Deficiencies of Micronutrients

influence of phosphate fertilizers on micronutrients in avocado leaves subject of long-term study of Fuerte orchard

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Because the deficiency of micronutrients in avocado trees is often a problem in southern California orchards a fertilizer experiment was started to evaluate treble superphosphate—among other phosphatic fertilizers—as a source for the micronutrient content of the leaves.

A Fuerte avocado orchard in northern San Diego County was selected for the experiment. The orchard is on Ramona stony sandy loam, a light textured, well-drained, shallow, acid soil having a cation exchange capacity of less than 4me—milliequivalents—per 100 grams. The soil was nontilled; irrigation was by individual under-tree sprinklers; weeds under the trees were controlled with oil and other chemical herbicides.

The avocado trees were planted in 1939 where Navel orange trees had been removed because of a condition now known to have been phosphorus deficiency. The avocado trees did not respond favorably to phosphorus fertilization. However, Valencia orange trees on the same soil type in the same orchard did respond favorably to phosphatic fertilization.

Prior to the establishment of the experiment, the avocado trees received three pounds of actual nitrogen per tree per year from sulfate of ammonia broadcast under the trees. Differential treatments were started in 1951. Three phosphorus levels, zero, low and high, were produced respectively by soil applications of 0, 10, and 20 pounds of treble superphosphate per tree per year in 1951 and 1952 only. These treatments were combined factorially with nitrogen treatments and were arranged so that each phosphorus level was applied to 20 single-tree plots randomly distributed in the experimental area. Leaf samples for chemical analysis were obtained in October 1955, August 1956, and September 1957, from the spring and summer flushes of growth. Each sample consisted of 20 fully developed avocado leaves and included both blades and leaf petioles.

Leaves from the avocado trees that received the high-phosphorus rate contained appreciably lower concentrations of zinc and copper than leaves from trees that received the zero-phosphorus rate. The same effect of phosphatic fertilizers on zinc was found in three consecutive years and on copper in only the first two years. Some of the high-phosphorus treatment plots showed zinc deficiency patterns on the leaves. Although high-phosphorus treatments applied to the trees reduced markedly the copper concentration in the leaves, no recognizable copper deficiency symptoms were observed. Leaves from trees that received the low-phosphorus and high-phosphorus rates contained appreciably higher concentrations of manganese than the leaves from trees that received the zero-phosphorus rate. Leaves from high-phosphorus trees contained appreciably lower concentrations of manganese than leaves from low-phosphorus trees in three consecutive years. Also, it was found that two pounds of nitrogen per tree per year from ammonium nitrate increased markedly the manganese concentration in avocado leaves in the same grove for three consecutive years. Boron and iron concencentrations were unaffected by the phosphorus treatments.

Results obtained in the studies indicate that soil applications of phosphorus fertilizers have complicated effects on the micronutrient concentration in avocado leaves. Evidence from many sources also indicates that most of the phosphorus applied to orchard soils accumulates in the topsoil, and does not leach out, although it may gradually change in form. Application of treble superphosphate to avocado trees not only increased the phosphorus in the plant tissue, but also reduced—directly or indirectly—the zinc and copper, and increased manganese concentrations in the leaves. Similar results have been obtained in other orchards and with different avocado varieties. However, phosphate applications, thus far, have had no beneficial influence on yield.

These studies suggest that trees in avocado orchards—that have been heavily fertilized over a period of years with chemical phosphorus or organic fertilizers containing large amounts of phosphorus—should be examined carefully for symptoms of micronutrient deficiencies, particularly zinc. If necessary, remedial nutritional sprays should be applied. Probably, heavy applications of phosphate fertilizers to avocado orchards are not advisable unless reasonable evidence indicates some benefit will result.

Effects of Soil Applications of Phosphorus Fertilizers on the Micronutrient Concentration of Avocado Leaves

Treble superphosphate app. rate	Parts per million in dry leaves														
	Zinc			Copper			Manganese			Iron			Boron		
	1955	1956	1957	1955	1956	1957	1955	1956	1957	1955	1956	1957	1955	1956	1957
Zero	35	24	19	4.2	7.6	7.8	528	382	419	50	60	..	37	40	41
Low	33	20	16	4.0	6.5	7.4	655	507	535	49	58	..	28	38	40
High	30	20	17	3.5	6.2	7.5	603	446	474	50	61	..	32	35	40
F value	**	**	**	**	*	NS	**	**	**	NS	NS	..	NS	NS	NS

NS indicates that the differences between means are not statistically significant.
Each value is the mean of 20 samples representing 20 single-tree plots.
* Fertilizer value significant at the 5% level.
** Fertilizer value significant at the 1% level or higher.

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Hartwell Bradford and Henry Grenfell of the Agua Tibia Ranch, and Ray Easton, Bradford Brothers Inc., cooperated in the studies reported.

CANNED FRUITS

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nery sales is associated with a decrease in cannery price; an increase in national income is associated with an increase in cannery price; and an increase in the relative price of competing canned fruits is associated with an increase in the cannery price of the respective item. These price effects vary in amount among the several canned fruits, but for each of the items the change in cannery price from year to year can be accounted for in most part by the combined interactions and influences of sales volume, national income, and the relative level of competing canned fruit prices.

As the industry enters the marketing

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