

CLEOMACEAE

白花菜科 bai hua cai ke

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Herbs [rarely shrubs], sometimes woody at base, producing mustard oils. Stems erect, sparsely or profusely branched, glabrous or glandular pubescent. Stipules scalelike or absent, caducous (petiolar spines sometimes present). Leaves alternate, spirally arranged, palmately compound; petiole often pulvinate; leaflets [1 or]3–7[–11]; leaflet blades with pinnate venation. Inflorescences racemes or corymbs or flowers solitary and axillary; peduncle present; bract present [or absent] at base of pedicels. Pedicel present; bracteoles absent. Flowers bisexual but sometimes appearing unisexual due to incomplete development, actinomorphic or slightly zygomorphic, rotate, crateriform, campanulate, or urceolate, hypogynous. Sepals 4, distinct or basally connate, persistent. Petals 4, distinct, imbricate, attached directly to receptacle; intrastaminal nectary-disk or glands present or sometimes absent. Stamens 6(–32); filaments free or basally adnate to gynophore (or along basal 1/3–1/2 in *Gynandropsis*); anthers dehiscent by longitudinal slits; pollen shed in single grains, 2-nucleate, commonly 3-colporate. Pistil 1, 2-carpellate; ovary superior; ovules 1 to many per locule, 2-tegmic, anatropous, placentation parietal; style 1, straight, short, thick; stigma 1, capitate, unlobed. Fruit an elongate capsule, ± dehiscent by lateral valves along their entire length [indehiscent or dehiscent schizocarp], usually stipitate from elongation of gynophore (lacking in *Arivela*). Seeds 1–10(–40) per capsule, tan, yellowish brown, or brown, cochleate-reniform, papillose or tuberculate, arillate or not; endosperm scanty or none but a persistent perisperm sometimes present.

Seventeen genera and ca. 150 species: worldwide in tropical and temperate regions; five genera and five species (three introduced) in China.

The generic reclassification of Cleomaceae followed here is based on studies of New World taxa by Iltis and Cochrane (Novon 17: 447–451. 2007). They recognized a number of smaller, more clearly delimited genera, based on seed anatomy and morphology, chromosome numbers, biogeographic analyses, and published molecular data. The resultant dismantling of the paraphyletic genus *Cleome* as it occurs in the New World is applicable in other regions, including Asia, because of the worldwide distribution of all the genera of the Cleomaceae.

Sun Bishin. 1999. *Cleome*. In: Wu Chengyi, ed., Fl. Reipubl. Popularis Sin. 32: 531–540.

- 1a. Bract at base of pedicels simple; petals 1.5–4.5 cm; filaments 3–8.5 cm; anthers 6–10 mm; seeds 1.9–3.5 mm.
 - 2a. Androgynophore 5–10 mm; gynophore 2–6 cm; nodal spines absent 2. *Cleoserrata*
 - 2b. Androgynophore absent; gynophore 4.5–8 cm; nodal spines present (prickles often present on petiole and major leaf veins) 3. *Tarenaya*
- 1b. Bract at base of pedicels 3-foliolate or sometimes apical-most simple; petals 0.7–1.4 cm; filaments 0.5–3 cm; anthers 1–3 mm; seeds 1–1.6 mm.
 - 3a. Androgynophore 3–7 mm (in fruiting specimens look for separate scars from filaments distal to sepals or sepal scars) 5. *Gynandropsis*
 - 3b. Androgynophore absent.
 - 4a. Stamens 6; sepals connate for 1/4–1/2 their length; leaflets 3; gynophore 3–12 mm 1. *Cleome*
 - 4b. Stamens 14–25; sepals distinct; leaflets 3 or 5; gynophore absent 4. *Arivela*

1. CLEOME Linnaeus, Sp. Pl. 2: 671. 1753.

白花菜属 bai hua cai shu

Herbs, annual, sparsely branched, glandular pubescent or glabrous, lacking spines. Stipules absent or scalelike and caducous. Leaves alternate, spirally arranged, pinnately compound; petiole long or short, with a pulvinus at basal or distal end; leaflets [1 or]3–7[–11]; petiolule bases connate, forming a pulvinate disk; leaflet blades lanceolate to oblanceolate, margin entire or serrulate. Inflorescences terminal or axillary from apical leaves, racemose, sometimes flat-topped or elongated, elongating in fruit; bract present [or absent] at base of pedicels. Flowers slightly zygomorphic. Sepals 4, equal, connate for ca. 1/2 their length, each often subtending a basal nectary. Petals 4, distinct, equal. Stamens [4–]6, distinct; filaments inserted on a discoid or conical receptacle (androgynophore). Gynophore slender, elongating and recurving in fruit or sometimes obsolete; carpel 1; style 0.2–0.8 mm, thick; stigma 1, capitate. Fruit an oblong capsule, dehiscent. Seeds 10–40 per capsule, reniform, arillate or not; cleft fused between 2 ends of seed.

About 20 species: Old World warm-temperate and tropical areas; one species (introduced) in China.

The center of diversity of *Cleome* is SW Asia with only one true *Cleome* naturalized in China. Other native and non-native species formerly included in *Cleome* are placed in *Arivela*, *Cleoserrata*, *Gynandropsis*, and *Tarenaya* following Iltis and Cochrane (Novon 17: 447–451. 2007).

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1. *Cleome rutidosperma* Candolle, Prodr. 1: 241. 1824.皱子白花菜 *zhou zi bai hua cai**Cleome ciliata* Schumacher & Thonning.

Herbs, annual or rarely perennial, 30–100 cm tall. Stems branched, often with decumbent branches, glabrous or glabrescent to slightly scabrous but sometimes glandular pubescent. Stipules ca. 0.5 mm, scalelike or absent. Petiole 0.5–3.5 cm, proximally winged; leaflets 3; leaflet blades oblanceolate to rhomboid-elliptic, 1–3.5 × 0.5–1.7 cm, abaxially with curved trichomes on veins especially when young, adaxially glabrous, margins entire or serrulate-ciliate, apex acute, obtuse, or sometimes acuminate. Inflorescences terminal and axillary, 2–4 cm but 8–15 cm in fruit, 3–6-flowered; bracts leaflike, 3-foliolate, 1–3.5 cm. Pedicel 1.1–2.1 cm but 1.8–3 cm in fruit. Sepals yellow,

narrowly lanceolate, 2.5–4 × 0.2–0.3 mm, ± persistent, glabrous, margin ciliate. Petals white or speckled with purple, oblong to narrowly ovate, 7–10 × 1.5–2.3 mm; central 2 petals outside with a yellow transverse band. Filaments yellow, 5–7 mm; anthers purplish brown, 1–2 mm. Pistil 2–3 mm, glabrous; style 0.5–1.4 mm. Fruit with a 4–12 mm gynophore; capsule 40–70 × 3–4 mm, striate. Seeds 4–25 per capsule, reddish brown to black with white funicular aril, 1–1.5 mm, slender, striately verrucose. Fl. and fr. Jun–Sep. $2n = 20, 30$.

Between paddy fields, streamsides, wetlands; near sea level to 200 m. Introduced and naturalized in Anhui, Guangdong, Guangxi, Hainan (Qionghshan), Taiwan, and W Yunnan (Luxi) [native to tropical Africa; naturalized in tropical America, Asia, and Australia].

This species is an invasive weed throughout most lowland wet tropical areas of Asia and Australia.

2. *CLEOSERRATA* Iltis, Novon 17: 447. 2007.西洋白花菜属 *xi yang bai hua cai shu*

Herbs, annual, sparsely or profusely branched, glabrous. Stipules absent [scalelike, caducous] (petiolar spines sometimes present). Leaves alternate, spirally arranged, palmately compound; petiole long or short, with pulvinus at basal or distal end; petiolule bases connate forming a pulvinar disk; leaflet blades lanceolate to oblanceolate, margin ciliate-serrulate. Inflorescences terminal or axillary from apical leaves, racemose or sometimes flat-topped or elongated, elongating in fruit; bract present at base of pedicels, small. Flowers slightly zygomorphic. Sepals 4, equal, each often subtending a basal nectary. Petals 4, distinct, equal. Stamens 6; filaments adnate to basal ca. 1/4 of gynophore, forming an androgynophore. Gynophore slender, elongating and recurving in fruit; carpel 1; style short, thick; stigma 1, capitate. Fruit an oblong capsule, dehiscent. Seeds 10–40 per capsule, reniform, not arillate; cleft fused between 2 ends of seed.

Five species: Africa, tropical America, S North America, South America; one species (introduced) in China.

1. *Cleoserrata speciosa* (Rafinesque) Iltis, Novon 17: 448. 2007.西洋白花菜 *xi yang bai hua cai*

Cleome speciosa Rafinesque, Fl. Ludov. 86. 1817; *C. speciosissima* Deppe ex Lindley; *C. yunnanensis* W. W. Smith; *Gynandropsis speciosa* (Kunth) Candolle.

Herbs, annual, 0.5–1.5 m tall. Stems simple or sparsely branched, fluted, glabrous or sparsely glandular pubescent. Petiole 2–12 cm, glandular pubescent; leaflets (3 or)5–9; leaflet blades narrowly lanceolate-elliptic, 6–15 × 1–5 cm, both surfaces glabrate to glandular pubescent, base attenuate, margin entire or serrulate, apex acuminate. Inflorescences 15–50 cm but 20–60 cm in fruit, glandular pubescent; bracts narrowly ovate-cordate, 0.3–1.8 cm. Pedicel 1–5 cm, glabrous. Sepals green, lanceolate, 4–7 × 0.8–1.2 mm, equal, distinct, persistent, glandular pubescent, base cuneate, margin entire. Petals brilliant pink to purple but fading to pink or white by second day,

rarely initially white, ovate, 1.5–4.2 × 0.8–1.1 cm, clawed. Androgynophore ca. 4 mm at anthesis; stamens 4–8.5 cm; anthers 6–10 mm. Pistil 6–10 mm; style 1–1.2 mm. Fruit gynophore 3–8.5 cm, with scars from filaments on ca. 1 cm of androgynophore and visible on ca. 1/4 of its length; capsule cylindrical but irregularly contracted between seeds, 6–15 cm × 3–5 mm. Seeds 10–30 per capsule, pale green to brown, subspherical, 2.5–3.5 × 1–1.2 mm, tuberculate. Fl. Aug–Nov, fr. Sep–Dec. $2n = 48$.

Disturbed places; near sea level to 1500(–3400) m. Introduced and sometimes escaped in Guangdong, Taiwan, and Yunnan [native to Mexico and Central America].

This species is often cultivated in gardens in S China and elsewhere in warm climates.

Cleome yunnanensis, described from China, is a variant of this species with mostly ternate leaves. The type, from Yunnan (*Forrest 13762*), probably represents escaped garden plants.

3. *TARENAYA* Rafinesque, Sylva Tellur. 111. 1838.醉蝶花属 *zui die hua shu**Cleome* sect. *Tarenaya* (Rafinesque) Iltis.

Herbs [or shrubs], annual [or perennial], sparsely branched, glabrous or glandular pubescent. Stipular thorns present [or absent]. Leaves alternate, spirally arranged, palmately compound, ± prickly; petiole spiny, with pulvinus at basal or distal end; leaflets [1 or]3–7[–11]; petiolule bases connate forming a pulvinar disk; leaflet blades lanceolate to oblanceolate, margin entire or serrulate. Inflorescences terminal or axillary from apical leaves, racemose or sometimes flat-topped or elongated, 10–80-flowered, elongating

in fruit; bract present [or absent] at base of pedicels. Flowers slightly zygomorphic. Sepals 4, equal, each often subtending a basal nectary. Petals 4, equal, distinct. Stamens 6; filaments inserted on a discoid or conical receptacle (androgynophore). Gynophore slender, elongating and recurving in fruit; carpel 1; style short, thick; stigma 1, capitate. Fruit an oblong capsule, dehiscent. Seeds 10–40 per capsule, reniform, not arillate; cleft fused between 2 ends of seed.

About 33 species: tropical W Africa and South America; one species (introduced) in China.

Traditionally included in a broad Linnaean circumscription of *Cleome*, *Tarenaya* is distinguished by its stipular thorns, petiolar spines, lack of arils, and seeds with a large cleft cavity. All species are native to tropical America, with the exception of one species in tropical W Africa. *Tarenaya hassleriana* is a popular garden subject and probably the most widely distributed member of the family, having been introduced worldwide in tropical and warm-temperate regions.

1. *Tarenaya hassleriana* (Chodat) Iltis, *Novon* 17: 450. 2007.

醉蝶花 zui die hua

Cleome hassleriana Chodat, *Bull. Herb. Boissier* 6, App. 1: 12. 1898.

Herbs, annual, (0.5–)1–1.5 m tall. Stems branched, glandular pubescent. Stipular spines 1–3 mm. Petiole 2.5–7.5 cm, glandular pubescent, with scattered 1–3 mm spines; leaflets 5 or 7; leaflet blades elliptic to oblanceolate, 2–6(–12) × 1–3 cm, abaxially glandular pubescent, adaxially glandular, margin serrulate-denticulate, apex acute. Inflorescences 5–30 cm but 10–80 cm in fruit, pedunculate; bracts ovate, 1–2.5 cm. Pedicel 2–4.5 cm, glandular pubescent. Sepals green, equal, distinct, linear-lanceolate, 5–7 × 0.8–1.3 mm, reflexed after anthesis, persistent, glandular pubescent, margin entire, apex acuminate. Petals pink to purple but infrequently white or fading to white

by second day, oblong to ovate, 2–3(–4.5) × 0.8–1.2 cm, clawed. Stamens purple, 3–5 cm; anthers green, 9–10 mm. Pistil 6–10 mm; style ca. 0.1 mm. Fruit gynophore 4.5–8 cm; capsule (2.5–)4–8 cm × 2.5–4 mm, in straight alignment with gynophore and pedicel, glabrous. Seeds 10–20 per capsule, dark brown to black, triangular to subspherical, 1.9–2.1 × 1.9–2.1 mm, tuberculate. Fl. (Apr–)May–Dec, fr. Jun–Dec. $2n = 20$.

Roadsides, vacant lots, dry hillsides; near sea level to 800(–2000) m. Introduced and sparingly escaped in Guangdong, Hainan, Jiangsu, Sichuan, Yunnan, and Zhejiang [native to South America (Argentina, Brazil, and Paraguay); widely cultivated and occasionally naturalized in tropical and warm-temperate regions].

In cultivation and in various floras (including FRPS 32: 534: 1999), this species has been treated under the name *Cleome spinosa* Jacquin; however, Jacquin's name and type apply to a different species, *Tarenaya spinosa* (Jacquin) Rafinesque.

4. **ARIVELA** Rafinesque, *Sylva Tellur.* 110. 1838.

黄花草属 huang hua cao shu

Herbs, annual, glandular pubescent or glabrous. Stipules absent. Leaves alternate, palmately compound; petiole long or short, with pulvinus at basal or distal end; leaflets 3 or 5; petiolule bases connate forming a pulvinar disk; leaflet blades ovate to oblanceolate-elliptic, margin entire or serrulate. Inflorescences terminal or axillary from apical leaves, racemose or sometimes flat-topped or elongated, elongating in fruit; bract present [or absent] at base of pedicels. Sepals 4, equal, distinct. Petals 4, equal, distinct. Stamens 14–25[–35]; filaments inserted on a discoid or conical receptacle (androgynophore). Pistil lacking a gynophore; style short, thick; stigma 1, capitate. Fruit an oblong capsule, partly dehiscent with persistent valves. Seeds 10–40 per capsule, spheroidal, not arillate; cleft fused between 2 ends of seed.

About ten species: Africa, Asia; one species in China.

1. *Arivela viscosa* (Linnaeus) Rafinesque, *Sylva Tellur.* 110. 1838.

黄花草 huang hua cao

Herbs, annual, (10–)30–100(–160) cm tall. Stems simple or branched, ± glandular hirsute, viscous. Petiole 1.5–4.5(–8) cm, glandular hirsute; leaflets 3 or 5; leaflet blades ovate to oblanceolate-elliptic, (0.6–)2–6 × 0.5–3.5 cm, both surfaces glandular hirsute, margin entire to glandular ciliate, apex acute to obtuse. Inflorescences 5–10 cm but 10–15 cm in fruit; bracts 1–2.5 cm, palmately compound, 3-foliolate, often deciduous, glandular hirsute. Pedicel 0.6–3 cm, glandular hirsute. Inflorescences 3–6-flowered. Sepals green, equal, distinct, 5–10 × 0.8–1.2 mm, lanceolate, persistent, glandular hirsute, base cuneate, margin entire. Petals bright yellow, basally sometimes purple, arranged in an adaxial semicircle before anthesis but radially arranged at anthesis, 7–14 × 3–4 mm, oblong to ovate, clawed. Stamens (dimorphic, 4–10 adaxial ones much shorter with a

swelling below anthers) green, 5–9 mm; anthers green, 1.4–3 mm. Pistil 6–10 mm, densely glandular; style 1–1.2[–8] mm; stigma capitate. Fruit lacking a gynophore; capsule 3–10 cm × 2–4 mm, strongly ridged longitudinally, dehiscent only partway from apex to base, glandular pubescent or essentially glabrous. Seeds 25–40[to ca. 100] per capsule, light brown, 1.2–1.8 × 1–1.2 mm, compressed spherical, transversely finely ridged. Fl. Jul–Sep, fr. Oct. $2n = 20, 34, 60$.

Grassy slopes, wastelands, orchards, rice paddies; near sea level to 300 m. S Anhui, S Fujian, Guangdong, Guangxi, Hainan, E Hubei, Hunan, Jiangxi, Taiwan, Yunnan, Zhejiang [Bhutan, Cambodia, India, Indonesia, Japan (Ryukyu Islands), Laos, Malaysia, Nepal, Pakistan, Sri Lanka, Thailand, Vietnam; tropical Africa, SW Asia, tropical Australia; naturalized in tropical America].

This species comprises three varieties, two of which occur in China and one of which occurs in India.

The seeds have a high oil content (ca. 26%) and are rich in linoleic acid; they are eaten in India. The leaves and seeds have been used

medicinally in Asia (S China, India) and the Pacific islands (Guam) for the eyes and intestines and as a poultice for headaches and rheumatism (Chopra et al., Glossary Indian Medicinal Pl. 1956; Manandhar, Pl. People Nepal. 2002).

- 1a. Plants throughout with thin yellow viscid glandular trichomes and pubescence, with a bad smell 1a. var. *viscosa*
 1b. Plants smooth and glabrous, without any special smell 1b. var. *deglabrata*

1a. Arivela viscosa var. **viscosa**

黄花草(原变种) huang hua cao (yuan bian zhong)

Cleome viscosa Linnaeus, Sp. Pl. 2: 672. 1753; *C. icosandra* Linnaeus; *Polanisia viscosa* (Linnaeus) Candolle.

Plants throughout with thin yellow viscid glandular trichomes and pubescence, with a bad smell. Fl. Jul–Sep, fr. Oct.

Grassy slopes, wastelands, orchards, rice paddies; near sea level to 300 m. S Anhui, S Fujian, Guangdong, Guangxi, Hainan, E Hubei,

Hunan, Jiangxi, Taiwan, Yunnan, Zhejiang [Bhutan, Cambodia, India, Indonesia, Japan (Ryukyu Islands), Laos, Malaysia, Nepal, Pakistan, Sri Lanka, Thailand, Vietnam; tropical Africa, SW Asia, tropical Australia; naturalized in tropical America].

1b. Arivela viscosa var. **deglabrata** (Backer) M. L. Zhang & G. C. Tucker, **comb. nov.**

无毛黄花草 wu mao huang hua cao

Basionym: *Polanisia viscosa* var. *deglabrata* Backer, Fl. Bat. 53. 1907; *Cleome viscosa* f. *deglabrata* (Backer) Jacobs; *C. viscosa* var. *deglabrata* (Backer) B. S. Sun; *P. icosandra* Wight & Arnott f. *deglabrata* (Backer) Backer.

Plants throughout smooth and glabrous, without a distinctive or unpleasant smell. Ovary and fruit glabrous. Fr. Oct.

Near sea level to 300 m. S Fujian, Guangdong, Jiangxi, Zhejiang [Indonesia, Malaysia, Vietnam].

This taxon is reported here for the first time from Vietnam (Phuoc Vinh, 6 Oct 1970, *R. V. Hoffman s.n.*, NY).

5. GYNANDROPSIS Candolle, Prodr. 1: 237. 1824, nom. cons.

羊角菜属 yang jiao cai shu

Pedicellaria Schrank.

Herbs, annual [or rarely short-lived perennials], glabrate or glandular pubescent. Stipules absent. Leaves alternate, spirally arranged, palmately compound; petiole long or short, with pulvinus at basal or distal end; leaflets 3 or 5; petiolule bases connate forming a pulvinar disk; leaflet blades oblanceolate to rhombic, margin serrulate-denticulate. Inflorescences terminal, racemose and sometimes elongated, elongating in fruit; bract present at base of pedicels. Flowers zygomorphic. Sepals 4, equal, each often subtending a basal nectary. Petals 4, equal, distinct. Stamens 6; filaments adnate to basal portion of gynophore receptacle forming androgynophore ± as long as petals. Gynophore slender, elongating and recurving in fruit, scars from filaments visible for 1/3–1/2 its length; style short, thick; stigma 1, capitate. Fruit an oblong capsule, dehiscent. Seeds 10–40 per capsule, subspherical, not arillate; cleft fused between 2 ends of seed.

Two species: pantropical and warm temperate; one species in China.

The center of diversity is in S Asia. *Gynandropsis* is allied to *Cleome* but is distinguished by the long, conspicuous androgynophore. It has sometimes been included in *Cleome*, but most regional accounts of Capparaceae or Cleomaceae (e.g., Jafri, Fl. Pakistan 34: 17–20. 1973) in the Old World have given it generic status, an approach followed here.

1. Gynandropsis gynandra (Linnaeus) Briquet, Annuaire Conserv. Jard. Bot. Genève 17: 382. 1914.

羊角菜 yang jiao cai

Cleome gynandra Linnaeus, Sp. Pl. 1: 671. 1753; *C. heterotricha* Burch; *C. pentaphylla* Linnaeus; *Gynandropsis heterotricha* (Burch) Candolle; *G. pentaphylla* (Linnaeus) Candolle; *G. sinica* Miquel.

Herbs, annual, (0.2–)0.9–1.5 m tall. Stems simple or sparsely branched, glabrate to glandular pubescent. Petiole 3.5–4.5(–8) cm, glandular pubescent; leaflets 3 or 5; leaflet blades oblanceolate to rhombic, 2.5–4.5 × 1.2–2.5 cm, both surfaces glabrate to glandular pubescent, margin serrulate-denticulate, apex acute. Inflorescences 5–20 cm but 10–40 cm in fruit, 5–12-flowered; bracts 1–2.5 cm, 3-foliolate, petiolate. Pedicel purple, 0.8–1.5 cm, glabrous. Sepals green, lanceolate, 3.5–5 × 0.8–1.2 mm, persistent, glandular pubescent, base cuneate, margin entire. Petals purple to white, oblong to ovate, 7–14 × 3–4 mm, clawed. Stamens purple, 0.8–3 cm; filaments adnate to

gynophore for 1/3–1/2 their length, diverging at anthesis; anthers green, 1–2 mm. Pistil 6–10 mm; style 1–1.2 mm. Fruit gynophore 1–1.4 cm, scars from filaments visible for 1/3–1/2 its length; capsule 4.5–9.5 cm × 3–4 mm, glandular pubescent. Seeds 10–20 per capsule, reddish brown to black, subspherical, 1.4–1.6 × 1–1.2 mm, rugose to tuberculate. Fl. (Apr–)May–Jul(–Oct), fr. Jun–Dec. $2n = 34, 60$.

Roadsides, wastelands, fields, often dry areas; near sea level to 300(–800) m. Anhui, Chongqing, Fujian, Guangdong, Guangxi, Guizhou, Hainan, Hebei, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Shandong, Taiwan, Yunnan, Zhejiang [Bhutan, India, Indonesia, Malaysia, Nepal, Sri Lanka, Thailand, Vietnam; tropical Africa; introduced in Central, S North, and South America].

This species is often grown as an ornamental and cultivated as a potherb (see Waitaha & Chweya, *Gynandropsis gynandra*, a tropical leafy vegetable: its cultivation and utilization. F. A. O. Pl. Prod. Protect. Pap. 107. 1991; Chweya & Mnzava, Cat's Whiskers: *Cleome gynandra* L. F. A. O. Pl. Prod. Protect. Pap. 1997). It is also used medicinally. The fresh plant has a peculiar odor that suggests burning *Cannabis*. The C4 photosynthetic pathway is reported from *Gynandropsis gynandra* (see Imbamba & Tieszen, Physiol. Pl. (Copenhagen) 39: 311–316. 1977).