Leaf Potassium

Valencia fruit size relationship shown to be variable by studies

W. W. Jones and Clarence B. Cree

The value or need of potassium fertilization—to increase Valencia orange fruit size—must be determined for each Valencia growing area because no critical level of leaf potassium can be universally assigned.

The relations between the concentration of potassium in the Valencia orange leaves and fruit size are generally positive, but the results of a study of representative leaf samples from 283 Valencia orchards in Ventura, Los Angeles, Orange, Riverside, and San Bernardino counties and the Escondido area of San Diego County show the relationship is not numerically consistent.

To determine whether such a relationship is general throughout the citrus growing areas—and whether leaf analysis is a means of ascertaining the need of potassium fertilization to increase fruit size—a representative leaf sample was obtained from each of the orchards in the survey.

They were analyzed in the laboratory for potassium, nitrogen, phosphorus, calcium, magnesium, and sodium.

Spring-cycle leaves were picked during a three-month period—November through January. Twenty leaves per tree from five representative trees were composited for a single sample of one hundred leaves for each orchard. In groves where more than one known rootstock was planted—or where there were blocks of trees of different ages—a separate sample was obtained to represent each type.

The laboratory analysis of the plant tissue was adjusted on the basis of previous research on the seasonal trend in leaf mineral composition so that all the data would be on a comparable basis as to sampling date.

Large-Fruit Orchards vs. Small-Fruit Orchards in the Same Areas

No. of areas	Relation of Potassium to size	Per cent Potassium		Per cent 252 and larger	
		Small fruit orch.	Large fruit orch.	Small fruit orch.	Large fruit orch.
25		.819	.929	34.7	55.3
16	Positive	.729	.948	32.0	53.4
9	Negative	.978	.897	39.7	58.6

A statistical study of the data was made to determine the relationship between fruit size—as obtained in the survey—and the mineral content of the leaves. The fruit size index for each orchard was based on a three-year harvest record and included fruit packed of size 252 and larger.

Each of 25 community areas was studied individually and the findings showed that the mean values of leaf potassium and fruit size varied greatly from one area to another. When the orchards in each community were separated into two groups—those having the larger fruit and those having the smaller fruit—it was found that on the average, the large-fruit orchards had the higher percentage of potassium in the leaves.

Of the 25 local areas considered, 16 had a positive, and nine a negative, relation between leaf potassium and fruit size. In the 16 local areas in which a positive relation existed the large-fruit orchards contained 0.219% more leaf potassium than did the small-fruit orchards. In the nine local areas in which a negative relation existed the large-fruit orchards contained only 0.081% less leaf potassium than did the small-fruit orchards.

When all 283 Valencia groves are considered as a unit the positive relationship between leaf potassium and fruit size is lost. The areas in which the largest fruit were produced contained the lowest mean percentage of potassium in the leaves, which means that factors other than potassium were more influential in affecting fruit size.

Concluded on page 15

FREEZING

Continued from preceding page

conditions. The freezing points of sample fruits obtained with thermocouples in the pulp, during a second freezing, exhibited no deviation from the freezing point of fruits not previously in alcohol. This appears to indicate that the lower spontaneous freezing point of fruits in alcohol can not be attributed to internal dehydration.

Immersion in alcohol undoubtedly greatly reduces the freezing point, and also the chance of freezing initiation, at and adjacent to the surface of the fruits, which indicates that freezing initiation occurred near the surface of the fruits cooled in air.

The possibility that rubbing together of wet fruit surfaces hinders subcooling was checked with a group of fruits. When the temperature of a spiral thermocouple first dropped to 29° F—and at each degree below that—fruits wet at the point of contact were brought together and rubbed against one another. These fruits subcooled less than any other fruits tested.

As a check, fruits in another group were cooled with water droplets on their surfaces and were rubbed together, but not at the location of a droplet. These fruits subcooled to an extent comparable to those cooled with no rubbing and no water droplets on them.

Effect of Surface Conditions on Subcooling of Detached Lemons and Lemon Parts

Group	Treatment	Spontaneous freezing point*
		° F
1	Detached vesicles	below 10
2	Fruits in 90% relative humidity	24.1
3	Fruits in 90% relative humidity and stems heated	24.5
4	Fruits in 55% relative humidity	24.8
5	Fruits in 8% relative humidity	24.9
6	Condensation on fruits	24.2
7	Fruits in alcohol	21.0
8	Fruits rubbed on water droplets	27.4
9	Fruits rubbed but not on droplets	24.7

* The values are the mean of 9 fruits.

The effectiveness of rubbing of wet fruit surfaces in reducing subcooling may explain reports that dew and wind lessen subcooling in citrus fruits in the orchard.

These investigations seeking the mechanism or mechanisms of ice initiation in citrus have disclosed that once freezing begins it spreads rapidly throughout a subcooled tree part; that freezing initiation appears to occur near the surface of detached lemons; and, that rubbing of wet fruit surfaces markedly reduces subcooling. However, further investigation of all these processes—on a larger scale—is highly desirable.

John W. Lucas was Research Assistant in Subtropical Horticulture at the time the studies reported above were conducted.

The above progress report is based on Research Project No. 877.

mosphere. A water sample was taken 204′ out in an irrigation check receiving water from the main ditch only 60′ from the point of treatment at the pump—a distance of 264′ between points of treatment and sampling. Only 2 ppm of carbon dioxide remained in the water sampled. This would be enough in an acre foot of water to dissolve 5.4 pounds of calcium, equivalent to about 25 pounds of gypsum.

Another set of water samples was collected later using care to retain any dissolved carbon dioxide. These samples were placed in quart bottles, which were tightly capped and refrigerated for transport to the laboratory. Even with these precautions, no more carbon dioxide was found in the water than in the field sample.

To be effective in alkali reclamation, carbon dioxide must increase the amount of soluble calcium—or magnesium, or both—over that amount which would be dissolved by the natural water.

Soil Test

The influence of treated and untreated water from the two Tulare County wells was tested on a normal and on an alkali Fresno fine sandy loam soil. One-to-five equilibrium water extracts were made and analyzed, with results as follows:

Calcium and magnesium extractable from Fresno fine sandy loam soil by natural and by carbon dioxide treated irrigation waters.

Water	Soil	Calcium + Magnesium lbs./Ac. ft. of soil*
Well No. 1	Normal	260
Natural	Alkali	200
Well No. 1	Normal	340
CO_2 treated	Alkali	185
Well No. 2	Normal	1070
Natural	Alkali	160
Well No. 2	Normal	1105
CO_2 treated	Alkali	150

*Would require 7.5 Ac. ft. of water per Ac. ft. of soil to extract these quantities.

These results show that neither of the treated waters dissolved more calcium and magnesium from the alkali soil than did the natural waters. The extracts from the normal soil show that the treated water brought additional calcium and magnesium into solution equivalent to less than 25 pounds of gypsum for each acre foot of water applied. The effect on the alkali soil was insignificant.

Warren R. Schoonover is Extension Soils Specialist, University of California, Berkeley.

J. C. Martin is Chemist in Plant Nutrition, University of California, Berkeley.

Fred Jensen, Farm Advisor, Tulare County, University of California, co-operated in the experiments reported in the above article.

QUOTAS

Continued from page 2

area if a one-year adjustment situation prevails.

The nature of the adjustment which must be made by the cotton producers of west Fresno, Kings, and southern Kern counties contrasts with those in both areas previously discussed. Large holdings of leased lands under which the water table has steadily declined complicate the adjustment problem. Profitable alternatives to cotton among the irrigated crops are extremely limited, and income reduction likely will be sharp on many farms.

Alfalfa, pasture, irrigated grains, and oil crops can not bear the costs of lifting water and other production expenses on a substantial portion of this region. Producers in this area may turn to nonirrigated cash crops, although they are poor alternatives to cotton, and many producers may leave a portion of their farms idle or fallow.

Net income per acre on diverted cotton land might decline by $30 to $60 if planted to safflower, dry barley or similar crops if prices, costs and yields are comparable to those of 1953.

Many tenants on large farms have made heavy capital investments in farm machinery and in farm improvements under terms of development leases. A transfer to these less intensive operations must bring sharply reduced returns.

Prices of feed grains which producers in the west and extreme south portions of the San Joaquin cotton area can produce without irrigation are expected to decline as production is increased in 1954. Yields without irrigation will be greatly reduced and per acre incomes—both gross and net—will fall substantially. Producers who are not burdened with high cash rents or debts will suffer a loss in income and a lower return on their invested capital. Tenants operating under cash leases and part owners operating large acreages are prevalent throughout this area. The decline in per acre earnings on such farms is particularly dangerous to the survival of the business. If a cash tenant is committed to a rental of as much as $30 per acre it is highly unlikely that alternatives will yield sufficient income to meet the rental payments and cover cash production costs as well.

Southern California cotton counties—Riverside and Imperial—expanded their cotton acreage sharply from 1950 to 1953. Partly because this shift was both recent and abrupt and also because of the climatic conditions in the winter months, the impact of the adjustment on individual producers may not be as severe as on producers north of the Tehachapi, particularly on the west side of the valley. Alfalfa and small grains are expected to replace nearly 50% of the diverted cotton acreage but such historically important crops as flaxseed, grain sorghums, and the vegetable and melon crops will be important alternatives for individual farmers.

An accelerated expansion of livestock on farms in the two southern cotton counties is anticipated, particularly if cotton allotments extend over two or more years. Feed availability, new feeding techniques, and new information on handling cattle in the summer climate should further induce livestock production on farms in this area where many farmers are thoroughly experienced in feeding beef cattle. What individual producers will turn to in the Palo Verde, Coachella, and Imperial valleys will be determined primarily by experience and location. Reduced incomes are certain, regardless of what alternatives are chosen. Net incomes on diverted cotton land could be from $15 to $40 lower than if they were planted to cotton—assuming the yield, cost and price conditions of 1953.

The over-riding consideration for California cotton producers as a group is that the 1954 cotton acreage limitation program is expected to bring sharply reduced earnings—both in total and for most individual cotton growers.

C. O. McCorkle, Jr., is Assistant Professor of Agricultural Economics, University of California, Davis.

T. R. Hedges is Associate Professor of Agricultural Economics, University of California, Davis.

The fourth—and last—article in this report will consider the role of livestock in the adjustment to cotton acreage allotments.

POTASSIUM

Continued from page 10

In the Escondido area there was a positive correlation between potassium and fruit size, even though this is an area of large fruit and low potassium. In the Whittier area—one of high potassium and small fruit—there also was a positive correlation. In the Anaheim and Azusa areas—where the correlation is negative—factors other than potassium were influential in controlling size.

One level of potassium concentration in the leaves can not be applied universally to all orchards to determine the need of potassium fertilization to affect fruit size. Other factors—location, soil, rootstock, cultural practices—must be considered, may affect potassium concentration in the leaves but not fruit size or fruit size and not the leaves.

W. W. Jones is Horticulturist, University of California, Riverside.

Clarence B. Cree is Principal Laboratory Technician, University of California, Riverside.