Sodium-Calcium in Young Citrus

ratio of sodium to calcium in the nutrient solution of sand cultures shown to affect mineral absorption and plant growth

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Irrigation waters applied to citrus orchards vary considerably—in their sodium and calcium content—in different locations, so studies were made with pure silica sand cultures with nutrient solutions of similar nitrate content and ratios of sodium and calcium.

The nutrient solution common to each culture contained, in parts per million—ppm—magnesium, 54; potassium, 185; sulfate, 390; phosphate, 105; boron, .2; manganese, .2; zinc, .2; iron, .2; aluminum, 3; copper, .25; and molybdenum, .05. To this solution was added similar concentrations of nitrate—986 ppm—to obtain various concentrations of sodium and calcium.

The concentrations of sodium were—ppm—0, 7, 14, 27, 41, 68, 95, 135, 189, 230, 270, 297, 311, 338, 351, 365, and those of calcium were—ppm—317, 311, 305, 294, 292, 259, 244, 195, 159, 122, 73, 61, 37, 24, 12, 0, the lowest sodium being used with the highest calcium and the highest sodium with the lowest calcium.

The galvanized iron containers—provided with drainage—were 7.5″ in diameter by 12″ deep and were heavily asphalt coated. On January 5, a rooted leafy-twig sweet orange—Riverside variety—cutting was planted in each culture. On the following December 7, the growth obtained in the glasshouse was photographed. The results indicated that for sand cultures with similar culture solutions—except for sodium and calcium—the growth of sweet orange seedlings was adversely affected as the concentration of sodium increases and that of calcium decreases.

Calcium and Magnesium Content in the Dry Matter of the Roots—Below the Uppermost Lateral Rootlet—of Citrus Seedlings Grown in Drained Soil Cultures That Received Hoagland's Nutrient Solution Containing Trace Elements and Increasing Concentrations of Sodium Nitrate. Cultures Grown in Glasshouse from September 2, to the Following August 24

	Sodium	Calcium	Magnesium
	ppm	% in root dry matter	
Sour orange —Spanish— R16, T9-11, 1ABC	0	1.976	.246
	60	1.849	.263
	120	1.786	.228
	180	2.067	.220
	240	1.913	.251
	300	1.908	.193
Pomeroy trifoliate orange, R34, T53, 1ABC	0	.880	.195
	60	1.038	.211
	180	.875	.191
Grapefruit, R4, T39, 1ABC	0	.835	.218
	60	.772	.231
	120	.783	.219
	180	.794	.236
	240	.829	.286
	300	.763	.184
Cleopatra mandarin, R13, T50, 1ABC	0	.750	.271
	60	.759	.257
	120	.764	.261
	180	.807	.260
	240	.806	.248
	300	.834	.263
Tangelo, R21, T52, 1ABC	0	.715	.223
	60	.786	.218
	120	.723	.215
	180	.748	.204
	240	.733	.211
	300	.746	.225
Rough lemon, R1, T52, 1ABC	0	.720	.241
	60	.700	.226
	120	.754	.232
	180	.724	.209
	240	.651	.206
	300	.654	.203
Sweet orange —Indian orchard— R11, T44, 1ABC	0	.501	.300
	60	.451	.235
	120	.524	.220
	180	.498	.239
	240	.538	.252
	300	.576	.220

The plants were harvested after being photographed and analyzed. Whenever possible, duplicate determinations were conducted and when the material was scant, the sodium-potassium determinations were given precedence. Double precipitation of calcium was used in each case.

The dry matter of the leaves generally contained lower percentages of calcium as the concentration of calcium in the nutrient solution was decreased. Magnesium and potassium were not varied in concentration in the different nutrient solutions and there was very little tendency for the percentages of magnesium to increase. However, the percentages of potassium increased as the concentrations of sodium in the nutrient solutions increased and calcium decreased.

In the dry matter of the twigs, the percentages of potassium again increased as those of sodium increased—even though the potassium concentrations in the nutrient solutions were alike.

In the roots, the sodium content in the dry matter increased as the sodium concentrations in the nutrient solutions were increased. The calcium percentages generally decreased as the calcium content in the nutrient was decreased. Again the potassium percentages tend to rise as the concentrations of sodium in the nutrient solutions were increased and those of calcium decreased. The effect of increasing the sodium contents of the nutrient

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Growth of rooted leafy-twig sweet orange—Riverside variety—cuttings in sand cultures with similar nutrient solutions except for various concentrations of sodium and calcium. *Extreme left*—ppm—0, sodium; 317 calcium; *extreme right*—ppm—365 sodium; 0, calcium.

SODIUM–CALCIUM

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solutions and decreasing those of calcium was to greatly reduce the fresh and dry weights of the root systems.

In drained soil cultures of three-gallon capacity the effect of adding increasing concentrations of sodium nitrate to Hoagland's nutrient solution was studied to determine whether any changes occurred in the calcium content of the dry matter of the roots when calcium was always abundantly supplied. At the two highest sodium concentrations, the calcium content of the roots of rough lemon seedlings showed a decrease. An increase in sodium nitrate in the nutrient solution was accompanied by an increased calcium content in Cleopatra mandarin roots.

The table on page 13 shows the consistently high calcium content of the roots of the sour orange—Spanish—seedlings in the various sodium nitrate cultures.

Results of the tests confirm previous preliminary findings on the calcium content of the roots of various citrus rootstocks collected from trees in the rootstock variety plots. In the plots of these orchard trees, there were no appreciable sodium concentrations and the results in the table indicate the tendency to maintain a more or less stable calcium and magnesium content in the roots of citrus seedlings when sodium is increased and the supply of calcium is maintained by the nutrient solution and initially increased by base exchange.

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APPLE APHID

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There were three heavy peaks of movement—in late July, late August, and early September. The sudden drop in September was due to the action of parasites which killed a high percentage of aphids during this time. In the treated plots, the downward movements can be used as a measure of the control obtained following the foliage applications. As shown by the almost negligible number of aphids trapped on the bands, 12008, 3911, and Diazinon were very effective. Good control—though less outstanding—was also obtained with 1303. In contrast to its effect on upward movements, the weakest of the phosphate compounds was 17147, the reason for which is not clear. Ryania—as compared with the check—again showed a reduction in aphid movement but was far less effective than the systemic and nonsystemic phosphate compounds.

As a check on the method of analyzing results by the use of sticky bands, colony counts and core aphid counts were made on each plot at harvest. The colony counts were made by recording the number of active colonies on four limbs in each tree and were expressed as the average number of aphid colonies per limb. The core aphid count was made by selecting 100 apples at random from each plot, cutting them in half from calyx to stem, and recording the number of infested cores. The materials used, dosages, times of application, and harvest counts are summarized in the table below.

Summary of 1955 Woolly Apple Aphid Plots, Watsonville, California

Material	Dosage per 100 gals.	Dates of application	Harvest counts: Av. no. aphid colonies per limb	Harvest counts: % core aphid
Ryania	6 lbs. 100% wettable	Apr. 19, May 26, June 23, July 27	2.7	7.0
Am. Cy. 12008	1 qt. 48% emulsion	Apr. 19, May 26, June 23, July 27	0.1	0.0
Stauffer 1303	1 pt. 50% emulsion	Apr. 19, May 26, June 23, July 27	0.5	1.0
Bayer 17147	1 lb. 50% wettable	Apr. 19, May 26, June 23, July 27	1.2	2.0
Diazinon	1 qt. 25% emulsion	Apr. 19, May 26, June 23, July 27	0.3	0.0
Check	No spray	....	9.6	16.0

The harvest counts correlated closely with the band counts. Excellent control was obtained with 12008, 3911, and Diazinon. Less effective—but still providing commercial control—were 17147 and 1303. Ryania was the least effective of the materials used.

At harvest—because the number of colonies present in the check trees indicated that a higher percentage of core aphid should have been present—a check was made and 50% of the apples were found to have an open calyx, which was less than had been recorded in previous seasons. Although many apples in the unsprayed plot had active aphid colonies on the stem and calyx end, the aphids were nevertheless unable to penetrate to the core. The variation in core aphid infestations from season to season is no doubt connected not only with the severity of aphid infestations in the tree but also with the factors which cause open and closed calyx ends in the fruit.

Most of the chemicals used in the Watsonville plots are still in the experimental stage. In the case of the systemic compounds—which were so effective in reducing the aphid movements—it may be possible, in further tests, to lengthen the intervals between treatments.

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PINE

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roots within the first month, October and November seedlings produced an average of less than three new roots over ½″ long per seedling, whereas the April transplants averaged more than eight new roots over ½″ long per seedling—a highly significant difference statistically.

Close examination of the seedlings that produced roots and of those that did not failed to reveal any external morphological differences. Apparently, therefore, some physiological condition exists which is associated with the ability of seedlings to produce new roots.

If these findings are substantiated by later and more comprehensive observations, a basic change taking place during the winter which increases the ability of the seedling to produce roots will be indicated.

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WALNUT APHID

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results can be obtained only where they are thoroughly applied with adequate equipment under favorable weather conditions.

In areas where the resistant walnut aphid is known to occur, an aphicide other than parathion, malathion, or TEPP must be used.

Insecticides used in the walnut aphid control program are poisonous and care must be exercised in handling and applying them, especially with parathion, TEPP, and Systox. Precautions—as given on the insecticide manufacturer's container—should be followed carefully.

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