JOSEPH N. BRUSCA and A. R. C. HAAS

Magnesium required by

Avocado Trees

but excessive amounts may be toxic

Avocado trees are fertilized according to the pattern used for citrus, but the leaves of both species differ considerably in composition. For example, the dry matter of healthy avocado leaves usually contains about 0.7% magnesium—about double that found in citrus leaves.

In order to determine the need of avocado trees for magnesium, tests were conducted with silica sand cultures planted to Nowels—Hybrid—avocado seedlings and grown in the glasshouse from September 12 to the following July 24. The nutrient solution consisted of 7.0 ppm—parts per million—sodium as chloride, 142 ppm potassium as sulfate, and 105 ppm phosphate as potassium acid phosphate, plus the trace elements: 0.1 ppm boron, manganese, iron, and zinc, and 3.0 ppm aluminum. To this nutrient solution were added 986 ppm nitrate, variously divided between calcium and magnesium nitrates, all culture solutions therefore containing equal concentrations of nitrate. Distilled water and chemically pure salts were used in all the experimental studies.

Calcium-magnesium Tests

Results show that leaves, trunks, and roots made the most growth when calcium was absent or most deficient and magnesium was at its highest concentrations. The poorest growth occurred when magnesium was absent or most deficient and calcium was highest in the nutrient solution.

A test was made in which the concentration of calcium in the nutrient solution was kept constant, whereas that of magnesium was varied. Fuerte—Hybrid—avocado seedlings were grown in well-drained soil cultures, the nutrient solution of which was that of Hoagland's A, B, C stock solutions—except that magnesium was omitted from A—plus ammonium nitrate to double the nitrogen content. The trace elements added were: 0.1 ppm boron, manganese, zinc, and iron, and 3.0 ppm aluminum. To this nutrient solution were added increasing concentrations of magnesium as sulfate: 0, 27, 54, 81, 108, 135, 162, 216, 243, 297, and 324 ppm. The calcium concentration in each culture solution was constant—159 ppm. At the two highest magnesium concentrations the trees died. At the 216-ppm magnesium concentration, the leaves showed marginal yellowing. In this case the excessive magnesium appears to be toxic in the presence of 159 ppm calcium. The degree and intensity of the marginal yellowing were considerably less, or absent, as the concentration of magnesium was in better balance with that of calcium.

Harman Seedlings

Another test was conducted with Harman—Mexican—avocado seedlings in silica sand cultures in which increasing concentrations of magnesium nitrate in the nutrient solutions were balanced by addition of ammonium nitrate to equalize the total nitrogen. The nutrient solution contained 11 ppm sodium as chloride, 213 ppm potassium as nitrate, 131 ppm potassium as sulfate, 318 ppm calcium as nitrate, 67 ppm calcium as sulfate, and 158 ppm phosphate as potassium acid phosphate. The trace elements were: 0.2 ppm boron, manganese, and iron, 1.0 ppm zinc, 3.0 ppm aluminum, 0.1 ppm copper, 5.0 ppm molybdenum, and 0.05 ppm chromium. The concentrations of magnesium were: 0, 18, 20, 36, 40, and 53 ppm.

Mature leaves of the last cycle of growth in the culture containing no magnesium showed a yellowing that began near the leaf margin and moved inward between the veins. The portion of the leaf

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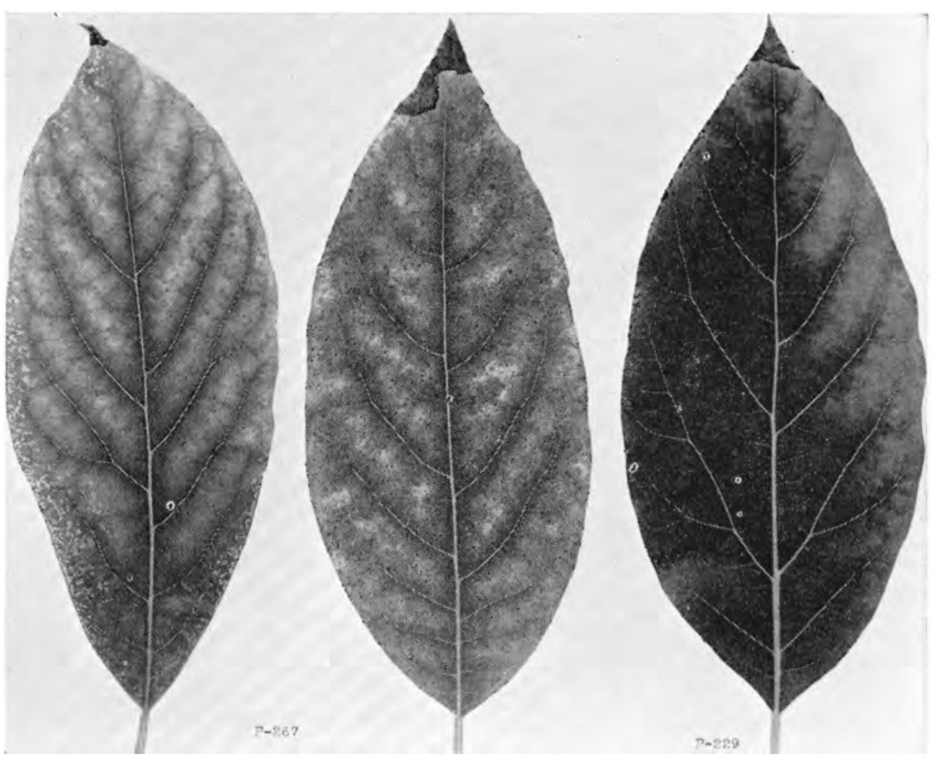

Magnesium deficiency in leaves of avocado grown in silica sand cultures. *Left* and *center*, Harman (Mex.) seedling; *right*, Fuerte (Carr) on Mexicola (Mex.).

DALE G. SMELTZER

A search for better Field Corn Varieties by intercrossing

The major portion of California's field corn acreage is planted to hybrid varieties developed in the Midwest. These varieties have produced relatively high yields under ample water and essential plant nutrients. However, it seems unlikely that such varieties would represent the ultimate in adaptation to conditions in this state.

Research is being conducted to develop varieties with higher yields, better disease resistance and improved stalk quality so that they would stand erect for harvest during the dry fall season.

In most corn-growing areas of the United States, a number of locally adapted open-pollinated varieties served as sources of parental lines in the development of superior hybrids. In California, only one variety was grown to any extent before the introduction of hybrids from the Midwest. That variety was known as King Philip Hybrid, although not a hybrid in the modern sense. Conventional methods of corn breeding with that variety used as a source of parental lines were not successful. Inbred lines were introduced from other areas to combine with those derived from the local source. This proved to be a promising approach to the development of better hybrids. However, most of the lines were lacking in one or more characteristics essential for maximum performance. A method is now being used which is a modification of the system of reciprocal recurrent selection which was proposed by researchers in North Carolina.

Potential Lines

In this method, two new sources of potential lines have been developed. Source *A* resulted from intercrossing a number of the most promising lines from the King Philip Source. This intercrossing should permit recombinations of their desirable attributes. Similarly, Source *B* was produced by intercrossing a number of promising lines from the Midwest.

From Source *A*, individual plants are chosen. Progenies from these plants are top-crossed to Source *B*. In reciprocal fashion, selected progenies of individual plants of Source *B* are top-crossed to Source *A*. Only the best selections from *A*, as determined by their performance in top-cross tests, are saved. They are intercrossed to form a new Source *A*. A similar procedure is followed with the selections from *B*. The cycle is then repeated. After two or more cycles of this type of selection it is expected that Source *A* when crossed with Source *B* will produce a superior variety as only the best types of plants in each source are saved after every cycle.

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AVOCADO

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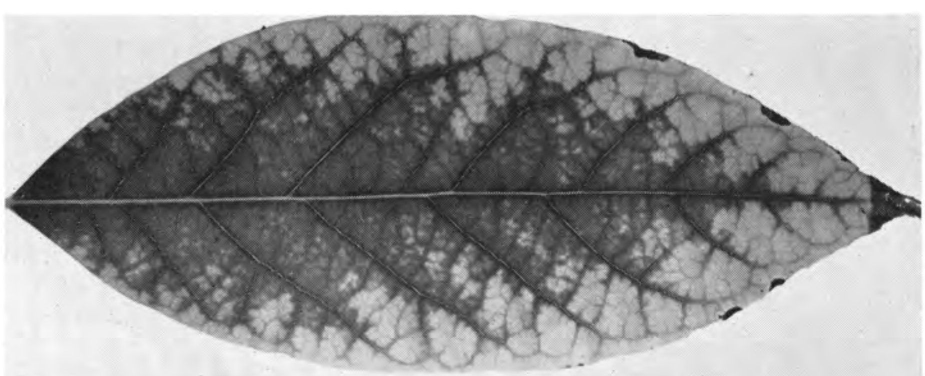
blade near the base of the midrib remained green longest. Dry matter of the uppermost mature leaves of the culture that received no magnesium contained 0.169% magnesium, whereas the lowermost leaves contained 0.202% instead of the 0.70% typical of healthy trees. The dry matter of the rootlets contained only 0.080% as against about 0.500% found in roots of healthy trees.

A similar nutrient solution was used with large, outdoor silica sand cultures with concentrations of magnesium nitrate in the nutrient solutions of 0, 18, 36, and 53 ppm. Ammonium nitrate was used to equalize the total nitrogen in all cultures.



Toxicity symptoms in an avocado leaf from a soil culture containing 216 ppm magnesium and 159 ppm calcium. Lowering the concentration of magnesium eliminated such symptoms.

Absence of Magnesium

When no magnesium was present in the nutrient solution, the green color began to disappear first along the margin of the leaf blade, with the portion along the midrib and near its base remaining green the longest. The culture with no magnesium produced the poorest roots, the dry weight of the entire rootstock—below the bud union—being only 770 grams whereas in the other cultures rootstocks weighed 1,472, 1,265, and 1,574 grams as the concentration of magnesium in the experimental nutrient solution was increased.

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