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8. WATER REQUIREMENTS

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Introduction

Most of the avocado trees in Israel, and especially those in the Western Galilee, are planted together with or into banana orchards. For the first few years avocado trees are irrigated according to the requirements of the banana plants. After the bananas have been taken out, irrigation schedules are changed to those optimal for avocados.

The yearly quantity of water commonly given in the Western Galilee is between 800 and 1000 m^3 per dunam, with weekly to fortnightly irrigations given according to soil conditions, local climate and tree age.

Not much research has been done on water requirements of avocado anywhere in the world, and that mostly on intervals of irrigation, with the aid of tensiometers. In Israel, observations have been carried out in commercial orchards. We report here on the first comprehensive irrigation trial, the aims of which are to find the best irrigation schedule for the combination of highest yield with best export quality; search for soil or plant physiological indicators usable by the growers to ascertain the condition of the plant, and plan irrigation accordingly; and find out what tensiometers can give to the grower in this respect.

Data and methods

In 1963, an avocado orchard was planted together with bananas, at the 'Akko Experiment Station, for the purpose of this irrigation trial. In July 1966, the bananas were taken out, and soon afterwards surface drainage was constructed. In 1967, preparations for the trial were made and uniform irrigation was given every fortnight at a rate of 40-45 m^3/du.

The trial was started in 1968. Sprinklers are placed 6 X 6 m apart, among four avocado trees. The quality of the water is very good and constant throughout the season. There are four treatments with five replications in randomized blocks. Each plot contains nine trees (three Ettinger, three Fuerte and three Hass) and double guard rows.

Treatments: The four treatments consist of 7, 14, 21 and 28 days between irrigations. The first irrigations in spring are given at shorter intervals so as not to endanger fruit set.

In the first two treatments (7- and 14-day intervals) enough water is given at each

irrigation to wet the soil to a depth of 30 cm, and additional quantities are given to wet the soil down to 90 cm whenever this is found necessary. For the third and fourth treatments (21- and 28-day intervals) water duty is fixed according to the requirement of the 0-60 cm soil layer, and additional quantities are given whenever needed to keep the soil moist down to 120 cm.

Soil and water tests

Moisture content of soil: Moisture tests were carried out with a neutron probe before and after each irrigation. For each treatment measurements were made in one plot with 36 access pipes, one for each 1 m^2 among four trees, which were arranged in six rows in a north-south direction. In the other four replications, four access pipes each were placed according to measurement of the distribution of water by the sprinklers. The neutron probe was calibrated to a depth of 0-30 cm. For deeper soil layers calibration was made through additional pipes with the help of parallel gravimetric measurements.

Salinity was measured in each plot in spring and autumn for the soil profile down to 150 cm.

The *quality of irrigation water* was measured at the beginning, middle and end of the irrigation season.

Evaporation was measured daily from a U.S.W.B. Class A evaporation pan placed near the orchard.

Tensiometers (Table B. 8.1): Six tensiometers were placed near each leading plot; the model used mercury and was designed and built by Nirim settlement. The aim of using tensiometers was to study if they can be used as indicators for the need to begin irrigation. Depth of tensiometer placement was established so that moisture changes are sufficient to obtain correct measurements but not so large that air would penetrate the tensiometer.

TABLE B. 8.1

DISTRIBUTION OF TENSIOMETERS ACCORDING TO TREATMENTS AND DEPTH OF SOIL

Depth (in cm)	*Days between irrigations*			
	7	14	21	28
30	3	3		
45	3	3	3	3
75			3	3

Measurements of the trees and fruits

Tree size was estimated in spring and autumn according to six grades. Additional growth of the trees was measured from aerial photos (1:500).

Trunk girth was measured at 20 cm above the bud union in spring and autumn, and

additional growth during the irrigation season was calculated.

Growth curves of the trunks were established by semi-weekly measurements with a dendrometer. Growth of the fruits was also measured.

Leaf burn was estimated in spring and autumn.

Yield: Fruits were counted on each tree, and the weight of the yield of each tree was recorded; the fruit was graded in the packing house, in the usual way, into three grades:

Export quality — sized 10 fruits (430 g) to 24 fruits (175 g) per box, without serious blemishes.

Local market quality — fruit larger or smaller than that suitable for export, with somewhat more blemishes, but sound and fit for use.

Culls — all other fruits.

The reasons for disqualifying fruit for export were recorded for each lot.

Fruit quality: Oil analyses of fruit of the Fuerte variety were made from representative samples from each of the 20 plots. Storage trials will be started in Winter 1969/70.

Precocity of flowering was estimated on 15.11.1969 from the length of inflorescences on the southern side of the tree.

Leaf analyses were carried out on leaves from Fuerte and Hass trees from each treatment.

Results

The trial is only in its second year and no differences in yield can be expected. Due to the alternate bearing of avocado trees, at least four seasons will be needed for evaluation of differences in yield. Some results from moisture and tree records are given.

Soil moisture **(Fig. B. 8.1):** Soil moisture fluctuations were found in all treatments to a depth of 60 cm. The fact that there were no changes in soil moisture in the deeper layers points to the shallow rooting of avocado trees. Soils became drier before irrigation, the longer the interval between two irrigations.

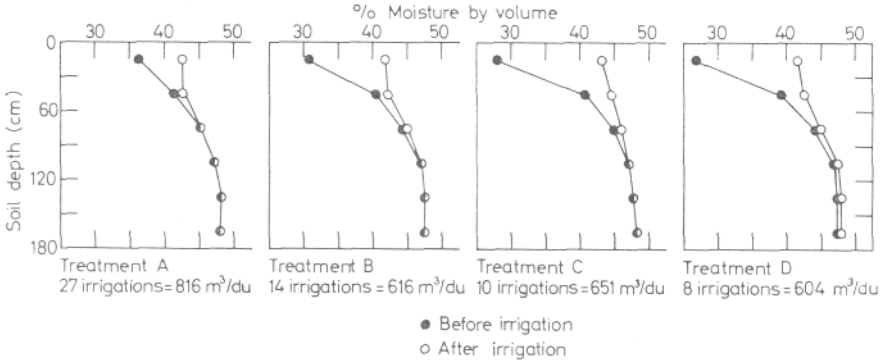

Fig. B.8.1. Moisture changes in soil (seasonal average) before and after irrigation.

Tree size: The trees were very uniform in size. Calculations from aerial photos gave a maximal difference of 8% between Fuerte trees, of 15% between Ettinger trees, and of 18% between Hass trees. Up to now, no connection has been found between treatments and differences in tree size.

Trunk girth **(Table B. 8.2):** A correlation between growth and availability of water in summer seems to be establishing itself.

Fruit quality **(Table B. 8.3):** There seems to be no effect of treatments on oil content of hard ripe Fuerte fruits of uniform size.

Precocity of flowering **(Table B. 8.4):** There seems to be a tendency to larger inflorescences (which means earlier flowering) with irrigation at short intervals.

TABLE B. 8.2

GROWTH OF TRUNK (in %) ACCORDING TO IRRIGATION TREATMENT

Year	*Variety*	*Days between irrigations*			
		7	14	21	28
1968	Ettinger	37.1	28.3	31.5	26.6
(1st year)	Fuerte	30.7	26.4	23.8	23.9
	Hass	25.4	24.2	25.1	21.2
1969	Ettinger	12.3	14.0	12.8	11.1
(2nd year)	Fuerte	8.4	8.2	7.2	6.8
	Hass	8.0	9.7	7.7	7.2

TABLE B. 8.3

PERCENTAGE OF OIL IN FUERTE FRUITS ACCORDING TO IRRIGATION TREATMENT

Date	*Days between irrigations*				*Weight of fruit* (g)
	7	14	21	28	
Nov. 18, 1967	16.9	16.9	13.0	14.1	457
Nov. 11, 1968	14.6	16.9	15.3	15.2	448

TABLE B. 8.4

LENGTH OF INFLORESCENCES (cm) ON FEB. 15, 1969, ACCORDING TO IRRIGATION TREATMENT

Variety	*Days between irrigations*			
	7	14	21	28
Ettinger	3.5	2.4	2.5	3.0
Fuerte	10.3	10.7	7.7	9.1
Hass	0.1	0.1	0	0

Central District — A. Ben-Ya'aov

In cooperation with the Extension Service of the Ministry of Agriculture, an irrigation trial has been carried out since 1969 with four different intervals between irrigations in five replications. The trial orchard is on heavy soil, with Fuerte and Hass only, four trees in each plot.