Oriental Persimmons in Florida

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HISTORY

Oriental persimmons Diospyros kaki L., have been grown in Florida for many years. At one time there were commercial plantings of astringent types numbering about 22,750 trees. Because of marketing difficulties, this industry ceased. Currently plantings of non-astringent types are increasing and both types of oriental persimmon are a popular dooryard fruit in Florida. Trees grow and fruit best in central and northern Florida and can produce high yields of quality fruit. In south Florida fruit quality is better with astringent types than with the non-astringent ones.

Oriental persimmons were introduced into this country by Commander M. C. Perry in 1856. The U.S. Department of Agriculture imported many trees in the 1870s and planted them in the southern United States. Professor Harold Hume of the University of Florida was one of the first to study the oriental persimmon in America. He developed a classification system in the early 1900s which is the basis for those used today. Hume, along with George Tabor of Glen St. Mary’s Nursery, also worked with breeding and cultivar evaluations. Judge Ware and Dr. Robert Dunstan, during the 1960s and 70s, imported and evaluated many important Japanese cultivars. Professor Ralph Sharpe, with the University of Florida, tested, evaluated, and published information on persimmons. During the 1980’s newer cultivars, especially non-astringent types, were introduced from Japan and studied in the department of Fruit Crops at the university. Florida has a rich history with oriental persimmons and has been a prominent state for cultivar evaluations.

Many persimmon cultivars exist in Florida from both importations and seedling grown trees. Persimmon names often represent an approximation of the Asiatic names by which the original imported trees were designated. Today, we have a number of cultivars with Asiatic or pseudo-Asiatic names and meanings, as well as some with truly American names. Some of the oriental words used have the following meanings: Kaki or Gaki - persimmon, Wase - early, Hana - flower of, Tanenashi - without seed, Fuyu - winter, Saijo - best, Gosho - imperial palace, Ichi - number one, and Ki - life.

PERSIMMON FRUIT CHARACTERISTICS

Classification

Persimmons are classified into two types based on fruit characteristics. The first classification is of the astringent and non-astringent cultivars. Astringent fruit must be soft or artificially treated before astringency is removed and they are suitable for eating. Fruit of the non-astringent types lose astringency while still hard and can be eaten hard or soft. The second classification relates to fruit flesh color when seeds are present. In pollination-variant types, the flesh is dark and streaked around the seeds,
but clear orange when seedless. Pollination-constant types lack the dark streaking regardless of seed set.

In astringent cultivars of the pollination-variant type, the dark flesh is non-astringent even when hard; therefore, seeded, pollination-variant, astringent cultivars perform as non-astringent types. The amount of dark flesh coloration around the seeds varies with cultivars. In most areas of the world, astringent pollination 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. Some dark specks can be found in the flesh of 'Fuyu' and other non-astringent cultivars. This is not linked to seed set, and has no significance to the variant-constant classification system.

Ripening

Harvest season for astringent persimmon fruit is just prior to and through the soft stage of fruit development. If picked during this time, the fruit is either soft or will become soft and the astringent tannins are coagulated, making the fruit suitable for eating. Generally, fruit can be picked and softened at room temperature about 7 to 10 days before it would be softening on the tree. The time varies slightly with cultivars, and is about the same for both astringent and non-astringent types. Not all fruit in the crop load develop to this state at the same time. The softening process will be less effective and take longer to occur the earlier the fruit is picked.

Choosing the proper harvest season for non-astringent persimmons is less complicated than for the astringent types, because they can be eaten firm. The astringent tannins are broken down earlier in the fruit development period at a time when the fruit is still hard. They are easier to harvest, store, and market than astringent types, and are very popular in many parts of the world. Fruit are harvested by color and can be rated for ripeness by a color chart. The elimination of green by the increasing development of yellow and/or orange to orange-red is a general indication of marketable fruit.

Softening and astringency removal can be induced by covering the fruit with uncooked dry rice for 3-5 days. Freezing the fruit for 24 hours will have similar results. Ethylene gas can be used to speed up the ripening process and develop more fruit color.

Environmental injury, such as picking by birds or scoring by wind, and fruit imperfections such as tip-end cracks, calyx separations, or apical growth rings, will also induce softening. Generally, the further the fruit is from the soft state when the openings or splits occur, the more localized the ripening spot is on the fruit. With growth ring cracks and tip splits the fruit ripen and develop color from the apical end upwards with the opposite true for calyx separations.

Marketing and Use

Marketing astringent persimmons in this country is often difficult. Soft fruit are hard to handle and spoil quickly. Many commercially marketed California astringent persimmons, although attractive, have been picked too early. This does not allow the fruit to lose astringency without treatment, and gives consumers a bad experience, such that they will be reluctant to eat persimmons again. In Japan, to remove astringency, fruit are sprayed with 35-40% ethyl alcohol and placed in a sealed container for 10 days at 69°F. The firm product is of good quality, is easily marketed, and will soon soften.

In this country, the ideal use of astringent persimmons is home consumption, drying, and u-pick operations. In oriental homes, fruit from the garden persimmon tree are peeled, strung or skewered, then hung to dry. Dried fruit are sweet and delicious with the sugar often crystallized on the fruit surface, making the product white and attractive. The dried peal is used as a dyeing agent. In Florida, sun drying halved or sliced fruit in a glass or polyethylene chamber or commercial food dryer produces a delicious product, ready in 3 to 7 days. The fruit may be sulfur fumigated for better appearance and storage. Drying naturally removes all astringency.

Non-astringent fruit are good for fresh eating and are excellent with pears, dates, apples, citrus, raisins, and/or coconut in salads. They have distinct advantages in marketing and handling because they can be picked earlier and have a longer shelf life. Consumer acceptance is greater because they do not have to be eaten in the "gooey-drippy" state which is objectional to many people.

Storage

Generally, since astringent persimmons must be soft, or near that state at harvest, they do not store well; however, non-astringent types can store up to 30 days at room temperature. Colors will increase
somewhat, sugar will remain the same, and weight will decline 7 to 10%. Only fruit without imperfections store well over a long period. Generally, the early maturing cultivars such as ‘Izu’ have a shorter shelf life than late season ones like ‘Fuyu’. In Japan, fruit are individually wrapped in thin polyethylene and stored at 32°F for 4-5 months. The fruit will still be of good quality when removed from storage.

**Sugars**

Percent of soluble solids or sugars increases for both types of persimmons as the fruit gets closer to the soft, tree-ripened stage. Sugars, measured as soluble solids, in non-astringent fruit average 15 to 20%. Generally, sugars in astringent fruits are slightly higher, sometimes reaching 24% in the later maturing cultivars. Fructose and glucose make up 90% of the total sugars, with sucrose a minor component.

**Texture**

The flesh texture of soft astringent and non-astringent fruit varies considerably. Some fruit like ‘Saijo’ are juicy with a high jelly consistency in the flesh and a translucent, deep-orange appearance. Other fruit like ‘Great Wall’ and ‘Tanenashi’ are pasty, somewhat dry, and opaque. Non-astringent fruit are of best quality when crisp like an apple with juicy, orange flesh and a small jelly area in and around the carpels. Some cultivars are quite stringy with fibers that attach to the calyx and go vertically around the carpel section towards the apical end. They are apparent when fruit are soft-ripe. Peel thickness also varies among cultivars, with ‘Hiratanenashi’ having a thick peel, ‘Tanenashi’ a medium one, and ‘Saijo’ a relative thin one.

**Physiological Fruit Imperfections**

The most common physiological fruit disorder of astringent types occurs on cultivars with conic or round-conic fruit. The disorder is concentric growth rings that appear as small dark lines around the apical end of the fruit. Uneven ripening occurs when these rings split open in the later stages of fruit development.

Separation of the calyx from the flesh section of the fruit is a disorder that appears more commonly on non-astringent than astringent types. A cavity develops in the fruit as the calyx ceases to grow in July, while the flesh section continues to enlarge up to harvest. The cavity forms on one side of the calyx and causes uneven ripening, poor storage and a site for disease infection. Fruit that have a large calyx relative to the size of the fruit at the time of flowering are less likely to develop the disorder.

Splitting at the apical end of the fruit is found on large-fruited, mainly non-astringent, types. The splits enlarge and crack during the last month of ripening. They are formed because fusion of the base of the stigma, during flowering and early development, is incomplete. This disorder is cultivar specific.

**Fruit Season**

The harvest season, especially for commercially grown non-astringent types, is generally the earliest time when the crop has enough color to be marketed. The crop can remain on the tree a month longer becoming softer with greater colors and sugar.

The harvest season in Table 1 and Table 2 is for trees grown under improved conditions with some insecticide/fungicide applications. Early fall defoliation will delay and sometime cease crop ripening. Type of rootstocks and certain physiological and environmental conditions may also affect ripening times.

**PERSIMMON FRUIT AND TREE DIMENSIONS**

**Fruit Shape**

Three general fruit shapes are: conic (cone-shaped), roundish (round and sometimes pointed at the apex like an acorn), and oblate (flattened like a large standard tomato). Other noticeable characteristics occur such as an indented ring around the fruit of ‘Midia’ and ‘Tamopan’. Four sides will sometimes be apparent on fruit of ‘Great Wall’ or ‘Saijo’. Distinctly lobed sections are present on ‘Sheng’ and ‘Peiping’. Some cultivars are tucked or folded in at the calyx like ‘Suruga’.

**Fruit Size**

Fruit size is affected by crop loads. The lighter the crop set, the larger the fruit. The sizes given in Table 1 and Table 2 are average size fruit under normal crop load. Small fruit generally weigh 3.5 to 4.5 oz, medium from 5.5 to 7.0 oz., and large 8 to 14 oz.
Tree Size and Shape

Semi-dwarf plants reach a height of around 6 to 8 ft and have a rounded spreading top. ‘Makawa Jiro’ and ‘Ichikikei-Jiro’ are examples of this type. Trees with medium size tend to be taller with more upright shoots. Their limbs are usually spread with crop loads. By far, most persimmon trees fall into this category. Trees in the tall class are upright and often have small fruit. Generally, tree size is reduced as trees are grown south of Gainesville to south Florida.

Descriptions of Some Non-astringent Cultivars

Early Season Cultivars

‘Izu’ is the earliest ripening non-astringent cultivar. The tree regulates crop loads well, producing large fruit which are generally blemish-free. The tree is not as vigorous or precocious as Fuyu are and it will come into production about 5 years from planting. Soluble solids, between 15 to 17%, are not as high as later maturing cultivars.

Mid-Season Cultivars

‘Matsumoto Wase Fuyu’ is an earlier ripening bud sport of ‘Fuyu’ discovered by Mr. Matsumoto. The tree sets many flowers and produces heavy clustered crops. The clusters should be thinned to prevent bent limbs with excessive fruit loads. The tree is moderately vigorous and of medium size. Soluble solids range from 16 to 19% which is generally true for most mid-season types.

‘Ichikikei Jiro’ is a bud sport from Jiro. The tree is comparatively smaller than most and regulates its crop loads well. It will mature seedless crops and is a good homeowner cultivar. Apical end splitting usually occurs in a percentage of the fruit. The tree is around 7 days later than most cultivars to begin growing in the spring. This sometimes helps it to escape spring freeze injury.

‘Hana Fuyu’, also known as ‘Yotsundani’, or ‘Giant Fuyu’ regulates crop loads well and is of medium vigor. The fruit are slightly larger than most, generally free of imperfections and may be slow to lose astringency. The tree is a good homeowner cultivar.

‘Hanagosho’ is a large tree with vigorous upright growth and a strong scaffold system. The tree will usually have a small amount of male flowering every year and crop regulation is good. The fruit and leaves are slightly more susceptible to late season pathogens than most cultivars. ‘Hanagosho’ is a large tree and a good homeowner cultivar.

‘Shogatsu’ is similar to ‘Hanogosho’ in tree habit, however, more problems with fruit end splitting and leaf spots occur.

‘Jiro’ can be erratic in cropping when the tree is young. Older trees have a good, well spreading shape and produce quality crops of mid-season fruit. Some apical end fruit splitting will occur.

‘Midia’ is the largest of the non-astringent types with fruit often weighing ¾ of a pound. An indented ring forms around the top half of the fruit. The tree is an inconsistent cropper, and seems more susceptible to tree decline than other cultivars.

Late Season Cultivars

‘Fuyu’, also known as Fuyugaki, is the most popular non-astringent tree in Florida and is the most widely grown persimmon cultivar in the world. Fruit thinning is usually necessary to ensure large fruit, prevent clustering and regulate crop loads. Incidence of fruit imperfections are low, yields are good, and the tree is generally well adapted. Soluble solids average 18 to 19%. Many different cultivars with the name ‘Fuyu’ or ‘Fuyugaki’ exist. The best cultivar is the one commonly available in Florida.

‘Suruga’ is the sweetest of the non-astringent types with soluble solids often over 20%. Red coloration in mature fruit is strong, and fruit imperfections are infrequent. Seeded crop loads must be thinned to prevent over production. The cultivar seems to have more problems with leaf defoliating pathogens than other cultivars.

Recommended Commercial Cultivars

Plantings of non-astringent persimmons can be made to include cultivars that will ripen fruit from late September to early December. The cultivars recommended seem to produce the highest percent of marketable fruit. ‘Izu’ is the choice for the early season, ‘Matsumoto Wase Fuyu’ for the mid-season, and ‘Fuyu’ for the late season. Fuyu is the most readily available and is generally considered the best commercial nonastringent cultivar in Florida.
Table 1. Characteristics of non-astringent cultivars.

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Harvest season</th>
<th>Fruit shape</th>
<th>Fruit size$^z$</th>
<th>Tip cracking</th>
<th>Pollination type$^y$</th>
<th>Tree vigor$x$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuyu</td>
<td>November to Early Dec.</td>
<td>Oblate</td>
<td>M-L</td>
<td>no</td>
<td>PC</td>
<td>M</td>
</tr>
<tr>
<td>Gosho</td>
<td>November</td>
<td>---</td>
<td>M</td>
<td>some</td>
<td>PC</td>
<td>M</td>
</tr>
<tr>
<td>Hana Fuyu</td>
<td>October</td>
<td>Oblate</td>
<td>M-L</td>
<td>no</td>
<td>PC</td>
<td>M</td>
</tr>
<tr>
<td>Hanagosho</td>
<td>Mid-Oct. to Mid-Nov.</td>
<td>Round conic</td>
<td>M</td>
<td>some</td>
<td>PC</td>
<td>V</td>
</tr>
<tr>
<td>Ichikikei Jiro</td>
<td>Mid-Oct. to Mid-Nov.</td>
<td>Oblate</td>
<td>M-L</td>
<td>some</td>
<td>PC</td>
<td>L</td>
</tr>
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<td>Izu</td>
<td>Late-Sept. to Mid-Oct.</td>
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<td>M-L</td>
<td>no</td>
<td>PC</td>
<td>L-M</td>
</tr>
<tr>
<td>Jiro</td>
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<td>Oblate</td>
<td>M-L</td>
<td>some</td>
<td>PC</td>
<td>M</td>
</tr>
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<td>Makawa Jiro</td>
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<td>M-L</td>
<td>some</td>
<td>PC</td>
<td>L</td>
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<tr>
<td>Matsumoto Wase Fuyu</td>
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<td>M</td>
<td>no</td>
<td>PC</td>
<td>M</td>
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<tr>
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<td>Late-Oct. to Mid-Nov.</td>
<td>Round Conic</td>
<td>L</td>
<td>no</td>
<td>PC</td>
<td>M-V</td>
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<tr>
<td>Ogosho</td>
<td>Mid-Oct. to Mid-Nov.</td>
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<td>---</td>
<td>PC</td>
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<tr>
<td>Okugosho</td>
<td>November</td>
<td>---</td>
<td>M</td>
<td>some</td>
<td>PC</td>
<td>V</td>
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<tr>
<td>Shogatsu</td>
<td>Late-Oct. to Mid-Nov.</td>
<td>Oblate Conic</td>
<td>M</td>
<td>some</td>
<td>PV</td>
<td>V</td>
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<tr>
<td>Suruga</td>
<td>November-early Dec.</td>
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<td>M-L</td>
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<td>Tenjigosho</td>
<td>October</td>
<td>---</td>
<td>M-L</td>
<td>some</td>
<td>PC</td>
<td>L-M</td>
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</tbody>
</table>

$^z$ M=Medium; L=Large
$^y$ PC=Pollination Constant; PV=Pollination Variant
$x$ L=Light; M=Medium; V=Vigorous

DESCRIPTIONS OF SOME ASTRINGENT CULTIVARS

Early Season Cultivars

‘Nishumura Wase’ is an early cultivar, ripening its first fruit in early August. It is pollination variant and must be fully seeded to be non-astringent. It consistently sets male flowers. The fruit have soluble solids around 13% to 15% and are somewhat watery. The tree is well-spreading, somewhat vigorous and a good annual cropper.

‘Saijo’ is similar to ‘Saijo’ in fruit quality, although the fruit are much larger and begin ripening 2 weeks later. Fruit are light translucent orange and thin pealed with a sweet, juicy, jelly type flesh. ‘Giombo’ fruit are a connoisseur’s choice. The tree is early to start growth in the spring and is sometimes injured by freezing temperatures.

Mid-Season Cultivars

‘Tanenashi’, the most popular astringent cultivar in Florida, matures heavy crops without pollination and will seldom set seed even if pollinated. It is usually desirable to thin the fruit to obtain some vegetative growth during the year. The fruit, often large, 3½” across, can weigh over ¼ of a pound. Skin color is deep yellow to orange when mature. The
flesh is orange, pasty, comparatively dry, and of acceptable quality. Soluble solids average 16%. Harvest duration may extend from September through November. It is a good tree for homeowners.

‘Hachiya’ is a commercial cultivar in California. Ability to set and hold fruit is sometimes a problem if this cultivar is propagated onto Diospyros virginiana rootstock. The fruit are high quality and jelly-fleshed with an attractive red skin coloration. Fruit will often have concentric ring cracking at the apical end and will ripen unevenly starting from these points. Perhaps more than one cultivar shares this name.

‘Hiratanenashi’ is a widely grown commercial cultivar in Japan. The fruit have a thick peel and a long shelf life. The flesh is juicy, somewhat watery and almost always seedless. The astringency is sometimes difficult to remove after the fruit have been harvested unless they are artificially treated.

‘Sheng’ is a well spreading tree with large fruit having lobed sections looking somewhat like a 4 or 6 leaf clover from the top. Fruit have a high jelly content, are bright orange, and when pollinated will set many seed.

‘Great Wall’ is a strong growing, upright tree having small 4-sided fruit. The flesh is dry, similar to ‘Tanenashi’, but of excellent quality.

‘Tamopan’ is a cultivar with large fruit having a circular depression around the top ⅔ nearest the stem. The fruit is juicy, watery and stringy, with a thick peel. More than one cultivar of this tree exists, some of which have better fruit than the one described.

‘Yomato Hyakume’ is a pollination variant type, but will not have a great deal of dark flesh around the seeds. The fruit are large with a deep orange-red color. Concentric ring cracking often occurs. This cultivar is a heavy annual cropper with good fall leaf retention. It is excellent for dried fruit and is one of the best astringent types.

‘Eureka’ has been widely propagated by southern nurseries and is a common cultivar in Texas. It has a large, round, flat-shaped, pollination variant fruit with a medium amount of dark flesh around the seed.

‘Gailey’ is the standard pollinating cultivar and has small to medium size fruit. Concentric ring cracking is common and its pollination variant fruit are very dark-fleshed, even with small seed numbers.

‘Ormond’ is sometimes called the Christmas persimmon. Fruit are long, conic and are often harvested in January. The tree begins growing early in the spring which increases chances for freeze injury.

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Harvest season</th>
<th>Fruit shape</th>
<th>Fruit size</th>
<th>Apex cracks</th>
<th>Pollination type</th>
<th>Tree vigor</th>
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<td>Round</td>
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<td>Ama Hyakume</td>
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<td>Round Conic</td>
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<tr>
<td>Atago</td>
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<td>Brad Sample</td>
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<td>Long Conic</td>
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<td>October</td>
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<tr>
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<td>PC</td>
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<td>Cultivar</td>
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<td>Fruit shape</td>
<td>Fruit size(^a)</td>
<td>Apex cracks</td>
<td>Pollination type(^b)</td>
<td>Tree vigor(^x)</td>
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<td>October</td>
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<td>V</td>
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<tr>
<td>Nia Nia</td>
<td>---</td>
<td>Round Conic</td>
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<td>M</td>
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<td>Nishumura Wase</td>
<td>Aug to Mid-Sept.</td>
<td>Round Conic</td>
<td>M-L</td>
<td>no</td>
<td>PV</td>
<td>M</td>
</tr>
<tr>
<td>Okame</td>
<td>October</td>
<td>Oblate</td>
<td>L</td>
<td>no</td>
<td>PV</td>
<td>M</td>
</tr>
<tr>
<td>Omiya Wase</td>
<td>Mid-Sept. to Mid-Oct.</td>
<td>---</td>
<td>S</td>
<td>---</td>
<td>PV</td>
<td>M-V</td>
</tr>
<tr>
<td>Ormond</td>
<td>December</td>
<td>Long Conic</td>
<td>S-M</td>
<td>no</td>
<td>PC</td>
<td>M-V</td>
</tr>
<tr>
<td>Peiping</td>
<td>Late Oct.-Mid-Nov.</td>
<td>Oblate</td>
<td>M-L</td>
<td>no</td>
<td>PC</td>
<td>V</td>
</tr>
<tr>
<td>Siajo</td>
<td>Mid-Sept. to Mid-Oct.</td>
<td>Conic</td>
<td>S-M</td>
<td>no</td>
<td>PC</td>
<td>M</td>
</tr>
<tr>
<td>Sheng</td>
<td>Mid-Oct to Mid-Nov.</td>
<td>Oblate</td>
<td>M-L</td>
<td>no</td>
<td>PC</td>
<td>M</td>
</tr>
<tr>
<td>Tamopan</td>
<td>November</td>
<td>Oblate</td>
<td>L</td>
<td>no</td>
<td>PC</td>
<td>M-V</td>
</tr>
<tr>
<td>Tanenashi</td>
<td>Late Sept. thru Nov.</td>
<td>Conic</td>
<td>M-L</td>
<td>no</td>
<td>PC</td>
<td>M</td>
</tr>
<tr>
<td>Triumph</td>
<td>October</td>
<td>Oblate</td>
<td>S-M</td>
<td>no</td>
<td>PC</td>
<td>M</td>
</tr>
<tr>
<td>Tsuru</td>
<td>November</td>
<td>Long Conic</td>
<td>M</td>
<td>---</td>
<td>PC</td>
<td>M</td>
</tr>
<tr>
<td>Yemon</td>
<td>October</td>
<td>Oblate</td>
<td>M</td>
<td>no</td>
<td>PV</td>
<td>M</td>
</tr>
<tr>
<td>Yatsumizo</td>
<td>October</td>
<td>Conic</td>
<td>S</td>
<td>no</td>
<td>PC</td>
<td>M</td>
</tr>
<tr>
<td>Zenj Maru</td>
<td>Late Aug. thru Sept.</td>
<td>---</td>
<td>S</td>
<td>---</td>
<td>PV</td>
<td>M</td>
</tr>
<tr>
<td>Yamoto Hy kume</td>
<td>October</td>
<td>Conic</td>
<td>M-L</td>
<td>yes</td>
<td>PV</td>
<td>M</td>
</tr>
</tbody>
</table>

\(^a\) S=Small, M=Medium; L=Large  
\(^b\) PV=Pollination Variant; PC=Pollination Constant  
\(^x\) M=Medium, V=Vigorous
Recommended Astringent Cultivars

Cultivars with good performance can be selected to represent a ripening season from mid-August to late December. They are ‘Nishumura Wase’, ‘Saijo’, ‘Tanenashi’, ‘Yamato Hyacume’, ‘Sheng’, and ‘Ormond’. ‘Nishumura Wase’ and ‘Ormond’ are the early and late fruits. ‘Saijo’, ‘Yamato Hyacume’ and ‘Sheng’ have clear flesh, high jelly content fruit with top sugar readings. ‘Tanenashi’ is the most widely planted cultivar and generally has consistent production of large medium quality fruit.

PERSIMMON CULTURE

Propagation

Rootstock

Most of the oriental persimmon trees grown in Florida are propagated onto the common native persimmon, Diospyros virginiana. It is distributed from Connecticut to Florida and as far west as Kansas and Texas. The fruit are small, seedy and astringent until fully soft with a delicious nutty flavor. This rootstock is desirable because of its adaptability in Florida. Its vast root system forages well and will handle both flooding and drought conditions. For seed production, both male and female trees should be selected for vigor and fall leaf retention.

D. kaki seedlings are used widely in other areas, but are not generally available in Florida. The root systems are more compact than D. virginiana making transplanting easier. Some seedling susceptibility to nematodes has been observed. This stock will provide tree resistance to Cephalosporium wilt which will kill D. virginiana. D. lotus is not recommended as a rootstock due to graft incompatibility in later years with some cultivars.

Rootstocks of D. virginiana are grown from seed that have been taken from mature fruit. Ripening dates for native trees vary from late August to December. The fruit are collected for seed as they ripen. The pulp is squashed, rinsed and floated off to separate it from the seed. Clean, damp seed are dusted with a fungicide such as Thiram, sealed in a plastic bag and stored in refrigeration (35-45°F). The seeds are planted usually January-February. The root shoot will emerge in 1 to 6 weeks and leaves will push off the seed coat 1 month later. Seeds can be sprouted between wet newspaper and then planted. D. kaki seeds should be treated in the same manner.

It is important that persimmon seeds not be dried down as this reduces viability.

Chip Budding

Trees can be chip budded a few weeks before foliation in the spring to a month before the leaves become inactive in the fall. Chip budding is the easiest and most versatile technique for propagation. The most successful time is just before the rootstock pushes in spring and continuing for a month after full leaf. Generally, it is important to make a shallow cut on the stock to reduce bleeding. The cut should only penetrate into the green-yellow, slick layers, which should be thick and juicy indicating an actively growing, healthy tree. Only a little to none of the white xylem area in the middle of the cut should be exposed in chip budding after the stock is active.

Chip budding is often used from late August into October on 5-7 month-old seedling nursery trees. Fall frosts must not occur within 6 weeks of budding to allow for sufficient callousing. The bud is forced in spring. For optimum bud take, rootstocks should be growing and full of leaves that are free from fungal spot. Buds should be placed in smooth bark 1-6 inches from the ground. Bud take will decrease in rough, thick, more mature bark and on trees with leaves that are dropping or heavily spotted. Callous will be slow late in the fall and on trees that are hardened off or have reddish purple leaves. The dark, softer root area below the ground surface may also be chip budded. The budded portion is covered up with soil until callousing is complete.

All chip buds are wrapped with plastic grafting tape, which covers the bud and cut surface. Linkup will occur in 2 to 6 weeks, and there will be enough callous to enable unwrapping 3 to 12 weeks after budding. The stock is cut off above the bud to force the shoot. The bud will green up in a few days and push leaves 1 to 1½ weeks later. To force fall buds in the spring the stock is usually allowed to form leaves before forcing. The longer wait minimizes chances of freeze damage. Shoots should be staked to prevent the rapidly-growing, tender shoot from breaking off in the wind.

Whip Grafting

Whip grafting is mainly done in the spring from a month before stock foliation to just after leaves emerge. The graft union can be placed below the soil line and then covered to increase take. Trees can
also be grafted low and a soil bank heeled up around the union, or the union placed 3-4" high and not covered with soil. Whip grafts can be preformed through the growing season with limited success. Both burying the union and waxing the scion will increase chances of take.

**Bark Grafting**

Trees are bark grafted successfully from just after full leaf, usually late April, through May and perhaps even later into the summer. The tree trunk or a large limb is sawed off leaving a flat surface from one to several inches in diameter. A few feeder limbs can be left below the cut for more rapid growth. A long, sloping cut is made on the scion leaving 2-4 buds. The same width and length cut is made on the stock starting at the top of the sawed off portion and going downward. The scion is inserted between the two layers that will easily slip from each other. The strip of stock bark will peal back and cover the back side of the scion as it is pushed down to the top of its cut. Two to four scions are inserted around the sawed-off trunk on the flattest portions available. They are then wrapped tightly around the stock with wide flagging or grafting tape.

Aluminum foil is placed on the stock top to reflect light. A clear plastic bag covers the whole union and cut area with the scions poking through. It is sealed to the tree and around the base of the scions with plastic budding or flagging tape. The scions can be waxed to prevent drying. Growth will begin in 2 to 4 weeks, and it will be rapid and strong making stakes necessary.

**Other Propagation Methods**

T-budding can be successful on persimmons when the bark will slip in the spring. Propagation material is dormant winter wood. Summer T-budding may also be successful and fresh wood with well developed buds is used. The xylem can be left intact on the scion bud or it can be removed. In the spring the buds are wrapped with a budding rubber and the bud is left exposed. Summer buds are covered with tape. The cleft graft can be used on large trees by cutting the tree off in the spring a month before and up until bud break. The stock is split by pounding a large knife or grafting tool approximately 1 inch into the top. The tool is removed and the cut is wedged open. Scions with two sloping cuts on each side forming a V are inserted on each end of the tree where the cambial layers will match. When the wedge is removed the scions will be held tight. All cut surfaces are then coated with wax or thick latex paint.

**Budwood**

Budwood can be collected in August for fall propagation. For spring budding or grafting, wood is usually cut in February or March before any bud swelling occurs. It is stored dry at 35-45° in a closed plastic bag and checked monthly for any signs of dehydration. If wood shriveling occurs, a small amount of moisture may be added to the bag. Winter budwood can be kept for 7 months and often be successfully propagated.

**Tree Planting**

The trees should be planted on moderate to well drained soil. It is advisable to select a site that allows for good air drainage or protection to reduce the possibility of freeze damage. Plant bare-root trees December through February, keeping the roots moist when out of the ground. Prune the tree back to ½ the original height at planting. Trees purchased in containers can be planted any time of the year, but water must be applied often during establishment since the container medium will dry out quickly. If the tree has been growing in the container for over 6 months, it is best planted when dormant by shaking off the potting soil and spreading out the roots which have grown around in the container. Transplanted trees can be staked for support.

The planting holes should be large enough so the root system is neither crowded nor bent. Badly broken roots should be pruned before planting. The graft union should be at or slightly below ground level, usually 2-4" below where it was planted before. It is advisable to put a small amount of soil into the hole, pack it around the roots, and repeat this procedure until the hole is full of soil and the plant firmly in place. After planting, make a soil ring around the edge of the hole to form a reservoir for water. This reservoir should be completely filled with water to settle the soil around the roots. The soil should not dry out, and when the tree starts growth watering 1 to 2 times per week during dry weather is essential for the first growing season.

The tree need not be fertilized at planting, but should have light monthly applications April through August for the first year. An area approximately 2-3 feet from the trunk of the tree should be mulched, herbicided, or shallow cultivated to control weeds.
Irrigation

Established persimmon trees are quite drought tolerant, especially when propagated on the native stock, *D. virginiana*. Leaf wilting usually does not occur during a 6 week dry period.

The quantity of irrigation water and when to apply it depends on the frequency and amount of rainfall, the type of irrigation system used and the soil type. More frequent irrigations will be required on sandy soil than on clay or organic soils. Newly planted trees will often need biweekly waterings. *D. virginiana* as a rootstock has a widespread root system and is able to tolerate dry conditions once established. The roots will also withstand submersion for periods of up to a week. The tree may shed its leaves, but will usually recover. *Phytophthora* root rot may at times cause problems on wet soils.

Microjet or drip are good types of irrigation which allow fertilizer injection. Microjet will provide cold protection by freezing water around the trunk on cold, still nights. It can also be used to cool the southeast side of trunks which are warmed by the winter sun and sometimes damaged during freezing nights late in the dormancy period.

Fertilization

Although fertilizer requirements for persimmons have not been studied extensively in Florida, recommendations based on practices in other parts of the world, especially Japan, can be made. Trees should be fertilized 3 times a year; in March when still dormant or about 2 weeks before foliation, in June, and again in late August to early September.

Generally, after 7 to 10 years a tree will reach good production and will need the highest rate of fertilizer. For mature trees, nitrogen and potassium are applied at 100 to 120 lb per acre or ½ lb per tree of each element every year. During the first application 50% of the rate is used with 25% applied in the two subsequent applications. Nitrogen in nitrate form is limited because it’s rapid availability may promote fruit drop. Phosphorus should be supplied at 50 lb per acre or 3/8 lb per tree annually. It can all be applied in the spring application. Magnesium should be used at 30 to 50 lb per acre applied with the first application or split between the three.

A good fertilizer mix for persimmons in peninsular Florida for the spring is ¾ lb of 46% urea, 1½ lbs of sulfate of potash magnesia, ¼ lb of triple super phosphate and ½ lb dolomite, dependent on pH, applied to a mature tree. June and August fertilizing should consist of ½ of a lb of a 1 to 2 mix of 46% urea and sulphate of potash magnesia.

Generally, 7½ to 10 lbs per tree of a 10-10-10-3 NPK Mg fertilizer can be applied annually using the 3 application times at the 50, 25, 25 percentages. Spring planted trees are not put on the regular fertilizer schedule but are fertilized only lightly during the first growing season. One-year-old trees are fertilized at one eighth the rate for mature trees or about ¼ lb of this fertilizer applied in 3 applications at the 50, 25, 25 percentages. Each succeeding year of tree age this fertilizer dosage is increased by ½ to 1 pound.

Native *D. virginiana* in Florida grows best on soils with pH of 6.0 to 7.0. Where pH is below 6.0, lime should be used to raise the pH to 6.5. In high pH soils, generally those over 7, iron and manganese problems can occur. Lack of iron will show up as intervenial yellowing and in severe cases whitish, yellow leaves. Magnesium deficiency can occur from high potassium or calcium levels. Stunted and blackened terminal leaf tips are indications of magnesium deficiency.

Fertilizer studies in Japan show nitrogen to increase flower production and is generally the most important element. Potassium appears to promote shoot growth, high phosphorus levels increase fruit color, and magnesium aids in the production of seed.

Training And Pruning

Modified Central Leader

Most persimmon trees in the United States are trained to the modified central leader system. Under this pruning system, trees approach the natural growth shape of an unpruned tree. Pruning should allow a density of 145 trees per acre with 15 ft between trees and 20 ft between rows. The main upward shoot is cut back or modified to force lateral growth of side shoots. Three to 6 branches are encouraged, starting 3 ft from the ground and up to 4 ft above that point. The branches should radiate around the canopy circumference and initiate from points not adjacent to one another. The final shape of the canopy is a broad-based, rounded-top pyramid.
Second year winter pruning consists of selecting lateral branches fitting the pattern and removing those which formed in the wrong places. Upright shoots that have narrow crotch angles are pruned out because they will not be strong enough to hold fruit loads. The central leader is trimmed back about \( \frac{1}{3} \) and the terminals of selected shoots are cut slightly to encourage further branching.

Third year winter pruning follows the same pattern as second year pruning along with removing inside or vertical limbs which cross or rub each other. Twig terminals and some side shoots on main lateral branches should be left unpruned. This pattern is followed each successive year. The height of the tree is limited by cutting off strong growing sprouts and the vertical growth of the central leader or any lateral branch. As the tree gets older, the fruiting portions tend to spread farther from the center. It is necessary to cut back some limbs providing more branching and fruiting terminals the following year. Attention must also be paid to thinning the canopy for light penetration. Pruning must maintain a balance between fruiting and vegetative vigor. Generally, not a lot of wood needs to be pruned from persimmon trees.

**Palmette System**

This system affords a greater yield per acre. It works well for persimmons, peaches, apples and pears in other countries. Trees can be planted 15 ft. in rows and 10 ft between the rows giving 290 trees per acre. The tree is flattened down the row and simulates the shape of a palmetto palm leaf. Limbs are supported along 3 or more horizontal wires in the center of the row running 3 to 3½ ft, 6 to 6½ ft, and 8½ to 9 ft parallel to the ground. The first two limbs are established opposite each other at 2 to 2½ ft, in line with the wires and spread out at 45 degree angles from the trunk. Two limbs are formed at each 2 ft interval. All limbs are attached to the wires as they meet them.

Young branches can be spread to a 45 degree angle by using a spacer between the trunk and branch. Limbs can be spread by pulling them with a string attached to the ground or by hanging dirt filled plastic bags around them such that the bag’s weight forces the limb down.

Two end posts 14 ft x 6 in are placed 4 ft in the ground in the row center 7½ ft back from the last planted tree. These posts are set in concrete and lean at an angle with the bottom 12 inches closer to the first tree than the top. The measurement is taken at the bottom of a plumb line hung from the top of the pole. Brace posts 14 ft x 4 in are placed 4 ft. deep every 60 ft in the row. Lengths of high-tensile 12½ gauge fence wire, such as USS Max-Ten 200, are strung through drilled holes in the poles or fence staples placed at the required height. Each wire is tensioned to 250 lbs and fastened to a 6 ft x 4 in tieback post set in concrete at a 45 degree angle 12 ft from each end post. This structure will hold fruit loads and improve fruit quality due to better sunlight exposure. It forms a structure for pulling cold protection material over the trees forming a tent which acts as an insulating blanket. The spun-bound-poly, plastic sheeting, or other material is stored in the row centers during critical times and removed after danger has passed. Growing trees in this manner is more costly, but helps to increase profits.

### Flowering, Pollination, Fruit Drop and Seed Set

#### Flowering

Most cultivars bear only female flowers in which the stamens do not have pollen for fertilization. To set seed in fruit, a cultivar must be pollinated by either male flowers or perfect flowers in which both the ovary and stamens are functional. Since perfect flowers are rare, they are not significant in pollination. Native persimmons will not pollinate the oriental type.

Male flowers are smaller than female flowers and are born on weak axillary stems with two to three flowers per cluster. Female flowers are single, surrounded by a large calyx and developed in the axis of the first leaves as the shoot expands in spring. Perfect flowers are intermediate in size. They may be in the center of a male cluster or borne singly in a leaf axis.

#### Pollination

Several cultivars have been selected for large amounts of annual male flower production and crop pollination. They are all pollination variant and small-fruited. ‘Gailey’, ‘Zenjimaru’, ‘Akagaki’ and ‘Omiya Wase’ are of this type. ‘Gailey’ is the most common in Florida and provides sufficient bloom overlap to serve as a male for all cultivars. The two large fruited astringent cultivars, ‘Nishumura Wase’ and ‘Komasoskie’, can also serve as pollinators
although male flower production is not as great. Male flowering occurs on a few of the non-astringent cultivars. A moderate amount is often seen on ‘Hanagosho’, ‘Shogatsu’ and some of the ‘Fuyu’ types.

Fruit Drop

Shedding of persimmon fruit can occur at various times throughout the growing period. The first drop is after petal fall and continues for 2 to 3 weeks. This post-bloom drop tends to bring crop loads down to a supportable level. Lack of pollination and seed formation may be factors contributing to the drop.

A second fruit drop may occur in June. Research in Japan indicates that lack of sunlight in the canopy area and vigorous vegetative growth may be contributing factors. Vegetative growth may be encouraged due to the summer rainy period common in Florida. Summer fertilizer applications should not include high amounts of readily available nitrogen which encourage vigorous vegetative growth.

Drops can also occur July, August, or September, but are not as regular as the previous two. The drops occur more with some cultivars than with others, but do not necessarily occur every year. Pollination, vegetative growth, lack of sunlight, disease pressures, rootstock interactions, soil conditions or heavy cropping the previous year may be contributing factors.

Seed Set

Generally, the astringent cultivars are better than the non-astringent ones at holding and ripening crops of seedless fruit. ‘Tanenashi’ and ‘Hiratanenashi’ seldom set seed even when pollen is available. Commercial, non-astringent orchards in many parts of the world use a pollinator ratio of 1 pollinator tree with every 8 to 16 trees, equally placed throughout the orchard. The more pollen produced, the better the pollinating conditions, and the more honey bees, bumble bees, and other insects that transfer pollen, the greater the seed numbers in the fruit.

Although seed production is desirable to prevent fruit drop, it is undesirable for other reasons. Heavy seed production relates to overfruiting and is known to weaken trees and increase chances for alternate bearing. Generally in Florida, non-astringent orchards have used a very low pollinator ratio, 1 to 20-40 trees. This adequately matures sufficient crop loads with 2/3 of the crop seeded and containing 1 to 3 seeds per fruit. Sufficient seedless crop loads in Florida on many of the non-astringent cultivars have been observed, but yields have not been studied over a many year period. Seedless or near seedless production may be advantageous in reducing the need to hand thin the crop.

Yields, Fruit Thinning and Harvesting

Yields

Mature trees of large fruited cultivars should be limited to 175 to 250 fruit. It is common, however, for these trees to mature 350 to 600 fruit. Heavy fruiting and seed formation will effect cropping the next year, vegetative growth, tree health, fruit size and ability to handle freeze damage. Less vigorous cultivars will have sufficient crop loads with 75 to 150 fruit. Small fruited vigorous cultivars are capable of handling crop loads of 350 fruit or more.

Fruit Thinning

To grow the best quality fruit and to regulate crop loads for optimum tree performance, thinning the fruit on a persimmon tree is often necessary. Persimmons have a tendency toward biennial bearing with large crops of small fruit one year and light crops of large fruit the next. Mature trees, especially when grown under non-improved conditions, regulate themselves, but overall yields are low. Growing conditions with increased fertility and pest control improve yields, but may lead to over-cropping and alternate bearing tendencies. Excessive cropping can be regulated by cutting fruiting twigs and thinning newly set fruit.

Most flowers are developed from the last few buds on a twig. Pruning out some of the less vigorous or inside growing fruiting twigs during late winter will reduce fruit formation in the spring. Shoots and twigs that are shaded by the canopy or are weak-growing can be removed.

Hand thinning of fruit is done after the post bloom drop or about 3 weeks past flowering. One to 4 fruit are left on a shoot. These should be spaced about 6 inches apart. Fruit should not touch each other when mature, since this provides a spot for the buildup of pests and produces scarred, sub-quality fruit. The first fruit toward the base of the shoot is generally the largest and best developed. It should be left and those that are small or misshaped should be removed. Selecting fruit with a large well-developed
calyx is important, because these fruit will have less chance for calyx-separations. The amount of thinning should be determined from the tree’s performance during previous years. Both heavy cropping and early defoliation the year before will encourage a light bloom the following year. Thinning should be limited in a year with a light fruit set. Under good growing conditions and/or pollination, thinning is important for maximizing quality annual yields.

Thinning fruit is more important on some cultivars than on other ones. ‘Fuyu’ and ‘Matsumoto Wase Fuyu’ tend to set excessive crops of clustered fruit. ‘Ichikikei Jiro’, ‘Jiro’, and ‘Izu’ regulate crop loads better so heavy thinning may not be necessary. ‘Tanenashi’ will overproduce and this sometimes limits tree size. Experience is often necessary to determine the amount of thinning and this can only be gained after 2 or 3 years of cropping.

Harvesting

Persimmons ripen from August through December. Non-astringent fruit are picked when color has developed to the yellow/orange/red stage and most or all of the green is eliminated. Astringent fruit are picked when soft or just before softening occurs.

Soft fruit can be clipped at the stem as pulling will often leave the calyx and some of the fruit on the tree. Firm fruit can be pulled if the proper technique is followed. The fruit are grasped and twisted to ½ turn, then pulled off in the same direction the twig they are attached to is growing. This will break the stem leaving the calyx with the fruit and will prevent breaking the limb or twig of the tree.

Bud Break and Freeze Damage

Bud break in oriental persimmons generally occurs late. Usually it is one month after apples, peaches, pears, blueberries and bunch grapes and two weeks before native persimmon, pecans and muscadine grapes. Since oriental persimmons are propagated on heterozygosis native trees bud break time among many trees of the same cultivar will vary.

Freeze damage usually occurs after buds swell and growth activity begins. This normally occurs February, March or April when frost or freezing temperatures follow a warm spell. Autumn and mid-winter non-dormant trees that are actively growing could also be damaged during freezing periods; however, these conditions are rare. In the fall, trees become dormant, loosing their leaves through natural senescence, leaf spot defoliation and/or frost. Lower winter temperatures occur and trees accumulate chilling units. It is not certain how much winter chilling is necessary for persimmons, but even with small amounts trees will break dormancy and grow satisfactorily. When long periods of warm weather occur after a dormant period, trees will initiate growth. Heat unit accumulation is a major factor in stimulating growth activity after dormancy. In January and February, generally 6 weeks of warm days without freezing temperatures are needed for bud swell. In late March and April only 1½ to 3 weeks are necessary for activity to occur.

If freezing temperatures occur after budswell, new leaves, shoots, swelling buds, and small twigs can be killed. If low temperatures are prolonged or severe they will cause damage to large limbs and trunks. Young healthy trees that are in the bud swell stage will usually recover from a brief period of 20°F. After a severe freeze the green cambium layer may change to brown and appear water soaked. If the terminal buds are killed, growth and sometimes flowering will occur from dormant lateral buds. Older and/or weaker trees or those that have already formed leaves will experience greater degrees of damage. Limbs, trunk portions, and entire trees may be killed. Growth, if it occurs, will come from adventitious buds on the trunk or latent buds in the limb axis. Trees may die or major damage may require 2 to 3 years for recovery. Weakened trees can be subject to fungi infecting the injured tissue and spreading to other sections of the tree. Tree borers may be associated with these injured sites.

Freeze damage may be lessened by choosing hilltops or areas with good air drainage. Cold pockets and low-lying areas should be avoided. Healthy trees are less susceptible to cold injury. Factors that cause tree stress such as over-production, inadequate nutrient levels or early autumn defoliation should be avoided. Painting trunks with white interior latex paint may prevent sunscald freeze damage, which occurs most commonly on the southeast side of the tree. When warmed by the sun, this portion of the trunk becomes active and is then frozen. Overhead irrigation of ¼ inch per hour during calm conditions and temperatures between 24 to 32°F will ice the trees and protect them from wood damage.

Placing the graft union slightly below the ground or covering it with mulch or soil will allow the tree to
sprout from undamaged scion portions. Young trees will rapidly reestablish from a new sprout. It is likely that during a 10-year period, trees in the central and northern areas of the state will suffer some freeze damage.

**Insect Pests**

**Scale Insects**

Of the insects that are associated with persimmons, those that attack the tree are more serious than those that affect the fruit. The most devastating insects are the scales found on the bark, and white peach scale is the most common. Infestations become highly visible when the males emerge in warm weather and cause a snowy-white appearance on limbs or trunks. If a scale insect is present, lightly slicing into the green cambial layer with a knife will reveal reddish-purple dots where it has probed and is feeding on the tree.

Scale insects can be scraped off with a knife, especially when colonies are small. If spring, summer, or fall buildup of scale occurs, an insecticide may be applied to the insects because they are somewhat mobile in warm weather. Severely infected limbs should be pruned out. A 3% dormant oil spray can be applied at, or just before, bud break in the spring. Since oil will cause increased tree temperatures and speed up leafing, the application should be late to guard against increasing chances of freeze damage.

**Persimmon Psylla**

The persimmon psylla is an insect which feeds on leaves. Small, black-bodied adult flies with large, transparent wings can be seen feeding on the upper leaf surface beginning at flowering and on through spring and summer. They attack tender foliage of *D. kaki* as well as *D. virginiana*. Older trees are not plagued by psylla, perhaps because they have less succulent growth. Generally, psylla are detrimental to establishment of young trees. Killing the flies during the bloom period will prevent successive generations and population buildup.

The female psylla lay eggs at the margin of the underside of the leaf. When the nymphs hatch they feed and inject toxins which cause the leaf to curl around them, making control difficult. Mealy bugs are also associated with the psylla nymphs in the curled leaf. Ants will feed on the honey dew or sweet excrement which is produced by the insects. Shoot stunting will result causing low yearly growth in young trees. Both the psyllid and scale insects are generally controlled by an insecticide in combination with a fungicidal cover spray at full bloom and 3 to 4 weeks later.

**Tree Borers**

Various moth and beetle larvae have been observed feeding on trees. They enter through wood left from exposed pruning cuts, dead limb stubs, cracking bark at crotch joints or other injured areas on the tree. Wood may be first softened or weakened by fungal infections or freeze damage. The larvae feed just under the bark boring out tunnels and filling them with a brown frass. More than one larva are usually found in infection sites. Flat-headed, wood-boring beetle larvae are common and appear to colonize wounds in July. Moth and other beetle larvae are found at different times. Vaporous insecticides which control borers are not labeled for persimmons.

A white roundish worm occasionally bores into small trees at soil level during late August and September. Proceeding downward into the soft root tissue, the insect pushes behind sawdust and excrement. Because they feed on live tissue, a gummy sap is secreted by the tree and combines with the insect’s waste to fill the tunnels. This oozing, gummy substance can be seen on the tree at the tunnel entrance. The worm feeds on the root tissue during winter, burrowing out a long tunnel and escaping in the soil. Vaporous insecticides are used by nurseries in early August to control this pest when it becomes a problem.

**Fruit Insects**

Of the insects associated with the fruit, stink bugs are the most significant. They are only a problem on non-astringent types and feed as the fruit colors in September through November. Damage will show up as off-white sections in the fruit just under the peel and are subject to decay. Various species of thrips can be seen on the flowers and around the newly developing fruit. They may increase early fruit drop and cause some fruit disfiguration. Although they are a significant pest in Japan, their impact here is not known.
Diseases

Leaf and Fruit Spots

A significant fungal pathogen limiting performance is *Cercospora* spp. leaf spot. It contributes to defoliation which starts in late August as the fruit begin to ripen and continues through September and October. Problems related to defoliation include cessation of fruit sugar accumulations and fruit ripening, biennial bearing tendencies with low overall yields, and increased susceptibility to freeze damage. Control can be obtained by applying a fungicide cover spray during full bloom and again 3 to 4 weeks later. *Cercospora* inoculation appears to begin at shoot expansion, leaf formation, and flowering.

Starting in late August and continuing until the leaves abscise in October, November, and December, various other fungal species are associated with spots which form on the leaves and fruit. *Alternaria* sp., *Gloeosporium* spp. and *Phyllosticta* sp. are three aggressive pathogens. Anthracnose or bitter rot, *Gloeosporium* spp., infects fruits, shoots and twigs in both Japan and Florida. ‘Fuyu’ and ‘Izu’ are susceptible, but some cultivars have resistance. *Colletotrichum* sp. has been detected on ripening fruit and *Ramularia* sp. has been found on leaves in early June.

Infections of these diseases become readily noticeable during late summer and fall. Inoculation times are earlier and cover sprays during mid-August to mid-October will improve leaf retention and decrease fruit lesions. Late summer sprays to control leaf spots will improve leaf retention and tree health, but are less important than the bloom and post-bloom sprays. Some cultivars have specific resistance to some pathogens. Two other diseases are reported in Japan; *Botrytis cinerea* causes brown leaf patches, and bacterial blast (*Pseudomonas syringae* pv. *syringae*) causes leaf spots and blackening of the stem and leaf petiole.

Wilt and Canker Diseases

With the introduction of the oriental persimmon into this country came the wilt disease *Cephalosporium diospyri*. *D. kaki* and *D. lotus* are immune to this pathogen, but the native *D. virginiana* had no resistance. Large trees throughout the south have been killed because of infections. Areas where root sprouts sucker up near dead trees and grow for a few years before dying are known to occur from disease infections.

If oriental cultivars propagated on *D. virginiana* are carrying the disease, the pathogen will move through the *D. kaki* to the rootstock and kill the tree. Wilting and death of the top are the usual symptoms. Occurrences of the problem are not common, but if infected native trees are near the planting site the potential exists for devastating infections.

The most likely method of cepehalosporium transmission is the twig girdler. The female visits various tree species, piercing the bark below buds of the terminal twigs to deposit an egg. After laying her last egg, she girdles the limb, which soon snaps off and falls to the ground. Egg laying occurs in the fall, generally in September and October. Insecticides with the late fungicide applications may be a method of control. Girdled limbs should be removed from the orchard and burned to limit next year's population buildup. Scouting for the pest during the fall and pruning back from her cut may also be important. The twig girdler frequents a variety of hardwood trees including hickory and pecan.

Other disease symptoms can sometimes be observed on persimmons. Occasionally, a tree will have small leaves and fruit with leafless terminal twigs, and die back of these shoots. The disease *Phomopsis* spp. has been associated with these problems, although this may not be the only cause. *Phomopsis* spp. has also been associated with the wilting and subsequent death of shoots as they grow during the spring. Cracking of the bark at limb joints is another disease symptom, and may relate to rapid growth and high nutrient levels. *Verticillium albo-atrum*, and *Botryospharia dothidea* have been reported to infect persimmons and may be associated with any of these problems. Budding trees with infected scion wood may transmit the symptoms. Pruning an infected tree and then a healthy one, without sterilizing the tool, appears to spread the disease.

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REFERENCES


