

Notes on Persimmons, Kakis, Date Plums, and Chapotes

by STEPHEN A. SPONGBERG

The genus *Diospyros* is not at present an important genus of ornamental woody plants in North America, and while native persimmons once were valuable fruits in the eastern United States, the fruits produced by *Diospyros* species no longer are important food items in the American home. In the countries of eastern Asia at least two species of *Diospyros* are among the most common trees encountered in doorway gardens and orchards, where they are cultivated for their edible fruits as well as for other uses and for their ornamental beauty. J. J. Rein, a German traveler and author, wrote in 1889 that *Diospyros kaki* Linnaeus f. was "undeniably the most widely distributed, most important, and most beautiful fruit-tree in Japan, Corea, and Northern China." And in Japan, where *D. kaki* is second in importance as an orchard crop only to citrus fruit, the kaki often is referred to as the national fruit (Childers, 1972).

The rarity with which species of *Diospyros* are found in cultivation in cool-temperate North America is partially due to the fact that most are native to regions of tropical and subtropical climate and are not hardy in areas of temperate climate. A member of the Ebenaceae or Ebony Family, the genus contains upwards of 400 species that occur

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Typical fruits of the kaki or oriental persimmon grown in dooryard gardens in Korea. Two types are shown, one with longitudinal furrows, the second completely smooth and unfurrowed. Photograph by S. A. Spongberg.

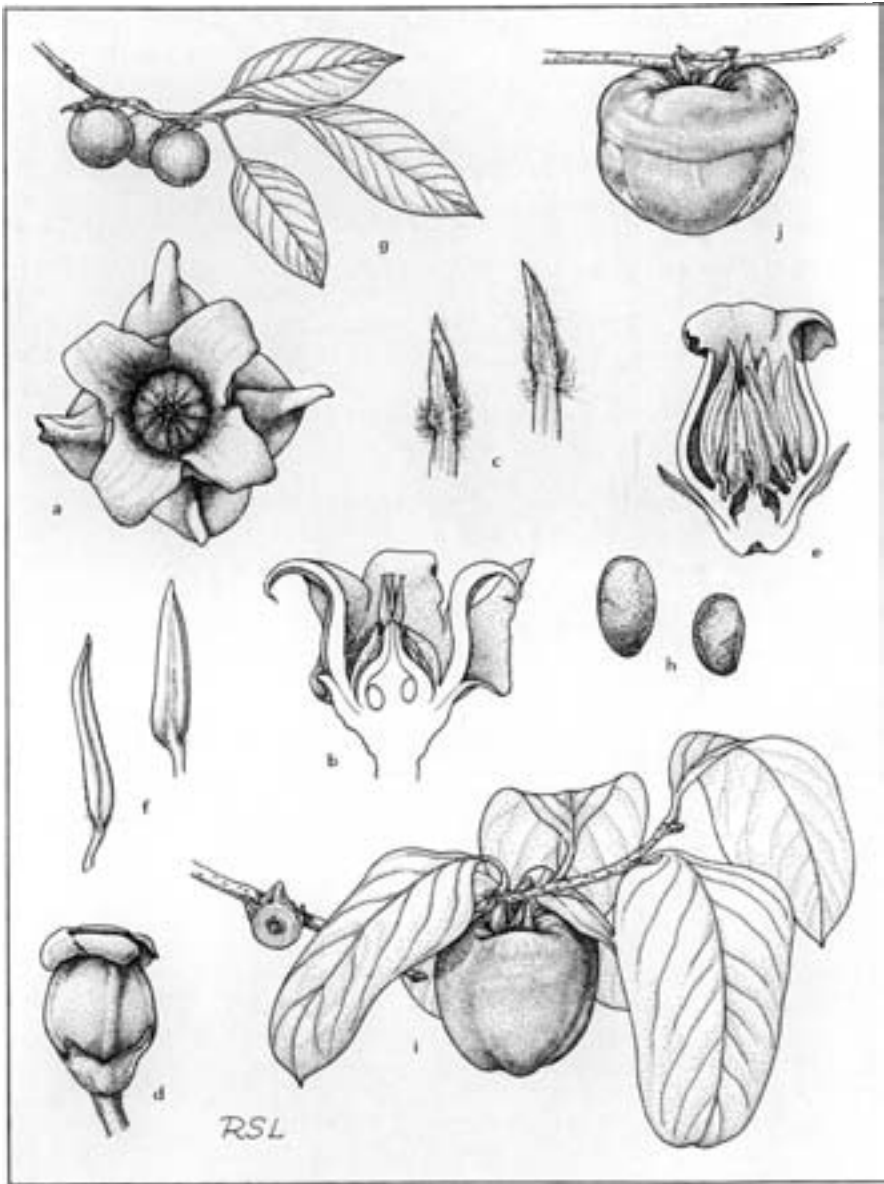


Figure 1. (a-h) *Diospyros virginiana*: (a) carpellate flower showing leafy calyx lobes, recurved corolla lobes, and staminodia over ovary, $\times 3$; (b) longitudinal section of carpellate flower, $\times 3$; (c) two staminodia, $\times 6$; (d) staminate flower, $\times 3$; (e) longitudinal section of staminate flower showing the stamens and non-functional gynoeceium, $\times 4$; (f) functional stamens from staminate flower, $\times 6$; (g) habit of fruiting branchlet of carpellate plant, $\times 3/8$; (h) seeds, $\times 1$. (i, j) *D. kaki*: (i) habit of fruiting branchlet of carpellate plant, $\times 3/8$; (j) fruit of the cultivar 'Tamopan', $\times 3/8$. Material of *Diospyros kaki* was kindly supplied by the Henry Foundation for Botanical Research, Gladwyne, Pennsylvania.

in both the Old and New Worlds with the greatest concentrations of species occurring in Madagascar (over 100 species), in Malaysia, and in Africa. The relatively few species native to regions of temperate climate come primarily from eastern Asia, but two species, *D. virginiana* and *D. texana* are indigenous to the United States.

A second reason even the hardy exotic and native species are rarely cultivated undoubtedly is related to a general lack of knowledge concerning when and how the fruits can be eaten, stored for future use, and prepared. While I always begin to look for persimmons in local markets and on Arnold Arboretum trees as the fall advances, many persons' experiences with these fruits understandably end when they first bite into a hard, astringent, and puckery persimmon. Such disappointments no doubt have contributed to a lack of demand for persimmons in American markets.

Despite the fancy prices asked for oriental persimmons or kakis in local vegetable stands and supermarkets, I am hopeful this article will stimulate enough interest to encourage readers to buy and enjoy a persimmon or two and to experiment with different ways of serving, and perhaps, preserving them. If native or American persimmons grow nearby, they can be gathered at little or no cost. I also am hopeful that both the oriental and American species will be more widely planted both for their fruits and as biologically interesting ornamentals. To this end, a list is appended of the few nurseries known to me that supply persimmon plants and seeds.

Characteristics of Hardy Exotic and Native Persimmons

The genus *Diospyros*, the name derived from the Greek *Dios*, of Zeus or of Jove, and *pyros*, grain, in allusion to the sweet fruits fit for the gods, consists of trees and shrubs, and while some are evergreen plants, all of the species considered below are deciduous. The wood of the majority of species is very hard with a watery sap, and the heart wood is often blackish. The heart wood of several of the tropical species, especially that of *D. ebenum* Koenig ex Retzius, is the source of ebony, a hard, black wood often used for piano keys and for other inlaid cabinetry work and undoubtedly the most widely-known product of this otherwise little-known genus. The bark varies from smooth and exfoliating in the chapote to deeply furrowed and checkered in the American persimmon. The simple, ovate or oblong to elliptic, glossy, dark green leaves are alternately arranged along the branchlets on short petioles, and the pinnately veined blades have entire, rarely ciliate, margins. The flowers, which are produced along the branchlets, usually of the current year's growth, in the axils of the leaves, are generally of two types that are arranged differently. The staminate or male flowers (Figure 1: d, e) are produced in shortly stalked cymose clusters of three or four flowers together, while the carpellate or female flowers (Figure 1: a, b) are generally solitary. The staminate flowers, which measure 6–14 mm. long are borne on short pedicels

that are surmounted by a small, usually four-lobed, greenish calyx, while the four whitish petals form a four-lobed, four-ribbed urceolate corolla that is much the size and shape of the corolla of a blueberry (*Vaccinium*) flower. Eight to twelve or sometimes sixteen lanceolate stamens (Figure 1: f) are attached to the inner wall of the corolla in one or two whorls, while an ovary is either absent altogether or poorly developed and functionless (Figure 1: e). The carpellate flowers also are produced on short pedicels that terminate in a four-lobed, green calyx, but the calyx lobes are much larger than in the staminate flowers, and leaflike, folded curiously downward along the median line. These lobes alternate with the four recurved lobes of the whitish to yellowish, more or less urceolate corolla and form a small flower whose shape is intriguing, especially when viewed from above (Figure 1: a). Inside the corolla, the globose, centrally located ovary is terminated by four or five styles (Figure 1: b), while curving over the surface of the ovary of most species are eight, silver-hairy, functionless stamens termed staminodia (Figure 1: c).

Like tomatoes, which they often resemble in size, shape, and coloration, the fruits developed from the carpellate flowers are technically berries (Figure 1: g, i, j). The seeds (Figure 1: h) are usually oblong in outline, and flattened, with tan to reddish-brown seed coats. Not all persimmons contain seeds, a phenomenon discussed below. The size and shape of persimmon fruits vary enormously, as does their color, which usually ranges from green through yellow to reddish-orange, brownish, blackish, or purplish when the fruits are ripe and edible.

The sexuality of persimmon trees and the production of persimmon fruits is poorly understood and in need of further detailed study. From what is known, persimmons are a biologically intriguing example of a variable and complex reproductive system. In general, the staminate and carpellate flowers are restricted to different individual plants, and the species is classified as dioecious (i.e., two households, male and female individuals separated). However, in some instances, flowers of both sexes occur on a single individual plant, a few branchlets of an otherwise carpellate tree bearing staminate flowers, or vice versa. Under these circumstances the species is said to be monoecious (i.e., one household, separate male and female flowers on the same plant). Yet another added complexity in *Diospyros* is that some plants consistently produce flowers of both sexes, but others change from year to year, producing flowers of both sexes in one year, but not in another. In still other, rarer instances, a few perfect flowers, that is, flowers that contain both functional male and female parts, may occur on staminate or carpellate plants or on plants producing both carpellate and staminate flowers.

Flowering occurs in late spring and early summer, usually during late May and June in the Arnold Arboretum, and swarms of small honey bees have been noted to work the flowers during this period.



*Fruiting branchlet of a carpellate tree of *Diospyros lotus* from Kwei Hsien, Shensi Province, China, where the local name, Ruan tze, signifies "round persimmon". Photograph by F. N. Meyer, September 10, 1914.*

Due to their small size, their nodding position in the leaf axils, and also because of their greenish and whitish to yellowish color, flowers of *Diospyros* are often unnoticed, and it may be only the activity of large numbers of insects visiting the flowers for pollen or nectar or both that draws attention to the fact the trees are in flower.

Initially green, hard, and with their high tannin content, extremely astringent, the fruits and their subtending calyces increase in size as the season progresses and gradually assume their mature color and texture. Depending on the cultivar, the fruits may ripen any time between July and December or even February, and, contrary to some reports, frost apparently is not necessary to reduce astringency or to hasten ripening. As a matter of fact, some cultivars of the oriental persimmon or kaki are sweet and edible when still green and hard, looking like, and with the texture of, green apples.

Ripe persimmons may either contain seeds, or, surprisingly, be totally free of seeds. Fruits containing seeds probably result from the normal sexual process whereby the egg cells contained in the ovules of the ovary of a carpellate flower are fertilized, and seeds and fruit develop. Seedless persimmons, on the other hand, develop without fertilization. The development of fruit without fertilization and hence without seeds is known as parthenocarpy. What factors are necessary to trigger parthenocarpic development in persimmons is not known to me and constitutes another aspect of the variable and complex reproductive mechanisms of the genus. Moreover, circumstantial

evidence involving a presumably totally carpellate tree of *Diospyros virginiana* in the Arnold Arboretum that regularly produces seed-filled fruits, yet is a considerable distance from the nearest staminate tree, suggests the possibility that some seeded fruits also may be produced without pollination and fertilization. The latter type of asexual seed production, termed *apomixis*, is known in some plant families, but has not been documented in *Diospyros* or the Ebenaceae. It might explain some of the variability of some species of *Diospyros*, including the kaki, and help in interpreting taxonomic complexities of the genus.

The species of *Diospyros* known to me to be cultivated in cool-temperate regions of eastern North America are discussed individually below, and the characters of their flowers, fruits, and habit, and their vegetative characteristics have been utilized to construct the following key for their identification.

Key to the Species of *Diospyros* in Cultivation

- A. Plants usually trees, rarely shrubs; leaf blades membranaceous to subcoriaceous, (1.4-)4-16(-20) cm. long, distinctly petiolate; flowers appearing after the leaves; anther sacs dehiscent by long, longitudinal slits; carpellate flowers with staminodia; fruits reddish through orange to yellow or yellowish-brown, sometimes green or purplish, rarely black.
- B. Branchlets \pm slender, glabrous or with grayish pubescence; staminate flowers 6-10 mm. long at anthesis; pedicels of carpellate flowers 2-7 mm. long, the corolla 5-12 mm. long; fruits to 4 cm. in diameter (very rarely larger).
 - C. Petioles (0.5-)1.8-3.2(-4.7) cm. long; staminate flowers 8-10 mm. long at anthesis; corolla of carpellate flowers ca. 12 mm. long, the four or five lobes 7-8 mm. long; mature berries reddish-orange to pinkish-yellow, rarely purplish or black, to 4 cm. (or rarely to 7.5 cm.) in diameter; seeds 11-17 mm. long.
 - 1. *D. virginiana*.
 - C. Petioles 0.7-1.2(-2.0) cm. long; staminate flowers 6-7 mm. long at anthesis; corolla of carpellate flowers ca. 5 mm. long, the four or five lobes 2-3 mm. long; mature berries yellowish-brown to bluish-black, to 2 cm. in diameter; seeds 8-12 mm. long.
 - 2. *D. lotus*.
- B. Branchlets \pm stout, variously fulvous-pubescent; staminate flowers 11-14 mm. long at anthesis; pedicels of carpellate flowers 8-32 mm. long, the corolla ca. 15 mm. long; fruits to 7.5 cm. in diameter.
 - 3. *D. kaki*.
- A. Plants often shrubs, sometimes small trees; leaf blades coriaceous, (1.4-)2.4-4.8 cm. long, subsessile; flowers appearing with the expanding leaves in spring; anther sacs dehiscent by short, apical slits; carpellate flowers lacking staminodia; fruits black.
 - 4. *D. texana*.

1. *Diospyros virginiana* Linnaeus, Sp. Pl. 2: 1057. 1753.

The American persimmon, common persimmon, simmon, or possum wood is native to a wide area of the eastern United States, from southern New England and Long Island south to southern Florida, and westward into eastern Iowa, Kansas, Oklahoma, and eastern



The fruits of the American persimmon (*Diospyros virginiana*) are an important item in the diets of many small mammals, including flying squirrels as shown here in a plate from Mark Catesby's *The Natural History of Carolina, Florida, and the Bahama Islands* (vol. 2, pl. 76, 1754).

The thick, "alligator-skin" bark of the American persimmon (*Diospyros virginiana*) is a good identification characteristic for the species as well as a noteworthy ornamental attribute. Photograph by R. E. Weaver.



Texas. Infrequent in southern New England, it reaches the northernmost limit of its natural distribution at Lighthouse Point in New Haven, Connecticut, but it is hardy further north and can be cultivated successfully throughout Rehder's Zone 4 (USDA Zones 5a and 5b). Common south of New England both east and west of the Allegheny Mountains, *Diospyros virginiana* is particularly plentiful in the southeastern states where it often invades fallow fields and forms dense thickets along roadsides, spreading by means of black, fleshy, stoloniferous roots. The trees usually grow in sandy, well-drained soils, but also occur in rich, wet soils of bottomland forests.

An extremely variable species over its wide range, known, for example, to have chromosome numbers of both $2n = 60$ and 90 , the American persimmon occasionally develops a shrublike habit, but generally is a small tree to 10 or 15 meters, rarely to 35 meters, often with spreading and pendulous branches. The bark, hard and of a brownish or blackish color, is irregularly and deeply fissured into small, blocklike plates, and resembles that of the flowering dogwood, *Cornus florida* L. Recognition of the species in winter is made easier by the characteristic bark pattern; the lack of terminal buds on the branchlets as well as the solitary bundle scars centered in the leaf scars are other useful identifying characters when the trees are leafless. Variation in plant habit, in the pubescence of the branchlets and leaves, in leaf size and shape, and in fruit size, shape, and color has provided characters on which several varieties and forms of

Diospyros virginiana have been based. Most of these taxa are of localized occurrence on the western and southern edges of the species range. A summary of these taxa is not given here, but has been presented elsewhere (Spongberg, 1977, pp. 154, 155).

The fruits of the American persimmon vary in size from that of a small cherry to that of a large plum (Sargent, 1894, p. 10, footnote) about 4 cm. in diameter, and in color from orangish to pinkish-yellow, often with a grayish bloom when ripe, to dark purple or bluish-black in f. *atra* Sargent. The fruits are an important food to many forms of wildlife, and opossums, racoons, and squirrels often strip the trees of any fruits remaining on the branchlets during the winter months. The fruits also were important food items to the Indians of eastern North America as well as to the first European settlers and explorers. Easily grown from seed, American persimmons were sent back to England and established in English gardens some time before 1629 (Sargent, 1894).

The Spanish explorer Don Fernando de Soto learned of the food value of the persimmon from the Indians of Florida in 1539 and probably was the first European to write about the fruit. In the next century, Captain John Smith, among others, took an interest in the *putchamins* of the Indians and likened them to medlars (*Mespilus germanica* L.), noting that "if it not be ripe it will draw a mans mouth awrie with much torment; but when it is ripe, it is as delicious as an Apricock" (quoted in Bailey, 1898, p. 172). The name *putchamin*, L. H. Bailey suggests, probably is a phonetic rendering of the Indian name for the plant.

Hedrick states that "of the several plants used by the Indians, two, the persimmon and sassafras, were of importance to the [colonists] of Maryland and Virginia" (1950, p. 115). European settlers in the southern states prepared a persimmon or simmon beer and used the fermented juice to distill an apparently very good brandy. In Pennsylvania, Isaac Bartram (1772) wrote a treatise on the preparation of persimmon wine. Persimmons also were eaten when ripe, or prepared in puddings, breads, or as preserves, while dried persimmons were stored and eaten as we eat figs and dates. The wood of the common persimmon has been valued for its hardness and density and has been used locally for innumerable items; it once was preferred for shuttles over any other American wood.

During the nineteenth and early twentieth centuries, considerable interest centered on the American persimmon as a potential orchard crop, and numerous cultivars, selected for fruit color, taste, size, and early maturation, were selected from wild populations and named. Lists and descriptions of many of these cultivars are included in the publications of Bailey (1925), Fletcher (1928, 1935), Troop and Hadley (1896), and Watts (1899). While interest in cultivars of *Diospyros virginiana* has continued to the present day, primarily in the Midwest (see the references by McDaniel, and Brooks & Olmo,

1972), to my knowledge American persimmons never have been grown successfully on a commercial scale. Undoubtedly, this in large part is due to the fact that the American appetite for persimmons is limited, and the California-produced oriental persimmons satisfy the current market demand. Nonetheless, local native and occasional cultivated trees help to satisfy those of us who enjoy our native persimmon.

Over and above its colorful small fruits, American persimmon is an attractive ornamental due to its graceful shape, its lustrous green leaves that turn scarlet in the fall, its adaptability to various soil types, and its general resistance to insect pests and diseases. Of considerable value to wildlife, American persimmon also has been suggested for planting in erosion control programs (Van Dersal, 1939).

2. *Diospyros lotus* Linnaeus, Sp. Pl. 2: 1057. 1753.

The date plum, *Diospyros lotus*, is very similar to the American persimmon in its morphology and may be the closest living relative of our native species. The two can be distinguished by the characters contrasted in the key above, but in all likelihood the date plum will be seen growing in North America only in botanical gardens and arboreta; no nurseries have been located that offer plants of the date plum, although at least one nursery offers seed. In the Old World, *D. lotus* is very widely distributed as a native, naturalized, or cultivated plant from southern Europe, the Caucasus, and Asia Minor eastward through the northwestern Himalayan region, and into China, Korea, and Japan. Cultivated since ancient times, the natural occurrence and original distribution of *D. lotus* no longer are possible to ascertain. In England and other areas of northern Europe, the date plum has been cultivated as an ornamental since the sixteenth century (Carder, 1975). In North America, the date plum is hardy at least as far north as the Boston area. It probably was introduced into North America when seeds were received at the Arnold Arboretum in 1884 from the Imperial Botanical Garden at St. Petersburg.

A small tree, usually with a rounded crown, that with age may attain 30 meters in height, *Diospyros lotus* is valued in Asia for its small, yellowish-brown to bluish-black fruits, which have a taste similar to dates and often are dried for winter consumption. The Chinese name for the species, *Ghae tsao*, signifies black date (Meyer, 1911). The fruits attain a diameter of about 2 cm., and those I have examined or eaten always have been almost completely filled with brown, oblong, and flattened seeds. Meyer (1911) reported a seedless type from China. The date plum is especially valued in eastern Asia as an understock onto which scions of the oriental persimmon are grafted.

Diospyros lotus grows, either as a native or naturalized plant, in rocky, protected ravines, along mountain streams, and on rocky



An old tree of Diospyros lotus approximately 26 meters in height growing at the foot of Fei-Yüeh-ling, Ching Chi Hsien, western Szechwan Province, China. Photograph by E. H. Wilson, August 3, 1908.

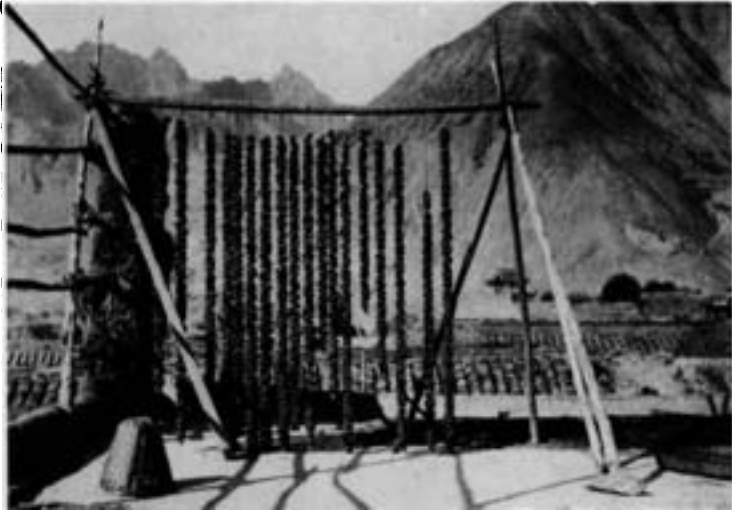
slopes. In Japan I saw a fruiting and healthy-appearing tree growing from a crevice in a rock outcrop on the Pacific Ocean beach at Matsushima. The date plum may prove of value as a small ornamental tree in coastal areas where salt spray limits the effective use of other ornamental species.

3. *Diospyros kaki* Linnaeus f., Suppl. Pl. 439. 1781.

The kaki, Chinese persimmon, Japanese persimmon, or oriental persimmon, with fruits sometimes the size of large tomatoes, is the persimmon that occasionally appears in American markets and abounds in markets in Japan, Korea, and China during the late summer and fall and into winter. Like the date plum, kakis have been cultivated for such an extended period of time that the natural species range has become totally obliterated. Grubov (1967), a Russian botanist, has suggested that the wild progenitor of the cultivated forms was native to northern China, while Rehder and Wilson (1916) state that *Diospyros kaki* var. *sylvestris* Makino, the reputed wild form of the kaki, with smaller, yellow, and often hairy fruits, is "abundant in the mountains of central and western China up to 4,000 feet altitude, where it forms a large tree 50 or 60 feet tall."

Due to the tremendous morphological variation exhibited by *Diospyros kaki*, botanists have questioned whether the cultivated forms might be of hybrid origin with two or more species in their genetic background (Hume, 1914). Other botanists have speculated that *D. kaki* might best be divided into more than one species (see, for example, Sargent, 1894, p. 4, footnote). In a recent article F. S. P. Ng (1978) suggests that domesticated kakis arose from *D. roxburghii* Carrière, a taxon of subtropical Asia that taxonomists often have included within *D. kaki*. Like *D. kaki* var. *sylvestris*, *D. roxburghii* differs from kakis primarily in its hairy fruits, and Ng asserts that it is possible "*D. kaki* [$2n = 90$, a hexaploid] arose directly from *D. roxburghii* [$2n = 30$, a diploid] through polyploidy, cultivation, and selection for smooth-skinned fruits."

That selection for differing fruit types has occurred is evidenced by the upwards of a thousand cultivars or forms of the kaki that are cultivated in Asia and maintained by ring-budding or grafting, primarily on date plum rootstock. Ranging in size from about 2 cm. in diameter, the size of a small plum, to about 8 cm. in diameter with a weight of over a pound, kakis can be astringent or sweet, seedless or seeded, and conical, round, flattened, or almost cubical in shape, and some cultivars have longitudinal or horizontal ridges or furrows. The 'Tamopan' or grindstone persimmon (Figure 1: j) is one of the bizarre forms, with an equatorial to near basal furrow, while the more regular, oblong-conical fruits of 'Hachiya' with rounded apices terminating in small, black, styler scars, are probably the most common kaki in American produce markets.



Above: Cords of peeled persimmons (*Diospyros kaki*) hung to dry in the village of Siku, Kansu Province, China, where the local name, Fang sze tze, signifies "square persimmon". Photograph by F. N. Meyer, November 16, 1914.

Sliced oriental persimmons (*Diospyros kaki*) drying on a wooden platform on a rooftop in the garden of Mr. Kim Chung-sok in Kwangyang, Cholla-namdo Province, South Korea. Photograph by S. A. Spongberg, October 12, 1977.

As noted previously, the astringency of persimmons is a variable character caused by tannins that, depending upon the cultivar, may or may not be present when the fruits are green and hard. Some forms never lose their astringency, even when soft. The tannin-bearing cells are scattered in strands throughout the flesh of the fruit, and the tannin is associated with a mucilage-like carbohydrate that coagulates and "absorbs" the tannin during ripening. Oxidation of the absorbed tannin causes the tannin-filled cells to turn red in some cultivars; the strands of cells are then easily distinguished (Condit, 1919). Kaki fruits are also very high in vitamin C and sugar content (glucose ca. 18%), the latter a variable character, like astringency, but have relatively low percentages of protein and fat (Condit, 1919). In Japan, hard, astringent persimmons were sometimes placed in used sake casks or tubs to ripen, and according to Rein (1889, p. 88) these "tub persimmons", which absorbed the flavor and perfume of the sake, were considered a delicacy. However, the Japanese apparently often ate the hard, unripened fruit, a fact that prompted Charles Sargent to observe that the kaki was "consumed in immense

Diospyros kaki. Top: Six small dried persimmons with the crystallized sugar from which small cakes are made locally. Obtained in Ssu shui, Honan Province, China, where the local name, Hui sze ping, is translated "boil-proof dried persimmon", referring to the fact that the fruit retains its shape even when boiled a long time. Bottom: One of the largest dried persimmons of China, most of the fruits measuring 10 to 11 inches in circumference. Formerly, fruits of this type were given as a tribute to the Imperial Court at Peking and sold at more than twice the amount paid for other varieties. The Chinese name, Ching sze ping, means "green dried persimmon". Photographs and notes by F. N. Meyer, April 21, 1914.



quantities by the Japanese, who eat it, as they do all their fruits, before it is ripe, and while it has the texture and consistency of a pavingstone" (1894a, p. 50).

Unlike Americans, who regard the kaki as a fresh fruit to be eaten when ripe or rarely frozen for later use, the peoples of eastern Asia for centuries have dried the fruits for storage and use during the winter and early spring months. The persimmons, either whole or sliced, and occasionally skinned, are dried in the sun until their flesh attains the consistency of a dried fig. I have seen sliced persimmons drying on wooden platforms on rooftops in Korea, while a photograph taken by Frank N. Meyer, Agricultural Explorer in China for the U.S. Department of Agriculture early in this century, shows the fruits strung on stout cords and suspended from a simple scaffold to dry in the sun and wind.

As they dry, or during a curing process after drying, sugar crystallizes on the surfaces of the fruits that are high in glucose content. By the time they are ready for storage or shipment, the flesh has turned blackish, and the sugar coating the surface is similar in texture to confectioner's or powdered sugar (S. Y. Hu, personal communication, and Meyer, 1915). Depending on the cultivar, the surface of the dessicated fruit may be evenly coated with sugar, or the sugar may appear in irregular scablike patches. Dried fruits, which become flattened if suspended on a cord while drying or which may be flattened mechanically after drying, are known as pressed persim-

mons; these are packed in boxes in Japan, while in China they often are stored on the cords. Dried kakis are eaten out of hand or stewed much the same way we stew dried apicots and prunes. In China they are a particular favorite during the New Year celebration in February. Once the spring rains begin and atmospheric humidity increases, the surface sugar liquifies, and the dried fruits no longer are considered edible (S. Y. Hu, personal communication).

Meyer's photographs also document another form in which the white, crystallized sugar is prepared for future use. In certain areas of China, the sugar is scraped from the surfaces of the dried kakis and compacted into thin, round cakes or loaves, while sugar of the highest quality is pressed into molds to produce ornamented tablets. The Chinese characters on the surface of the tablets photographed by Meyer (see page 306) signify "double happiness": couples engaged to be married often present these tablets to friends from whom they have received wedding gifts. The tablets of sugar also are served as one of the eight comestibles offered with tea during the first course of traditional Chinese banquets (S. Y. Hu, personal communication).

The kaki is grown in Asia for more than its edible fruits. Numerous medicinal properties have been attributed to different parts of the plants. The green unripe fruits of what in China is known as the oil persimmon, *Diospyros kaki* var. *sylvestris*, the reputed wild form of the domesticated kakis, are used to make a varnish oil that renders hats and umbrellas waterproof (Wilson, 1913, p. 73). In Japan, Shibu, a highly astringent, milky, light or dark gray fluid rich in tannin, is prepared from unripe kakis and date plums during the summer and is used to toughen paper, wood, and fishnets. It also is required in one stage of the complicated process of making fine Japanese lacquer work and in the preparation of sake and certain dyes. Rein (1889, p. 265) notes that in Japan the kaki is a favorite subject for bonsai.

Sir Joseph Banks, botanist on Captain James Cook's first voyage around the world, is credited with the introduction of *Diospyros kaki* into Europe, while the first trees of the kaki in North America probably were grown from seeds obtained in Japan by Commodore Perry in 1856. Likened by some to an apple or pear tree in size and shape, but with larger, lustrous green leaves that turn scarlet in the fall, when it is particularly handsome with its brilliant fruits, the kaki was considered by Sargent to be the most beautiful of any fruit tree of cold temperate climates. Knowing that the kaki is hardy in Peking, Sargent (1894a) speculated that it would be hardy in New England "if plants of a northern race can be obtained." Unfortunately, kakis, even some grown from seed obtained near Peking, never have survived in the Arnold Arboretum for longer than a few growing seasons. Young trees are growing on Martha's Vineyard, and beautiful old trees (one the 'Tamopan') growing at the Henry Foundation for Botanical Research attest to their hardiness in the Philadelphia area.



Above: A basketful of pressed dried persimmons (*Diospyros kaki*) offered for sale in a market in Peking. Photograph by F. N. Meyer, March 22, 1913.



Right: Square tablets of persimmon sugar obtained from the dried fruits of a variety with the Chinese name, Pen sze sse. The Chinese characters signify "double happiness". Photograph by F. N. Meyer, Peking, April 19, 1914.

According to fairly recent statistics (U.S.D.A., 1975), cultivation of kakis for the American market is totally confined to California, where on the average only 1,910 tons (compared with 20,000 tons for dates and 112,000 tons for plums) were harvested annually between 1970 and 1974. We hope that seeds collected from persimmons in a very cold district of Korea during the Arnold Arboretum collecting trip in 1977 will provide at least one reliably hardy strain for New England.

4. *Diospyros texana* Scheele, *Linnaea* 22:145. 1849.

Unlike the carpellate flowers of the American persimmon, the date plum, and the kaki, carpellate flowers of the chapote, black persimmon, or Mexican persimmon lack sterile stamens or staminodia. Moreover, the flowers appear on the branchlets of the previous year's growth, and the anthers of the staminate flowers open by short, apical slits, while those of the other species dehisce by longitudinal slits that continue down the entire length of the anther. These dif-

ferences help to distinguish *Diospyros texana* from the other species of the genus and were considered by John K. Small of enough significance to merit placing *D. texana* in a separate, monotypic genus, *Brayodendron*. However, most botanists have continued to regard the chapote as a unique species of *Diospyros*.

The chapote further differs from the other species discussed in this article in its shrubby, often many-stemmed habit, although it may develop into a single-stemmed, twiggy tree that occasionally reaches 25 meters in height. The bark of the chapote also is distinctive; it is smooth, light reddish-gray or reddish-brown, and the outer layers exfoliate in irregular sheets, exposing the smooth, gray, inner bark. In appearance, it is reminiscent of the mottled bark of the crape-myrtle (*Lagerstroemia indica* L.) and is one of the characters that recommend the chapote as an ornamental plant.

Native to the United States, the chapote is distributed in central and western Texas and ranges southward into the Mexican states of Coahuila, Nuevo León, and Tamaulipas. Over its range it grows in rich moist soils of bottomlands as well as on dry rocky mesas and in isolated canyons. The small, hairy, black fruits mature to 2.5 cm. in diameter. When mature, they are sweet but rather insipid. They leave an "indelible black stain upon everything with which [they] come in contact" (Standley, 1924, p. 1127) and have been used by Mexicans of the Rio Grande Valley to dye sheepskins.

Sargent (1894, p. 12) notes that this species should prove valuable as a cultivated ornamental for its attractive, lustrous foliage, the interesting black fruits of the carpellate plants, and its mottled bark. It is recorded as cultivated in Virginia and in Pennsylvania, and although it has not yet proven hardy at the Arnold Arboretum, it may be hardy as far north as southern New England. Trials of *Diospyros texana* grown from seed collected on the northern edge of its range in Texas may provide plants hardy in Boston; seed would be gratefully received by the Arnold Arboretum staff for this purpose.

Eating Persimmons

The kakis I have found to be available in Boston markets should be fully ripe before eating; at this stage the fruit is soft to the touch over its entire surface, the skin is slightly loose and feels as if it could be slipped off the flesh, and the green calyx can be pulled off with relative ease. Likewise, my experience with American persimmons is that they should be equally as soft when eaten. Since all the American persimmons I have gathered have been filled with seeds, I have seeded them and used the pulp in persimmon pudding, served with heavy cream or ice cream. I mostly enjoy eating kakis out of hand, but the flesh can also be used in recipes for pudding, ice cream, and bread; I have always wanted to experiment with a kaki chutney.

While the kakis in markets usually are hard, they will ripen with

time at room temperature. But don't be too eager to bite into one or you may never be tempted again. It has been suggested that putting persimmons in a plastic bag with an apple will hasten ripening. Recipes using persimmons are not found in many standard cookbooks. The *Joy of Cooking* (Rombauer & Becker, 1964) includes recipes for ice cream, an exceptionally good pudding, and Japanese persimmon salad, and *Stocking Up* (Stoner, 1973) offers notes on freezing persimmon pulp for future use. The U.S.D.A. Farmers' Bulletin 685 (Fletcher, 1928, 1935) contains the widest variety of recipes for persimmon pulp, including recipes for bread, crumpets, griddlecakes, persimmon-peanut muffins, persimmon cake, pudding, ice cream and sherbet, persimmon taffy and fudge, and persimmon whip. Fletcher notes that "since heat makes the astringency . . . more apparent, it is always well to add one-half teaspoon of baking soda to each cup-full of persimmon pulp in all recipes where the fruit is subjected to heat" (1928, p. 22). The soda is not necessary if the fruits are completely ripe.

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Appendix: Nursery Sources for *Diospyros*

The following nurseries are known to me to have offered *Diospyros virginiana* plants in recent catalogues. Only one, Mellinger's Nursery, has offered both *D. virginiana* and *D. kaki*. Before ordering from any of the nurseries, written inquiry should be made to determine selling practices and availability.

Boyd Nursery Company, Inc., P.O. Box 71, McMinnville, Tennessee 37110

Brimfield Gardens Nursery, Rocky Hill, Connecticut 06067

Greenbrier Farms, Inc., 201 Hickory Road, West, Chesapeake, Virginia 23322

Hess' Nurseries, Inc., P.O. Box 326, Route 553, Cedarville, New Jersey 08311

The Home Nursery, C. S. Ingels & Sons, P.O. Box 148, Route 17, Lafayette, Illinois 61449

Mellinger's Nursery, 2310 West South Range, North Lima, Ohio 44452

The following nursery offers seed of *Diospyros kaki*, *D. lotus*, and *D. virginiana*:

F. W. Schumacher Co., Sandwich, Massachusetts 02563

These lists undoubtedly omit many nurseries that offer persimmon plants or seeds; their exclusion is by no means intentional.