

BURMANNIACEAE

水玉簪科 shui yu zan ke

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Herbs, annual or perennial, small, mycotrophic, semi-mycotrophic, or autotrophic, often rhizomatous or tuberous. Leaves alternate, simple, entire; autotrophic species with basal rosette leaves; all with cauline leaves. Inflorescences terminal, many-flowered cymes or racemes, or flower solitary. Flowers bisexual. Perianth of 1 or 2 whorls and each whorl of 3 tepals, corolline, tubular or campanulate. Perianth tube often 3-angled or 3-winged; tepals sometimes appendaged; appendages terminal, elongated, slender. Stamens 3 or 6, if 3 then sessile in perianth throat, if 6 then pendent in perianth tube; connectives large, often appendiculate. Ovary inferior, 1-loculed with parietal placentation or 3-loculed with axile placentation; ovules numerous, anatropous, bitegmic; style filiform, shortly cylindrical, or conic; stigmas 3, sometimes connate. Fruit capsular, occasionally fleshy, with either persistent perianth tube and style or only persistent basal ring of perianth, dehiscence irregular or by transverse ventral slits. Seeds small, numerous; endosperm present.

About 16 genera and 148 species: tropical and subtropical regions; three genera and 13 species (two endemic) in China.

Wu Te-lin & Chen Sen-jen. 1981. Burmanniaceae. In: Wu Te-lin, ed., Fl. Reipubl. Popularis Sin. 16(2): 169–175.

- 1a. Perianth tube urceolate, circumscissile; style very short; stamens 6 3. *Thismia*
- 1b. Perianth tube salverform, cylindrical, trigonous, or campanulate; style ± as long as perianth tube; stamens 3.
 - 2a. Perianth persistent after anthesis; ovary 3-loculed with axile placentation 1. *Burmannia*
 - 2b. Perianth caducous after anthesis; ovary 1-loculed with parietal placentation 2. *Gymnosiphon*

1. BURMANNIA Linnaeus, Sp. Pl. 1: 287. 1753.

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Herbs, annual or perennial, mycotrophic, semi-mycotrophic, or autotrophic, sometimes rhizomatous. Stems simple, rarely branched. Basal leaves in a distinct rosette; cauline leaves bractlike, small. Flowers solitary or in terminal cymes. Perianth tube actinomorphic, cylindrical or trigonous, with 3 lateral wings or sometimes wings absent, without annulus at tube mouth; tepals generally 6, apically distinct; outer tepals larger than inner, unlobed; inner tepals often minute, occasionally lacking. Stamens 3, sessile or subsessile on perianth tube; connective with 0–2 apical and 0 or 1 basal appendages. Ovary trigonous, 3-loculed, with axile placentation; stigmas 2-labiate to funnel-shaped. Fruit capsular, with persistent perianth, dehiscence generally irregular.

About 57 species: tropical and subtropical regions; ten species (one endemic) in China.

- 1a. Plants with chlorophyll, autotrophic or semi-mycotrophic; basal rosette leaves present.
 - 2a. Basal leaves numerous; cauline leaves 1.5–8 cm; inflorescences 8–20-flowered 1. *B. disticha*
 - 2b. Basal leaves few; cauline leaves 0.5–3 cm; inflorescences 1–6(–8)-flowered.
 - 3a. Stems to 40 cm tall; outer tepal margins double and prominent; inner tepal margins double 2. *B. coelestis*
 - 3b. Stems to 24 cm tall; outer tepal margins single or double and shallow; inner tepal margins single.
 - 4a. Inflorescences 1–3(or 4)-flowered; flowers 3–8 mm; stamens sessile in perianth tube 3. *B. chinensis*
 - 4b. Inflorescences (1–)3–5(–8)-flowered; flowers 9–14 mm; stamens with short filament, basally adnate to perianth tube 4. *B. filamentosa*
- 1b. Plants without chlorophyll, holomycotrophic; basal rosette leaves absent.
 - 5a. Stems, leaves, and flowers ± purplish blue.
 - 6a. Perianth wings narrow or reduced to ribs; outer tepals ca. 1 mm 7. *B. wallichii*
 - 6b. Perianth wings conspicuous, 1–2 mm wide; outer tepals 1.5–2 mm 8. *B. itoana*
 - 5b. Stems, leaves, and flowers whitish or yellow.
 - 7a. Inflorescences (1–)3–13-flowered; inner tepals present, sometimes very small.
 - 8a. Perianth wings conspicuous, 1–2 mm wide; stamen connectives with a pendent basal spur; seeds fusiform 5. *B. nepalensis*
 - 8b. Perianth wings reduced to ribs or absent; stamen connectives without a pendent basal spur; seeds subglobose 10. *B. championii*
 - 7b. Inflorescences 1–4-flowered; inner tepals absent.
 - 9a. Stems to 20 cm; perianth tube 4.5–5.5 mm; perianth wings 3–5.5 mm wide; stamen connectives with 2 apical crests; seeds fusiform 6. *B. oblonga*
 - 9b. Stems to 9 cm; perianth tube 3–4 mm; perianth wings 0.5–2.5 mm wide; stamen connectives with 1 apical crest; seeds ellipsoid 9. *B. cryptopetala*

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1. *Burmanna disticha* Linnaeus, Sp. Pl. 1: 287. 1753.

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Plants with chlorophyll, autotrophic, flowering when 12.5–70 cm tall. Stems green, robust. Basal rosette leaves numerous, linear-lanceolate, 0.2–1.7 × 0.3–2 cm. Cauline leaves linear, 1.5–8 × 0.2–1 cm. Inflorescences 8–20-flowered; bracts lanceolate, 0.5–2.4 cm. Flowers pedicellate, bluish purple or yellow, 1–2.6 cm. Perianth tube 3–8 mm; wings conspicuous, 1–3.5 mm wide; outer tepals triangular, 1.5–4.5 mm, margin double and shallow; inner tepals lanceolate, 1–2 mm, margin single or double and shallow. Stamens sessile; connectives with 2 apical crests and a pendent basal spur. Ovary ellipsoid, 6–12 mm. Capsule obovoid. Seeds ellipsoid. Fl. Apr–Jun, fr. Jun–Sep. $2n = ca. 136$.

Wet thickets or grasslands; 400–3000 m. Fujian, Guangdong, Guangxi, Guizhou, Hainan, Hunan, Yunnan [Cambodia, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, New Guinea, Sri Lanka, Thailand, Vietnam; Australia].

2. *Burmanna coelestis* D. Don, Prodr. Fl. Nepal. 44. 1825.

三品一枝花 san pin yi zhi hua

Plants with chlorophyll, semi-mycotrophic, flowering when 10–40 cm tall. Stems green, slender. Basal rosette leaves few, linear-lanceolate, 0.5–2 cm × ca. 3 mm. Cauline leaves linear, 0.5–3 × 0.2–0.3 cm. Inflorescences (1 or)2–6(–8)-flowered; bracts lanceolate, 3–6 mm. Flowers pedicellate to subsessile, bluish purple with yellow tepals, 1–1.5 cm. Perianth tube 4.5–13 mm; wings conspicuous, 1.5–3 mm wide; outer tepals ovate-triangular, 1–2 mm, margin double and prominent; inner tepals triangular, 0.5–1 mm, margin double. Stamens sessile; connectives with 2 apical crests and a pendent basal spur. Ovary ellipsoid to obovoid, 3–7 mm. Capsule obovoid. Seeds ellipsoid. Fl. Jun–Oct, fr. Oct–Feb. $2n = ca. 16$.

Generally in wet grasslands; sea level to 300(–800) m. Guangdong, Guangxi, Hainan [Bangladesh, Cambodia, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, New Guinea, Thailand, Vietnam; Australia].

3. *Burmanna chinensis* Gandoger, Bull. Soc. Bot. France 66: 290. 1919.

香港水玉簪 xiang gang shui yu zan

Burmanna pusilla (Wallich ex Miers) Thwaites var. *hongkongensis* Jonker.

Plants with chlorophyll, semi-mycotrophic, flowering when 4.5–20 cm tall. Stems green, slender. Basal rosette leaves few, lanceolate, 0.3–1.2 cm × 1–3 mm. Cauline leaves linear, 5–18 × ca. 2 mm. Inflorescences 1–3(or 4)-flowered; bracts lanceolate, 5–6 mm. Flowers pedicellate to subsessile, purple or yellow, 3–8 mm. Perianth tube 4–6.5 mm; wings conspicuous, 1–3 mm wide; outer tepals broadly ovate, 1–3 mm, margin single or double and shallow; inner tepals spatulate, 0.5–1.2 mm, margin single. Stamens sessile; connectives with 2 apical crests and sometimes a pendent basal spur. Ovary ellipsoid to obovoid, 2.5–7 mm. Capsule obovoid. Seeds ellipsoid. Fl. Jun–Oct, fr. Jul–Jan. $2n = ca. 32$.

Generally in wet grasslands; (sea level to) 300–1300 m. Fujian, Guangdong, Guangxi, Hainan, Hunan, Jiangxi, Yunnan, Zhejiang [India, Laos, Thailand, Vietnam].

4. *Burmanna filamentosa* D. X. Zhang & R. M. K. Saunders, Nordic. J. Bot. 20: 392. 2001.

粤东水玉簪 yue dong shui yu zan

Plants with chlorophyll, semi-mycotrophic, flowering when 8–24 cm tall. Stems green, slender. Basal rosette leaves few, triangular-lanceolate, 0.5–1.4 cm × 2–3 mm. Cauline leaves linear, 5–15 × 1.5–3 mm. Inflorescences (1–)3–5(–8)-flowered; bracts lanceolate, ca. 5 mm. Flowers subsessile, bluish purple, 0.9–1.4 cm. Perianth tube 6–7.5 mm; wings conspicuous, 2–3 mm wide; outer tepals narrowly triangular, 1.5–3 mm, margin double and shallow; inner tepals lanceolate, 1–2 mm, margin single. Stamens with short filament, basally adnate to perianth tube; connectives with 2 apical crests but lacking a pendent basal spur. Ovary ellipsoid, 3–7 mm. Capsule obovoid. Seeds ellipsoid. Fl. and fr. Oct–Nov.

• Wet open areas; 300–800 m. E Guangdong.

5. *Burmanna nepalensis* (Miers) J. D. Hooker, Fl. Brit. India 5: 666. 1888.

宽翅水玉簪 kuan chi shui yu zan

Gonianthes nepalensis Miers, Trans. Linn. Soc. London 18: 537. 1841 [“*Gonyanthes*”]; *Burmanna fadouensis* H. Li; *B. liukiensis* Hayata.

Plants without chlorophyll, holomycotrophic, flowering when 4–13 cm tall. Stems whitish, slender. Basal rosette leaves absent. Cauline leaves triangular, 2–3.5 × ca. 1 mm. Inflorescences (1–)3–9-flowered; bracts triangular-lanceolate, 2–3 mm. Flowers pedicellate, whitish or yellow, 4–7 mm. Perianth tube 1.5–2.5 mm; wings conspicuous, 1–2 mm wide; outer tepals oblong-ovate, 0.5–1.2 mm, margin single; inner tepals orbicular, very small, margin single. Stamens sessile; connectives with 2 apical crests and a pendent basal spur. Ovary subglobose, 1.5–3 mm. Capsule subglobose. Seeds fusiform. Fl. and fr. Jul–Dec.

Wet areas in forests; 400–1600 m. Fujian, Guangdong, Guangxi, Hunan, Taiwan, Yunnan [India, Indonesia, Japan, Nepal, Philippines, Thailand].

6. *Burmanna oblonga* Ridley, J. Straits Branch Roy. Asiat. Soc. 41: 33. 1904.

裂萼水玉簪 lie e shui yu zan

Burmanna bifida Gagnepain.

Plants without chlorophyll, holomycotrophic, flowering when 7–20 cm tall. Stems whitish, slender. Basal rosette leaves absent. Cauline leaves triangular, 1.5–3 × 1–2 mm. Inflorescences 1–4-flowered; bracts triangular-lanceolate, 2.5–3 mm. Flowers pedicellate to subsessile, whitish, 0.8–1.4 cm. Perianth tube 4.5–5.5 mm; wings conspicuous, 3–5.5 mm wide; outer tepals broadly oblong, ca. 2 mm, margin single; inner tepals absent. Stamens sessile; connectives with 2 apical crests and a pendent basal spur. Ovary globose to rhomboid, ca. 4 mm. Capsule subglobose. Seeds fusiform. Fl. and fr. Jul–Dec.

Wet evergreen forests; 800–1100 m. Hainan [Cambodia, Indonesia, Malaysia, Thailand, Vietnam].

7. *Burmanna wallichii* (Miers) J. D. Hooker, Fl. Brit. India 5: 666. 1888.

亭立 ting li

Gonianthes wallichii Miers, Trans. Linn. Soc. London 18: 537. 1841 [“*Gonyanthes*”].

Plants without chlorophyll, holomycotrophic, flowering when 4–11.5 cm tall. Stems purple, slender. Basal rosette leaves absent. Cauline leaves triangular-subulate, 1.5–3.5 × 1–1.5 mm. Inflorescences 1–3-flowered; bracts triangular-lanceolate, 2–3.5 mm. Flowers sessile, bluish purple, 5–10 mm. Perianth tube 2.5–5.5 mm; wings narrow or reduced to ribs, 0.2–0.8 mm wide; outer tepals ovate-triangular, ca. 1 mm, margin single; inner tepals orbicular, very small, margin single. Stamens sessile; connectives lacking apical crests, sometimes with a pendent basal spur. Ovary ellipsoid to subglobose, 1.5–3 mm. Capsule subglobose. Seeds ellipsoid. Fl. and fr. Jul–Nov. $2n = 32$.

Wet areas in dense forests; sea level to 700 m. Guangdong, Hainan, Yunnan [Myanmar, Thailand, Vietnam].

8. *Burmanna itoana* Makino, Bot. Mag. (Tokyo) 27: 1. 1913.

纤草 xian cao

Burmanna pingbienensis H. Li; *B. takeoi* Hayata.

Plants without chlorophyll, holomycotrophic, flowering when 5–15 cm tall. Stems light blue, slender. Basal rosette leaves absent. Cauline leaves ovate-lanceolate, 2.5–3.5 × 1.5–2.5 mm. Inflorescences 1–3-flowered; bracts ovate-lanceolate, ca. 5 mm. Flowers pedicellate, bluish purple, 8–11 mm. Perianth tube 3.5–5.5 mm; wings conspicuous, 1–2 mm wide; outer tepals ovate-triangular, 1.5–2 mm, margin single; inner tepals orbicular, very small, margin single. Stamens sessile; connectives with an apical crest and a pendent basal spur. Ovary subglobose, 2–3.5 mm. Capsule subglobose. Seeds ellipsoid. Fl. and fr. Jun–Dec.

Wet evergreen forests; 300–1200 m. Guangdong, Guangxi, Hainan, Taiwan, Yunnan [Japan].

9. *Burmanna cryptopetala* Makino, Bot. Mag. (Tokyo) 27: 3. 1913.

透明水玉簪 tou ming shui yu zan

Burmanna cryptopetala var. *daxikangensis* Y. B. Chang & Z. Wei [“*baxikangensis*”]; *B. daxikangensis* (Y. B. Chang & Z. Wei) S. C. Chen & H. Li.

Plants without chlorophyll, holomycotrophic, flowering when 5–9 cm tall. Stems whitish, slender. Basal rosette leaves absent. Cauline leaves ovate-lanceolate, 3–3.5 × 1.5–2.5 mm. Inflorescences 1–3-flowered; bracts ovate-lanceolate, ca. 3 mm. Flowers pedicellate, whitish with yellow tepals, 1–1.2 cm. Perianth tube 3–4 mm; wings conspicuous, 0.5–2.5 mm wide; outer tepals triangular, 1.5–2 mm, margin single; inner tepals absent. Stamens sessile; connectives with an apical crest and a pendent basal spur. Ovary subglobose, 3.5–5 mm. Capsule subglobose. Seeds ellipsoid. Fl. and fr. Jun–Nov.

Wet areas in dense forests; 200–800 m. Guangdong, Hainan, Zhejiang [Japan].

10. *Burmanna championii* Thwaites, Enum. Pl. Zeyl. 325. 1864.

头花水玉簪 tou hua shui yu zan

Burmanna daziellii Rendle; *B. hunanensis* K. M. Liu & C. L. Long.

Plants without chlorophyll, holomycotrophic, flowering when 3–22 cm tall. Stems whitish, slender. Basal rosette leaves absent. Cauline leaves ovate-triangular, 1.5–6 × 1–3 mm. Inflorescences 3–13-flowered; bracts ovate-triangular, 1.5–6 mm. Flowers pedicellate or sessile, whitish with yellow tepals, 5–11 mm. Perianth tube 3–5 mm; wings reduced to ribs or absent; outer tepals narrowly triangular, 1.5–3 mm, margin single; inner tepals spatulate, 0.8–1.4 mm, margin single. Stamens sessile or with a short filament, basally adnate to perianth; connectives sometimes with 2 small apical crests but lacking a pendent basal spur. Ovary ellipsoid to obovoid, 2.5–3.5 mm. Capsule subglobose. Seeds subglobose. Fl. and fr. May–Aug.

Wet areas in forests; sea level to 1700 m. Fujian, Guangdong, Guangxi, Hunan, Taiwan [India, Indonesia, Japan, Malaysia, New Guinea, Sri Lanka, Thailand; Pacific islands].

2. GYMNOSIPHON Blume, Enum. Pl. Javae 1: 29. 1827.

腐草属 fu cao shu

Herbs, annual, without chlorophyll, mycotrophic, rhizomatous. Stems simple or branched. Leaves cauline, bractlike, small. Inflorescences terminal, racemes or flower solitary. Perianth tube actinomorphic, salverform, lateral wings absent, without annulus at mouth; tepals 6, apically distinct; outer tepals larger than inner, slightly 3-lobed; inner tepals very small. Stamens 3, sessile on perianth tube; connectives generally not appendaged. Ovary ovoid to globose, 1-loculed, with 3 parietal placentae; placentae each with a large globose gland at both sides of apex; stigmas 3, often appendiculate. Fruit capsular, perianth caducous but perianth base persistent; dehiscence generally irregular or by longitudinal slits.

About 26 species: Africa, tropical America, Asia, New Guinea; one species in China.

1. *Gymnosiphon aphyllus* Blume, Enum. Pl. Javae 1: 29. 1827.

腐草 fu cao

Burmanna nana Fukuyama & T. Suzuki; *Gymnosiphon nanus* (Fukuyama & T. Suzuki) Tuyama.

Plants holomycotrophic, flowering when 7–8 cm tall.

Stems white to pale yellow. Leaves narrowly ovate-triangular, 1.5–2 mm. Inflorescences branched or not, 5–8-flowered; bracts ovate-triangular, ca. 2 mm. Flowers pedicellate, white. Perianth tube cylindric, ca. 3 mm; outer tepals ovate, ca. 1 mm; inner tepals ca. 0.2 mm. Stamens inserted immediately below inner

tepals. Stigmas curved, funnel-shaped, not appendiculate. Fruit ca. 3 mm, dehiscence by irregular perforation of wall between costae. Seeds ovoid.

Tropical rain forests; low elevations. Taiwan [Indonesia, Malaysia, New Guinea, Thailand].

3. *THISMIA* Griffith, Proc. Linn. Soc. London 1: 221. 1845.

水玉杯属 shui yu bei shu

Plants annual, without chlorophyll, mycotrophic; tuberous. Stems simple or branched. Leaves cauline, bractlike, small. Flowers 1–4, terminal. Perianth tube actinomorphic to zygomorphic, cylindric, urceolate, or sometimes campanulate, with prominent annulus at mouth, lateral wings absent; tepals 6, apically distinct; outer tepals as long as or shorter than inner tepals; inner tepals sometimes apically connivent or connate into an erect mitre. Stamens 6, generally laterally connate, pendent from annulus, occasionally distinct; connectives with 0–2 apical and 0–2 basal appendages. Ovary obconic or obovoid, 1-loculed, with 3 parietal placentae; stigmas 3, simple or bilabiate. Fruit fleshy with persistent perianth base; dehiscence by abscission of apex.

About 43 species: pantropical; two species (one endemic) in China.

Phylogenetic relationships within the Dioscoreales remain uncertain: *Thismia* may be sister to *Tacca* J. R. Forster & G. Forster (hence warranting recognition as a distinct family, Thismiaceae), although the Thismiaceae may be paraphyletic (V. Merckx et al., Amer. J. Bot. 93: 1684–1698. 2006; V. Merckx & M. I. Bidartondo, Proc. Roy. Soc., B, 275: 1029–1035. 2008; V. Merckx et al., Cladistics 25: 64–77. 2009).

- 1a. Flowers entirely white; inner tepal appendage 2.8–3.3 cm; outer tepal appendage 5–8 mm 1. *T. taiwanensis*
 1b. Flowers white with yellow annulus and orangish red tepal appendages; inner tepal appendage ca. 1.7 cm; outer tepal appendage absent 2. *T. tentaculata*

1. *Thismia taiwanensis* Sheng Z. Yang, R. M. K. Saunders & C. J. Hsu, Syst. Bot. 27: 485. 2002.

台湾水玉杯 tai wan shui yu bei

Plants holomycotrophic. Stems ± absent at anthesis, 1.3–4 cm and carnose in fruit. Leaves scalelike, 3.3–5.5 × 0.4–1 mm. Flowers solitary, sessile, with 2 or 3 subtending bracts. Perianth tube white, translucent, actinomorphic, urceolate, ca. 9 × 5 mm, circumscissile. Outer tepals ovate, 2.5–3.5 mm excluding appendage, radiating outward; appendage white, erect, subulate, 5–8 mm. Inner tepals spatulate, ca. 5 mm excluding appendage, apically imbricate and forming a loose mitre over perianth chamber; appendage white, erect, subulate, 2.8–3.3 cm. Stamens apparently distinct. Fruit capsule white, translucent, cup-shaped, 3.3–3.7 × ca. 4 mm, apically dehiscent; fruiting peduncle 5–8 cm. Seeds ellipsoid. Fl. and fr. Sep.

• Fagaceae forests; 2000–2100 m. S Taiwan (Gaoxiang).

2. *Thismia tentaculata* K. Larsen & Averyanov, Rheedea 17: 16. 2007.

三丝水玉杯 san si shui yu bei

Plants holomycotrophic. Stems white, unbranched, erect, 2.5–3 cm. Leaves scalelike, 1.5–5.7 × 0.8–1.1 mm. Flowers 1–4, sessile, with subtending bracts. Perianth tube white, translucent, actinomorphic, urceolate, ca. 7.3 × 4.8 mm, circumscissile. Outer tepals broadly triangular, ca. 1.4 mm, lacking appendage. Inner tepals narrowly triangular, ca. 2.3 mm excluding appendage; appendage orangish red, spreading, filiform, ca. 1.7 cm. Stamens apically connate. Fruit capsule white, translucent, cup-shaped. Seeds ellipsoid. Fl. and fr. Jun–Aug.

Evergreen montane forests; 600–800 m. Hong Kong [Vietnam].