of crates. In fact, data on this point could be obtained much more reliably from a study of actual commercial shipments than from any experimental procedure in which an attempt was made to simulate commercial conditions.

From the standpoint of its effect on damage, waxing of puffy tangerines appears to be without influence. However, other factors, such as shrinkage control, would determine the choice in this case.

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THE RELATION OF SIZE OF FRUIT TO SOLIDS, ACID AND VOLUME OF JUICE IN THE PRINCIPAL VARIETIES OF FLORIDA ORANGES

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Introduction
Most of the information accumulated during the investigation on the seasonal changes of Florida oranges (citrus sinensis, Osbeck) during development and ripening on the tree has been published. However, since little if any concrete data have appeared in print on the relation of the size of the fruit to solids, acid and volume of juice, results secured in the above mentioned studies are now being made available.

These results show how the size of the fruit affects total soluble solids, total acidity and the volume of juice at different times prior to and throughout the harvesting period for the principal varieties of Florida oranges.

The findings are based on a systematic study during three seasons from 1935 to 1938, involving the analyses of more than 13,000 individual fruits, but in this paper only the results for some of the principal varieties of oranges are presented. The complete report will be published as a bulletin by the United States Department of Agriculture.

Material and Methods
The history of the different varieties, the rootstocks on which they were grown, cultural and growing conditions, and other pertinent information have been discussed in United States Department of Agriculture Technical Bulletin 753.

Oranges for the tests were taken at random, care being exercised to pick only exposed fruit of the regular bloom.

Samples were usually collected at intervals of two weeks until the commercial picking of the plots. After this time only a few trees were reserved to supply fruit for later analyses, which were made at somewhat longer intervals depending on the amount of fruit reserved.

Each variety was sampled over a period of several months so that fruits of various stages of development and ripening were included. Tests on early and midseason oranges commenced about September 1, whereas,
tests on Valencia oranges were started about December 1. The time covered by each year’s experiment was from six to eight months.

The findings on the very immature fruit are not included, since this information would be of little importance to the industry.

The results reported herein are average values obtained from individual fruit measurements and individual fruit analyses. To facilitate graphic presentation, the data were grouped within the following arbitrary periods for early and midseason oranges: first, between September 1 and October 13; second, between October 14 and November 24; third, between November 25 and January 5; and fourth, between January 6 and February 16. For late or Valencia oranges: first, between January 4 and February 28; second, between March 1 and April 25; and third, between April 26 and June 20. An adequate population was obtained by having a large number of fruits in each sample, by
Figure 4
ORANGES: RELATION OF FRUIT SIZE TO SOLIDS, ACID, AND VOLUME OF JUICE
PINEAPPLE - ROUGH LEMON ROOTSTOCK - CENTRAL FLORIDA

Figure 6
ORANGES: RELATION OF FRUIT SIZE TO SOLIDS, ACID, AND VOLUME OF JUICE
VALENCIA - ROUGH LEMON ROOTSTOCK - CENTRAL FLORIDA

Figure 5
ORANGES: RELATION OF FRUIT SIZE TO SOLIDS, ACID, AND VOLUME OF JUICE
SEEDLINGS - OWN ROOTS - CENTRAL FLORIDA

Figure 7
ORANGES: RELATION OF FRUIT SIZE TO SOLIDS, ACID, AND VOLUME OF JUICE
VALENCIA - SOUR ORANGE ROOTSTOCK - CENTRAL FLORIDA
frequent sampling, and by replication of the investigation for three seasons. The consistency of these data as shown in figures 1 to 7 indicates their reliability.

The size of the fruit was determined by measurement of the diameter of the cut halves. Juice was extracted by a pressure extractor and the volume of juice ascertained after the removal of pulp and seeds. Total water soluble solids were determined by an Abbe (Bausch & Lomb) refractometer, and total acid by titration of the juice with standard NaOH using phenolphthalein as an indicator.

Results

Total Soluble Solids:
An increase in percent of total solids is indicated with the development and ripening of the fruit. During the period from September 1 to October 13, early and midseason oranges showed comparatively slight differences among smaller and larger sized fruits, i.e., between sizes 250's, 216's, 200's, 176's, 150's, 126's, and 96's. After this period the divergence usually became greater and the fruits of the smaller sizes were consistently higher in solids than the larger ones. In Valencia oranges these differences were found throughout the sampling period, the smaller sized fruit containing the greater amount of solids.

Rootstocks on which Parson Brown and Valencia oranges were grown influenced the content of total solids. It will be noted that more solids resulted when the fruits were from trees grown on sour orange, while less solids resulted when they were grown on rough lemon rootstocks. For comparisons, see figures 1 and 2, and figures 6 and 7.

Of the many varieties tested, Seedling oranges were most acid. The high acid and high solids content account for superior quality of fruit whether influenced by variety, as in the case of Seedlings, or by rootstock, such as sour orange.

An interesting point brought out in this study of Seedlings and Parson Brown oranges grown on sour orange rootstock is the close correlation among the fruits of the various sizes in solids and acid. See figures 5 and 2. With the other varieties greater differences existed among the regression lines, and these differences were most pronounced late in the season with ripe fruit.

Volume of Juice:
Usually most varieties of oranges had their highest juice content when they were in prime eating condition. There was less juice when the fruit was less mature, also late in the season when granulation was in evidence in senescent fruit. Pineapple and Valencia oranges were exceptions, maintaining throughout their season an almost uniform volume or a slight increase in volume of juice with the ripening of the fruit.

The size of the fruit influenced the amount of juice obtained. Figures 1 to 7 show that when the volume of juice was calculated as gallons per standard box (1 3/5 bu.), the larger sized fruits of sizes 96's, and 126's contained much less juice than smaller sizes, such as 250's, 216's, 200's, 176's and 150's. The data also showed that in a few instances fruits of the size 96's and 126's contained less than four and a half gallons per standard box, while sizes 250's, 216's, 200's, and 176's usually exceeded five gallons and in the case of Valencia (figure 7)
sizes 200's and 216's exceeded six and a half gallons per standard box. Unless prices are satisfactory, the large sized fruits, such as 96's and 126's are seldom packed and shipped in any great quantity. When they are packed they are usually moved before excessive "drying out" occurs and, therefore, encounter little trouble in passing the juice requirement.

From the data presented in figures 1 to 7 it may be noted that with the exception of the very large fruits most sizes and varieties of Florida oranges encountered little difficulty in passing a requirement of five gallons of juice per standard box of 1 3-5 bushels.

Summary
1. The results herein show how the size of fruit affects total solids, total acidity and the volume of juice at different times prior to and throughout the harvesting period for the principal varieties of Florida oranges.
2. The findings are based on a systematic study during three seasons, involving more than 13,000 individual fruits.
3. The results are averages obtained from individual fruit measurements and individual fruit analyses. The data have been grouped according to arbitrary periods to show the seasonal behavior of the various constituents in different sized fruits.
4. The results are consistent and indicate that with the ripening of the fruit, there is an increase in total solids and volume of juice and a decrease in acidity for all of the standard sizes, i.e., for pack 250's, 216's, 200's, 176's, 150's, 126's, and 96's.
5. Throughout the various stages of ripening, the smaller sized fruits contained the most solids and acid, and on the basis of a standard packed box (1 3-5 bu.), a greater volume of juice.
6. Differences in solids, acidity and volume of juice for different sized fruits of the same variety were most pronounced late in the season.

THE VITAMIN C, SOLIDS AND ACID IN ORANGE AND GRAPEFRUIT JUICES USED FOR CANNING PURPOSES

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The data presented in this report were obtained from the daily laboratory records of orange and grapefruit juices extracted for canning purposes by the Dr. P. Phillips Canning Co. From a compilation of these records it has been possible to show seasonal levels and intraseasonal trends of vitamin C, total soluble solids and total acid. An interesting probability distribution has been noted for vitamin C and acid, and an association indicated between these.

A laboratory situated in a canning plant offers an excellent opportunity to participate in an investigation of this nature. Composite samples of large quantities of fruit were available. Juice was extracted each day from thousands of boxes of fruit. Tests were made