Valencia Orange Fruit Size

affected by the relation of calcium to magnesium as demonstrated by tests with nutrient solutions

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The Valencia orange fruit size problem can not be ascribed to one and the same single cause in all citrus areas.

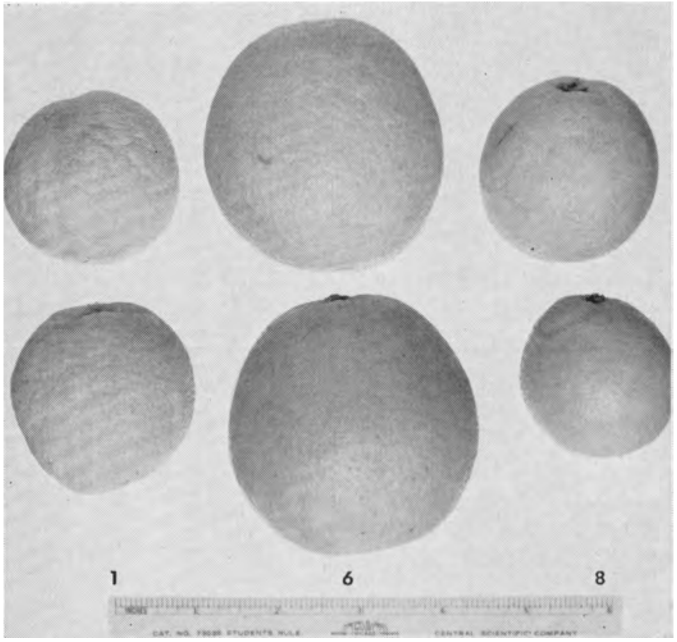
Some of the factors considered as possible causes of small sizes are: pruning, girdling, thinning, ratio of foliage to fruit, smog, nematodes, weak trees, rootstocks, faulty irrigation, zinc deficiency, excessive phosphate or manuring, potash deficiency or excess, need of hormone stimulation, and temperature extremes.

Though it is essential to know how to produce larger fruit, it is equally, if not more, important to know about the factors that affect fruit size. When an excess of large fruits is available, the market might make it desirable to produce small fruit.

In California, scant attention is given to the calcium or magnesium factors in the chemical treatment of citrus orchard soils. In contrast to this near indifference shown in California, calcium and magnesium receive first consideration in the nutritional program of a citrus orchard in Florida where orchards are noted for large fruit sizes.

To study the relation of calcium and magnesium to fruit size in California, eight out-of-door metal containers, 14″ in diameter by 17″ deep, filled with silica sand were planted with Valencia orange trees on Keen sour orange rootstock, except culture—treatment—No. 4 where Brazilian sour orange was the rootstock.

The nutrient solution used consisted of distilled water containing in parts per million—ppm—potassium, 184; sodium, 7; sulfate, 174; phosphate, 105; and chlorine, 10; plus 0.2 ppm each of boron, manganese, zinc, and iron, and 3 ppm of aluminum. The solution had an acidity pH 4.4 — relative acidity-alkalinity with 7 as neutral. To this solution were added various concentrations of calcium in the form of nitrates; 0, 12, 29, 41, 61, 82, 159, and 318 ppm, and magnesium at 194, 185, 177, 168, 157, 144, 97, and 0 ppm for cultures Nos. 1 to 8. Each culture solution contained the same concentration of nitrate—982 ppm. Thus, culture No. 1 received a nutrient solution containing no calcium and 194 ppm magnesium, whereas culture No. 8 received a culture solution containing 318 ppm calcium and no magnesium.



Valencia orange fruit typical of sand cultures Nos. 1, 6, and 8. The culture solution for culture No. 1 contained no calcium and high magnesium; that for No. 8 contained no magnesium and high calcium; whereas those for cultures Nos. 2 to 7, inclusive, contained various concentrations of both calcium and magnesium. All the nutrient solutions were the same except for calcium and magnesium.

The cultures were grown from February 25, 1949, to June 23, 1952, when the diameters of the rootstocks at the bud union—on Keen sour orange rootstock—were: 1.30; 1.30; 1.21; 1.49, on Brazilian sour orange rootstock; 1.39; 1.40; 1.52; and 1.31 inches in cultures one to eight. Of the Keen sour orange rootstocks, the diameter of culture No. 7 was the largest. The dry weights of the root systems of the Keen sour orange rootstocks—as far up as the bud union—were: 683; 747; 646; 900, on Brazilian sour orange rootstock; 804; 894; 1,140; and 939 grams for cultures Nos. one to eight.

The fresh weights of the fruit picked

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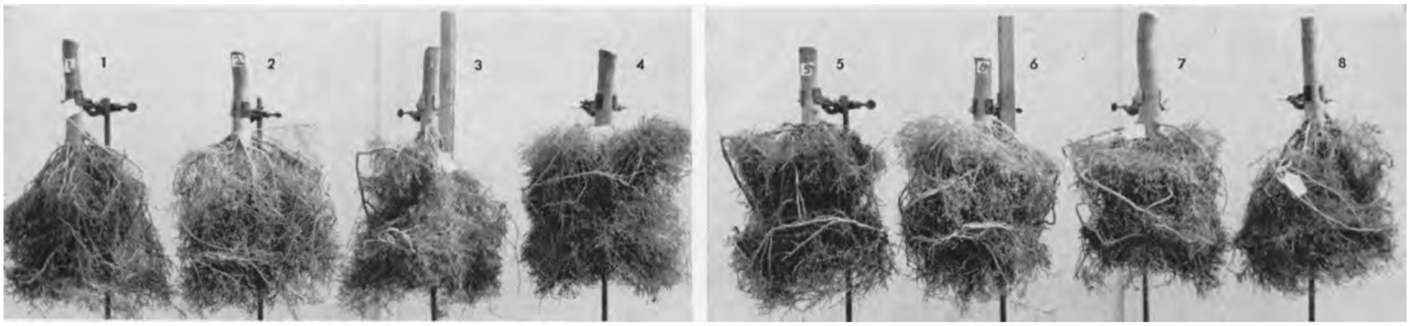
Root systems—No. 4 Brazilian sour orange rootstock, rest are Keen sour orange rootstock—of Valencia orange trees grown in sand cultures with the same nutrient solutions except for containing various concentrations of calcium and magnesium. Note the reduced growth and the small diameter of the rootstock at the bud union as the calcium in the culture solution was markedly decreased—culture No. 7 down to No. 1 which had no calcium and also when magnesium was absent—culture No. 8.



VALENCIA

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on June 23, 1952, were: 1,056, 1,219, 1,654, 1,638, 2,215, 2,027, 1,121, and 1,183 grams for cultures Nos. one to eight. The fruit measurements of the Keen sour orange rootstocks showed: 2.24; 2.29; 2.36; 2.26, on Brazilian sour orange rootstock; 2.35; 2.44; 2.50; and 2.26 inches average diameter for cultures Nos. one to eight.

The illustration of Valencia orange fruit shows a comparison of the fruit sizes obtained in three of the cultures—Nos. one, six, and eight. The two fruits—shown to the left—from culture No. 1, the culture solution of which contained no calcium and high magnesium, averaged 70 grams fresh weight per fruit; the two fruits—center—from culture No. 6, the culture solution of which contained 82 ppm calcium and 144 ppm magnesium, averaged 172 grams fresh weight per fruit; whereas the two fruits—shown to the right—from culture No. 8, the culture solution of which contained high calcium and no magnesium, averaged 64 grams fresh weight per fruit.

The improvement in the root system as calcium in the nutrient solution was increased is seen in the illustration showing the root systems. The depressing effect on the fruit size and on the root condition of very low calcium or magnesium values is clearly shown by the illustrations.

As the calcium in the nutrient solution increased and the magnesium decreased, the fresh weight of the peel as a percentage of the fresh weight of the whole fruit—Keen sour orange rootstocks—shows changes: 35.06; 35.73; 29.24; 30.76, on Brazilian sour orange rootstock; 29.37; 29.92; 27.52; and 29.88% for cultures Nos. one to eight. The fruits from cultures Nos. one and two—those that received a nutrient solution low in calcium and high in magnesium—had the largest percentages of peel, and some of the fruit of culture No. one—no calcium, high magnesium—were somewhat misshapen and the peel pebbly. The fresh weight of the pulp of an average fruit from cultures Nos. one—lowest calcium, highest magnesium—to eight—highest calcium, lowest magnesium—was: 59.5, 59.9, 94.6, 76.8, 81.3, 87.4, 101.5, and 72.2 grams. Except for culture No. 3 and culture No. 8—highest calcium, no magnesium—a decrease in magnesium and an increase in calcium in the nutrient solution was accompanied by an increase in the fresh weight of the fruit pulp.

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ALKALI

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in several plots failed to germinate, but where the crop did germinate and come through the soil, it usually died before making but a slight growth.

Of the plants mentioned, yellow-blossom sweet clover, tall wheatgrass, and Lemons alkaligrass proved the most rapid in obtaining stands. The alfalfa and alta fescue—although somewhat slower in starting—eventually did a better job of growing than the others, the one exception being tall wheatgrass.

The first year, spotty stands of all five named plants were obtained on the 4-, 8-, and 16-ton gypsum plots. A sparse selection of plants appeared on the 2-ton gypsum plot and no plants germinated on the sulfur or check plots. The first year the plots were watered nine times and by the end of the season the rate of water penetration in the 4-, 8-, and 16-ton gypsum plots was very rapid and the rate of the 2-ton gypsum plot had increased appreciably. The sulfur and check plots had only a very slow water penetration rate, resulting in increased evaporation losses.

During the second season, the plots were all reseeded to Ladak alfalfa. Excellent stands were obtained in all gypsum-treated plots, but a stand could apparently not be obtained in the sulfur or check plots. Although the growth was slower in the 2-ton gypsum plot, a good stand was obtained, and during the third year the alfalfa growth on the 2-ton gypsum plots was as vigorous as the others. But even after three years of leaching on seven different plots, the sulfur applications up to 3,000 pounds per acre show no appreciable benefit. Gypsum and sulfuric acid appear to be much more economical than sulfur.

Field tests indicate that slick spots will respond more rapidly to applications of sulfuric acid than to equivalent amounts of calcium applied in the form of gypsum. Slick spots should be diked and leached several times prior to planting; otherwise, suitable forage-type cover cannot be obtained.

The table on page 10 shows results of the applications of gypsum and soil sulfur. Two growing seasons occurred between the tests. The figures show that the pH—relative acidity-alkalinity—was reduced considerably by the gypsum applications, and subsequent leaching of the salts is shown by the reduction of conductance values. This is particularly true in the 4- and 8-ton gypsum treatments and to a lesser degree in the 2-ton gypsum application.

On the check plots the salinity increased. This was apparently due to the accumulation of salts from the evaporated irrigation water. All gypsum treatments reduced the per cent soluble and exchangeable sodium, while the untreated plots showed evidence of the per cent sodium increasing.

Little effective reclamation was accomplished by the sulfur treatment. The pH values were lowered very slightly and the salinity reduced a little. No reduction was observed in either the exchangeable or soluble sodium of the soil. Practically no plant growth was obtained, even after three seasons on plots receiving the sulfur treatment, as shown in the illustration on page 10.

The tabulated figures are merely an indication of reclamation. In no instance has reclamation been possible in one year. Generally, at least two years are needed, and on the worst alkali soils, up to five or six years may be needed. Reclamation is only possible if there are adequate drains so that the salts can be removed by leaching.

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SULFUR

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less manganese deficiency symptoms on the leaves where sulfur has been added, but again this difference is of doubtful commercial importance.

Fruit Production

The final measure of any possible benefit from such treatments, as applied in these experiments, is their influence on yields. The tabulated yields—in four-year periods—show that the acidification of the soil by the use of sulfur in these experiments had no effect on fruit production.

Sulfur has other agricultural uses—such as in the reclamation of alkali soils—but where other nutrients are not limiting and where soil structure has not been greatly affected, the use of sulfur to increase soil acidity has been of no benefit in these experiments.

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