mg/100 ml) followed by a quick dip in 2000 ppm IBA. All cuttings were stuck in sand-peat medium under intermittent mist with bottom heat, as in 1969. Twenty cuttings divided into two replications of ten were used for each treatment.

Cuttings were taken about the first of February, April, June, August and October, and rooting results were taken periodically beginning about two months after sticking and continuing until no additional rooting occurred, a period of one to two months.

Effect of season

Time of taking cuttings had marked effect on rooting response but the peak rooting was with cuttings taken in June rather than in August as in 1969 (see table). There was no exact counterpart of the January 1969 lot, but cuttings taken in February did not root well.

The cause of the shift of peak rooting from cuttings taken August (1969) to those taken in June (1970) cannot be determined. The spring and summer weather patterns were quite different these two years. Undoubtedly the range of conditions under which this clone of olive will root is limited.

Effect of auxin concentration

Again in 1970, 2000 ppm IBA resulted in better rooting of semi-hardwood cuttings than did 1000 ppm (see table). However for softwood cuttings the 2000 ppm treatment was slightly superior to the 1000 ppm which was in contrast to 1969 results. Overall auxin concentration of 2000 ppm gave better rooting than 1000 ppm. The addition of indole was of no benefit and may actually have been detrimental.

Effect of wounding

In contrast to 1969 results, wounding was of no benefit with terminal cuttings. When all data are pooled, the differences between wounding and no wounding were small (see table).

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DRIP IRRIGATI EXPERIMENTS AVOCADOS *in San Diego*

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A NEW APPROACH TO IRRIGATION, called drip irrigation, was developed in Israel in recent years. Under the leadership of Professor Dan Goldberg, Head, Department of Irrigation, Hebrew University, this system has now been tested for 10 years and developed to its present stage. About 10,000 acres of commercially grown vegetables, field crops, and fruit trees are being irrigated by drip irrigation in that country today.

Because of the good results with drip irrigation in Israel, an irrigation project was initiated on avocados in San Diego County. The system was designed by an Israeli engineer, Dr. Baruch Gornat, who was visiting and studying in California. It was built in Israel to Dr. Gornat's design and was imported into this country and installed in June, 1970, on an avocado orchard located near Bonsall in northern San Diego County.

The purpose of the test is to compare drip irrigation with the sprinkler method now commonly used in avocado orchards. Evaluation of the two methods will include: (1) A comparison of the growth and productivity; (2) A study to determine if satisfactory soil salinity for avocado growth can be maintained under drip irrigation; (3) A comparison of total annual costs for drip and sprinkler irrigation; (4) A study to determine if avocado trees are more, or less, susceptible to avocado root rot (Phytophthora cinnamoni) under drip irrigation; (5) A study to determinine if the drip irrigation equipment will perform properly and will satisfactorily wet the soils in which these avocados are growing.

The soil is a complex of Vista sandy loam soil and Fallbrook fine sandy loam with scattered rock outcroppings. The orchard is equipped with a permanent P.V.C. irrigation system for sprinkling with a riser to each tree. The trees were planted on June 1, 1970, and consisted of two varieties, Hass and Reed.

Test plot

The five-acre test plot was divided into eight blocks, four under drip irrigation and four under sprinklers. The two varieties, Hass and Reed, were evenly divided in each block. The 673 trees were planted 15 x 20 ft in blocks. Three hundred and forty nine trees were drip irrigated and 324 were sprinkled. Two tensiometer stations, each having instruments at 12 and 24-inch depths, were placed within each block. Initially the 12-inch instruments were inserted into the balls of the newly planted trees.

The drip irrigation system includes a fertilizer tank, filter, water meter, irrigation controller, pressure regulator, pressure gauges, flexible hose for submains and laterals, and the emitters. The system operates at 15 pounds per square inch and each emitter discharges approximately one gallon per hour. Three emitters are placed at each tree—one near the trunk and the other two on

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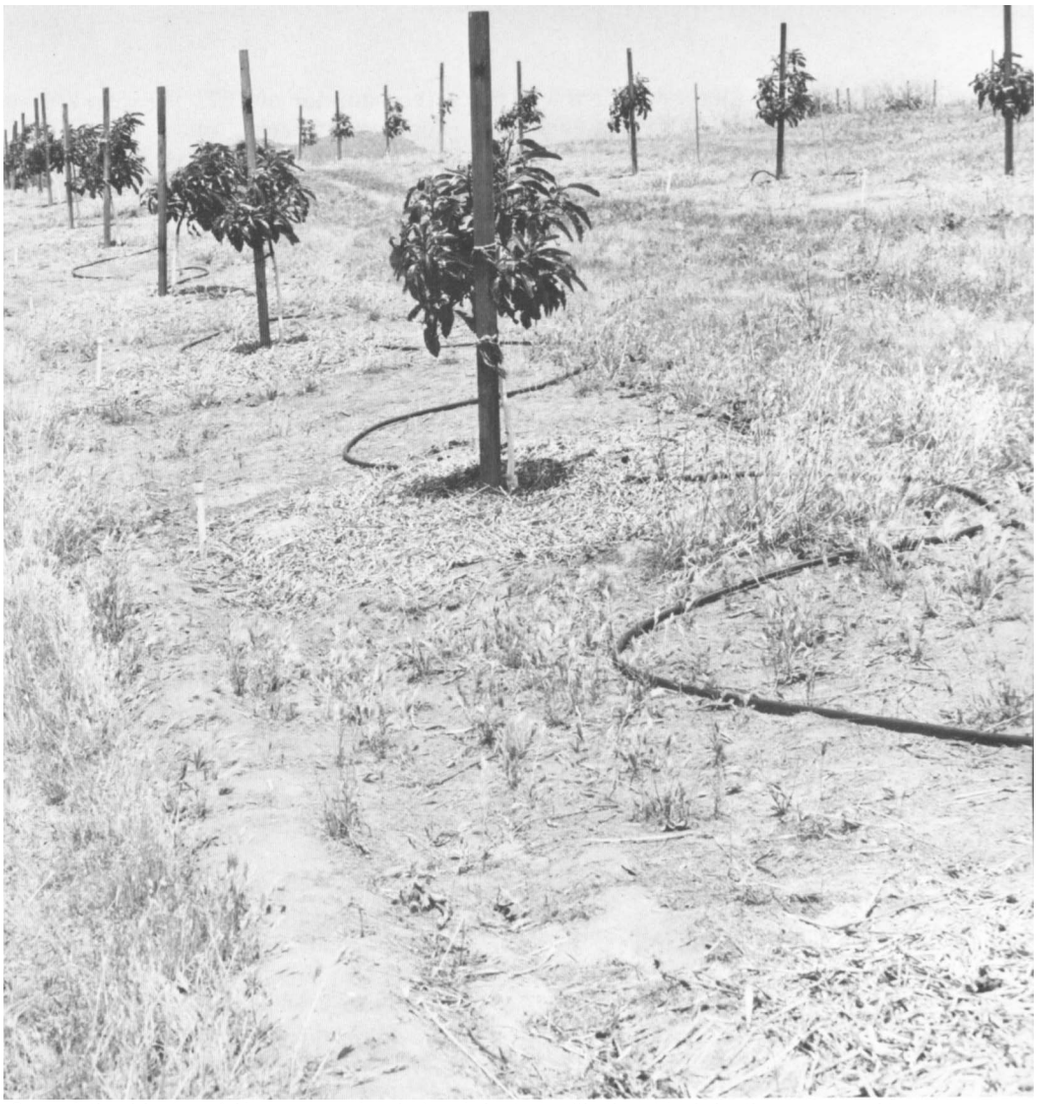
either side, 2 ft. away from the trunk.

Sprinkler irrigation, except in winter, has been scheduled once each week, a pattern typical for avocados in this area. The amount of water applied has varied seasonally based on weather, tensiometer readings, and judgment. Fixed jet sprinklers, one per tree each with a discharge rate of 0.8 gallon per minute were operated 30 to 75 minutes per week depending on the season. This has provided 24



One of the blocks of Hass avocados being irrigated with the drip irrigation system. Also visible in photo is the installed, but as yet unused sprinkler irrigation system available if the drip irrigation system should fail.

Tensionmeter location is shown with respect to the tree and the drip irrigation line.

TABLE 1. AVERAGE DIMENSIONS OF AVOCADOS AT ONE YEAR AGE

	Drip	Sprinkled
HASS†		
Height	50.8	47.0**
Width	23.9	22.5*
Trunk circumference above bud	3.1	3.0NS
REED†		
Height	39.6	40.6NS
Width	20.8	21.4NS
Trunk circumference above bud	2.6	2.7NS

*Significant at 5% level
**Significant at 1% level
†All measurements in inches

TABLE 2. AVERAGE SOIL SALINITY IN ROOTZONE, NOVEMBER, 1970

Depth	Sprinkler Irrigation		Drip Irrigation	
	ECe x 10^3	Chloride	ECe x 10^3	Chloride
inches	mmhos/cm	me/l.	mmhos/cm	me/l.
0 - 6	1.6	4.5	3.0	6.1
6 - 12	1.4	3.6	1.6	3.1
12 - 24	1.4	3.6	1.3	2.6

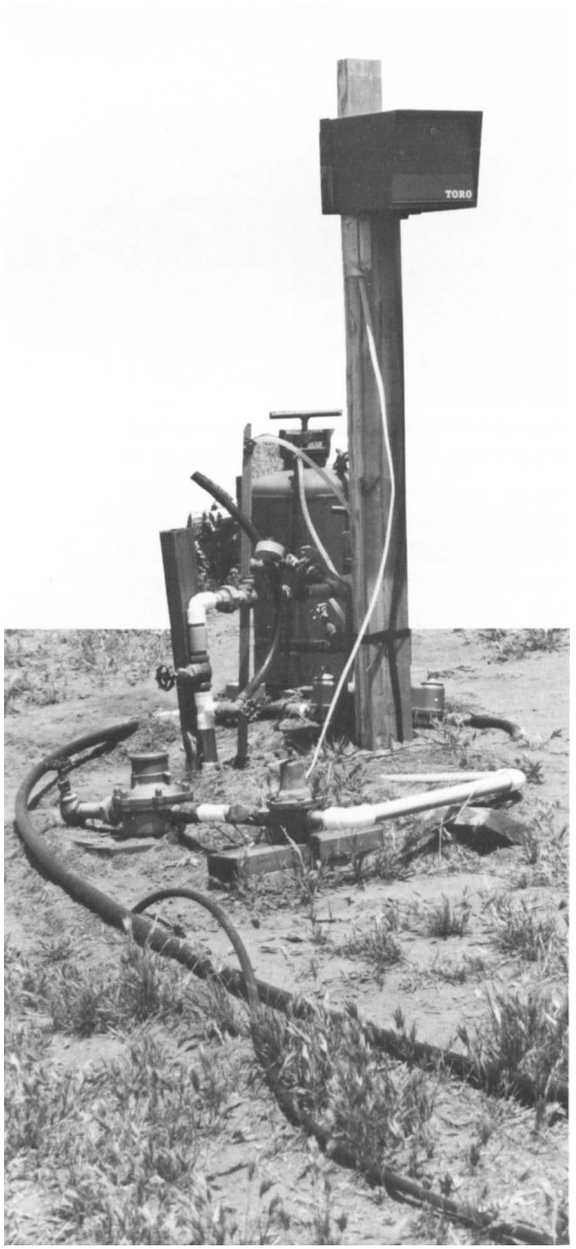
TABLE 3. AVERAGE SOIL SALINITY IN ROOTZONE, MARCH, 1971

Depth	Sprinkler Irrigation		Drip Irrigation	
	EC x 10^3	Chloride	ECe x 10^3	Chloride
inches	mmhos/cm	me/l.	mmhos/cm	me/l.
0 - 6	1.7	2.4	1.4	2.2
6 - 12	1.0	1.5	1.1	1.7
12 - 24	1.0	1.6	1.0	2.1

to 60 gallons per week or 3.5 to 8.5 gallons per day (GPD) to each tree.

Drip irrigation started on a weekly basis, 4 hours each week. In October 1970, an automatic controller was provided by Toro Manufacturing Company of Riverside that permitted the more frequent irrigation necessary for the drip method. Except during the winter rains, the drip system was operated on alternate days for 60 minutes until April, 1971. During the summer of 1971 the drip system operated each night for periods ranging from 42 to 60 minutes, guided by tensiometer readings. Amounts applied during the summer ranged from about 1.5 GPD per tree in 1970; to 3 GPD in 1971.

Water head showing fertilizer injector tank, various control valves, pressure regulating valve, water meter, and time clock control device for control of the drip irrigation system.



Fertilization was done each week with the drippers. Urea fertilizer was placed in the fertilizer tank and applied through the irrigation water. The trees under sprinklers receive urea twice a month by hand application. The total amount of fertilizer applied was the same for all trees.

Tree performance has been observed and measured during the experiment. Tree measurements after one year are shown in table 1. Hass trees responded favorably to drip irrigation for height and width. Reed trees show no significant difference between the treatments for any measurement; Hass trees show none for trunk girth.

Soil salinity

Soil salinity was first determined when the orchard was established in June, 1970. Samples were taken down to 2 ft.—maximum soil depth in general—at two sites in each of the eight blocks. In no case did the soluble salts, as measured by electrical conductivity of the saturation extract and chloride, exceed established safe levels for avocados on Mexican rootstock—i.e. 2 mmhos and 5 me./1. respectively. Thus, the potential salinity hazard in the experimental orchard was related to the possible accumulation of salts from the irrigation water (which has marginal levels of total soluble salts and chloride for avocados). The irrigation water quality factors were: EC x 10^3, 1.2 millimhos; SAR, 2.6; Cl, 2.9 me./1.; and B, 0.2 ppm.

Soil salinity was determined again in November, 1970, after the first irrigation season and before the winter rains. Six sites were established for monitoring salinity in the root zone periodically. Three sites were in sprinkler irrigated blocks and three were in drip irrigated blocks. Samples were taken at the trees' drip line; four cores from around each tree were composited for each depth. Results of the analyses of the November samples for total soluble salts and chloride are given in table 2.

Salinity values for all depths under the sprinkler-irrigated trees were still within the safe limits previously described. Under drip irrigated trees, some accumulation of soluble salts beyond the recommended limits occurred but only in the 0 to 6 inch depth, for which the values were 3 mmhos (total soluble salts and 8 me. Cl/1.

In March, 1971, after the winter rains, soil salinity was determined again, and the results are given in table 3. Winter rains were effective in leaching any accumulated salt from the soil.

Results of the monitoring program during the first year indicate that control of soil salinity in the root zone was adequate for both sprinkler and drip irrigated trees. The evaluation of salinity control in successive years will also include leaf analysis for chloride.

Mechanical performance of the irrigation system has been checked frequently. Filters are flushed weekly and reveal the absolute need for good filtration. Emitters have maintained a steady design flow rate with no plugging. Initially their rate varied as a function of elevation differences. Installation of pressure regulators corrected this. Line drainage after each irrigation was a source of variation in this hilly terrain yet to be corrected. Soil wetting at a 2 to 4-ft. radius from the emitters was observed by excavation, with weed growth correspondingly limited.

A follow-up article on the second year's results will appear in a future issue.

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The Trendel Brothers permitted the project to be conducted on their property; Bruce Brown purchased the Israeli drip system and donated it to the project; Bill Johnson managed the orchard; Sheldon Pooley, Irrometer Company, donated 32 tensiometers; and the Toro Manufacturing Company, Riverside, donated the automation unit.