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AVOCADO FERTILIZER EXPERIMENTS

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Avocado fertilization in California at present is strongly influenced by recommendations made for citrus fertilization and by practices followed by successful avocado growers. Very little experimental evidence from the field exists to aid the grower in formulating a fertilizer program. It is the purpose of this paper to report on the progress of avocado fertilization research which was initiated by the University of California Citrus Experiment Station in 1950. Two orchards are included in this study. It is a progress report and is not intended to be a recommendation on fertilizer practice.

ORCHARD NUMBER ONE

Orchard number one is a non-tilled, sprinkler irrigated Fuerte orchard and is situated in northern San Diego County on a light-textured, well-drained, shallow, acid soil. Weeds are controlled under the trees with oil. The trees were planted in 1939 in an orchard where navel orange trees were removed because of a condition which probably was phosphorus deficiency. Valencia orange trees on this same property have responded remarkably well to applications of phosphorus .Until 1950, the fertilizer program for the avocados consisted of three pounds of nitrogen per tree per year in three applications from sulfate of ammonia.

The experimental plots were established in 1951. Single tree plots are used and for nitrogen comparisons are replicated 30 times. Thus, 30 trees are getting two pounds of nitrogen from ammonium nitrate each spring and are compared to 30 trees that receive no nitrogen. Applications of phosphate, potash, and dolomite have shown no commercial benefit in this experiment, even though orange trees responded very well to phosphates on this same property. Therefore, the only data presented here is on nitrogen (Table 1).

Table 1. Summary of nitrogen studies, Orchard Number One. Thirty single tree plots are represented in each mean.

Pounds N per tree per year and statistical indices	Yield, Pounds per tree	Yield, No. Fruits per tree	Average wt. per fruit (oz.)	% Oil by wt. in fruit pulp[a]	Leaf N % Dry Wt.
		1952-53 Season			
		4/53		1/53	10/53
0	54	93	10.1	13.9	1.79
2	35	62	9.0	12.8	2.12
Significance	*[b]	NS[b]	**[b]	**	**
		1953-54 Season			
		2/54		12/53	8/53
0	85	182	8.1	12.6	1.60
2	68	153	7.5	12.6	2.08
Significance	NS	NS	*	NS	**
		1954-55 Season			
		4/54		10/54	9/54
0	104	193	8.8	7.3	1.48
2	126	240	8.6	7.6	2.00
Significance	NS	NS	NS	NS	**

[a]Average of 5 fruits per tree.

[b]NS–not significant statistically; *–statistically significant at the 5% level; **–statistically significant at the 1% level or higher.

It can be seen that withholding nitrogen resulted in higher yields for the first two response years. The third year the yields were in favor of the two-pound application of nitrogen. It appears that the lower yields of the no-nitrogen trees for the third year is the result of a deficiency of nitrogen. This is related to the very low nitrogen values in the leaves, and the observation that the foliage on the no-nitrogen trees has been markedly more yellow since the beginning of 1953.

Visual observation indicates that the value of 1.79 percent N in the leaves for the first response year was low enough to reduce vegetative growth slightly but not low enough to critically reduce the chlorophyll content in the leaves. This could result in more utilization of photosynthate (carbohydrate) for flowering and fruiting, while with the high nitrogen value, more photosynthate would be used in vegetative growth. Observation indicates that as the nitrogen value in the leaves dropped below 1.79 percent during the second and third response years, chlorophyll was reduced in the leaves. This would result in the production of less photosynthate, so that both flowering and fruiting, and vegetative growth, might suffer.

The larger fruit has been produced on the no-nitrogen trees. However, the differences have been less each succeeding year. Oil content in the fruit was different only in the first year of response. It remains for future experimentation to determine whether or not fruit size and oil content in the fruit may be influenced by control of carbohydrate and nitrogen relationships in the tree.

Table 2. Summary of nitrogen studies, Orchard Number Two, for 1952-54[a].

Variety	Pounds N per tree per year 0	0.5	1	Significance
	Yield–Lbs. per tree[b]			
Hass	95	96	97	NS
Fuerte	56	76	44	NS
MacArthur	104	89	74	NS
	% N in leaves, 7/54			
Hass	2.07	2.08	2.27	**
Fuerte	2.04	2.08	2.16	**
MacArthur	1.60	1.76	2.00	**

[a]Each value in the table is the average of: 16 trees for Hass, 8 trees for Fuerte, and 8 trees for MacArthur.

[b]Average for 1952, 1953, and 1954 for the Hass and MacArthur varieties, and 1952 and 1954 for the Fuerte variety.

ORCHARD NUMBER TWO

Orchard number two is located in Ventura County on a medium textured, apparently well-drained, slightly alkaline soil. It is cultivated and furrow irrigated. The mixed planting of Hass, MacArthur, and Fuerte avocados were planted in 1947 on old citrus soil that had been rather heavily fertilized. The avocados were fertilized lightly during the first three years.

The experiment was initiated in 1950. In each plot in each replicate there are a minimum of four Hass, two Fuerte, and two MacArthur trees. The treatments consist of 0, 0.5, and 1 pound of nitrogen per tree per year from ammonium nitrate applied in the spring. The treatments are replicated four times.

From table 2 it maybe seen that there are no consistent yield trends for the Hass and Fuerte varieties, and that the nitrogen in the leaves was 2.0 percent or higher in July of 1954. However, the MacArthur variety shows a strong trend for reduced yields with increasing nitrogen levels. This trend for reduced yields is associated with a markedly higher content of nitrogen in the leaves. These data also indicate that the MacArthur variety is a less efficient user of nitrogen than the Hass or Fuerte varieties.

DISCUSSION

The individual tree yields for avocados are extremely variable. This makes fertilizer studies very difficult. Nevertheless, yield trends in relation to nitrogen fertilization that have developed in both orchards may be of some importance even though the differences are, for the most part, not statistically significant. Results from these experiments indicate that many more trees will be needed in future experiments to overcome the influence of the extreme yield variability on the experimental results.

It is significant that withholding nitrogen from certain trees in orchard number one from the spring of 1950 to the spring of 1955 did not result in a reduction in yield until 1955. In orchard number two, yields have not yet been reduced by withholding nitrogen from 1950 to the present. Yield responses have been closely associated with the nitrogen levels in the leaves.

Steer manure is included among the treatments in both experiments. In the non-tilled orchard, two pounds of nitrogen per tree per year in the form of manure has resulted in only slightly more nitrogen in the leaves than in leaves of trees getting no nitrogen. The manure has been applied under the trees where the irrigation water has been applied. However, in the second orchard where manure is worked into the soil, 0.5 pound of nitrogen applied as manure has resulted in nitrogen values in the leaves that are very near those from trees getting 0.5 pound nitrogen from ammonium nitrate, these values being definitely higher than those in the leaves from trees receiving no nitrogen.

In conclusion, it appears that greater production in avocados may result by maintaining nitrogen at about 1.8 percent in the leaves in August and September, than by having it above 2.0 percent at this time. This lower nitrogen level could result in more photosynthate going into flowering and fruiting. Evidence from these experiments also indicates that steer manure is not an efficient source of nitrogen when applied to non-tilled avocado orchards.

LITERATURE CITED

1. *Embleton, T. W., J. D. Kirkpatrick, and E. R. Parker. 1952. Field response by orange trees to phosphatic fertilizers. Citrus Leaves 32(9): 6-9.*