Phosphatic Fertilizers on Va

field response in phosphorus-deficient orchard reveals improvements in foliage growth and color, and in fruit qual

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Phosphatic fertilizers applied to Valencia orange trees improved foliage growth and color, the fruit quality and increased the number of fruits set.

Studies were made in northern San Diego County where the soil of the experimental orchard is Ramona stony sandy loam—a shallow, well-drained alluvial soil of very low exchange capacity. The trees are on sour orange rootstock, and were planted in 1927.

Previous to 1950, the fertilizer program consisted of the annual application of three pounds of actual nitrogen per tree in the form of sulfate of ammonia, which was broadcast under the trees.

In recent years, the orchard has not been tilled, and grass and weed growth have been eliminated from under the trees by oil sprays. Irrigation water is applied by individual sprinklers under each tree, no irrigation water being applied on the row middles. In 1950, the pH—the relative acidity-alkalinity—of the top 18″ of soil under the trees averaged 4.5, while that of comparable soil from the row middles averaged 6.5 with pH7 as neutral. Large crops of early maturing, excellent-quality fruit were produced in this orchard for a number of years after the trees came into bearing. Then symptoms of phosphorus deficiency began to appear.

The quality of the fruit gradually deteriorated, the fruit became large, coarse, and misshapen, with exceptionally thick peel and hollow centers. Legal fruit maturity—8:1 Brix/acid ratio—was attained later each picking season.

After the fruit quality began to deteriorate, the foliage density became progressively thinner. Fewer leaves were produced and those leaves were smaller than normal and dropped prematurely. Accompanying this reduction in foliage density was a decrease in yields. By 1950, the trees were very small for their age, of low vigor, and had a dull-green foliage. There was only a weak spring flush of growth, and in the late fall and winter the foliage took on a bronzed cast. Some twig dieback was present.

Visual ratings were made of 60 trees in 1950. The correlation coefficient between degree of defoliation and fruit size was +0.95, indicating that, as the degree of defoliation increased, fruit size increased.

In September, 1950, 29 soil treatments were established in this orchard, and for each treatment, plots of two trees were replicated five times.

Experimental results from 14 of these treatments are reported here to show the influence of soil applications of phosphatic fertilizers upon phosphorus-deficient orange trees in a commercial orchard.

The 14 treatments were grouped into four major classifications.

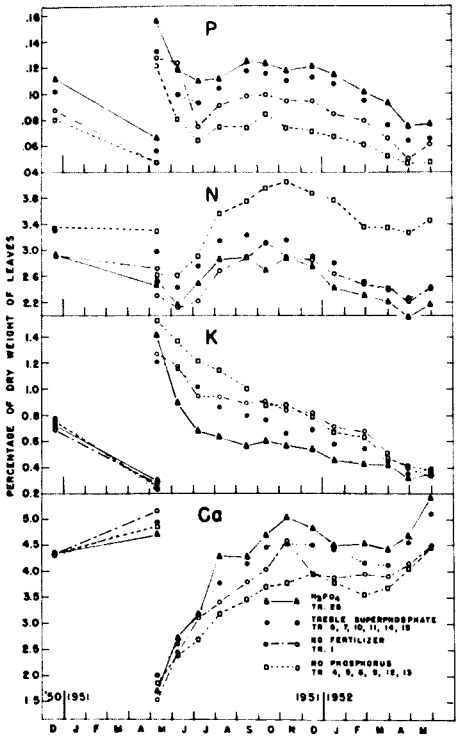
The first group—one treatment—used liquid phosphoric acid as the source of phosphorus. The second group—six treatments—employed various combinations of fertilizers and dolomite plus treble superphosphate as the source of phosphorus. The third group—one treatment—received no fertilizer nor soil amendment. The fourth group consisted of six treatments comparable to those in the treble superphosphate classification, but a source of phosphorus was omitted.

On each sampling date, 20 spring-cycle leaves from nonfruiting twigs were harvested per tree from each plot in the first two replications, and were composited. Thus, the sample from each treatment for each leaf harvest date consisted of 80 leaves.

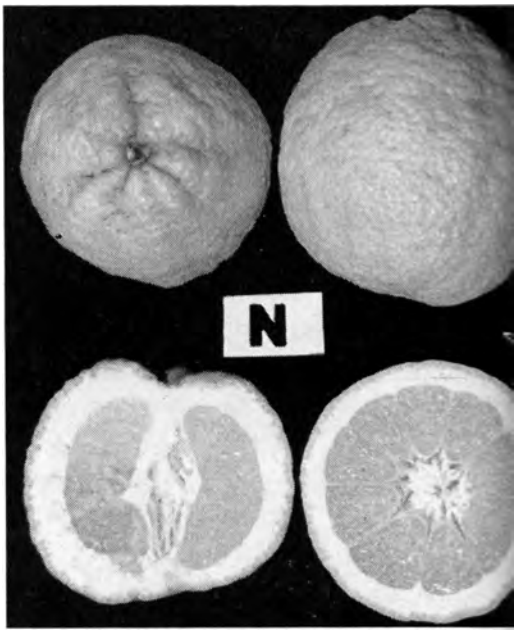
In December, 1950—three months after initiation of the experiment—trees receiving soil applications of liquid phosphoric acid were in a full flush of growth. A few trees treated with treble superphosphate or manure had a limited amount of early winter flush of growth. None of the remaining trees, in nonphosphorus-treated plots, had any appreciable new growth.

Little difference was observed in the 1951 spring flush of growth of trees in the various treatments. Trees of all treatments produced fair flush. Trees that received liquid phosphoric acid, treble superphosphate, or manure continued to grow slowly during the summer; on the remainder of the trees, growth was weak and ceased early in the season. The magnitude of this flush of growth was greatest in the plots treated with liquid phosphoric

Influence of soil applications of phosphatic fertilizers upon the seasonal chemical composition of Valencia orange leaves. The curves for the treble superphosphate and the no-phosphorus treatments represent averages of six treatments each.



Influence of phosphatic fertilizers on fruit. monium nitrate—treatment no. 4. NP—Repr nitrate plus liquid phosphoric acid—treatm



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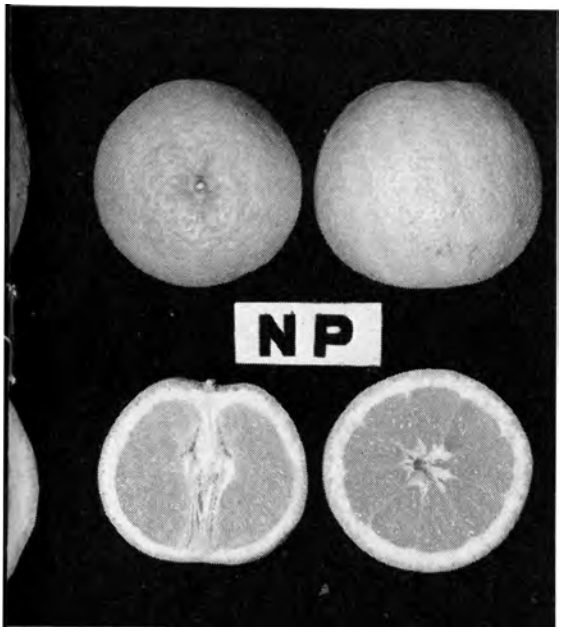
acid. Growth in the manure-treated plots ranked between that in the treble superphosphate-treated plots and that in the plots which received no phosphatic fertilizers. During bloom, the trees that were not fertilized with phosphorus had an exceedingly heavy drop of the previous year's leaves, while phosphorus-fertilized trees retained their older leaves. Many of the leaves that dropped had developed a V-shaped tipburn.

Fruits harvested late in the summer of 1951 had been set about five months prior to the initiation of the experiment. Data from the first harvest showed no significant differences in yield or fruit size due to treatment. Fruit from the plots treated with liquid phosphoric acid had a higher Brix/acid ratio, however, than fruit from the remainder of the plots. Increasing the Brix/acid ratio is of commercial significance, as the fruit of the experimental orchard has not been reaching legal maturity until late in the picking season, and this has been an economic handicap.

In July, 1952, the trees which received liquid phosphoric acid or treble superphosphate were denser, bearing markedly more fruit, smoother-textured fruit, and

N—Representative fruits from trees receiving am-esentative fruits from trees receiving ammonium ent no. 25.



***Left:* Phosphous-deficient tree, fertilized with ammonium nitrate, treatment no. 4. *Right:* Phosphorus-fertilized tree, fertilized with ammonium nitrate plus liquid phosphoric acid, treotment no. 25.**

smaller fruit than the trees which received no phosphatic fertilizers.

This visible improvement in tree condition and fruit quality was accompanied by a change in the percentages of the mineral constituents in the leaves.

Throughout the year leaves from the phosphorus treatments contained distinctly more phosphorus than did leaves from treatments not receiving phosphorus fertilization. As the graph on page 8 shows, the phosphorus-leaf values from the treatments receiving phosphorus were the only ones above the range of slight phosphorus deficiency—tentatively established as 0.07% to 0.10% phosphorus, dry weight basis, in three- to seven-month-old orange leaves.

Applications of nitrogen plus phosphorus—liquid phosphoric acid and treble superphosphate treatments—to phosphorus-deficient trees resulted in a marked increase in the percentage of phosphorus in the leaves. Nitrogen applied without phosphorus—no-phosphorus treatments—resulted in a distinct reduction in the phosphorus percentages in the leaves.

Leaves having high phosphorus values have low nitrogen values and vice versa. From August to May the percentages of nitrogen in the leaves of the no-phosphorus treatment were extremely high. This may be the result of nitrogen applications in conjunction with little or no growth after the spring flush.

Phosphorus applications resulted in a decrease in the percentages of potassium and an increase in the percentages of calcium in the leaves.

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Soil Treatments Used in Valencia Orange Orchard Experiment in Northern San Diego County, California.

Classification	No.	Material[a]	Pounds per tree per year[b]
Liquid phosphoric acid	25	Ammonium nitrate	6
		Liquid phosphoric acid (75%)	16
Treble superphosphate	6	Ammonium nitrate	6
		Treble superphosphate	20
	7	Ammonium nitrate	6
		Potassium sulfate	20
		Treble superphosphate	20
	10	Dolomite	40
		Ammonium nitrate	6
		Treble superphosphate	20
	11	Dolomite	40
		Ammonium nitrate	6
		Potassium sulfate	20
		Treble superphosphate	20
	14	Dolomite	100
		Ammonium nitrate	6
		Treble superphosphate	20
	15	Dolomite	100
		Ammonium nitrate	6
		Potassium sulfate	20
		Treble superphosphate	20
No fertilizer	1	No fertilizer	..
No phosphorus	4	Ammonium nitrate	6
	5	Ammonium nitrate	6
		Potassium sulfate	20
	8	Dolomite	40
		Ammonium nitrate	6
	9	Dolomite	40
		Ammonium nitrate	6
		Potassium sulfate	20
	12	Dolomite	100
		Ammonium nitrate	6
	13	Dolomite	100
		Ammonium nitrate	6
		Potassium sulfate	20

[a] All materials broadcast or sprayed under the trees in an area extending about two feet beyond skirts of trees.

[b] Dolomite applied in two applications per year.