tion in soil solution for the 1-ET and 5/3-ET treatments at the 320-pound rate of applied nitrogen, it can be seen that the higher concentration occurs in the 1-ET irrigation treatment. Moreover, a comparison of the pounds-per-acre values for the same depth shows considerably fewer pounds in the 5/3-ET treatment. Since the same amount of fertilizer was applied in both cases, it is evident that a larger amount of nitrate must have been leached below the root zone or denitrified with the excessive water application at 5/3 ET. Furthermore, even where no nitrogen fertilizer has been added for four years, the nitrate-nitrogen concentration in the soil solution below those plots is still in excess of the 10 ppm standard for water

These data point to the problem encountered in setting a standard for determining the degree of nitrogen pollution. Wherever soils and plants exist together, nitrogen will move below the root zone and ultimately will reach receiving bodies of water. However, because of the extreme variability of climate, soils, crops, and management, both the amounts and the concentrations of nitrogen that may reach water supplies will vary greatly. Consequently, a single uniformly applied criterion for judging the degree of nitrogen degradation to be allowed is inappropriate.

In an agricultural system, nitrogen fertilization and water management practices that use adequate amounts to achieve maximum production have been shown to have minimum potential for pollution. Consequently, management practices that result in the greatest nitrogen uptake efficiency will provide both environmental protection and food production.

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# U.C. guidelines for interpretation of agricultural water quality

**Robert S. Ayers ■ Roy L. Branson**

In early 1973, the University of California Committee of Consultants was requested by the State Water Resources Control Board staff to submit a set of guidelines for interpretation of water quality for agriculture. These were to set forth a method of agricultural water quality evaluation and also suggest numerical guidelines that could be used in the comprehensive water-quality management plans then being prepared to manage the water resources of each of the state's 16 water basins.

The guidelines were prepared by the U.C. Committee of Consultants in collaboration with the U.S. Salinity Laboratory (Riverside), and staff of the State Water Resources Board. These guidelines (first submitted April 1973 and modified slightly since then) have been adopted as official guidelines by several state agencies, used extensively in planning and management of irrigated agriculture, and found to be useful and practical in production agriculture. They were the basis for the recently published (October 1976) FAO-Irrigation and Drainage Paper 29 "Water Quality for Agriculture" prepared by the Food and Agriculture Organization of the United Nations-Rome, for use worldwide by FAO field personnel.

These guidelines are not rigid but are simply what their name implies—guidelines. They do not mean that the problems indicated necessarily will occur if suggested values are exceeded. They do mean that certain problems can be expected if guidelines are exceeded—unless adequate management practices are adopted that will correct, delay, or prevent the problem.

Management practices include leaching, selection of tolerant crops, and improved water management to produce "more crop per drop" of water used. Each type of problem is best met by fairly specific management practices.

More detailed data are available from U.C. Cooperative Extension farm advisors in each county.

**Guidelines for Interpretation of Water Quality for Irrigation**

| Irrigation problem | Degree of problem: No problem | Increasing problem | Severe problem |
|---|---|---|---|
| SALINITY (affects water availability to crop) | | | |
| ECw (mmhos/cm) | < 0.75 | 0.75-3.0 | > 3.00 |
| PERMEABILITY (affects infiltration rate of water into soil) | | | |
| ECw (mmhos/cm) | >0.5 | 0.5-0.2 | < 0.2 |
| $adj_{}$ SAR | < 6 | 6-9 | > 9 |
| SPECIFIC ION TOXICITY (affects only sensitive crops) | | | |
| Sodium ($adj_{}$ SAR) | < 3 | 3-9 | > 9 |
| Chloride (meq/l) | < 4 | 4-10 | > 10 |
| Boron (mg/l) | < 0.5 | 0.5 | 2.0-10.0 |
| MISCELLANEOUS EFFECTS (affects only susceptible crops) | | | |
| $NO_3$-N (or) $NH_4$-N (mg/l) | < 5 | 5-30 | > 30 |
| $HCO_3$ (meq/l) [overhead sprinkling] | < 1.5 | 1.5-8.5 | > 8.5 |
| pH | | [Normal range 6.5 - 8.4] | |

< means less than
> means more than
ECw means electrical conductivity, a measure of water salinity
$adj_{}$ SAR means adjusted Sodium Adsorption Ratio
$NO_3$-N means nitrogen in the water in form of nitrate
$NH_4$-N means nitrogen in the water in form of ammonia
pH is a measure of acidity (0-7) or of alkalinity (7-14). pH = 7 is neutral

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