COOPERATIVE EXTENSION UNIVERSITY OF CALIFORNIA

SOIL and WATER

Summer 1978 - No. 37



ONE WET WINTER FILLED UP SHASTA LAKE. The top picture was taken on September 30, 1977, after two successive dry seasons had lowered Shasta Lake to 630,000 acre feet, less than 14% of its 4.5 million acre foot capacity. The lower picture was taken on June 19, 1978, with the lake at 96.5% of capacity. See article entitled "Reservoir Aerial Photos". (Photography by Jack K. Clark, Visual Aids, Davis)

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RESERVOIR AERIAL PHOTOS

In the fall of 1977, there wasn't much cheer among water agencies. Two years of drought had lowered many of the reservoirs to their lowest levels ever since their original filling. Shasta Lake, for example, had dropped 220 feet in elevation below its high water mark, and contained around 13% of its total storage capacity.

Although there were domestic water shortages in the Bay area and agricultural water shortages in parts of the state, both municipalities and agriculture survived the two year drought amazingly well. That they did is a tribute to past water planning, emergency programs for water conservation, and a good measure of ingenuity.

Nevertheless, there wasn't much optimism about the winter of 77-78 improving the prospect. Another dry winter would cause widespread crop failure. Even a normal winter would not make up for the depleted reservoirs and groundwater tables of the previous two years. There were those who said it would take years to bring the water supply situation back to normal.

While this may be true regarding groundwater, the surface water supply has essentially been brought back to normal by one wet and snowy winter. Aerial photos taken during mid -June showed most reservoirs in northern and central California to be 80 to 100% full, with plenty of snow remaining in the Sierra.

Our program of photographing reservoirs began with 19 reservoirs in October 1976. Its purpose was to provide slides and prints for educational use in water conservation by County Extension offices and other public agencies. When reservoirs weren't much fuller in April 77 than they had been in fall 76, it appeared that another round of photographs would be useful. This time coverage was expanded to include essentially all of the public, utility, and irrigation district reservoirs in the Sierra Nevada and Coast Ranges surrounding the Central Valley, 146 reservoirs in all. Most of these same reservoirs were again photographed in the fall of 1977 (lowest levels) and in June of 1978 (high levels).

The photos are oblique shots and are available in 35 mm color slides or 8 x 10 black and white prints by ordering from Visual Aids, UC-Davis. A complete index and order form for all photos is being prepared and will be sent to County Extension offices soon. Persons other than Extension personnel may receive an index and order form by writing to:

Bill Wildman
LAWR: 169 Hoagland Hall
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Davis, CA 95616

-- Bill Wildman

SOIL AND WATER AMENDMENTS IN IRRIGATED AGRICULTURE

Soil and water amendments are things that are added in the expectation that on improvement in crop productivity or other equally positive results can be obtained. Results sometimes come up to expectations, sometimes they do not. How can the uncertainty of results be improved and the chances for good results be greatly increased?

If the problem is correctly diagnosed, the chances of success with amendments can be greatly improved.

In irrigated agriculture, there are four general problem areas to be looked at. (Climate, pests, and fertilizers are not part of this discussion).

Problem 1: Salinity

Salinity affects the ease with which water in the soil can be extracted and used by crops. It is usually evaluated from a measurement of the soil salinity or water salinity and a consideration of the salt tolerance of the crop to be grown.

Amendments will not neutralize salts or greatly change the salinity status of either soil or water. Therefore, amendments have almost no chance of appreciably improving production if the problem is salinity.

Problem 2: Soil Permeability

This has to do with the ease with which water enters the soil. Once the water enters the soil and is stored within the crop root zone, it can later be withdrawn and used by the crop. A suspected permeability problem can be evaluated by taking a measurement of the rate at which water enters the soil. An infiltration rate of less than 0.1 inch/hour is often considered to be a problem since it becomes difficult to get enough water into the root zone during one irrigation to prevent water stress before the next irrigation.

Soil permeability problems can be of a chemical nature and caused by either excesses of sodium (exchangeable sodium) or by shortages of calcium. Poor permeability is often associated with quality of the applied water- either extremely low salt water (ECw less than 0.2 mmho/cm) or high sodium water (adj.SAR above 6 to 9).

Amendments have an excellent chance of improving water infiltration rates where the problem is poor water infiltration and is chemical in nature. Amendments such as gypsum, sulfur, and sulfuric acid are effective because they either supply soluble calcium or add electrolyte (soluble material) to the water and improve infiltration.

The user of the amendment will still need to decide whether any improved water penetration is worth the effort and results in a worthwhile improvement in yield or other less tangible benefit.

Amendments are not the only solution to a permeability problem. Since the problem related to a water shortage to the crop, any practice which supplies adequate water is an equally good solution. More frequent irrigation, or extending the duration of each irrigation might supply adequate water. Return flow tailwater systems, cultivation, rough tillage, incorporation of crop residues, or even simple crop rotations might also be helpful.

Problem 3: Toxicity

Certain constituents of soil or water are taken up by crop and accumulate in the plant to toxic concentrations. Included here are sodium, chloride, and boron.

Amendments are seldom of much help to correct toxicities. However, calcium from gypsum in some cases may counteract sodium toxicity and in a few other cases may speed leaching and thereby reduce toxicities of chloride or boron.

Problem 4: Miscellaneous Problems

These problems include all others not covered by problems 1-2-3 above.

Nutrient problems from high nitrogen content in soil or water will be unchanged by any of the usual amendments.

Deposits on fruit or leaves resulting from overhead sprinkling with water high in bicarbonate can be reduced by acidification of the water to pH 6.5. Sulfuric acid or sulfur dioxide are the two amendments that have been used. pH must be carefully controlled to prevent damage to aluminum, concrete, and transite pipelines if pH gets much below pH 6.5. Night time sprinkling is probably much more effective than is use of amendments.

The above four problem areas cover most of the common problems encountered in irrigation agriculture that are related to soil or water chemistry and for which amendments are usually applied.

In summary, the chances of amendments such as gypsum to alleviate the problem are about as follows:

salinity problems- poor chance
permeability problems- good to excellent chance
toxicity- poor to fair chance
miscellaneous- poor to good chance depending on the specific problem

Amendments should be used on a "show me" basis. Following use, the results should be evaluated to assure that benefits as measured by improved yield or other less direct benefits, are at least equal to costs. Then, finally, the user should decide whether equally good results could be obtained from some less costly procedure.

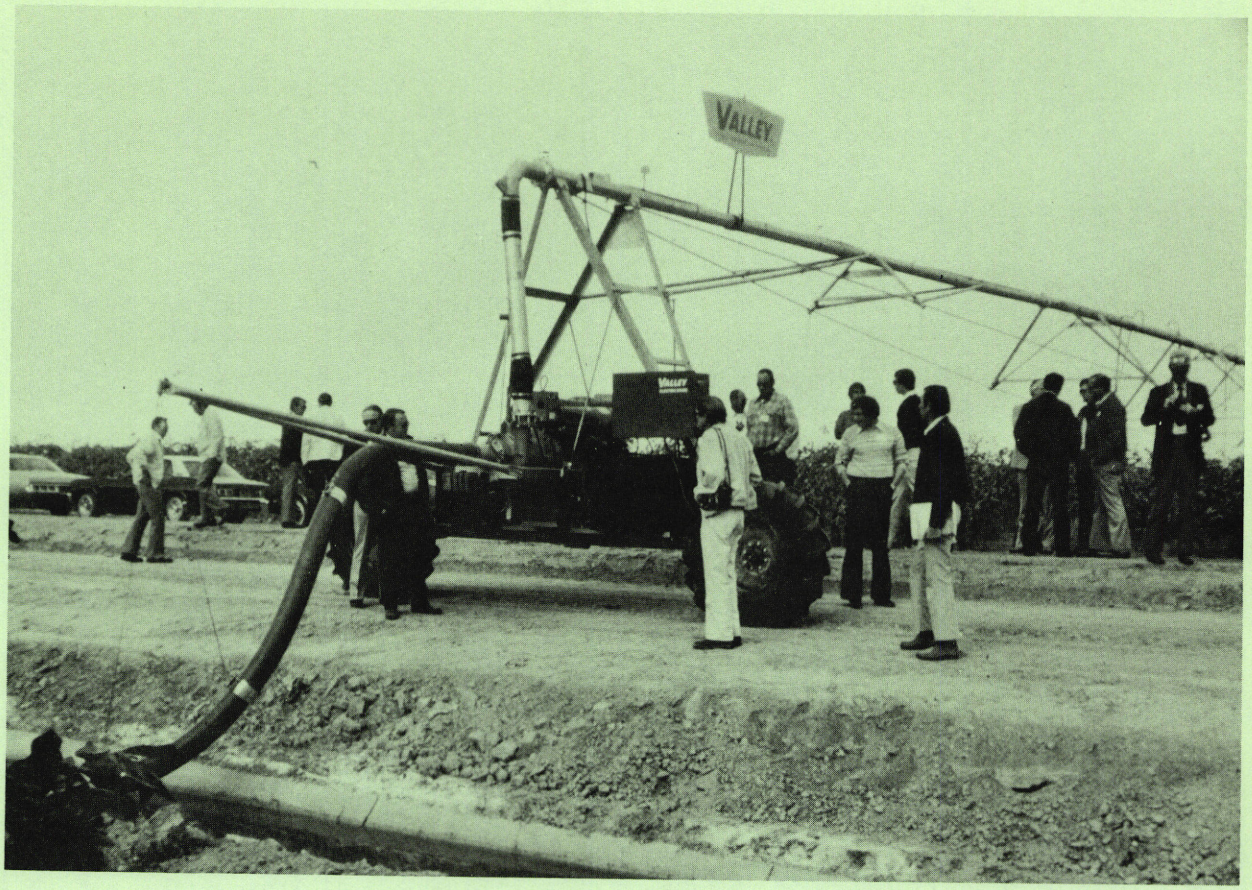
-- Robert Ayers

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LINEAR PIVOTS UNDER TEST IN KERN COUNTY

In Kern County, linear pivots are being tested on potatoes, wheat and vines. Three pivots are in operation, each with a straight arm of 1/4 mile, moving forward for one mile during each irrigation. When reaching the end of the mile, the machines shut off automatically and return empty to the starting point ready to repeat the cycle. The systems are powered by air cooled diesel engines with pumps delivering up to 1600 GPM. Two 120 gallon diesel tanks supply enough fuel for one week of continuous operation.

Presently, these machines obtain water from a parallel level concrete lined ditch which costs about $6/linear foot. The intake from the ditch to the machine is achieved through a flexible hose with a strainer.



In field crops, spray heads are mounted on the pivot every 8.5 feet. In grape vineyards a 3/4 inch galvanized pipe is suspended from the top of every other middle to about one foot from the ground distributing water to two spray nozzles, one to each vine. The extra water runs in two small furrows located directly under the vines.

The linear pivot is capable of using lower application rate sprinklers or misters if needed to suit the soil intake rate. The machines used in Kern County, use relatively low application rate misters, and these linear pivots are able to operate at a lower pressure than conventional center pivot system. The ones in Kern County were operating at 20-40 PSI at the misters. The fully automated systems costs $600/ac including the ditch, and if the ditch is shared by another pivot on the other side, the cost drops by $50/ac.

The pivots at the potato and the vineyards were set to deliver 2 inches of water every 6 days. The application depth could be adjusted by increasing or decreasing the speed of the machines. At the vineyard, the design was based on 7.2 GPM per acre, and it was set to apply 9.2 GPM per acre at the potato field.

There are some disadvantages. The

linear machine does not perform on rolling ground. The grower does not know yet the maintenance costs. Yet to be determined is the evaporative loss due to the interaction of the fine droplets with winds and high temperatures.

-- Falih Aljibury

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SEWAGE EFFLUENT QUALITY CONSIDERATION

Many cities throughout the country are now upgrading their sewage treatment plants to include secondary treatment. The government grants that finance most of this improvement carry a requirement that the cleaner effluent produced by such treatment not be wasted if possible -- that it be considered for some beneficial reuse where economically feasible. Judging from past experience with effluent use in California, additional use of these waters is likely to be mainly for irrigation of crops, recreational areas or landscaping.

As with any type of irrigation water, the quality should be checked before use for any potential adverse effects on soil and/or plants. The water quality guidelines developed by the U. C. Committee of Consultants in cooperation with the U. S. Salinity Laboratory are applicable for this purpose to all kinds of irrigation waters including sewage effluents. However, some modification appears to be necessary in using the guidelines to evaluate the sodium hazard of effluents. Prediction of the sodium hazard of effluents by means of the equation for adjusted SAR may result in overestimating the actual sodium hazard. This showed up in the results of a field trial with Morro Bay effluent. The adjusted SAR of this effluent was 16, indicative of a serious sodium hazard, but the SAR of the soil solution after use of sufficient effluent to establish equilibrium was only 6.

Cause of this overestimation is not yet certain, but two possibilities seem likely. Chemical analyses of these waters characteristically show unusually high bicarbonate levels compared to normal irrigation waters. This may be due to an error in measurement of bicarbonate by the conventional titration method which will record organic acids incorrectly as bicarbonate. Organic acids are present in effluents. Such an error in bicarbonate measurement could result in an incorrect calculation of adjusted SAR which has a bicarbonate component. Another possible cause of the discrepancy between predicted and field-measured sodium buildup with some effluents is the high (relative to normal irrigation water) organic matter content of effluents. Decomposition of the organic matter increases soil carbon dioxide which in turn may result in less precipitation of calcium carbonate than occurs with use of normal irrigation water.

Until this matter is researched further, it seems advisable, in interpreting the sodium hazard of sewage effluents, to regard the adjusted SAR value as a possible overestimation. The importance of taking this into consideration is illustrated by the fact that in some cases, including that of the Morro Bay effluent, the only potential problem with effluent reuse for irrigation is sodium, as predicted by current water quality guidelines.

-- Roy Branson

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POTTING MIX STUDY

At the last U. C. Soil Fertility Conference (Davis, March 30-31) a report was given on the results of a study of commercial potting mixes conducted at the request of the State Department of Food and Agriculture. The mixes were evaluated by chemical analyses and greenhouse tests. As so often happens, there were some unexpected results that should be of interest to those of you working with soil mixes:

1) The drop in pH after three months of plant growth was positively correlated with the concentration of NH_4 -N in the saturation extract of the initial mix. All mixes were liquid fed with 200 ppm each of N & K from ammonium nitrate and potassium nitrate. (see Table)

2) There was a strong suggestion that 30 ppm $NaHCO_3$ -soluble phosphorus in the initial mix is a critical level above which the probability of a response to added P fertilizer is very low. (see Fig. 1)

3) After three months growth, the plants were rated for market quality on a 1 to 5 scale. Ratings of 4 and 5 were considered indicative of marketable quality. Nitrogen analyses of the leaf blades revealed that no samples with less than 3% nitrogen were in the 4 to 5 category. (see Fig. 2)

Such findings emphasize the usefulness of laboratory analyses of programming production with soil mixes.

-- John Rible

(see pages 7 and 8 for table and figures)

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Copies of the Proceedings of the National Conference on Management of Nitrogen in Irrigated Agriculture which are available from the University Bookstore, University of California, Riverside, CA 92521 at $13.00 each.

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The University of California publication, Water Wells and Pumps: Their Design, Construction, Operation, and Maintenance, by V. H. Scott and J. C. Scalmanini, is now available. Copies can be obtained from LAWR: Water science, Cooperative Extension, University of California, Davis, California 95616.

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Blaine R. Hanson

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Drainage and Groundwater Specialist

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TABLE

pH		pH Difference	
Initial	Final	(Initial-Final)	NH_4-N in satn ext. meq/l
7.1	5.9	1.2	1.0
4.1	4.3	-.2	1.1
4.6	4.4	.2	1.2
6.6	6.2	.4	1.6
6.6	6.5	.1	3.3
6.1	5.9	.2	4.1
6.6	4.7	1.9	5.8
5.0	4.3	.7	6.9
4.3	3.8	.5	9.3
5.7	4.7	1.0	10.2
5.3	4.3	1.0	11.9
5.8	3.8	2.0	14.3
6.6	3.7	2.9	16.4

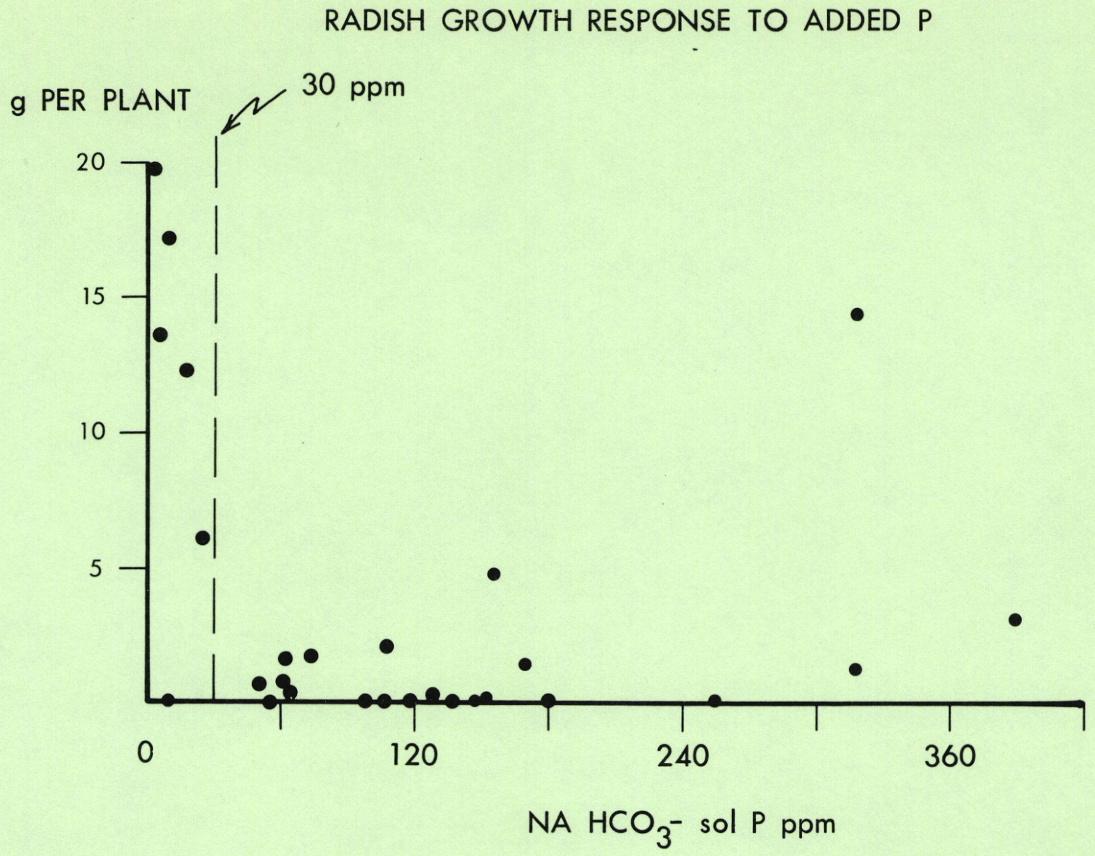


Figure 1

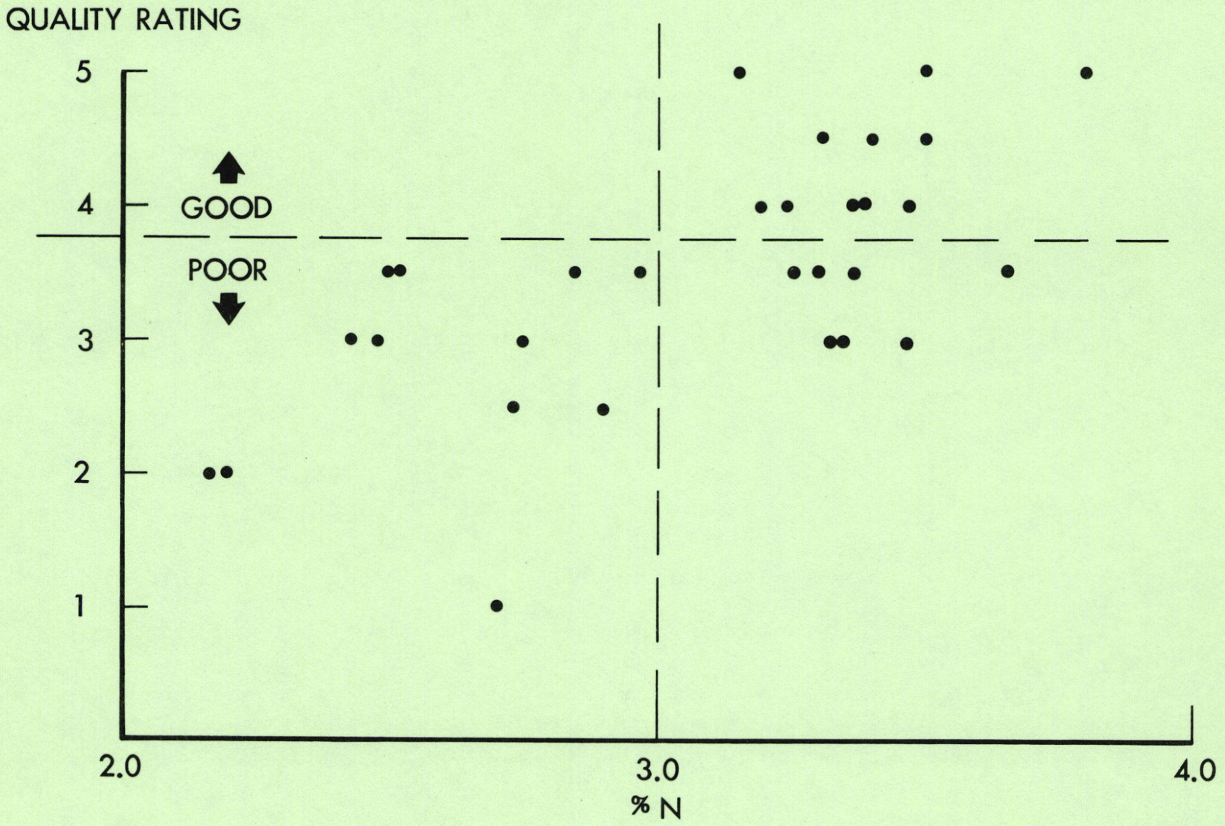


Figure 2

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