. 2: 997. 1753.

胡桃属 hu tao shu

Trees or rarely shrubs, deciduous, monoecious. Branchlets with chambered pith. Terminal buds with false-valved scales. Leaves odd-pinnate; leaflets 5–31, margin serrate or rarely entire. Inflorescences lateral or terminal on old or new growth; male spike separate from female spike, solitary, lateral on old growth, pendulous; female spike terminal on new growth, erect. Flowers anemophilous. Male flowers with an entire bract; bracteoles 2; sepals 4; stamens usually numerous, 6–40, anthers glabrous or occasionally with a few bristly hairs. Female flowers with an entire bract adnate to ovary, free at apex; bracteoles 2, adnate to ovary, free at apex; sepals 4, adnate to ovary, free at apex; style elongate with recurved branches; stigmas carinal, 2-lobed, plumose. Fruiting spike erect or pendulous. Fruit a drupelike nut with a thick, irregularly dehiscent or indehiscent husk covering a wrinkled or rough shell 2–4-chambered at base. Germination hypogeal.

About 20 species: mainly temperate and subtropical areas of N hemisphere, extending into South America; three species in China.

- 1a. Leaflets abaxially pubescent or rarely glabrescent, margin serrate or rarely serrulate; nuts 2-chambered at base;  
 husk indehiscent; shell rough ridged and deeply pitted ..... 3. *J. mandshurica*
- 1b. Leaflets abaxially glabrous except in axils of midvein and secondary veins, margin entire to minutely serrulate; nuts  
 4-chambered at base; husk irregularly dehiscent into 4 valves; shell wrinkled or smooth ridged and deeply pitted.
- 2a. Leaflets 5–9; shell wrinkled, without prominent ridges ..... 1. *J. regia*
- 2b. Leaflets 9–15; shell smooth-ridged with deep pits and depressions and 2 or more prominent ridges 2. *J. sigillata*

**1. *Juglans regia*** Linnaeus, Sp. Pl. 2: 997. 1753.

胡桃 hu tao

*Juglans duclouxiana* Dode; *J. fallax* Dode; *J. kamaonia* (C. de Candolle) Dode; *J. orientis* Dode; *J. regia* var. *sinensis* C. de Candolle; *J. sinensis* (C. de Candolle) Dode.

Trees to 25 m tall. Leaves 25–30 cm; petiole 5–7 cm; petiole and rachis glabrescent, without glandular hairs; leaflets (3 or)5–9, entire on mature trees, sometimes obscurely serrulate on young plants; lateral leaflets subsessile or petiolule 1–2 mm, blade elliptic-ovate to long elliptic, 6–15 × 3–6 cm, abaxially glabrous except for tufts of hairs in vein axils, without glandular hairs, base oblique, subrounded, apex obtuse or acute to shortly acuminate; terminal petiolule 2.5–6 cm. Male spike 5–10(–15) cm. Stamens 6–30(–40). Fruiting spike usually with 1–3(–38) nuts. Nuts subglobose, 4–6 cm; husk glabrous, irregularly dehiscent; shell thick except in commercial varieties, wrinkled. Fl. Apr–May, fr. Oct.  $2n = 32$ .

Mountain slopes; 500–1800(–4000) m. Widely distributed in C, E, NW, and SW China [SW Asia to Himalayas, SE Europe]. Commonly cultivated in China from 23–42° N for its edible, oily nuts and hard, fine grained wood. *Juglans regia* has a very long history of cultivation in China and elsewhere; as a result, there are many cultivars, including five Chinese taxa that L.-A. Dode (Bull. Soc. Dendrol. France 2: 67–98. 1906), recognized on the basis of differences in shell thickness, size, etc.

**2. *Juglans sigillata*** Dode, Bull. Soc. Dendrol. France 2: 94. 1906.

泡核桃 pao he tao

Trees to 25 m tall. Leaves 15–50 cm; petiole 7–12.5 cm, glabrescent; rachis glabrescent; leaflets 9 or 11(–15), entire or obscurely serrulate; lateral leaflets sessile or petiolule ca. 1 mm, blade ovate-lanceolate or elliptic-lanceolate, 6–18 × 3–8 cm, base oblique, apex acuminate; terminal petiolule 2–3 cm. Male spike 13.5–18 cm. Stamens 24–27. Fruiting spike with 1–3 nuts. Nuts ovoid-globose or subglobose, 3.4–6 × 3–5 cm; husk glabrescent, irregularly dehiscent; shell thick,

smooth with 2 or more prominent ridges and deep pits and depressions. Fl. Mar–Apr, fr. Sep.

Forests in valleys and on mountain slopes; 1300–3300 m. Guizhou, Sichuan, SE Xizang, Yunnan [Bhutan, Sikkim].

This distinctive relative of *Juglans regia* is cultivated in Yunnan for its edible nuts and hard wood. The name refer to the many seal-like depressions (sigillatae) in the shell, and the species has subsequently received recognition in China as the “iron walnut.”

**3. *Juglans mandshurica*** Maximowicz, Bull. Cl. Phys.-Math. Acad. Imp. Sci. Saint-Petersbourg, sér. 2, 15: 127. 1856.

胡桃楸 hu tao qiu

*Juglans cathayensis* Dode; *J. cathayensis* var. *formosana* (Hayata) A. M. Lu & R. H. Chang; *J. collapsa* Dode; *J. draconis* Dode; *J. formosana* Hayata; *J. stenocarpa* Maximowicz.

Trees or sometimes shrubs, to 25 m tall. Leaves 40–90 cm; petiole 5–23 cm; petiole and rachis sparsely to moderately glandular pubescent, occasionally densely so; leaflets (7 or)9–19, lateral ones sessile, blade elliptic to long elliptic or ovate-elliptic to long elliptic-lanceolate, 6–17 × 2–7.5 cm, abaxially tomentose or occasionally slightly pubescent, generally without glandular hairs, slightly to densely eglandular and glandular pubescent along midvein, base oblique, subcordate, margin serrate, rarely serrulate, apex acuminate; terminal petiolule 1–5 cm. Male spike 9–40 cm. Stamens 12–40. Fruiting spike with 5–10(–13) nuts. Nuts globose, ovoid, or ellipsoid, 3–7.5 × 3–5 cm; husk densely glandular pubescent, indehiscent; shell thick, rough, with 6–8 prominent ridges and deep pits and depressions. Fl. Apr–May, fr. Aug–Oct.  $2n = 32$ .

Mixed forests on mountain slopes or in valleys; 500–2800 m. Anhui, Fujian, Gansu, Guangxi, Guizhou, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Jilin, Liaoning, Shaanxi, Shanxi, Sichuan, Taiwan, Yunnan, Zhejiang [N Korea].

*Juglans mandshurica* has often been characterized as a species with abaxially glabrescent leaflets, fruiting spike with 4 or 5 nuts, and a distribution N and NE of the Huang He valley. *Juglans cathayensis* was thought to differ in its tomentose leaflets, fruiting spike with 6–10 nuts, and a distribution S of the Huang He.

**6. ANNAMOCARYA** A. Chevalier, Rev. Bot. Agric. Trop. 21: 504. 1941.

喙核桃属 hui he tao shu

*Rhamphocarya* Kuang.

Trees evergreen, monoecious. Branchlets with solid pith, rarely with hollow pith probably due to ants. Terminal buds with false-valved scales. Leaves odd-pinnate; leaflets 7 or 9(or 11), margin entire. Inflorescences lateral or

terminal on new growth; male and female inflorescences separate: male spikes in clusters of 5–8, lateral in axils of new foliage leaves, pendulous; female spike terminal on new growth, erect. Flowers anemophilous. Male flowers with an entire bract; bracteoles 2; sepals apparently absent; stamens 5–15, anthers pubescent. Female flowers with an entire bract adnate to ovary; bracteoles 3, adnate to ovary; sepals apparently absent; style possibly present; stigmas commissural, stigmatic disc apparently absent. Fruiting spike erect. Fruit a drupelike nut with a thick, 4–9-valved husk covering a smooth shell 2-chambered at base. Germination hypogeal.

One species: SW China, N Vietnam.

This taxon has been variously placed in different genera. The authors of this account believe that *Annamocarya* has a number of uniquely derived characters not shared with *Carya* (e.g., prominent buttresses, entire leaflets, male spikes in clusters of 5–8, abaxial bundles of nut located in outer shell wall vs. in primary partition), and therefore warrants recognition at generic rank.

**1. *Annamocarya sinensis*** (Dode) Leroy, Rev. Bot. Agric. Trop. 30: 426. 1950.

喙核桃 hui he tao

*Carya sinensis* Dode, Bull. Soc. Dendrol. France 24: 59. 1912; *Annamocarya indochinensis* (A. Chevalier) A. Chevalier; *Carya integrifoliolata* (Kuang) Hjelmqvist; *C. tsiangii* Chun; *Juglandicarya integrifoliolata* (Kuang) Hu; *Juglans indochinensis* A. Chevalier; *Rhamphocarya integrifoliolata* Kuang.

Trees to 30 m tall. Leaves 30–50 cm; petiole 5–15.5 cm, glabrous; rachis glabrous; leaflets 7 or 9(or 11), peltate scales rare or absent; lateral leaflets with petiolule 2–8

mm, blade long elliptic to elliptic-lanceolate, 12–23 × 4–9 cm, abaxially glabrous except for a few hairs in axils of midvein and secondary veins, base cuneate or obtuse, apex acuminate; terminal petiolule 5–20 mm. Male spikes 13–15 cm; peduncle 3–6 cm. Nuts globose or ovoid-ellipsoid, apex acuminate-beaked, 6–8 × 4–6 cm; husk with prominent, longitudinal ribs or keels; shell without longitudinal ridges, 3–4 mm thick, lacunae absent. Fl. Apr–May, Nov, fr. Aug–Nov.

Forests along riverbanks; 200–700 m. Guangxi, S Guizhou, SE Yunnan [N Vietnam].

**7. *CARYA*** Nuttall, Gen. N. Amer. Pl. 2: 220. 1818, nom. cons.

山核桃属 shan he tao shu

*Hicoria* Rafinesque, nom. rej.

Trees deciduous, monoecious. Branchlets with solid pith. Terminal buds naked or with false-valved scales (or overlapping). Leaves odd-pinnate; leaflets 3–17, margin serrate. Inflorescences lateral or terminal on old or new growth; male and female inflorescences separate: male spikes in clusters of 3, lateral at base of new growth or rarely on old growth, pendulous; female spike terminal on new growth, erect. Flowers anemophilous. Male flowers with an entire bract; bracteoles 2; sepals usually absent; stamens (2 or)3–7(–10), anthers pubescent or rarely glabrous. Female flowers with an entire bract adnate to ovary; bracteoles 3, adnate to ovary; sepals absent; style absent; stigmas commissural, stigmatic disc 4-lobed. Fruiting spike erect. Fruit a drupelike nut with a thick, 4-valved husk covering a smooth or wrinkled shell 2–4-chambered at base. Germination hypogeal.

About 17 species: E Asia, North America; five species (three endemic, one introduced) in China.

1a. Terminal bud scales 4 or more, false valved; leaflets (7 or)9–13(–17), commonly falcate ..... 1. *C. illinoensis*

1b. Terminal buds naked; leaflets 5–9, not falcate.

2a. Buds brownish black; rachis glabrous; peltate scales virtually absent on leaflets abaxially; anthers glabrous; lacunae present in nut shell ..... 2. *C. kweichowensis*

2b. Buds rusty brown; rachis pubescent; peltate scales conspicuous on leaflets abaxially; anthers pubescent (*C. hunanensis* unknown); lacunae absent in nut shell.

3a. Petiole tomentose; nuts subglobose ..... 3. *C. tonkinensis*

3b. Petiole glabrescent; nuts ellipsoid or obovoid.

4a. Leaflets 5 or 7; husk winged to base; nuts ellipsoid, 2–3 × 1.5–2.3 cm; shell 1–2 mm thick 4. *C. cathayensis*

4b. Leaflets (5 or)7 or 9; husk winged to middle; nuts obovoid, 3–3.7 × 2.3–2.8 cm; shell 1.5–2.5 mm thick ..... 5. *C. hunanensis*

**1. *Carya illinoensis*** (Wangenheim) K. Koch, Dendrologie 1: 593. 1869.

美国山核桃 mei guo shan he tao

*Juglans illinoensis* Wangenheim, Beytr. Teut. Forstwiss. 54. 1787; *Hicoria olivaeformis* (Michaux) Nuttall; *H. pecan* (Marshall) Britton; *Juglans olivaeformis* Michaux; *J. pecan* Marshall.

Trees to 50 m tall. Terminal buds with 4 or more false-valved scales, yellowish brown. Leaves 25–35 cm; petiole 4–8 cm, glabrous or glabrescent; rachis generally glabrous or glabrescent; leaflets (7 or)9–13(–17), lateral ones shortly petiolulate or sessile, blade ovate-lanceolate to elliptic-lanceolate or long elliptic, 7–18 × 2.5–4 cm, with scattered, peltate scales, abaxially pubescent or glabrescent, base oblique,



broadly cuneate or subrounded, apex acuminate; terminal petiolule 5–25 mm. Male spikes 8–14 cm; peduncle nearly absent. Anthers sparsely pilose. Nuts ovoid-ellipsoid, 3–5 × 2–3 cm; husk without prominent wings; shell without longitudinal ridges, ca. 1 mm thick, 2-chambered at base, lacunae present. Fl. May, fr. Sep–Nov.  $2n = 32$ , rarely 64.

Cultivated. Fujian, Hebei, Henan, Hunan, Jiangsu, Jiangxi [native to United States].

Grown extensively in China for its edible nuts.

**2. *Carya kweichowensis*** Kuang & A. M. Lu ex Chang & Lu, Acta Phytotax. Sin. 17(2): 43. 1979.

贵州山核桃 *gui zhou shan he tao*

Trees to 20 m tall. Terminal buds naked, immature leaflets brownish black. Leaves 11–20 cm; petiole 2–4 cm, glabrous; rachis glabrous; leaflets 5, lateral ones with petiolule 1–5 mm, blade elliptic to elliptic-lanceolate, (3–)6–14 × 2–7 cm, virtually without peltate scales, abaxially glabrous except for hairs along midvein and clusters in axils of secondary veins, base oblique, obtuse or cuneate, apex obtuse or acute; terminal petiolule 5–10 mm. Male spikes ca. 14 cm; peduncle ca. 1 cm. Anthers glabrous. Nuts compressed-globose, 2–2.5 × 2–2.5 cm; husk wingless; shell without longitudinal ridges, ca. 2.5 mm thick, 4-chambered at base, lacunae present. Fl. Mar–Apr, fr. Oct.

• Forests on mountain slopes; 1000–1300 m. SW Guizhou.

**3. *Carya tonkinensis*** Lecomte, Bull. Mus. Hist. Nat. (Paris) 27: 437. 1921.

越南山核桃 *yue nan shan he tao*

Trees to 15 m tall. Terminal buds naked, brown. Leaves 15–25 cm; petiole ca. 6 cm, pubescent; rachis pubescent; leaflets 5 or 7, lateral ones sessile or shortly petiolulate, blade ovate-lanceolate to elliptic-lanceolate or obovate-lanceolate, 7–18 × 2–6 cm, with abundant, peltate scales, abaxially glabrous except for hairs along midvein and in axils of secondary veins, base oblique, apex acuminate; terminal petiolule 0–5(–10) mm. Male spikes 12–13 cm; peduncle 1–5 cm. Anthers puberulent. Nuts subglobose, 2.2–2.5 × 2.6–3 cm; husk without prominent wings; shell with 4 faint, longitudinal ridges, 1.2–2.3 mm, 4-chambered at base, lacunae absent. Fl. Apr–May, fr. Sep.

Mountain slopes; 1300–2200 m. Guangxi, NW to S Yunnan [India, N Vietnam].

There are no reports of the cultivation of this tree in China, but the oil is used for cooking.

**4. *Carya cathayensis*** Sargent, Pl. Wilson. 3: 187. 1916.

山核桃 *shan he tao*

*Hicoria cathayensis* (Sargent) Chun.

Trees to 20 m tall. Terminal buds naked, rusty brown. Leaves 16–30 cm; petiole 4–9 cm, glabrous; rachis pubescent; leaflets 5 or 7, lateral ones sessile or with petiolule ca. 1 mm, blade lanceolate or ovate-lanceolate, 10–18 × 2–5 cm, with abundant, peltate scales, abaxially glabrous except for hairs along midvein and in axils of secondary veins, base cuneate or subrounded, apex acuminate; terminal petiolule 4–10 mm. Male spikes 10–15 cm; peduncle 1–2 cm. Anthers puberulent. Nuts ellipsoid, 2–3 × 1.5–2.3 cm; husk winged to base; shell with 4 faint, longitudinal ridges, 1–2 mm thick, 4-chambered at base, lacunae absent. Fl. Apr–Jun, fr. Aug–Sep.

• Forests on mountain slopes, valleys, riverbanks; 400–1500 m. Anhui, S Guizhou, Jiangxi, Zhejiang.

Commonly cultivated for its oily, edible nuts.

**5. *Carya hunanensis*** W. C. Cheng & R. H. Chang ex Chang & Lu, Acta Phytotax. Sin. 17(2): 42. 1979.

湖南山核桃 *hu nan shan he tao*

Trees to 14 m tall. Terminal buds naked, rusty brown. Leaves 20–30 cm; petiole 4–8 cm, glabrous; rachis pubescent; leaflets (5 or)7 or 9, lateral ones sessile, blade elliptic to elliptic-lanceolate, (6–)11–18 × (2–)3.5–7 cm, with abundant, peltate scales, abaxially ± glabrous except for hairs along midvein and in axils of secondary veins, base cuneate, apex acuminate; terminal petiolule 0–5 mm. Male spikes unknown. Nuts obovoid, (2–)3–3.7 × 2.3–3 cm; husk winged to middle; shell with 4 faint, longitudinal ridges, 1.5–2.5 mm thick, 4-chambered at base, lacunae absent. Fl. Mar–Apr, fr. Sep–Nov.

• Forests in valleys, riverbanks; 900–1000 m. Guangxi, Guizhou, Hunan.

Cultivated for its edible nuts, which are also pressed for oil. *Carya cathayensis* and *C. hunanensis* are very similar, including the leaf color which tends to be green adaxially and rusty brown or bronze abaxially. They differ mainly in the number of leaflets, nut size, and the extent of wings on the husk.

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