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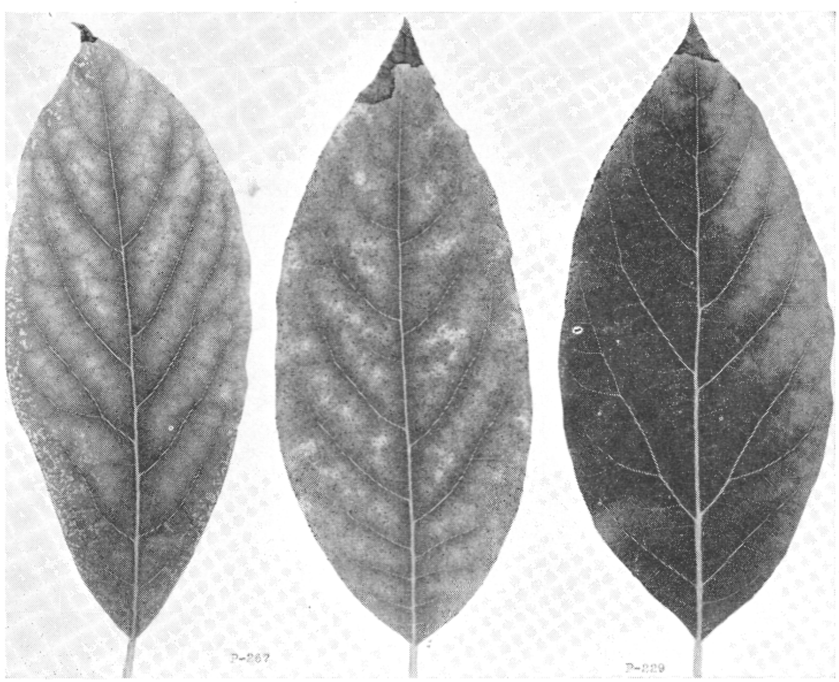
Magnesium required by avocado trees but excessive amounts may be toxic

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

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.

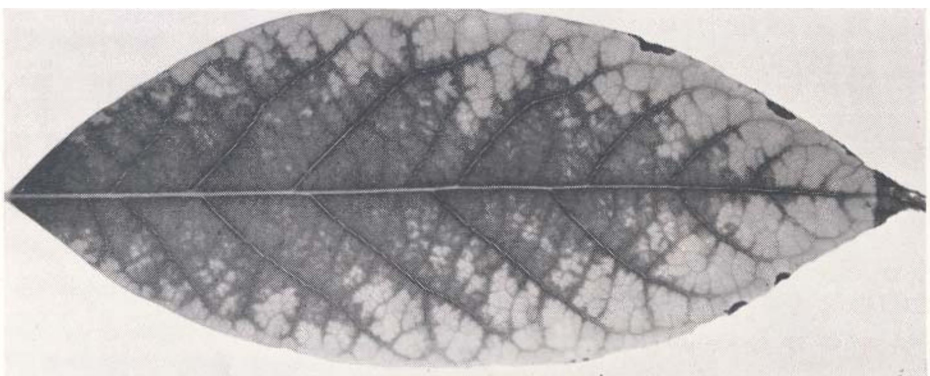


Magnesium deficiency in leaves of avocado grown in silica sand cultures. *Left* and *center*, Harman (Mex.) seedling; *right*, Fuerte (Carr) on Mexicola (Mex.).

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.



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.

Harmon 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 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.

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.

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

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

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