Carbohydrates in Citrus

studies of seasonal changes in sugar and starch in leaves, twigs of Valencia orange and in leaves of Eureka lemon

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Citrus leaves and twigs contain a minimum of sugar and starch during the summer and a maximum of sugar during the winter.

A study was undertaken to obtain a better understanding of the carbohydrate metabolism of the citrus tree which may result in improved cultural practices, help interpret variations in cold tolerance of various citrus species, and aid in the management of pathologically affected trees.

Starch is the storage form of carbohydrates, found in all parts of the tree. Since the leaves appear to reflect most sensitively the carbohydrate status of the tree, the study of seasonal changes was based on leaf analyses. Some data for twig analyses were also included.

Valencia orange leaf and twig samples were taken from a grove in Ventura County. Leaf samples were also taken from groves in Orange and Los Angeles counties. Leaf samples of Eureka lemon were obtained from a Ventura County grove.

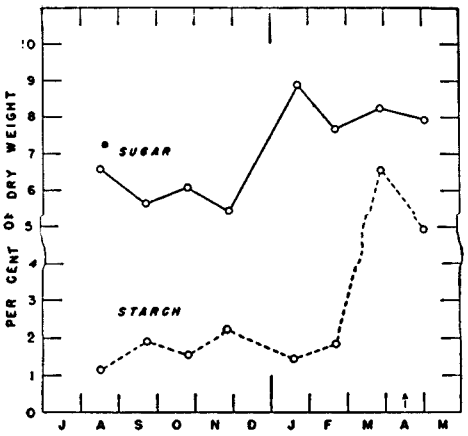
All samples were from vigorous, high-producing trees. Each sample consisted of 20 leaves—or 10 twigs—from each of four trees.

Valencia Orange

On orange trees the most well-defined and uniform growth cycle is initiated in the spring—March to May—concurrently with bloom. During the remainder of the year there may be no more new growth or there may be one to three less well-defined vegetative cycles.

The study considered the leaves and twigs produced in one spring growth. In addition to the spring-cycle growth, the trees from Los Angeles County made a pronounced summer flush of growth in July; the trees from Orange County produced a sparse growth, and those from Ventura County no growth during summer. From these data it appears that summer growth is preceded by an accumulation of starch in the leaves. Spring growth is also preceded by such an accumulation.

Leaves contained four to five times as much sugar as starch, and sugar was high in young leaves. As the leaves aged, the sugar was reduced, reaching a minimum during September, October, and November. This reduction is probably associated with leaf maturation, translocation, and fruit growth.



Sugar and starch in Eureka lemon leaves from Ventura County. Each point represents the mean of two samples.

Beginning in December, there was a rapid increase in sugar, which reached a maximum in late January and preceded a large increase in starch accumulation.

As new growth started in April and May, there was a decrease in sugar. During the summer months, and through the fall and winter to late February, the starch content of the leaves was at a relatively low level, except in the trees from Los Angeles County where the increase in starch was followed by a flush of growth. As the weather became warmer in late February and March, there was a marked increase in starch, followed by a decrease concurrent with spring growth.

The lack of change in the starch content during the winter months, and the increasing amount of sugar during the same time, is probably brought about by the continuous photosynthesis that occurs during the winter, and by the failure to utilize or translocate all of this photosynthate or to convert it to starch. As soon as the weather becomes warmer in the spring, and before the new growth starts, there is a conversion of sugar to starch. This procedure appears to be a cold reaction somewhat different from that found in deciduous trees but nevertheless a response to low temperatures.

In the samples taken from Ventura County starch was slightly higher and sugar lower in the twigs than in the leaves, but variations in sugar and starch content of leaves and twigs were parallel at various times of the year.

Eureka Lemon

The growth habit of lemon trees in the coastal area where samples were taken is more irregular than that of orange trees, and it is more difficult to sample lemons for this type of study.

Lemon leaves showed an increase in sugar during the winter months, but not to the same extent as did the orange leaves under study.

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***Left,* sugar and starch in Valencia orange leaves from different localities. Each point represents the mean of four samples. Arrows indicate the beginning of growth flushes. *Right,* sugar and starch in Valencia orange leaves and twigs from a Ventura County grove. Each point represents the mean of six samples.**