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# NITROGEN FERTILIZATION OF THE MacARTHUR AVOCADO

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It has been shown that applications of too little or too much nitrogen to Fuerte avocados result in a reduction in yield. Maximum production occurs when the percentage of nitrogen in spring cycle leaves sampled in August or September is between 1.6 and 2.0 (1). This desirable range of nitrogen level in Fuerte avocado leaves has been obtained on medium-sized trees growing in a light-textured soil with no weeds or cover crop, by applying about one pound of nitrogen per tree annually (1).

A fertilizer experiment established in 1950 by the Department of Horticulture in the Thille orchard indicated that the MacArthur variety was not as efficient in obtaining nitrogen from the soil as were the Fuerte and Hass varieties (Table 1).

Table 1.—Varietal differences in the levels of nitrogen in the leaves of trees in the Thille avocado nitrogen experiment.

| Variety | Mean Percent Nitrogen in Dry Leaves for 7 Sampling Dates in Various Months—1954-1958 | | | |
|---|---|---|---|---|
| | Pounds Nitrogen Per Tree Annually | | | |
| | 0 | ½ from $NH_4NO_3$ | 1 from $NH_4NO_3$ | ½ from Manure |
| Hass | 2.02 | 2.08 | 2.25 | 2.06 |
| Fuerte | 1.91 | 1.97 | 2.09 | 1.96 |
| MacArthur | 1.69 | 1.74 | 1.94 | 1.78 |

With the same rate of nitrogen applied to the soil the MacArthur variety had a markedly lower concentration of nitrogen in the leaves than did the Fuerte or Hass varieties.

In a mature orchard in which the MacArthur and Fuerte varieties were alternately planted and which had received no nitrogen fertilizer for two years it has been observed that the MacArthur variety appeared to be deficient in nitrogen while the Fuerte variety showed no signs of a lack of nitrogen. A leaf sample was obtained from each variety and showed that the Fuerte variety contained 2.02 percent nitrogen while the MacArthur

variety contained only 1.48 percent nitrogen in the dried leaves.

In the spring of 1956 two nitrogen fertilizer experiments on the MacArthur variety were initiated in Ventura County.

## THE SUDDEN EXPERIMENT

The Sudden experiment was established in an orchard that was planted in 1951 on Yolo gravelly fine sandy loam, a light-textured soil in which drainage is good. The orchard is kept free of weeds by cultivation and is furrow irrigated. Prior to establishing the experiment the only nitrogen applied to the avocado trees was one-quarter of a pound per tree in 1953 from an inorganic source. Results to date from this experiment are summarized in Table 2. The data in Table 2 show that two pounds of nitrogen per tree applied in 1957 and 1958 resulted in more fruit in 1958 and 1959 than did one pound of nitrogen and that three pounds of nitrogen applied in 1959 resulted in substantially more fruit in 1960 than did one and one-half pounds of nitrogen. In 1960 the rates of nitrogen applications were further increased.

Table 2.—Nitrogen applications, yields, and percentage nitrogen in the leaves for the Sudden MacArthur avocado nitrogen fertilizer experiment.

| | Rate Nitrogen Application from Ammonium Nitrate | | | |
|---|---|---|---|---|
| Date Applied | Low | Medium | High | Extra High |
| | Pounds Nitrogen Per Tree | | | |
| 2/56 | 0 | 0.5 | 1 | 2 |
| 3/57 | 0 | 0.5 | 1 | 2 |
| 3/58 | 0 | 0.5 | 1 | 2 |
| 2/59 | 0.38 | 0.75 | 1.5 | 3 |
| 1/60 | 0.62 | 1.25 | 2.5 | 5 |
| Date Harvested | | Pounds Fruit Per Tree | | |
| 6/57[1] | 30 | 20 | 16 | 13 |
| 6/58 | 58 | 86 | 148 | 180 |
| 5/59 | 54 | 152 | 210 | 278 |
| 5/60 | 4 | 17 | 62 | 179 |
| Date Sampled | | Nitrogen in Leaves—Percent Dry Weight | | |
| 8/56 | 1.61 | 1.68 | 1.90 | 1.94 |
| 9/57 | 1.46 | 1.60 | 1.71 | 1.76 |
| 9/58 | 1.18 | 1.31 | 1.57 | 1.70 |
| 9/59 | 1.29 | 1.39 | 1.51 | 1.59 |

[1] *In 1957 some fruit was lost by theft prior to harvest.*

Even though, in a given treatment, the rates of nitrogen application have been increased in this experiment the nitrogen content in the leaves has been decreasing. Except for the nitrogen content in the leaves sampled in 1956 none of the treatments have resulted in leaf nitrogen values that exceed the peak of the Fuerte avocado leaf nitrogen-yield curve (1), which is about 1.8% nitrogen in the leaves.

The trees receiving the extra high rate of nitrogen are without question larger with a more dense, darker green foliage than are the trees receiving lesser amounts of nitrogen. These differences in tree size have developed since the beginning of the

experiment.

In March, 1958, micronutrient analyses were made of the leaves. The results are summarized in Table 3. An increase in the rate of nitrogen application resulted in a substantial increase in the manganese and a slight increase in the iron concentration in the leaves and a reduction in the concentrations of zinc, copper, and boron. This is similar to results that have been reported for the Fuerte and Hass varieties (2, 3, 4). The levels of micronutrients are all within an adequate range except for zinc. However, the low zinc values are apparently not restricting production.

Table 3.—Nitrogen effects on micronutrient content in leaves from the Sudden MacArthur avocado nitrogen experiment, March, 1958.

| Element Determined | Rate Nitrogen Application from Ammonium Nitrate | | | |
|---|---|---|---|---|
| | Low | Medium | High | Extra High |
| | ppm in dry leaves | | | |
| Zinc | 18.5 | 14.2 | 13.3 | 12.9 |
| Copper | 9.4 | 9.7 | 6.9 | 6.2 |
| Manganese | 58.2 | 64.5 | 68.5 | 106.2 |
| Boron | 71.5 | 64.7 | 50.5 | 46.5 |
| Iron | 79.7 | 89.5 | 86.2 | 89.5 |

## THE WALKER EXPERIMENT

The Walker experiment was established in an orchard that was planted on the Oxnard plain in 1947 on a soil that is predominantly Yolo silt loam. This relatively heavy-textured soil contains lime and is not well drained. It has high moisture retention properties.

The orchard is furrow-irrigated and cultivated. However, cultivation is not frequent enough to keep weed growth down continuously. The avocado trees had not been fertilized prior to establishing the experiment. Because of crowding conditions and variable limb breakage the experiment was discontinued in 1959 after obtaining leaf samples in September.

Results from this experiment are summarized in Table 4. As in the Sudden experiment it was necessary to increase the rates of nitrogen applied to the various treatments as the experiment progressed. The highest yield was obtained with the highest nitrogen rate. However, the highest rates of nitrogen applications resulted in only a moderate level of nitrogen in the leaves. Varying the rates of nitrogen in this experiment had very little effect on tree size; foliage density and foliage color were affected less than in the Sudden experiment.

Table 4.—Nitrogen applications, yields, and percentage nitrogen in the leaves for the Walker MacArthur avocado nitrogen fertilizer experiment.

| Date Applied | Rate Nitrogen Application from Ammonium Nitrate: Low | Medium | High | Extra High |
|---|---|---|---|---|
| | Pounds Nitrogen Per Tree | | | |
| 2/56 | 0 | 0.5 | 1 | 2 |
| 3/57 | 0 | 0.75 | 1.5 | 3 |
| 3/58 | 0 | 0.75 | 1.5 | 3 |
| 2/59 | 0.5 | 1 | 2 | 4 |
| **Date Harvested** | **Pounds Fruit Per Tree** | | | |
| 10/57 | 4 | 3 | 4 | 4 |
| 9/58 | 56 | 44 | 102 | 174 |
| 8/59 | 277 | 348 | 279 | 400 |
| **Date Sampled** | **Nitrogen in Leaves—Percent Dry Weight** | | | |
| 8/56 | 1.75 | 1.75 | 1.82 | 1.81 |
| 9/57 | 1.54 | 1.58 | 1.67 | 1.75 |
| 9/58 | 1.36 | 1.42 | 1.46 | 1.56 |
| 9/59 | 1.68 | 1.77 | 1.85 | 1.86 |

## DISCUSSION

Evidence accumulated thus far strongly suggests that the MacArthur variety is not as efficient in obtaining nitrogen from the soil as are the Fuerte and Hass varieties. In the experiments thus far, the optimum rate of nitrogen for maximum production of the MacArthur variety apparently has not been reached. It is evident that the rate of nitrogen fertilization for maximum production of the MacArthur variety is substantially higher than that for the Fuerte.

Leaf analysis studies indicate that for maximum production the percentage nitrogen in spring leaves sampled in the August-September period from non-fruiting terminals should be at least 1.8%. Thus the Fuerte leaf nitrogen-yield curve published in the 1959 Yearbook (1) appears to fit the MacArthur variety for the range 1.2-1.8% nitrogen. However, to obtain 1.8% nitrogen in the leaves substantially more nitrogen must be applied to the MacArthur than to the Fuerte or Hass variety. Continuation of these studies should determine if it is possible to get the nitrogen in MacArthur leaves well above 2.0%. If such values can be achieved it will then be possible to determine if high levels of nitrogen in the leaves are associated with reduced yields, as is the case with the Fuerte variety.

## LITERATURE CITED


1. Embleton, T. W., W. W. Jones, and M. J. Garber. 1959. Leaf Analysis as a guide to nitrogen fertilization of avocado. Calif. Avocado Soc. Yearbook 43:94-95.
2. Labanauskas, C. K., T. W. Embleton, M. J. Garber, and S. J. Richards. 1958. Effects of irrigation treatments and rates of nitrogen fertilization on young Hass avocado trees. V. Micronutrient content of leaves. Proc. Amer. Soc. Hort. Sci. 71:315-319.
3. Labanauskas, C. K., T. W. Embleton, and W. W. Jones. 1958. Influence of soil

applications of nitrogen, phosphate, potash, dolomite, and manure on micro-nutrient content of avocado leaves. Proc. Amer. Soc. Hort. Sci. 71:285-291.
4. Labanauskas, C. K., T. W. Embleton, S. J. Richards, and F. M. Handy. 1960. Effects of nitrogen and irrigation treatments on the micronutrient concentration in Hass avocado leaves. Calif. Avocado Soc. Yearbook 44:97.