Takasi YAMAZAKI*: Gamopetalous plants in Far Eastern Asiatic regions and Micronesia (2)** Ebenaceae

山崎 敬: 日本周辺及びミクロネシアの合弁花植物 (2)** カキノキ科

Ebenaceae

Trees or shrubs, dioecious, often monoecious or polygamous. Leaves alternate, simple, entire, estipulate. Flowers regular, 3-4-merous, axillary, solitary or in small cymose clusters. Calyx 3- or 4-lobed, united at base, persistent, valvate. Corolla urceolate or tubular, 3- or 4-lobed, contorted in bud. Stamens inserted on the corolla-tube, two to four times as many as the petals; staminodes usually present in female flowers; anthers linear, 2-locular, dehiscing laterally by longitudinal slits or apical pores. Ovary superior, 3-12-locular, with one or two ovules in each locule. Ovule anatropous, with two integuments, suspended from the summit of the axile placenta. Style linear, 3-8-lobed; stigma small. Fruit a berry, few seeded. Seeds laterally or dorsiventrally compressed, with hard testa. Endosperm copious, often ruminate. Embryo straight, shorter than the endosperm, with a long hypocotyl and foliaceous cotyledons.

Endosperm formation is of the Cellular type and has no haustorium. The embryo development is assigned to the Polygonad type (Yamazaki 1974).

Four genera and about 450 species, distributed in the tropics and subtropics of the world.

Diospyros L., Sp. Pl. ed. 1, 2: 1057 (1753). Hiern, Monog. Eben. 144 (1873). Bakhuizen in Bull. Jard. Bot. Buitenzorg, ser. III, 15: 6 (1936). Wood and Channell in Journ. Arnold Arb. 41: 18 (1960).

Maba J.R. et G. Forster, Charact. Pl. 12 (1776), Hiern, l.c. 106 (1873).

A large genus of about 400 species, distributed in the tropics and subtropics of the world; nine indigenous and two cultivated and naturalized species are known in the treated area.[1)]

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** (1) in Journ. Jap. Bot. 49: 149-160 (1974).

1) This area is restricted in Manchuria, Korea, Sakhalin, Japan, Ryukyu, Taiwan and Micronesia.

A. Flowers 4-merous; calyx 4-lobed; corolla tubular or urceolate, 4-lobed; ovary usually 8- rarely 4-locular in female flower, with a single ovule in each locule; style 4-lobed; seeds surrounded by a linear belt..... ..... Subgen. Diospyros

B. Calyx and corolla densely hairy outside; corolla tubular; anthers glabrous; filaments glabrous; ovary densely hairy; seeds laterally compressed..... Sect. Ermellinus

C. Branchlets densely tomentose or villose; leaves oblong to lanceolate, acute to acuminate at apex; calyx densely villose or tomentose, deeply lobed to 3/4 the length.

D. Branchlets clothed with villose ferrugineous hairs; leaves thin-chartaceous, lanceolate, acuminate at apex, darkly reddish-brown in drying, 7–11 cm long, 2–4 cm broad; fruit ovoid, 1.5–2 cm long, 0.8–1 cm broad..... *D. eriantha*

D. Branchlets clothed with tomentose fulvous hairs; leaves coriaceous, oblong to oblong-lanceolate, acute at apex, glaucous beneath, 15–30 cm long, 5–13 cm broad; fruit depressed-globose, about 8 cm across, densely villose ..... *D. discolor*

C. Branchlets glabrescent; leaves elliptic to obovate, obtuse at apex; calyx with sericeous fulvous hairs, lobed to 1/2 the length; fruit depressed-globose, clothed with sericeous fulvous hairs, 1.5–2 cm across ..... *D. maritima*

B. Calyx glabrous, or densely hairy outside when young, finally glabrous; corolla urceolate or campanulate.

C. Corolla glabrous or sparsely hairy outside at the upper part of the lobes; anthers glabrous, dehiscing laterally by longitudinal slits; filaments hairy; seeds laterally compressed ..... Sect. Diospyros

D. Calyx lobed to about 1/2 the length, the lobes broadly ovate, triangularly ovate or orbicular.

E. Evergreen trees; branchlets, pedicels and calyces clothed with sericeous fulvous hairs; leaves coriaceous, elliptic to ovate-lanceolate, acuminate at apex, 4–9 cm long 2–4.5 cm broad, reddish-brown in drying; petioles 5–13 mm long, with pubescent rufous hairs .....*D. morrisiana*

E. Deciduous trees; branchlets clothed with rufous hairs when

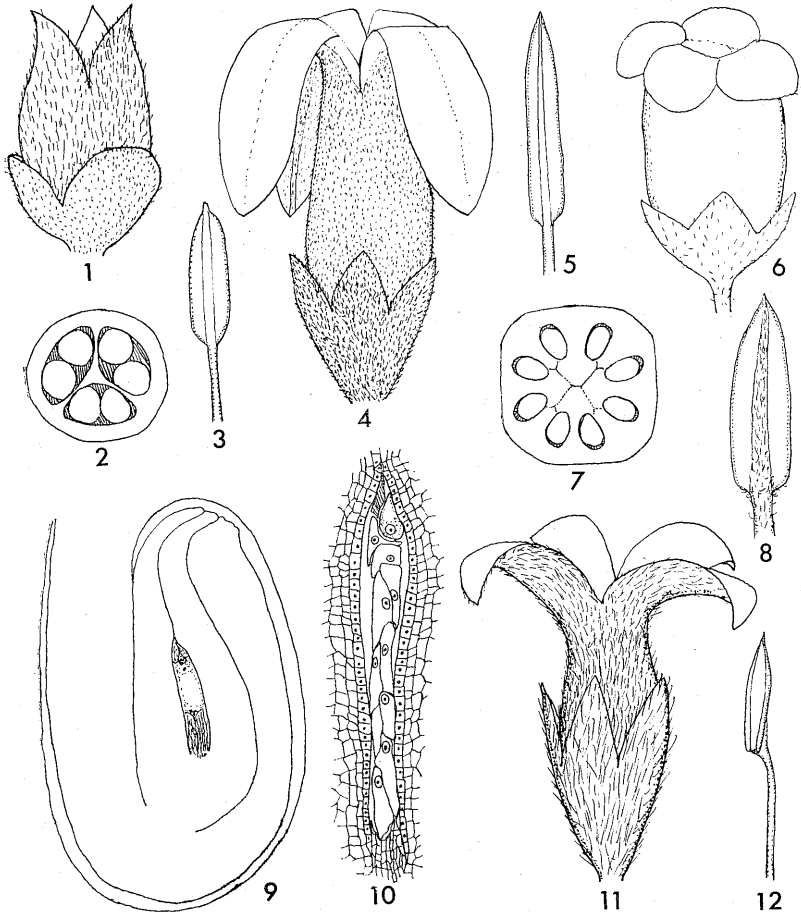

Fig. 1. Ebenaceae. 1-2. *Diospyros palauensis*: 1. Female flower ×4. 2. Cross section of ovary ×8. 3. *D. ferra*, stamen in dorsal view ×10. 4-5. *D. maritima*: 4. Male flower ×4. 5. Stamen, dorsal view ×5. 6-8. *D. japonica*: 6. Male flower ×4. 7. Cross section of ovary ×8. 8. Stamen, dorsal view ×5. 9-10. *D. kaki*: 9. Vertical section of ovule ×40. 10. Young endosperm ×80. 11-12. *D. eriantha*: 11. Male flower ×4. 12. Stamen, lateral view ×8.

young, finally glabrous; leaves membranaceous, pale and more or less glaucous beneath; petioles 1–2.5 cm long .... *D. japonica*

D. Calyx deeply lobed to 2/3 the length, the lobes lanceolate to ovate.

E. Branchlets clothed with rufous hairs; corolla sparsely hairy outside at the upper part of the lobes; fruit 3–8 cm across .... *D. kaki*

E. Branchlets glabrous, or clothed with sparse rufous hairs when young, finally glabrous; corolla glabrous outside; fruit 1.5–2 cm. across.

F. Lower surface of leaves pubescent along the midrib, pale and more or less glaucous; male flowers 1–2 in axils of the leaves, subsessile; calyx-lobes ovate, sparsely pubescent when young ..... *D. lotus*

F. Lower surface of leaves glabrous or pubescent along the midrib when young, finally glabrous, nearly concolored; male flowers 3–6, clustered in axils of the leaves; calyx-lobes lanceolate, glabrous outside ..... *D. oldhami*

C. Corolla glabrous outside; anthers papillose under the lens, dehiscing laterally by short longitudinal slits or apical pores; filaments glabrous; seeds dorsiventrally compressed .... Sect. Leucoxylum. *D. kotoensis*

A. Flowers 3-merous; calyx campanulate, 3-lobed; corolla 3-lobed; ovary 3-locular in female flower, with 2 ovules in each locule; style 3-lobed at apex; seeds without a linear belt ..... Subgen. Maba

B. Leaves elliptic or oblong-lanceolate, obtuse or acutiuscule at apex, 6–14 cm long, 3–6 cm broad; female flowers pedicellate .... *D. palauensis*

B. Leaves obovate or rounded at apex, emarginate, 3–6 cm long, 1.2–2 cm broad; female flowers subsessile..... *D. ferrea*

Subgen. **Diospyros**.

Subgen. Eudiospyros Bakh., l.c. 12 (1936).

Sect. **Ermellinus** (Cesalp.) Hiern, Monog. Eben., 146 (1873).

Sect. Cavanillea (Desr.) Hiern, l.c. 146 (1873).

Series **Eriantha** (Bakh.) Yamazaki stat. nov.

Sect. Eriantha Bakh., l.c. 30 (1936).

Diospyros eriantha Champ. ex Bentham in Hook., Kew Jour. Bot. 4: 302 (1852), Bentham, Fl. Hongkong. 210 (1861), Hiern, l.c. 202 (1873), Kanehira, Formos. Trees, rev. ed. 573, f. 531 (1936), Bakhuizen, l.c. 182 (1938), Liu,

Ill. Lign. Pl. Taiwan 2: 1004, f. 832 (1962), Li, Wood. Fl. Taiwan 730 (1963), Hatusima, Fl. Ryukyus 474 (1971), Fig. 1, 11–12.

Distr. Southern Ryukyu, Taiwan, southern China and Indo-China.

Series **Ebenaster** (Bakh.) Yamazaki stat. nov.

Sect. Ebenaster Bakh., l.c. 26 (1936).

Diospyros discolor Willd., Sp. Pl. 4: 1108 (1805), Kanehira, Fl. Micronesia 309 (1933), Bakhuizen, l.c. 145 (1937), Liu, l.c. 1002, f. 830 (1962), Li, l.c. 731, f. 298 (1963).

Diospyros utilis Hemsley in Ann. Bot. 9: 154 (1896), Kanehira, Formos. Trees, rev. ed. 572, f. 530 (1936).

Distr. Southern Taiwan and Philippines, cultivated in the tropics of eastern Asia and Micronesia.

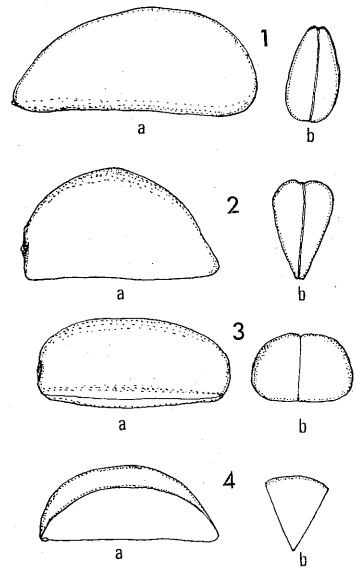

Fig. 2. Seeds. 1. *Diospyros morrisiana.* 2. *D. maritima.* 3. *D. kotoensis.* 4. *D. palauensis.* a: lateral view. b: apical view. All ×3.

Ser. **Nesindica** (Bakh.) Yamazaki stat. nov.

Sect. Nesindica Bakh., l.c. 36 (1936).

Diospyros maritima Blume, Bijdr. Fl. Nederl. Ind. 669 (1825), Kanehira, l.c. 575, f. 532 (1936), Bakhuizen, l.c. 265 (1938), Hara, Enum. Sperm. Jap. 1: 102 (1948), Liu, l.c. 1006, f. 834 (1962), Li, l.c. 731 (1963), Hatusima, l.c. 474 (1971). Fig. 1, 4–5, Fig. 2, 2.

Distr. Ryukyu, Taiwan, southern China, Indo-China, Malaysia, Philippines, New Guinea and tropical Australia.

Sect. **Diospyros**.

Sect. Danzleria (Bert.) Hiern, l.c. 146 (1873).

Sect. Lotus Bakh., l.c. 32 (1936).

Series **Morrisianae** Yamazaki ser. nov.

Calyx usque ad 1/2 longitudinem lobatus, lobis late ovatis vel orbiculatis. Type. *D. morrisiana.*

Diospyros morrisiana Hance in Walp., Ann. Bot. Syst. 3 : 14 (1852), Kanehira, l. c. 576, f. 533 (1936), Hara, l. c. 103 (1948), Makino's New Ill. Fl. Jap. 481, f. 1924 (1961), Liu, l. c. 1008, f. 836 (1962), Li, l. c. 730 (1963) excl. syn., Ohwi, Fl. Jap. rev. ed. 1069 (1965), Kitamura, Col. Ill. Woody Pl. Jap. 1 : 104, pl. 21, 126 (1971), Hatusima, l. c. 474 (1971). Fig. 2, 1.

Diospyros nipponica Nakai in Bot. Mag. Tokyo 35 : 137 (1921), Trees and Shrubs Jap. rev. ed. 300, f. 141 (1927).

Distr. Southern Honshu, Shikoku, Kyushu, Ryukyu, Taiwan and southern China.

Diospyros japonica Sieb. et Zucc. Fl. Jap. 136 (1846), Hatusima in Journ. Jap. Bot. 14 : 238 (1938), Kitamura in Bot. Mag. Tokyo 59 : 40 (1945), Hara, l. c. 101 (1948), Li, l. c. 733 (1963), Ohwi, Fl. Jap. rev. ed. 1070 (1965), Kitamura, l. c. 106 (1971), Hatusima, l. c. 475 (1971). Fig. 1, 6–8.

Diospyros glaucifolia Metcalf in Ling. Sci. Journ. 11 : 22 (1932).

Distr. Southern Honshu, Shikoku, Kyushu, Ryukyu, Taiwan and central China.

Series **Diospyros**.

Diospyros kaki Thunberg in Nova Act. Reg. Soc. Sci. Upsal. III, 208 (1780), Fl. Jap. 157 (1784), Nakai, Trees and Shrubs Jap. rev. ed. 303, f. 143 (1927), Hara, l. c. 101 (1948), Makino's, l. c. 481, f. 1922 (1961), Ohwi, l. c. 1069 (1965), Kitamura, l. c. 105, pl. 21, 127, f. 63 (1971). Fig. 1, 9–10.

Diospyros kaki L. f., Suppl. Pl. 439 (1781), Hiern, l. c. 227 (1873).

Distr. Native in China, cultivated and naturalized in Japan.

Diospyros lotus L. Sp. Pl. ed. 1, 1057 (1753), Hiern, l. c. 223 (1873), Hara, l. c. 102 (1948), Makino's, l. c. 481, f. 1923 (1961), Ohwi, l. c. 1069 (1965), Kitamura, l. c. pl. 21, 128 (1971).

Distr. Native in western Asia, cultivated and naturalized in Japan.

Diospyros oldhami Maxim. in Bull. Imp. Acad. Sci. St.-Pétersb. 31 : 67 (1886), Masamune in Trans. Nat. Hist. Formos. 29 : 344 (1939), Li, l. c. 733 (1963), Hatusima, l. c. 474 (1971).

Diospyros oldhami Maxim. var. *chartacea* Hayata, Mat. Fl. Formos. 186 (1911), Kanehira, l. c. 576, f. 534 (1936).

Diospyros sasakii Hayata, Icon. Pl. Formos. 7 : 33, f. 8 (1918), Kanehira, l. c. 576, f. 535 (1936), Liu, l. c. 1009, f. 837 (1962).

Distr. Taiwan.

This species seems to be very near to *Diospyros tsangii* Merrill of southern China.

Sect. **Leucoxylum** (Blume) Hiern, l.c. 146 (1873).

Sect. Kurzella Bakh. l.c. 29 (1936).

Diospyros kotoensis Yamazaki sp. nov. Fig. 2, 3 and Fig. 3, 1–3.

Diospyros nitida (non Merrill) Liu, Sasaki et Keng in Quart. Journ. Taiwan Mus. 8: 314 (1955), Hatusima in Mem. Fac. Agr. Kagoshima Univ. 7: 320 (1970).

Ramus glaber lenticellatus, ramulis glabris viridescentibus, nigro-lenticellatis. Folia chartacea, persistentia, elliptica vel oblonga, obtusa, integra, basi cuneata, utrinque glabra, supra ad costas intrusas scabridula, in sicco nigro-viridia, 4–6.5 cm longa, 1.5–3 cm lata, nervis inconspicuis 6–8 arcuatis, petiolis 3–4 mm longis scabridis. Flores masculi axillares, 3–5 in cymis glabris brevissime pedunculatis. Calyx cupulato-campanulatus, glaber, 2 mm longus 2 mm latus, profunde 4-lobatus, lobis ovatis 1.5 mm longis 1 mm latis, apice obtusis, extus minute ciliolatis. Corolla immatura 3 mm longa, extus glabra, 4-lobata, contorta. Stamina 12, 2-seriata, antheris sagittatis, apice acutiusculis, 1 mm longis, sub lente papillatis, filamentis glabris. Fructus globosus, in sicco 1.5 cm longus 1.3 cm latus, glaber, 2-seminifer. Semina fuscata, hemisphaerica, dorsiventraliter compressa, 9 mm longa 4 mm lata.

Hab. Taiwan: Is. Botel Tobago, alt. 250 m (Ikeda, Aug. 4–17, 1968, no. 2280, type in Tokyo Univ.), ibid. (C.E. Chang, April 24, 1962, no. 2788 and Aug. 19, 1962, no. 3160, Taiwan Univ.).

This species is near to *D. nitida* Merrill of the Philippines (Fig. 3 and 4), but differs from it by having glabrous branchlets and leaves, ovate sepals and larger fruits and seeds.

Subgen. **Maba** (J.R. et G. Forst.) Bakhuizen in Gard. Bull. St. Set. 7:

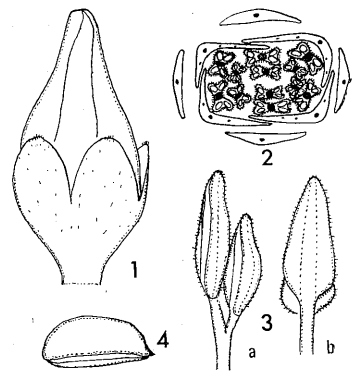

Fig. 3. 1–3, *Diospyros kotoensis*. 1. Young flower ×10. 2. Cross section of the male flower ×10. 3. Stamens ×1.5, a: lateral view. b: dorsal view. 4. Seed of *D. nitida* ×3.

161 (1933).

Maba J.R. et G. Forster, l.c. 121 (1776), Hiern, l.c. 106 (1873).

Sect. **Ferreola** (Roxb.) Fosberg in Bull. Torr. Bot. Cl. **65**: 609 (1938).

Sect. Forsteria Bakh., l.c. 8 (1936).

Diospyros palauensis (Kanehira) Hosokawa in Trans. Nat. Hist. Soc. Taiwan, **33**: 212 (1943). Fig. 1, 1-2 and Fig. 2, 4.

Maba palauensis Kanehira in Bot. Mag. Tokyo **48**: 405 (1934).

Maba buxifolia (non Pers.) Kanehira, Fl. Micron., 309 (1933).

Diospyros ferrea var. *nandarivatensis* Fosberg in Bull. Torr. Bot. Cl., **65**: 610 (1938) pro parte, specimens of Is. Yap and Is. Palau.

Diospyros ellipticifolia (non Bakh.) Hosokawa, l.c., 212 (1943).

Distr. Micronesia, Isls. Carolin, Palau and Yap.

This species is near to *D. sandwicensis*[1] of Polynesia, but differs by having smooth pedicels and sparsely pubescent calyx, while the latter species has pedicels with small scales or traces of the fallen scales and silky tomentose calyx.

Diospyros ferrea (Willd.) Bakhuizen in Gard. Bull. St. Set., **7**: 162 (1933), in Bull. Jard. Bot. Buitenz. ser. III, **15**: 50 (1937) pro parte, including var. *buxifolia* (Rottb.) Bakh.

Maba buxifolia (Rottb.) Persoon, Synops. Pl., **2**: 606 (1807). Hiern, l.c., 116 (1873). Kanehira, Form. Trees, ed. 2, 578, f. 535 (1936).

Diospyros ferrea Bakh. var. *buxifolia* (Rottb.) Bakh., l.c. 57 (1937), Liu, l.c. 1003, f. 831 (1962), Li, l.c. 735, f. 229 (1963), Hatusima, l.c. 473 (1971), Hara, l.c. 101 (1948). Fig. 1, 3.

Distr. Isls. Bonin, Ryukyu, Taiwan, southern China, Indo-China, Malaysia, India and Australia.

References

Bakhuizen van den Brink, R.C., Enumeration of Malayan Ebenaceae Gard. Bull. St. Settlem. **7**: 161-188 (1933). ——, Revisio Ebenacearum Malayensium. Bull. Jard. Bot. Buitenzorg, ser. III, **15**: 1-515 (1936-41). Chen

1) **Diospyros sandwicensis** (A. DC.) Yamazaki comb. nov.—*Maba sandwicensis* A. DC. in DC. Prod., **8**: 242 (1844)—*Diospyros ferrea* Bakh. var. *sandwicensis* (A. DC.) Bakh. in Bull. Jard. Bot. Buitenz. ser. III, **15**: 58 (1937).

Luetta, *Diospyros* in southeast China. Lingnan Sci. Journ. **14**: 661-685 (1935). Hiern, W.P., A monograph of Ebenaceae. Trans. Cambridge Phil. Soc. **12**: 27-300 (1873). Wood, C.E. and R.B. Channell, The genera of the Ebenales in the southeastern United States. Journ. Arnold Arb. **41**: 17-22 (1960). Yamazaki, T., Embryological studies in Ebenales (4). Ebenaceae. Journ. Jap. Bot. **47**: 20-28 (1972).

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カキノキ科は4属知られている。3属はアフリカ，マダガスカルにあり，種類数は少ない。カキ属は約400種知られる。半数はアフリカ，マダガスカルに，残りの半数がマレーシアを中心とする熱帯に分布し，南北アメリカ大陸に数種類知られる。日本周辺，ミクロネシアはマレーシアに分布するカキ属の東北部および東部の限界にあり，種数は少なくなり，11種知られる。これらはリュウキュウコクタン亜属とカキ亜属にわけられる。前者は花は3数性，種子の断面は3角状で，種子を取巻く帯はない。リュウキュウコクタン *D. ferra* とミクロネシアの *D. palauensis* が入る。カキ亜属には残りの9種があるが，花は4数性で，種子には1周する帯状の溝が走る。3節にわけられる。1つは台湾の紅頭嶼のもので，種子は前後にやや扁平となり，広い背腹面の中央を帯がとりまいている。葯の表面には乳頭状突起がある。これは従来，フィリッピンの *D. nitida* にあてられていたが，初島住彦氏がそれとは無毛である点で異ると報告しているように，全体無毛であるほか，がく片は小さく，種子は倍の大きさがあり，別の種類である。Sect. Leucoxylum に属し，これに属すものは紅頭嶼の *D. kotoensis*, のほか *D. nitida*, 華南の *D. vaccinioides*, マレーシア，オーストラリア，ニューギニアにある *D. buxifolia* などがある。

ケガキ *D. discolor*, ヤワラケガキ *D. eriantha*, リュウキュウガキ *D. maritima* は sect. Ermellinus に入り，花冠は筒状で，花糸や葯は無毛である。種子は左右に扁平であるが，カキ節のものほど扁平の程度は著しくない。

カキ節は花冠はつぼ状又は鐘形で，花糸に短毛がはえる。種子は著しく扁平でその縁に一周する帯がある。トキワガキ列とカキ列の2系統がある。前者はがくは1/2ほどまで浅くさけるものでトキワガキ *D. morrisiana*, リュウキュウマメガキ *D. japonica* があり，近縁種は華南に分布する。カキ列にはカキノキ *D. kaki*, マメガキ *D. lotus*, オルドガキ *D. oldhami* があり，がくは2/3以上に深くさけ，がく片は大形である。北アメリカの *D. virginiana* もこの仲間である。