Potassium and Lemon Fruit Size

larger sizes obtained in soil cultures when potassium was increased and calcium decreased in laboratory experiments

A. R. C. Haas and Joseph N. Brusca

Tests on the effect of potassium and calcium soil fertilization on lemon fruit size—made when the fruit was in the silver stage of maturity—showed that the potassium-calcium ratio in the nutrient was effective in bringing about a marked response in the potassium and calcium content in the peel and pulp. Comparative results obtained with lemon flowers also indicated that the period of flowering and fruit setting can be of considerable importance in setting the pattern of mineral nutrition to be followed in the fruit until maturation occurs.

Eight 12-gallon earthenware containers, with drainage, were used for the soil cultures. In each container a lemon tree on sour orange rootstock was planted.

The nutrient solution consisted of distilled water containing in ppm—parts per million—sodium, 7; magnesium, 54; chlorine, 10; sulfate, 216; and phosphate, 105 as ammonium dihydrogen phosphate. The content of minor elements in the culture solution was—in ppm—boron, .2; manganese, .2; zinc, .2; iron, .2; aluminum as the citrate, 3; copper, .1; and molybdenum, .1.

To this nutrient solution for the various cultures was added—in ppm—calcium 318, 298, 277, 237, 159, 80, 40, 0 and potassium 0, 39, 77, 155, 310, 467, 545, and 622, in the form of nitrate as to supply equal concentrations of nitrate—986 ppm—and various ratios of calcium and potassium. Thus culture No. *1* received a nutrient solution containing 318 ppm calcium and 0 ppm potassium, whereas No. *8* received a nutrient solution containing 0 ppm calcium and 622 ppm potassium. At various times distilled water was added to each culture to take care of transpiration losses.

When the fruits were in the silver stage of maturity, the lemon trees appeared as seen in the accompanying photograph. Average fruit size—diameter—for each culture is shown in the table on page 14. As the concentration of calcium in the nutrient solution was decreased and that of potassium increased, the average diameter of the fruit was increased.

The peel and pulp of six lemon fruits

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Effect of Various Ratios of Calcium and Potassium in Otherwise Similar Nutrient-treated Soil Cultures on the Composition of Flowers and Fruits in the Silver Stage from Lemon Trees on Sour Orange Rootstock.

Culture No.	Parts per million in nutrient		Lemon flowers Per cent in dry matter				Lemon peel Per cent in dry matter				Lemon pulp Per cent in dry matter			
	Calcium	Potassium	Calcium	Potassium	Magnesium	Sodium	Calcium	Potassium	Magnesium	Sodium	Calcium	Potassium	Magnesium	Sodium
1	318	0	.978	1.847	.205	.078	1.095	.507	.095	.064	.336	1.426	.103	.070
2	298	39	1.004	1.845	.211	.012	.982	.568	.083	.057	.281	1.385	.096	.042
3	277	77	.995	1.987	.235	.001	.928	.729	.081	.039	.267	1.450	.103	.058
4	237	155	.898	2.032	.218	0	.913	.796	.087	.065	.249	1.615	.104	.037
5	159	310	.701	2.140	.226	0	.673	1.035	.068	.076	.183	1.731	.103	.060
6	80	467	.580	2.264	.239	0	.543	1.318	.062	.069	.159	1.911	.098	.019
7	40	545	.540	2.309	.209	.074	.455	1.659	.067	.053	.132	2.077	.096	.056
8	0	622	.521	2.559	.203	.074	.490	1.777	.064	.055	.142	2.237	.099	.019

Growth and fruiting of young lemon trees on sour orange rootstock grown in soil cultures with similar nutrient except for different ratios of potassium and calcium. *Extreme right,* Culture No. 1: highest calcium, lowest potassium. *Extreme left,* Culture No. 8: highest potassium, lowest calcium. Fruit of largest average diameter was produced by Culture No. 8 with highest potassium and lowest calcium in the applied nutrient.

New Mite Predators

four species from Guatemala show promise in southern California

C. A. Fleschner

The Guatemalan *Stethorus*—a small, black, lady beetle mite predator—is being propagated by the thousand in the insectary at Riverside for release in southern California avocado and citrus groves.

As a result of an exploratory trip through Mexico and Central America during the winter of 1953–54 to study the natural balance of pests of avocado trees in their native habitat, several species of natural enemies controlling mite pests of wild avocado trees were found in the Guatemalan highlands. Although Guatemala is a tropical country, frost may occur in the highlands above 5,000′ during the colder months, so it was thought that beneficial species collected from this area could possibly be established in southern California.

Consequently, after methods were developed for their propagation, nine species of these mite predators were shipped to Riverside in the spring of 1955, and four of these—one cheyletid mite, two typhlodromid mites, and one *Stethorus*—are being propagated. All four are new, undescribed species.

Stethorus, particularly, shows promise. Over 7,000 of this predator have already been released in the southern counties where it is working and reproducing well, although it remains to be seen how satisfactorily it will work through the winter months. Large numbers will be used experimentally in mass liberations at critical times in attempts to prevent the development of injurious plant-feeding mite infestations.

Since *Stethorus* feeds on a wide range of mite species, it may be used in this experimental manner not only on avocado and citrus but on various truck and field crops and other trees. This is also true of the cheyletid mite and the two typhlodromid mites, which—as laboratory studies have shown—will feed on all mite pests of avocado and citrus trees except the citrus bud mite.

Propagation of these beneficial species will be continued until they have been given an opportunity to become established in southern California groves.

C. A. Fleschner is Associate Entomologist, University of California, Riverside.

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FRUIT SIZE

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from each culture were tested in duplicate determinations for their content of calcium, potassium, magnesium, and sodium, the results of which are shown in the larger table. The calcium percentage in the peel was approximately doubled while that of potassium was more than tripled in the extreme. Hoagland's nutrient solution regularly contains 159 ppm of calcium. When the concentration of calcium in the nutrient solution was increased above this strength—as shown in the larger table—the calcium percentage in the peel made its greatest increase. Above a concentration of 237 ppm of calcium in the nutrient, calcium percentage in the peel increased only slightly.

The peel readily absorbed large amounts of potassium when the concentration of potassium in the nutrient solution was increased and that of calcium was simultaneously decreased. In the peel there were very small increases in the percentages of magnesium accompanying the increased calcium and reduced potassium percentages though the magnesium concentrations in the nutrient solutions were similar for all cultures.

Yields and Sizes of Lemon Fruits in the Silver Stage of Maturity Grown on Trees in Soil Cultures That Received Similar Nutrient Solutions Except for the Ratio of Calcium and Potassium

Culture	Calcium	Potassium	No. of fruit	Wt. of fruit grms.	Diameter of fruit ins.
	ppm in nutrient				
1	318	0	12	1134	2.095
2	298	39	23	2335	2.165
3	277	77	15	2400	2.169
4	237	155	13	1503	2.193
5	159	310	18	2027	2.228
6	80	467	19	2227	2.252
7	40	545	11	1299	2.272
8	0	622	8	1100	2.374

In the pulp the calcium percentages, while relatively low in comparison with those of potassium, showed a consistent increase, whereas the magnesium—constant in each nutrient—showed minor increases as calcium in the nutrient was increased and potassium decreased.

Lemon fruit therefore responded very well to changes in the calcium-potassium content in the nutrient solution applied to the soil when the concentration of the applied other nutrient elements was not varied in any of the cultures. The larger table also shows that the calcium and potassium percentages in the dry matter of lemon flowers can be markedly affected by varying the ratio of calcium to potassium in the nutrient applied to soil cultures. The high calcium content of many irrigation waters should make the potassium supply of considerable importance.

A. R. C. Haas is Plant Physiologist, Emeritus, University of California, Riverside.

Joseph N. Brusca is Principal Laboratory Technician, University of California, Riverside.

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CITRUS

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tion of importation bud of wood or cuttings was modified, and introduction of citrus budwood from other countries is permissible under quarantine measures.

Quarantine regulations—imposed in the 1930's—prohibited importation of budwood or cuttings from out of state because of the danger of introducing contagious diseases with the incoming material.

Material introduced under current quarantine measures is carefully screened and indexed for various diseases at the U.S.D.A. Plant Industry Station greenhouses at Beltsville, Maryland. Satisfactory material can be released to California where it will again be placed in isolation quarantine greenhouses. The introductions will be budded into various rootstock combinations and into different seedlings to index for miscellaneous virus and other diseases. Material found to be satisfactory will be released from quarantine to governmental agencies for experimental field trials.

The variety orchard provides a wide source of propagating material of miscellaneous varieties and a varied population of genes for breeding studies. Wide use of such trees is made in rootstock tests and in the search for nematode and disease-resistant stocks.

W. P. Bitters is Associate Horticulturist, University of California, Riverside.

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