Small Fruit Sizes of Valencias

continuing long-range study in state's Valencia districts produces evidence that climatic factors may be critical

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Small fruit size is one of the most serious problems of the California citrus industry.

In 1929, Valencia fruit sizes were noticeably small; it took 20% more oranges to fill a box than in the previous year. The problem was acute again in 1939. Much study has centered on the cause and possible solutions. A wide variety of factors influence fruit size, but the basic physiology, anatomy, biochemistry, energy relations, and the individual and relative influences of climate, nutrition, and water are little known.

With the co-operation of growers and packing house managers, yearly peak size packout records on 153 individual Valencia orchards in 13 major citrus districts from 1932 to 1952 were obtained and the yearly average for each district plotted.

There are some objections to the use of peak size as an index of fruit size from a given orchard in a given year, but it provides a readily obtainable single-value index which—over a period of years and averaged with a number of orchards—represents major size trends about as accurately as though a weighted average of all fruit from an orchard were obtained. A weighted average was impossible to develop because of the volume of variable uncounted small sizes going to by-products.

From the point of view of indicating major changes in fruit sizes from year to year and differences between districts, the data collected for this study are regarded as reliable.

The outstanding feature of the data is the marked and simultaneous decrease in fruit sizes in all districts—except Tulare County—in 1945 and continuing through 1949. In 1950 and 1951, there was a substantial though varying upswing in all areas, followed by a drop again in 1952. Also evident was a marked drop in fruit sizes in 1939 in all save the Escondido area, where the decrease was only slight.

The only tenable explanation of these major and simultaneous shifts in fruit sizes in all areas except Tulare County is the occurrence of some climatic factor or complex of climatic factors affecting the physiology of the tree and fruit size.

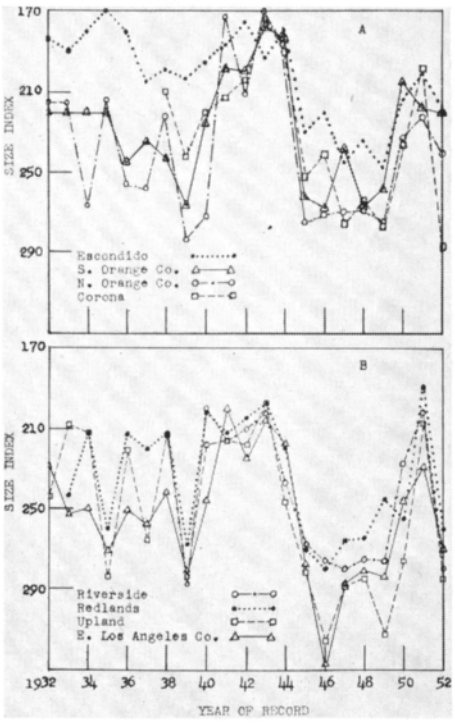
While it is established that fruit sizes can be influenced by nutrition and other soil factors, such factors do not explain the sudden and simultaneous decrease in fruit sizes in the wide variety of orchards and soils from Ventura to San Diego counties. Mild deficiencies of zinc, manganese, and iron, together with low potassium—working in combination with a major climatic factor—might make for greater size decreases in one grove or area than in another, but by themselves, soil factors cannot account for the simultaneous break in all districts except Tulare County. The same reasoning applies to management and irrigation practices, insects and insect-control treatments, advancing age of orchards, and all the other nonclimatic factors.

The view has occasionally been advanced that small sizes are due to a symptomless virus. While a virus disease or diseases—as factors in the fruit-size problem—cannot be completely ruled out, it would be difficult to explain on this basis the sudden simultaneous and widespread decrease which began in 1945.

Increasing air pollution has often been mentioned as a major factor, but that would not explain the size decreases in the Escondido area and the Ventura County districts.

Concluded on page 13

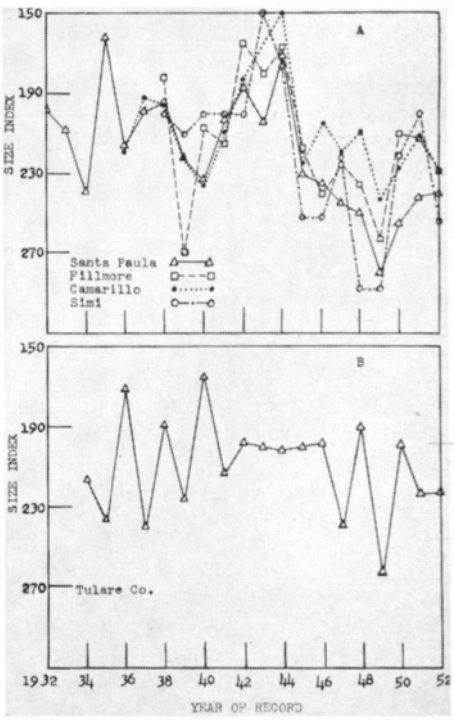
Average peak sizes as represented by number of fruit per packed box of Valencia oranges from 1932 to 1952 in different districts. Number of individual orange orchards averaged: Escondido 8, South Orange County 18, North Orange County 9, Corona 4, Riverside 13, Redlands 19, Upland 11, and East Los Angeles County 17.



A Classification of 13 California Citrus Districts in Order of Descending Fruit Size, as Indicated by Averages of Peak Sizes of Valencia Orange Orchards.

District	Peak size average	No. of orchards	Years of record
Escondido	193	8	1932–52
Tulare Co.	211	21	1934–52
Camarillo	211	6	1936–52
Fillmore	214	7	1938–52
S. Orange Co.	219	18	1932–52
Santa Paula	220	10	1932–52
Simi	221	10	1938–52
Corona	233	4	1938–52
Redlands	235	19	1932–52
N. Orange Co.	238	9	1932–52
Riverside	243	13	1938–52
Upland	251	11	1932–52
E. Los Angeles Co.	254	17	1932–52

Average peak sizes as represented by number of fruit per packed box of Valencia oranges from 1932 to 1952 in various districts. Number of individual orchards averaged: Santa Paula 10, Fillmore 7, Camarillo 6, Simi 10, and Tulare County 21.



chief difference found in rooting quince cuttings was that of variety—the West Mammoth being the one which was the most easily rooted.

Tests in 1954

In the 1954 tests, treatments were included with the Marianna 2624 plum and the quince to determine which part of the cutting wood—vigorous shoots 3′ to 4′ long of the previous season's growth—resulted in the highest rooting percentages.

One type of cutting, termed a heel cutting, was made, which included a small section of the old wood on which the cutting stick grew. The other types of cuttings were termed basal—the lowermost cutting obtainable from the cutting stick; hyperbasal—just above the basal; subterminal—the next cutting along the cutting stick; and terminal—the outermost cutting used. This was not the actual terminal, however, as some portion of the stick was discarded, being too thin to use for cuttings. The portion of the cutting stick used definitely influenced the percentage of cuttings rooted, the basal sections being superior to the terminal sections. This may be due to higher stored foods or native auxins in the basal section or, in the case of the quince, greater numbers of preformed root initials.

The hormone treatments of the cuttings in these tests were made by dissolving the pure crystals of the chemicals in a few drops of alcohol, then diluting the solution to the proper strength with water. Such dilute solutions are not stable and should be used immediately after preparing.

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VALENCIAS

Continued from page 6

It is true that the small-size years of 1929 and 1945 were years of heavy-per-acreage yield, but a significant negative correlation coefficient is not obtained when the relationship between fruit size and yield is ascertained for the years 1932 through 1952 for California Valencia oranges.

The major effect on sizes—in all save Tulare County—as revealed by available data, appears to be based on some climatic circumstance or circumstances. Small sizes are not a problem in Florida or in most of the Mediterranean areas or in many other parts of the world. Moreover, the size-trend patterns in Tulare County—where climate is different from that in the South Coastal basin—again suggest that climate may be the major influence.

Using United States Weather Bureau data for the various districts, simple correlation coefficients were calculated between the size-trend data and some weather factors.

A significant correlation between heat summation—degree hours above 55F—both seasonally and annually, and fruit sizes in various districts was not obtained.

In three districts—Escondido, Upland, and Santa Paula—a highly significant correlation was obtained between summation of degree hours under 32F and size, indicating that the colder the season the smaller the fruit. This did not hold true in other areas, but the possible relation should receive further study because night temperatures may conceivably be a very important factor in the problem.

No significant correlations were obtained between fruit size and rainfall records for the various districts during the period of 1932–52, but one of the outstanding features of the period 1943–51 was the dry years. During winters of subnormal rainfall, there are usually longer periods of low humidity than in periods of high rainfall. More irrigation water—all containing salt—is used in such years, the leaching effect of rain is less, and salts build up in the second, third, and fourth feet of orchards soils. There were many orchards in California where salts markedly accumulated during the period of dry years. All factors associated with subnormal rainfall, lower humidity, drier soils, and salinity build-up act to intensify water stress, which makes for smaller sizes. This might have been an important influence operating during 1945–49. However, there was substantial improvement of sizes in 1950 and again in 1951, when rainfall was still subnormal. Moreover, sizes did not markedly increase following the year of good rainfall in the winter of 1951–52.

It seems quite probable that seasonal influences and especially some feature of microclimate such as humidity, night temperatures, and cloudiness—alone or in combination—might be much more significant than macroclimate features. Although attempts to link the 1945–49 period of small sizes definitely with some feature of climate—based on existing weather records—were largely unsuccessful, the major drop in sizes during 1945–49 appears explicable on no other basis.

All elements of climate are interrelated in their effects on plant growth, and it is very possible that the simple correlations used in these studies are not satisfactory in relating fruit size and weather effects. Hence, a more complete statistical study is planned, in which interactions of the climatic elements will be considered in relation to their effect on fruit size.

In addition to the size-fluctuation patterns, available information indicates that—over the period of record—certain areas consistently produced Valencia orange fruits of smaller size than other districts. The lowest average sizes were in East Los Angeles County and the Upland district, whereas the highest average sizes were found in the Escondido area and Tulare County. The average peak size in Escondido for the period 1932–52 was 193—fruit per packed box—and for East Los Angeles, 254.

A comparison was made between the peak-size average for the period 1932–44 and for the period 1945–52, although only eight of the 13 districts had sufficient records available for study. The percentage reduction in fruit size for the period 1945–52 for each of these districts—as compared with 1932–44—was ascertained. These data indicate that the Santa Paula, Escondido, and Upland districts had the greatest drop in fruit size during 1945–52, with a percentage reduction of about 17%. The East Los Angeles County, Redlands, and North Orange County districts were grouped together with a percentage drop of about 12%, while the South Orange County district dropped 9.1%, and the Tulare County district showed a percentage fruit size reduction of 5.4%.

Continued study on local climatic and soil conditions is needed to throw more light upon the size variations noted between districts.

Percentage Fruit Size Reduction in Eight California Citrus Districts for Period 1945–52 Compared to 1932–44, as Indicated by Averages of Peak Sizes of Valencia Orange Orchards.

District	1932–44 peak size average	1945–52 peak size average	1945–52 reduction in fruit size
			%
Santa Paula	203	247	17.9
Escondido	188	228	17.6
Upland	233	282	17.3
E. Los Angeles Co.	240	275	12.7
Redlands	222	254	12.6
N. Orange Co.	226	257	12.1
S. Orange Co.	220	242	9.1
Tulare Co.	205	217	5.4

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