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AVOCADO IRRIGATION MANAGEMENT

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Early work on avocado irrigation at Riverside was reported in the California Avocado Society Yearbook (2, 3). The limits in frequency of irrigation management were studied, and it was found that drying the soil out to 10 Bars of suction caused the tree to drop out of production. The wet treatment, 0.5 Bars (50 cb) of suction or less, was irrigated too frequently from an economic standpoint. Reference to rootstock propagation, nitrogen fertilization, and top pruning appears in this Yearbook (4).

Some years ago a program was proposed by Richards and Marsh (1) for managing irrigation based on tensiometer readings at two (or more) soil depths. Briefly stated, it is considered time to irrigate when tensiometer readings reach a prescribed value for a soil depth where feeder root concentration is greatest. The duration of the irrigation or amount of irrigation water applied is judged by instruments reading soil suction at a deeper location. If readings at this second depth are low, an irrigation of short duration is indicated; conversely, if they are high, irrigation should be applied such that tensiometer readings following the irrigation respond downward.

The availability of resources at the South Coast Field Station to study irrigation management for avocado trees in a coastal climate appeared to provide an excellent opportunity to explore further the use of soil water sensors, to relate irrigation management not only to growth and production but to water economy as well.

The South Coast Field Station is located about 10 miles inland from the Pacific Ocean near the city of Tustin, California, The air temperature and humidity are strongly influenced by on-shore air movements. For occasional brief periods, from August to September, when air movement is toward the shore, peak midday air temperature can exceed 100° F.

The land used is an alluvial sandy loam soil. Prior to the present use it was farmed exclusively to dry farm crops. In preparation for this experiment, the land was leveled to a one percent grade. The soil in general is weakly constructed and tends toward a moderately low infiltration rate.

Since the Bacon avocado trees were planted, in 1958, there has been no visual frost injury; but, during September to January, wind storms in some years have caused moderate to severe defoliation, with heavy fruit drop at times.

Bacon avocado trees on Ganter rootstock were set out in 20 foot rows with 12.5 foot spacings between trees in rows to provide double spacing for rootstock propagation evaluation. In the winter of 1967, before bloom, alternate trees were removed to allow

12 trees per irrigation plot. Each irrigation treatment was replicated with 6 plots, 3 plots on seedling rootstock and 3 plots on rooted cutting rootstock. A row of guard trees, all on seedling rootstock surrounds each quarter of the field.

The entire grove of approximately 8 acres was irrigated as a unit with a furrow system from planting in July 1958 through 1964. In Nov. 1964, an underground pipe system was installed for sprinkler irrigation to 3 quarters of the field with the remaining quarter continued under furrow irrigation.

The field plots had no provision for runoff, therefore irrigations had to he carried out to keep all the water applied on each individual plot. The sprinkler system provided a low application rate rotating sprinkler in the space of four trees on the 12.5 foot spacing. The average water application rate was estimated at 0.14 inch per hour over the entire plot area. The irrigation of each plot was controlled by a single valve, and any one plot could be irrigated within two or three days of the time when the soil water indicators reached the planned values. Water meters were provided to measure the water applied to each plot. Differential irrigations were not applied until after the alternate trees were removed.

TABLE 1. IRRIGATION TREATMENTS BASED ON TENSIOMETER READINGS EXPRESSED AS CENTIBARS

		Treatment 1	*Treatment 2*
Time to Irrigate (based on 12 inch depth)		60 cb	80 cb + 2 days
	Soil Suction		
Amount of Irrigation (based on 24 inch depth)	30 cb	1.5″	2.0″
	30 cb	2.0″	2.5″
	60 cb	3.0″	3.5″
Surface inches of water			

Table 1 gives a summary of the differential irrigation treatments initiated in 1967. Two locations with tensiometers to indicate water conditions at 12- and 24-inch depth were installed on each plot near the drip line of the tree.

The Treatment 1 plots were irrigated when the tensiometers at 12-inch depths averaged 60 cb. Irrigations for the Treatment 2 plots were delayed for 2 or more days after the 12-inch instruments indicated 80 cb. Extrapolation of the tensiometer records gave estimated values between 150 and 200 cb when these plots were irrigated.

When it was time to irrigate, the quantities of water applied are given in Table 1, based on the readings of the deeper or 24-inch tensiometers. The quantities given are volumetric meter readings converted to average depth units for the entire plot area. The values specified were obtained from experience gained from managing the plots prior to differential treatments. The furrow plots were irrigated as an entire block when the average tensiometer reading was 80 cb. Because of soil differences in the block, there was a wide variation in tree growth in the early years.

A Treatment 3 was initially planned to be the equivalent of Treatment 1 until soil salinity buildup occurred, then additional amounts of water were to have been applied for leaching. Although salinity levels were rather high in the first years of this study, winter rains in later years were sufficient to leach out excess salt. Soil sampling at both the 0-

12", and 12-24" depth in spring and fall showed EC values of soil water extracts were less than 2 milimhos/cm for all treatments including the furrow plots, hence Treatment 3 remained the same as Treatment 1 the entire time.

Response to Treatments

Trunk circumference measurements were made each year. No significant difference in trunk size due to the irrigation treatments was found.

TABLE 2. AVOCADO YIELD IN LBS. PER TREE

Sprinkler Treatment	*1967*	*1968*	*1969*	*1970*
1	101	183	142	206
2	103	190	153	210
Furrow	115	188	141	250

Annual avocado fruit yield averages are shown in Table 2. There was no significant difference between sprinkler irrigation treatments.

Irrigation Water Requirements

An equally important economic factor is related to the amounts of irrigation water required to carry out a prescribed irrigation management. Table 3 gives the amounts of water used for the two sprinkler treatments. Values for Treatment 1 are an average of 12 plots and 6 plots for Treatment 2. There was no method to measure the amount applied to the furrow plots, and the number of irrigations correspond to the number 2 sprinkler treatment.

TABLE 3. AVERAGE ANNUAL NUMBER OF IRRIGATIONS AND ANNUAL AMOUNT OF SURFACE INCHES OF WATER APPLIED

Sprinkler	*1967*		*1968*		*1969*		*1970*	
Treatment	*No.*	*Amt.*	*No.*	*Amt.*	*No.*	*Amt.*	*No.*	*Amt.*
1	8	25.7	13	30.9	14	28.8	16	35.0
2	7	23.6	11	31.2	10	28.6	13	35.5
Annual Rainfall		13.3		6.3		13.2		10.5

The amount of water applied is the same for each of the 2 treatments as nearly as one would expect following the prescribed treatments in Table 1. The drier treatment required fewer irrigations, therefore more water was required at each irrigation to replenish the water used. Total annual rainfall (corrected for runoff) given in Table 3 explains some of the yearly variation in irrigation. Also, the gradual increase in total water use over the four years is probably due to increase in tree growth.

Conclusions

A sprinkler irrigation program for Bacon avocado trees was carried out based on tensiometer soil water sensors. Two treatments based on irrigating at 60 and by extrapolations to 150 cb. resulted in no measured differential response to tree growth or fruit yield.

Irrigation water management based on soil water sensors essentially is designed to apply water to maintain soil water conditions between prescribed bounds. Irrigation water is applied to replace the water depleted from the soil by root action which in turn is influenced by climate and plant vigor variables.

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