PERSIMMONS FOR LOUISIANA'S CHILDREN - YOUNG AND OLD

II. UNDERSTANDING THE ORIENTAL PERSIMMON, *Diospyros kaki* L.

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This article is the second part of a compilation of information gathered on the persimmon. Part I dealt primarily with the American persimmon, *D. virginiana*. Part II is concerned primarily with the Oriental persimmon, *D. kaki*. This article is a revised and updated version of an (unpublished) compilation on the subject prepared in 1992. The information has been gathered from the published literature, from personal communication with researchers, authors and hobbyists, and from personal experience. Brackets [ ] enclose words added to quotations, background comments, and personal opinion of the author.

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1. INTRODUCING THE ORIENTAL PERSIMMON

Common Names. American: persimmon, Oriental persimmon, Japanese persimmon, Chinese persimmon, Asian persimmon, kaki persimmon, kaki, tame persimmon; Japanese: kaki, yamagaki; Spanish: caqui, persimmino; English: Sharon fruit (after the Sharon Valley in Israel).

The common name, "persimmon," is a corruption of the native-American name for *D. virginiana* L., in the Powhatan dialect (Algonquin of Virginia), which may have meant "dried fruit." It was first used by the colonial English for the wild American persimmon. In California and in the U. S. commercial market it is used for the Oriental persimmon.

Scientific Name. *Diospyros kaki* L. [1] (from the Greek: *dios* – divine, *pyros* – wheat; *kaki* - Japanese name for persimmon; L. – abbreviation for Linnaeus the Swedish botanist who first described the Oriental persimmon in Latin) is one of 175 or more species, mostly tropical, of the plant genus Diospyros belonging to the ebony family, Ebonaceae.

Two species which are native to the United States are *D. virginiana* L. in the eastern United States, and *D. texana* Scheele in Texas and northeastern Mexico. *D. lotus* L., native to China, is used commercially as a rootstock.

[1] In scientific names, the second part of the binomial is the specific epithet. The first name (always starting with a capital letter) is the genus to which the species has been assigned. The name or letter following the binomial identifies the scientist who first published the name along with a description of the plant in Latin. Once mentioned in an article the genus designation is reduced to one letter – as long as it does not cause confusion, e.g., *D. kaki*. In textbooks the binomial is printed in italics; on a typewriter it is underscored. The scientific name is universal. It does not change with language or local dialects, or with geographical regions as do common names.

The earliest name published of a new species, accompanied with a description in Latin is the valid scientific name. Names with Latin descriptions of previously described species (published at a later date) are considered synonyms.

Wild *D. kaki* trees with small seedy fruits do occur in China – and also in Korea and Japan where *D. kaki* culture was introduced. These wild trees, which include the descendants of escapees from cultivation, received the botanical subgroup name *D. kaki* var. *sylvestris* Mako (from the Latin: sylvestris - wild). In Japan, the common name is yamagaki or mountain persimmon.

Horticulturists recognize named **cultivated** varieties. These are usually registered, and along with a published description, are circulated in professional literature.

A cultivated variety (shortened to cultivar, abbreviated to cv.), called "variety" in the trade and in general conversation, consists of either a few trees, or thousands of trees that were asexually (vegetatively) propagated (cuttings, root sprouts, layering, grafting) from one original seedling. The individual trees of the variety 'Tanenashi' are actually ramets (branches) of one seedling. In botanical classification it is written: *D. kaki* cv. 'Tanenashi'.

Origin of The Species. The ancestor of *D. kaki*, if it still exists in the wild, remains a mystery. The species, *kaki*, was described from material collected in Japan, which is not the place of its origin.

One hypothesis is that *D. kaki* may have originated from *D. roxburghii* (*D. grandulosa*), a wild species in the forests of Assam (northern Bangladesh) to Indochina (Vietnam) (Smith, in Simmons 1976 pp 306-7). This hypothesis of phylogenetic relationship has not been supported by DNA testing (R. Yanemari, et al.).

Could it be "a mixture of two or more species, hybridized and grown under cultivation for centuries?" (Hume 1914 p 403). [The question mark makes this an innocent speculation.]

Ancient Trees and Cultivars. Kaki trees can be long lived. In China *D. kaki* on *D. lotus* rootstocks produce large trees of an indefinite length of life (Camp & Mowrey 1945 p 25).

"In Japan . . . one variety, Zenjimaru, has been cultivated for at least 770 years. Trees 200 to 300 years old exist in Japan" (T. Chino, translation, 1984).

In Oomachi, Kagami-cho, Okayama Prefecture is the oldest persimmon tree in Japan – a grafted specimen of the cultivar 'Saijo', estimated to be 600 years old. It is 65 feet in height and 16 feet in circumference at chest height (Cottage & Gleichenia, 1987 p 15 & fig. 15). The original tree of 'Hiratanenashi' in Niizu, Niigata Prefecture is about 300 years old, and is still productive (ibid. p 4 & fig. 4).

History and Geography. The Oriental persimmon is native to southern China where it has been cultivated for at least 2,000 years. Under cultivation and through seedling selection, reseeding, and reselection over the centuries, the species has been adapted northward into northern China, and on into Manchuria and Korea. By 800 A.D. (1200 b.p. (before present) it was introduced into Japan, where it flourished. "The kaki . . . was the most widely grown fruit in the Orient until the twentieth century when apples became popular" (Reich 1991 p 75).

By the end of the 19th century, the Oriental persimmon had been introduced into other warm climates of the Northern and Southern temperate zones, i.e., the Mediterranean area, the southern United States, Australia, New Zealand, southern Brazil, and India.

Following Commodore M. C. Perry's visit to Japan in 1856, persimmon seeds were introduced into the United States and planted at the Naval Observatory in Washington, D.C. The seedlings subsequently froze. And such was the fate of later seed importations in the 1860s (Camp & Mowrey 1945).

Starting in 1870 grafted trees of select cultivars were introduced by the U. S. Department of Agriculture, primarily from Japan. A persimmon orchard was established at Chico, California. Other orchards were fostered in Florida, Virginia, and elsewhere.

Several seedless forms were collected from the persimmon regions of China by plant explorer, Frank Meyer, including 'Tamopan' from the province of Chihli [now Hopeh] (Fairchild 1938 P 338).

Individuals, *including Japanese* immigrants in California, began to import grafted trees directly from nurseries in Japan, a

practice that continued until the adoption of the Federal Quarantine Act in 1919. By special permit issued by the Bureau of Plant Quarantine (a privilege, not a right), fruit trees can still be introduced today by individuals.

Florida has been a leading state for cultivar introductions and evaluations. Hume (1914) noted "large introductions from China, Japan, France, and elsewhere." Miller and Crocker (1992) noted that during the 1960s and 70s, Judge Ware and Dr. Robert Dustan imported and evaluated many important Japanese cultivars. Professor Ralph Sharpe with the University of Florida, tested, evaluated and published additional information. Further, during the 1980s newer cultivars, especially non-astringent types, were introduced and studied in the Department of Fruit Crops at the University.

Commercial Production. Outside the far east, only modest commercial plantings exist today in the United States, Italy, Israel, New Zealand, Australia, Brazil, and, more recently, Chile. The Oriental persimmon has not found a large demand in the overcrowded American fruit market.

In many cases, especially early in the 20th century in the United States, persimmon fruit production was poor because it was not-understood that some cultivars needed pollinator trees. Early orchard production started in California, and to a lesser extent in the South. Persimmons encountered marketing difficulties in the South.

Before World War II, California production was dominated by the astringent cultivar 'Hachiya', which produced abundant seedless fruit and good crops without pollinator trees. Bearing acreage in California, listed at 140 acres in 1919, rose to a high of 1878 acres in 1932, then began to decline, dropping to 701 acres by 1950 and down to a low of 430 acres by 1968 (see figure 1) before it began to increase. The new plantings were of the non-astringent varieties of the fuyu-type. Acreage had increased to 2479 harvested acres by 1996.

It is apparent that this rise and fall and rise again is associated with the number of old-country-born Asian residents, which in turn reflects changes in the United States immigration policies.

Fig. 1. California Persimmon Acreage 1919-1969. From: California Department of Food and Agriculture, Division of Plant Industry, Plant Pest Detection Manual D.T. 4-19, 1971.

Home or Dooryard plantings [2] extend from central Maryland and coastal Virginia southward to mid Florida and westward across southern Arkansas to Texas, – and on the Pacific Coast, California into coastal Oregon. In Maryland tests conducted have lead to the recommendation of a few cultivars that are adequately cold resistant to extend plantings into USDA Hardiness Zone 7a, the northern part of Zone 7 (see map in Figure 2).

[2] Dooryard - a colloquialism used in some parts of the South, including Florida and Louisiana, for plantings near the house, or in the lawn near the residence.

From 1900 through 1955, dooryard plants were dominated by three varieties: in the Southeast by the astringent 'Tanenashi' and the non-astringent 'Fuyu[3]'; and in California by the astringent 'Hachiya' and non-astringent 'Fuyu.' Today the home gardener has a wide range of cultivars from which to choose, some of which are superior to the old standbys.

Interspecific Hybrids. In theory the basic number of chromosomes in the ancient ancestor of persimmons is 15. Thus the formula for the diploid plant (i.e., a plant with two complete sets of chromosomes, one set from each parent) would be 2n = 2x = 30. *D. kaki* is a 90-chromosome species, a hexaploid, having received three complete sets of chromosomes from each parent, the pollen parent and the seed parent. Thus, the formula for the Oriental persimmon is 2n = 6x = 90. *D. virginiana* has a 60-chromosome race and a 90-chromosome race, or tetraploid and hexaploid races, neither of which can pollinate the other. The formula for the American persimmon is 2n = 4x,6x = 60,90 (P.M.Smith, in Simmons 1976 pp 306-307).

"The two species (*D. kaki* and D. virginiana) are cross-incompatible hybrid seed, development being arrested in an early age" (ibid.). J. C. McDaniel's attempts at hybridizing *D. virginiana* x *D. kaki* and E. Griffith's attempts with reciprocal cross-pollinations, i.e., *D. kaki* x *D. virginiana*, yielded a few apomictics (asexually produced seedlings) showing characteristics of only the seed parent (Griffith & Griffith 1982 p 118 - cited henceforth as G&G).

Successful hybrids have been claimed, one in the United States and one or more in the Crimea of Russia.

Diospyros cv. 'Kawakami', reported to be a hybrid of *D. virginiana* x *D. kaki* originated near Dennison, Texas (note: the female parent is always mentioned first). Some investigators consider it to be a large-fruited American persimmon (McDaniel 1974 p 60).

Diospyros cv. 'Rosseyanka' "is one of several Russian hybrids of *Diospyros kaki* x *D. virginiana*." Fruit is slightly larger than the largest *D. virginiana*, weight averaging 2.24 ounces, color is light orange to red-orange, seed averaging one in a group of seven fruit. Flavor is that of kaki. A grafted tree is now being grown in Terre Haute, Indiana, 500 to 1,000 miles above the northern limits of kaki (Lehman 1999).

2. ECOLOGY BACKGROUND

Ecology. As defined by Blackmore (1984 p 112), ecology is "the study of the relationships between living and nonliving factors in the environment." These factors set the limits for a species and for each of its varieties. A cultivar's range of adaptability is fixed by its genetic code. But the species, open to generations of sexual reproduction, encountering gene mutations and genetic reshuffling, can adapt to a broader range, or even to a different range.

Diospyros is basically a tropical genus in which some species have adapted to temperate climates. Man, over the last two millennia of selection and reselection, has adapted *D. kaki* to serve mankind and has extended its culture northward out of south China.

Cold hardiness. Information as to the northern limits of the Oriental persimmon in the United States is variable.

"The trees of some varieties at least are moderately resistant to cold, surviving in all parts of California except the rather high mountains and as far north as parts of Virginia in the Atlantic coast region, as far north as southern Arkansas in the Mississippi Valley" (Chandler 1957 p 412).

"The northern limit for reliable culture in Maryland is Southern, Central, and Eastern shore. Cultivars noted were 'Great Wall', 'Giboshi', 'Kyungsun Ban-Si', 'Tecumseh', 'Peiping', Tamopan', and 'Yamagaki', -the latter being a pollinator" (Shanks 1995 p 17).

[3] In the early days there were two or more look-alike non-astringent cultivars propagated and sold under the name Fuyu, – at least one of which produced fruit with an occasional seed. Fuyu translates to "winter".

“Oriental persimmon trees are hardy from southern Pennsylvania, south to northern Florida and westward to central Texas,” . . . and on the west coast, California and up into coastal Oregon (G&G 1982 p 3).

In the Southeast severe damage can occur from an early hard freeze in the fall, a late hard freeze in the spring, and also, from warming trends in the winter followed by freezing temperature. The more succulent the growth, or the more active the cambium at the time of the freeze, the greater the susceptibility to freeze injury.

BACKGROUND NOTES

Ecology study-aids. Maps of temperature zones have been published. The objective of each is to serve as a tool in predicting performance of plants in different geographical locations in the United States. Attention is called to three types of maps briefly noted here. Of the three, the first has been the most widely reproduced. It is referred to when recommending nursery cultivars for the South. All three are mentioned here to serve as trivia available for later deep thinking during the process of developing insights.

USDA Plant Hardiness Zone Map (Fig. 2) first published in 1930 by horticulturists, then revised by the U. S. Department of Agriculture in 1965 and again in 1990, is based exclusively on “average annual minimum temperatures,” the average of the lowest minimum temperature recorded for each year. For the 1900 map the years were 1974 through 1986. The map is printed in black and white and IN COLOR in the USDA Agricultural Research Service Miscellaneous Publication 1475 (not-copyrighted).

The 46"x46" color map, encompassing Canada, Mexico and the United States is more detailed, showing county lines and subzones A and B of zones 2 through 10. A 5-1/2"x6" version of the Hardiness Zone Map is available at the USDA Agricultural Research Service’s National Arboretum site on the internet, found at www.ars-grin.gov/ars/na/hardzone/ushzmap.html. [A 3"x4-1/2" version limited to the contiguous 48 states and showing subzones has been printed in Burpee’s catalogs.]

Fig. 2. USDA Hardiness Zone Map (1990) for the contiguous 48 states.

The original intent was to draw lines that would help predict the northern geographical limits of perennial species and varieties. The zone designations have nothing to do with the length of winter, neither with lateness of killing frost in the spring or earliness in the fall, nor with other climatic factors.

It is known that in addition to cold tolerance, heat tolerance can be a limiting factor. Some catalogues and books have adopted the map as an aid to buyers, listing both ends for each bulb or tree cultivar, the cold and the hot, e.g., Zones 7-9 (zones 7 through 9). Beyond these included ranges the buyer should be discouraged.

The printed range recommendations should not be taken as gospel, as in “It is written!” for three reasons:

First, the different publications do not always agree in their recommendations;

Second, references printed prior to 1992 will be referring to the 1965 edition of the map. In the 1990 version, Zone 8 has slipped ½ a zone southward when compared to the 1965 map, indicating that in the Southeast the average annual minimum temperature is 5 F^{O} cooler.

Third, microclimates are found within each zone. Many factors such as sun, wind, rainfall, snow cover, slope (facing N or S) and natural or artificial protection (windbreaks, lakes, cities, large buildings) create changes in climate within a few square miles, a few acres, or a few square yards, thus allowing survival (e.g., winter-killed out in the open, survived under pines; also, bougainvillea and jacaranda, both Zone 10, will survive and bloom outside in the south-facing cove of the California state capitol building located in Zone 9b, but not in a duplicate north-facing cove).

American Horticultural Society PLANT HEAT ZONE MAP of the United States (copyrighted) is available in full color. To purchase a durable 2 x 3 foot poster, call (800) 777-7931 ext. 0. Have your credit card ready. Price $14.95 as of June 1999. A 3-1/4"x5-1/4" miniature in color can be found in the last pages of "The American Gardner," the magazine of the American Horticultural Society (AHS).

"The 12 zones of the map indicate the average number of days each year that a given region experiences 'heat-days' -- temperatures above 86 degrees (30 degrees Celsius). Eighty-six degrees Fahrenheit is the point at which plants begin to suffer physiological damage from heat" (AHS). The bulk of Louisiana is in heat-zone 9 (121-150 heat-days). The extreme south coast and patches in northwestern and northeastern Louisiana are in heat-zone 8 (91-120 heat-days).

Heat units affect fruit quality. "In South Florida fruit quality is better with astringent types than with non-astringent ones." "Non-astringent varieties require more heat units to reach full flavor than astringent ones" in California. "We find that many nonastringent persimmons, such as 'Suruga,' do not receive enough heat to ripen high quality fruit nor are they sufficiently winter hardy for Maryland."

A Degree Day Map [4] was published in an Agricultural Extension Circular giving the heat zones within California's grape growing areas. The objective was quality production of wine grapes through recommendation of cultivars suited for each heat zone. The old circular is out of print.

The temperature at which biological activity was stimulated within the grape buds, 50 ^{O}F, is the standard temperature. Thus for grapes, 10 days averaging 51 degrees each day, or one day averaging 60 degree, equals 10 degree days (10 ^{O}D). The degree day (^{O}D) technology is still evolving and is not only concerned with variety adaptation but also with integrated pest management (IPM).

OBSERVATIONS

Winter chilling. "Many persimmons do not fruit well in extreme southern Florida where there is little winter chilling" (Crocker & Andrews 1984 p 4). Whereas the tolerance to minimum temperatures may mark the northern survival limit of a cultivar, it is the winter chilling, i.e., the rest period, the number of hours below a designated degree Fahrenheit, that may mark the southern limit of satisfactory quality production of a specific cultivar.

The required hours-of-chilling is apparently minimal when compared to other deciduous, temperate zone fruits. In Japan the commercial exploitation of Oriental persimmon is greatest in the agricultural zone between apples and citrus. In the southeastern United States the best climate range is the cotton belt.

D. lotus, which is used only as a rootstock outside of China, has a considerably greater chilling-hour requirement than kaki. The requirement of this rootstock species from north China is nearly as great as Elberta peach (Chandler 1957 p 409).

Climate and cultivar types. The quality production of non-astringent persimmons is more restricted by climate than astringent.

[4] Degree-day: one degree of deviation, on a single day, of the mean temperature from a given standard temperature: five degrees above or below the standard temperature would be recorded as five degree days. – The Random House Dictionary of the English language, unabridged 1969. ^{O}D is the current abbreviation used in agriculture.

"Astringent varieties are better suited to colder areas and can be grown anywhere in Japan where the annual average temperature is above 10 degrees Centigrade [50 ^{O}F] and where the average is 16 ^{O}C [60.8 °F] or more from April through October. Sweet, non-astringent varieties, can be grown in virtually every part of Japan where the annual average temperature is 13 degrees (55.4 ^{O}F) or above, with a 19-degree average [66.2 ^{O}F] during the period between April to October . . . In the warmer parts of Kyushu the quality becomes somewhat coarse" (T. Chino 1984).

"In cooler parts of Japan, . . . fruit of non-astringent cultivars is not completely free of astringency at maturity." Japanese experiments "with potted young 'Fuyu' grown at 15, 25, or 30 ^{O}C [59, 77, 86 ^{O}F] during the fruit growth stage I (22 June - 6 August) have shown that the higher the temperature, the lower the content of soluble tannin in fruits." When the experiment was continued until the end of fruit growth stage II (24 September), fruit grown at 20 and 15 ^{O}C [68 & 59 ^{O}F] contained some soluble tannins. In comparison, soluble tannins had disappeared by 5 August at 30 ^{O}C and by 19 August at 25 ^{O}C (Kitagawa & Glucina 1987 p 57).

"Non-astringent varieties require more heat units to reach full flavor than astringent varieties." "The same variety planted in the Central Valley will reach optimum maturity several weeks later in San Diego County, California" (Claude Sweet 1987).

"In south Florida fruit quality is better with the astringent types than with the non-astringent ones" (Miller & Crocker 1992 p 1). [Think of this in terms of the American Horticultural Society Plant Heat Zone Map.]

Latitude. Height of cultivars in Florida becomes shorter as they moved southward (Ibid. p 3).

Rootstock. [5] "Since Oriental persimmons are propagated on heterozygous native persimmon, bud break times among many trees of the same cultivar will vary" (Miller & Crocker 1992 p 12). "Type of rootstock and certain physiological and environmental conditions may also affect ripening times" (Ibid. p 3). [The qualifying key word is "may."]

Certain virginiana rootstocks start growth in Ocean Springs, Mississippi around March 10; others bud out about April 6. Grafting kaki on late-budding virginiana rootstock avoids late-freeze damage (Sharpe 1993).

In China kaki and lotus rootstocks produce large trees of indefinite life, but in the South a commercial planting on virginiana stock seldom exceeds 10 years (Camp & Mowrey 1945 p 24). [10 years? This 1945 observation needs to be reevaluated.]

Shade. Twigs and small branches that have been shaded may be shed by dying at their junction with the larger branch during the winter. The amount is small compared to native American persimmons. Fruit drop just after flowering is a natural reduction. Natural thinning after initial fruit set may be up to 75%, and higher with an overload or when too shaded.

3. KAKI DESCRIPTION AND CULTIVAR GROUPINGS

Description. *D. kaki* is primarily a domesticated species. Although wild kaki trees occur in China, and "wild or naturalized trees occur widely distributed in northern Korea and on the three southernmost islands of Japan," (Knight 1979, in G&G p 123) man is primarily concerned with cultivars for either commercial or dooryard plantings, plus prized seedlings and sports (mutations) perpetuated by their proud owners. A useful description would call attention to the range of variation displayed by the cultivars, the unique variations to be encountered, and where appropriate, an explanation of the groupings of the cultivars.

Tree. Cultivars vary from short to tall, generally 20 to 40 feet at maturity, and from columnar to spreading in shape. They drop their leaves in the fall (deciduous), with the late ripening varieties displaying fruit on bare limbs.

In general, most cultivars are either monoecious (bearing functional male and female floral parts in different flowers on

[5] For brevity in writing and in conversation the three rootstock species, *D. kaki*, *D. lotus*, and *D. virginiana*, will be referred to as kaki, lotus, and virginiana.

the same tree) or dioecious (bearing the functional male flowers and functional female flowers on different trees). The rare exceptions are three known monoecious cultivars and some dioecious male seedlings that bear a few perfect flowers (male and female parts functional in the same flower). Pollination is by insects. Black native bees are the most common pollen carriers.

Harvest season timing and length of ripening period varies between cultivars. Ripening may start in late summer (late August) or may be delayed until late fall. The harvest may last only a few weeks for one variety or may extend over a two-month period for another. Limbs are brittle and may break when overloaded.

Upon being wounded, kaki does not produce the copious gumming (a defensive reaction) characteristic of *D. virginiana*.

Bark. The bark on young trees is grey to dark grey and cracked by shallow, wavy longitudinal grooves.

Wood. Yellow, close grained, and comparatively heavy.

Root. Jet black on the surface with yellow porous wood below. Seedlings produce a strong taproot with few fibrous roots.

Leaves. Simple without stipules, smooth edged, oval-elliptical, 2 to 7 inches long, leathery with a slight upward cupping, dark glossy green above and lighter green below, smooth above and below, with some cultivars showing a light fuzz along the large veins on the lower side.

A display of autumn foliage may occur, the colors varying with the cultivar from bright yellows to clear oranges, light pinks to fire engine reds. Only a few cultivars will express good fall coloring in the coastal South.

Twigs. New twigs are first green, with short light fuzz on the surface, changing to brown or reddish-brown as they mature. Leaves are arranged alternately along two sides. *The terminal bud is missing*.

Spring flowering twigs arise from the bud farthest out and the 2 or 3 succeeding buds on the well-matured wood of last season's growth. Within these plump buds the initials of this year's flowers were set during last year's late summer.

Flowers are commonly unisexual, either female (pistillate) or male (staminate), but are rarely perfect, i.e., both male and female parts present and functioning. Male and female flowers are easily distinguishable.

Female flowers are borne singly. They have a cup-in-saucer type of formation. The greenish white corolla tube (4 petals united into a cylinder), with 4 reflexed lobes at the upper edge, and 8 (some cultivars have 4) aborted stamens attached on the inner surface, sits in a prominent 4-lobed saucer-shaped green calyx (4 sepals united), with calyx lobes flared outward from the corolla base. The female corolla is shed as a *cylinder open at both ends*. The calyx remains behind attached to a stem arising from the twig at the base of a leaf. There is a pair of strap-like stipules on the flower stem, at least during the early bud stage.

Male flowers are borne in a cluster of usually three flowers on a branching stem with the oldest flower at the apex (a cymose inflorescence). The cyme is attached to the stem at the base of a leaf. The male flower is similar to, but slightly smaller than the female flower. It has functional stamens (with pollen) attached on the inner surface of the corolla tube. Female parts are aborted. The calyx is reduced and clasping, with the calyx lobes pressing against the corolla. Each flower on the cyme opens at a different time, the oldest flower (the apical flower) first; later breaking off just below the calyx, thus the flower falling intact, – *the calyx attached to the corolla and closing the bottom of the corolla tube.*

NOTE: Seeds present in the fruit indicate male flowers are being produced on either the tree with the seeded fruit, or a nearby tree. To detect male flowers the next spring, black plastic sheeting can be placed under the trees. Among the corollas, open at both ends, the intact male flower is easily recognized by the presence of the calyx. After male flowers are seen, the tree can be searched for a branch bearing male flowers.

Detection of a rare perfect flower would be more difficult. It is presumed that one would be looking for a corolla open at both ends and showing the presence of pollen on the stamens attached to the inside wall.

Fruit. The fruit is a berry, to which the persistent calyx remains attached. Mature fruit of the different cultivars range in

diameter from 1.2 to 4.1 inches and contain zero to 8 large, hard, flattened, elliptical, brown seed. Fruit ranges in shape from flattened to globose to conical to elongated conical, and smooth to grooved to lobed. Thickness of the fruit skin varies among the cultivars.

Developing fruit is green in color and astringent before maturity; becoming bright colored at maturity, with color varying from yellow through shades of orange to red. Flesh color is yellow to yellow-orange to burnt orange, and in some cultivars becomes cinnamon to dark chocolate if seeds are present.

Persimmon fruit continues to ripen after harvest. They become edible when mature but still firm in some cultivars, while in others must be soft ripe before the astringency is lost. The fruit flavor may range from lacking to delicious. Flesh of astringent types varies from completely dry and pasty, to jelly-like, to almost a watery soup.

Each seed of soft ripe fruit is surrounded by a gelatinous mass that makes it easy to slip down the throat of the consumer, be it man or animal. SMALL CHILDREN BEWARE. Large fruit sizes often produce large seed.

Pollination is absolutely required for seed production. If there are no male flowers in the orchard or vicinity, the fruit that is formed will be seedless.

Alternate bearing, i.e., a heavy crop one year followed by a light or no crop the next, is characteristic of some cultivars that tend to bear too many fruit. With overloading, the energy is utilized for fruit production leaving little energy for new growth, the new growth that will bear next spring's flowering twigs.

CULTIVAR GROUPINGS. Varieties have been separated into groups based on tree sexuality, on fruit edibility when mature but firm, on flesh color change when seed are present, and a few miscellaneous categories. These characters are used when describing a particular cultivar.

Tree sexuality. Based on the flowering habit of the individual cultivar, Professor Hume (1914 p 404) of Florida designated three classes: (1) Staminate Constants – monoecious trees "which bear staminate flowers and do so regularly every time the tree blooms," (2) Staminate Sporadics -monoecious trees "which produce them [staminate flowers] one season and not another, in fact are very irregular in this particular," (3) Pistillate Constants – dioecious trees "which produce only pistillate flowers." [The dioecious male was not mentioned.] "It is . . . impossible to determine the flowering habit of any variety until it has been under observation for a number of years" (Ibid. p 406).

Staminate Sporadic would include the light male flowering that sometimes occurs in 'Fuyugaki' (Miller 1984 p 343).

"In general, kaki plants show many types of sexual expression. Most of the important cultivars . . . are dioecious and differentiate female flowers. Fuyu and Jiro need pollinators because of their low parthenocarpic ability . . . [some] are monoecious, and set both female flowers and male flowers. These are used as pollinators. trimonoecious cultivars [we assume this means cultivars which set male flowers, female flowers, and perfect flowers] are also recorded, [such as Shogatsu, Meotogaki, and Ama-Yotsumizo . . . Androdioecious seedlings are also found which set male flowers and perfect flowers" (Kajiura 1982 in G&G p 128).

Parthenocarpy is the production (without fertilization) of seedless fruit, which apparently is of no benefit to the plant in the wild. It is exploited by man. There are varieties that have a strong parthenogenic tendency, e.g., 'Hachiya', 'Tanenashi', 'Triumph'. The cultivar 'Fuyu' will set a crop of parthenocarpic fruit, but will set a heavier crop if pollinated. There are some cultivars that have little or no natural tendency for parthenocarpy. These must have a pollinator in order to set a crop. 'Hiratanenashi' sets few seed even if pollinated.

Induced parthenocarpy. Some cultivars must be pollinated to bear fruit. In Maryland, in the absence of pollen, some cultivars (not all) have been induced to set parthenocarpic (seedless) fruit by spraying blossoms with 25 ppm (parts per million) of gibberellin (Shanks & Newel, HRB1; Popenoe 2000). A little wetting agent is added to the spray. [For a local sales outlet for gibberellic acid in the South, contact your local camellia hobbyist.]

Astringent and Non-Astringent fruit. All persimmons are astringent (cause the mouth to pucker) when green in color. Astringency discourages animals from eating the fruit before the seeds are ripe. As fruit approach maturity the green color

disappears on the surface and the soluble tannin [6] in the flesh becomes bound up and inactive. Cultivars vary in the amount of tannin and the timing (the maturity) at which they lose astringency and become edible.

The Japanese separated the varieties into two groups - Astringent and Sweet. *Astringent* (A) – flesh not edible until soft ripe, and Sweet (or *Non-Astringent*, NA) – flesh edible when mature and still firm. The latter is also edible when soft-ripe.

Pollen Constant and Pollen Variant. Hume (1914) observed in Florida that some cultivars were astringent (A) when seedless, and non-astringent (NA) when seed were present due to successful pollination. Also, the flesh of the fruit of some cultivars turned dark brown to black around the seed, while others with seed remained light colored. "In the final analysis the flesh color is fixed by the pollination factor" (Ibid. p 400). The terms chosen were Pollen Constant and Pollen Variant, even though it is the presence or absence of seed that is the determining factor. Thus, the two groups: (1) *Pollen Constant* (PC) – flesh remains light-colored whether seed are present or not, e.g., 'Fuyu', 'Hachiya', 'Tanenashi', 'Tamopan'. 'Triumph', 'Tsiri', and (2) *Pollen Variant* (PV) – flesh remains light-colored if no seeds are present (unpollinated), but flesh is dark-colored if seeded (pollinated).

"One important quality of PV cultivars is that the dark-fleshed fruit (from pollinated flowers) is never astringent, and light-fleshed fruit (from unpollinated flowers) is astringent until it softens" (Knight, in G&G p 124). Caution: if one side of a PV cultivar is seeded and dark-colored and the other side is seedless and light-colored, the light-colored side is astringent and will remain so until soft-ripe. [7] The dark flesh is edible; it is not rotten.

A new clone cannot be properly classified if never exposed to a pollinator. The pollen-variant darkening of the flesh will only be encountered if there is a nearby tree that produces male flowers.

Combination of Classes. By combining the two groupings above (NA & A with PC & PV) one can have the four groups, PCNA, PCA, PVNA, and PVA, used by T. Chino (1984). [8]

	NA	A
PC	PCNA	PCA
PV	PVNA	PVA

Based on firm mature fruit, Chino's definitions are:
(1) Pollination Constant, Non-Astringent (PCNA) – sweet, regardless of pollination (seed production), with few if any brown lumps. The main varieties of PCNA are `Fuyu`, `Ichigike Jiro`, `Maekawa-Jiro`, `Matsumoto-wase-fuyu`, `Izu`, `Suruga`and `Goshio`.
(2) Pollen Constant, Astringent (PCA) – Astringent, regardless of pollination (seed production), with no brown lumps. The main varieties are `Yokono`, `Saizo`, `Yotsumizo`, `Ichidagaki Hachiya`.
(3) Pollen Variant, Non-Astringent (PVNA) – When pollinated (having seeds) and with substantial brown lumps around them - sweet; when without seeds - astringent. In some fruit where there are just a few seeds, brown lumps result in partial astringency. Main varieties are 'Nishimurawase', 'Zenjimaru', 'Amahiyakume' and 'Mizu'.
(4) Pollination Variant Astringent (PVA) – Astringent, this group produces seeds and has brown lumps around them in quite small limited areas. Main varieties are 'Hiratanenashi', 'Aizumishirazu', 'Koshu Hiyakume', 'Yamato Hyakume' . . . .

Personal experience with pollinated PVA group is lacking. Observations are needed in local varietal collections that have strong pollinators scattered among them, plus a clear identification of the cultivars. (See later: cultivar identification confusion.) For the present we must use the experience and evidence gathered by the authors. [9]

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[6] Tannins are a loosely defined group of phenolic chemicals that have the ability to bind protein molecules together. The one identified in the Oriental persimmon as causing astringency is called kaki-shibu or kaki-tannin, which is the chemical leucodelphinidin.

[7] There is a simple, though crude, chemical test for astringency. Moistened filter paper with a five percent solution of ferric chloride and hold it against the cut half of a persimmon. The more intense the color of this indicator, the more astringent the fruit (Reich 1991 p 82).

[8] Chino, T. 1984. A typewritten translation in NAFEX Library, Kaki file.

[9] 'Hiratanenashi', listed as PVA above and by Ryugo 1994 p 8, is listed as PCA by Kitagawa & Glucina 1987 p 4 and by Reich 1991 p 90. Is this a judgment call?

Now once again, the combinations. According to Kajiura (1982, in G&G p126) within the pollen variant groups: "The natural breakdown of astringency is closely related to seed formation. . . When the number of seeds is few, breakdown is localized to the flesh only around seeds. . . This group is divided into the two following types:
a) Pollination variant non-astringent type: The degree of breakdown is high.
b) Pollination variant astringent type: The degree of breakdown is low. In general, pollination constant and variant non-astringent types are called nonastringent kaki, and pollination constant and variant astringent types are called astringent kaki."

Placement of some of the pollinated PV cultivars may require a judgment call.

Commercial Astringent/Non-astringent. "In most areas of the world astringent pollen variant types, which have a great degree of dark flesh, are classified as non-astringent cultivars. However, typically in Florida, these persimmons are grown without pollinators and their seedless astringent fruit necessitates classifying them as astringent types" (Miller & Crocker 1992 p 1). Neither seeded nor dark fleshed fruits are marketed. Thus, the PCNA cultivars supply the non-astringent market. All PV cultivars are sold as astringent seedless fruit.

Commercial Fuyu. FUYU has become the trade name for the non-astringent fruits produced in orchards – which includes 'Fuyu', 'Suruga', 'Jiro' and others of the PCNA group, just as sweet potato growers have usurped the name "yam" for the baking-type sweet potato cultivars.

Fruit size may be classified by weight or measurement: small, 3.5-4.6 oz.; medium, 5.6-6.1 oz.; large, 6.7-8.8 oz. (Miller, 1984). Fruit 2-1/2 inches across is classified medium, 3 inches is large (Reich, 1991 p 89). Fruit size varies with the crop load – the heavier the load the smaller the fruit.

Ripening season is autumn. In Florida the terms used for the ripening season of individual cultivars are: *early*, Sept. 1-20; *mid-season*, Sept 20-Oct. and *late*, Nov.-Dec. The length of the ripening period of the different varieties varies from 3 weeks to 8 weeks (Miller, 1984).

4. CULTIVAR CHAOS

The Problem. From the beginning, varietal confusion has marked the progress of Oriental persimmons in the United States: multiple names for a single variety, more than one cultivar sharing same name, and many variations in spelling. Many of the names that came with scionwood were the name of the province or area. The state-of-the-art set the stage for name chaos. In the latter years of the 19th century and early years of the 20th century, there was less concern for maintaining the name of a clone, [10] be it fruit, or nut.

An example is the case of the walnut variety, "Santa Barbara Soft-shell," marketed in California. A bag of walnuts was purchased in San Francisco and planted in Santa Barbara. Some of the seedling trees bore soft-shelled nuts. Hard shelled seedlings were grafted over using scions from soft-shelled seedlings. Other orchards were started from this clonal mixture. The nuts were marketed as the variety 'Santa Barbara Soft Shell'.

The sophistication of maintaining purity of clonal lines started later. If a clone was good, it was propagated. If the name had been lost, it was renamed. If an unidentified cultivar looked like cultivar "J", then it was labeled "J" and perpetuated under the assumed name.

A survey in 1912 recorded 1030 named persimmon cultivars plus 937 unnamed cultivars in Japan alone.

Starting in the 1870s the USDA began importing persimmons from Japan and China and planting them at the Plant Introduction Gardens at Chico, California and elsewhere. In addition, until the passing of the quarantine law in 1919, imports were made by Japanese immigrants in California, and by individuals in California and the Southeastern United States. Clones from Japanese immigrants and from the USDA Plant Introduction Gardens went into the variety collections of the University of California (UC).

[10] Clone - all the plants that are vegetatively propagated (cuttings, grafts, root sprouts) from one original seedling.

Most scionwood material used in recent years originated from the varietal collections at two UC locations and the USDA plant introduction garden at Chico (Parfitt, D.E., et al. 1991 pp 107-113).

Using state-of-the-art laboratory techniques and the cooperation of Koyoto University in Japan, comparisons were made between selected trees in the two UC collections and the varietal planting in Koyoto, Japan. Thirty one trees in the UC collections were confirmed as true; *13 mistakes were detected*.

The Fuyu Name Problem. The Oriental persimmon variety 'Fuyu' was introduced by the USDA, and distributed under S.P.I[11]. numbers 26491, 32868, and 26773 . . the first two . . under the name Fuyu and the last as Fuyugaki" (Camp & Mowry 1945 p 15). "At least four different importations were made under the original name 'Fuyugaki' " (Miller 1984 p 343). "Many different cultivars with the name 'Fuyu' or 'Fuyugaki' exist" (Miller & Crocker 1992 p 4). Translated, fuyu means "winter"; fuyugaki translates to "winter persimmon". Which of the Fuyu cultivars is the true 'Fuyu' of Japan?

In Israel and Italy it was observed that the 'Fuyu' from Japan did not produce any male flowers, while 'Fuyu' from California occasionally produced male flowers and thus occasionally the fruit had seed. Fruit of the two were indistinguishable in shape, size, and color, but were genetically different. While trying to clarify the situation the latter cultivar was assigned the name California-fuyu or "Cal-Fuyu". It was later decided that Cal-Fuyu was 'Fuyugaki' that was introduced as Fuyu PI 26491.

And so it may well be that some of the Fuyu of the home gardens in the Southeast and in California were not the true 'Fuyu' of Japan, but instead was a similar PCNA cultivar. [I recall the occasional seed found in the "Fuyu" of my childhood in the 1930s in Crowley, Louisiana.]

The true 'Fuyu' of Japan is Fuyu PI 72662, – orchard tree 9, row 21 in the Wolfskill Experimental Orchard (WEO) at UC Davis; tree 15 row 1 at UC's Southcoast Field Station (SCFS) at Irvine. The cultivar 'Matsumoto Wase Fuyu' is an early maturing sport of the true 'Fuyu' of Japan found by Mr. Matsumoto.

Now to complicate things further, the name Fuyu has been commercialized in the fresh fruit trade to represent all the seedless non-astringent types of fruit in the market place. And in keeping with the name in the fruit market place. One California nursery advertises two fuyu: "Fuyu (Jiro)" and "Fuyu (Imoto)".

The 'Tamopan' problem. The Louisiana Extension Service publication 1855 (published 1996) listed Tamopan as non-astringent, yet a 'Tamopan', purchased in Natchez, Mississippi and planted in St. Francisville, Louisiana, is definitely astringent. How could this be? Here are the clues: (1) "Cultivars classed as NA in Japan are not always so in the United States. As an example, 'Tamopan' is said to be non-astringent in parts of China and Japan, and a few localities in California, but in Florida the unripe fruit is always astringent" (Knight 1979, in G&G p 124),
(2) ". . the Tamopan persimmon . . . is the most important fruit in North China" (Fairchild 1938 p 322D). "During his travels through the persimmon-growing regions of China, Frank Meyer had sent several seedless forms of this remarkable fruit, particularly of the famous Tamopan or Grindstone persimmon grown in Chihli" (Ibid. p 338) [12] , (3) "All the varieties introduced by Frank Meyer . . . in 1905 from northern China belong to the group of pollen constants" (Hume 1914 p 404), (4) the 'Tamopan' at the University of California's Southcoast Field Station, orchard tree 13 in row 1, is astringent (Parfitt, et al. 1991); and (5) two notes in a Florida publication suggest that there are look-alikes.
a) First: listed under non-astringent mid-season cultivars: "Midia is the largest of the non-astringent types with fruit often weighing 3/4 pound. An indented ring forms around the top half of the fruit." ['Media'? or 'Midai'?]
b) Second: listed under astringent mid-season cultivars: "Tamopan is a cultivar with large fruit having a circular

[11] The earlier "S.P.I." designation, later shortened to "PI," followed by a number, identified a single (specific) plant introduction made by the United States Department of Agriculture, Section of Plant Industry (later the Division of Plant Industry). It was a serial number that simplified record keeping.

[12] The *D. kaki* persimmon 'Tamopan, was collected in Ming Tombs Valley, in north China, during Frank N. Meyer's first expedition into China, and was received by the USDA 12/28/1905 (Cunningham 1984 p 274, map p 30). This germplasm is listed as available at the Fruit Crops Department, University of Florida, Gainesville as Tamopan PI 16921 (Ibid. p 284). On his third expedition (1912-1915) Meyer collected south of Sian, Shensi Provence, China (Ibid., map p 158). His 41 persimmon introductions were: PI 37525-40, 37648-58, 37661-65 37572-78. Some persimmons were round, some had four vertical furrows, and others were *flat with horizontal incisions* (Ibid. p 275).

depression around the top 1/3 nearest the stem . . . More than one cultivar of this tree exists . . ." (Miller & Crocker 1992 pp 4 & 5).

A ringless-fruited Tamopan has been noted (Santamour & Batzuli 1990. POMONA 23(3):3-4.) labeled 'Tamopan Capless' (Santamour, p.c.). Prior to 1920 was the name "Tamopan" applied to a specific clone of persimmon from north China? Or, was it at some time used loosely to designate a locality, a type, or a mixture of clones collected by Meyer during either of his two persimmon-collecting expeditions into northern China?

Mis-labeling continues. From a retail outlet in Natchez, Mississippi came a tree labeled 'Tanenashi' (on *D. virginiana* rootstock). It was not 'Tanenashi'. It resembles 'Eureka' in fruit shape and in the pollen variant character. It produces male flowers. [For the present it is labeled clone 69.]

From a St. Francisville, Louisiana retail outlet came a tree labeled 'Eureka'. The tree grows like Tamopan, the fruit looks like Tamopan, and the fruit is astringent until soft ripe.

It has been observed that in catalogues, a picture of 'Hachiya' has been used often to advertise 'Tanenashi'.

5. USES AND CULTIVATION

Use. The oriental persimmon is cultivated in commercial and home orchards and dooryard plantings for fruit production. It has found very limited use in either landscaping or as an attractant for birds. A few named cultivars and seedlings display beautiful autumn foliage, and orange to red fruit after the leaves fall.

Fruit. Used either fresh, dried, or frozen as a desert; and as an ingredient in the culinary arts, e.g., salads, pudding, jam, jelly, cakes, cookies, and others. Many recipes have been compiled (see Griffith & Griffith 1982 pp 25-110). CAUTION: Do not gorge yourself on the persimmon pulp, either American or Oriental. "When consumed in large quantities on an empty stomach, persimmons can form an indigestible, troublesome mass" called a bezoar[13] in the human stomach (McGee 1990 p 150).

Fruit peelings. The peel, a byproduct of drying, is used as a dying agent (Miller & Crocker 1992 p 2), and to accent some types of pickles.

Juice. The juice from crushed unripe fruit is used for staining wood, giving it a rich color like walnut. By adding juice of unripe fruit to sake, proteins are precipitated and sake is clarified.

It stores for at least 1 year and turns reddish black. This astringent substance, kaki-tannin, was once used widely in Japan to paint paper and cloth, giving them a more durable texture.

Wood. In the Orient wood is used for carvings, cornices, solid articles of furniture, and utensils.

Seedlings. Used as rootstock on which named cultivars are grafted, in California and many other areas of the world.

Dried fruit. In the past, dried fruit has been used by the Japanese as a sweetener. It contains up to 50% sugar. Demand has dropped but is now increasing as a health food item.

CULTIVATION

Planting. Recommended spacing has been 20 by 25 feet. The persimmon does best when planted in full sun and in well drained soil. Trees are set at the same depth they are grown *in the nursery row*. Roots should not be allowed to dry when exposed and should be watered immediately after planting.

Bare rooted nursery stock and seedling rootstock , if not planted immediately, should be heeled-in. A shallow trench in

[13] As defined, a bezoar, or bezoar stone, is a hard indigestible mass composed of plant or animal matter, or mineral, or a combination of two or more, formed in the stomach of some animals, especially ruminants. They can obstruct the passage of food. Phytobezoars can be caused by common foods such as celery, coconut, and oranges.

well drained soil is opened, roots are separated, covered with soil and kept moist.

Bare rooted stock, available in late autumn to early winter and packaged for holding by the retail nursery, should be planted as early as possible in the dormant season thus allowing time for root growth before top growth starts in the spring. The later the planting the more attention the tree will demand in a hot dry summer.

Recommendations are that the tops should be pruned back a third to two thirds to match the root systems that were pruned during digging. This places the growth of first-year transplants within reach of foraging deer. Late in the dry summers of 1998 and 1999 foraging deer, overstocked for their food supply, defoliated and pruned the branch tips of all first-year and second-year transplants that had been cut back when transplanted, resulting in zero growth for 2 years. A bare rooted tree with a few smaller roots can be brought through the first year without pruning at planting time, provided there is either sufficient rainfall or facilities for watering.

Container-grown plants (not field-grown plants stuffed into a container for quick retail, or to carry over into summer) can be planted anytime if adequately watered during dry periods. CAUTION: Within 30 yards of large oak trees the ground will be sucked dry during periods of drought. If container-grown trees have become pot bound they will take two years to recover, unless drastic action is taken. The pot-bound roots are cut on two sides of the ball to encourage new roots and to avoid later root strangulation.

Protect nursery stock being held for later planting (i.e., container-grown or individually wrapped bare-rooted plants on display) from deep winter freezes to avoid root injury. Black plastic pots heat up when exposed to the sun. Roots on the side exposed to summer sun are damaged or killed.

Fertilizer. Fertilizer at planting time is to be avoided. If fertilizer must be used the first year, it should be used in moderation and applied in June and again in January. If all the new growth is one foot or more on a bearing tree there is too much nitrogen.

Pruning. Young trees should be pruned and shaped. R. D. Wallace (19–, Alachua, Florida) recommends the following: Head back to 3 feet when planting. Train to form a modified leader system, a strong framework of 3 to 5 limbs spaced one foot apart up and down the stem, pruning away the rest. Vigorous shoot growth is pinched back the first and second year. Once production begins, lightly prune during the dormant season, removing weak, shaded out, and cross-over branches. It also may be necessary to thin fruit.

Harvest. Not all fruit on a tree develop to harvest stage at the same time. The length of the ripening period varies with the cultivar, from 3 to 8 weeks. In addition, some trees may have sporadic ripening of an occasional fruit prior to the cultivar's normal ripening time. Depending on variety, fruit may be available on trees as early as August, or as late as December, and with no hard freeze, may hold on into January. The exact timing order (early, mid-season, late, and intermediates thereof) varies with the variety as influenced by climate.

When the fruit is mature, the peduncle (the stem connecting the twig with the calyx still on the fruit) is still strongly attached. The peduncle should be either cut with shears, or the fruit is turned sharply by a skilled hand. Fruit continues to ripen after picking.

"The rich flavor and taste of the persimmon occurs only when the fruit is harvested with full color development around the calyx" (Claude Sweet, 1987). Fruit picked when immature does not soften evenly and may remain partially astringent. Skill in timing the harvest depends on knowledge of characteristics of each cultivar and its reaction to local conditions (usually learned by trial and error).

In California the commercial regulations require a mature, firm fruit of "good color." In Florida it is suggested that astringent cultivars with 70%, of their final color would adequately soften and loose astringency. For non-astringent cultivars a 90% replacement of the green by color is recommended. "The crop can remain on the tree a month or longer becoming softer with greater color and sugar" (Miller & Crocker 1972 p 3).

Short-term storage. Fruit picked and held at room temperature will, in general, ripen 7 to 10 days earlier than on the tree. They are placed in a shallow, open box, and, if left outside, are covered with 1/4 or 1/2 inch hardware cloth to protect them from birds and animals. They are left in the shade to soften.

“Early maturing non-astringent cultivars such as ‘Izu’ have a shorter shelf-life (10 days) than later-maturing cultivars such as ‘Fuyu' (20 - 30 days)” (Kitagawa & Glucina 1987 p 50). “Some Japanese people keep Fuyu and other non-astringent varieties in cool, dry rooms until they have shriveled somewhat, when they have a very pleasant flavor” (Chandler 1957 p 414) .

Longer storage. Non-astringent types can-be stored up to 30 days at room temperature (Miller & Crocker 1992). ‘Fuyu’ can be kept several months at 40 degrees Fahrenheit or higher, but at low temperatures fruit becomes pasty and dull (Chandler). At 32 ^{O}F ‘Fuyu’ can be stored about 2 months. Controlled atmosphere storage enables ‘Fuyu' fruit to be kept 5 to 6 months (Kitagawa & Glucina 1987).

Astringent ‘Hachiya’ will keep 4 months or longer at 30 ^{O}F, 2 months at 32 ^{O}F, and a month at 36 ^{O}F (Chandler).

Dried Persimmons. At the market they come in two types: half dried (ampo-gaki with a short storage period of 2 to 3 weeks; and fully dried (Kitagawa & Glucina p 53). Fully dried persimmons can be kept in a refrigerator for months, in a freezer for years (Hasegawa 1989 p 16).

Astringency Elimination. Mature but still firm astringent kaki fruit can be processed before use to reduce or eliminate astringency. “This is done mainly by treating with carbon dioxide gas, alcohol, hot water, or by peeling and drying (with natural or artificial heat)” (T. Chino 1984).

Drying. Only astringent persimmons are used. Non-astringent fruit and pollen-variant fruit with seed become hard when dried. Among the varieties mentioned for drying are ‘Hachiya’, ‘Hiratanenashi’, ‘Tanenashi’, and ‘Saijo’.

Cool dry conditions are needed to sun-dry persimmons. Mature firm fruit is machine-peeled (leaving a patch of peel at both ends), hung on a pole with the stem tied by a string, or skewered on a bamboo spear and hung out in the sun, or artificially dried (Kitagawa & Glucina 1987, p 52). Fruit needs protection from rain and pests, including birds.

Fruit should be hung in a well-ventilated place or room for drying. The time necessary for drying depends on fruit size and conditions while drying. Generally, 4 to 6 weeks is required to make them firm (fully dried). After 2 or 3 weeks, fruit becomes soft (half dried), the astringency is gone and it is sweet. (Hasegawa 1939).

After sun-drying, fruit should be stored in a location with temperature about 65 ^{O}F and relative humidity of 50% to 60%. During either storage or slow drying a white sugar coating forms on the dark surface. Dried fruit may contain up to 50% sugar (Kitagawa & Glucina). The major sugars are fructose, glucose and sucrose (Senter, et al. 1991).

The USDA has shown that persimmons “can be dried readily at 122 ^{O}F in the standard evaporator and . . . the darkening of the flesh can be prevented by steaming the fruit before drying.” Fruit should be peeled with a nickeled or stainless steel knife to avoid staining the flesh (Camp & Mowry, 1945 p 7).

Freezing. It has been reported that fruit placed in a freezer for 24 hours to destroy astringency is still firm and edible when removed. Opinions differ as to firm or soft when thawed after 24 hours. McGee (The Curious Cook, Chap. 9, p 137) reports the freeze process takes 10 to 90 days and the resulting flesh is mushy. [Was he working with immature ‘Haychia’ fruit?]

Ethylene gas. “Some unripe fruit can be hastened to edible condition by placing them in a paper bag with coarsely-chopped apple pieces. The bag should be closed to trap the ethylene gas liberated by the damaged apple tissues and kept at room temperature for several days” (Capon, text book 1990 p 127-128). The riper the apple the more ethylene produced. Other items that can be used to generate ethylene are pear, banana, passion fruit, and apple peelings.

Since the second requirement of ethylene ripening is the exclusion of air, a clear, covered fruit dish can be substituted, thus enabling observation of the process.

What happens to astringency? The reduction in astringency during ripening isn't a matter of tannin disappearing, but of it being sequestered into unreactive pellets due to the action of acetaldehyde production by the fruit itself (McGee 1990). In an air-tight container persimmon fruit generate enough acetaldehyde to eliminate astringency (Pessis, et al. of Israel). As the fruit uses up the oxygen and gives off carbon dioxide there is a shift to acetaldehyde production.

Suggested for Trial. The curious cook (McGee 1990) modifies and combines the closed container treatment and the hot water treatment. 'Hachiya' fruit is wrapped tightly in 3 layers of Saran Wrap (polyethylene will not work), placed in a warm place (100 ^{O}F) for 12 or more hours, e.g., a gas oven with pilot light or an electric oven kept warm with light bulb, then returned to room temperature for 12 hours. The longer the heat period the stronger the flavor. Things to be considered are the variety, fruit maturity, and your taste.

6. PROPAGATION

Types of propagation. Oriental persimmons have been propagated vegetatively (asexually) and by seed (sexually). Sexual reproduction allows for shuffling of the genetic code giving new, individual seedlings, each with its own unique characteristics. However, rarely are the new ones an improvement over the cultivated varieties already available. Asexual reproduction (cloning) enables orchard production of trees that are actually branches (ramets) of the selected original seedling.

Sexual. Seed is used to grow seedling rootstocks of *D. kaki*, and in breeding programs to search for new varieties. Seeds are stratified for 120 days at about 50 ^{O}F. If seed dries excessively, the germination is lowered. Dry seed should be soaked 2 days before beginning stratification.

Stratification is a cold treatment used to remove the dormancy that prevents fall sprouting. Essentially, it is the nursery practice of placing seed between layers of moist sand or peat moss and exposing them to low temperatures, usually by leaving them outside during the winter months. Small lots of seed can be mixed with moist sand, peat moss, or vermiculite, then placed in a labeled polyethylene bag which is then closed and stored in a refrigerator for 4 months.

Fresh seed can be planted in the field immediately. Stratified seed are planted in the spring, either in nursery flats, or outside in nursery rows as early as 2 weeks before anticipated last frost.

Seed can loose viability through extreme heat, extreme cold and drying.

Asexual. Desirable varieties are cloned by grafting (which includes budding) and by cuttings. (Textbooks on propagation are available.)

Grafting. Thrifty young stock can be grafted in late winter, or spring at budbreak time of the rootstock, or late summer to early autumn. Types of graftage most commonly used are whip-and-tongue (for winter bench grafting and for budbreak time) and chip budding (early spring and late summer). Less commonly used are whip (splice) grafting, bark grafting, cleft grafting, and T-budding (shield budding). Scionwood used in winter and late summer can be collected fresh as needed. Scionwood used for spring grafting must be dormant wood, collected in late winter, given special handling, then stored under refrigeration until needed.

It has been suggested that almost any graftage used for pears and apples can be used for persimmon. This could be so on kaki rootstock, but persimmon on *D. virginiana* rootstock is tricky. For the layman wanting only a few trees it is best to order from a nursery.

Top-working. "Top-grafting . . . should be carried out fairly late in spring when the weather becomes warmer and more settled. Cleft, side or whip grafts can be used" (Kitagawa & Glucina 1984 p 18), using 2-bud dormant scions. [They worked with kaki rootstock.]

Propagation Notes

Scionwood storage. Scionwood can be kept indefinitely if collected from dormant trees and kept in moist sphagnum (Camp & Mowry 1948 Fla. AES Bul. 124).

T-budding. To prevent free flow of sap into wounds and its accumulation around the inserted bud, a narrow strip of bark in the form of an inverted-V may be removed, just above the point where the bud is inserted into the stock (Camp & Mowry, 1948).

Top working. I use a modified cleft graft adapted by Camellia hobbyists. Two parallel tangential cuts (clefts) are made; 4 scions slipped into the 4 available locations; scions inserted to line-up the cambiums of stock and scion; then scion slightly touched moving

the top of scion a wee bit outward to be sure cambiums cross at some point. Finally, the union is tied to cover wounds then bagged. This procedure gives a strong union. Also, the twin tangential clefts give me the best chance of success with wild scionwood that are only match-size twigs.

Plastic Bag Nursery. Rootstock seedlings can be germinated in trays. When 3 inches tall the tap root is cut, removing 25% to encourage fibrous root production, and then transplanted into a tall planter bag equipped with drainage holes at the bottom. Under warm conditions seedlings can reach grafting size after one season's growth.
To maximize a small area, long planter bags, approximately 6 x 15 ½ inches, can be made on a sewing machine using 3-mil polyethylene. Bread bags are approximately 8½ x 18 inches. Max Kenny (POMONA 25(1):608, 1992) noted that plastic growing bags (5 x 18 inches) are available in boxes of 500 from R. R. M. Manufacturing, 14380 Industrial Circle, La Mirador, CA 90636.

Note on Bench Grafting. Jonathan Cowley of Just Fruits emphasized sanitation and quality of buds. Timing in north Florida is winter, January-February. Scionwood can be used fresh or stored under refrigeration. Scionwood is cut from a healthy limb 6 to 10 inches long. Scions contain two good center buds, (the tip buds or stub buds are not used). The dormant seedling stock is dug, root pruned, then washed with 10% Clorox (1-9 dilution), then soaked 4 to 6 minutes in a captan/maneb suspension (1 to 1½ tablespoons each gallon). Hands are kept clean with alcohol or Clorox. The graft is made, tied, then quick-dipped into wax to cover the scion and the top of the stock to just below the union. The grafted seedlings are healed-in using a box filled with moist sphagnum moss, placing the box outside under-shade. Later, they are potted and watered by a drip irrigation system.

Rootstocks. Seedlings of three species of Diospyros (kaki, lotus, and virginiana) have been used widely. *D. kaki* is the Oriental persimmon which originated in south China, *D. lotus* the date plum native to north China, and *D. virginiana* the American persimmon native to the eastern United States. Most of the Oriental persimmon trees grown in the eastern U.S. are propagated on virginiana rootstock from local sources.

Each of the three species, as a rootstock, has its desired qualities as well as its defects. In addition, the comparative response of each kaki cultivar when grafted onto each species remains undetermined. The yield of 'Hachiya' was lowered when placed on lotus stock, and further lowered when on virginiana stock (Schroeder 1950). Some non-astringent cultivars go into slow decline when on lotus stock (Hodgson 1940). In Israel a decline of Oriental persimmon on virginiana stock has been reported.

***D. kaki* rootstock.** Of the three species, kaki is the most widely used and has the greatest compatibility with its own cultivars. It is the least hardy, but is suitable for mild climates.
Kaki seedlings produce long taproots with few fibrous roots, thus making grafted rootstock difficult to transplant. When seedlings are about 34 inches high, the tap root can be cut to reduce its length 25% to encourage development of fibrous lateral roots. "Large seed appear to develop into the strongest seedlings. Large sized fruit (0'gaki) usually contain large seeds" (Kitagawa & Glucina 1987 p 16).

***D. lotus* rootstock.** Date plum (mamegaki, ghae tsao, a native of north China that produces small fruit) is used widely in China, Italy, northern Japan (Kitagawa & Glucina 1987 p l6) and in California for some cultivars. It is drought resistant and more cold-hardy than kaki. It produces vigorous, uniform seedlings with a rather fibrous root system that transplant easily.

When used as rootstock for several pollen-constant non-astringent cultivars, e.g., 'Fuyu', 'Gosho', 'Izu, 'Jiro', and 'Suruga', there is a serious graft incompatibility that causes a slow growth followed by decline. 'Fuyu' top worked on a kaki cultivar established on *D. lotus* roots makes a satisfactory tree (Hartmann., et al. 1990 p 551).

The *D. kaki* cultivar 'Hachiya' does not produce well on lotus rootstock due to excessive shedding of fruit in all stages (Schroeder 1950).

In 1905 in north China, plant explorer Frank Meyer "collected the wild persimmon because he had observed that the Chinese used it successfully as a rootstock for the cultivated persimmon" (Cunningham 1984 pp 34-35).

***D. virginiana* rootstock.** The American persimmon is used widely in the eastern United States and in Australia. It has been used in Israel, but a decline problem has been encountered. In Florida it "is desirable because of its adaptability. Its vast root system forages well and will handle both flooding and drought conditions" (Miller & Crocker 1992 p 7). Virginiana tolerates the widest range of soil conditions of the three major rootstock species. Most cultivars make good union with this stock.

Virginiana seedlings produce a pronounced taproot system with few fibrous roots, thus grafted trees are often difficult to establish after transplanting.

Writers have not distinguished between the virtues of the 60- and 90-chromosome races except to suggest that the 90-chromosome race is more robust and therefore more desired by nurseries as a rootstock. Since virginiana in its natural range extends from Lake Okeechobee in Florida to Connecticut and mid Texas one can expect considerable variation due to evolutionary (survival) pressures within the local ecologies. Locally adapted wild trees are usually available for selection as seed parents. "Both male and female trees should be selected for vigor and leaf retention" (Miller & Crocker 1992 p 7). Seeds must be protected from excessive drying. They must be planted in the fall, or stratified about 60 to 90 days at 50 ^{O}F (Hartmann, et al. 1990 p 551) .

Virginiana performs poorly in California's hot growing conditions. Also it was noted that "trees on this stock have not been uniform in size and vigor" (LaRue, et al. 1982 p 8). Within seed lots collected in West Feliciana Parish there is variation in vigor of the seedlings, and in some lots a few remain stunted. [Why not test these seedlings as dwarfing rootstock?]

It has been reported that the early and late bud breaking of the seedling stock influences the timing of the bud break of the kaki cultivar, thus a delayed bud-break could reduce chances of late freezes damaging early-flowering kaki cultivars (Sharpe 1993). [Would this also affect fruit maturity dates?]

Virginiana, grafted or not grafted, has a bad tendency to send up root suckers. [The use of systemic weed killers to destroy the suckers can cause death of the attached grafted tree (Guidry p.c.).]

In California (Los Angeles area) when compared to the cultivar 'Hachya' on kaki rootstock, the Haychia-lotus combination produced more blossoms but mature fruit was reduced 29.5%; the Hachiya-virginiana combination produced a smaller tree, less flowers, and reduced mature fruit 43.2% (Schroeder 1950).

Choosing the rootstock – kaki, lotus, or virginiana?

Kaki? From Florida, 1945, we read: "It was found that it [Oriental persimmon] did not make a thrifty growth on its own root in the Southern United States and resort was had to the native persimmon, *D. virginiana* as a rootstock" (Camp & Mowry 1945 p 24). In 1973 we read "The common and Japanese persimmons have been tried as rootstocks at Gainesville and no yield advantage has been noted for either." (Sharpe & Sherman in POMONA fall 1973). Does the latter still hold true 25 years later?

How old is the oldest surviving seedling or kaki rootstock in the Southeast? The seedling, Pete Humble, near Zachary, Louisiana is 20. The surviving rootstock, Spillman, that grew at Spillman, Louisiana was 40 when the top was killed back severely by a late spring freeze and the tree was finished off by wood borers during the next 2 years.

Kaki persimmon seedling stock does not sucker readily. It is resistant to Persimmon Wilt disease. It should be tested for resistance (actually tolerance) to Kaki Sudden Death disease.

It is advocated that kaki rootstock be tried in orchard areas where trees have been killed by either the fungous disease, Persimmon Wilt, or the disease, Kaki Sudden Death. In either situation, if successful, the scionwood (from kaki on kaki rootstock) should be considered a potential "Typhoid Mary" (a symptomless carrier), and should not be sold, traded, or given away."

Lotus? Susceptibility to root rot has been reported in Florida. Lotus has a chilling requirement about that of Elberta peach (Chandler 1957), a peach cultivar that is not recommended for coastal deep-South.

Lotus is resistant to Persimmon Wilt disease and susceptible to Crown Gall disease. It needs to be tested for its ability to survive in hardiness zones 8a and 7, and for its tolerance to Kaki Sudden Death disease when in combination with non-astringent kaki cultivars that are not susceptible to Fuyu Decline.

Virginiana? In most areas of the Southeast seeds of local wild trees are readily available. Virginiana does not make a good rootstock in areas where pathogens of either Persimmon Wilt or Kaki Sudden Death are present.

Exploiting the Rootstock Taproot. The tendency to produce a dominant taproot has been exploited in Camellias. Three or 4 seeds are germinated in place. Later, all seedlings are grafted in place. Of those that are successful, the best one is selected to remain. The other grafts or seedlings are either cut out or removed later. The natural, uncut taproot rapidly reaches downward toward the watertable to provide an improved drought resistance in the early life of the plant. Both virginiana and kaki rootstocks are taproot types.

7. PERSIMMON DISEASES

Kaki Sudden Death (Reighard & Payne 1991. Ann. Report, Northern Nut Growers Assoc. 2:17-169). A killer disease of kaki cultivars on American persimmon rootstock, was noted in the literature in 1988 (Scott & Payne). It occurs in Georgia and South Carolina (Reighard & Payne) and in Mississippi (Reese 1994, Jacobs 1999). During a 5-year variety evaluation study at Byron, Georgia, the disease killed 90% of 238 trees.

In the spring, about 2 - 3 weeks after shoot elongation, the symptoms begin. The disease progresses rapidly for another 2 - 3 weeks (through the flowering period), then stops (about mid-May in Columbia, S.C.) with the onset of hot weather. Within a few weeks after leafing out, grafted trees die-back starting at the limb tips and progressing back to the graft union. Trees not killed before the onset of hot weather may recover and mature fruit, only to show symptoms again the following spring. The American rootstock does not die. It sprouts out apparently healthy, but, when the surviving virginiana rootstock is regrafted, the kaki scions start to grow then curl-up and die, indicating American persimmon is a symptomless carrier of the pathogen.

Symptom sequence *to be investigated* as an aid in field diagnosing is: a) black discoloration of main leaf veins, top and bottom; b) defoliation starting from the tips of branches; c) young green shoots show black streaking followed by shriveling and dying; d) death progresses downward into the trunk and stops at the graft union; e) under the bark streaking is evident in the cambium and on the wood surface. Intensity of symptoms progresses during the active period, during the cooler weather of spring. Clues to look for are: (1) pattern of spread through the orchard suggests something is moving through the soil, (2) virginiana rootstock sprouts out from under dead trees and shows no symptoms [14] , (3) grafts placed on rootstock sprouts start vigorous growth then collapse, (4) progress of disease halted by hot weather.

Reaction of kaki cultivars propagated on either kaki or lotus rootstocks is not known.

An isometric viral particle has been observed associated with diseased persimmon trees. Other plants, *Chenopodium quinoa*, *C. amaranthicolor*, and *Prunus persica* (peach), have been successfully sap-inoculated using juice from diseased plants, but the ritual of proving the viral particle can cause Sudden Death has not been completed (Scott & Payne 1983), thus to the orthodox scientist there is no proof that Sudden Death is a viral disease.

Circumstances strongly suggest the causative agent can be transmitted in scionwood,[15] and can be carried without symptoms in *D. virginiana* which could serve as a "Typhoid Mary". [My SWAG is that Kaki Sudden Death is caused by a soil-borne, nematode-transmitted, large-host-range virus related to the Tomato Ringspot Virus group, and is native American.]

Virus-like diseases have been reported in Italy and in Brazil. *D. virginiana* rootstock is not used in either country.

Persimmon Wilt (Crandal & Baker 1950 Phytopathology **40**: 307-325) is a fungous [16] disease caused by the fungus,

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[14] A black necrotic streaking of the major leaf veins of *D. virginiana* may occur starting about mid-summer on trees that are susceptible to Anthracnose disease. Diseased leaves remain on the tree until autumn leaf fall.

[15] CAUTION. The acceptance of scionwood from states where Kaki Sudden Death disease is present is to be avoided, along with scionwood from the Mediterranean area. This is a fail-safe precaution.

[16] Spelling note: noun singular - fungus; noun plural - fungi; adjectives - fungal & fungous. It is noted that words ending in "us" and used as an adjective require an "o" before the "us", – thus the adjectives are either fungal or fungous, – your choice. For a disease caused by a virus, the "ous" rule does not apply , yet. "Virous" is not in the dictionaries. Properly it is "viral

Cephalosporium diospyri. It kills American persimmon trees and destroys Oriental persimmon trees on American rootstock by killing the root system under the grafted tree. Both *D. kaki* and *D. lotus* have high tolerance to the fungus but they are not immune. The fungus can grow in the tissue of each species. Thus, in California where the rootstock is either kaki or lotus, there is no problem.

The fungus was probably introduced into the United States on merchandise shipped directly to the destination by nurseries in the Orient before the enactment of the plant quarantine law in 1919. Prior to 1936 the disease had become established in the eastern states. By 1942 it had been confirmed in the southern states of: TN, NC, SC, GA, FL, AL, MS, and TX.

Note: Persimmon Wilt kills virginiana rootstock; Kaki Sudden Death does not.

Lesser disease problems in the United States include the following:
Stem Pitting. "Stem pitting disease, probably of virus nature, has been observed on trees planted on *D. kaki*, but not on *D. lotus*." [17] (LaRue, et al. 1982 p 9). No details. A search of the files and records in Visalia, California left by LaRue failed to reveal any information on stem pitting (Kevin Day, p.c. [personal communication]).
Witches Broom. Excessive sprouting of branches from normally dormant buds has been observed in Texas. Its cause is a mycoplasm-like organism (MLO). **Anthracnose.** A fungus, *Gloeosporium* sp., spread by splashing water causes black leaf spots and dark spots on the fruit as it ripens. **Fly Speck.** The fungus, *Schizothyrium pomi*, grows in the surface wax of the fruit producing evenly spaced tiny specks. **Green Algae.** *Cephaleuros virescent* causes algal leaf spot in humid climates. **Mistletoe.** Both American mistletoe in the Southeast and the European mistletoe in California have been found on persimmon.
Fuyu Decline. A decline of Oriental persimmons was reported in commercial orchards of non-astringent cultivars in California in 1987 (Bender & Sims). Orchard trees sold as 'Fuyu' on lotus rootstock experienced up to 90% decline and death over a 5-year period. The trees showed leaf scorching at the edges and patches of dead bark on trunk, limbs, and small branches. Other symptoms include sudden collapse of the top and suckering from the rootstock. In early stages a dark band is found under the bark at the graft union.

A flare-up of this disease occurred in the 1980's in San Diego and Stanislaus Counties, California, following a rapid expansion in the planting of 'Fuyu'. Yet there were Fuyu orchards on lotus rootstock near Visalia, California, that were 10- to 15-years-old with no evidence-of decline. It was suggested by Bender (p.c.) that the latter were really the cultivar 'Jiro'.

The disease is a graft union incompatibility between some of the PCNA (pollen-constant, non-astringent) cultivars and *D. lotus* rootstock [18] (Hodgson 1939). Reich (1991 p 85) lists 'Fuyu', 'Jiro', 'Suruga', and 'Gosho'. In Italy, imported non-astringent cultivars that showed "negative affinity" for lotus included: 'Fujiwara Gosho', 'Gosho', 'Ichikikei Jiro', 'Jiro', 'Matsumoto Wase Fuyu', and 'Suruga', all imported from Japan, while 'Jiro C-24276' imported from California had a "positive affinity" (Bellini & Gianelli 1982? p 19-30).

Foreign Virus-like Diseases. Virus-like diseases of *D. kaki* worthy of note are: (1) a persimmon decline in Israel, (2) an Oriental persimmon disorder in Italy, and (3) a mosaic disease in Brazil. It is noted that importation of persimmon scionwood in the distant and recent past has involved countries in southern Europe, North Africa, and Asia Minor, – the Mediterranean area.

ISRAEL
Israeli Persimmon Decline. (Cohen, Y., et al., 1991. Sciencia Horticulture 8:1 1-170. This disorder is a slow decline of *D. kaki* cultivars grafted onto *D. virginiana* rootstock. It is reported to be widespread in nurseries and orchards in Israel, and includes all cultivated varieties. Trees grafted on *D. kaki* rootstocks do not decline [19].

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disease"; not "virus disease". "Virous disease" is still in the future. Until then the only choice remains "viral disease".

[17] Confusing. Is *D. lotus* resistant? Or does it mean that the disease has never been encountered in other orchards where *D. lotus* is the understock?

[18] What happened? Several things contributed to the flare-up in the 1980s: data overload of modern science, persimmon a minor crop, cultivar chaos since the beginning; success with "Fuyu" on lotus rootstock in Visalia, and gung-ho.

[19] If the cause is a biotic factor, and if the factor passes into the kaki scionwood, then a grafted tree on kaki rootstock

Symptoms are weak growth, small upward-folded leaves, swollen buds, protruding lenticels, dense internodes, and sometimes shallow bark cracks in the zone of the graft union. Similar symptoms may be produced by drought, trunk ringing, insect attack, and bending of branches (Taur 1984).

According to Cohen and co-workers, their research "results suggest the presence of a transmissible biotic factor, both in *D. virginiana* rootstocks and *D. kaki* scions causing decline only in *D. kaki* scion tissues." They further speculate that "a transmissible biotic factor in latent form in certain *D. virginiana* trees without showing symptoms . . . may, apparently, be transmitted by seed and passes from infested rootstocks into *D. kaki* scions . . ."

The cultivar used in the Israeli experiments was 'Triumph' of Israel, NOT our 'Triumph' of Florida [20]. It is noted that the catalog of a nursery in Oregon advertises the cv. 'Triumph', quote "Imported from Israel."

ITALY

Oriental Persimmon Disorder (Mazzetti, Alberto, 1956. Food and Agriculture Organization Plant Protection Bulletin 4:181-183). This is a disorder of Oriental persimmon that shows symptoms under unfavorable environment or unfavorable growing conditions. It was first noted in 1947, and apparently has become widespread in Italy.
Severity of the disorder is affected by environmental conditions, and in a few cases trees have died. With proper care trees apparently recover. Diseased scions grafted onto apparently healthy kaki plants have recovered, except for occasional mild symptoms.

Symptoms, normally beginning in May, are characterized by "a partial black discoloration of leaf veins . . . generally accompanied by a chlorosis of the leaf . . ." and, if sufficiently severe, can cause leaf drop by June or July on shoots at top of tree. Suberose (corky) blisters and necrotic longitudinal furrows are sometimes observed on shoots, and necrotic spots appear on bark of larger shoots and branches and black longitudinal streaks occurring in the wood.

If the cause is a biotic factor, and if the factor passes into the kaki scionwood, then a grafted tree on kaki rootstock would have no trouble passing through the USDA Postentry Quarantine observation period and would be released for propagation after passing visual inspections made during two growing seasons.

Trees grown from seed planted near trees formerly-diseased-and-recovered show localized veinal necrosis often accompanied by chlorosis. These symptoms usually disappear after a short time.

When wire is tied around a branch of a grafted, recovered, or apparently healthy tree, typical symptoms develop.

Cause of this disorder has not been established. The possibility of a virus has been suggested. Rootstocks used in Italy are kaki and lotus.

BRAZIL

Mosaico del Caqui (Herbas-A. Remberto, 1969. Turrialba **19** (4): 480-490. Spanish with English summary). In Brazil in the state of Sao Paulo, a polyhedral virus causes a systemic disease that expresses symptoms on the above-ground parts of the tree. Symptoms show on leaves, flowers, fruit, and shoots. The viral disease is characterized by (1) mottling of the leaves and necrotic streaks on leaf veins, (2) leaf distortion, (3) premature leaf fall, (4) necrosis of flowers which extends to calyx and down the petiole, sometimes entering the shoot, (5) flower fall, (6) necrotic spots on fruit, wood, shoots and twigs, which may lead to dieback.

Using juice from infected leaves showing symptoms, the virus was successfully inoculated into, and produced symptoms on the leaves of *D. kaki*, *D. lotus*, tobacco, tomato, petunia, three species of *Chenopodium*, beet, bean, cowpea, zinnia, and

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would have no trouble passing through the USDA Postentry Quarantine observation period and would be released for propagation after passing visual inspections made during 2 growing seasons.

[20] The 'Triumph' cultivar of Israel "is a pollen variant selection made in Israel and should not be confused with the variety of the same name grown in Florida" (Claude Sweet, Ag Alert 6/10/87). The latter was named by G. H. Horton, Eustis, Florida, and commercially propagated prior to 1887 (USDA Yearbook 1913 p 118-121). The 'Triumph' of Florida is pollen constant (Hume 1914 p 402).

lettuce. It was retransmitted from *Chenopodium* back to *D. kaki*. [*D. virginiana* rootstock is not used in Brazil.]

8. COMMON PESTS

Persimmon Pests and Problems. When an exotic (foreign) plant is introduced and proposed as a crop, it is usually touted as being "pest free." But, as time passes the pests and pathogens from the point of origin begin to "hitch-hike" to new locations and pests native to the new areas begin to transfer onto the introduced plant species. As additional materials of foreign origin are introduced and culture intensifies and scatters into different climatic zones, new problems may appear.

Diseases inhibited by the Mediterranean climate (i.e., no summer rains) and the cultural practices of California become more of a problem in the humid South where, in addition to summer rains and humidity, a different rootstock is used. Persimmon Wilt and Kaki Sudden Death can completely destroy orchards of Oriental persimmon growing on American rootstock.

A major insect pest native to, and restricted to the eastern United States is the persimmon root borer. At the other end, the persimmon psylla [pronounced sil'ah] and the fall web-worm are conspicuous, they are not deadly.

Persimmon is still a low maintenance dooryard and home orchard fruit, requiring few pest control activities. [Under Louisiana Administrative Law, very few pesticides are allowed for use in persimmon. Florida has a longer list.]

INSECTS AND MITES

Persimmon psylla. *Trioza diospyri*, a member of the jumping plant lice family, is attracted to just-emerging leaves of new growth produced in late spring and throughout the summer. Tiny clear-winged, black-body adult psylla rest on the emerging leaves, mate, then the female lays her eggs along the leaf edge. The sucking of the nymphs stimulates the leaf to roll downward, or upward, at the edge producing a protective covering of the louse colony. A white waxy powder produced by the pink nymphs protects them against wetting when sprayed. [These are not mealybugs.]

The internode length of the elongating new growth can be reduced 50% or more. Young seedlings, especially late seedlings, can be severely stunted.

No chemicals are recommended for persimmon psylla control in Louisiana. One research approach would be to test the contact insecticides that are effective against aphids, plus a good wetting agent. Testing the use of systemics on young grafted plants is to be avoided, unless handled as a special test.

Fall webworm, the larval stage of the moth, *Hypantria cunea*, lives in colonies protected by a silk web while the larvae strip a limb of new and old leaves. They then extend the web to enclose nearby limbs and continue their activity. Unless there is a severe infestation, the damage is more conspicuous than damaging.

Removing the limb to remove the webworms creates greater loss than that caused by defoliation. When webs are spotted within reach, they can be stripped by hand or with the aid of a rake, then placed in a plastic bag to be left in the sun. An old method was to singe webs and worms using a kerosene-soaked rag held in an improvised, enclosing wire basket attached to the top of a pole, – or leave-it-be, due to fire hazard.

Persimmon root borer, the larva of the clear-winged moth, *Sannia uroceriformis*, native to the eastern United States on *D. virginiana*, is related to the peach tree borer. A loss as high as 50% of virginiana seedlings and grafted trees has been reported to occur in American-persimmon nurseries.

Eggs are laid on the bark by the moth. On hatching, the larva bores through the bark and tunnels through the wood. It may penetrate downward as far as 1½ feet into the root.

There are no Louisiana-recommended treatments against this insect problem of persimmon. One research approach would be to test the chemicals and the timing of treatments that are used for peach tree borer. Observations need to be made on the influence of the imported fire-ant on the persimmon borer. [I have not encountered this borer.]

Citrus whitefly, the nymph of *Dialeurodes citri*, feeds on Oriental persimmon creating honeydew as a byproduct. The honeydew settles on the tops of leaves. A sooty mold, *Capnodium* sp., grows on the honeydew on the leaf surface

producing a black layer, which captures energy from the sunlight and thus reduces the light available for photosynthesis.

By rubbing the leaf surface the black fungus can be removed leaving a sheen, showing that the leaf tissue is not penetrated. The whitefly is the parasite; the fungus is not.

The problem is mild to non-existant on Oriental persimmon if trees are grown in open sun light, but it can be severe in heavy shade. Whitefly infestations are greatly reduced if the insect is controlled while overwintering on evergreen hosts, especially gardenia.

Hickory twig girdler. The adult female, *Oncideres cingulata*, a member of the long-horned beetle family, induces winter pruning of limbs of several forest tree species. In late winter, small persimmon branches 2 to 4 feet long and 1/4 to 1/2 inch in diameter are found on the ground. The subsequent effect on yield of both *D. kaki* and *D. virginiana* is not noticeable.

Adults emerge in the summer. First, the female does a maturation feeding on the bark of young shoots. In late summer to early fall, after sexual maturation and mating, the female lays an egg under the bark of a small limb and then retreats trunk-ward to carve a V-shaped groove around the branch leaving a wood attachment of one-third the diameter of the branch. The attachment allows for outward flow of water and dissolved nutrients to keep the branch alive, while the girdling prevents the return of carbohydrates via the phloem tissue in the bark, thus saving the food for the larva. The groove is deep enough to enable breakage during winter winds. The twig, still alive, falls to the forest floor. The larva continues to feed into the summer, inside the detached limb, then it pupates and emerges later as an adult beetle.

Picking up the fallen branches in the orchard and burning them makes one feel better, but is of doubtful value since fallen branches under pecan, hickory, and oak can be an added source of mature beetles.

Powderpost beetles. The adult beetles, *Xylobiops basilaris* of the horned powderpost beetle family, usually restrict their attacks to freeze injured, stressed, dying, or dead persimmon trees or branches.

The female of the powder post beetle burrows through the bark, tunneling out a long brood chamber and laying eggs along the chamber. The larvae spread out from the brood chamber. *D. kaki* lacks the copious gumming secreted by *D. virginiana* which floods out and gums up adults and their brood chambers.

The author observed that almost immediately following a late spring hard freeze in West Feliciana Parish, *D. kaki* trees received a mass attack of either shothole borers or powder post beetles (species unknown) characterized by conspicuous threads of frass stiffly projecting outward from the holes made by adult beetles. Most trees survived but continued to remain stunted and misshapened for several years. One 40-year-old tree lingered 3 years before it died because of secondary attacks by other beetles and by wood rotting fungi.

Eriophyid mites. The eriophyid mite, *Aceria theospyri*, is a native pest that produces a small purse-like gall on the leaf of American persimmon rootstock, but cannot parasitize *D. kaki*.

Aceria diospyri was found under bud scales and under the fruit button (calyx) of *D. kaki* in October, 1943, near Garden Grove, California. Although it was reported *associated with* a tendency of the fruit to separate from the calyx, there is no evidence that the mite is the cause of the problem.

Foreign threats. Persimmon fruit moth, *Stathmopoda masinissa* Meyrick of the oecophorid moth family, has been listed as an important pest of persimmon in Japan (Kitagawa & Glucina 1987 p 42). The larvae attack bark, shoots, and fruit.

ANIMAL PROBLEMS. At harvest time blue jays and mocking birds are early samplers of the fruit, and if there is a shortage of squirrel food, the grey squirrels discover the non-astringent cultivars.

Whitetail deer, *Odocoileus virginiana*, browse both *D. virginiana* and *D. kaki*. In the late summer under pressure of a food shortage, they have defoliated the same kaki transplants for two successive years (1998 and 1999), nipping the limb tips and removing all the foliage. On older Oriental persimmon trees they removed all the foliage up to 4-1/2 feet.

Male whitetail deer establishing their territory, scarred the bark, delimbed young trees, and even killed a few young transplants.

Birds. As fruit begins to ripen and show the first indication of red color coming through the yellow, two birds become frequent visitors: the blue jay, *Cyanocina cristata*, and the northern mocking bird,[21] *Mimus polyglattes*. The jay moves around pecking several fruits, while the mocking bird continues to feed on the same fruit. A reduction in the jay population results in an increase of the mocking bird population. [22]

In a mixed stand of astringent and non-astringent cultivars, the latter suffer the least damage.

Hound dogs, *Canis familiaris*, will consume any ripe fruit within reach. In California coyotes, *C. latrans*, have acquired the same habit.

Young dogs with the retriever instinct create a problem during the grafting season. They may remove ground-level articles touched either during grafting or later when examining grafted seedlings, articles such as plastic bags, milk-jug cloches, paper bags, and aluminum labels.

9. RECOMMENDATIONS

Selecting Cultivars. My objective for a home orchard is to accumulate a series of good tasting varieties that will provide a long harvest season of fruit (available from August into January).

Today's home gardener has a wide range of commercial (orchard) and home or dooryard types from which to select. This includes recent imports from Japan, in addition to the old standbys, plus a seedling or two that originated in the United States. If possible, taste the fruit of the different cultivars before a selection is made.

Each person varies in the thresholds at which they can detect different chemicals, i.e., the things that contribute to flavor. If possible, one should get to know the local persimmon hobbyists. View the cultivars as the fruit ripens, again as fall leaf color shows, and again after leaf fall, if the fruit are still on the tree. Scrounge a few of the different fruits. Ask for the ones he would pick for his own use. Become aware of your personal impressions. Some people love 'Tanenashi', yet I recall one person who cut down a magnificent, heavy bearing tree. Excuse? "I don't like persimmons!" [23]

Variety Recommendations for Home Planting. Melvin Guidry recommends the following cultivars for home planting in south Louisiana: (1) for the small garden or yard - the non-astringent 'Ichi-ki-kei-Jiro', a sport of 'Jiro', dwarfed and earlier than 'Jiro', (2) for the persimmon lover - the non-astringents 'Matsumoto Wase Fuyu', a sport of the 'Fuyu' of Japan, and 'Suruga', the result of a cross of 'Hanagosho' x 'Okugosho' made in Japan and released in 1959, which ripens a little later than 'Fuyu'. Others include the astringents 'Giombo', said to be the gourmet's persimmon, and 'Saijo', said to be the sweetest of all the persimmons.

Carl "Dump" Metz and Julius "Moochie" Metz would add the astringents 'Yotsumizo' for daily sampling, and 'Triumph' of Florida. Both have a high parthenogenic potential and a tendency to show fall leaf color. 'Yotsumizo' will produce male flowers.

I would add the clones 'Spillman' and 'Pete Humble', 'Spillman' for fruit flavor, bird food, and summer and fall foliage, and 'Pete Humble' for late, late fruit.

Introducing Clones "Spillman" and "Pete Humble."
Spillman is interpreted as the surviving kaki rootstock of a tree purchased as a grafted plant circa 1948 and planted in the Spillman community, 12594 La. Hwy. 421, West Feliciana Parish (WFP), Louisiana. Surviving are 5 ramets on virginiana rootstock: two at place of origin, one at 6191 Metz Road and two at 5159 Pine Street, St. Francisville (all in WFP).

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[21] Our southern mocking bird. The official common name is northern mockingbird, – the northern most of the 12 species belonging to the genus *Mimus*, which extends southward to the Galapagos and Tierra del Fuego.

[22] You can't win even if you don't get caught.

[23] If you become enthused and tell someone about the taste of a special variety and then hear the words, "I don't like persimmons," back off and change the subject. People take great pride in their personal fetishes.

The tree is vigorous, upright, reaching 25 feet, deep green foliage, and with a tendency to display yellow-orange fall foliage color. The clone is pistillate-constant, pollen-variant non-astringent (PVNA). Fruit is small, spheroid, 2" diameter x 1½ long; with medium thick, red-orange skin. Flesh is yellow-orange if seedless, astringent until ripe, and sweet. Flesh is black if seeded, with up to 8 seed, edible when mature firm but less flavorful. It has a tendency to develop black concentric cracks on fruit apex. Ripening season is late September through October, holding fruit after leaf fall. Vigorous young-bearing trees set a few summer fruit (2nd crop) that do not mature before freezing weather.

Pete Humble is the one surviving seedling of kaki seed planted circa 1948 at 17388 Blackwater Road (La. Hwy. 410), East Baton Rouge Parish (EBRP), Louisiana by the late Pete Humble. In addition to the original seedling tree there are 4 ramets: one at place of origin in EBRP, one at 6191 Metz Rd. and two at 5159 Pine St., St. Francisville in WFP, La.

The tree is slightly spreading, reaching about 20 feet. "Pete Humble" is pistillate-constant. The fruit is small, resembling 'Saijo' in size and shape, astringent until soft ripe, yellow-orange with medium thick skin. The flesh is yellow and sweet. Ripening starts late October continuing through December and, if no hard freeze, the fruit holds on the tree into January. It is definitely an alternate bearer. [Fruit with seed have not been observed .]

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Compilers assemble information into an over-all story that serves as a review of the state of the art at a given point in time, which is 2 to 5 years before the publication of the summary. Teachers and compilers have neither the time, the money, nor the facilities for verifying all that is either printed or passed along by oral contact. Interpretation of the information gleaned from many sources is based on the reviewer's professional knowledge, professional naivety, and state-of-the-art. There will be mistakes in interpretation. This compiler reserves the right to be wrong. As a lady who played the piano in church said to him – "I'm not the best, but I am the best of those willing to do the job."
Become a good observer and you will observe: Most scientists and doctors are trained to focus on one system which is usually isolated from all others. Their first reaction to something new from the outside is to defend their turf, and also, to deny new evidence coming from those they consider less qualified. Actually we, ourselves, are all guilty of this "Territorial Imperative" of subject matter.

This compilation is dedicated to the late Captain Arthur L. Holdeman, 1917-1999, merchant seaman, who could have been a great botanist if fate had not turned him toward the sea.

TRANSLATIONS

Glossery - Kitagawa & Glucina, p71.

amai	- sweet
-gaki	- [suffix] persimmon
amagaki	- sweet (non-astringent) persimmon
ampo-gaki	- half-dried persimmon
hoshigaki	- dried persimmon
"Kinokawagaki"	- trade name for 'Hiratanenashi' fruit treated with alcohol while still on the tree
mamegaki	- pea or small (*D. lotus*)
o' gaki	- large persimmon
shibugaki	- astringent persimmon
yamagaki	- wild or mountain persimmon (*D. kaki*)
jukushi	- overripe, fruit very soft
kaki	- Oriental persimmon (*D. kaki*)
kaki-shibu	- kaki-tannin, substance causing astringency
o' or oh	- large
oku	- late maturing
shibui	- astringent
tanenashi	- seedless
wase	- early maturing

Variety Names - after Reich pp 90-91.

'Fuyu'	- Winter
'Fuyugaki'	- Winter Persimmon
'Hanafuyu'	- Winter Flower
'Hanagosho'	- Flower of the Imperial Palace
'Hiratanenashi'	- Flat Seedless
'Saijo'	- Very Best One
'Tanenashi'	- Seedless
'Matsumoto Wase Fuyu'	- Matsumoto's Early Fuyu