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## I. THE KADOTA FIG

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## II. KADOTA FIG PRODUCTS

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# I. THE KADOTA FIG

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## THE KADOTA FIG IN ITALY

The Kadota fig, under the name Dottato, has been grown in Italy since ancient times, and is still the leading commercial variety of that country. The derivation of the variety name seems to be from the Italian, *fico addattato*, or adapted fig, undoubtedly referring to the wide adaptability of this fig to soils and climatic conditions as well as to possible uses.

*History and Italian Literature.*—Savastano<sup>2</sup> describes the Kadota as a good variety for drying. According to Siniscalchi<sup>3</sup> it is the commercial variety par excellence and in some districts is rightly called the 'golden fig.' Ferrari<sup>4</sup> states that this variety is the one best adapted to local conditions both along the coast and in the foothill valleys protected from sea breezes. The Kadota fig thrives along the coast of Sicily and, according to Portale,<sup>5</sup> furnishes the bulk of the dried figs for local and export trade. Guglielmi,<sup>6</sup> in his discussion of fig culture in southern Italy, classes it as the most esteemed variety for commerce, the figs being consumed mostly in the dried form. Pellicano<sup>7</sup> also gives it first rank among the figs of Calabria. De Rosa<sup>8</sup> classes it highly for production of dried figs, with its few seeds, sweet pulp, and delicate, although relatively thick, skin, and recommends it for districts where other figs sour or are inferior.

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<sup>1</sup> Associate in Subtropical Horticulture.

<sup>2</sup> Savastano, L. Il fico. Ann. R. Scuola Sup. Agric. Portici, 4:36. 1885. Fichi da seccare. Bol. Arbor. Ital., 4:134. 1908. Arboricoltura, pp. 608, 836. 1914. F. Giannini and Figli, Napoli.

<sup>3</sup> Siniscalchi, A. La coltivazione del fico nel Cilento. Bol. Arbor. Ital., 7:25-54. 1912.

<sup>4</sup> Ferrari, E. La coltivazione del fico nel Circondario di Paola (Cosenza). Ann. Staz. Grum. Frutti, 1:141-177. 1912.

<sup>5</sup> Portale, F. La coltivazione del fico nel circondario di Mistretta. Bol. Arbor. Ital., 6:49-101. 1910.

<sup>6</sup> Guglielmi, G. Coltivazione industriale del fico nel Leccese. Bol. Arbor. Ital., 4:11-18; 57-65; 114-125; 152-156. 1908.

<sup>7</sup> Pellicano, A. Il fico nel circondario di Gerace. Bol. Arbor. Ital., 3:122-150. 1907.

<sup>8</sup> Rosa, F. de. Di alcuni fichi Salentini. Atti R. Istit. d'Incorr. Napoli, VI, 9:1-36. 1911.

The best and most complete account of the Kadota is given by Vallese<sup>9</sup> in his book on Italian figs. He calls attention to the fact that caprification affects the fruit, making it larger, sweeter, and more pulpy than uncaprifried fruit.

*Italian Fig Districts and Climatic Data.*—The culture<sup>10</sup> of the Kadota fig, in Italy, as far as export trade is concerned, is almost entirely confined to districts lying south of Naples. Cosenza, where some of the best dried figs are grown and packed, is inland beyond the coast mountains at an elevation of 1266 feet. The other districts



Fig. 1.—Whole Kadota figs on elevated drying trays at Cosenza, Italy, September 17, 1923.

are in the vicinity of the coast, where drying conditions are not so favorable.

Two distinct methods of drying figs are used in Italy. At Cosenza, the Kadota figs are picked fully matured and spread out on elevated trays for drying (fig. 1). At Lecce, the figs are picked in the same manner, but before drying are cut in half from the stem towards the apex, leaving a slight attachment at the eye (fig. 2).

Climatic data for some of the fig districts show the maximum temperature for Cosenza to be 106° F., and for Lecce 107° F. The mean relative humidity at Lecce during the summer months varies from 60 to 63 per cent. Rainfall at Naples totaled 40 inches in 1916

<sup>9</sup> Vallese, F. *Il fico*, pp. 93-98, figs. 31, 32, 1909. F. Battiato, Catania.

<sup>10</sup> Most of the account of the Kadota fig in Italy is the result of personal investigation made by the writer in that country in 1923.

and 34.28 in 1917; at Lecce the total was 32.64 inches in 1916 and 23.4 in 1917. Early rains between August 20 and 26, 1923, did considerable damage to the fig crop of southern Italy, nearly half of the crop being ruined for food or reduced in grade. A three-day rain about the middle of September caused serious injury to or total loss of



Fig. 2.—Italian women in the Lecce Province of Italy cutting Kadota figs from stem to eye and spreading on a drying tray.

about one-third of the Cosenza crop the same season. Dottato figs dropped badly and rotted on the ground.

*Crop Statistics and Exports.*—According to the United States Commerce Reports,<sup>11</sup> the fig crop of southern Italy amounted to 165,040,000 pounds in 1920. It was distributed as follows:

Abruzzi .....	10,752,000 lbs.
Campania .....	15,680,000 lbs.
Puglia .....	84,400,000 lbs.
Calabria .....	51,296,000 lbs.
Sicilia .....	2,912,000 lbs.

A normal dried-fig crop for Italy is considered to be about 100,000,000 pounds.

Exports vary from 40,000,000 to 50,000,000 pounds, Austria taking by far the largest quantity for industrial purposes, largely the manufacture of coffee and alcohol. In 1923, the United States received 780 tons of dried Kadota figs from Italy; in 1924, over 1400 tons; and

<sup>11</sup> Byington, H. Fig culture in southern Italy. U. S. Com. Reports, 150:1831. 1921.

in 1925, 2150 tons valued at \$208,388. The bulk of these arrived during the months of October, November, and December. The value of the 1925 imports exceeded the total value of the Kadota fig crop of California for the same year and almost equalled the value of the 1926 crop of this state.

*Production and Cultural Methods.*—According to Ferrari, the average production of fig trees in the Paola region is 280 kilos per hectare (249.3 lbs. per acre), an average of 16.5 pounds per tree. The production in exceptional orchards has reached 88 pounds of dried fruit per tree.

Fruit trees in Sicily are planted close together, the common spacing for lemons being from 10 to 16 feet and for figs 16 feet, the latter allowing about 170 trees to the acre. In the specialized fig orchards of San Fratello, the production is given as 3,562 pounds of dried figs per acre.

The orchards in the vicinity of Cosenza are mainly on the hillsides and in the mountains, mostly unirrigated.

Interplanting of fig and olive trees is very common and various grain and vegetable crops are grown in practically all of the orchards.

*Land Values and Returns.*—The best land in the Lecce district is used for tobacco and annual crops, fig trees being grown on poorer land. Orchards are commonly operated on a rental basis, in some cases for cash, in others for a share of the crop. In 1923 one grower rented four acres of land for \$5.37 per acre; in addition to this he paid the owner 16 lira per quintal (68.8 cents per 220 pounds) for the dried figs produced. One peasant stated that if figs sell for less than 100 lira he pays only 12 lira per quintal (51.6 cents for 220 pounds) as rent. A grower at Messagne rented two acres of land for \$8.60, the tract being in producing olive and fig trees 20 years old.

At Cosenza one grower received 3.5 cents a pound for his dried figs in 1918; in 1919, 1920, and 1922, he received 3.9 cents; and in 1921, 5.4 cents a pound. For cull figs he received one-half these prices.

The growers at Cosenza received from 3.7 to 4.3 cents a pound for the crop of 1922. At Lecce in 1923 the average for good figs was 1.3 to 1.5 cents a pound and for figs for manufacturing purposes 0.77 to 0.88 cents a pound.

Literature on the fig industry of Italy generally deplores the conditions existing in the harvesting and packing of the fruit. Dr. Biaseo of Lecce stated that better varieties of figs should be planted and more care taken in the production so that larger quantities of figs

could be used for edible purposes as well as industrial. Merchants of Paris and London spoke well of the quality of the Kadota figs from Cosenza. They stated that the Italian figs are of good quality but are very poorly packed. The whole dried figs, however, have a thick, tough skin as compared with Smyrna figs. The dried figs of Italy could undoubtedly be improved by better methods of handling in the dry yards and packing houses.

#### THE KADOTA FIG IN THE SOUTHERN STATES

The behavior of the Kadota fig in the southern states is not definitely known. Starnes<sup>12</sup> lists both the Dottato and the Dottato White among the varieties being grown at the Georgia Experiment Station in 1907 but no later records of their success are given. Other publications on figs from the Gulf States fail to mention the variety. However, G. E. Murrell, horticulturist for the Southern Railway, wrote in August, 1925, that young Kadota trees were bearing at Citronella, Alabama. Trees were also planted at Carriere, but were seriously injured the following winter by a temperature of 14 degrees. The fruit did not sour even with continuous showers and was marketed satisfactorily "by express to cities within twelve hours distance."

Judging from the behavior of the Kadota fig near the coast of California and the tendency of the skin to develop dark spots, the variety may not be so satisfactory along the Gulf Coast as the Magnolia or the Celeste. In fact a grower at Beaumont, Texas, has complained of the susceptibility of the Kadota leaves to rust and of the fruit to spotting and mildew.

#### THE KADOTA FIG IN CALIFORNIA

##### HISTORY

About 1889, J. E. Cutter of Riverside, a member of the nursery firm of Twogood and Cutter, received cuttings of seven varieties of figs through H. E. Van Deman of the United States Department of Agriculture. After a period of trial, the Dottato, as the name appeared on the original label, was the only one which appeared worthy of further propagation. According to Mr. Cutter it was called to public attention at the Fruit Growers' Convention held in November, 1893, in Los Angeles, where he showed specimens of the

<sup>12</sup> Starnes, H. N. The Dottato. Georgia Agr. Exp. Sta., Bull. 77:67. 1907.

fruit and invited people to sample them. In 1892, an account<sup>13</sup> of the new fig appeared in the Riverside Press and Horticulturist. It was stated that of the seven varieties being tested, all but one had a tendency to sour as the figs ripened. This one, the Dottato, ripened its fruit perfectly. The specimens submitted were said to be of fine flavor and delicious in cream for dessert. The report concluded that even though this fig were inferior in flavor, it would still be worth propagating if it should continue to prove free from the souring which affects the fig so generally in irrigated sections.

In his annual report for 1890 the Pomologist of the United States Department of Agriculture refers to this variety as follows:<sup>14</sup>

“Through the courtesy of Mr. William Saunders, Superintendent of Gardens and Grounds of this Department, I have been able to distribute cuttings of the following varieties of fig obtained through commercial channels: Bianco Precoce, Prolifero, Natalino, Dottato, and others.”

In 1898 Stephen H. Taft of Sawtelle obtained ten cuttings of the Dottato fig from Cyrus Way of Whittier and from them propagated nursery stock. He gave it the name of Kadota, which is evidently a corruption of Dottato.

In 1890 the Report<sup>15</sup> of this station included the “White Dattato” in its list of fig varieties planted at the Pomona Station. In the Report<sup>16</sup> for 1901–1903 it was stated that at Pomona a fig to which the name White Dottato had been given was the best for the third or fall period; the fruit ripened in August, in some seasons about the first but usually about the middle of the month; the trees bore a continuous crop from that time until frost. It was regarded as the best white fig at the station and was reported to go through fog and rain without souring. The origin of the trees is not given.

In a letter received from the Pioneer Nursery, Monrovia, April 8, 1916, it is stated that about 1904 the fig called Kadota was offered as a new and very fine variety at high prices by S. H. Taft of Sawtelle. Trees were purchased and when they began to fruit, no difference could be seen between this variety and the White Pacific which they had been growing for some years.

N. M. P. Close of Exeter obtained a tree of the same variety from S. Thompson of Orange County and grew it for about eighteen years under the name ‘Datato.’ J. C. McCubbin of Reedley has a large

<sup>13</sup> Anonymous. A new fig. Pac. Rural Press, 44:322. 1892.

<sup>14</sup> Van Deman, H. E. Distribution of seeds, plants, and scions of fruits. Rept. Sec. Agr., U. S. D. A., 1890:414. 1890.

<sup>15</sup> Shinn, C. H. Fig varieties. Rept. Calif. Agr. Exp. Sta., 1890:299. 1891.

<sup>16</sup> Stubenrauch, A. V. Figs. Rept. Calif. Agr. Exp. Sta., 1903:192. 1903.



Kadota tree which was purchased from S. H. Taft in 1909. One of the oldest Kadota trees in Tulare County is that on the place of George Reynolds near Orosi, who was one of the first to plant a commercial orchard of this variety in the San Joaquin Valley.

#### NOMENCLATURE

The variety names Dottato (sometimes Dattato), Kadota, White Endich (sometimes spelled Endrich), White Pacific, and Clarkkadota, are synonymous; all refer to the same variety. The origin of the names Dottato and Kadota has already been referred to. White Endich is the name applied to a fig introduced into the Stockton district previous to 1870 and named for Mr. Endich of that city. According to G. P. Rixford the nursery catalogues of W. B. West of Stockton of 1873 and 1874 list the "Endrich" fig<sup>17</sup> and state that it was imported from the south of Italy many years ago by an old citizen of Stockton. White Endich trees are common around Stockton and in various parts of the interior valleys. They are identical in tree character, foliage, and fruit to the Kadota.

The name White Pacific<sup>18</sup> was given to a fig propagated by W. R. Strong and Company, Sacramento, and described in their catalogue of 1883. The parent tree was found on the fruit farm of Mr. White at Penryn, Placer County. It was very prolific and produced excellent fruit, the only objection being the rather thick skin. The tree was at least ten to fifteen years old at that time.<sup>19</sup> The White Pacific as grown in various parts of the state cannot be distinguished from the Kadota, although in Los Angeles County the two sometimes appear to be distinct.

Francis Heiny of Brawley wrote February 3, 1917, that he has fig trees under the names of Kadota, Dottato, White Pacific, and White Endich, and all are identical with the exception that some have white and some pink flesh. As explained later, flesh characters are decidedly influenced by various factors, especially caprification.

Mr. George Roeding stated in a letter dated September 12, 1914, that he was certain the Kadota and White Endich were the same. In his nursery catalogues issued from year to year, he lists the variety generally under the name White Endrich with Kadota in parentheses

<sup>17</sup> According to Louis Vistica, a nurseryman of Stockton, and a son-in-law of Mr. Endich, the proper spelling of the family name is Endich rather than Endrich.

<sup>18</sup> Strong, W. R., & Co. Pac. Rural Press, 26:430. 1883.

<sup>19</sup> Anonymous. Report of the fourth annual state fruit growers' convention. Rept. California State Board Hort., 1884:84. 1884.



Fig. 3.—Typical leaves of the Kadota fig from a bearing tree.

and states it has been sold by various parties as White Endrich, White Pacific, Smyrna, and Kadota. The Kirkman Nursery, Fresno, listed it in their catalogue of 1920 as "Kadota (White Endrich.)" The catalogue of the Armstrong Nursery, Ontario, 1921, gives the following: "White Pacific (Endich or Kadota)."

The name, "Clarkadota," was coined in 1920 by a development company at Stockton<sup>20</sup> and purported to represent trees of the "superior" or "exceptional" Taft strain. Since Mr. Taft of Sawtelle secured his trees indirectly from the Riverside importation, they do not represent any strain or stock superior to that of numerous other large Kadota trees in southern California.

The name Kadota is so firmly established in California that it would seem difficult, however desirable it might be, to reestablish the true name, Dottato, for the variety.

#### CHARACTERISTICS OF THE TREE AND FRUIT

The Kadota tree is a vigorous grower, although no more so than trees of other commercial varieties grown under the same conditions. When allowed to grow naturally, the trees develop into a round-topped form, broad, but not so spreading as the White Adriatic. The leaves (fig. 3) are fairly large, variable in shape, entire to three or five-lobed, with cordate base and crenate margins. The bark on one-year-old mature wood has a golden or yellowish color; older branches assume the normal gray of most fig wood.

Like most other common varieties of figs the Kadota bears two crops, the first crop appearing on wood of the previous season's growth, from buds differentiated in the upper leaf axils during the fall months. These buds become active in the spring along with the terminal or lateral buds, continue to enlarge during April and May, and mature into fruit about the middle of June in the interior valleys. Typical figs of this crop are large, green or yellowish green in color (fig. 4), pear-shaped, with a distinct thick neck, indistinct ribs, and fairly large, open eye. The pulp is violet-tinted, juicy and of excellent quality. It is used almost exclusively for the fresh fruit market if harvested at all.

The second-crop figs (fig. 5) are produced on wood of the current season, one, and often two, in the axil of a leaf. Some of the figs mature the latter part of July and others continue to ripen as long as the weather remains favorable. As with many other varieties,

<sup>20</sup> Donaldson, M. V. Use of the name, "Clarkadota." Fig Olive Jour., 4 (8):17. 1920.

immature figs may hang on the tree throughout the winter and if not injured by cold, ripen in early spring. The fruit of the second crop is of medium size, globular in shape or somewhat oval, with a slight neck; stalk one-quarter to three-quarters of an inch long or

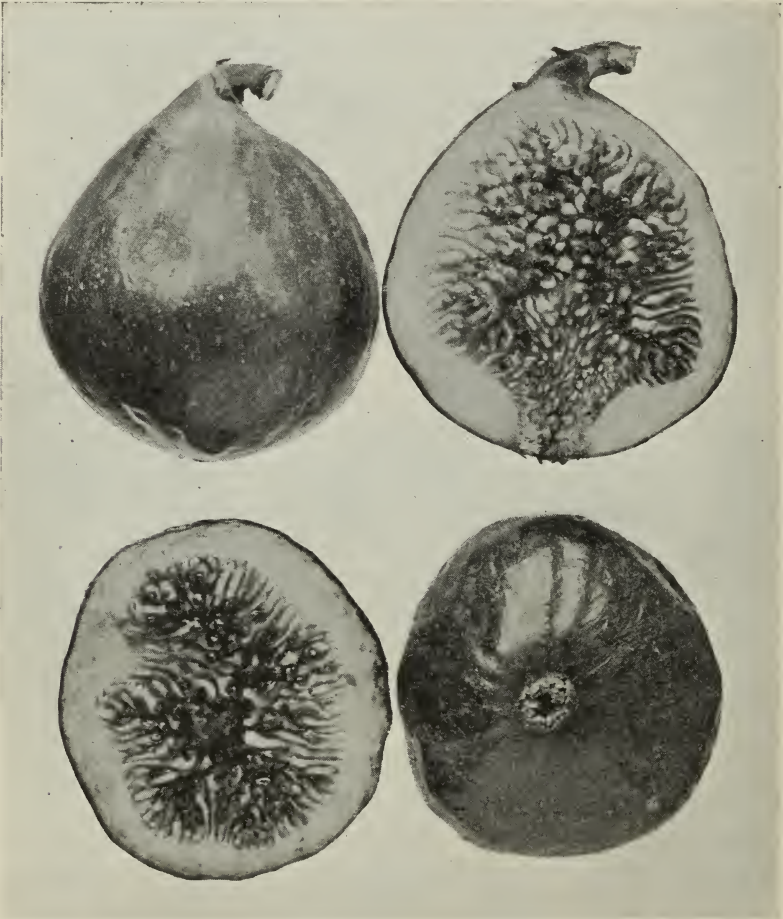


Fig. 4.—First-crop Kadota figs from Terra Bella. Pear-shaped specimens are common. (Natural size.)

longer, sometimes objectionably so; eye medium, closed by scales or frequently by a drop of clear gum; skin yellowish green to lemon-yellow when mature; pulp amber, sweet, but lacking character or distinct flavor. The outer skin and white meat surrounding the pulp, constitute a sort of rind with a rubbery consistency, one of the characters which makes the fig suitable for commercial canning. This thick rind, however, is responsible for making an inferior, leathery product when dried.



A



B

Fig. 5.—A. Typical second-crop Kadota figs from the San Joaquin Valley with golden-yellow skin and amber pulp. B. Typical second-crop Kadota figs from the original Taft trees at Sawtelle, with distinct neck, green skin, and violet-tinted pulp.

## EFFECTS OF CAPRIFICATION

Caprification or artificial pollination of the Kadota fig is not necessary to make the fruit set and mature. When caprifried, the fruit is very materially changed in appearance and character from normal fruit. The differences may be noted as follows:

The color of the uncaprifried fig is a light lemon yellow, the surface somewhat glossy; the color of the caprifried fig is green or yellowish green, and the surface dull. Ribs on uncaprifried figs are practically absent; on caprifried fruit, the ribbed appearance is marked, especially in the wilted specimens. The meat or rind is seemingly little affected in thickness and texture. The color of the flesh in uncaprifried figs is amber or pinkish amber to light strawberry; in caprifried specimens the color is much deeper. Uncaprifried figs are practically seedless, the seeds being small and hardly noticeable; caprifried figs have numerous, large, fertile seeds.

The value of caprification of the Kadota fig depends upon the ultimate use of the fruit. The green color given the skin by caprification is unattractive in the fresh-fruit market and unacceptable to canners. For drying, the caprifried figs, being larger and more meaty, are much superior to the uncaprifried, although the skin is still thick and tough. For preserving, the uncaprifried figs are much more desirable because they are smaller, better in appearance, and have a firmer texture. Most growers prefer the uncaprifried fruit and avoid caprification if possible.

## ADAPTABILITY TO SOILS AND CLIMATES

As already pointed out, the Kadota fig seems to be able to adapt itself to a variety of conditions. Vigorous tree growth has occurred on a wide variety of soils. It should be noted, however, that trees on sandy soils are more likely to be injured by root knot caused by nematodes than trees on heavy soils. Kadota figs are being produced on hard-pan land where the layers of hard pan are thoroughly broken up by blasting the tree holes before planting. If use is made of hog-wallow land that has been levelled, it may be difficult, on account of the varying depth of the surface soil, to get a uniform growth of trees. In any case, and with any type of soil, thorough preparation and careful leveling of the land are essentials to success in Kadota production on account of the absolute necessity for irrigation.

Commercial production of Kadota figs for canning purposes is most successful in the interior valleys and in districts not seriously affected by coast fogs and cool breezes. The greater humidity and lower temperatures of the coastal belt delay maturity, prevent proper coloring of skin and accumulation of sugar, produce tenderness of skin and rind, and increase fruit blemishes as well as tree troubles. Kadota trees have been planted in the Coachella and Imperial valleys and there seems to be no good reason why they should not succeed there in commercial plantings. In Tulare and Fresno counties serious loss of small figs sometimes results from periods of high temperatures in June or July. This appears to be analogous to the so-called June drop of the Navel orange, in which the developing fruits wilt on account of excessive transpiration from the leaves. This loss of figs is minimized by proper attention to soil moisture.

During the 1926 season, canning plants at Reedley, Fresno, and Orland began receiving Kadota figs from July 24 to July 28; at Modesto, fig canning started on August 18 and at Stockton on August 25. On account of the lower day temperatures and relatively higher humidity at Stockton, figs ripen later than in Fresno and Tulare counties. What effect a shorter season will have upon total production per acre can only be shown by future records. Reference to the temperatures for four points, namely, Visalia, Fresno, Merced, and Stockton for the months of June, July, August, and September, 1922, a typical year, shows the following mean average temperatures for day and night respectively: Visalia, 97.3 and 59.8; Fresno, 95.5 and 63.7; Merced, 94.7 and 58.8; Stockton, 91.7 and 59.1 degrees F. At Orland, the day temperatures average about the same as at Merced. Humidity records are not available for Stockton, but the conditions in this respect are very similar to those at Sacramento. The average mean relative humidity for the four months of July, August, September, and October for the three years of 1922, 1925, and 1926 at each of the following stations is: Sacramento, 54; Fresno, 40; Los Angeles, 70.

That the climatic conditions around Los Angeles do affect the canning quality of Kadota figs is evidenced by the opinion of canners themselves. One of them states there is a noticeable difference in the figs grown around Los Angeles and those grown farther north. He considers the figs grown in the Fresno and Tulare districts better for preserving than those grown in the vicinity of Los Angeles.

According to N. E. Beckwith,<sup>21</sup> of Reedley, experience in his orchard shows the following as to crop season:

<sup>21</sup> Beckwith, N. E. Heat damage to Kadota figs discussed. Fresno Republican, Farm News Section. June 11, 1922.

CROP OF 1918		CROP OF 1920	
August .....	56 per cent	September .....	39 per cent
September .....	30 per cent	August .....	45 per cent
CROP OF 1919		CROP OF 1921	
August .....	47 per cent	August .....	56 per cent
September .....	42 per cent	September .....	27 per cent
June, July first crop .....	6 per cent	First crop .....	9 per cent

From this it appears that about one-half of the crop matures in August, about 40 per cent in September, and from 5 to 10 per cent in October at Reedley.

In 1926 the picking season for second-crop Kadota figs in Tulare County extended from July 21 to October 21; in Fresno County, from July 27 to October 19; in Merced County, from August 12 to October 15; in Stanislaus County, from August 9 to October 29; in San Joaquin County, from August 27 to October 14; and in Glenn County, from July 28 to November 5.

Strong winds cause considerable leaf scarring of Kadota figs. Such scarred fruit is either not acceptable at all for canning or acceptable only at reduced prices. Wind damage can be reduced to some extent by wind breaks planted at intervals of about 660 feet.

Drops of rain or heavy dew remaining on the fruit leave dark spots which ruin the naturally good appearance of the fruit. Prolonged early rains may, of course, result in serious loss of crop.

In the interior valleys the cool weather of the fall retards ripening of the fruit and prevents proper coloring, as well as development of sugar. This condition is liable to occur throughout the season along the coast.

Low temperatures accompanied by frost seldom come at a time when fruit might be injured, but the trees themselves are liable to damage, especially during the first few years.<sup>22</sup> Early frosts coming in November while the foliage is still green frequently kill the leaves and the buds in the leaf axils, so that the tree must be renewed from suckers in the spring. Late spring frosts coming after buds have started growth are more serious than fall frosts in their effects because recovery is slow; in fact, numerous trees have died root and all from sour sap after such spring frosts. Wrapping of young fig trees in middle or late October with corn stalks, tules, or straw is commonly practiced to prevent damage from fall frosts. The proper time for the removal of wrappings from the trees is difficult to decide upon. Their

<sup>22</sup> Condit, I. J. Frost prevention measures outlined. Fresno Republican, Farm News Section. Oct. 15, 1922.



removal in March may subject the tree to serious injury from a late frost coming after growth has started. Continuing the protection into April delays cultivation, pruning of the trees, and removal of brush. The latter procedure seems to be the safer where late spring frosts are to be feared. Hundreds of acres of young fig trees have been frozen to the ground in various districts, and this hazard must be taken into account in establishing a Kadota orchard.

#### WATER SUPPLY

Since irrigation is essential to successful production of Kadota figs, a good water supply must be assured. Few growers, if any, measure the amount of water applied to fig orchards, but in general from 12 to 24 acre-inches per acre of irrigation water should be available. The amount will vary with the rainfall, nature of the soil, age and vigor of tree, climatic conditions, growth of cover crop or weeds during the summer, etc. The quality of the water used for irrigation is just as important as the quantity. While fig trees will stand more alkali than some other fruit trees, many have been and are being seriously injured by the presence of various salts in the soil. In general it can be said that the presence of 400 parts per million of one or more of the so-called "alkali" salts may be considered the maximum for safety in fig-orchard soils. Analyses recently made of eight samples of well water to be used for irrigation purposes in one district showed the total solids to range from 226 parts per million to as high as 3792 parts per million. Many citrus growers have learned to their sorrow the danger of using salty water for irrigation purposes. Prospective investors in fig lands should thoroughly investigate this as well as other matters connected with the water supply.

#### PROPAGATION

Fig trees are grown exclusively from cuttings; budding or grafting of nursery stock is not necessary. Wood for cuttings is available at any time during the winter but is usually prepared at pruning time. Since Kadota trees are generally pruned heavily, there is plenty of vigorous wood from which to select good cuttings. Tip cuttings can be used but have a greater tendency to sucker on account of the greater number of buds which start into growth. Because the amount of growth depends to a certain extent upon the plant food stored in the cutting, small wood (branches less than three-eighths of an inch

in diameter) should not be used. The cuts are made with a pair of sharp pruning shears just below a joint at the base and just above a joint at the tip, leaving the cuttings from 8 to 10 inches in length. These are tied with wire into bundles of fifty and buried in a well-drained loam soil, butt ends up, to remain until the nursery space is ready for planting. The cuttings are then set upright a few inches apart in furrows prepared with a plow or a shallow subsoiler, the rows being spaced four feet apart. Planting should be immediately followed by an irrigation. Soil moisture should later be carefully regulated so as to maintain a steady growth of the young trees. Suckers and laterals are removed whenever they appear. Rooted fig trees may be dug and planted when one year old. If not dug, the nursery tree should be cut back almost to the ground before spring growth starts, and a new top grown as before. A one-year trunk on a two-year root system makes an ideal tree for orchard planting, as buds from new wood start much more readily than from wood two years old.

Some growers have had good success in planting cuttings directly in the orchard where they are to grow without transplanting. However, it is much easier to take care of cuttings properly in a small nursery than on a larger tract, and the practice of field planting of fig cuttings is not to be encouraged.

Fig trees of any other variety can be grafted over to the Kadota if they are healthy and vigorous. The scions should be placed in low branches in order to facilitate the development of the spreading type of tree later described. Branches up to 3 or 4 inches in diameter can be grafted by the common cleft system, but larger wood is generally bark grafted. Young trees are being budded successfully in the Merced section.

#### STARTING THE ORCHARD

One of the oldest and most successful Kadota orchards in California is spaced 40 by 40 feet. It is generally conceded that the trees have been planted too far apart, especially during the early life of the orchard. Many young trees have been set 24 or 25 feet on the square, which seems to be the most favored spacing. Some growers are planting a tree in the center of the square with the expectation of removal when crowding begins. Others are planting in rows 20 or 24 feet apart with the trees 10 or 12 feet apart in the row. The latter allows a wide space for tractors and cultivators, for irrigation

furrows, and for harvesting, and gives heavier yields for the first few years than does the wider spacing.

Roots of one-year-old fig trees are tender and easily mangled, while those of two-year-old trees are firm and well united to the stock. In digging and transplanting trees of any age, care should be taken to preserve the main roots as much as possible. Fig roots are unusually susceptible to injury from exposure to sunshine or dry air; thousands of trees have been thus ruined or seriously damaged. Nursery trees should be heeled in promptly after digging, covered completely with canvas if transported any distance, and the roots kept from drying out until actual planting is accomplished.

Fig nursery stock is sorted into grades of trees from  $\frac{3}{8}$  to  $\frac{5}{8}$  inch in caliper and from 2 to 6 feet or more in height. There seems to be no advantage in planting large fig trees since medium-sized trees with a good root system make an excellent growth if properly handled. The planting of fig trees differs little from the planting of any other fruit tree. In old grain land or in soils where a plow sole has been formed, subsoiling in the tree row is a good practice. Holes can be dug before or at the time of planting. Since fig trees are grown on their own roots there is no disadvantage, but probably an advantage in setting the young tree two or three inches deeper than it stood in the nursery. Immediately after the planting, water should be applied from a furrow, or from a tank wagon if the irrigation system is not completed.

#### ORCHARD MANAGEMENT

*Tillage Operations.*—Cultivation and handling of the soil in a Kadota fig orchard follows closely the methods used by intelligent growers of peaches, apricots, or plums. Spring plowing or disking to incorporate with the soil the natural vegetation grown during the winter and early spring is necessary. Subsequent cultivation does not conserve moisture except as it prevents weed growth. It prepares the land to receive water either from rain or from an irrigation system. Frequent cultivations at the same depth, especially when the ground is wet, compact the soil into what is commonly called a "plow pan" or "plow sole." This can be avoided by reducing the number of cultivations to the minimum, by varying the depth of cultivation, and by proper use of cover crops.

While clean cultivation is the usual practice in fig orchards, many growers are allowing weeds and grass to grow along the irrigation furrows during the summer season, and eliminating cultivation after

irrigation. A few have planted a strip of alfalfa in the row with open furrows on either side next to the trees. The competition between the alfalfa and the trees is bound to be more or less keen both for water and plant food and the practice is not to be generally encouraged. The other practice of non-cultivation is being successfully followed in young orchards, but in connection with it more irrigation water must be applied to replace that lost through the leaves of weeds and grass. To what extent such a practice encourages the development of a shallow root system has not been determined.



Fig. 6.—Furrow irrigation in a Kadota orchard near Reedley.

On account of the low and spreading type of tree developed for Kadota figs, types of cultivators and implements that have extensions are desirable. The shade produced by the trees during the summer discourages weed growth and minimizes the necessity for cultivation near the trunk.

*Irrigation.*—In order to apply irrigation water intelligently, it is necessary to understand how the tree uses soil moisture and how water moves in the soil. The tree takes moisture from the soil only through the fine root hairs and loses it only by transpiration from green leaves or to a slight extent from the bark. Except for some surface evaporation following an irrigation, water is lost from the soil only through plant roots and leaves or by percolation to depths below the root zone. The movement of water by capillarity from a mass of moist soil to a dry one is so slow that it is of doubtful value to the tree. This emphasizes the importance of wetting the entire soil mass including that in the tree row as well as in the space between the rows. Irrigation furrows (fig. 6) should be close enough together

to wet the soil between them. By the use of a soil auger one can determine the depth to which irrigation water has penetrated. Some growers learn to determine this by the appearance of the tree, but it is poor practice to wait until the leaves droop and green fruit wilts before beginning to apply irrigation water. Serious loss of crop may result from such delay.

It is impossible to give definite directions as to the number of times to irrigate, the length of furrows, the amount of water to use, or the method of application. These vary according to locality, soil type, climate, and season. The object sought is to keep the terminal buds growing steadily, and to stimulate a normal set as well as proper maturity of fruit. In at least two orchards in the San Joaquin Valley, Kadota fig trees have made an excessive vegetative growth, but fruit production has been disappointing. To what extent soil moisture has influenced tree growth and production in these orchards has not been determined.

In the hotter parts of the interior valleys, it is a common practice to provide a late winter or early spring irrigation to supplement the natural rainfall or to help any deficiency in supply. This, of course, is not necessary in case the winter rains have brought the soil moisture in the root zone up to the optimum. After spring cultivation, irrigation water is commonly applied at intervals of about a month, depending upon the conditions already mentioned. In uncultivated orchards water may be run every ten days or two weeks during the hottest part of the season. Sufficient moisture should be maintained during the fall months to prevent early or abnormal leaf drop. Late irrigation of young trees has a tendency to prolong the growing season, if weather conditions are favorable, and to accentuate the danger from fall frosts.

*Intercropping.*—Satisfactory intererops for young fig trees are very limited in number. In Stanislaus County beans thrive and have made a satisfactory as well as profitable intercrop. Vegetables have been tried in some districts with varying but usually unsatisfactory results. On the right kind of soil, cotton offers good possibilities as a crop for young orchards. Since Kadota trees are spaced more closely than other fig trees, and since the young trees bear a certain amount of fruit, the practice of interplanting or double planting the rows with the Kadota tree itself probably offers as good a chance for profitable returns as any annual intercrop.

*Fertilization.*—The maintenance of soil fertility in deciduous fruit orchards of California has been much discussed in the past but definite

facts on the subject are lacking. Since both walnut and fig trees are deep rooted, the results of the application of commercial fertilizers to the surface soil will be very slowly apparent if at all. Three extensive field trials with different kinds and amounts of fertilizers on walnut trees in southern California have after seven years shown an increase of production from nitrogen alone, and that insufficient to pay for the cost of the material applied. Two seasons' applications of fertilizers to bearing fig trees in various parts of the San Joaquin Valley failed to show any visible effects on tree or fruit. This does not mean, however, that no attempts should be made to maintain the natural fertility of the soil or to improve it.

Experiments with other fruit trees, especially citrus, in California, have shown that the application of potassium or phosphorus has not been beneficial, that nitrogen is the only element, and organic matter the only other fertilizing material, which have decidedly improved tree growth or production. The fall application of some bulky organic material such as bean straw, alfalfa hay, or barnyard manure is generally advisable. Early spring application of some form of quickly available nitrogen such as nitrate of lime or sulfate of ammonia, or of organic nitrogen such as dried blood, tankage, bone meal, etc., may be desirable to stimulate growth and yields.

The growing of a winter cover crop is to be recommended. The kind of crop to use, and the time and method of planting should be ascertained from county agricultural agents.

There is a very general impression that the fig tree is a "lime-loving" plant and therefore the application of lime to the orchard soil will be decidedly beneficial. Most soils in California, however, are well supplied with lime. The use of lime in citrus orchards has rarely shown any beneficial results. In a Modesto fig orchard, the application of amounts of lime varying from three and one-half to ten and one-half tons, and of gypsum up to three and one-half tons to the acre showed no improvement either in soil condition or tree behavior.

*Pruning.*—The Kadota fig tree has not been grown commercially for a sufficient length of time to determine the best and most satisfactory system of pruning. No pruning plots have been established and carried through a period of years with yield records as have been done with many other fruit trees. The practices which are being used more or less successfully by various growers will therefore be discussed.

For purposes of harvesting fresh figs economically a low, spreading type of tree is desirable (fig. 7). A standard tree with a

single trunk is generally preferred to one with several trunks. After planting, therefore, the young tree is cut back just above a bud or joint about 12 inches from the surface of the ground. Waxing over of the tops to prevent die-back is not necessary. If one-year-old trunks have been planted, buds should readily start from various points, and from three to five well-spaced framework branches can be selected. On older trunks the buds are more dormant, slower to start, and generally appear near the top. Judging from the behavior and



Fig. 7.—Example of improper heading and pruning of a Kadota fig tree. The picking expense on such a tree is almost prohibitive.

appearance of bearing trees, three framework branches are most satisfactory.

In case young trees are frozen back to the main trunk or to the ground the tree must be developed from suckers. It may be possible to find one central leader from which a standard tree can be developed. Generally, however, several strong suckers start in various directions from the trunk, in which case three or possibly four can be selected for the framework of the tree. It is very important in selecting such suckers to see that they are firmly attached to the main trunk. Suckers which are not desired should be removed early in the growing season and not left until winter.

Subsequent pruning may follow one of two much-discussed systems. Advocates of long pruning believe that Kadota fig trees can

be developed for several years at least, by the same methods which are now being commonly used with other deciduous fruit trees.<sup>22</sup> The main branches are not headed back at the end of the first season, and laterals are encouraged to develop during the second season (fig. 8). Subsequent pruning consists in thinning out branches where



Fig. 8.—A long-pruned tree in the pruning plot at Stockton, before and after pruning. This system results in a larger first crop of figs and earlier ripening of the main crop, and has been used successfully in Tulare County. A. Before pruning; B. After pruning.

they become too thick and cutting back some of the laterals to renewal spurs as illustrated. Limited experience with this system indicates that earlier production may be secured than by the other system to be described. Since most of the wood of the previous season remains on the tree, there is a heavy production of first-crop figs which may be marketed more or less profitably as fresh fruit. In one orchard thus pruned the trees made a vigorous growth and even at the end of six growing seasons the fruit was still being harvested without the use of stepladders. The main difficulty with this system is the same one experienced with vigorous Calimyrna trees, viz., lack of development of laterals except near the tip. Summer pruning of uprights at the desired height will overcome this objection, however, if it is systematically practiced. Closely planted trees may be pruned to an upright form with lateral spurs similar to the system used with some varieties of grapes (fig. 9).

<sup>22</sup> Tufts, W. P. Pruning young deciduous fruit trees. Calif. Agr. Exp. Sta., Bul. 313:113-149. 1919.



The great majority of Kadota orchards are, however, being developed by heavy annual pruning. The dwarfing effect of heavy stubbing back of fig trees may not be so marked as in some other fruit trees<sup>23</sup>; furthermore the fig crop is produced on vigorous wood secured by such pruning. In this system the three framework branches are cut back to 12-inch or 14-inch stubs at the end of the first growing season. The cut should be made just above an outside bud to encourage spread. Framework branches which come out at an acute angle



Fig. 9.—An upright tree pruned to lateral spurs, a system possibly adapted to small grounds, and closely planted orchards.

may split down in future years and should be selected with this in mind. Central wire bracing may be applicable in such cases but the wires seriously interfere with picking of the fruit. At the end of the second season the upright branches should be thinned out to two or three, and each one cut back to a stub 10 or 12 inches in length. The aim should be to develop a flat-topped, spreading type of tree; therefore inside branches are cut shorter than outside ones (fig. 10). Low hanging branches should not all be removed but the strongest ones should be cut back to two or three buds, the stubs to serve as renewal spurs.

Subsequent pruning consists in cutting back vigorous upright branches each year to stubs shorter than in previous seasons. If sufficient spread has already been secured the stubs may be left suc-

<sup>23</sup> Three-year records of percentage increases in trunk circumferences of 280 Calimyrna fig trees pruned in different ways show the following: heavy pruning, 25.2 per cent; light pruning, 26.3; and minimum or no pruning, 26.4 per cent average increase.



Fig. 10.—A and B. A three-year-old Kadota fig tree before and after pruning. C and D. Same tree after two season's growth.

cessively shorter until in bearing trees they show only two or three buds, or sufficient to produce the new wood desired (fig. 11). The center of the tree should be kept open sufficiently to allow pruners and pickers easy access. A passageway for workmen is generally kept free from brush on one side of the tree.

*Time of Pruning and the Protection of Cuts.*—Mature fig trees may be pruned at any time after the leaves drop and the wood becomes dormant. The practice of pruning any fruit tree before the leaves mature is fundamentally wrong since the manufacture of plant food and its storage in the branches continue practically until the leaves turn yellow and are ready to drop. While there is no experimental evidence to prove it, there is a general impression that fig trees pruned shortly after the leaves fall will bud out earlier in the spring than trees pruned in January or February. Such early pruning might



A



B



C

Fig. 11.—A. Eleven-year-old tree in December, 1925, before pruning. B. Same, after pruning. C. Same tree, December, 1926. (Courtesy of Beckwith Co., Reedley.)

help to hasten the breaking of the rest period and to overcome the advantage of polarity of the terminal buds. On heavy land, early pruning, after leaf drop, is to be favored, because the work can often be finished and the brush removed before winter rains soak up the ground. Pruned fig trees have shown no greater susceptibility to frost damage or to drying out at the tips than unpruned trees of the same age, grown under the same conditions. Unusually severe weather might, however, result in greater injury to early pruned trees. Spring pruning of fig trees after growth starts will delay the lower and more dormant buds, that is, give the tree a "set back," and should be practiced only in case late spring frosts are to be feared.

The stubs of branches headed back in winter do not need protection. The same is true of small pruning wounds on the trunk and main framework branches. Wounds two inches or more in diameter on old trees should be painted over with a dressing such as asphaltum.

#### HANDLING THE CROP

In California the Kadota fig is primarily grown for fresh-fruit purposes. As a dried fig it is not regarded favorably. Even in Italy, where the Dottato furnishes the bulk of the figs for both local and export trade, the quality of the dried fruit fails to approximate that of the Smyrna fig either in thinness and texture of skin or syrupy nature of the pulp. The rubbery texture of the meat or rind which makes the fresh Kadota fig almost ideal for canning purposes, produces an inferior, leathery product when dried. Packers generally class dried Kadota figs with the White Adriatic and pay the same price for them according to grade. Since the dried Kadota is on the average somewhat smaller than the Adriatic and considerably smaller than the Calimyrna, the proportion of fancy and extra fancy fruit is comparatively low.

In districts where Kadota and Calimyrna orchards are in proximity, a problem in handling the crop presents itself. Some of the Kadota figs become caprifigged. Since the caprifigged figs are not attractive for fresh-fruit markets and not accepted by canners, they should be left on the tree for drying. The difficulty is to harvest the uncaperfigged fresh figs without having the ripe and dried fruit trampled into the ground by pickers. To help overcome this problem, the fresh figs should be picked at frequent intervals and the dried fruit removed from the ground before each picking.

*Fresh-Fruit Shipping.*—The brebas or first-crop Kadota figs are excellent for table use on account of their appearance, large size, and good quality. They find a ready sale in local markets that are not overstocked. Such figs should be well developed, properly colored, firm ripe, and packed in an attractive manner. The carrying qualities to distant markets in comparison with the Mission fig have not been determined.

Except for the very first pickings, second-crop Kadota figs are somewhat small in size to compete successfully on the fresh-fruit market with the Calimyrna or Brown Turkey. This applies both to local and distant markets. Many people, however, prefer the fresh Kadota fig for table use and for home canning because it is practically seedless and is mild in flavor. While limited shipments have been made to eastern cities, it appears that the Kadota fig has a tendency to develop dark spots in the skin when packed and shipped in refrigerator cars. The same is true to a certain extent of fresh Kadota figs on local markets. The success of the second-crop Kadota fig as a fresh fruit shipped to distant markets on a large scale in competition with the Calimyrna has yet to be demonstrated.

*Fruit for Preserving and Canning.*—Since the Kadota fig is being largely used for preserving and canning it is important for the grower to study the specifications submitted by the packer. Cultural methods should then be worked out which will produce the maximum quantity of the fruit desired. Most packers specify figs of a golden-yellow color, free from over-ripe, sunburned, or caprifigged fruit. "He does not want over-ripe figs because they go into jam and he develops sufficient jam stock during the processing. Green figs shrivel in the cooking, do not fill out nicely, and are inferior in appearance. Sunburned figs have a tough fiber, do not take the sugar properly, and have yellow hard spots especially around the eye, making the fruit unpalatable. Caprifigged figs are worthless to the preserver as they have a green color, contain many seeds, and do not take the syrup properly."<sup>24</sup> Some preservers prefer the figs with short stems left attached, but most canners are not particular on this point.

Pickers equipped with gloves and a picking hook to pull in branches should go over the tree often enough to get a large proportion of the fruit in the condition desired by the canner. This may mean every second or third day in the height of the season. The fruit

<sup>24</sup> Kimball, J. H. Figs for preserving. Proc. Tenth Ann. Fig Inst., Fresno, pp. 26-29. 1926.

is picked into one-gallon cans, shallow buckets, or baskets, suspended by a strap or rope from the shoulders. Pickers are paid by the day, or preferably by the hour, plus a bonus for every box credited to them. Pickers average 300 to 400 pounds a day during the season. For local delivery, shallow lug boxes holding from 18 to 20 pounds are used. For express shipments to distant canneries, shallow crates are generally furnished by the buyers.



Fig. 12.—Size grades of Kadota figs for canning, from small to large as follows:  $\frac{17}{16}$ ,  $\frac{19}{16}$ ,  $\frac{21}{16}$ ,  $\frac{23}{16}$ ,  $\frac{25}{16}$ ,  $\frac{27}{16}$ , and  $\frac{30}{16}$  inches, packing from 60 to 180 figs to a No. 10 can.

*Grades.*—The size grades of figs put up at Reedley, with the number in a No. 10 can, run about as follows:  $\frac{17}{16}$  of an inch in diameter, packing 180;  $\frac{19}{16}$ , packing 160;  $\frac{21}{16}$ , packing 140;  $\frac{23}{16}$ , packing 120;  $\frac{25}{16}$ , packing 100;  $\frac{27}{16}$ , packing 80; and  $\frac{30}{16}$ , packing 60 to a No. 10 tin (fig. 12). Early in the season, larger figs are sometimes packed 30 to 40 to a can.

Growers of Kadota figs must consider the labor problem. From late July to middle October there is or should be a steady succession of crop which must be picked in the right condition for most profitable returns. Steady, reliable pickers must be available for, as elsewhere stated, the over-ripe and dried product cannot be relied upon for much revenue.

## YIELDS

The Kadota fig tree is precocious and a heavy producer when compared to Calimyrna, Mission, or Adriatic trees of the same age. In some parts of southern California it does not compare favorably in production with the Brown Turkey. The most successful Kadota orchard in California, planted in 1915 with thirty-seven trees to the acre, produced in 1925 four tons, and in 1926 five tons, of marketable fruit to the acre. Figures sometimes seen, on the probable crop from the same orchard with more trees planted per acre, are mere speculation.

The results of a survey recently made, show that very few Kadota orchards produce enough fruit the third season to make it worth harvesting commercially. Even in the fourth and fifth seasons, hundreds of acres have failed to produce crops worthy of commercial consideration. On the other hand, some orchards which have escaped serious frost injury and have had good care have produced from a ton to a ton and a half of marketable fruit during the fourth season. The records of production given in table 1 (p. 36) are taken from orchards considered successful for their districts. They show a wide variation in pounds of fruit per acre. Other records show the following production per acre: one orchard fourth season, 4000 pounds; two orchards sixth season, 1500, and 5055 pounds respectively; one orchard seventh season, 4071 pounds; one orchard eighth season, 3181 pounds of fresh fruit. As in all horticultural crops, the average production of Kadota figs per acre, if figures were available for the total acreage, would be very low indeed. When considering the total production of fresh fruit per acre the Kadota fig suffers materially in comparison with the canning peach, which frequently produces three tons per acre the third season, ten tons at five years and twenty tons or more when in full production. Such terms as "guaranteed production" appearing in advertising pamphlets are entirely misleading when applied to farm and orchard crops, which depend so completely on the vicissitudes of climate, rainfall, and pests, to say nothing of price fluctuations. The best guarantee of successful production and returns is the presence of the owner on the property and his personal supervision. This can be emphasized by the following example: In Tulare County there are two adjoining orchards, both planted in 1920. In 1925 No. 1 was operated by the owner living on the property and No. 2 by an absentee owner. The crop on the first

orchard of thirteen acres totalled  $13\frac{3}{4}$  tons, while on the second of seven acres the crop was only  $\frac{1}{3}$  of a ton. Early in 1926 the owner of orchard No. 1 took charge of No. 2 as well as his own, and that season delivered 48.5 tons of figs from the twenty acres, 32.2 tons from his own and 16.1 tons from the second orchard.

#### DISEASES

The Kadota is somewhat similar to the Mission fig in that the tree thrives and produces excellent fruit in a wide variety of soils and climates. Figs of both varieties are almost closed at the eye, and insects which carry yeasts and bacteria enter with difficulty, if at all. Souring<sup>25</sup> of the mature fruit is, therefore, of rare occurrence. For the same reason fig smut<sup>26</sup> is seldom found either in Kadota or Mission figs. When caprified, however, fruit of both varieties is susceptible to endosepsis or internal rot,<sup>27</sup> a disease known to be introduced into the fig by the female blastophaga.

Winter die-back of the branches of young fig trees is a common occurrence and is the result of leaving green fruit on the tree in the fall. Such figs soften or are frosted and become infected with a fungus (generally a species of *Botrytis*). This frequently extends through the stem of the fig and kills the bud or girdles the branch. This is of little consequence in case heavy pruning is practiced since the die-back seldom progresses below the joint or cut desired by the pruner.

In Italy, as in California, the Kadota fig has few serious diseases. Ferrari states that a gummosis of the fruit,<sup>28</sup> probably a form of souring, is prevalent in the district of Cosenza.

#### ORCHARD INJURIES AND PESTS

The danger of frost injury to young fig trees has already been discussed. Another climatic factor which may cause serious loss of marketable fruit is sunburn, already referred to under picking. Sunburned fruit is generally the result of lack of vigor in the tree because

<sup>25</sup> Caldis, P. D. Souring and internal rot of the fig. Pac. Rural Press, 111:500. 1926.

<sup>26</sup> Phillips, Edith H., et al. Fig smut. Calif. Agr. Exp. Sta., Bul. 387:9. 1925.

<sup>27</sup> Caldis, P. D. Etiology and transmission of endosepsis (internal rot) of the fruit of the fig. Hilgardia, 2:318, 322. 1927.

<sup>28</sup> *Loc. cit.*



of poor pruning, improper attention to soil moisture, or to foliage injured by red spider. Remedying such conditions will reduce the percentage of sunburned figs or eliminate them entirely.

All varieties of fig trees are susceptible to root injury from nematodes, minute worms which attach themselves to the roots and cause bead-like swellings or galls. Injured roots rot off and the plant must produce new rootlets to replace those that succumb. This is a drain upon the vitality of the tree, the seriousness of which depends upon the extent of the nematode infestation. No effective remedy is known when trees once become infested. Attempts are being made to find rootstocks resistant to attack. Especial care should be taken to plant nursery trees free from rootknot.

Fig trees are very susceptible to the attacks of gophers and these rodents should be controlled by trapping, drowning, or poisoning.<sup>29</sup>

The most serious pest of the Kadota tree is the red spider or two-spotted mite. This mite not only injures the foliage but spots the surface of the fruit and prevents its proper development. Growers who have been most successful in protecting their crop from serious injury have anticipated red-spider attacks and sprayed their trees early in the season. Efforts to control the spread of the spider after serious injury has become apparent are generally disappointing. The following spray formula<sup>30</sup> has been used successfully:

Lime-sulphur concentrate .....	1 gallon
Sublimed or powdered sulphur .....	5 pounds
Calcium caseinate .....	½ pound
Water .....	100 gallons

This was applied when the new season's growth was from five to eight inches long, or about May 1.

Sulphur dusting of Kadota trees when the fruit is maturing is unsatisfactory from two standpoints: the sulphur dust irritates the eyes and skin of the pickers, and it causes black specks to appear in the syrup when the figs are being cooked.

Since considerable experimental work is being done with new spray formulae and materials for controlling red spider, growers should consult their county agricultural agents for information as to measures which are most successful in their locality.

<sup>29</sup> Dixon, J. The control of the pocket gopher. Calif. Agr. Exp. Sta., Bul. 340:337-350. 1922.

<sup>30</sup> DeOng, E. R. The control of red spiders in deciduous orchards. Calif. Agr. Exp. Sta., Bul. 347:61. 1922.

An insect pest which is of minor importance at present but is gradually spreading in Fresno and Tulare counties is the European fig scale, *Lepidosaphes fici*. This scale attacks the branches and leaves but is most apparent on the ripening fruit. Spots of green persist around each individual scale and form a marked contrast to the natural golden-yellow color of normal Calimyrna or Kadota figs. Satisfactory control measures have not yet been worked out, although certain formulae may be used with good results.<sup>31</sup>

#### ECONOMIC CONSIDERATIONS

According to the most reliable figures available, there have been planted in California 11,131 acres of Kadota figs, distributed by counties as follows: Glenn, 500 acres; Yuba, 40; Sacramento, 150; Solano and Yolo, 100; San Joaquin, 2480; Contra Costa, 100; Stanislaus, 1006; Merced, 2500; Madera, 100; Fresno, 1500; Tulare, 2100; Kern, 140; Los Angeles, 345; Riverside, 70. A few small plantings are found in other counties. The trees vary in age from one to twelve years, the great majority having been planted since 1920. Some of this acreage is being neglected and will probably never come into bearing, but it is difficult to estimate what percentage of the total acreage will eventually be productive. Judging from the mortality figures of other fruit trees and from the present condition of some of the Kadota plantings, the total acreage can be discounted at least one-third in figuring potential production. Reliable growers and canners deprecate any plans to augment rapidly the present acreage, although a steady increase seems to be justified.

The following figures give the tonnage of figs canned and preserved in California during the past five seasons:

Year	Calimyrna tons	Kadota tons
1922 .....	1396	341
1923 .....	1619	547
1924 .....	610	325
1925 .....	400	1025
1926 .....	400	2568

*Costs of Production.*—It seems obvious, from an examination of the figures in table 1, that there is a wide variation in both yield and cost of production of Kadota figs. No attempt has been made, therefore, to average the figures for orchards of the same age. In general,

<sup>31</sup> McGregor, E. A. Report on the control of the Mediterranean fig scale. Blue Ribbon Inform., Calif. Peach and Fig. Growers, Fresno, 2:2. 1926.

as with all such figures, the cost of production per unit is inversely proportional to the total production per acre. The orchard producing 800 pounds of fresh figs showed a cost of 9.3c, while that producing 5500 pounds showed a cost of only 4.2c per pound. While these figures are not complete in all details, it is believed that they represent fairly well the present situation in the industry. Some growers are beginning to make good returns on their investment while others have been sadly disappointed in the cash value of their fresh figs. The profits from the few orchards which are showing a balance on the right side of the ledger do not indicate the bonanza which the Kadota fig has sometimes been pictured. Like any other fruit crop it will undoubtedly prove profitable in many cases, but it must face the vicissitudes of climate, pests, prices, and market fluctuations.

*Canning Plants.*—The 1926 crop of Kadota figs was handled by twelve companies, three in southern California, seven in the San Joaquin Valley, one in the Sacramento Valley, and one in the bay district. One of these companies obtained all of its supply of fresh figs and another practically all, by express from interior-valley points. While the carrying charges on fresh figs to the plant and on empty crates back to the grower amount to a considerable item, this is offset by the nearness to supplies of glass and tin containers, sugar, and other such items. By far the largest percentage of the figs was put up in tins as canned figs in a light syrup, testing from 31 to 45 degrees Balling. One company specializes in preserved figs in a 50-degree syrup packed in glass containers. Other Kadota products include spiced and pickled figs, candied and glacé fruit, broken figs, and jam.

*Prices.*—Prices to growers in 1925 were in general five cents a pound, and in 1926, six cents a pound for No. 1 figs. Some canners paid three cents for No. 2 figs in 1926; others accepted only first-grade, unscarred fruit. The 1927 price dropped back to five cents a pound. The Kadota fig has been canned in California under forty-five different brands.

*Competition.*—Reference to the figures on tonnage of canning figs shows that during the past five years there has been a marked decrease in the output of canned Calimyrna figs and a much more decided increase in the quantity of canned Kadota figs. Part of the decrease in Calimyrna tonnage has been due to the difficulty the canners have experienced in getting figs unaffected by the fungus disease known as internal rot. The control of this rot may result in an increase in the use of the Calimyrna fig for canning purposes. Although the Calimyrna is larger than the Kadota and full of seeds, it has a flavor and character which are preferred by many.

TABLE 1  
COSTS OF PRODUCTION, KADOTA FIGS, 1926 SEASON

Orchard	Num-ber acres	Season	Yield per A. in lbs. fresh figs.	Total gross income	Cul-tural costs per A.	Prun-ing	Spring plow-ing	Cul-tiva-tion	Spad-ing around trees	Fur-row-ing	Irri-gation	For-ti-liza-tion	Spray-ing	Taxes	In-terest on invest-ment	Other costs	Cost har-vest-ing per lb.	Total costs per A.	Net gain or loss per A.	Cost per pound
																	Cents			Cents
No. 1	10.0	6	4392	\$237.20	\$50.71	\$7.20	\$9.04	\$4.66	\$1.00	\$3.24	\$11.32	\$1.22	\$12.27	\$0.76	\$53.67	\$20.00	1.72	\$200.14	-\$37.06	4.5
No. 2	10.0	4	3429	186.88	37.61	4.06	*4.00	4.80	0.64	2.61	17.50	.....	2.61	4.00	38.33	.....	1.70	134.23	+ 52.65	3.9
No. 3	145.0	4	92	5.54	50.35	.....	.....	18.46	2.25	2.50	2.00	.....	3.14	10.00	*36.00	12.00	4.00	90.03	- 84.49	97.0
No. 4	14.0	6	5500	299.00	68.50	15.00	3.50	12.50	.....	.....	21.00	3.00	8.50	5.00	28.00	15.00	2.25	235.25	+ 63.75	4.2
No. 5	11.5	8	3805	206.29	50.08	6.24	.....	5.13	2.81	.....	25.51	.91	.....	9.48	*36.00	.....	1.29	138.70	+ 67.59	3.6
No. 6	10.0	6	800	46.90	28.26	5.49	.....	2.90	.....	.40	17.37	.....	.....	2.10	33.00	.....	2.50	83.51	- 36.61	9.3
No. 7	15.0	6	1549	85.06	42.28	5.10	3.50	16.15	.....	4.40	10.28	1.20	3.30	4.35	*36.00	.....	2.82	127.99	- 42.93	8.2
No. 8	40.0	6	2976	163.17	17.35	3.20	1.50	4.00	.....	1.75	2.75	.....	2.00	2.15	*36.00	.....	2.00	113.87	+ 49.30	3.8
No. 9	6.2	4	1964	113.20	24.41	3.32	2.90	6.45	1.35	4.03	2.58	.....	2.82	0.96	28.84	.....	1.36	80.96	+ 32.24	4.1
No. 10	20.0	6	1150	69.00	24.65	4.75	.....	8.50	.....	.....	8.00	.....	2.50	*0.90	*36.00	.....	2.15	85.37	- 16.37	7.4
No. 11	20.0	6	751	39.48	52.94	.....	.....	35.00	.....	.....	.....	.....	5.00	11.37	51.00	1.57	2.60	158.46	- 118.98	21.0
No. 12	14.0	4	1709	91.31	46.25	4.00	.....	12.50	1.50	3.75	1.50	2.00	9.00	12.00	30.00	.....	2.20	113.87	- 22.56	6.6
No. 13	15.0	6	1549	85.06	48.28	5.10	3.50	16.15	.....	4.40	10.28	1.20	3.30	4.35	*36.00	.....	2.80	127.99	- 42.93	8.2

\* Estimated.

The only other variety of fig used commercially in California for preserving is the Brunswick, and the available tonnage is at present small. The trees do not grow so vigorously nor produce so heavily as the Kadota, but the quality of the preserved fruit is excellent. One canner who has used a considerable tonnage regards the quality of the Brunswick equal to that of the Kadota.

No European or other foreign fig districts are at present canning or preserving figs in any quantities for export. It is a mistake, however, to state that California need fear no competition in this respect. All of the Gulf Coast states, and especially Texas, have considerable acreages in figs. According to reliable statistics for 1925 there were growing in Texas 13,510 acres of fig trees, a fourth of them being three years old or over. The tonnage preserved was approximately 2500, more than twice the output of California during the same season. The estimated output of Texas figs in 1926 was 275,000 cases, from eighteen plants. Although these were mostly preserved in a heavy syrup, an increasingly large quantity is being processed in a light syrup similar to that used in the California product.

The variety grown in Texas is called Magnolia, but it appears to be identical to the Brunswick already mentioned. The figs are peeled with lye before preserving, hence the misleading term "skinless fig." The Magnolia is, like the Kadota, practically seedless. The quality of the Texas product is well recognized by the trade and on account of low costs of production and canning, it has been able to undersell California canned figs. This competition must, therefore, be recognized by fig growers, investors, and canners in California.

Canned figs, both of Texas and California, must also meet the competition of other canned fruits such as peaches, apricots, and pears.

#### ANALYSES

Analyses of Kadota figs are not numerous. The figures in table 2 are from Pellicano<sup>32</sup> and compare Smyrna figs with the Kadota, the latter from various parts of Italy. According to these figures, Kadota figs are more commonly caprifified in Italy than is generally recognized.

Guglielmi<sup>33</sup> made analyses of caprifified and uncappifified Kadota figs with the results shown in table 3.

<sup>32</sup> Pellicano, A. Il fico nel circondario di Gerace. Bol. Arbor. Ital., 3:140, 141. 1907.

<sup>33</sup> Guglielmi, G. Coltivazione industriale del fico nel Lecceese. Bol. Arbor. Ital., 4:23. 1908.

TABLE 2  
ANALYSES OF SMYRNA AND KADOTA FIGS

Source	Average weight one fig grams	Average volume one fig c.c.	Water per cent	Reducing sugars per cent
Smyrna fig.....	17.68	14	20.10	46.4
Dottato figs from Amantea.....	14.48	12	20.25	57.9
Dottato figs from Agropoli.....	12.75	10.75	21.60	39.4
Dottato figs from Gerace.....	13.86	11.6	20.7	52.2
Dottato figs from Gioiosa.....	16.73	15.2	20.9	45.1

COMPARISON BETWEEN PERCENTAGE OF SKIN, PULP, FERTILE AND STERILE SEEDS

	Smyrna	Amantea	Agropoli	Gerace	Gioiosa
Skin.....	48.78	51.2	58.6	53.3	51.8
Pulp.....	51.22	48.8	41.4	46.7	48.2
Fertile seeds.....	97.0	73.5	70.0	72.2	71.7
Sterile seeds.....	3.0	26.5	30.0	27.8	28.3

TABLE 3  
ANALYSES OF KADOTA FIGS

	Caprifried per cent	Uncaprifried per cent
Water.....	21.10	20.35
Fats.....	5.04	4.20
Cellulose.....	7.35	6.00
Protein.....	4.81	5.25
Reducing sugar.....	54.35	58.40
Non-nitrogenous.....	5.01	3.43
Ash.....	2.34	2.37

He concluded that caprification of the Kadota was unprofitable as it reduces the nutritive properties of the fruit and forms numerous seeds which are annoying to the consumer. According to Guglielmi a careful experiment showed that the Kadota lost 66 $\frac{2}{3}$  per cent of its weight in drying.

Siniscalchi<sup>34</sup> gives an analysis (table 4) by Rossi of dried Kadota figs of the Cilento district:

He states that if the quantity of sugar contained in the Smyrna fig is considered as 1.00, that in the Kadota fig would be 1.058; considering the albuminoids of the Smyrna fig as 1.00, those of the

<sup>34</sup> Siniscalchi, A. La coltivazione del fico nel Cilento. Bol. Arbor. Ital., 7:51. 1912.

TABLE 4  
ANALYSIS OF KADOTA FIGS BY ROSSI  
Average weight of each fig 10 grams.

	<i>per cent</i>
Water.....	18.04
Albuminoids.....	4.97
Sugar.....	62.90
Pectose.....	6.39
Fats.....	.95
Fiber.....	4.05
Ash.....	2.70

Kadota would be 0.863. The Kadota figs of Cilento are lighter in weight, richer in sugar, and poorer in albuminoid substances.

The Kadota figs of Agropoli are not so soft or sugary as those of Cosenza, which accounts for the fact that they are quoted at lower prices on foreign markets.

Analyses of Kadota figs by W. V. Cruess and F. W. Albro<sup>35</sup> show the following:

	Caprified	Uncaprified
Partly dried figs.....	35.2 per cent sugar	28.4 per cent sugar
Dried figs.....	75.36 per cent sugar	68.16 per cent sugar

Counts of the seeds in four caprified Kadota figs, made in 1917, showed the numbers to be 544, 412, 402, and 667 fertile seeds. Counts of fertile seeds in two lots of Calimyrna figs showed the average number to vary from 529 to 1226 seeds per fig.

Analyses of fresh figs made by the Twining Laboratories, Fresno, are shown in table 5.

TABLE 5  
ANALYSES OF FRESH KADOTA FIGS

	White Endich		Kadota from Strathmore	Kadota from Reedley	
	<i>Caprified per cent</i>	<i>Uncaprified per cent</i>	<i>Caprified per cent</i>	<i>Caprified per cent</i>	<i>Uncaprified per cent</i>
Moisture.....	70.80	75.80	74.80	65.32	72.00
Ash.....	0.662	0.576	0.627	0.76	0.58
Reducing sugar.....	19.56	19.48	19.10	26.0	22.44
Cane.....	1.33	0.49	0.89	2.23	1.48
Starch.....	0.45	0.28	1.64	1.12	1.08
Acidity.....	0.24	0.24	0.24	0.48	0.36
Crude fiber.....	2.29	1.28		1.807	0.836

<sup>35</sup> Condit, I. J. Caprifigs and caprification. Calif. Agri. Exp. Sta., Bul. 319: 372, 373. 1922.

In 1921 the Twining Laboratories, Fresno, made analyses of nineteen samples of dried Calimyrna figs from different orchards of California. These showed the average percentage of total reducing sugar to be 62.84 and of invert sugar of 67.52. One analysis of caprifig Kadota fig made by the same laboratory showed a percentage of reducing sugar of 60.68. The discrepancies in comparative figures of the sugar content of Calimyrna and Kadota figs are probably due to the different climatic conditions under which the figs were grown.

During the season of 1926 the writer collected twenty-seven different samples of firm-ripe Kadota figs from representative orchards between Orland and Exeter. Figs from each sample were put through a meat grinder and stored in glass in a freezing room for about six weeks. The sugar content was then tested by means of a Brix spindle and found to vary from 19 to 24 per cent. The percentage of acid varied from 0.10 to 0.44 per cent.

#### GENERAL OUTLOOK

It should be emphasized that the Kadota fig industry is of very recent origin in California. The immense increase in acreage in the past six or eight years has been largely due to the activities of land promoters who, in many cases, have profited financially at the expense of investors. Bare land to be planted to Kadota figs and to be given three years' care has been and is still being sold at figures far above those which would purchase bearing orchards in proven fig districts. Some developments are on lands and in districts where the successful production of the Kadota fig is extremely doubtful. Experience gained so far indicates that the territory which will produce high-quality Kadota figs for canning is more limited than authorities believed even five years ago. High summer heat, a relatively low humidity, a minimum of strong winds, a satisfactory soil, and a sufficient supply of good irrigation water are some of the prime requisites for success.

During the short period in which the canning-fig industry has been established, better methods of handling the fruit have been learned and the processing has been improved. As the recent processor's conference showed,<sup>36</sup> there are many problems connected with the canning and marketing of the product which require serious consideration. The canned figs now on the market vary considerably in quality. Some leave much to be desired from this standpoint. The

<sup>36</sup> Proc. Tenth Ann. Fig Inst., Fresno., pp. 9-32. 1926.



fact that at least forty-five brands of canned and preserved Kadota figs have already appeared is surprising for an industry hardly ten years of age. Success in establishing other food products in American homes, however, has not been attained by multiplying brands. National advertising of a few standard brands representing high-quality products seems to be the path leading toward success. Growers and packers should cooperate to discourage extensive and injudicious Kadota plantings, to standardize products as far as practicable, and to develop markets which will absorb the increasing output.

#### SUMMARY

The Dottato fig is the principal drying variety of Italy. It has been introduced into California and acquired various names such as White Endich, White Pacific, and Kadota. The last name is so firmly entrenched that it is probably impracticable to reestablish the true name Dottato for the variety in California.

The Kadota tree normally produces two crops of figs. The first crop, which ripens in June in the San Joaquin Valley, is good for fresh-fruit markets but is very small in quantity under the prevailing system of heavy tree pruning. The second or main crop ripens during the months of August, September, and October and the golden-yellow figs are well adapted to commercial canning. The dried Kadota fig is not highly regarded in California on account of the leathery texture of the product.

Orchard operations, except for pruning, conform rather closely to those of other deciduous orchards. While heavy pruning, or annual stubbing back of the season's growth, is producing good results, modified systems are being tried out in the hope that young trees will bear earlier in life, first-crop shipping figs be more abundant, and second-crop figs ripen earlier in the season.

There are no Kadota orchards in California in full bearing. The oldest, at twelve years of age, has produced five tons of fresh figs per acre, which is only a quarter of the tonnage produced by good peach orchards at the same age. Very few Kadota orchards bear commercial crops the third season, and hundreds of acres have failed even at five and six years of age to produce crops of much financial value.

During the 1926 season there were canned in California 2568 tons of fresh Kadota figs, for which growers generally received six cents a pound. These were handled by twelve companies under at least

forty-five different brands. Kadota figs come into competition with preserved and canned Magnolia figs of Texas, where the acreage of canning figs is larger and the output greater than in California. Reliable growers and packers deprecate any extensive or rapid increase in the Kadota acreage, although a steady increase seems to be justified.

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## II. KADOTA FIG PRODUCTS

W. V. CRUESS<sup>37</sup>

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*The Canning of Figs.*—It has been demonstrated by commercial canners that there is a much greater potential demand for figs canned in a syrup of medium sugar concentration than for fig preserves. While fig preserves are popular and appeal to most consumers, they are extremely sweet and on this account only a small quantity can be eaten at a time. Furthermore, the retail price is necessarily relatively high. Figs canned in light to medium syrup are, on the other hand, not excessively sweet and not unduly costly. They may be used as a breakfast fruit or dessert.

The process of canning varies greatly in the different canneries. The following method is based on present practice in several of the more successful canneries.

Kadota figs are gathered firm-ripe in shallow lugs or in grape baskets and delivered without delay to the cannery. Firm-ripe fruit rather than soft-ripe or slightly underripe fruit is preferred.

The figs are graded usually over a grader into the size grades given on page 30. They are then blanched (parboiled) a short time, usually about three minutes in water at 140–180° F. to cleanse them and to remove some of the waxy coating and “raw flavor.”

They are then cooked a short time, about 30 minutes, in a light syrup to make the tissues permeable to the syrup used in canning and to make the figs translucent after canning. This cooking may be done in jelly kettles or in pans heated electrically or by steam. After standing several hours or overnight in the syrup, the figs are canned, a 50°–55° Balling syrup is added, the cans are exhausted (preheated in steam 5–8 minutes, sealed, and sterilized in boiling water 1–2 hours).

In one cannery the figs are canned direct from the hot syrup used in the preliminary boiling process. In others the figs are blanched in water in the cans by heating the cans of figs in boiling water. The water is drained off, syrup is added, the cans are exhausted, sealed, and then sterilized as noted above.

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Preliminary cooking in syrup or water greatly improves the appearance of the finished product. Experiments at the University demonstrate that such cooking can be done in the cans by heating the figs, water or syrup, and cans in live steam, draining after cooking, adding fresh syrup, and proceeding with exhausting and sterilizing as previously described.

One cannery blanches the figs in hot water, cans them at once, adds a heavy syrup of about 70° Balling, exhausts, seals, and sterilizes as already described.

In all cases the attempt is made to obtain a canned product of tender texture, plump and unbroken, translucent in appearance, and a syrup in the can that will contain 35–40 per cent sugar, that is, test 35–40 degrees Balling by hydrometer, after sterilization and storage.

*Preserving.*—Several methods of making Kadota preserves are in use. At the University the following method has proved satisfactory. Firm-ripe figs are sorted and graded for size. They are then blanched in hot water 3–5 minutes at 180°–200° F. One pint of water and one pound of sugar to each pound of figs are added and the mixture is boiled slowly to about 220° F., set aside overnight, sorted, packed in glass jars or cans and the syrup used in cooking them is added to fill the containers. The containers are heated to about 160° F., sealed and pasteurized at 180° F. for 30 minutes.

In one factory the blanched figs are cooked to 220°–221° F. in syrup of 60° Balling added at short intervals during boiling. One preserver lye-peels the figs; some others puncture them through and through with large needles. This can be done mechanically and is said to promote penetration of the syrup.

Boiling should be very slow and should be done in small lots in order that as few of the figs as possible may be broken.

Jam is made from the broken figs and overripe stock. This can be done by coarsely grinding the figs, adding an equal weight of sugar and cooking to 221° F. The demand for the jam is limited.

Overripe fruit is precooked in kettles without sugar in one factory, packed “solid pack” in number 10 cans, and sterilized, for use in the baking and ice-cream industries.

*Candyng and Glacéing.*—The Kadota fig is one of the most popular of fruits for candyng and glacéing. In some factories the figs are first stored in dilute sulfurous-acid solution in barrels for several weeks before being candied. In others the fresh fruit is used.

In experiments at the University the fresh fruit has given the better flavor. The following process has proved satisfactory.

Firm, ripe figs are punctured through and through in several places with a silver fork. They are then boiled in water until tender.

A syrup made of a mixture of equal parts cane sugar and glucose syrup added to water to give 40° Balling (i.e., 40 per cent sugar) is placed on the figs. The mixture is boiled 2-3 minutes and set aside 24 hours. The syrup is drained off and enough of the 50:50 glucose-cane sugar mixture added to increase the concentration to 50° Balling. The fruit and syrup are boiled 2-3 minutes and set aside 24 hours. On succeeding days the concentration is increased as previously described to 60°, then to 70°, and finally to 72°-74° Balling. The fruit is allowed to stand in this last syrup at least two weeks to become plump. It is then drained, wiped with a wet cloth or dipped in hot water to remove excess syrup, and dried at 135°-140° F. in a dehydrater or at room temperature on screen trays until no longer sticky.

It is then packed in candy boxes. It should be consumed within three months, as in time it becomes over-dry and tough or filled with sugar crystals.

If packed in vacuum-sealed jars, the candied figs keep indefinitely.

A recipe for the home preparation of candied fruits, including figs, may be had on application to the College of Agriculture, Berkeley.

One company has developed a good market for the figs canned in the final syrup used in candying, the product being used by candy makers, who need only drain and dry the figs in order to prepare candied figs.



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