each week a volume of water equivalent to a 4%-inch irrigation was applied to each plot. After 5 feet of water had been applied, the application rate was doubled so that, by the end of the project, each plot had received a total of 17 feet of water.

Five sets of soil samples were collected: before treatment; after 70, 103, and 168 inches of water had been applied; and after termination of the treatments.

The SAR values for the 0- to 3-inch depths are shown in figures 1 and 2. Similar relationships were found at lower depths. City water had a negligible effect on the SAR. Effluent water raised SAR levels at both sites, but gypsum acted to lessen this effect. Maximum SAR values of 4.5 to 5.5 were reached after less than half the total amount of effluent water had been added. Further applications did not increase the SAR value. Electrical conductivity of the saturation extract (ECe) for the surface foot of soil from effluent-treated plots did not rise above 1.9 mmhos at either site.

Infiltration rates

Infiltration tests were made at approximately three-week intervals throughout the six months of water application. Initial rates were high for the Salinas fine sandy loam (12 inches per hour) and gradually declined to about 7 inches per hour after six months. There was no significant difference in infiltration rates between city water and effluent water, with or without gypsum on the plots.

Initial rates were moderate for the Diablo clay (1 inch per hour), and actually increased during the experiment to about 4 inches per hour. These high rates were attributed to the applied water being conducted downward through vertical cracks in the soil, which never closed up completely. To compensate for this anomaly, duplicate 6-inch-diameter infiltrometer rings were driven into each plot. Resulting in-ring infiltration rates were dependent on whether or not the rings intersected cracks. Those that did gave rates of 1 to 3 inches per hour. Those that did not gave rates as low as 0.01 inch per hour. Again, there was no consistent difference between the city and effluent waters.

Conclusions

On the basis of information obtained in this trial, it may be concluded that use of this effluent water on these soil types would not be expected to result in excessive sodium accumulation and serious water penetration problems.

Even though amounts of water equivalent to at least four years of irrigation were applied, soil SAR values leveled off and remained below 6 in the effluent treatments. At this level, no lowering of infiltration rates would be expected from continued use of effluent water, and none was found.

The trial results also indicate that guidelines used for evaluation of the sodium hazard of irrigation waters may need to be modified to make them applicable to sewage effluents.

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Using food-processing wastewater for irrigation

Jewell L. Meyer

Food processing in California requires large amounts of water, most of which becomes waste. Since the late 1960s, the major canners, with about 10 plants in the Central Valley, have been irrigating crops with this valuable resource. Many processing plants produce 2 to 4 million gallons per day of effluent during the summer irrigation season. This is sufficient water to irrigate 400 to 800 acres of cropland at each site.

Monitoring of the effluent quality and its effect on crops and soils was begun in 1970, following the enactment of the California Porter-Cologne Clean Water Act. Since then, cooperative research involving the processors, Regional Water Resources Control Boards, and U.C. Cooperative Extension has shown that irrigation is a practical alternative to conventional treatment and evaporation ponds or to discharge to local streams.

The problem constituents in food processing wastewater are:
- Added nutrients (nitrogen and phosphorus). However, nutrients can be used by plants to produce food and fiber.
- Added salts, including sodium and other elements contributing to total dissolved solids (TDS). In general, salinity is increased about twofold during food processing. Occasionally, sodium concentration increases enough to become a hazard to soil permeability. In that case, calcium—in the form of gypsum—is metered into the effluent to mitigate the problem.
- Fruit sugar resulting in biochemical oxygen demand (BOD). Elevated oxygen demand can occur with high-sugar fruits. However, odors and anaerobic soil conditions may be controlled by very shallow irrigation or by cultivation within three to four days after the effluent goes onto the soil.
- Assuming most crops in California's Central Valley require 40 to 48 inches of water annually, between 180 and 225 acres are needed for each 1 million gallons per day of wastewater effluent during the processing season. For that reason, acreage requirements are large for proper irrigation management and total usage of processing effluent.

The key to use of processing wastewater has been (1) careful monitoring of effluent quality, (2) making management adjustments for water quality problems, and (3) sound irrigation principles. A normal irrigation season is 120 to 150 days. The food-processing season usually covers most of this time.

Crops that have been successfully grown with cannery wastewater include pasture grasses, alfalfa, sorghum, barley, oats, and grapes. These crops have yielded well, provided good irrigation practices are conducted. Wastewater applications should not exceed crop water requirements plus a reasonable leaching fraction, about 15 percent above crop needs. Deep soil monitoring has shown that agricultural crops use the major portion of added nutrients and that soil permeability has not been adversely affected at any monitoring site. Odors and surface layers of organic matter have not been a problem under proper cultural management.

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