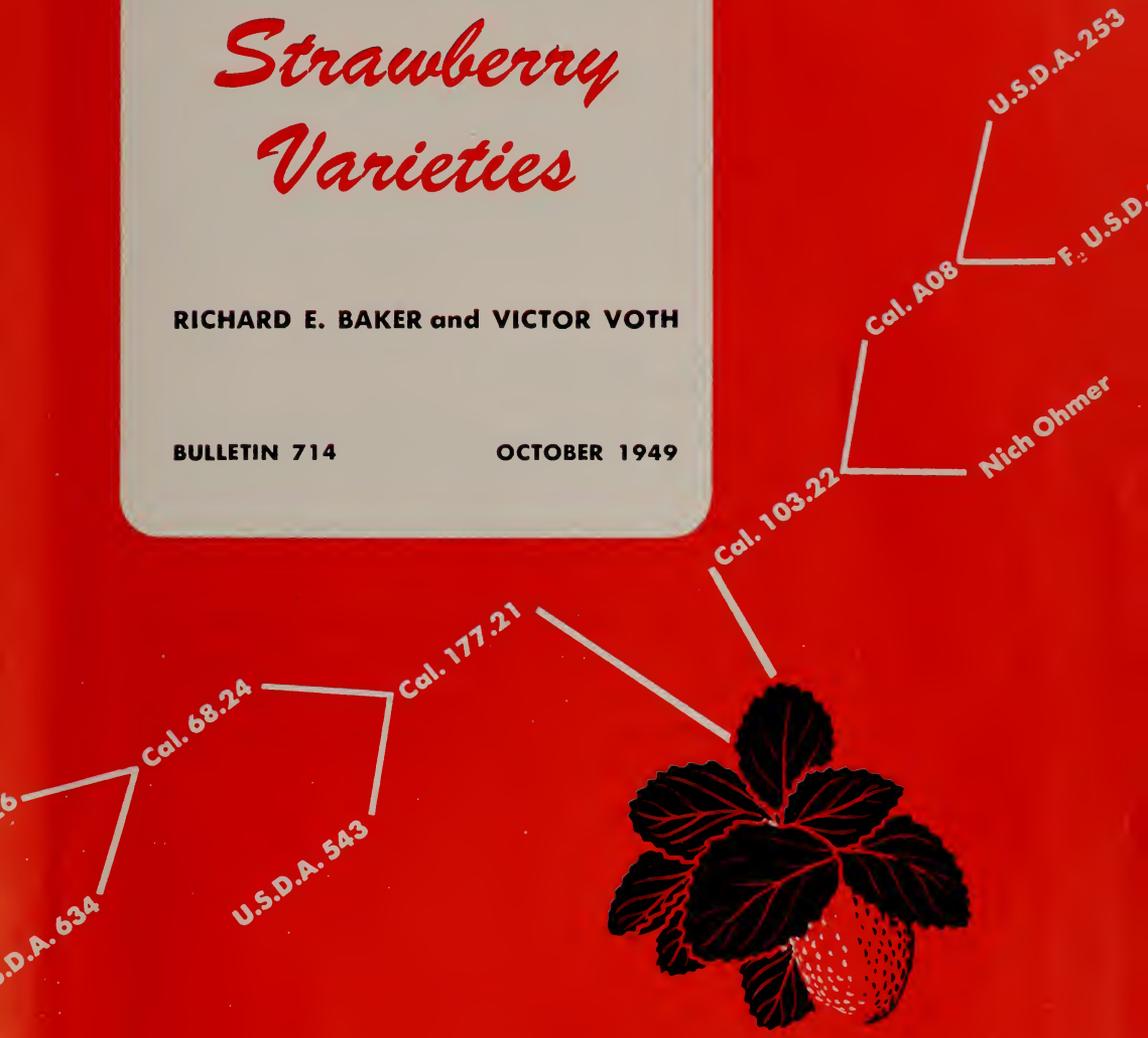


**BREEDING AND
TESTING**
*Strawberry
Varieties*

RICHARD E. BAKER and VICTOR VOTH

BULLETIN 714 **OCTOBER 1949**



A Strawberry Breeding Program,

with its goal the development of varieties especially suited to California growing conditions, has been under way at the University of California for a number of years.

FIVE NEW VARIETIES were introduced in 1945. These varieties—SHASTA, SIERRA, LASSEN, TAHOE, and DONNER—were described and made available for trial as fresh market berries, but their adaptation to all parts of California was not then adequately determined.

This Bulletin is intended to do two things:

1—make a report on the horticultural value of the five varieties introduced in 1945, in the light of four more years of trial in numerous growing areas;

2—introduce two new selections, CAMPBELL and CUPERTINO, which have shown promise in experimental plots and in a number of small commercial plantings, but the extent of whose adaptation is not yet known.

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REPORT
OF THE
AGRICULTURAL EXPERIMENT STATION
OF THE
UNIVERSITY OF CALIFORNIA

From July 1, 1949, to June 30, 1950

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Agricultural Experiment Station Bulletins 714-716

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BREEDING AND TESTING

Strawberry Varieties

RICHARD E. BAKER and VICTOR VOTH

SINCE THE INTRODUCTION of the five so-called University varieties of strawberries in 1945, further tests of the selections, as well as of some 1,100 seedlings, have been made. An isolation nursery has furnished virus-free plants for trial in test plots throughout the state.

As a result of this continuing testing program, the characteristics, adaptation, and horticultural value of the varieties have become better known. In addition, the tests have indicated that two new selections are worthy of introduction at this time.

Conditions of the Tests

Isolation Nursery. All of the selections have been maintained in separate plots in an isolation nursery near Winters. None of the plants in this nursery is known to be infected with virus diseases. The location is isolated from commercial and home-garden plantings of strawberries. The normal spread of virus diseases of the strawberry is known to be relatively slow in the Winters district. Only varieties, selections, and new seedlings developed at the University are maintained there. Commercial varieties and selections from outside sources are not planted in or near the isolation nursery. This nursery is maintained as a source of virus-free strawberry plants for trial in the various test plots throughout the state.

Fruit Records. Plants of all selections have been taken from the isolation nursery and planted in small trial plots in the central coast area, in the interior valley, and in southern California. Notes have

been taken several times throughout each season on the characteristics of the fresh fruit. Records of production, size, and appearance have been accumulated for each picking for each selection throughout each season from 1946 through 1948. The same type of record has been kept for all selections in replicated plots and in commercial trials.

Preliminary storage tests have been used for the more promising selections with fruit samples stored at 40° F for 10 days. Notes have been taken on each sample before and after storage. This procedure indicates in a preliminary way the shipping quality. Preliminary tests also have been used to determine the value of selections for freezing. This work has been done in cooperation with the Division of Food Technology.

Plant Records. The resistance of the more promising selections to verticillium wilt has been tested in a disease nursery at San Jose. Selections have been inoculated with this disease and planted in infested soil. Standard varieties of known commercial resistance have been included in the test for comparison with the selections which were being studied. The resistance of the selections to strawberry yellows, powdery mildew, salinity, and red-spider damage has also been recorded.

A summary of plant and fruit characteristics is given on pages 8 and 9; pictures of the fruit on pages 10 and 11; and pedigrees for the University varieties on pages 15 and 16.

EVALUATION OF VARIETIES INTRODUCED IN 1945

In response to many requests for recent information on the Shasta, Lassen, Sierra, Tahoe, and Donner varieties, an evaluation based on commercial trials is given here. These varieties have almost completely replaced the Banner variety in the central and north coast region where they are adapted. They have been planted extensively in the interior valley and in southern California where their adaptation was not definitely known.

Many plantings are located in moderately saline soils. The Lassen and Donner varieties have fair resistance to salinity. The Sierra, Tahoe, and Shasta varieties are less resistant. In coastal locations some growers are attempting to leach neutral salts out of the surface soil by using sprinkler irrigation at all times of the year except during the picking season.

Because sprinkler irrigation during the picking season may cause too much fruit rot, a special type of double-row bed with a high central ridge is used to avoid salt

accumulation near the plants. The irrigation water is distributed in furrows between the beds, and the plants are located on the sides of the bed and close to the furrows. The salts which accumulate in the surface soil as a result of this type of irrigation are concentrated mostly in the high ridge between the rows of plants; thus the plants may escape injury from the salt accumulation. This type of bed has been used for strawberry culture in the Imperial Valley, but it has not been used extensively for commercial plantings in other locations.

In semi-coastal and interior locations, it is possible that the sprinkler system may not cause too much fruit rot during the picking season so that it could be used throughout the year. In any case the irrigation water must not contain high concentrations of sodium or chlorides. Water of this kind would increase the salinity problem regardless of the method of application.





Fig. 2. Lassen has large, smooth, glossy leaves cupping slightly upward.

Shasta

In the central and north coast areas Shasta is the most popular variety. The total seasonal yield is greater than that of all other varieties except Lassen. Production is fairly continuous throughout the season with peaks less pronounced than for other varieties.

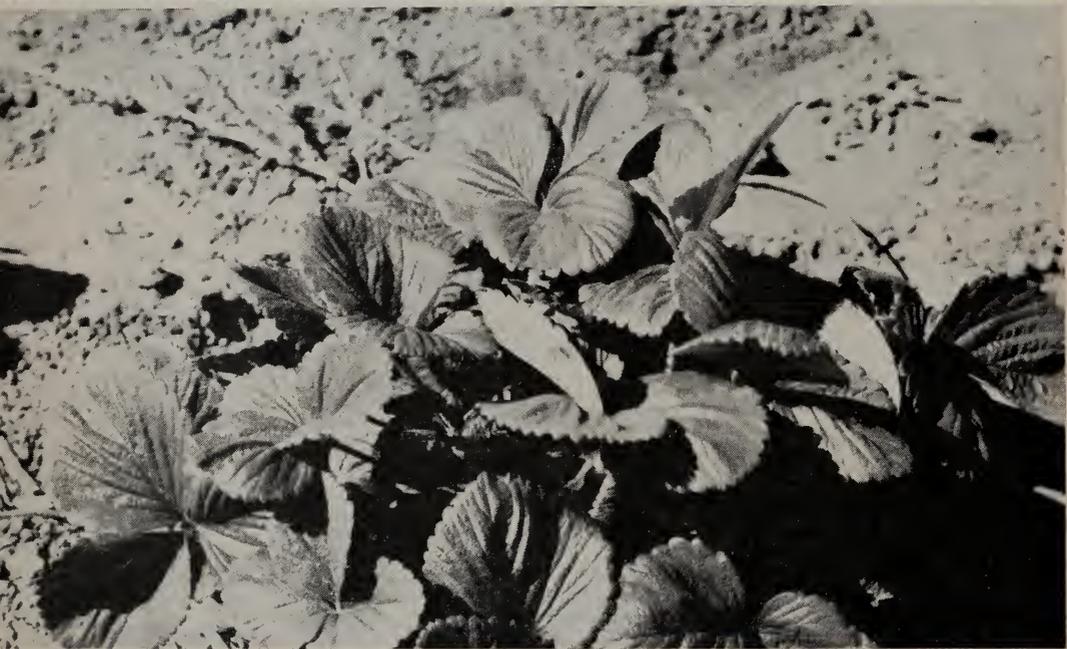
This variety is susceptible to injury from verticillium wilt and moderate salinity. It ranks above Donner and Lassen but below Tahoe and Sierra in resistance to verticillium wilt. It is more susceptible to injury from moderate salinity than any of the five varieties. In the Sacramento and northern San Joaquin valleys the Shasta variety has not produced satisfactorily. Crops have been light and the production season is short. In southern California it is short-lived in all locations where it has been observed because it is not tolerant to moderate salinity. Shasta has fair resistance to the hot-water-dip treatment used for the control of cyclamen mite.

Fig. 1 (Left). Round leaves of the Shasta variety are bluish green and cup downward.

Lassen

Lassen ranks second in popularity in the central and north coast region. In total production it may sometimes surpass the Shasta variety. The seasonal production, however, is less continuous than that of Shasta and tends to have definite peaks in the spring and fall. It is probably more susceptible to verticillium wilt than any of the five varieties. On the other hand, it is probably the most resistant to moderate salinity. In the interior it has produced as much as the Oregon Plum (Banner) variety. It does not turn dark upon ripening like the Oregon Plum, but it is probably about as soft.

In moderately saline locations in southern California the Lassen variety has made more vigorous growth than Klondike, but the production has not been satisfactory. The Lassen variety may grow vigorously until April or May, when the concentration of sodium and chlorides in the surface soil on raised beds is sufficient to cause severe injury. Many of the plants will recover partially or completely the following winter and early spring, and may even produce a portion



of a normal crop. Apparently the winter rains leach enough of the toxic salts out of the surface soil so that the plants can recover for a few months.

Donner

The Donner variety is third in popularity in the central and north coast region. Its season of production is similar to Lassen but the total yield is less. Donner is probably more susceptible to strawberry yellows than any of the five varieties. For this reason many plantings in the central and north coast region are short-lived. It is only slightly more resistant to verticillium wilt than the Lassen variety and ranks next to the latter in its tolerance to modern salinity.

In the interior and southern California its performance is approximately the same as that of Lassen, even in regard to production. Since strawberry yellows is not a major problem in the interior, Donner may be as long-lived as Lassen in that region. In coastal regions of southern California, where strawberry yellows is a major problem, the Donner variety may be short-lived because of this disease.

Sierra

The Sierra variety is fourth in popularity in the central and north coast region. The total production is less than that for Donner. Both the spring and fall crops are relatively light. The fruit is rather rough, the seeds protrude from the flesh, and the tip is often green or whitish in color instead of red. In verticillium resistance, however, this variety surpasses all others. It ranks with the Banner variety in its resistance to this disease.

In salinity tolerance Sierra ranks below Lassen and Donner but above Shasta. In the interior valley, production has been poor, and fruit characteristics have been unsatisfactory as mentioned above. In southern California the Sierra variety has made weak growth and produced only light crops on moderately saline soils. In soils which are relatively free of sodium and chlorides the Sierra variety will produce light crops of large, attractive fruit the first season following winter planting.

Tahoe

The Tahoe variety is the least desirable of the five varieties in the central and north coast region. Production is too light; the fruit is small, soft, and poorly colored. Tahoe ranks next to Sierra in resistance to verticillium wilt, but it probably does not have enough resistance for commercial plantings in most soils infested with this disease.

In salinity tolerance the Tahoe variety ranks about the same as Sierra; in other words it is not very tolerant. In the interior it will produce more than Shasta or Sierra, but less than Lassen and Donner. A few berries will mature during the summer and fall months but not enough for a commercial picking. In southern California its growth response is about the same as Sierra but production is less.

Fig. 3. Top, Donner variety has smooth, light green leaves; center, leaves of Sierra are wrinkled and dull gray-green; bottom, Tahoe plants have medium sized, dark leaves which cup upward.

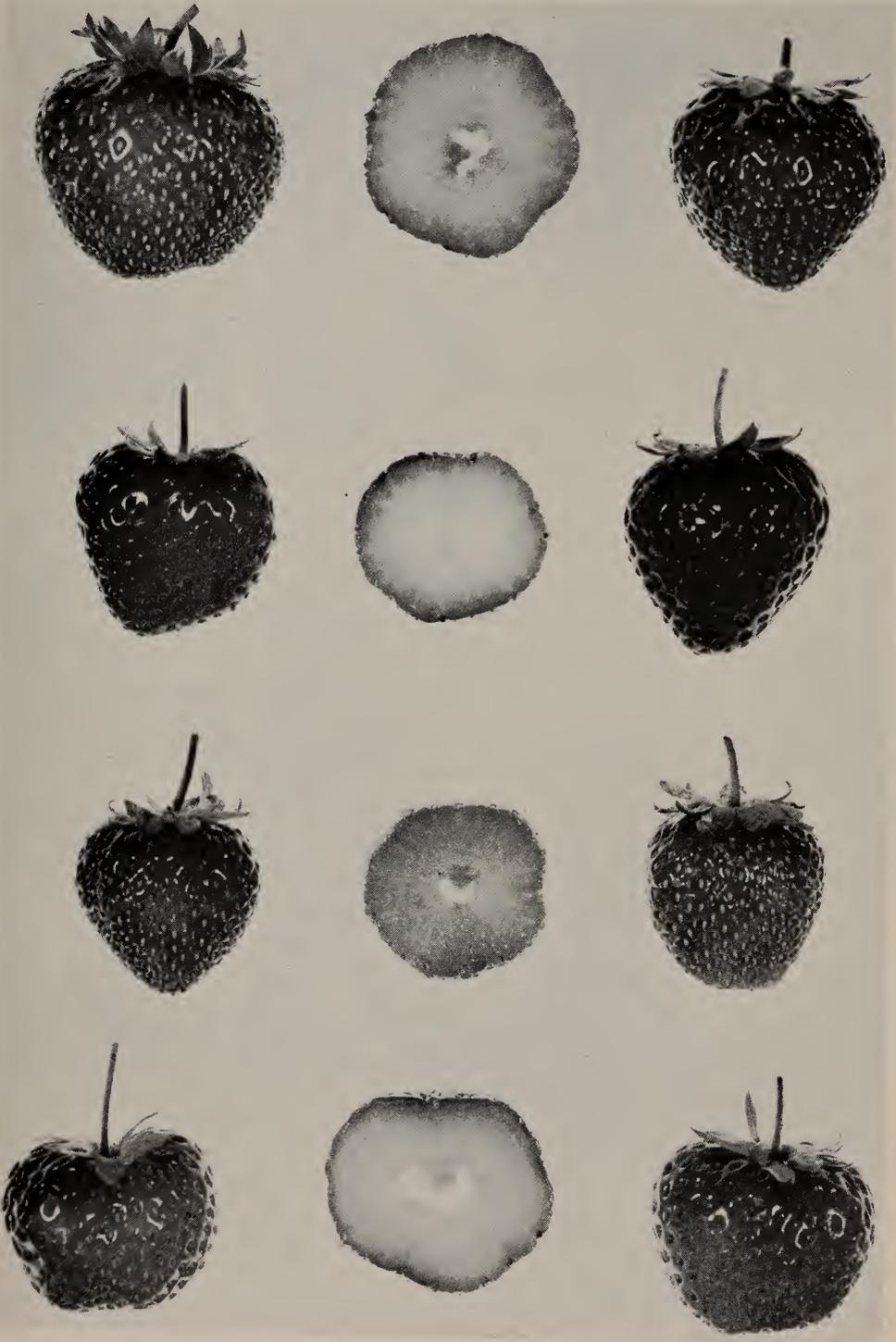
Plant and Fruit Characteristics OF STRAWBERRY

	Lassen	Sierra	Tahoe
Adaptation	Central and north coast; central valley	Central and north coast; Sierra foothills	Central and north coast
Periods of poor production	early summer; early fall	first $\frac{2}{3}$ summer	first $\frac{2}{3}$ summer
Begins bearing	end of April	first week May	first week May
Nubbins	summer, many	summer, many	summer, many
Total production	very good	fair to good	fair to good
Vigor	good	fair to good	good
Runner production	very good	good	excellent
Leaf type	large; smooth; glossy	wrinkled; large; dull green	medium size; smooth
Flower stem type	medium long; high branching	long and high branching	medium long; high branching
Longevity of plant	good	good	fair
Virus resistance	good	fair	fair
Verticillium wilt resistance	poor	excellent	fair to good
Mildew resistance	fair	fair	poor
Red-spider resistance	excellent	poor	fair
Salinity resistance	fair	poor to fair	poor to fair
Fruit color	light red; glossy	medium red; glossy; white tip	light red; glossy
Fruit shape	round conic to blunt conic	conic or wedge	long conic
Fruit size	large	primaries large	medium
Seed color and position	yellow; flush with surface of fruit	yellow to red; flush to raised	yellow or red; flush
Aroma	slight	slight	slight
Skin texture	tender	medium tender	medium tender
Flesh texture	soft	medium firm	medium firm
Flesh color	light red	red	light red
Hollow	small	small	small
Juiciness	juicy	moderate	moderate
Flavor	subacid	subacid	subacid
Quality fresh	fair or poor	fair	fair
Value as shipper	fair to good	fair to good	fair to good
Use of fruit	fresh market	fresh market	fresh market
Quality frozen	poor to fair	fair	poor; too soft
Resistance to hot-water dip	fair to good	excellent	fair to good

VARIETIES INTRODUCED BY THE UNIVERSITY OF CALIFORNIA

Shasta	Donner	Campbell	Cupertino
Central and north coast; S. San Joaquin	Central and north coast; central valley	Central and north coast	Central and north coast
first ½ summer	first ½ summer; fall	late summer; late fall	late summer; early fall
last week April	last week April	last of April	early May
few	few	few	few
good	fair to good	good	good
fair	good	good	good
good	good	very good	good
bluish green; cupped down	similar to Lassen	medium size; smooth	medium size; smooth
medium long	short	medium long	medium long
fair	fair	good	good
fair	poor	good	fair
poor	poor	poor	poor
fair	poor	poor	fair
fair	fair	poor	fair
poor	fair	fair	fair
medium red; glossy	bright red; glossy	medium red	medium to dark red
round conic to blunt conic	long conic	conic to wedge	conic
medium	medium to large	medium to large	large
greenish yellow; flush	yellow; flush	yellow; flush	yellow; flush
none	slight	slight	highly aromatic
medium tender	medium tender	medium tender	medium tender
medium firm	medium firm	medium firm	medium firm
medium red	red	bright red	red to whitish
small	small to medium	small	large
moderate	juicy	moderate	moderate
mild subacid	subacid	subacid	subacid
fair	good	fair	good
fair to good	fair to good	fair to good	fair to good
fresh market	fresh market; home garden	fresh market	fresh market
fair	fair	no commercial trials	no commercial trials
fair to good	fair to good	fair	fair

The Fruits Compared



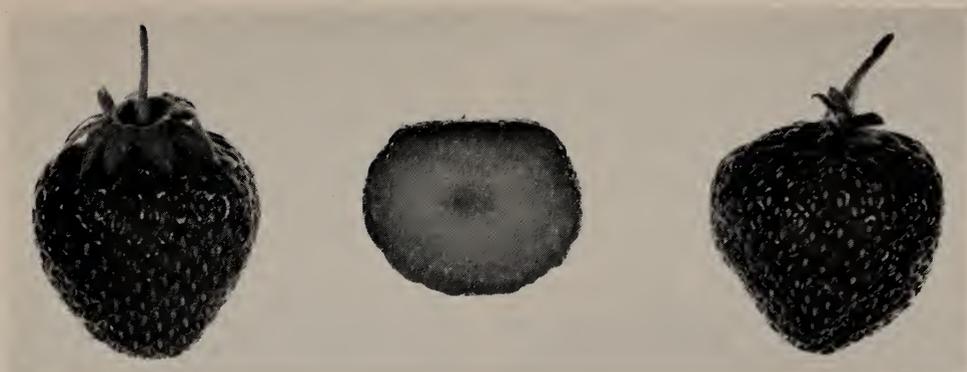
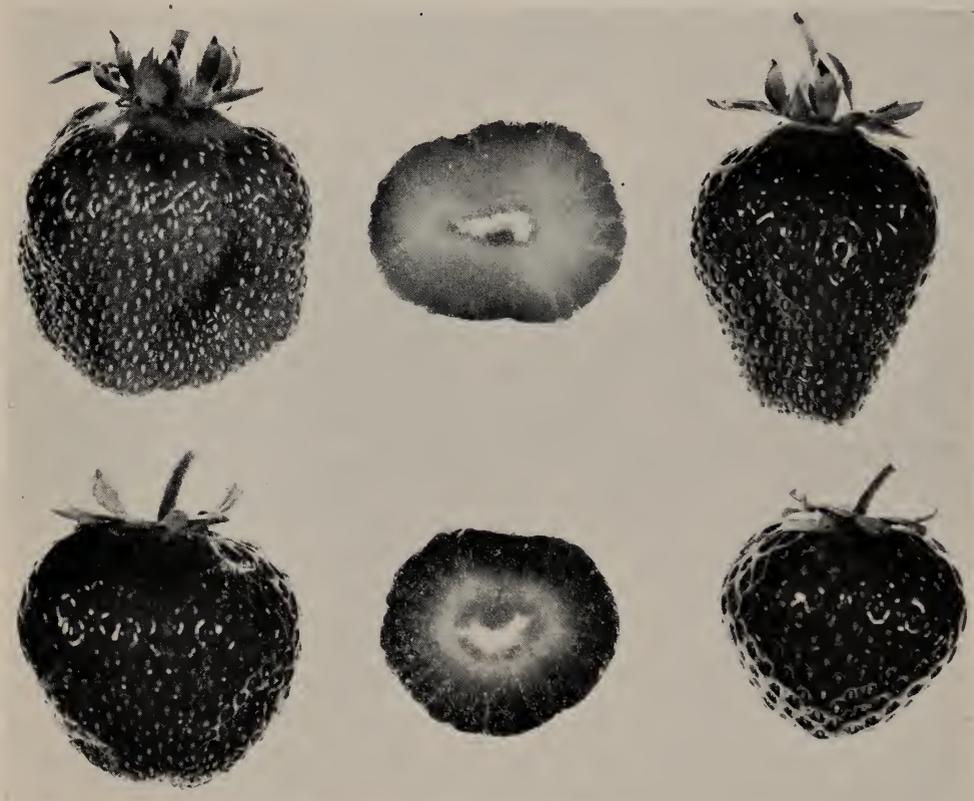


Fig. 4 (Opposite). Top to bottom: Shasta, medium red and glossy, round conic to blunt conic in shape, greenish yellow seeds; Tahoe, long conic berry, light red in color; Sierra, medium red with white tip, conic or wedge shaped, yellowish seeds sometimes raised; Lassen, round or blunt fruit, light red in color.

Fig. 5 (Above). Donner, a bright red, glossy fruit with long conic shape.

Fig. 6 (Below). The new introductions: Campbell, a medium red, conic to wedge-shaped fruit; Cupertino, dark red, conic berry, and highly aromatic.



NEW INTRODUCTIONS

The two new strawberry varieties described below are being introduced for trial in the central and north coast regions as fresh market berries. Their performance in trial plantings in southern California and in the interior valleys indicates that they are probably not adapted there. Both have shown merit in several locations in the central and north coast region. Since neither has been sufficiently tested to determine the extent or limits of its adaptation, no final recommendations for use can be given here, nor is it assumed that both varieties will have enduring value.

These varieties are the sixth and seventh to be introduced as a result of the breeding program. They represent what appear to be two of the more promising progeny of crosses made in 1935 and 1939 by H. E. Thomas and E. V. Goldsmith. Their release at this time has been brought about by numerous requests from commercial strawberry growers in

the central coast region who are thoroughly satisfied with their performance in small commercial plantings. They have been selected by them for expanded plantings even though some of the fruit and plant characters are not ideal.

Both varieties have specific characteristics which are not possessed by any other strawberry variety grown in California. They have already been used by commercial growers as desirable additions to plantings of the 1945 University introductions.

Botanically the two new varieties have perfect flowers. Neither, however, has been grown entirely alone and away from other strawberries; therefore both have always had opportunity for cross-pollination. The characteristics of strawberry plants and fruit vary from season to season and from year to year. The descriptions which follow will therefore not be accurate in every detail for all fruits in all seasons or years.

Campbell

The variety Campbell has shown promise in all test plantings made in the central coast area during the seasons of 1946 and 1947. It has been used successfully by commercial growers in the Santa Clara Valley during the seasons of 1946 to 1948. It was included in trial plantings at El Monte and Oxnard from 1946 to 1948 where it was moderately vigorous and tolerant to salinity, but the production was unsatisfactory. In the interior valleys it was tested during the 1947 and 1948 seasons. The production period lasted only three weeks and the total yield was less than that for Donner and Lassen. Campbell has been tested under the University number of California 467.1. It is the result of a cross made in 1935 and was selected in 1937.

Characterization

The plants of Campbell are similar to Tahoe in many respects. They are not exceptionally large. The leaves are similar to those of Tahoe but they are cupped upward less than those of Tahoe. The plants are moderately long-lived if they are given good care. This variety will yield an abundance of runners. One mother plant will produce as many as 125 runner plants.

The berries are borne on strong, upright, moderately high-branching stems. They are conic, symmetrical, and medium red in color. The flesh is medium firm, juicy, bright red. The finish is bright and the size is medium to medium large. The seeds are approximately flush with the surface of the fruit and yellow in color. The dessert quality is equal to that of Tahoe, Shasta, or Sierra.

Campbell starts production as early as any of the 1945 University varieties in the central coast region. It bears throughout the season from late April or early May until late fall. The crop is somewhat heavier during spring, early summer, and early fall but production is continuous between peaks. Its early summer peak follows the spring peaks of the other University varieties while its early fall peak precedes the fall peak of the others. The inclusion of Campbell in a planting with other University varieties would therefore spread the heavy production season over a longer period of time.

Campbell is only slightly more resistant to verticillium wilt than is Lassen. It is rather highly resistant to yellows but susceptible to mildew and to injury from red-spider. It is fairly resistant to injury from the hot-water-dip treatment used for the control of cyclamen mite.

Description of the Fruit

Size, medium to large; shape, conic, with good symmetry; color, bright red with good gloss; seeds, yellow, flush with

the surface of the berry, and medium in size and spacing; skin, moderately tender; flesh, moderately firm and juicy, bright red; slight hollow; aroma, very little; dessert quality, fair; shipping quality, good; total production, good with peaks in spring, early summer, and early fall in the central coast region.

Cupertino

This variety has shown promise in small commercial plantings in the Santa Clara and Pajaro valleys during the production seasons of 1946 to 1948. It was tested in trial plantings at El Monte and Oxnard during the seasons of 1946 to 1948. It was moderately susceptible to salinity. The vigor was less than for Campbell. The production was unsatisfactory. In the interior valleys it has been tested at Davis and Florin during the seasons of 1946 to 1948. It begins production a few days later than other University varieties and continues for only three weeks. The total crop is too light and the

Fig. 7. Campbell has smooth leaves cupping upward and with brilliant luster.





Fig. 8. Cupertino has dark green, somewhat pointed leaves.

season is too short. During unusually cool seasons in the interior valleys, there may be some summer and fall production.

Cupertino has been tested under the University number California 829.9. It is the result of a cross made in 1939 and was selected in 1941.

Characterization

The plants of Cupertino are moderately vigorous, dark green, and unlike any of the other University varieties in appearance. The plants are long-lived when planted in the proper site and under good cultural conditions. It will not yield as many runner plants as Campbell. One mother plant will produce approximately 90 runner plants.

The berries are borne on low to moderately high-branching stems. They are conic, symmetrical and medium to dark red in color. The flesh is medium firm, juicy, and light red to whitish in color. The finish is exceptionally bright, the size is large, and the aroma is pleasing; these three characteristics are the outstanding features of the fruit. The seeds are flush with the surface of the berry and yellow in color. The dessert quality is good when not overripe. The flavor is poor and the color becomes dark as the berry approaches maturity. Berries of this variety must be picked at the proper

stage of maturity for best color and flavor.

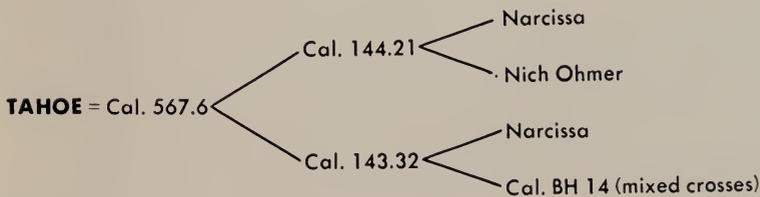
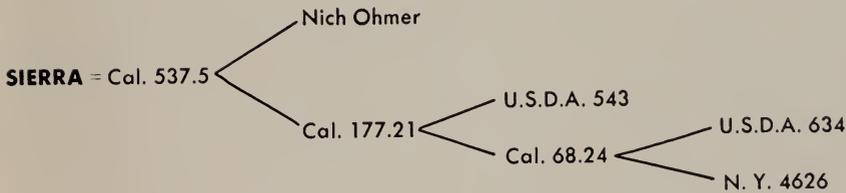
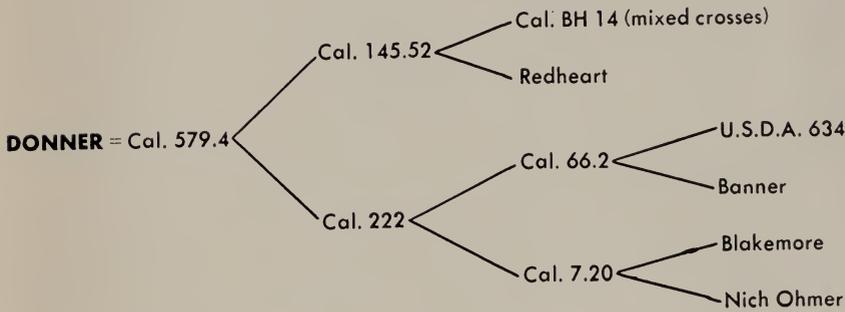
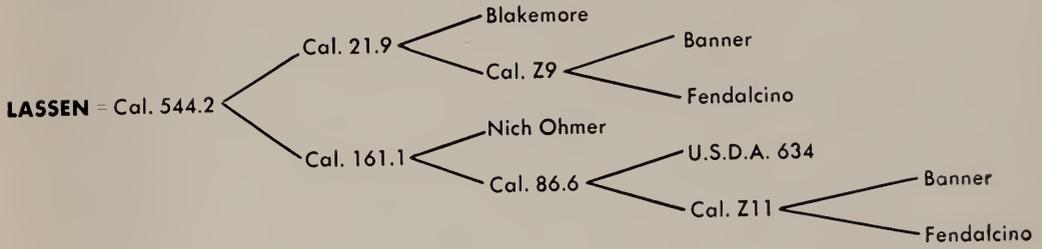
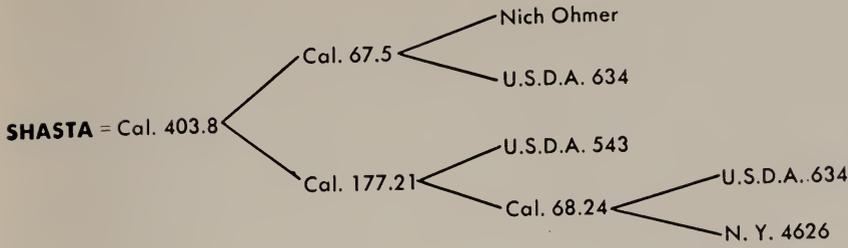
Cupertino starts production several days later than other University varieties in the central coast region. It bears throughout the season from early May to October. The crop is somewhat heavier during late spring, early summer and late fall. Its peaks of production do not coincide with those of other varieties. Its inclusion in a planting of other University varieties would therefore help to spread the heavy production season over a longer period of time.

This variety is less resistant to verticillium wilt than the Lassen variety. It is moderately resistant to yellows, mildew, and red-spider. It is fairly resistant to injury from the hot-water-dip treatment used for the control of cyclamen mite.

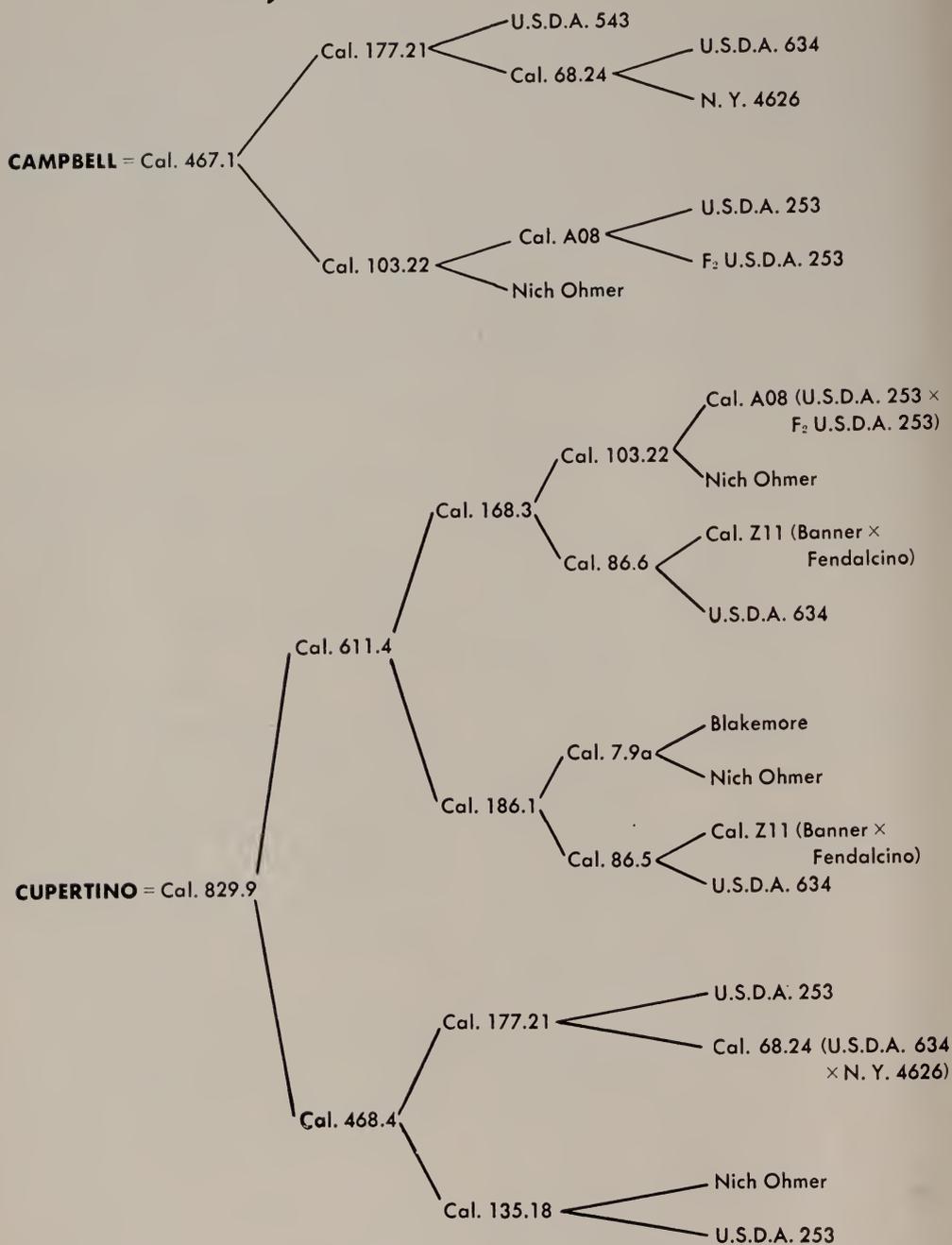
Description of the Fruit

Size, large; shape, conic, with good symmetry; color, medium to dark red with exceptional gloss; seeds, yellow, flush with the surface of the berry, and medium in size and spacing; skin, moderately tender; flesh, moderately firm and juicy, light red to whitish; large hollow; highly aromatic; dessert quality, good at proper stage of maturity; shipping quality, good; total production, good with peaks in late spring, early summer, and late fall in the central coast region.

Pedigrees OF UNIVERSITY VARIETIES



Pedigrees OF NEW INTRODUCTIONS



Requests for information concerning sources of nursery plants of any of the varieties discussed in this publication may be directed to the Division of Pomology, University of California College of Agriculture, Davis, California.