Valencia Fruit Sizes Increased

calcium acid phosphate found effective in outdoor cultures of pure silica sand and nutrient solution

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The Valencia fruit size problem has interrelationships of various factors, and to learn how certain ones operate—when as many as possible of the usual complicating factors are removed—a series of experiments were set up using pure silica sand and nutrient solution. This type of experimental approach makes it possible to synthesize some of the actual orchard nutritional conditions in certain areas where large sizes of fruit often predominate.

Practically every California citrus grower applies nitrogen to the soil or directly to the trees. Many growers do but little more as regards fertilization. The soil is frequently given too much credit as regards its containing adequately available and properly balanced supplies of nutrient elements required by the tree. In many orchards, cover crops and manures are no longer used for various reasons. Frequently nitrogenous fertilization in its purest form is the sole treatment and too much is often expected from it. Even the different forms of nitrogen applied may affect, in different ways, the availability of certain elements. The interrelationship, or nutrient balance, and the availabilities of the various nutritional elements can have considerable effect on the tree and its fruit.

Number and Average Diameter of Valencia Orange Fruits in Relation to the Calcium Acid Phosphate Concentration.

Culture No.	Phosphate (PO_4) added to the nutrient as calcium acid phosphate $Ca(H_2PO_4)_2.H_2O$	No. of fruit on Jan. 19, 1954	Average diameter of fruit (inches)	
			Jan. 19, 1954	May 19, 1954
1	31	9	2.15	2.27
2	62	13	2.05	2.12
3	77.5	1	2.22	2.36
4	93	6	2.95	2.96
5	108.5	9	2.72	2.74
6	124	5	2.99	3.10
7	139.5	17	2.55	2.60
8	155	9	2.91	2.97
9	170.5	14	2.65	2.63
10	186	15	2.45	2.70
11	201.5	11	2.36	2.47

Studies conducted at the Citrus Experiment Station at Riverside have already indicated that the use of potash may frequently result in the production of larger fruit. Recently, by means of silica sand cultures, the calcium-magnesium ratio was found to be important in the production of Valencia oranges of various sizes.

Sand Cultures Used

In the present investigations, interest was focused on the effectiveness of calcium acid phospate on the size of Valencia oranges produced in sand cultures.

Galvanized iron containers 20″ in diameter and 26″ deep—heavily coated with asphalt on the inside surfaces—were provided with excellent drainage and filled with silica sand into which a Valencia orange tree on sour orange rootstock was planted. Previous studies have shown that the varietal nature of the rootstock—the sour orange, in this case—governs in a large degree the nutrient element accumulation that takes place in the scion variety—the Valencia orange in this test—leaves and fruit.

The containers were covered with cement lids made in the form of half

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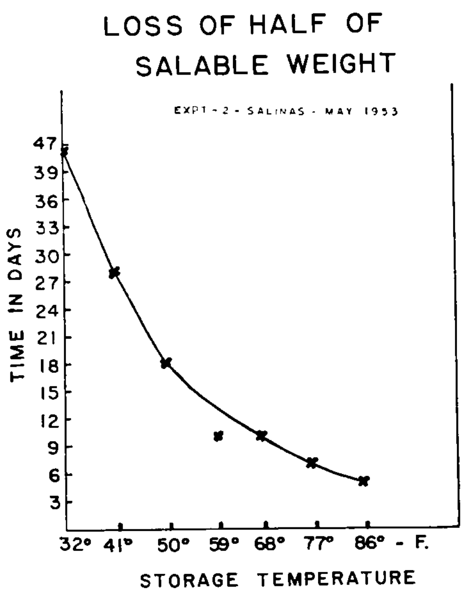
Valencia orange fruit sizes in relation to the concentration of calcium acid phosphate in the nutrient solution applied to trees on sour orange rootstock in large out-of-doors pure-silica sand cultures. Note the larger fruit sizes as the concentration of calcium acid phosphate was increased. The need of an increase in magnesium was evident in the leaves at the higher calcium acid phosphate concentrations.

life at 32° F is also reflected in better quality at any time after harvest. A higher rate of respiration also means a higher rate of heat production by the lettuce—more ice will be melted per day by the lettuce at a higher temperature because of the heat of respiration.

Similar data were obtained for the experiments in which the lettuce was trimmed by continually removing spoiled outer leaves. There is very little difference between the rates of respiration under these two types of treatment; both the shapes and magnitudes of the curves are similar. A higher temperature—86° F—was included in some experiments, and the results are those that could be expected—the rate of respiration is higher than at 77° F, and the storage life is shorter.

A numerical rating scale arbitrarily numbered from one to nine was used to



The effect of temperature on time elapsing before half the salable weight was trimmed away because of deterioration.

evaluate quality loss in terms of appearance. The ratings are shown in the graphs in columns 2 and 3 on page 14. Each head was individually rated, and the curves were drawn as the best fit to the averages of all head ratings. As expected, the life of untrimmed lettuce at the higher temperatures was short. Any lowering of storage temperature for a given holding period resulted in a measurable improvement in quality. There was a striking reduction in quality, even at 32° F, during the unavoidable holding period between field and consumer.

A rating based on appearance cannot be applied to the heads which were trimmed during the experiments, because the appearance was continually being improved by the trimming. The number of days required at various temperatures before half the salable weight of lettuce was lost by trimming are shown on this page. The graph illustrates the type of data that can be expected for the deterioration of any fresh produce that is not subject to chilling injury.

Storage Life

The storage life of lettuce at the higher temperatures is short, and as the temperature is lowered, storage life progressively lengthens, following a mathematically predictable curve which holds all the way to the lowest possible storage temperature.

The conclusions to be drawn from the experiments on lettuce apply in both kind and degree to the handling of broccoli, asparagus, celery, spinach, green peas, cabbage, carrots, and other cool-season crops—and also to sweet corn. They do not apply to most warm-season crops such as tomatoes, melons, summer squash, cucumbers, or sweet potatoes—which are subject to chilling injury.

With the established behavior of the best lettuce as a yardstick, an evaluation is planned of the comparative gain or loss of storage life resulting from different fertilizer and other cultural practices, field defects or diseases, variety differences, and the role of mechanical injury and delays in handling.

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circles and heavily coated with asphalt and then on the upper surface with aluminum paint. The lids usually were only partially closed. The transpirational water loss was replenished with distilled water which was employed at all times in preparing the nutrient solutions to be used in the tests.

The same nutrient solution was used for each culture except for the various concentrations of calcium acid phosphate. Before the phosphate was added, the nutrient solution was prepared by using Hoagland's stock solution A and double Hoagland's stock solution B, and substituting 185 ppm—parts per million—of potassium as the sulfate for the usual 42 ppm of potassium as the phosphate found in Hoagland's stock solution C. Expressed as concentrations of the various elements, the test solution contained—in ppm—calcium, 318; magnesium, 54; potassium, 327; sodium, 7; chlorine, 10; sulfate, 444; and nitrate, 1211. The trace or minor elements used were—in ppm—boron, .2; manganese, .2; zinc, .2; iron—as sulfate—.2; aluminum—as citrate—3; copper, .25; and molybdenum, .1.

Concentrations Varied

To the nutrient solution—common for each culture—were added the various concentrations of phosphate shown in the table on page 11. During the first two years of growth, culture No. 11 received only 15.5 ppm of phosphate in its culture solution. When it was evident that the tree would be severely injured or die, the concentration was increased to 201.5 ppm. The data given in the table shows the average diameter of the largest fruit as being approximately three inches. The data also shows that the fruits produced at the three lowest phosphate concentrations were the smallest in size, regardless of the number of the fruits.

The leaves of the trees grown at the three or four highest calcium acid phosphate concentrations showed definite symptoms of magnesium deficiency and indicated that the concentration of magnesium should have been increased. That this would be the case might have been predicted because the high calcium and potash content of the nutrient was unbalanced by increasing the calcium content through the addition of the calcium acid phosphate. Phosphate, moreover, was also found to be more effective when an adequate magnesium supply was available.

The results obtained with these silica sand cultures lend support to the view that one of the means of affecting Valencia orange fruit size may lie in the interrelation or improved balancing of the various elements that go to make up the trees' nutrient solution.

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