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Supplemental Irrigation by Sprink Increases Delta Sugar Beet Yields

Tensiometers, electrical resistance blocks and soil samples were used by the Irrigation Department to determine soil moisture content in sugar beet test plots at Davis.

Use of sprinklers to supplement the usual subbing method of irrigation increased October-harvested sugar beet production by 8.4 tons per acre. In addition to alleviating drought conditions, sprinkling increased the plant uptake of nitrogen and phosphorus from this highly organic soil.

SUGAR BEETS in some areas of the Sacramento Delta are commonly irrigated by maintaining a water table 3 to 4 feet below the soil surface. Crops usually exhaust the available water in the top 2 feet of soil by early summer. For the balance of the season, plants obtain most of their water and mineral nutrients from a narrow zone of soil, 1 foot or less above the water table. Under these conditions sugar beet plants frequently wilt during warm summer afternoons and often suffer a severe loss of leaves. Field observations indicate that more water in the top 2 feet of soil might improve plant growth by alleviating drought and increasing the uptake of mineral nutrients.

In 1955, an experiment comparing supplemental sprinkler irrigation with the usual practice of subirrigation showed little improvement in crop production, because a severe phosphorus deficiency developed by midseason. Field trials in 1956, 1959 and 1960 indicated that fertilizer phosphorus was readily taken up by sugar beets under sprinkler irrigation. Yields increased considerably when the supply of soil phosphorus was low and crops were fertilized and sprinkler-irrigated. A 1961 field trial demonstrated that phosphorus placed 10 or 16 inches deep was taken up by plants grown with subirrigation; but drought, nitrogen deficiency and virus yellows appeared to severely limit growth.

Ryer Island test

An experiment was conducted on Ryer Island in 1962 in a soil with an organic matter content of about 20%. Plots had been fertilized the previous fall with 200 pounds of P_2O_5/acre, placed at a depth of 13 inches, and the beets were planted on March 20. The entire field was irrigated in the usual manner; the water table was maintained between 35 and 45 inches below the surface throughout the season. Four replications of large plots were randomly located and received five sprinkler irrigations (see vertical arrows

Typical sugar beet plants from plots that received supplemental sprinkler irrigations (left) and from plots that were subirrigated only (right). By October 9 sugar beets like those on the left produced 24.4 tons of roots/acre, while those on the right produced 16.0 tons/acre.

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on the graph for approximate dates of irrigation).

At each irrigation enough water was applied to re-wet the soil to a depth of 2½ feet, to reach the area wetted by capillary rise from the water table below. A good supply of soil-moisture was maintained in the top two feet of soil of the sprinkler-irrigated plots, but by late May, the subirrigated plots were very dry. By early June, growth response was visible in the supplementally irrigated plots. Top growth in the nonsprinkled plots was greatly reduced and many leaves died.

Yield data were collected at three different harvest dates in the fall. Top and root production was greater in the sprinkler-irrigated plots at all dates of harvest. By August 13, sprinkler-irrigated plots produced three more tons of roots per acre than nonsprinkled plots. This difference increased to 5.4 tons/acre on September 10 and to 8.4 tons/acre on October 9.

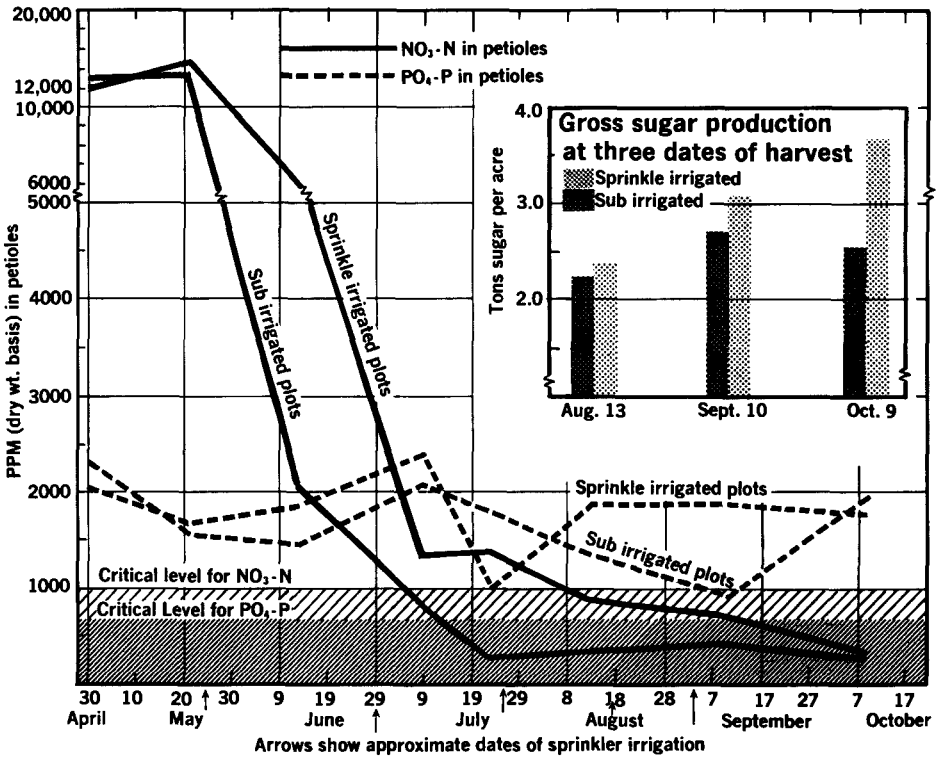
Sucrose concentration

Sugar beet roots from subirrigated plots had higher sucrose concentrations at each harvest date, but the difference decreased considerably at the last harvest date when there was a longer interval between the last sprinkler irrigation and harvest. Differences in sugar concentration were due in part to a lower moisture content in the roots of subirrigated plants and in part to the more rapid growth made by the sprinkler-irrigated plants.

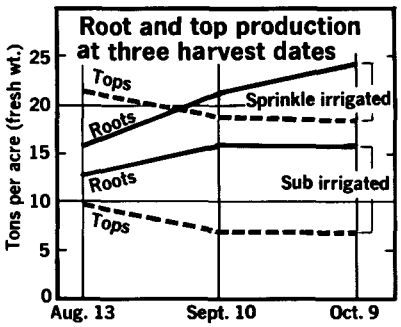
Sprinkler-irrigated plants produced more sugar per acre at all harvest dates than subirrigated plots: 3.2 one-hundred-pound bags more per acre on August 13; 7.6 more on September 10; and 22.8 more on October 9.

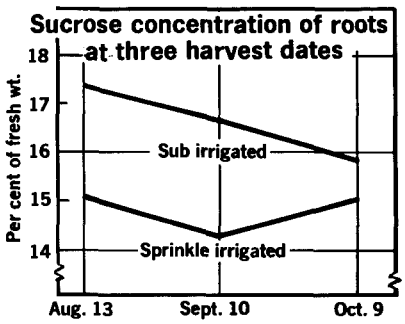
Petiole (leaf stalk) samples, taken throughout the season, showed that supplemental sprinkler irrigation increased plant uptake of nitrogen and phosphorus (see graph). Research and experience have shown that PO_4-P values in sugar beet petioles must be below a critical value of 750 ppm for a period of time before plants show reduced growth. Since the values, even in the subirrigated plots, were above this level all season, it does not appear that increased phosphorus uptake accounted for improved growth in sprinkler-irrigated plants.

The NO_3-N content of petioles from subirrigated plants fell below the critical level (1,000 ppm) the first of July. From this time until the last harvest the sprinkled beets took up greater amounts of nitrogen and therefore would be expected to show increased growth. Thus, it appears that the improvement in production associated with sprinkler irrigation was due to improved nitrogen nutrition, as well as to better soil-moisture conditions. Further increases in sugar production might have been obtained at the August 13 and September 10 harvests if more careful attention had been given to the time of the last irrigation, in relation to harvest. Allowing the topsoil to dry to a greater extent prior to harvest could reduce the uptake of nitrogen by the plants and increase sugar concentrations in roots.



The effect of supplemental sprinkler irrigation on the uptake of nitrogen and phosphorus by sugar beet plants and the effect on beet production at three dates of harvest.





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The Jongeneel and Hechtman Farming Company and Hanneson and Riddle, consulting agronomists, cooperated in the Ryer Island tests.