

ACORACEAE

菖蒲科 chang pu ke

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Perennial herbs, glabrous, aromatic, growing in marshes or as emergent aquatics; laticifers and raphides absent; aerenchyma present. Rhizome creeping, much branched, lacunose, with specialized aromatic oil cells; roots on lower side and bearing leaves at apex. Leaves distichous, bases overlapping, unifacial, ensiform, not differentiated into petiole and blade; intravaginal squamules present in leaf axils; venation parallel. Inflorescence solitary, terminal, borne laterally on leaflike scape (usually interpreted as peduncle and spathe; peduncle with 2 separate vascular systems); continuous shoot arising in axil of leaf preceding inflorescence; spathe much longer than spadix, erect, persistent (appearing merely as a vertical extension of leaflike peduncle); spadix jutting out at an angle from peduncle, sessile, conoid, cylindric and fingerlike or slender and tail-like, flowering from base to top. Flowers bisexual, with perigone, densely arranged, bractless, 3-merous; tepals 6, in 2 whorls of 3, free, thin, arched; stamens 6, in 2 whorls of 3, free, filaments linear-oblong and flattened, anthers introrse, thecae globose-ellipsoid, subopposite, dehiscent by longitudinal slit, connective inconspicuous; pollen monosulcate, ellipsoid, small (15–20 μm), exine shallowly and remotely or more densely foveolate, otherwise psilate, apertural exine subpsilate; gynoecium (pistil) obconic-cylindric, only slightly exceeding tepals, ovary 2- or 3-locular, ovules several per locule, orthotropous (atropous), pendent on apical placenta, both integuments bearing trichomes and inner integument longer than outer, forming micropyle, stigma minute (± punctate), subsessile (a broad stylar region especially seen by longitudinal cut). Fruit a few-seeded berry, oblong-obovoid with thinly leathery pericarp, enclosed by tepals, ± whitish with brownish stigma remnant when fresh, soon drying to straw-brown, 1–5(–9)-seeded. Seed oblong to ellipsoid; testa light brown, with small pits (slightly foveolate) (*Acorus calamus*) or smooth (*A. gramineus*), long integumentary trichomes (bristles) present at micropyle (*A. gramineus*) or absent (*A. calamus*); embryo axile, cylindric or conoid (*A. gramineus*), with perisperm and abundant endosperm. $2n = (22), 24, 36, (44), 48$.

One genus and two species: temperate and subtropical Asia and North America, tropical Asia; introduced and naturalized in Europe, New Guinea (at least partly), and North America (partly); both species in China.

Li Hen. 1979. *Acorus*. In: Wu Cheng yih & Li Hen, eds., *Fl. Reipubl. Popularis Sin.* 13(2): 4–9.

1. ACORUS Linnaeus, Sp. Pl. 1: 324. 1753.

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Morphological characters and geographical distribution are the same as those of the family.

Acorus has been considered for a long time to be a member of the Araceae and only recently has it been removed from the family, although the family Acoraceae was already established in 1820. There are a number of significant characters that distinguish *Acorus* from the Araceae: unifacial leaves, two separate vascular systems in the peduncle, absence of raphides, presence of perisperm and endosperm in the seeds (never a perisperm in Araceae), trichomes on the micropyle of the ovules, and presence of special ethereal oil cells and other anatomical characters; laticifers are also lacking but quite a number of Araceae are also without them. DNA studies show that *Acorus* is a sister taxon to all other monocots, which means that it is not closely related to the Araceae at all.

The pollination of the *Acorus* species is not known, but entomophily is likely because the pollen is sticky. Pieces of rhizomes are easily dispersed by water along rivers and creeks. In particular, the sterile triploid *Acorus calamus* has been dispersed by this means. The seeds also are dispersed by water along streams or river margins.

The rhizomes are used for treatment of neurasthenia, chronic bronchitis, diarrhea, abdominal distention, chills, colds, externally for abscesses, liver disturbance, and stomach and gut disease. Mainly the rhizome of *Acorus calamus* is used because the content of the essential oil is highest in the rhizome; the leaves are also used, although the roots and leaves have poor oil content and are therefore of no wide or practical use. Other uses are reported as aromatizer for wine and tobacco, as perfume and insecticide, and as medicine for ulcers, kidney disease, and other diseases, though beta-asarone is said to be carcinogenic (Keller & Stahl, *Planta Medica* 47: 71–74. 1983). Both species are grown as ornamentals in bog gardens.

- 1a. Leaves with a distinct midrib, (60–)70–100(–150) × (0.7–)1–2(–2.5) cm; rhizome stout, (0.8–)1–1.5(–3) cm in diam.; spadix 4.5–6.5(–8) × 0.6–1.2(–1.5) cm; seed without long bristles, testa slightly foveolate 1. *A. calamus*
1b. Leaves without distinct midrib, (15–)20–45(–55) × (0.3–)0.5–1(–1.4) cm; rhizome slender, 0.4–0.6(–0.8) cm in diam.; spadix (3–)4–10(–14) × (0.3–)0.4–0.6(–0.7) cm; seed with long bristles, testa smooth 2. *A. gramineus*

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1. *Acorus calamus* Linnaeus, Sp. Pl. 1: 324. 1753.

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Acorus americanus (Rafinesque) Rafinesque; *A. angustatus* Rafinesque; *A. angustifolius* Schott; *A. asiaticus* Nakai; *A. calamus* var. *americanus* Rafinesque; *A. calamus* var. *angustus* Besser; *A. calamus* var. *angustifolius* (Schott) Engler; *A. calamus* var. *spurius* (Schott) Engler; *A. calamus* var. *verus* Linnaeus; *A. calamus* var. *vulgaris* Linnaeus; *A. cochinchinensis* (Loureiro) Schott; *A. griffithii* Schott; *A. spurius* Schott; *A. triquetus* Turczaninow; *Orontium cochinchinense* Loureiro.

Rhizome stout, 4–10(–20) × (0.8–)1–1.5(–3) cm, aromatic; roots at lower side of rhizome. Leaves several, mid-green, often reddish at base, ensiform, (60–)70–100(–150) × (0.7–)1–2(–2.5) cm (mostly 1–1.5 cm wide), apex acuminate; midrib conspicuous on both sides. Peduncle compressed triangular, (15–)40–50 cm. Spathe mid-green, leaflike, 30–50 cm, acute. Spadix straight or slightly curved, erect, oblique, narrowly conic to subcylindric (tapering toward apex), 4.5–6.5(–8) × 0.6–1.2(–1.5) cm, densely flowered. Flowers yellowish green, 1.8–2 mm in diam. seen from above; tepals oblong, 2.5–3 × 1–1.2(–1.4) mm, keeled, membranous, apex triangular hooded; filaments oblong, flat, 2–2.5 × 0.3–0.5 mm, anthers cream-colored, 0.4–0.5 mm in diam.; pollen grains ca. 20 μm, exine shallowly and remotely foveolate; gynoecium obconic-cylindric, 2.5–3.5(–4) × (0.8–)1–2.3 mm, with conic, spongy apex and stigma very small. Infructescence 1.5–2 cm in diam., straw-brown at maturity, berries densely arranged. Berry oblong-obovoid, 1- to few seeded, (3.5–)4–4.5 × 2–3(–3.5) mm. Seed oblong-ellipsoid to ovoid, 2.5–3(–4) × 1–1.2(–1.8) mm, without bristles; testa light brown, subsmooth and slightly foveolate. Fl. (Feb–)Apr–Sep. $2n = 24, 36, 48$.

Swamps, pond sides, standing water, also cultivated; below 2800 m. Throughout China [Afghanistan, Bangladesh, Bhutan, India, Indonesia, Japan, Korea, Malaysia (Sarawak), Mongolia, Nepal, Pakistan, Russia (Far East, Siberia), Sri Lanka, Thailand, Vietnam; SW Asia, Europe (except S), North America].

For a full synonymy, see Govaerts et al. (World Checkl. & Bibliogr. Araceae, 545–553. 2002).

Acorus calamus is diploid, triploid, and tetraploid. Diploids are known to grow naturally in E Asia (Mongolia and C Siberia, at least) and North America; tetraploids are known only from Asia (India, E Siberia, and Japan); and triploids are typical for the plants in Europe, SW Asia, India (Himalayan region), and E North America. The triploid cytotype probably originated in the Himalayan region, as a hybrid between the diploid and tetraploid cytotypes. It then probably dispersed naturally or with humans to Sakhalin and with humans to Turkey, then to Europe, and finally to E North America as a medicinal plant (Evstatieva et al., *Fitologiya* 48: 19–22. 1996; Löve & Löve, *Proc. Genet. Soc. Canada* 2: 14–17. 1957).

The different cytotypes show a great morphological variability and also a large variation in the chemical composition of the essential oils from the rhizome and leaves. As a result, they have been considered as representing species or varieties: *Acorus calamus* var. *calamus* (or *A. calamus* var. *vulgaris*) for the triploids, *A. calamus* var. *americanus* for the diploids, and *A. calamus* var. *angustus* for the tetraploids. *Acorus calamus* is considered in this treatment as a variable species, and infraspecific taxa are not recognized because there is an overlap in the width of the leaves, from 0.8 cm to 1.5 or 2 cm, also from Asiatic collections from different geographical regions, and furthermore the length of the spadices is variable. It can be observed that several collections from Asia have somewhat narrower leaves, ca. 1 cm wide; but there are also broader ones, and there is a continuous series.

2. *Acorus gramineus* Solander ex Aiton, Hortus Kew. 1: 474. 1789.

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Acorus brevispathus K. M. Liu; *A. gramineus* var. *flavomarginatus* K. M. Liu; *A. gramineus* var. *japonicus* M. Hotta; *A. gramineus* var. *macrospadiceus* Yamamoto; *A. gramineus* var. *pusillus* (Siebold) Engler; *A. humilis* Salisbury; *A. latifolius* Z. Y. Zhu; *A. macrospadiceus* (Yamamoto) F. N. Wei & Y. K. Li; *A. pusillus* Siebold; *A. rumphianus* S. Y. Hu; *A. tatarinowii* Schott; *A. tatarinowii* var. *flavomarginatus* K. M. Liu; *A. xiangyeus* Z. Y. Zhu.

Rhizome slender, 5–10 × 0.4–0.6(–0.8) cm, aromatic. Leaves several, dark green, ensiform, (15–)20–45(–55) × (0.3–)0.5–1(–1.4) cm, midrib lacking, apex acuminate. Peduncle compressed triangular, (4–)9–20(–24) cm. Spathe green, leaflike, (8–)10–24(–25) × 0.2–0.4(–0.5) cm. Spadix straight or slightly curved, narrowly cylindric to subcylindric, (3–)4–10(–14) × (0.3–)0.4–0.6(–0.7) cm, densely flowered. Flowers yellowish or yellow-green to somewhat whitish, 1.8–2 mm in diam. seen from above; tepals ± oblong, 1.5–2 × 0.7–1 mm, keeled, membranous, apex rounded or acute; filaments oblong, flat, ca. 1.5 mm, anthers yellow, 0.4–0.5 mm in diam.; pollen grains ca. 15 μm, exine more densely foveolate; gynoecium obconic-cylindric, (2–)2.5–3 × (1.2–)1.8–2 mm, with conic, spongy apex and stigma very small. Infructescence yellowish to yellow-white at maturity, 1–1.5 cm in diam., berries densely arranged. Berry obovoid-globose, few to several seeded, 3–3.5 × 2.2–2.5 mm. Seed ellipsoid, (2–)2.5–3 × (0.8–)1–1.2 mm, with many long (3–4 mm) bristles (longer than seed itself); testa light brown, smooth. Fl. Feb–Jul, fr. Jul–Aug. $2n = 24$.

Dense forests, moist rocky stream banks, meadows; below 2600 m. Anhui, Fujian, Gansu, Guangdong, Guangxi, Guizhou, Hainan, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Ningxia, Qinghai, Shandong, Shanxi, Sichuan, Taiwan, Xinjiang, Xizang, Yunnan, Zhejiang [Cambodia, NE India, Japan, Korea, Laos, Myanmar, Philippines, Russia (E Siberia), Thailand, Vietnam].

Acorus gramineus occurs only in diploid populations.