Where peat soils merge with mineral soils around the periphery of the Delta, soil variability within a field can cause management problems.

Salinity in Delta peat soils

Jewell L. Meyer
Terry L. Prichard
Franz R. Kegel
Robert J. Mullen

Subsurface irrigation, which provides an inexpensive means of applying water to crops in the Delta peatlands, maintains a water table that ranges from less than a foot to 3 to 4 feet below the surface. This shallow water table prevents leaching for salinity during the cropping season. As a result, although Delta irrigation water is relatively low in salinity, salts accumulate in the crop root zone during the growing season. Generally, they are leached in the winter out by rainfall or surface flooding.

A study was designed to monitor and evaluate the salinity status of Delta organic soils at various locations, under sprinklers and under typical subsurface methods of irrigation. Twenty locations were selected on seven islands or tracts of farmed peat soil. One site was sprinkled; all others utilized subsurface methods. Typical Delta crops such as corn and alfalfa were studied. The soil at each location was tested for salt content at the beginning and at the end of each crop season, with samples taken every 6 inches from the surface to the water table, or about 4 feet. This made it possible to observe both salt accumulation during the crop year and the effectiveness of winter leaching.

Salt buildup

The peat soils at the test sites were found, not unexpectedly, to be highly variable in organic matter content, texture, density and profile uniformity. At all subirrigated locations, however, one effect of consumptive water use by crops was rapid salt accumulation in the upper root zone. Results at a representative site are shown in figure 1. At

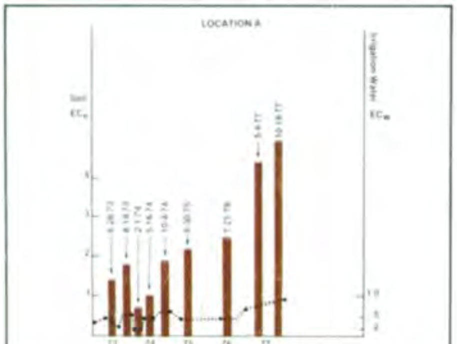


Figure 1. Salt accumulation over five years in a field of subirrigated corn. Lowered salinity levels in 1974 resulted from winter flooding; sharp increase in 1977 was caused by lower quality irrigation water, a result of the drought. At this location and others, soil salinity values shown represent the average throughout the root zone.

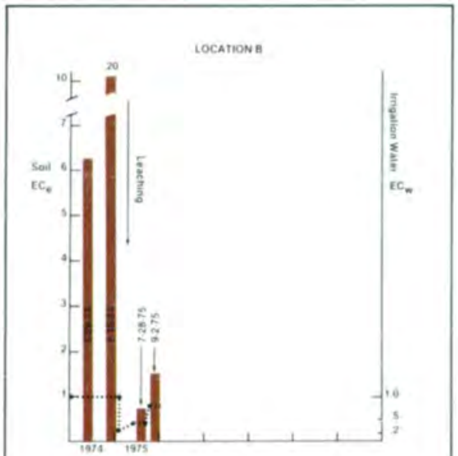


Figure 2. Results of effective leaching. This field was flooded from December 20, 1974, through February 1, 1975, with drainage pumps running continually.

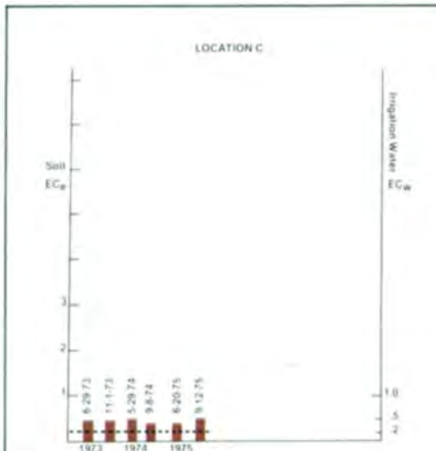


Figure 3. Results of sprinkler irrigation. Drainage pumps maintained the water table at approximately 3 feet. The crop was alfalfa.

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

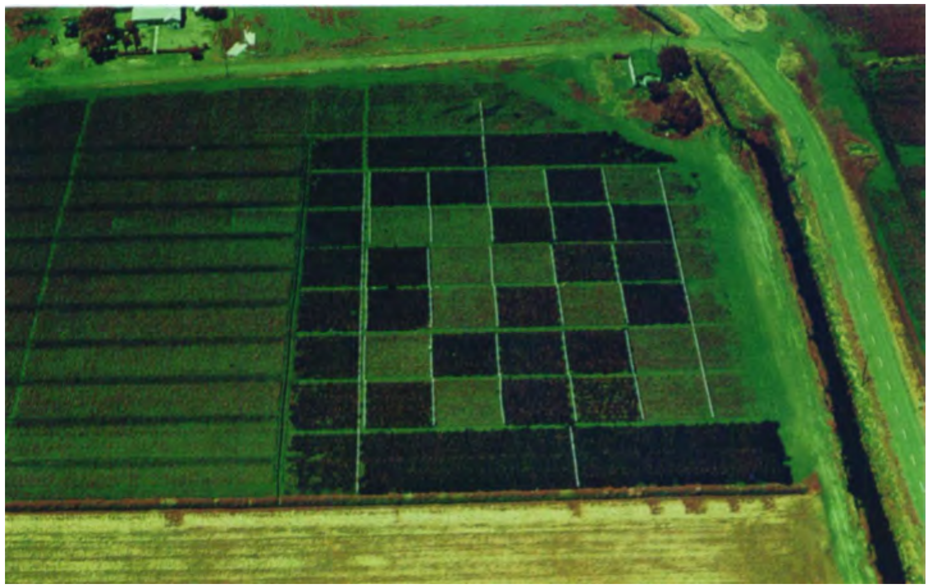
These experiments demonstrated that soil salinity can accumulate rapidly in subirrigated peat soils that are under the influence of a shallow water table. Even with applied water of low salinity (ECw of 0.3), salts in the upper root zone may build up under subsurface irrigation from three- to tenfold 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.

Jewell L. Meyer is Extension Irrigation and Soils Specialist; Terry L. Prichard is Extension Area Soils and Water Specialist; Franz R. Kegel and Robert J. Mullen are Farm Advisors in San Joaquin County.



Salt tolerance of corn in the Delta

G. T. Hoffman ☐ E. V. Maas ☐ Jewell L. Meyer
Terry L. Prichard ☐ Donald R. Lancaster

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