this location the irrigation water quality varied between 0.2 and 0.9 ECw during the experiment's five years, while soil salinity increased to an ECe level of nearly 5dS/m (5 mmhos/cm). Thus, although the irrigation water was not significantly saline, lack of leaching or ineffective leaching led to a substantial increase in soil salinity.

The effects of well-managed leaching at another location are shown in table 2. Soil salinity was reduced more than tenfold in early 1975 by careful flooding and continuous removal of groundwater by pumping during the leaching process. The salts had accumulated to the high level shown in 1974 during a period of only 5 years since the previous leaching in 1969.

The sprinkler-irrigated location (table 3) showed a very low seasonal accumulation of salts, similar to but perhaps somewhat lower than would normally be expected in mineral soil with surface irrigation. Water quality was constant at ECw 0.2. Soil salinity averaged only 0.5 dS/w in the top 3 feet of soil during the 3 years.

Summary

These experiments demonstrated that soil salinity can accumulate rapidly in subirrigated peat soils that are under the influence of a shallow water table. Even with applied water of low salinity (ECw of 0.3), salts in the upper root zone may build up under subsurface irrigation from three- to tenfold in only one cropping season. With sprinkler irrigation, however, accumulation of salts did not take place.

It is evident that only with timely and effective removal of accumulated salts from the root zone can crop yields in the Delta peatlands be sustained. If water quality should be degraded for any reason, there would be even greater need to leach effectively and possibly at more frequent intervals.

Sprinkler irrigation is an option in controlling salinity in peat soils, but requires large capital expenditures along with high energy costs to pressurize the systems. These costs would be in addition to the Delta farmer's continuing costs of pumping to maintain the water table below the root zone.

This study, supported in part by the Department of Water Resources, the South Delta Water Agency, the Central Delta Water Agency, and San Joaquin County, is continuing. It is coordinated with other ongoing studies of irrigation water movement in peat soils and the salt tolerance of corn.

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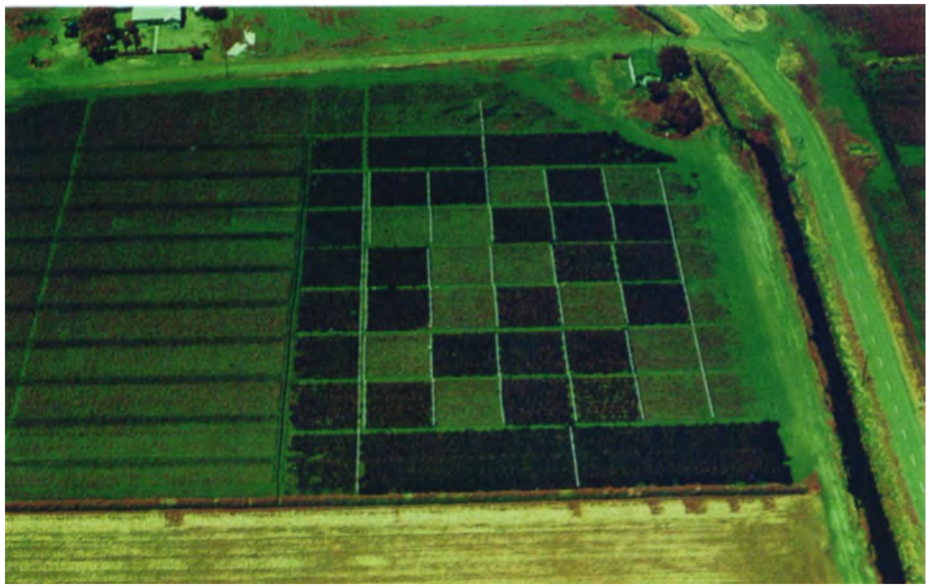

Salt tolerance of corn in the Delta

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Knowledge of the salt tolerance of corn is essential for managing irrigation waters in the Sacramento-San Joaquin Delta and for setting water quality standards. Corn, an important crop in the Delta, occupies about half of its 50,000 ha of irrigated organic soils each year. Because corn is also one of the most salt-sensitive crops, it follows that waters acceptable for corn will be suitable for other commercially important crops grown on the organic Delta soils.

Irrigation water in the North and Central Delta is of good quality and suitable for irrigating any crop with proper management. It averages about 200 mg/l of total dissolved salts (electrical conductivity or EC is 0.3 dS/m) during the crop season. However, the predominant irrigation practice—subirrigation resulting in a shallow water table—prevents adequate leaching for salinity control in the root zone during the crop season. Without leaching, salts continually accumulate near the soil surface as the irrigation water moves upward because of water uptake by the crop and evaporation from the soil surface. Thus, although the irrigation water is not saline, the soil salinity increases throughout the growing season. Both winter rainfall and surface flooding can leach the salts from the root zone if accompanied by adequate drainage.

Two basic criteria are necessary to relate crop response to irrigation water quality. The first is the relationship between the salt concentration in the irrigation water and the resultant concentration in the soil. The equation currently used for subirrigated organic soil, expressed in terms of the EC of the irrigation water (ECw) and the soil saturation extract (ECe), is ECe = 3.8 ECw. (Substantiation of this relationship is the primary objective of another study.) The second criterion is the relationship between the salt concentration of the soil water and crop yield. Current information on salt tolerance, unfortunately, is inadequate to predict the effects of soil salinity on Delta corn production. Available data were obtained either in water cultures or on mineral soils with surface irrigation and continuous leaching. Under those conditions, the maximum salt concentration in the soil saturation extract that does not reduce corn yields is about 1100 mg/l total dissolved salts (ECe - 1.7 dS/m). From the equation above, it would appear that the maximum permissible salt concentration of irrigation water to sustain corn production is about 300 mg/l, or an ECw of 0.45 dS/m. Because of the Delta's unique growing conditions, however, it is necessary to determine more explicitly the salt tolerance of corn grown on organic soils there. The field experiment described here was designed for that purpose.

Experimental setup

Figure 1 is an aerial photograph of the

3-ha field site selected to evaluate the salt tolerance of corn on Delta organic soil. It is located on the Marian Fry farm on Terminous Tract, San Joaquin County. The soil, about 2 meters deep, is typical of the Delta soils in composition and uniformity. The experimental design, shown schematically in figure 2, consists of 5 sprinkler-irrigated treatments replicated 6 times and 4 subirrigation treatments replicated 4 times. The sprinkler treatments are irrigated with low-level sprinklers to provide uniform water applications with ample leaching. The resultant soil salinity profiles should simulate those in standard salt tolerance trials so that the results can be compared with those from trials of other crops. The subirrigation treatments are similar to the commonly accepted irrigation practices for corn in the Delta. Comparison of the two systems provides the means to evaluate any differences in salt tolerance because of the irrigation method.

The salinity levels of the water used in the 5 sprinkler treatments are 0.2, 0.6,1.0, 2.0, 3.0 dS/m. The levels for the 4 subirrigation treatments are the same except that the 3.0 dS/m treatment is omitted. Water for the least saline treatment is taken directly from the south fork of the Mokelumne River. During the growing season, the river water has an average electrical conductivity of about 0.2 dS/m and a chloride concentration of nearly 10 mg/l. The remaining water treatments are prepared by mixing the river water with saline well water. The well, drilled near the experiment, delivers water having an EC of 8.1 dS/m and a chloride concentration of 2200 mg/l.

Irrigation treatments

The sprinklered plots are irrigated weekly to meet the evapotranspirational demand of the crop plus about 50 percent additional water for leaching. This maintains fairly uniform soil salinity throughout the root zone. Leaching is possible in the sprinkler plots because we installed subsurface drains on a 15-m spacing at a depth of 2 m. The subirrigation treatments are irrigated 3 times during the season to raise the water table to within about 0.1 m of the soil surface.

Land preparation, planting, fertilization, and cultivation are performed by the farmer and they match those for corn grown in the area. One of the typical corn varieties, DeKalb XL 75, is being grown. Yields will be determined by hand harvesting the center portion of each plot. In addition to grain yield, plant density, plant height, and stover weight will be determined and correlated with soil salinity measurements.

This three-year study, supported in part by the California State Water Resources Control Board and the California Department of Water Resources, is in its initial year. It will be finished, however, before the water quality standards in the Delta are reevaluated in 1982.

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Caprification:

A unique relationship between plant and insect

Marvin Gerdts □ Jack Kelly Clark

By transferring pollen from inedible caprifigs to edible Smyrna-types, a tiny wasp helps create an important commercial crop.

In California, the fig, like many other fruits, was introduced when the mission at San Diego was established in 1769. Commercial culture started in 1885 and dried Adriatic figs were shipped east in 1889; but these were inferior in eating quality to imported Smyrna-type figs. Smyrna figs, which require pollination to set fruit, were introduced into California in 1881-1882, but it was not until about 1900—through the efforts of George Roeding of Fresno and L. O. Howard and Walter Swingle of the USDA—that the fig wasp, *Blastophaga psenes* L., was established and used successfully to transfer caprifig pollen to Smyrna-type figs to obtain fruit-set (a process called "caprification"). This success stimulated interest in commercial production of Calimyrna (Sari Lop, California Smyrna) figs in California, and acreage expanded in the early 1900s.

Pollination of Calimyrna figs involves complex symbiotic relationships between caprifigs and the fig wasp. Over the years, University of California researchers have investigated and described these relationships. They have also studied methods of using fig wasps in the commercial production of Calimyrna figs, while insuring that the crop is protected from fruit diseases that can be transmitted by *Blastophaga*. Gustav Eisen described the fig wasp life cycle and its relationship to caprifigs in 1901. Ira Condit, U.C. Subtropical Horticulturist, added further descriptions in 1918 and 1920. Their descriptions of caprification, a horticultural word used to describe the pollination process in figs, illuminated the complex relationships of plant and insect.

Caprification

The fig fruit is a hollow peduncle bearing numerous pistillate (female) flowers on the inner wall. For Calimyrna fruits to mature,