three intervals of application. Stands were first established and then the irrigation intervals were imposed, based on the rate of evaporation from a class A US Weather Bureau pan. The wettest interval involved an irrigation for each 1½ inches of water evaporation; the intermediate treatment, for each 2 inches; and the dry treatment, for each 3 inches of evaporation. Results of this experiment showed that the sprinkler irrigation removed soil-surface salt, producing a higher rate of emergence of cabbage, carrots and onion seedlings. The driest treatment significantly reduced onion bolting on early plantings. The intermediate treatment on carrots produced a significantly higher yield of carrots than the dry treatment, and used less water than the wet treatment. Both carrots and onions were shown to have growth rates dependent upon plant population density.

These results indicate that in changing from furrow to sprinkler irrigation, either rates of seeding should be reduced, or a longer time allowed for the crops to mature. Water use under furrow irrigation was 2½ times greater than that required by sprinkler irrigation. Additional experiments are under way to adjust herbicide and insecticide applications in changing from furrows to sprinklers.

A series of experiments with precision planting of lettuce resulted in the achievement of 84% of a perfect stand of lettuce from a 12-inch spacing of raw lettuce seed placed with the UC-Giannini precision planter. During September and October of 1966, growers germinated more than 1,000 acres of lettuce by sprinkler irrigation for the first time in the Imperial Valley. Rainfall caused a soil crust to develop on one field, but where sprinkler irrigation had been used, an acceptable stand was obtained. Where furrows had been used no stand was obtained and replanting was necessary. Results from sprinkling on lettuce were generally favorable and it is anticipated that considerably more acreage will be put under this method of irrigation in coming years.

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Effects of

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To obtain maximum yields of barley in the San Joaquin Valley, a normal (12" to 14") pre-irrigation and at least one supplemental crop irrigation are required, according to these studies. When a heavy pre-irrigation is applied, the soil may be wetted below the potential rooting depth of the barley, in which case the moisture would not be available to the plants.

BARLEY IS PLANTED on more irrigated acres in the San Joaquin Valley than any other single crop. Yields fluctuate greatly from season to season, and from area to area—from a low of 1800 lbs per acre to 5800 lbs per acre. This great fluctuation in barley yields can be attributed mostly to moisture availability during critical times of the growing season—although soil-fertility levels, planting dates, and the disease situation can also play key limiting roles.

Pre-irrigation with 12 to 14 inches of water and one additional irrigation in late February or early March (when the barley is in the early boot stage) produced the most economical returns in earlier, non-replicated, trials. A 1964 study demonstrated that pre-irrigation without supplemental irrigations, a common practice of many barley growers in the San Joaquin Valley, resulted in production of yields that were uneconomical and below optimum levels.

In the study reported here, an irrigation experiment was conducted on a Panoche clay loam soil to determine yield responses to varying amounts of water applied by pre-irrigation and crop irrigations on barley. The experiment was conducted on a grower's field (Boston Ranch Company, Westhaven, Fresno County), and included four treatments with three replications. The treatments were as follows: B1, heavy pre-irrigation only; B2, normal pre-irrigation plus two crop irrigations (early boot stage and flowering stage); B3, normal pre-irrigation plus one crop irrigation (early boot stage); B4, normal pre-irrigation only. Plots were 25 ft wide and 640 ft long. All plots were uniformly fertilized, prior to the pre-irrigation, with NH_3 gas injected in the soil to a depth of 9 inches with 16-inch spacing, at the rate of 80 lbs of nitrogen per acre. Following pre-irrigation in mid-October, 70 lbs per acre of California Mariout barley were drilled into the plots on December 4. Plots were machine harvested (center 12 ft for the full length of the plot taken for yield measurement) on June 23. Rainfall between planting and harvest was approximately 2.5 inches.

The amount of water applied in pre-irrigation and in each crop irrigation was measured through siphon tubes for each plot. The amounts applied to the treatments were as follows: B1, 22.1 inch pre-irrigation; B2, 12.2 inch pre-irrigation plus 7.6 inch early boot stage and 4.8 inch at flowering stage (total 24.6 inch); B3, 12.6 inch pre-irrigation plus 7.8 inch early boot stage (total 20.4 inch); B4, 14.5 inch pre-irrigation.

Soil samples were taken from each foot to a depth of 8 ft from eight locations in the field, prior to pre-irrigation, to determine the initial moisture content of the field. All treatments were sampled at two locations after pre-irrigation and after harvest. The bulk density, averaging 1.4 gm/cm^3 at 8 ft, was determined from two pits dug in the field after harvest, with a back hoe. Using the density figure of 1.4 gm/cm^3 and the oven-dried weight of the soil sample, calculations were made of the total inches of water for each treatment at the time of sampling. From the soil samples collected before and after pre-irrigation, it was found that 29% of the 22.1-inch pre-irrigation in B1 percolated below the 8-ft depth of sampling.

Evapotranspiration rates for treatment B1, B2, B3, and B4 (see table) were 47%, 72%, 74% and 72% respectively, of

IRRIGATION TREATMENTS ON BARLEY YIELDS

total water applied. By adding the 29% percolation loss to evapotranspiration use (47%) in the case of B1, then all treatments will have nearly the same ratio of water use to water applied. Approximately 25% of the total water applied remained in the 8-ft soil profile, as determined by soil sampling before the pre-irrigation and after harvest.

EFFECT OF PRE-IRRIGATION AND CROP IRRIGATION ON THE EVAPOTRANSPIRATION AND YIELDS OF BARLEY

Treatment	Pre-irr. Oct. 15 1963	Crop irrigation Mar 19 1964	Crop irrigation Apr 21 1964	Calculated evapotranspiration	Yields
	(Inches)			(inches)	lbs/acre
B1	22.1	--	--	10.3	4014 a*
B2	12.2	7.6	4.8	17.8	5218 b
B3	12.6	7.8	--	15.0	4805 b
B4	14.5	--	--	10.5	3909 a

* Yields having the same letters are not significantly different at the 1% probability level.

Each plot was instrumented with gypsum blocks to determine the wetting and extraction pattern for the various treatments. Blocks were installed on January 15 at 2-, 4-, 6-, and 8-ft depths at two locations within each treatment. The gypsum blocks were read at weekly intervals and the readings for B1 and B2 have been plotted in the graphs. Treatments B1 and B2 were selected as they represent the extreme range in evapotranspiration, as shown in the table. The readings, in microamperes, were plotted against dates. As the soil moisture increases, the block reading also increases. In B1 nearly all the moisture was extracted by the barley roots from the second and fourth, very little from the sixth, and practically none from the eighth foot (graph 1). In B2 the same state of moisture depletion occurred for the second-and fourth-ft depth, but later than in B1 due to the irrigations which were applied on March 19 and April 21. The increase in microamperes for the second- and fourth-ft curve in graph 2 indicates the depth of soil rewetted by the irrigation. The 7.6-inch irrigation of March 19 rewetted to a depth of at least 4 ft as the block reading increased after the irrigation, and the 4.8-inch irrigation of April 21 probably did not rewet the 4-ft depth, because the reading remained the same after the irrigation.

Yield differentials seem to depend on total quantity of available water and timing of application of the crop irrigation. In this soil where the experiment was located, it was not possible to store sufficient water in the rooting zone of the barley—the bulk of the roots apparently were in the top 4 ft of the soil—to carry the crop to maturity and not sacrifice yields (see table). Yields in B2 and B3 indicate the necessity for supplemental irrigation for barley.

Bushel weight is a measure of the physical quality of barley. Most California barley will average about 48 lbs per bushel. Well-matured barley will exceed 48 lbs per bushel. The bushel weights of the grain in these treatments increased with the calculated evapotranspiration losses, and were as follows: 47.7, 49.7, 49 and 48.3 for B1, B2, B3, and B4 treatments, respectively. There was a significant difference in bushel weight at the 5% level between B1 and B2 treatments. There was no significant difference between any of the other treatments. The bushel weight and the calculated evapotranspiration losses were in a direct ratio, which gives some indication that a crop irrigation is necessary to carry a barley crop to maturity.

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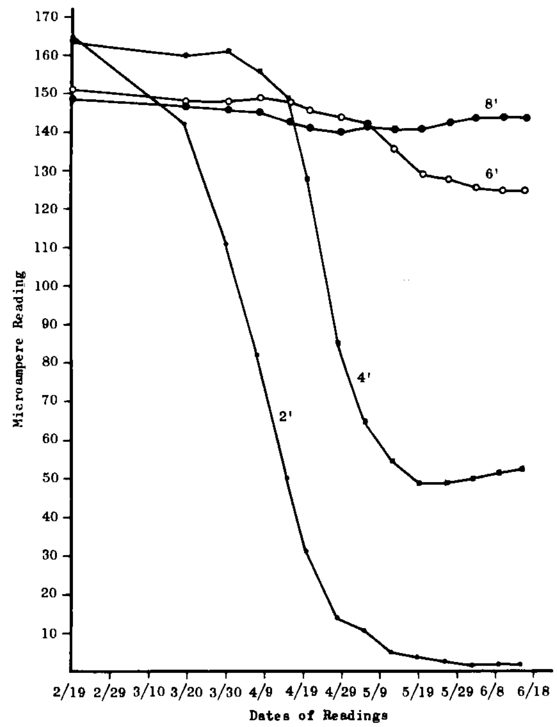
Don A. Patterson and Jim Fisher of Boston Ranch, Westhaven, assisted in conducting this experiment.



Graph 1, above, shows average of 6 gypsum block readings for test B-1, barley irrigation, Fresno County, recorded during season at depths of 2, 4, 6, and 8 ft. Graph 2, below, shows average readings for test B-2—dates of irrigation indicated.