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IRRIGATION OF AVOCADOS

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Plots for studying the irrigation of avocado trees were started at Riverside in 1952 with financial assistance from research funds of the California Avocado Society. The plot records are continuing to show that irrigation management has a very marked influence on the vigor and growth of avocado trees. Progress reports in the 1955 and 1958 Yearbooks have given information on the treatments and early tree growth records. Varying nitrogen fertilizer applications were also applied as split plot treatments. The effects of the fertilizer as measured by soil and leaf analyses are being reported by Doctors Bingham, Embleton, Jones, and Labanauskas in separate publications.

This irrigation study on avocados is one of the early experiments dealing with horticultural crops where soil moisture measuring instruments were used. The treatments were based on measuring an index to soil water availability called soil suction. Tensiometers measure soil suction directly without requiring interpretation for each soil. Instruments were installed to read soil suction at the 1-foot depth and approximately 4 feet out from the trunks of selected trees in each plot. For the different treatments, irrigations were applied when soil suction reached approximately 1/2 bar (a reading of 50 on most tensiometers), 1 bar (two days after tensiometers indicated 80), and 10 bars. The 10-bar readings were made with resistance blocks which had been calibrated to indicate soil suction. In this experiment no use has been made of the soil properties called field capacity and wilting point. It is of interest to note that the driest treatment based on a soil suction reading of 10 bars is not as dry as the wilting point which is commonly estimated at 15 bars.

During the past year daily measurements of tree trunk diameters were continued for six trees in each of the ½ - and 10-bar treatments. A graph showing such measurements was given in the 1958 California Avocado Society Yearbook. Again this year it was shown that the rate of trunk growth decreased as the soil suction increased beyond the range indicated by tensiometers and stopped completely well before the 10-bar value was reached. The total annual increase in trunk diameter for the 10-bar treatment was 0.21 inches compared with 0.72 inches for trees irrigated at the 1/2-bar level. Trunk growth measurements alone, however, would not be a satisfactory index on which to base irrigation practices. Rate of growth measurements were influenced by climatic factors as well. During hot and dry periods in the summer, and particularly windy periods, growth rates decreased on all plots independent of irrigation treatments. During the winter months no increase in trunk diameter was observed while the soil temperature at the 12-inch depth was below 60° F.

Table 1. Average number of irrigations and fruit yield on the irrigation plots for the 1958 and 1959 crop year with the average trunk diameter at the end of the 1959 irrigation season.

	1958		1959		Trunk Diameter
Irrigation Treatment	Ave. No. of Irrigations	Fruit Yield lbs./tree	Ave. No. of Irrigations	Fruit Yield* lbs./tree	Nov., 1959 Inches
Maximum Suction					
½ bar	31	79	46	83	7.6
1 bar	24	64	26	75	6.8
10 bars	11	48	11	8	5.2

Corrected for fruit lost by wind damage.

Table 1 gives the number of irrigations required to achieve the control of soil moisture based on instrument readings. The crop production is also indicated. Average tree trunk diameters resulting from differential treatments for six irrigation seasons are given in the last column of table 1. The number of irrigations per season is greater than would be required for average grove conditions. Because of limited space, irrigation treatments of this experiment were planned without guard rows between them and for this reason sprinkler irrigation was restricted to a single Star-type sprinkler under each tree. If irrigation water had been applied uniformly over all of the soil area between rows, more water would have been available for each tree, and water would have been extracted less rapidly from the zone near the tensiometers.

The yield data are of primary interest to growers, but some allowance must be made for conditions of the experiment. The production of avocados, even for the better treatments, as indicated in table 1, is rather low in comparison with the production of 6 and 7 year old Hass trees grown in more favorable climatic regions. The side hill planting at Riverside was selected to avoid winter frost injury, but the exposure to fall and winter winds has resulted in severe defoliation on several occasions. Fruit is also lost during windstorms as well. Periods of extremely high air temperatures have also resulted in shoot die back and leaf scorch. These latter injuries were rated even more severe for the ½ -bar treatment since the trees were usually in a more succulent state of growth.

The relative effect of irrigation treatment on fruit yield is much greater in 1959 than in 1958. The difference is explainable in terms of rainfall variations. While 1958 was not a high rainfall year in terms of the total amount, there were several inches of rain during the spring months when the fruit was setting. This resulted in no differential irrigation among the various treatments. In contrast, the 1959 rainfall was almost noneffective and soil water availability resulting from the irrigation treatments caused greater differences in crop production, particularly on the 10-bar treatment.

The last column in table 1 appears to be a good index of the cumulative effects of differential irrigation treatments on tree growth. Differences in overall tree growth, leaf size, and tree vigor correspond with the trunk size measurements shown. In fact, several secondary factors such as sunburning of the limbs and branches and apparent minor element deficiency symptoms are much more evident on trees irrigated at the 10-

bar level.

Trees receiving differing amounts of calcium nitrate fertilizer are showing some trends with respect to the irrigation treatments. For the 1/2 - and 1-bar irrigation treatments there is no measurable size difference between trees receiving 3/4 and 3 pounds of N per year. The trees receiving the lower nitrogen show yellowing leaf symptoms during the spring months. However, for the 10-bar irrigation treatment, those trees receiving 3 pounds of N have observably greater tip burn, defoliation, and sunburn relative to the trees receiving low nitrogen applications. Because of the large variability in production among trees under the same treatment, it is not possible to measure the effects of all of the treatments on yield with the limited number of trees in this experiment. A larger experiment using the Bacon variety is in progress at the University's South Coast Field Station.

Since starting this experimental work on irrigation in 1952, many cooperative trials by growers and agricultural extension workers have shown that tensiometers can be useful in guiding irrigation practices on avocado groves.