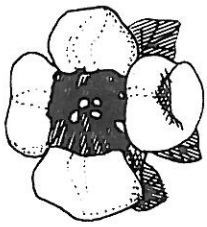

GROWING PERSIMMONS

Division of Agricultural Sciences
UNIVERSITY OF CALIFORNIA

LEAFLET 21277

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COOPERATIVE EXTENSION
UNIVERSITY OF CALIFORNIA
MERCED, CALIFORNIA

GROWING PERSIMMONS IN CALIFORNIA

INTRODUCTION

Oriental persimmons can be grown in many areas of California. At one time they were widely grown commercially in southern California, but commercial production is now largely confined to the the San Joaquin and Sacramento Valleys. As an ornamental or yard tree the Oriental persimmon is prized for its fruit, which matures in October and November, and its freedom from pests and diseases.

The Oriental or Japanese persimmon *(Diospyros kaki)* has been grown widely in China and Japan for centuries. A member of the Ebenaceae family, it is related to other persimmon species including *D. lotus* and *D. virginiana* (native American persimmon) which are used for rootstocks. Certain species in tropical Asia and Africa furnish ebony wood.

The best Japanese and a few Chinese varieties were introduced as grafted nursery trees between 1870 and 1920 by the United States Department of Agriculture, the University of California, and commercial growers. Out of more than 500 introductions only a few varieties are presently marketed.

Virtually all persimmon fruit sold in the U.S. is grown in California. In 1981, there were about 700 acres in California, although the average in the 1930's and 1940's reached 2,000 acres. Statewide yields average about 5 tons per acre and individual trees have been known to produce up to 400 pounds of marketable fruit.

With satisfactory cultural conditions, a persimmon orchard may come into commercial production by the fifth or sixth year. Full production is seldom attained until the tenth year. Development costs may be amortized by the end of the tenth year if cultural conditions are favorable.

The characteristic astringency of unripe persimmons is caused by soluble tannin in the flesh. This astringency disappears in most varieties when the fruit ripens and softens; in others it disappears when the flower is pollinated and the fruit becomes seedy. In Fuyu and a few other nonastringent varieties, the flesh is edible when mature and firm.

Hachiya variety, a seedless astringent type, is picked when mature and firm, but must be allowed to soften before astringency disappears, after which the fruit may be eaten.

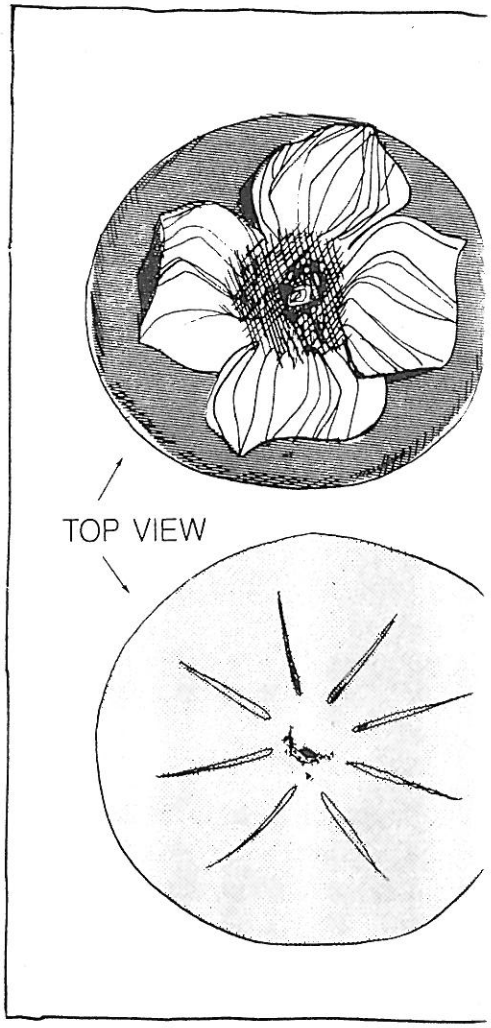
COMMERCIAL VARIETIE

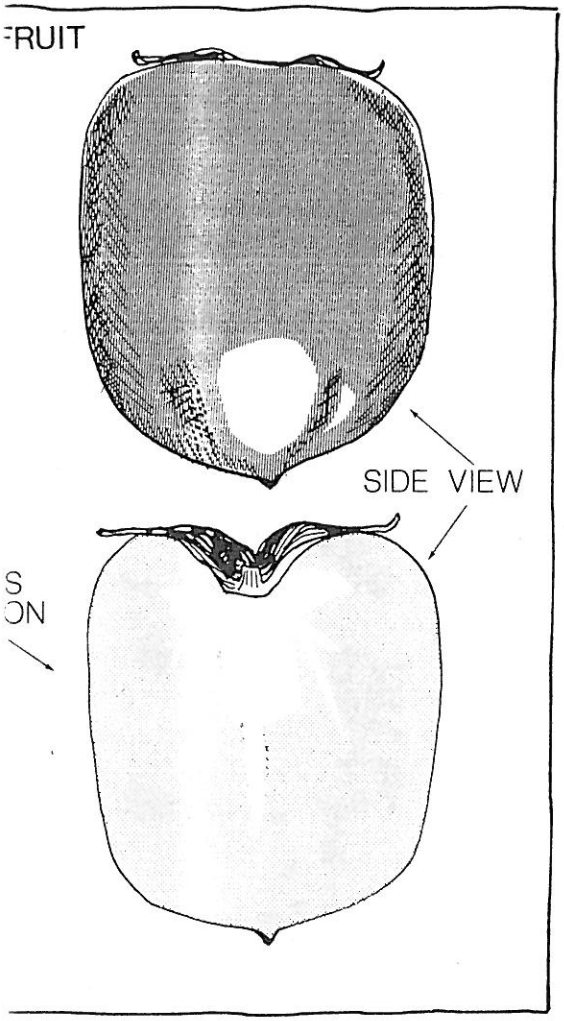
Hachiya is by far the most desirab popular variety grown in Californ accounts for about 90 percent of th ing acreage. Most of the remaining a is made up of nonastringent Fuyu some specimen plantings of several ent varieties.

Hachiya fruit is large, oblong, c (acorn shaped), and deep orang Properly handled it ripens uniform is usually seedless with an attractive golden orange flesh. It brings the bes on the fresh-fruit market.

Hachiya trees may produce light crops ı some areas, especially when young. Vhen pollinated, black areas appear in he flesh around the seed. As this gives ut fruits an undesirable appearance, the Iachiya variety should be planted in solid locks without pollinators. The flowers will enerally set good crops parthenocarp- cally (without pollination) and produce eedless fruit.

The Hachiya tree is the best growing f major commercial varieties. With care- ul training it develops a structurally strong op capable of bearing a tremendous load f fruit.

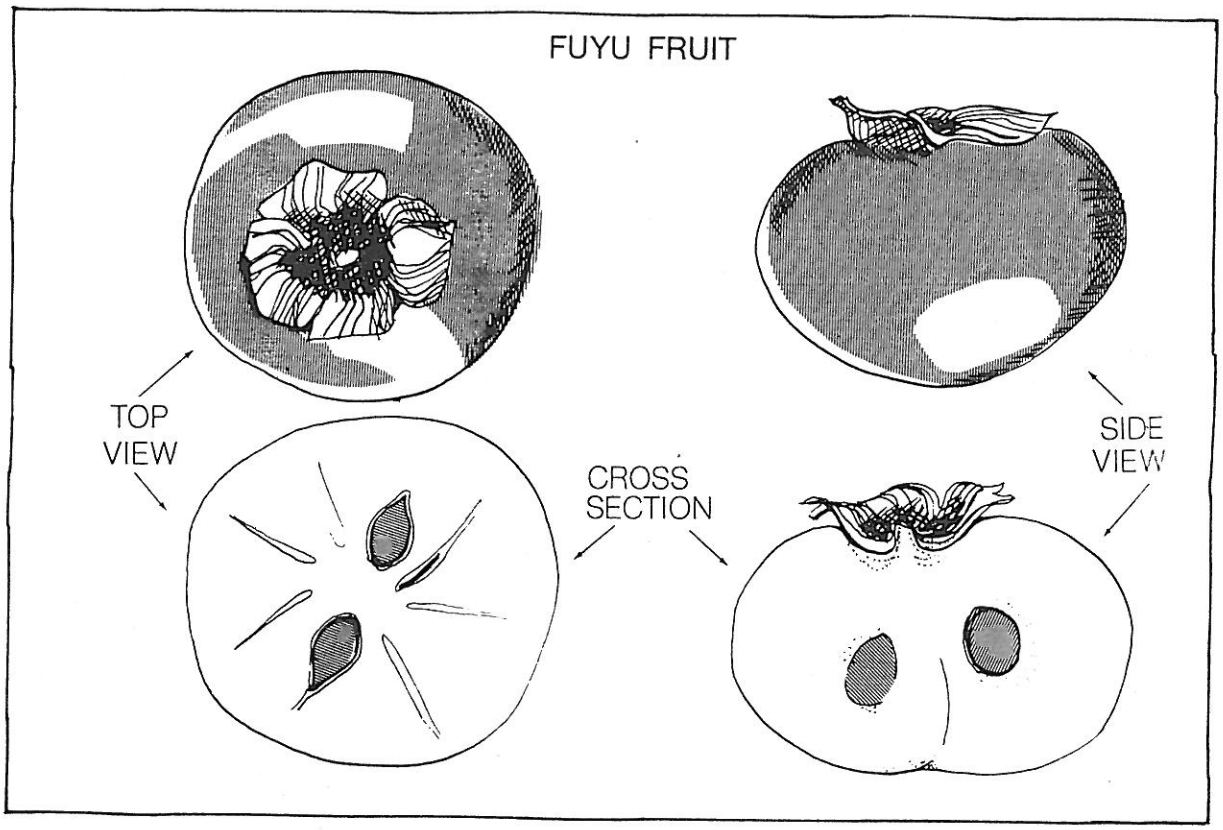




Fuyu fruit is flat and nearly round with an orange-red color. The flesh is firm and nonastringent with a pleasing flavor. Fuyu produces only female flowers fruiting without pollination. If another variety producing male flowers is present some of the fruit will be seedy. Leaves of the Fuyu tree are a distinctive yellow color in the spring.

Fruit of the Giant Fuyu tends to be larger than the older selection of Fuyu. The tree is a good bearer and has an upright, vigorous growth habit making it easy to train and maintain.

Other varieties are of interest but not important commercially. Hyakume is an orange colored, medium size, late maturing fruit and generally has chocolate or cinnamon colored flesh resulting from pollination. Maru includes several cultivated varieties that produce round orange-colored fruits which have sweet chocolate-colored flesh. Tamopan is a large, astringent, thick skinned, orange colored, late ripening persimmon with a characteristic constriction around the center of the fruit. Tanenashi is a large orange colored fruit resembling the Hachiya but with inferior flavor and mealy texture.



CLIMATE

The Oriental persimmon grows and produces well in both subtropical and temperate areas of California including southern California, the Central Valley and the San Francisco Bay area. It produces well in the hot Sacramento and San Joaquin Valleys and adjacent foothills as well as in the milder, more humid coastal sections of central and southern California.

The persimmon does not require the winter chilling needed by most deciduous fruits, and blooms late enough in April to miss spring frosts in most areas. Large mature trees can tolerate winter temperatures as low as 10° F.

SOILS AND IRRIGATION

Persimmons grow well on a wide range of soils. Although they grow better on heavy clay soils than most other fruit trees, they grow and produce best on deep, fertile, medium textured, well drained soils. Persimmons are about as sensitive as walnuts to excess salinity and boron.

Although persimmon trees withstand considerable drought, fruit size and yield suffer if there is insufficient moisture during the growing season. Satisfactory fruit set and adequate early shoot growth require that ample moisture be present in the soil before spring growth. For maximum fruit size, continued tree growth, and ample foliage development, adequate soil moisture must be maintained by irrigation throughout the entire growing season. A total of 36 to 48 inches of irrigation water in addition to rainfall is needed to produce a good persimmon crop.

Root injury may result if the soil remains saturated during the growing season. When grown on *D. lotus* rootstock, persimmons tolerate excessive soil moisture better than most other deciduous fruit trees. Persimmons tolerate hard-pan soils better than most trees but crop and tree size will be limited.

ROOTSTOCKS

The three Diospyros species grown in California have also been used as rootstocks for the Oriental persimmon varieties.

D. lotus is now the most widely used persimmon rootstock in California. It produces uniform seedlings and rarely produces suckers. Trees grown on *D. lotus* are thrifty and adaptable to a wide range of soil conditions. It is compatible with most commercial varieties.

D. kaki seedlings produce long taproots with few fibrous laterals and the oldest orchards in California are propagated on this species. Seed taken from seedy varieties known to produce uniform vigorous seedlings provide the most desirable source for rootstock propagation.

Seedlings of *D. virginiana* have good fibrous root systems that tolerate both drought and excess moisture. Unfortunately, trees propagated on this stock have not been uniform in size and vigor, and the rootstock suckers badly.

PROPAGATION

Seedlings may be grown from fresh seed although it is advisable to sow in the fall or stratify at 45° to 50° F for 60 to 90 days. After stratification they can be ger-

minated in boxes in a greenhouse held at about 70° F. Germination of seeds is not high, with 25 to 35 percent germination being common. The seedlings are then lined out in the nursery row during spring, when soil temperature is 55° F or higher. Care must be taken to prevent loss of roots from drying or rough handling. Transplanted seedlings must be shaded until they become well established.

Seeds may be planted directly in the nursery row, but by using seed beds and transplanting when plants are 6 to 8 inches high a better lateral root system develops. Plants are set from 8 to 12 inches apart in the row, with rows spaced 3 to 3½ feet apart.

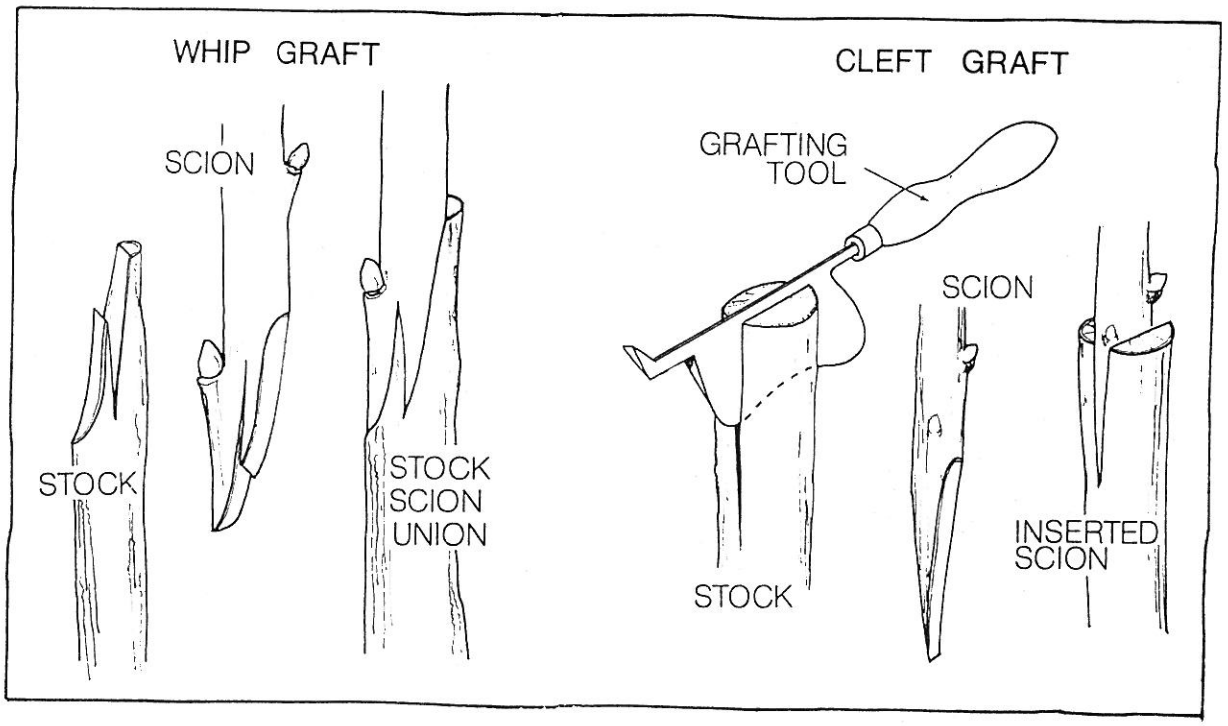
Seedlings usually attain sufficient size for budding or grafting at the end of a season's growth. Grafting is done when stock and scion are dormant. Scions taken from vigorous shoots of the previous season's growth should be ¼ to ⅜ inch in diameter and 3 to 5 inches long with 2 to 4 buds.

Whip grafting of small trees and cleft grafting of large ones give best results in topworking persimmon seedlings and trees. Some propagators have had good results bark grafting using stored scion wood. Budding gives variable results and is seldom done.

ORCHARD SPACING AND PLANTING

In shallow, less fertile soils, lower-vigor varieties such as Fuyu can be spaced as closely as 12 by 16 feet to obtain good yields without serious tree crowding. In deeper, well-drained soils Fuyu is best planted 15 to 18 feet apart. In contrast, the vigorous Hachiya is best at 24 by 24 feet to avoid crowding on deep soils, and 20 by 20 feet apart on shallow soils.

Because the persimmon tree has fragile roots it must be transplanted with care. Trees should be set in the field at the same depth they grew in the nursery row.



Roots must be protected against drying at all times. To insure good root contact with moist soil, trees should be irrigated immediately after planting.

FERTILIZATION

Persimmons respond to nitrogen fertilization. Mature trees require about 1 pound of nitrogen per year depending on the inherent fertility of the soil.

Phosphorus and potassium requirements are not high and most California soils are amply supplied with these macronutrients. Micronutrient deficiencies such as zinc may be corrected by foliar sprays in a manner similar to that used for stone fruits.

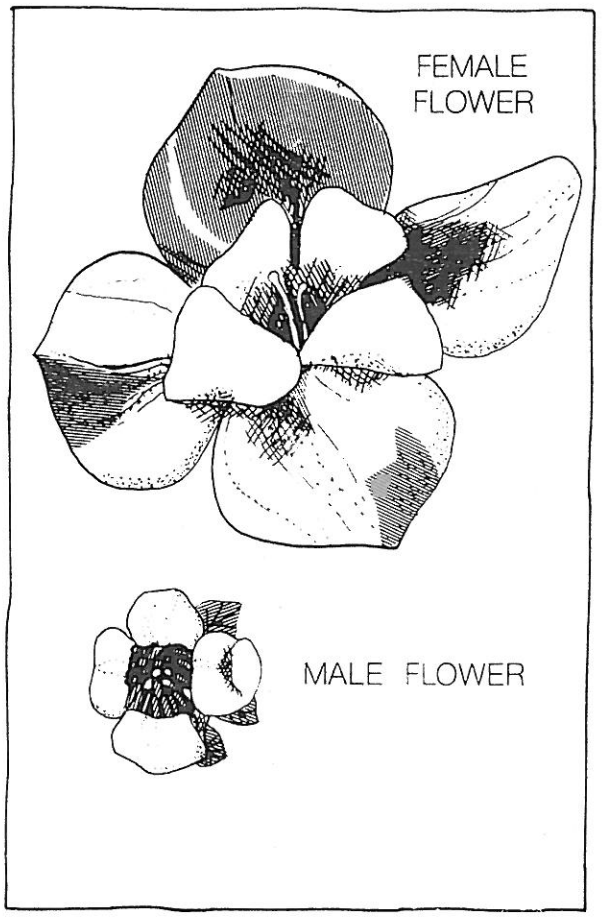
TRAINING AND PRUNING

Young trees are trained to develop a modified leader system with well spaced lateral branches. To establish an upright, structurally strong tree, especially in areas where there is wind or strong prevailing breezes, stake it with a stout 4- to 5-foot stake for the first 2 or 3 years. Develop 3 to 5 main limbs at about 1-foot intervals with the first limb about 3 to 4 feet above the ground. Pinching off (heading) vigorous shoot growth during the first and second growing seasons helps force the growth into the proper framework branches.

The pruning of mature trees should be light and confined mostly to small cuts to thin out weak shaded branches, or to head back excessively vigorous growth. If large saw cuts are needed, it usually indicates that training has been neglected. Cross-over, diseased, and broken limbs are removed during the annual winter pruning. Low branches in danger of breaking from the weight of fruit should be pruned back or propping and tying may be necessary to prevent breakage.

Because flowers of *D. kaki* are borne on wood of the current season's growth, moderate pruning every year or two is desirable to stimulate moderate new growth. Vigorously growing young trees shed more fruit than do older ones with moderate growth, and heavy pruning causes long shoots that break when heavily cropped in future years. On the other hand, weak growing, lightly pruned trees do not mature good crops of acceptable market-sized fruit. Moderate annual pruning helps keep trees fruitful and structurally strong to support heavy crops.

Picking persimmons from a hydraulically operated man positioner.



PESTS AND DISEASES

The persimmon is relatively free from serious pests and diseases. Citrus mealybug, *Panococcus citri*, largely controlled by natural enemies, may at times be troublesome in southern California. Orange tortrix, *Argyrotaenia citrana*, occasionally attacks persimmon fruit in southern California but is of little consequence in the San Joaquin Valley. Sporadic infestations of the red-humped caterpillar, *Schizuva concinna*, may defoliate persimmon trees. Olive scale, *Parlatoria oleae*, has also been found on persimmons but this pest is normally controlled by parasitic wasps.

Root-knot nematode is not a serious pest of persimmons. Citrus and other nematode species have been found on persimmon roots but apparently cause little damage. Crown gall, caused by *Bacterium tumefaciens*, is the most troublesome disease of persimmon. Infections may be avoided by using disease-free nursery stock and preventing injuries to trunk or crown roots that may permit entrance of the bacteria. *Stem pitting* disease, probably of virus nature, has been observed on trees planted on *D. kaki* but not on *D. lotus*.

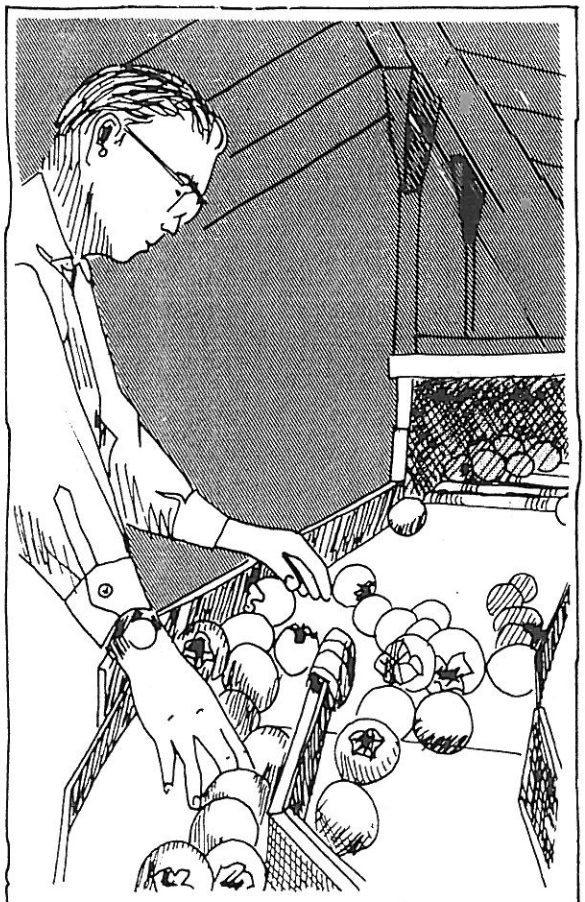
HARVESTING

Persimmons picked for the fresh-fruit market should be well matured and of characteristic color. Standards set by the California Agricultural Code require persimmons to attain a specified color before being marketed. Experience shows that firm fruit allowed to remain on the tree until they develop good color command the best prices and provide maximum consumer satisfaction. Fruit picked when still immature does not soften evenly and may remain partly astringent.

To harvest, the fruit is clipped leaving the calyx and a short stem attached to the fruit. Persimmons may be snapped, but this takes some skill and may cause fruit injury.

Careful handling minimizes bruising. Bruising causes brown spots which lower the grade. Using rigid containers such as picking buckets reduces fruit injury (as compared to picking in picking bags). Because of their pointed apex, Hachiya must receive special handling care. Field boxes or bins are used for transporting fruits from orchard to packinghouse.

Harvesting of early-maturing varieties starts about September 25 and, with later varieties, continues to approximately December 10. The most active period is from October 10 to November 15.

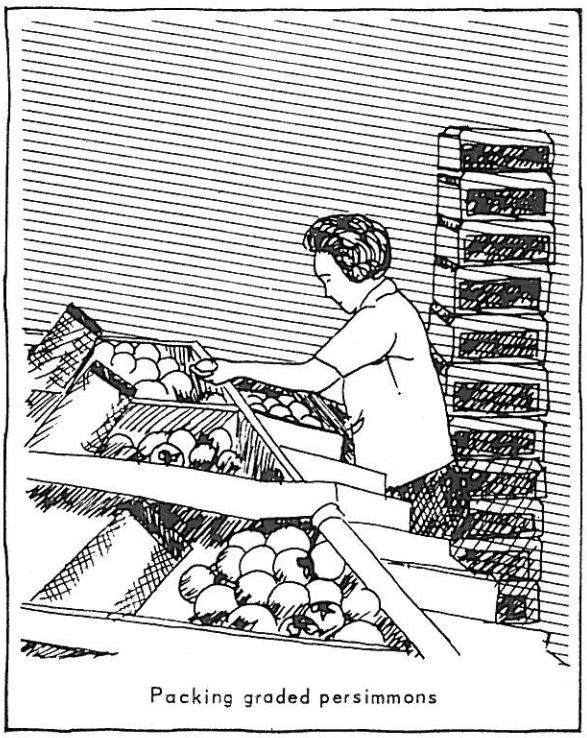


Grading washed and waxed Hachiya persimmons

PACKING

Persimmons are picked and packed when ripe but still firm. Care must be taken during the entire process to prevent bruising. Most persimmons are commonly packed in 1-layer lugs, although 2-layer lugs are sometimes used. Plastic tray packs are also used in both 1- and 2-layer boxes. Packers must conform to size and maturity standards adopted by the industry and stated in the Agricultural Code.

Markets usually require each box to show the name and address of the grower or packer, and the variety and count size.



Packing graded persimmons

MARKETING

About half of California's persimmon crop is shipped to local California markets, principally San Francisco and Los Angeles. The rest usually goes to eastern markets—New York, Philadelphia, and Chicago; a small portion goes to Hawaii. Many areas in the U.S. remain untapped potential markets for this delicious fruit.

UTILIZATION

Cold storage facilities enable growers to harvest Hachiya fruits at optimum maturity and hold them for orderly marketing. Consumers can keep persimmons in a cool place for a considerable time before use. They can also be frozen and held for a year or longer—before freezing they may be peeled, pureed and then frozen in tight containers. They also can be frozen whole in plastic bags and then thawed as needed.

When put in cold storage persimmons hold best at 32° F.

Besides being used fresh in salads, the persimmon may also be eaten as a dessert. Persimmons are widely utilized in cookies, breads, cakes, pies, ice cream, jams, and jellies.

Dried persimmons are commonly used in the Oriental diet. Fruits used for drying are harvested when ripe and firm. After being peeled and sun dried, they are stored at about 65° F and in a relative humidity of 50 to 60 percent. During storage or slow drying a surface covering of sugar crystals gradually appears, and this improves the appearance of the product. Dried persimmons contain a large amount of dextrose and are comparable to dried peaches in food value.

REMOVING ASTRINGENCY

When persimmons are picked ripe but still firm, they are sometimes slow to soften and lose astringency. This process may take 2 to 3 weeks at 70° F but can be speeded up by placing the fruit in a freezer for about 24 hours. When the persimmons are removed and thawed, they are both soft and free of astringency, and may be eaten fresh immediately or cooked.

Firm, ripe persimmons may be placed with an apple in a plastic bag or fruit-ripening bowl. Ethylene gas released by the apple speeds up the process of softening and astringency loss in persimmons.

Persimmons for California

Kay Ryugo ❑ Charles A. Schroeder ❑ Akira Sugiura ❑ Keizo Yonemori

Oriental persimmons were probably introduced into Europe from Japan by early silk and tea traders. Europeans, especially the Italians, refer to the persimmon, *Diospyros kaki* L. (Ebenaceae family), by the Japanese name kaki. This is because the name persimmon is strictly American, of Algonquian origin. In 1856, Commodore Matthew C. Perry obtained persimmon seeds when the American naval fleet visited Japan. He had them planted on the grounds of the Naval Observatory, near Washington, D.C., but none of the seedlings survived.

Later, the U.S. Department of Agriculture (USDA) imported from the Orient a large number of cultivars as well as the species *D. lotus*, which is commonly used as a rootstock for *D. kaki* cultivars. These and other cultivars brought over by Japanese and Chinese immigrants before 1919 were propagated at the USDA Plant Introduction Garden then in Chico, California. The USDA station at Beltsville, Maryland, also assembled many cultivars, which were distributed primarily to the southern states.

In 1919, a quarantine was imposed on the importation of persimmons to prevent introduction of diseases and insect pests. Many cultivars from the Chico Plant Introduction Garden were repropagated on the University of California campus at Los Angeles and at the UC Wolfskill Experimental Orchards in Winters. Part of the UCLA collection was moved to the UC South Coast Field Station in Santa Ana in 1960.

The distribution of cultivars from these sites, nurseries, and individual growers provided the nucleus of the persimmon industry in California. Some cultivars assembled at the Chico Plant Introduction Garden were subsequently discovered to have been mislabeled, misspelled, or carried under the provincial names of their points of origin in China, Korea, or Japan when they were introduced. Researchers in California, Italy, and Israel noticed that a cultivar presumed to be Fuyu that was distributed from Chico occasionally bore male flowers, whereas other Fuyu trees did not. Male flowers have never been reported on the original Fuyu trees in Japan. In Italy and Israel, the cultivar that bears male flowers is referred to as the California Fuyu, because the cultivar was initially sent to these countries from California.

Although the fruits of Fuyu and California Fuyu or Cal-Fuyu are indistinguishable in shape, size, and color, the two clones should be marketed as separate cultivars. During our attempt to clear up the confusion in names and identification of other persimmon cultivars, we found these two clones to be genetically different. Leaves sampled from trees growing in the two campus collections were analyzed for isozyme patterns using starch gel electrophoresis (as described by Tao and Sugiura, *HortScience* 22:932-35, 1987). Cal-Fuyu and Fuyu differ from one another in their GPI (glucose-phosphate isomerase) patterns but are nearly alike in their PGM (phosphoglucomutase) patterns (fig. 1). GPI patterns of Fuyu and Jiro are indistinguishable, but the

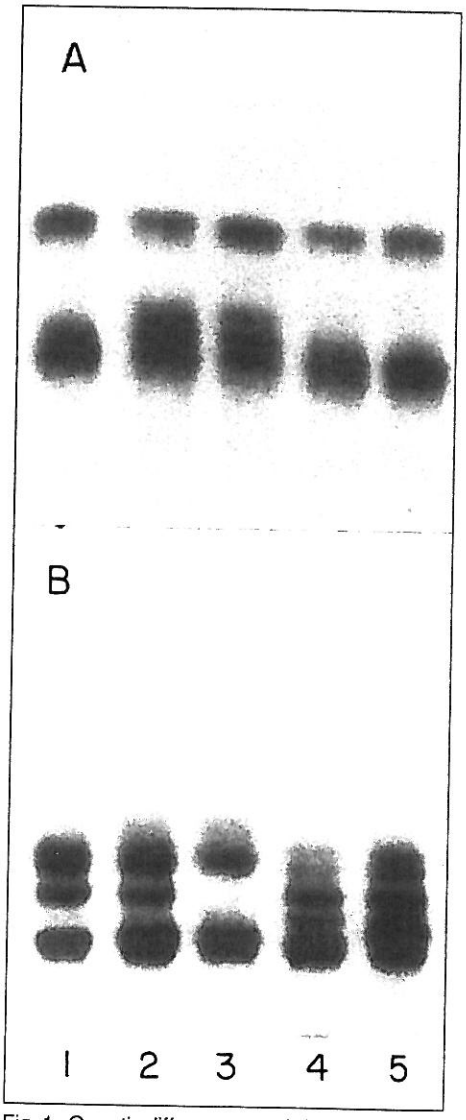
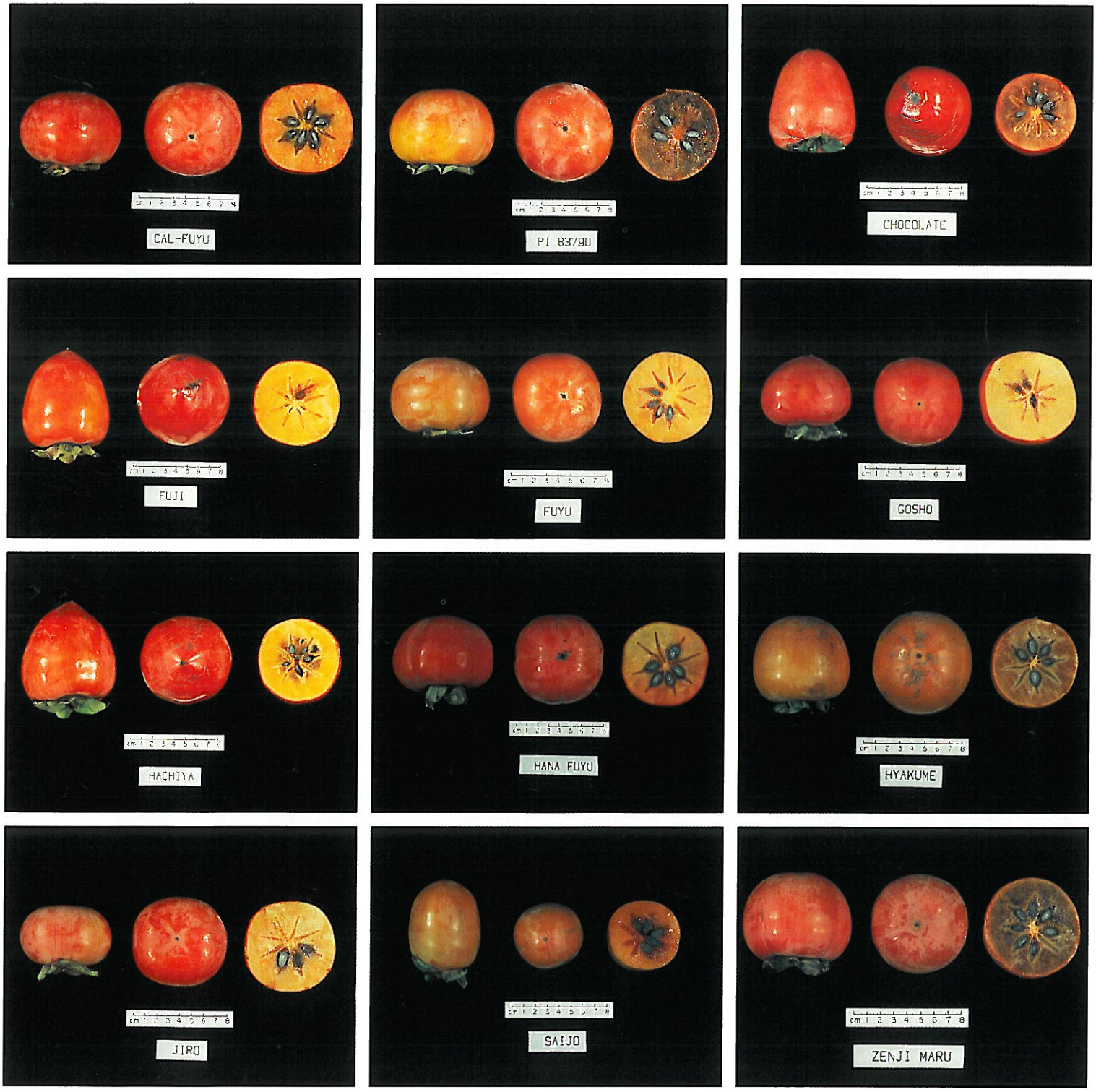


Fig. 1. Genetic differences and similarities in persimmon cultivars are apparent in leaf isozyme patterns of glucose-phosphate isomerase (A) and phosphoglucoisomerase (B) for California Fuyu (1), Fuyu (2), Jiro (3), Hana Fuyu (4), and Gosho (5).

Although the name 'persimmon' is American, of Algonquian origin, the major cultivars grown commercially in California belong to a species first brought to the United States from Japan in the 1800s. Most of these cultivars have distinct differences in fruit size, shape, and color.



PGM isozyme patterns of these two cultivars are distinctly different. The differences and similarities in isozyme patterns among Fuyu, Jiro, and Gosho are the same as gel patterns obtained from the persimmon collection at Kyoto University, Kyoto, Japan.

Classifications

Asian persimmons are classified as either pollination-constant or pollination-variant (table 1). The flesh of pollination-constant fruits, such as Fuyu and Cal-Fuyu, remains orange-yellow even though they have seeds. The flesh of pollination-variant types, such as Chocolate, turns brown around the seed.

Each group is further divided into astringent and nonastringent types, based on their flavor at maturity. Japanese horticulturists have subdivided the pollination-variant group into the two types according to the degree of browning of the flesh. By this classification, which is subjective, Zenji Maru is nonastringent and Hachiya is astringent. The classification is also arbitrary, because nonastringent cultivars, such as Fuyu, tend to be slightly astringent if they are grown where summers are short and cool, as in northern Japan. The astringency cannot be removed from fruits grown in these districts by treatment with ethanol fumes or ethylene as it can be with other astringent cultivars.

Persimmons are also classified as (1) pistillate-constant if only female flowers are borne; (2) staminate-constant if male flowers are produced consistently; or (3) staminate-sporadic if the clone bears male flowers in some seasons and not in others. Of the cultivars listed in table 1, Chocolate, Gosho, Hana Gosho, and Zenji Maru are staminate-constant; Cal-Fuyu is staminate-sporadic; the others are pistillate-constant. Seedlings that produce only male or mostly male flowers may exist in the wild, but they are not cultivated.

Cultivar information

California Fuyu or Cal-Fuyu. This cultivar was introduced as Fuyugaki syn. Fuyu kaki and labeled PI 26491 on the map of the former USDA Plant Introduction Gardens at Chico, California. Unlike Fuyu, some Cal-Fuyu trees bear male flowers sporadically on isolated branches. Cal-Fuyu has been marketed as Fuyu because of their similarity.

California Maru. This cultivar was introduced as PI 83790 but mislabeled as Jiro. Jiro is pollination-constant, has entirely different fruit characteristics, and differs genetically (as indicated by isozyme patterns) from California Maru. It is being renamed California Maru, because its origin cannot be traced. Currently there is no other cultivated persimmon with its eating quality. The ripe fruit is juicy and has a crisp texture, unlike that of Zenji Maru or Hyakume, which tend to be more buttery. Seeded fruits of California Maru have the shape of Zenji Maru; the skin color of California Maru is orange, while that of Zenji Maru is more reddish.

Chocolate. The size, shape, and coloration of this cultivar match those of Tsuru-no-ko. Chocolate produces many male flowers, however, while Tsuru-no-ko is reported to be pistillate-constant. Chocolate should be an excellent pollenizer for the pollination-variant cultivars, California Maru, Hyakume, and Zenji Maru, which require seed formation for the flesh to turn brown.

Fuji. This cultivar is considered the same as Hachiya in Japan, because fruits and leaf isozymes appear identical. Fruits of Fuji frequently produce the browning reaction around the seeds, as do those of Hachiya. Fuji trees grown at the Wolfskill Experimental Orchard always set a better crop than do Hachiya trees.

Fuyu. The leaf isozyme patterns and fruit size and eating quality indicate that this cultivar is identical to the original cultivar Fuyu, widely grown in Japan. Trees tend to bear in alternate years, producing large quantities of small fruit in the "on" year and a modest crop of large fruit in the "off" year. In Japan, the crop is thinned early in the on year to obtain large fruit at harvest.

Gosho or Gosho-gaki. Even seedless fruits of Gosho size well and have a reasonably good storage life, but the seeded fruits with slightly darker flesh color develop better flavor.

Hachiya. This cultivar was the basis of the persimmon industry in California until recently, when nonastringent types like Fuyu and Jiro became more popular. Hachiya fruits frequently produce brown flecking around the seeds in some seasons and areas but not in others; as a result, it has been reclassified as pollination-variant. Hachiya is eaten fresh, frozen, or as a dried product, and is used in puddings and cookies.

Hana Fuyu. Labeled Jumbu at Wolfskill, Hana Fuyu is marketed as Giant Fuyu in California. The fruit is large but it softens very soon after harvest and lacks flavor, being almost insipid.

Hyakume. The light yellow skin of Hyakume forms concentric cracks around the apex at maturity. When seeded, the brown flesh has a spicy flavor and a firm nonmelting texture.

Jiro. This cultivar has also been propagated and sold as Fuyu in California. Jiro fruits are more truncated and squarish in cross-section than those of Fuyu. Leaves of Jiro trees, more so than Fuyu leaves, appear chlorotic in the early spring, especially after a cold, wet winter.

Saijo. Fruits are small and are a dull yellow when mature. The flavor of a ripe Saijo fruit is ranked among the best by gourmets. The mature fruits are attractive when dried, especially if they are treated with sulfur dioxide before dehydration to prevent browning.

Zenji Maru. A Japanese Buddhist monk introduced Zenji Maru in about 800 AD to provide dessert fruit for the poor. The cultivar is an alternate bearer. The fruits develop a deep red color but tend to become soft and juicy when fully ripe. If harvested in prime condition, the brown flesh of the seeded fruits has an excellent flavor and texture.

The cultivars Hana Gosho, Hiratanenashi, Izu, Maekawa Wase Jiro, Matsumoto Wase Fuyu, and Suruga (table 1) have been imported by nurseries and private growers. These cultivars are established under quarantine in the National Germplasm Repository on the UC Davis campus and will not be available for distribution until January 1989.

TABLE 1. Classification of Asian persimmons by flesh color and astringency

Pollination-constant		Pollination-variant	
Astringent	**Nonastringent**	**Astringent**	**Nonastringent**
Saijo	California Fuyu	Fuji	Chocolate
Tamopan	Fuyu	Hachiya	California Maru (PI 83790)
Tanenashi	Hana Fuyu (syn. Yotsudani, Jumbu, Giant Fuyu)	Hiratanenashi	Hyakume (syn. Ama-hyakume)
Tsuru	Gosho		Zenji Maru
	Hana Gosho		
	Izu		
	Jiro		
	Maekawa Wase Jiro		
	Matsumoto Wase Fuyu		
	O-Gosho		
	Suruga		

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