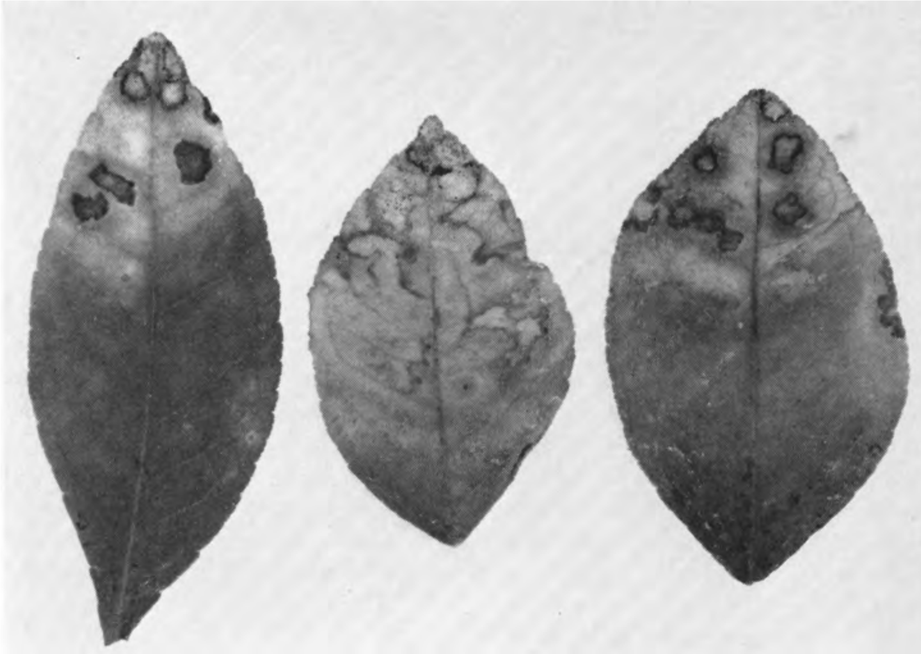


Severe lithium toxicity pattern on field-grown citrus leaves from Chuckwalla Valley (Desert Center area), with lithium accumulation of about 40 ppm on a dry-weight basis from irrigation water containing 0.12 ppm lithium.

from the standpoint of total salt concentration (< 22 ME/L), as reported by the U. S. Salinity Laboratory at Riverside. Graph C shows no relationship between lithium and potassium but low lithium is associated with a low sodium percentage in graph D. About 10% of the samples with a satisfactory sodium level ($< 60\%$ Na) for irrigation of citrus, contained potentially undesirable levels of lithium for citrus growth.

Since there are few wells in the Imperial Valley south of the Salton Sea, four samples of leachate from drain tiles installed in an Imperial Valley citrus orchard were analyzed for lithium. They contained about 0.3 ppm lithium. This represents a concentration 10 times the lithium content of Colorado River water which was used for irrigation. The sodium and chloride ion also increased 10 times, suggesting that the lithium ion remains in solution under these conditions and is concentrated by water loss through evaporation and transpiration. The citrus growing under these conditions adsorbed deleterious amounts of lithium. This particular occurrence of lithium toxicity illustrates a problem resulting from the use of a large quantity of irrigation water having a relatively low lithium content (0.03 ppm), but involving a heavy soil with impeded drainage.

Although the lithium content of the Colorado River water is low by comparison with many of the well waters sampled in this study, it is about 10 times greater than the lithium content of the water analyzed from 15 major rivers in the United States and Canada by the U. S. Geological Survey. Because there is considerable variation in lithium content of well waters from adjacent areas such as the Coachella and Chuckwalla valleys, it is conceivable that a major portion of the lithium content of certain river waters may originate from a few limited numbers of tributaries or springs.

As agriculture, industry, and population expand into the arid and semiarid areas of the world there is increased demand on all available water supplies. The increasing use of lithium compounds in industry and defense activities is a potential source of artificial contamination of water supplies in addition to the natural contamination occurring through underground geological processes. This report emphasizes the need for routine analysis of water samples for lithium by agencies responsible for maintaining water quality standards.

Gordon R. Bradford is Associate Specialist with the Department of Soils and Plant Nutrition, Citrus Research Center, University of California, Riverside. *David L. Shatto, Assistant Public Health Chemist with the State Department of Water Resources Laboratory at Riverside, made available analytical data, maps, etc., which assisted in the preparation of this report.*

SUGAR IN

Limited by High Temp and High Levels of Soi in Kern County Tests

G. V. FERRY · F. J. HILL

Rapid root growth, stimulated by a plentiful supply of soil nitrogen and high summer temperatures, held the sugar content of beet roots down to 15% or lower during July and August in a 1961 field experiment in Kern County. Enough fertilizer nitrogen should be applied to promote early top growth and prevent any deficiency before mid-May. However, a nitrogen deficiency period of from eight to ten weeks before harvest is essential for maximum sugar production from the roots.

SUGAR BEET crops in the lower San Joaquin Valley usually produce excellent root yields but with low sucrose concentrations. High temperatures experienced in this area during the summer months are not conducive to sugar accumulation in beet roots. Research has shown that a period of nitrogen deficiency prior to harvest is very effective in raising the sugar content of roots.

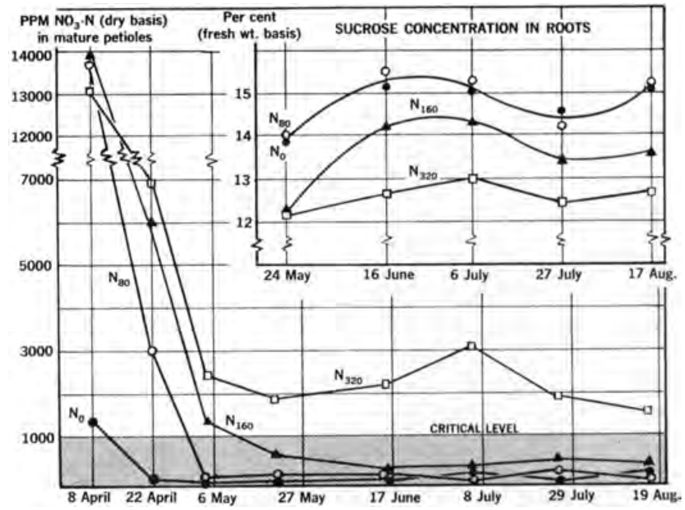
A field experiment was conducted on the N. L. Ritchey farm in Kern County to determine the duration of the nitrogen deficiency period before harvest for maximum sugar production in this area. Sugar beets were planted in early January, 1961, in Hesperia fine sandy loam. Three rates of nitrogen (80, 160 and 320 lbs/acre) and a control plot were compared in four replications. Each plot was large enough to permit harvesting subplots of two 50-foot-long rows at each of five harvest dates. Petiole samples were collected from the plots at regular intervals throughout the season.

BEET ROOTS

eratures
l Nitrogen

S · R. S. LOOMIS · A. ULRICH

GRAPH 1. NITROGEN STATUS OF SUGAR BEET PLANTS AS DETERMINED BY PETIOLE ANALYSIS, AND SUGAR CONTENT OF BEET ROOTS, AT FIVE DATES OF HARVEST. PLANTS BECOMING DEFICIENT IN NITROGEN IN MID-MAY AND EARLIER ATTAINED MAXIMUM SUCROSE CONCENTRATIONS BY MID-JUNE. LONGER PERIODS OF NITROGEN DEFICIENCY DID NOT INCREASE SUGAR CONTENT.



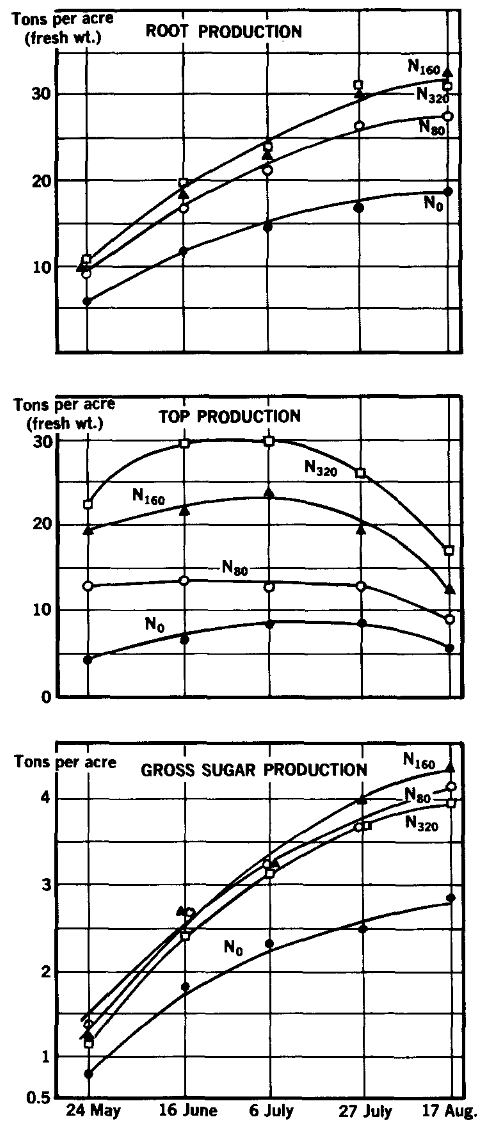
Nitrogen fertilization substantially increased top and root production, as shown in graph 2. The sucrose concentration of roots increased in response to nitrogen deficiency (graph 1). Control plants, with nitrogen withheld, became deficient (NO_3-N concentration in petioles fell below the critical level of 1,000 ppm, as shown in graph 2) in early April. The plants given 80 lbs N/acre became deficient in early May. By May 24, plants of both of these treatments had sugar contents of about 14% and reached a maximum of about 15% in mid-June. Despite continuing nitrogen deficiencies, sugar contents did not increase further, but rather declined somewhat in July. Plants that were fertilized with 160 lbs N/acre became deficient about mid-May and reached a slightly lower maximum sugar concentration of 14.2% in mid-June. Petioles of plants that received 320 lbs N/acre remained above the critical level all season. The roots of these plants never had sugar contents above 13%.

Nitrogen deficiency

Even though plants were nitrogen deficient during the summer months, they were taking up enough nitrogen to make considerable root growth. From June 16 to July 27, beets that were not fertilized increased 5.6 tons per acre; those receiving 80 lbs N/acre increased 9.2 tons per acre; and those fertilized with 160 lbs N/acre grew as well as those that received 320 lbs N/acre (both increased by 11.4 tons per acre). Nitrogen deficiency caused a rapid decline in top growth. Tops of the unfertilized plants, and those from plots treated with 80 lbs N/acre, had very small leaf areas during the summer months. The considerable root growth made by these plants and the rapid root growth of the plants that received 160 lbs N/acre indicate that the degree of nitrogen deficiency was not great—despite low NO_3-N concentrations in petioles. This factor, along with high temperatures and reduced leaf areas, explains why the sugar content of roots did not increase beyond the concentrations attained in mid-June. The smaller amount of sugar produced with such reduced leaf areas is used for growth and little is left for storage in the roots.

From the results of this trial, it appears that sugar beets should be given enough fertilizer nitrogen to promote vigorous early top development so that the land area is completely covered with leaves as soon as possible. Plants should not be nitrogen deficient before mid-May if maximum sugar production is to be attained in mid-July. Maintaining plants in a vigorous green condition up to harvest will result in lower sugar content of roots, little or no additional root production, and less total sugar than would be produced by plants deficient in nitrogen from eight to ten weeks prior to harvest.

G. V. Ferry is Farm Advisor, Kern County; F. J. Hills is Extension Agronomist, and R. S. Loomis is Assistant Agronomist, University of California, Davis; and Albert Ulrich is Plant Physiologist, U.C., Berkeley.



GRAPH 2. TOP, ROOT AND SUGAR PRODUCTION AS AFFECTED BY NITROGEN FERTILIZATION AT FIVE DATES OF HARVEST. FOR THIS FIELD, 160 POUNDS OF NITROGEN PER ACRE RESULTED IN THE MOST SUGAR PER ACRE FOR A MID-JULY, OR LATER, DATE OF HARVEST.