light energy reaches the muscles, is transformed into heat energy which expands the capillaries, lets new blood course through the veins to wash away the congested poisons of disease and bring new strength to the sick parts.

(Here follow experiments with infra-red light, filters, radiometer, photo-cells, et cetera.)

THE IRRIGATION OF SUGAR BEETS

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The preliminary work on sugar beet irrigation has been conducted at Davis, California. For the past four years thirty 20th-acre field plots have been used in the experiment. Experimental procedure has been to maintain widely different soil-moisture conditions and to measure the effect on growth, yield, and sugar content of beets. In some of the plots the soil moisture content has been maintained at a high level by frequent irrigations. In others the beets have been allowed to deplete the moisture to the permanent wilting percentage and irrigation has been withheld until a decided evidence of water shortage could be observed. Other treatments include plots in which the soil-moisture content was allowed to drop to a certain percentage within a specified depth of soil.

The results obtained the first four years are in agreement. Representative results for the four outstanding treatments for the four years are given in the following table.

Yield, percent sugar, number of irrigations, acre-inches water, dates of irrigation, for four irrigation treatments of sugar beets at Davis.

Treatment	Yield tons per acre	Percent sugar	Number irrigations	Acre-inches water applied	Dates of irrigation
			1933		
1	13.3	15.3	1	15.0	June 15
2	24.4	15.5	7	35.9	May 24, 26, June 6, 15, 22, July 1, 12
3	22.6	15.2	4	33.8	May 14, June 6, 22, July 12
4	22.5	14.2	3	32.2	May 26, June 22, July 12
			Harvested July 20		
			1934		
1	28.7	17.4	1	13.2	June 28
2	41.6	17.1	8	46.0	April 20, May 10, 31, June 15, 29, July 6, 24, August 7
3	42.4	16.7	4	37.1	May 9, June 8, July 9, Aug. 3
4	37.3	17.5	3	32.0	May 17, June 20, July 16
			Harvested August 20		

(Continued next page)

Treatment	Yield tons per acre	Percent sugar	Number irrigations	Acre-inches water applied	Dates of irrigation
			1935		
1	12.6	14.7	1	13.5	July 16
2	27.6	16.4	6	30.1	May 16, 29, June 14, July 5, 22, 30
3	23.4	16.4	3	28.0	May 28, June 24, July 17
4	22.5	15.5	3	25.1	June 6, July 8, 30
			1936		
1	10.0	16.8	1	9.1	
2	19.3	17.1	7	32.5	
3	17.9	17.7	4	31.2	

Treatment 1 - Soil was allowed to dry and the beets wilted for approximately a month, one irrigation.

Treatment 2 - Moisture was maintained at a high level in the soil by frequent irrigation.

Treatment 3 - The soil moisture was allowed to drop to within about 2% of the permanent wilting percentage in the soil occupied by the roots and then the soil was irrigated.

Treatment 4 - The soil moisture was allowed to drop to the permanent wilting percentage in the soil occupied by the roots before the soil was irrigated--occasionally slight wilting occurred in this treatment just before irrigation.

The yields are nearly the same for all the irrigation treatments in which the soil moisture was maintained above the permanent wilting percentage. There was a reduction of about 50 percent in yield when the beets remained wilted for about a month. Sugar and purity content of the beets was approximately the same at harvest time in all treatments and did not seem to be affected by irrigation.

Root distribution studies revealed that beets first wilt when the readily available moisture is exhausted in the top four feet of soil. At this time the beets were about half grown. During the latter half of the growing period the sugar beet roots will develop into the fifth and sixth foot and will use all the readily available water at this depth.

The percentage of sugar in the beet during the growing season showed no appreciable differences in the different treatments except where the beets were allowed to remain wilted for a month before irrigation. During the period of wilting the sugar content increased about 5 percent over that in the irrigated plots. After irrigation they lost what had been gained during the wilting period and the final sugar content was approximately the same in all plots.

During the year 1936 and 1937 four field plots were established in different sections of the state and on various soil types. The results are

the same as those obtained at Davis, namely, that the yield and content of sugar in the beets was not affected until the soil moisture had reached the permanent wilting percentage; and the first wilting does not occur until all the readily available water has been extracted from the top four feet during the first part of the growing season. During the latter part of the growing season water will be extracted to the depth of six feet. The results indicate the rational system of irrigation is one in which water is applied just before the soil moisture is exhausted. Such a system is probably most economical since waste is lessened by less frequent application of water.

SOIL MOISTURE STUDIES IN CALIFORNIA

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The influence of soil moisture variations on the development of weight, sucrose percentage, purity, and nitrogen of the sugar beet root was studied in tests conducted in the Sacramento, San Joaquin and Salinas Valleys of California by the Spreckels Sugar Company during the two seasons, 1936 and 1937. As a result of these studies, an attempt is being made to establish an accurate basis for determining irrigation procedure in commercial beet fields.

While the primary purpose of this discussion is to show soil moisture conditions as they existed in normally irrigated commercial beet fields in California and to discuss the procedure developed to improve irrigation practices, a summary of the more outstanding and practical results secured from the detailed study of soil moisture and beet growth is of importance.

Plots for this study were located at Woodland, Manteca, Salinas, and King City in 1936 and 1937 and were conducted in cooperation with the Division of Irrigation, University of California. At each location two plots received four hundred pounds of Ammonium Sulfate per acre and two received no fertilizer. Also two plots received irrigation treatments differing from another set of two plots. At two-week intervals sixty beets from each plot were removed for weighing and analysis. These beets were taken from six different locations in each plot.

Conclusions drawn from these studies are as follows:

1. The maximum growth of beet root and maximum development of sucrose and purity were secured when soil moisture was maintained, throughout the growing season, above the permanent wilting point and below the moisture equivalent for the majority of the soil column in which the roots penetrated. Under normal conditions the roots, by the middle of June, were removing soil moisture from at least the first six feet of the soil column, the depth to which moisture determinations were obtained in this study. When soil moisture was maintained above the permanent wilting point but below the moisture equivalent, the rate of root and sucrose development was not greatly influenced by the quantity of moisture in the soil.